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STRATEGIC PLAN FOR

BUILDING NEW NUCLEAR POWER PLANTS

SECOND ANNUAL UPDATE

NUCLEAR POWER OVERSIGHT COMMITTEE

STRATEGIC PLAN

FOR BUILDING

NEW NUCLEAR POWER PLANTS

Second Annual Update

NUCLEAR POWER
OVERSIGHT COMMITTEE

November 1992

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MESSAGE FROM THE CHAIRMAN

In November 1990, the Nuclear Power Oversight Committee (NPOC) published its *Strategic Plan for Building New Nuclear Power Plants*. This is the second annual update to that plan.

Much has changed in the past two years, but one fact remains unaltered. Our conviction that nuclear energy must be available to serve the American people's growing need for electric power is as constant as ever. All the companies represented on the Nuclear Power Oversight Committee--electric utilities, equipment suppliers, engineering and construction firms--share that belief.

By any measure, nuclear power is good for the United States, and for the other nations of the world that have followed America's lead in using this technology. In the United States, nuclear power is one of the cleanest, safest, most reliable sources of electricity available. Our 110 nuclear plants produce about 20% of our electricity, second only to coal. Partly because of these plants, America's electric utilities were able to reduce their dependence on imported oil dramatically through the 1970s and 1980s. And because nuclear power plants do not produce greenhouse gases or other forms of air pollution, they satisfy the American people's basic need to protect and improve their environment.

The United States faces energy challenges in the 1990s and beyond. And this nation's electric power industry faces a future filled with uncertainties and unanswered questions. These include uncertainties about the future price and supply of natural gas, the dominant fuel for new generating capacity in the United States today; questions about the success of programs to manage growth in electricity demand by increasing the efficiency of use; and the possibility of increasingly stringent restrictions on fossil fuels.

In this shifting, uncertain environment, it is only wise and prudent to plan for more nuclear power plants. The Nuclear Power Oversight Committee's Strategic Plan was, and is, prudent insurance against a number of unpleasant surprises in energy supply that may await us in the 1990s and the early years of the 21st century.

Although there are many uncertainties, it is clear that the United States will need additional electric generating capacity in the coming years, to meet the needs of its growing population, to sustain its economic growth, and to replace obsolescent capacity, even with our industry's aggressive pursuit of energy efficiency.

Deciding on the type of generating capacity that must be installed in the 1990s and the early years of the 21st century is a complex undertaking. Those decisions will require the balancing of many risks, many uncertainties and many competing interests. No single fuel can satisfy all circumstances. Fuel diversity is one of the great

strengths of the U.S. electric supply systems, and nuclear energy has a key role to play. This key role includes not only new plants but in the license renewal of existing plants.

In the two years since NPOC published the Strategic Plan, we have seen solid progress in many areas but there is much more to be done. This second update reflects those developments and documents a number of accomplishments, modifications and adjustments to the plan. A few significant accomplishments are worth noting here:

- The safety and performance of the present operating reactors continues to improve. NRC reported a very favorable trend in the occurrence of significant events in nuclear plants: steady annual reductions from an average of 2.4 events per unit in 1985 to 0.3 events per unit in 1991. The INPO "1991 Performance Indicators for the U.S. Nuclear Utility Industry" reported that the median unit capability factor of the plants increased from 71.7% in 1990 to 75.7% in 1991, resulting in a generation of 21.7% of the electric power in the United States--a record high. The average production costs of the plants decreased by 1.4% in 1991 compared to 1990 as measured in mills per kilowatt hour.

- The joint program between the industry and the Department of Energy to perform the first-of-a-kind engineering for the advanced light water reactor (ALWR) plants was initiated. The Advanced Reactor Corporation was reorganized to manage the program for and by the utilities under a Cooperative Agreement signed with the Department of Energy. Requests for proposals to perform the design work were issued, and responses were received for two evolutionary and two passive plant designs.

- Significant progress was made in obtaining NRC review and approval of the advanced plants. The final safety evaluation report was issued on the Utility Requirements Document for the evolutionary plants. A safety evaluation report for the advanced boiling water reactor (ABWR) is expected to be issued before year's end. The draft safety evaluation report for System 80+ was issued on schedule. The design certification submittals for both passive plants have been delivered to NRC on schedule.

- This progress in design and regulatory review has created the need for enhanced coordination of the project-specific "building blocks," of the plan. Thus, the Advanced Reactor Corporation will undertake the overall coordination role in the coming year, assuming the responsibilities of the several industry steering committees and working groups that have provided leadership on the individual project-specific building blocks.

- In its National Energy Policy Act of 1992, the Congress has adopted the nuclear portion of the National Energy Strategy, providing for licensing

reform, advanced reactor development funding, and the establishment of a separate government corporation for uranium enrichment along with significant improvement in the process to establish appropriate safety standards for a radioactive waste repository.

- DC Court of Appeals overturned ruling on preoperational public hearings, thus upholding Part 52 provisions.

- Public acceptance continues to improve with over 75% of Americans judging that nuclear power is important for the future.

Despite these encouraging signs of progress, there are other areas where we wanted to accomplish more. The industry attempted to accelerate the Nuclear Regulatory Commission's schedule for design reviews but due to complex, first-time process issues, some delays have been encountered. Thus, some industry schedules have been adjusted to accommodate the NRC's review schedules. There were some positive judicial decisions to permit the Department of Energy to move ahead with the characterization of the Yucca Mountain site for a final radioactive waste repository. Progress, however, on this subject has continued to move slowly.

The Nuclear Power Oversight Committee recognized, when it published the Strategic Plan in November 1990, that all elements of our society--government, industry, academia, environmental groups, political institutions and others--must work together to enable the United States to increase its reliance on secure, domestic energy sources like nuclear power. By working together, we can ensure a major role for nuclear power in this country's energy strategy, and a bright future for America in the years to come.

Sherwood H. Smith, Jr.

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Chairman
Nuclear Power Oversight Committee
and
Chairman and Chief Executive Officer
Carolina Power and Light Company

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SECTION I: EXECUTIVE SUMMARY

THE NEED FOR A PLAN

In November 1990, the Nuclear Power Oversight Committee (NPOC) published a *Strategic Plan for Building New Nuclear Power Plants*. The plan's goal: to create the conditions under which electric power companies could order new nuclear power plants during the mid-1990s, with the first of those plants entering service around the turn of the century.

This is the second annual update to the Strategic Plan. This update reflects progress and modifications to the plan since the last update in November 1991. Section II of this report provides an outline of the plan. Section III includes detailed action plans.

NPOC represents companies and associations with a commercial interest in nuclear power--electric utilities, equipment suppliers, and engineering and construction companies. Through NPOC, these companies developed the plan and are actively supporting its implementation, because they are convinced that the United States will need more nuclear power plants early in the next century.

For the 1990s, NPOC believes that existing plants will provide an adequate supply of electricity in most regions of the United States, and the added nuclear energy in this period will be limited to those units presently under construction. The electric power industry's plans for the 1990s include a variety of resources--conventional generating capacity (primarily gas turbine), demand-side management, conservation, and nonutility generation--that should support a growth rate in electricity demand of 2% to 3% a year. This is within the range of most credible forecasts of growth in electricity demand.

Beyond the 1990s, however, NPOC sees a growing need for new baseload capacity for two reasons:

- The U.S. electric supply system is aging rapidly. In 1970, 83% of the U.S. baseload power plants were less than 20 years old; only 9% were over 30 years old. By 2000, however, only 27% of the baseload power plants will be less than 20 years old; 36% of them will be over 30 years old. Some of this existing baseload capacity must, almost certainly, be replaced as it reaches the end of its useful life.

- The composition of the U.S. electric supply system is changing. In the 1980s, virtually all of the new generating capacity built was baseload

capacity, and by 1990, the proportion of baseload capacity was above historical norms. As a result, in the 1990s, much of the new capacity built will be peaking capacity. By the year 2000, the proportion of peaking capacity will be at an all-time high, and the proportion of baseload will be back near or below the historic norm. This suggests that the United States will need new baseload power plants in the early years of the next century. This is corroborated in the results of the NPOC CEO survey concluded in April 1991.

Two factors will contribute to increased consideration of nuclear power for that baseload capacity addition:

- New requirements for air pollution controls on coal plants, such as those identified in the new amendments to the Clean Air Act, will increase the cost and regulatory uncertainty of electricity generation from coal.

- Increased concern about the possible long-term effects of greenhouse gas emissions calls for greater priority in developing and utilizing electric generation processes that do not produce greenhouse gases.

In a Position Paper* issued concurrently with the original Strategic Plan, NPOC outlined the outstanding record of today's 110 U.S. nuclear plants, a record which has improved since the paper was issued. The paper also summarized the industry's major effort to improve the operations of present plants, and identified the programs underway to design, build and operate even safer, more reliable, and more economic standardized nuclear plants for the future. The extensive operating experience with today's light water reactors (LWRs), and the promise shown in recent technical developments, leads the industry to the conclusion that the next nuclear plants ordered in the United States will be advanced light water reactors (ALWRs). A recent study by the National Academy of Sciences, "Nuclear Power: Technical and Institutional Options for the Future," reaches the same conclusion. Advanced designs for both 600 MWe and 1300 MWe blocks of capacity are being developed, including both pressurized water and boiling water types. Both approaches rely on proven technology. In addition to the technical design issues, federal and state regulatory uncertainties must be reduced so that the financial risks of nuclear plant construction and operation are acceptable.

The need for new baseload power plants early in the next century dovetails well with the NPOC *Strategic Plan for Building New Nuclear Power Plants.* In the mid-1990s, new advanced-design nuclear plants will receive final regulatory approval from the U.S. Nuclear Regulatory Commission. Also in the mid-1990s, companies must start planning the new power plants they will need in the early years of the next century. Given the time it takes to site, license, and build new baseload power

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* A Perfect Match: Nuclear Energy and the National Energy Strategy, November 1990, published by U.S. Council for Energy Awareness, 1776 I Street NW, Suite 400, Washington, DC 20006

plants, it is important that planning, orders, and some construction be started by the mid-1990s if these plants are to be on-line around the turn of the century.

THE CONTENT OF THE PLAN

This Strategic Plan, then, outlines an integrated effort to address the range of institutional and technical issues on which significant progress must be achieved to make nuclear power attractive for the 1990s and beyond. The plan:

- identifies all the significant enabling conditions (technical/industrial, regulatory, environmental, financial, legislative/legal, organizational, political, and public acceptance) which must be met to achieve the goal;
- assigns lead and supporting responsibilities to the appropriate existing organizations or standing committees in the industry to detail and implement the action plan for achieving each condition;
- fosters joint, coordinated efforts between government and industry which would enhance implementation of the strategies and provide for sharing resource requirements.

Fourteen enabling conditions, or "building blocks," have been defined, each of which uniquely contributes to the complete structure. The "building blocks" are outlined in Figure I-1, which shows the title and lead industry responsibilities, and are grouped into four categories:

A. Prerequisites From Ongoing Programs

There is a need to increase confidence in nuclear power through continued improved performance. That need is being addressed in ongoing programs, but progress in those programs must be monitored and coordinated since they influence the prospects for success of the overall plan. Four of the building blocks comprise these prerequisite conditions and have the following individual goals:

- Maintain and improve the high safety and reliable performance of operating plants.
- Improve the economic performance of existing plants.
- Achieve progress with the high-level radioactive waste (spent fuel) disposal system that includes a permanent repository and a temporary monitored retrievable storage (MRS) facility.
- Assure availability of low-level radioactive nuclear plant waste processing and disposal capacity.

Figure I-1: BUILDING BLOCK SUMMARY

PREREQUISITES FROM ONGOING PROGRAMS

Current Nuclear Plant Performance (Utilities)	Low-Level Radioactive Waste (EEI-ACORD)
High-Level Radioactive Waste (EEI-ACORD)	Adequate, Economic Fuel Supply (EEI)

GENERIC SAFETY/ENVIRONMENTAL REGULATION & INDUSTRY STANDARDS

Predictable Licensing & Stable Regulation (NUMARC)	ALWR Utility Requirements (EPRI-USC)

PROJECT-SPECIFIC ACTIVITIES

NRC Design Certification (Plant Designers)	Siting (EPRI/NUMARC)
First-of-a-Kind Engineering (ARC-EPRI)	Life-Cycle Standardization (INPO)

INSTITUTIONAL STEPS

Enhanced Public Acceptance (USCEA)	Clarification of Ownership & Financing (EEI)
State Economic Regulatory Issues (EEI)	Enhanced Governmental Support (ANEC)

- Assure a continuing stable and economic supply of nuclear fuel.

B. <u>Generic Safety/Environmental Regulation and Industry Standards</u>

Construction of new nuclear plants requires a stable and predictable safety and environmental regulatory process. The primary need is for early public input and decision making prior to plant construction, thus permitting a combined construction and operating license. Companies must be able to obtain a license to operate the standardized plant at the same time they obtain a license to construct it. The Nuclear Regulatory Commission (NRC) issued a new rule on this subject in 1989, titled "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Reactors" (10 CFR 52). In implementing the new rule, the design certifications and combined licenses must be based on standardized regulatory requirements that will neither vary nor change throughout the life of the design certification or the life of the plant, unless stringent backfit criteria are met. They must also include Inspections, Tests, Analyses, and Acceptance Criteria and a "sign as you go" process, which will assure the regulator and the owner that the plant is built in accordance with existing regulations and the licensing requirements established during the design certification and combined license review and hearings. Another key task is reconciling regulatory definitions, jurisdiction, and responsibilities among the NRC, the state safety agencies, the state environmental regulatory agencies, the Environmental Protection Agency (EPA), and the Federal Emergency Management Agency (FEMA). The goals of this building block are:

- Assure that regulatory processes are in place for predictable licensing, including design certification, site approval, and combined construction and operating license to allow for construction, startup and commencement of full-power operation of new plants.

- Assure that a high-quality, stable regulatory process is in place for safety and environmental protection, with the objective that the regulatory process encourages but does not duplicate industry self-improvement initiatives, instills public confidence, and permits the reasonable cost of electricity generated by nuclear power plants.

- Achieve regulatory acceptance of appropriate aspects of standardized operational elements and resolution of related issues associated with life-cycle standardization.

- Assure that a predictable and stable process is in place that facilitates economically viable extension of existing plant operating licenses.

To increase confidence in both safety and economic performance, future plants must be designed to incorporate lessons learned over the past 30 years of commercial nuclear power operation. The next generation of plants must also

use features that have been proven adequate for safe, reliable, and economic service with respect to operations and maintenance. This obviates the need for prototype testing. The building block to address these needs is based on the concept of user-defined design requirements and has the following goals:

- Obtain NRC approval of the ALWR Utility Requirements Document.
- Assure that ALWR designs conform to the full-scope ALWR Utility Requirements Document.

C. Project-Specific Activities

The building blocks in this group are the technical activities of design, development and testing, site qualification, regulatory review, and project cost and schedule estimates for standardized plant designs. These activities provide the design, construction and operational specifications for the plant. The first major design activity is to obtain certification of standardized plants from the NRC. The second design step, called first-of-a-kind engineering, is the additional design and confirmatory testing necessary to produce sufficient construction drawings, equipment specifications, construction and operational procedures to provide for firm cost and schedule estimates in order to prepare for construction of ALWRs. Selection, qualification, and licensing of suitable plant sites must proceed in parallel with these design activities and the results factored into the first-of-a-kind engineering processes.

One of the key elements of this Strategic Plan is a comprehensive industry commitment to standardization: through the Utility Requirements Document, design certification, combined license, first-of-a-kind engineering, construction, operation and maintenance of nuclear power plants. For many years, the U.S. nuclear power industry has recognized the significant economic advantages which would have accrued if it had been possible to build nuclear power plants to standard designs. The most obvious example of the success of standardization can be found in France. We have achieved standardization on a smaller scale in the United States, such as in the SNUPPS, Byron-Braidwood and Palo Verde projects, and recognize the clear advantages of its large-scale implementation in the future.

The NPOC plan proposes four stages of standardization in ALWRs. The first stage is established by the ALWR Utility Requirements Document which specifies owner/operator requirements at a functional level covering all elements of plant design and construction, and many aspects of operations and maintenance. This document provides a major step towards standardization, because it represents a consensus of future customers on design features for ALWRs of both the large-size evolutionary type (1300-MWe range) and the medium-size passive type (approximately 600 MWe). Through submission of the document to NRC for review and approval, it is expected that agreement will be reached

with the industry on the resolution of generic safety issues that will provide a basis for NRC design certification. The document describes the owner/operator requirements for design features that improve plant safety and simplicity, increase design margins, and addresses areas such as layout, availability goals, instrumentation and control capability, human factors, balance-of-plant design, radiation control and capital and operating costs.

The second stage of standardization is that achieved in the NRC design certification. This certification level includes requirements, design criteria and bases, functional descriptions and performance requirements for systems to assure plant safety. The level of detail will vary based on the safety significance of the component or system and includes the design information necessary for the NRC to make its final safety determinations.

The third stage of standardization, commercial standardization, carries the design to a level of completion beyond that required for design certification to enable the industry to achieve, through standardization, potential increases in efficiency and economy. As such, it addresses design decisions beyond the regulations and provides for the design standardization achieved outside of the regulatory scope. Industry commitment to achieve those economic benefits, in combination with modern design and construction techniques, will permit an economically optimum attainment of commercial standardization. First-of-a-kind engineering programs form the basis for achieving this objective and are under utility leadership through the Advanced Reactor Corporation (ARC).

The final stage of standardization is called life-cycle standardization. A standardized approach is being developed in construction practices, operations, and maintenance training, and procurement practices. This area creates the ground rules and organizational entities that would maintain standardization throughout the life of the plant. Commitment to such ground rules and organizational entities will ensure that the optimum economical and technical benefits of standardization will be achieved and then maintained during the plant operating life.

This comprehensive standardization program enables the NRC to proceed with design certification with the confidence that standardization beyond the regulations will be achieved. This confidence should answer the question of design detail required for design certification, and demonstrate that the NRC should require no further regulatory review beyond that required by 10 CFR Part 52. The cooperative efforts of NRC and industry to achieve standardization in their respective spheres of responsibility should achieve dramatic savings in time and capital, and permit new nuclear plant operation in time to meet the urgent demands for increased baseload capacity at the turn of the century.

Policy Statement on Standardization

The NPOC Ad Hoc Committee drafted a policy statement on standardization and prepared a position paper describing these four steps of standardization. This position paper* was reviewed and approved by NPOC and reviewed by all nuclear utility CEOs before publishing. This position paper is reproduced as Appendix C. The Standardization Policy Statement is as follows:

> Nuclear power plant standardization is a life-cycle commitment to uniformity in the design, construction and operation of a family of nuclear power plants. Rigorous implementation of standardization is expected to achieve the efficiency and economy typically associated with increases in scale or breakthroughs in technology.

Benefits of Standardization

The benefits of standardization in this context include the following:

1. Early definition of requirements to ensure regulatory stability and eliminate unnecessary changes.

2. Timely, systematic and thorough resolution of design, construction, operation and related regulatory problems.

3. Optimization of design to improve constructibility, reliability, operability, and maintainability.

4. More simple and uniform designs that are easier to construct and operate leading to more efficient and effective regulatory oversight and enhanced public confidence.

5. Focused and efficient application of technical and financial resources.

6. An expanded resource base that enhances support capabilities for design, manufacturing, construction, installation, inspection, testing, operation, maintenance and replacement parts.

7. Maximized learning from past experience and accelerated experience feedback.

All of the above benefits should make new nuclear power plants viable, cost-competitive sources of electricity as well as contribute to safety.

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* "Position Paper on Standardization--Building New Nuclear Power Plants," Nuclear Power Oversight Committee, April 1991, see Appendix C.

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Underlying Principles of Standardization

The following principles will be applied for each family of standardized plants:

- Standardization will be maintained throughout the life cycle of the family of standardized plants. An owner/operator structure will be established with clear mechanisms for maintaining standardization including a formal process for the review of proposed deviations.
- Elements of standardization within systems, structures and components needed for safety will be subject to regulatory acceptance. Elements of standardization of safety systems and standardization within systems required for reliable power generation will be maintained by all the owner/ operators of a family of standardized plants or by the organizational entity established and charged with that responsibility by all the owner/operators of that family.
- The site-independent features of the plant design will be transferable, without alteration, to any site within the design envelope for the family of plants.
- Layouts of major systems and components will be identical. Plant layout should preclude the use of shared equipment between units.
- System functional requirements will be identical, with siting consideration as the only acceptable reason for differences.
- Major structural, mechanical, electrical, or I&C components (including installed spares) essential to nuclear safety or reliable power generation will be identical for the site-independent plant features.
- Functional, physical, and interface requirements for other components will be identical. The specifications should identify critical design characteristics to allow selection of the component that best meets the requirements and allow qualified substitutions without modifying essential identical components.
- Each plant within a family will be built to construction drawings and specifications that are identical to the extent noted above. It is recognized that construction drawing and specification differences will arise due to site-specific requirements and variations within acceptable construction tolerances.
- Permanent modifications to site-independent features of systems, structures, or components essential to nuclear safety or reliable power generation will be made consistent with the limitations of Part 52 and the

design certification rulemaking and only after review and approval of the organizational entity established and charged with that responsibility by all the owner/ operators of a family of standardized plants. Such review and approval by the family of plants may be deferred in the case of an emergency modification. However, modifications to replace failed or obsolete components should maintain standardization or, if necessary, be planned so as to recover standardization as the same components are replaced in the other plants within the family.

- Based on the principles cited above, life-cycle standardization will be implemented in such areas as training, maintenance and operating procedures, quality assurance, licensing, spare parts management and outage management.

The goals of the four building blocks in the project-specific activities category are:

- Obtain NRC certification of ALWR designs.
- Obtain NRC approval of suitable site(s) for new nuclear plants, either through early site permitting or through submission of an application for a combined construction and operating license and NRC approval to build and operate the plant to a certified design under its standardization rule.
- Complete engineering on certified designs in sufficient detail to define firm cost and schedule estimates and prepare for construction of standardized ALWR plants.
- Ensure that the institutional infrastructure is in place to provide resources and manage completion of the detailed designs.
- Define the process to achieve commercial standardization, that is the design standardization beyond that required for certification.
- Establish an institutional framework and approach to implement and oversee a model for life-cycle standardization of a family of plants.
- Develop standardized operational elements to provide a basis for uniformity in appropriate aspects of the organizational structure, administrative controls, and startup, operating and maintenance practices.
- Develop an approach to maintain the standard design and design intent in all units of a family of plants over their lifetimes.

D. Institutional Steps

The final four building blocks move from the relatively "narrow" world of the nuclear power industry and its safety and environmental regulators to the "wide" world of financing, rate regulation, public acceptance, and governmental support.

Many lessons have been learned in the "narrow" world which, along with significant innovations, are being incorporated into the above-mentioned ten building blocks. This Strategic Plan, however, also recognizes the lack of sufficient confidence and support in this "wide" world. The plan addresses this in the final four building blocks, which have the following goals:

- Achieve broad U.S. public acceptance of nuclear power.
- Positively influence local public attitudes, at potential plant sites, on the need for new plants and encourage attitudes which are conducive to new plant siting, construction and operation.
- Analyze and propose structures for the financing, ownership, and operation of nuclear plants which reasonably compensate owners, investors and, if applicable, vendors and operators.
- Achieve support by state regulatory agencies for predictable and stable handling of permitting and financial matters.
- Enhance and maintain governmental support for the necessary institutional framework, including laws, regulations, and programs, that encourage the construction and operation of new nuclear plants.

A strong component of the plan, which is key to the success of these last four building blocks, is to communicate the progress on the previous building blocks broadly and effectively outside the industry. This communication will provide visibility to this "wide" world audience of the benefits of the country's current investment in nuclear power; and of the major improvements in current plant operations and in future nuclear power plant designs, particularly their safety features and the effectiveness of their public safety and environmental regulation and economic benefits. The confidence of the rate regulators and financial analysts can be built on the foundation of standardized, detailed designs and stabilized nuclear regulation.

IMPLEMENTATION OF THE PLAN

The plan is divided into building blocks that are integrated into an overall plan. Each block has a separate organization as the lead responsible for achieving one or more subordinate goals. Each block also has a series of milestones that will assist in

monitoring and managing the project. The status of each milestone is updated from last year's revision. Blocks are linked together by "tie-ins" to ensure coordination between the diverse organizations and the subordinate projects. This ensures that the schedule can be monitored, maintained and that the final goal, the option for standardized nuclear power plants on-line by the turn of the century, is achieved.

Action plans have been developed for each building block. Each lead organization is responsible for implementing its phase of the plan utilizing its own resources, augmented as required, to achieve the block's goal(s). Each block has a series of supporting organizations assigned to provide input and assistance to the lead organization as required. Most portions of the plan are well underway. The present status of each building block is described in Section 3.

The plan also recognizes that success in achieving the goals depends on government actions as well as industry. Where government rather than industry has the basic responsibility and authority over a building block, "primary" or "regulatory" responsibility is given to a government agency, not as an assignment, but to recognize that authority. The "industry lead" organization is assigned responsibility for providing input to the processes in that building block. "Primary" responsibility is also assigned to industry organizations where the eventual implementation requires that one or more industry organizations must form and become involved through a major commitment of funds. In such cases, the "lead industry" organization will handle the building block in the interim.

NPOC established an Ad Hoc Committee early in 1990 to develop this plan which was published in November 1990. The Ad Hoc Committee coordinates the work of the lead industry organizations on behalf of NPOC. This coordination, and periodic assessments of progress against the plan, allows adjustments to the plan. This update reflects the adjustments to date. The explicit portrayal of "tie-ins" encourages "self-coordination" to minimize overall project management requirements in this time frame.

The Ad Hoc Committee is specifically charged to:

- facilitate the coordination of the action plans among those having the lead responsibilities in order to achieve consistency, mutual support, and compatibility among the action plans in a total team effort;

- facilitate the implementation and effectiveness of the Strategic Plan by monitoring and reporting progress on the various action plans and recommending to NPOC changes to the Strategic Plan where appropriate; and

- identify, recommend, and foster the needed government-industry shared efforts.

Of course, project management will eventually be needed to carry out the detailed activities as the plan matures. Much of this will have to be provided by the organization(s) that see the need to order new plants. Past experience shows that an outstanding project management team is essential to assure that schedules and budgets are met and to instill confidence in those providing and approving the financial arrangements. The timing for formation of any such organization will presumably coincide with accomplishment of the second goal of the Ad Hoc Committee, complementary to the first goal which is to develop the plan itself. The second goal is to secure firm commitments from sponsoring organizations to devote the necessary resources to build and start operating one or more standardized ALWR nuclear plants.

However, with the movement into high gear of the regulatory reviews of utility requirements and applications for design certification (Building Blocks 2, 3 and 4), increasing activity in plant siting (Building Block 5), the initiation of first-of-a-kind engineering (FOAKE) (Building Block 6) and life-cycle standardization activities (Building Block 7), interim project management capability is needed. NPOC has asked ARC to undertake in the coming year the coordination of the safety regulation, utility requirements and project-specific Building Blocks 2, 3, 4, 5, 6 and 7, now being performed by several oversight committees.

A Utility Management Board (UMB) would report to, and implement the policies of, ARC in the form of an expansion of the Project Management Board (PMB) now in place to oversee the FOAKE Program. The UMB would be made up of one executive from each domestic utility contributing to the FOAKE Program, i.e., the Class I members of ARC. The UMB would include, where practicable, utility executives who have had previous experience in the utility oversight committees in the ALWR Program, such as the Standardization Oversight Working Group (SOWG), the ALWR Utility Steering Committee, and the Industry Siting Group. An Executive Committee of three members of the UMB would also be formed to permit frequent interaction with the UMB staff on policy matters and overall direction.

It is envisioned that the UMB staff will initially number about six full-time people, consisting of an Executive Director and a staff made up of executives loaned for that purpose and sustained by individual utilities, EPRI, INPO and NUMARC. This staff will continue to be supported by EPRI technical project and administrative management, as well as by NUMARC for regulatory activities and INPO for operational activities, and by EEI serving as treasurer and secretary for ARC/ UMB. The staff should be capable of addressing key technical issues with the vendors and NRC, using EPRI, NUMARC and INPO support, as well as administrative issues with DOE and the vendors using EPRI support.

The changes proposed will take some time to implement, and it is important that the present committee structure continue to function until the UMB is put into place. This is particularly critical in the FOAKE Program which is on an extremely tight schedule. Nevertheless, the transition should be initiated promptly, and an

approach for the transition of responsibility has been defined by building block to provide for continuity as follows:

Building Block 2. The Standardization Oversight Working Group (SOWG) activity will be folded under ARC/UMB when the policy and procedural issues associated with Part 52 are resolved and "implementation" begins in mid-1993. At that time, the SOWG would be dissolved. NUMARC will continue to provide regulatory support as needed.

Building Block 3. The Utility Requirements Document effort will continue under the ALWR Utility Steering Committee (USC)/EPRI leadership until the NRC review is essentially complete, at which time it will be transferred to ARC/UMB responsibility and the ALWR USC will be dissolved. This shift is anticipated to occur in mid- to late-1993.

Building Block 4. Coordinated with the timing of the Building Block 3 shift in responsibility, the responsibility for the Utility Requirements Document conformance in design certification will be shifted to ARC/UMB with EPRI continuing to provide the technical support for that effort and continuing to provide for technical advisory oversight of the EPRI-ALWR Passive Plant Program by its participating utilities.

Building Block 5. The DOE-industry joint effort on siting could be transferred to ARC/UMB at the end of the selection phase (mid-1993), and the Industry Siting Group will then be dissolved.

Building Block 6. It is expected that the ARC/UMB will have overall responsibility for managing the implementation of the FOAKE Program as it is now established for PMB. However, the detailed engineering work that will be necessary and the planning considerations and design standardization process which must provide for beyond-FOAKE project activities in procurement, construction, site-specific requirements, and operations will require delegation of such responsibilities to utility-sponsor groups (USGs) made up of the utilities who have chosen to sponsor a family of plants and the contractors selected to develop the FOAKE design and the design for certification for that family. Such delegation would occur at the beginning of the FOAKE implementation phase. The exact form of such delegation has not been formulated and will require unambiguous definition of the responsibilities of the USGs for design of the family and its related aspects, as well as continuing responsibilities of ARC/UMB for consistency with the NPOC Strategic Plan, conformance with the Utility Requirements Document, standardization, uniform technical positions with NRC, and continuing management assessment of contractor performance and schedule.

Building Block 7. ARC/UMB will provide coordination and oversight while INPO continues to have the lead responsibility.

The effective pursuit of these project-specific activities, particularly as construction and siting issues are addressed, will require the insights of architect-engineers (AEs) and constructors. Although AEs have been represented through NPOC, NUMARC, and as supporting contractors in the ALWR Program to date, it is proposed to establish a formal AE/Constructor Participant Advisory Group who would meet periodically with the UMB to receive updates on progress on the project-specific building blocks.

In summary, coordination and oversight responsibility for all of the project-specific Blocks 4, 5, 6 and 7 and the Part 52/SOWG portions of Block 2 and the utility requirements (Block 3) will go to ARC/UMB, and the role of the responsible lead and support organizations assigned to those blocks will continue as assigned in the NPOC Strategic Plan. The NPOC Ad Hoc Committee will continue to facilitate and monitor progress against the entire Plan on behalf of NPOC. The "prerequisite" and "institutional" Building Blocks 1, 2, 8, 9, 10, 11, 12, 13 and 14 will remain the responsibility of the NPOC Ad Hoc Committee with the continued support of the lead organizations assigned in the NPOC Strategic Plan. The Ad Hoc Committee will place increased emphasis on improving the goal definitions and addressing the increasing interdependence of these building blocks.

In keeping with the NPOC Strategic Plan, the UMB is not a permanent organization but is to provide the overall function stated above. As sponsoring utilities or utility groups make a commitment for projects entailing activities beyond the FOAKE implementation phase, UMB will phase out, turning over full responsibility to the project management team of those utilities or groups. Additionally, at an appropriate time, functions related to the roles of industry associations will revert to the appropriate association (EPRI, INPO, NUMARC).

PROGRESS ON THE PLAN

Significant progress toward resolving the issues identified in this plan has been made since initiation of the plan two years ago, but much more is needed before firm commitments to order more nuclear plants can be expected. It takes many years to design, license and build the nuclear power plants that will contribute to the needed electric generation capacity in the future. That is why it is so important to maintain progress and hold to the overall schedule goals of the plan.

New nuclear power plants must ultimately compete in the marketplace against other baseload generating options. An analysis* completed in 1992 indicates that, assuming the activities identified in this plan are successfully accomplished, standardized advanced-design nuclear power plants can compete with the other generating options available for use after the year 2000.

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* "Advanced-Design Nuclear Power Plants: Competitive, Economical Electricity," U.S. Council for Energy Awareness, Washington, DC, June 1992.

The major accomplishments, changes or adjustments made to the plan in the past year are listed in the following table:

BB#	Title	Significant Accomplishments, Changes or Adjustments
1.	Current Nuclear Plant Performance	• Plant performance continued to improve in 1992; one important basis for measuring plant performance is the 1995 set of International Performance Indicators. The 1991 performance was in line with the 1995 indicator goals • Total nuclear generation increased by about 10% from 1989 to 1990 and an additional 6% from 1990 to 1991; electricity from nuclear power plants represented 21.7% of total U.S. electric utility generation in 1991 • Production costs per MWe decreased on average by 1.4% from 1990 to 1991 and 4.4% from 1989 to 1991
2.	Predictable Licensing & Stable Regulation	• Level of detail issue for design certification resolved (SECY issued) • Common understandings on ITAAC scope, form and content with NRC as well as design certification rule form, content and proceedings close to achievement • DC Court of Appeals overturned earlier ruling, thus upholding Part 52 provisions relative to public's right to a preoperational hearing • Legislation passed to codify the NRC's Part 52 rule and provide for certification of standardized designs, combined licensing, informal hearings and interim operation
3.	ALWR Utility Requirements	• NRC issued final safety evaluation report (SER) on evolutionary plant Utility Requirements Document (URD) • Progress made on passive plant URD SER with resolution of almost all policy issues; industry effort to improve on NRC schedule has not been successful to date; final SER expected by September 1993 (delay of seven months)
4.	NRC Design Certification	• Final SER approval for ABWR is on schedule and expected to be issued by end of 1992 • SSARs for AP 600 and SBWR submitted to NRC on schedule

		• Adjustments in NPOC ALWR certification schedules (issuance of final SER/FDA by NRC) – ABWR by 12/92 – System 80+ by 11/93 – AP 600 by 7/94 – SBWR by 9/94 • ITAAC submittals made to NRC on ABWR • Draft SER issued by NRC on System 80+
5.	Siting	• Industry response to DOE RFQ with phased program put in place; formal agreement with DOE signed • Substantive progress made on evaluation phase; first industry workshop held
6.	First-of-a-Kind Engineering	• Nuclear utility CEOs survey conducted • Program, management and funding plans defined and approved • Advanced Reactor Corporation (ARC) reorganized to provide management vehicle for utilities; Project Management Board formed • EPRI established as project manager • ARC and DOE sign cooperative agreement • Request for proposals to perform design work issued and bids received • Plans developed for enhanced coordination of the project-specific building blocks through the Advanced Reactor Corporation and design-specific utility owners groups • Legislation passed to authorize the ALWR and FOAKE programs that will support commercialization by 1995
7.	Life-Cycle Standardization	• ALWR life-cycle standardization project established within INPO • Assessment of industry experience with standardization completed • Standardization of operational elements started
8.	Enhanced Public Awareness	• Growing evidence of public support for nuclear power; over 75% of U.S. public consider nuclear power important in the future • Increased focus on public and opinion leaders education • Comparative cost study published

9.	Clarification of Ownership & Financing	• Alternative ownership options have been analyzed as to feasibility; results of national energy legislation to be used to define feasibility of certain alternatives • Cost of ownership alternatives have been analyzed; report in preparation • Insurance coverage of investments in ALWR analyzed; report being reviewed. • Some information on NPOC Strategic Plan communicated to investment community
10.	State Economic Regulatory Issues	• No change
11.	High-Level Radioactive Waste	• Yucca Mountain site characterization continued • Progress on monitored retrievable storage with 21 localities considered as potential host sites • Legislation passed to direct the EPA to repromulgate disposal standards for Yucca Mountain consistent with the findings and recommendations of the National Academy of Sciences
12.	Low-Level Radioactive Waste	• The progress being made in development of the regional radioactive waste compacts is very slow and not sufficient to meet the Congressional-established timetable. • Some temporary relief has been introduced by the decision to keep the Barnwell storage facility available to out-of-state shipments • Supreme Court ruled support for the LLW legislation except for requirement of states to take title of waste in 1996
13.	Adequate, Economic Fuel Supply	• National Energy Policy Act of 1992 passed to restructure uranium enrichment enterprise (UEE) • Efforts initiated to convert highly enriched uranium from defense programs for use as civilian nuclear fuel

14.	Enhanced Governmental Support	• Positive government reaction to NPOC Plan • Prominent role of nuclear energy in the National Energy Strategy • National Energy Policy Act of 1992 passed that reforms licensing process, restructures uranium enrichment enterprise, authorizes advanced reactor R&D, and directs the repromulgation of safety standards for HLW disposal

SECTION II

OUTLINE OF STRATEGIC PLAN

STRATEGIC PLAN FOR BUILDING NEW NUCLEAR POWER PLANTS

SECTION II: OUTLINE OF STRATEGIC PLAN

STRUCTURE OF THE PLAN

The enabling conditions to meet the primary goal of the Strategic Plan are defined. Each enabling condition is framed as a "building block" which uniquely contributes to the complete structure. All the building blocks and their interdependencies are identified and factored into a strategy leading up to putting the last block in place for a firm commitment to build ALWR plants by the mid-90s. Placing the last block in place would include the formalization of resource commitments.

The enabling conditions or "building blocks" are outlined in Figure II-1, which shows the title and lead industry responsibilities. The building blocks are grouped into four categories: (1) Prerequisites From On-Going Programs, (2) Generic Safety/Environmental Regulations and Industry Standards, (3) Project Specific Activities, and (4) Institutional Steps. Each building block is a summary statement of a more detailed action plan which has been developed by the industry organization/standing committee assigned lead responsibility for that block. Each block is formulated in five parts:

1. Title
2. Goal(s) (i.e., the enabling conditions)
3. Responsibility assignments to existing industry organizations for each building block
4. Major milestones
5. Major tie-ins

"Lead industry responsibility" means that the assigned organization will develop and implement its action plan, utilizing its own resources and seeking assistance and advice as appropriate. Assignments of industry supporting responsibilities are made to designated organizations whose assistance and advice would be most appropriate. The term "utility" is used in each case where the responsibility is assigned to the organization(s) licensed and ultimately responsible for owning and operating a nuclear plant. The terms "utility," "licensee," "owner/operator" are interchangeable.

The plan also recognizes that success in achieving the goals depends on government actions as well as industry. Where government rather than industry has the basic responsibility and authority over a building block, "primary" or "regulatory" responsibility is given to a government agency, not as an assignment but to recognize that authority. The "industry lead" organization is assigned responsibility for

Figure II-1: BUILDING BLOCK SUMMARY

PREREQUISITES FROM ONGOING PROGRAMS

(1) Current Nuclear Plant Performance
(Licensees)

(12) Low-Level Radioactive Waste
(EEI-ACORD)

(11) High-Level Radioactive Waste
(EEI-ACORD)

(13) Adequate, Economic Fuel Supply
(EEI)

GENERIC SAFETY/ENVIRONMENTAL REGULATION & INDUSTRY STANDARDS

(2) Predictable Licensing & Stable Regulation
(NUMARC)

(3) ALWR Utility Requirements
(EPRI-USC)

PROJECT-SPECIFIC ACTIVITIES

(4) NRC Design Certification
(Plant Designers)

(5) Siting
(EPRI/NUMARC)

(6) First-of-a-Kind Engineering
(ARC-EPRI)

(7) Life-Cycle Standardization
(INPO)

INSTITUTIONAL STEPS

(8) Enhanced Public Acceptance
(USCEA)

(9) Clarification of Ownership & Financing
(EEI)

(10) State Economic Regulatory Issues
(EEI)

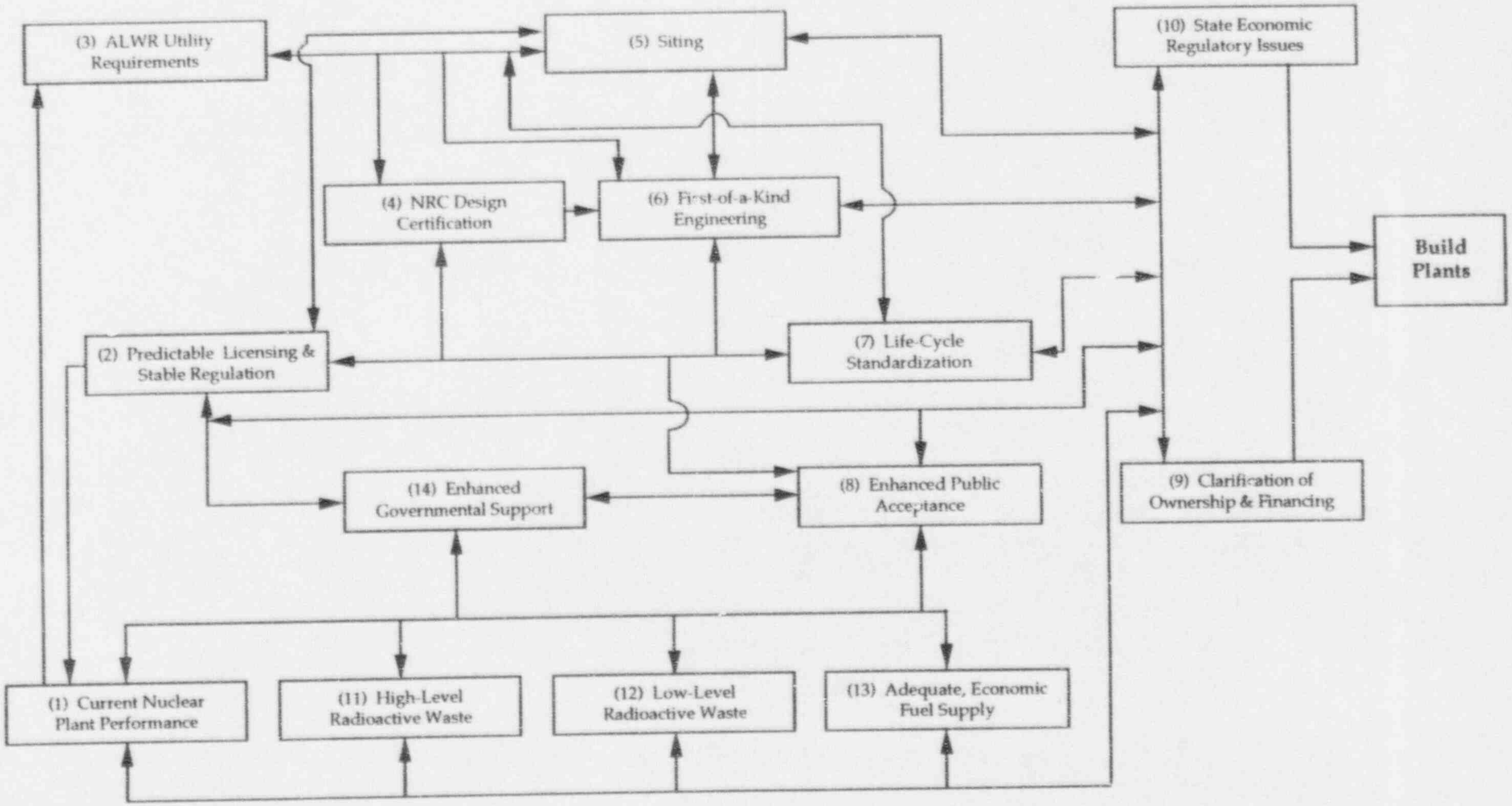
(14) Enhanced Governmental Support
(ANEC)

providing input to the processes in that building block. "Primary" responsibility is also assigned to industry organizations where the eventual implementation requires that one or more industry organizations become involved through a major commitment of funds. In such cases, the "lead industry" organization will handle the building block in the interim.

Since this is an institutional as well as a technical plan, the milestones are not all as definitive or as measurable as are normal project engineering milestones. They represent a best effort to schedule steps of progress against the goals and will be used to assess that progress as a milestone date is reached.

The tie-ins define the key coordination steps among building blocks. Figure II-2 is a simplified schematic of the major tie-ins so as to portray the concept. This explicit portrayal of coordination points is an effort, in accordance with NPOC directions, to minimize overall project management requirements in this time frame.

Figure II-2: SCHEMATIC OF MAJOR BUILDING BLOCK "TIE-INS"



THE BUILDING BLOCKS

Block 1: Current Nuclear Plant Performance

Goals:

1. Maintain and improve the high safety and reliable performance of operating plants.
2. Improve the economic performance of existing nuclear plants.*

Responsibilities:

Industry Lead	Utilities
Primary	Utilities
Industry Supporting	INPO/EEI/NUMARC/EPRI/Plant Designers
Regulatory	NRC

Milestones:

1. Through the INPO** evaluation program, conduct periodic evaluations of nuclear plant performance; provide assessments to utility management.
2. Through the INPO SEE-IN Program, analyze events worldwide to identify precursor events. Analyze and disseminate operating data and follow up on effectiveness of corrective actions.
3. Support activities of National Academy for Nuclear Training and support continuing accreditation of training programs.
4. Monitor and provide annual progress reports against the 1995 goals based upon the uniform set of performance indicators agreed upon for worldwide use by WANO.
5. Annual review of average O&M cost data by EPRI.
6. Enhance economic performance of existing nuclear plants and, as projected, for the operation of new plants.

Tie-Ins:

- From Blocks 2 and 10--Stable regulatory environment that encourages industry self-improvement initiatives.
- To Block 3--Provide industry operating experience and long-term goals input to ALWR Utility Requirements Document.
- To Blocks 8, 10 and 14--Provide industry performance indicator results for public dissemination.

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* Economic performance of existing nuclear plants is being addressed by the industry separate from this plan.

** INPO was formed by the industry to promote the safety and reliability of nuclear operating plants. INPO continues its assigned role as an ongoing part of this block.

Block 2: Predictable Licensing and Stable Regulation

Goals:

1. Assure that regulatory processes are in place for predictable licensing, including design certification, site approval, and combined construction and operating license to allow for construction, startup and commencement of full-power operation of new plants.
2. Assure that a high-quality, stable regulatory process is in place for safety and environmental protection; and encourage industry self-improvement initiatives, instill public confidence, and ensure the reasonable cost of electricity generated by nuclear power plants.
3. Achieve regulatory acceptance of appropriate aspects of standardized operational elements and resolution of related issues associated with lifecycle standardization (Building Block 7).
4. Assure that a predictable and stable process is in place that facilitates economically viable renewal of existing plant operating licenses.*

Responsibilities:

Industry Lead	NUMARC
Primary	NRC
Industry Supporting	ARC/Plant Design Teams/Utilities/EPRI-ALWR Utility Steering Committee (USC)/USCEA/ANEC
Regulatory	NRC
Others	DOE/EPA/FERC/FEMA/State Regulatory Agencies/CEQ

Milestones:

1.	Completed	Obtain NRC agreement, via Commission policy, on level of design detail required for design certification.
2.	12/92	Obtain NRC acceptance on the scope and content of ITAAC.
3.	3/93	Obtain NRC agreement on design certification issues.
4.	9/93	Work with EPRI to support NRC review of the Utility Requirements Document to achieve milestones in Block 3.
5.	Ongoing	Work with plant designers and NRC to establish an effective design certification process and schedule to achieve milestones in Block 4.
6.	Completed	Review siting-related regulations and procedures.
7.	Completed	Assess amendments to siting-related regulations.
8.	Completed	Finalize programs associated with early site approval regulations.
9.	6/93	Develop strategies and methodologies to implement a COL to achieve milestones in Block 2.

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* Industrywide efforts to develop a predictable and stable license renewal process are being addressed outside of this plan.

10.	Ongoing	Minimize impact due to overlap of regulatory responsibilities among NRC, EPA, FEMA, and state safety and environmental regulators.
11.	Ongoing	Resolve issues identified in NUREG-1395 and Generic Letter 90-01.
12.	Ongoing	Provide regulatory interface support for Building Block 7 to address regulatory acceptance and related issues associated with aspects of life-cycle standardization.
13.	Ongoing	Establish predictable and stable license renewal process.
14.	Ongoing	Provide the regulatory interface, and work to ensure the stable and predictable implementation of environmental protection regulations under Part 51.
15.	Ongoing	Provide regulatory interface coordination and support, as appropriate, for siting activities under Building Block 5.

<u>Tie-Ins</u>:

- To Block 1--Stable regulatory environment that encourages industry self-improvement initiatives.
- To Block 4--Define and obtain NRC concurrence to an implementation schedule that permits completion of certifications on schedule.
- To Blocks 4 and 6--Closure on level of detail required for certification.
- To Block 5--Regulatory coordination and support for site approval activities.
- To Block 7--(1) Stable regulatory basis for life-cycle standardization; (2) regulatory interface and regulatory acceptance of appropriate aspects of standardized operational elements.
- To Block 8--Communications support for legislative and regulatory actions.
- From/to Block 14--Legislation to support predictable licensing.

Block 3: ALWR Utility Requirements

Goals:

1. Obtain NRC approval of the ALWR Utility Requirements Document.
2. Assure that ALWR designs conform to the full-scope ALWR Utility Requirements Document.

Responsibilities:

Industry Lead	EPRI-USC
Primary	EPRI-USC/Plant Design Teams
Industry Supporting	NUMARC
Government Supporting	DOE
Regulatory	NRC

Milestones:

1.	Completed	NRC final SER on evolutionary ALWR Utility Requirements Document.
2.	12/92	Formal endorsement by utility CEOs of evolutionary ALWR Utility Requirements Document.
3.	9/93	NRC final SER on passive ALWR Utility Requirements Document.
4.	6/93	Assess evolutionary and passive ALWR certification design conformance to the Utility Requirements Document.
5.	1/94	Formal endorsement by utility CEOs of passive ALWR Utility Requirements Document.
6.	12/95	Assess ALWR first-of-a-kind engineering designs for conformance to the Utility Requirements Document.

Tie-Ins:

- From Block 1--Input of operating experience from current plants to development of ALWR requirements.
- To Blocks 4, 5, 6 and 7--Evolutionary and passive ALWR Utility Requirements Document submittals to NRC and plant designers as basis for initial design certification submittals to NRC, enveloping siting parameters, first-of-a-kind engineering (FOAKE) development, and design basis for standardization beyond design.
- To Block 4--Assess design for conformance to passive ALWR Utility Requirements Document.
- To Block 6--Check of FOAKE design conformance to passive ALWR Utility Requirements Document.

Block 4: NRC Design Certification

Goal:
Obtain NRC certification of ALWR designs.

Responsibilities:

Industry Lead	Plant Design Teams
Primary	NRC
Industry Supporting	EPRI-USC/NUMARC/ANEC/USCEA
Government Supporting	DOE
Regulatory	NRC

Milestones:

1.	12/93	Evolutionary ABWR design certification obtained.
2.	11/94	Evolutionary System 80+ design certification obtained.
3.	Completed	Passive AP 600 standard SAR submitted to NRC.
4.	Completed	Passive SBWR standard SAR submitted to NRC.
5.	7/95	AP 600 design certification obtained.
6.	9/95	SBWR design certification obtained.

Tie-Ins:

- From Block 2--NUMARC input to plant designers on resolution with NRC of ITAAC requirements, level of detail required for design certification, and other 10 CFR Part 52 implementation issues.
- From Block 3--ALWR utility requirements for the design with integrated consensus utility requirements for all future ALWR designs and design resolutions of open regulatory issues.
- From/to Block 5--Site parameters for standard design established by NRC-approved ALWR Utility Requirements Document and implemented in design certification.
- To Block 6--Standard plant designs submitted for design certification are the starting point for first-of-a-kind engineering and will influence the approach taken to life-cycle standardization.
- To Block 7--Design input to approaches taken in life-cycle standardization.
- To Block 8--Individual design descriptions to assist in public communications.
- From Block 13--Designs must consider relationship between fuel design and fuel availability.

Block 5: Siting

Goal:

Obtain NRC approval of suitable site(s) for new nuclear plants either through early site permitting or through submission of an application for a combined construction and operating license and NRC approval to build and operate the plant to a certified design under its standardization rule.

Responsibilities:

Industry Lead	EPRI/NUMARC
Primary	Utilities/ISG
Industry Supporting	ANEC/EEI/USCEA
Government Supporting	DOE
Regulatory	NRC

Milestones:

1.	Completed	Formation of Industry Siting Group.
2.	Completed	Response to DOE RFQ is made.
3.	Completed	Evaluation phase initiated as part of DOE-sponsored early site permit program.
4.	12/92	Establish timing for initiation of formal approval process.
5.	12/92	Integrate technical/regulatory schedule and work with communications schedule.
6.	12/92	Completion of evaluation phase.
7.	Completed	Initiation of selection phase.
8.	6/93	Site characterization, or review and updating of characteristics of presently approved site(s).
9.	6/94	Submission of application for site approval.
10.	1995	Receipt of final decision on site acceptability from NRC.

Tie-Ins:

- From Block 2--To provide specific experience in implementing NRC's standardization rule (10 CFR 52).
- From Blocks 3, 4, and 6--To assure that the specific site characteristics fall within the enveloping site design parameters of the ALWR Utility Requirements Document and standard designs being certified.
- To Blocks 8 and 10--To determine timing of actions and coordinate with local communications programs; to address state and local regulatory and economic issues.

Block 6: First-of-a-Kind Engineering

Goals:

1. Complete engineering on certified designs in sufficient detail to define firm cost and schedule estimates and prepare for construction of standardized ALWR plants.
2. Ensure that an institutional infrastructure is in place to provide resources and manage completion of detailed design.
3. Define the process to achieve commercial standardization, that is the design standardization beyond that required for certification.

Responsibilities:

Industry Lead	EPRI-ARC
Primary	Potential Owner-Operators/Plant Designers/AEs/DOE
Industry Supporting	NUMARC/EEI/INPO/USCEA
Others	DOE/NRC

Milestones:

1.	Completed	Develop funding plan.
2.	Completed	Initiate ARC-DOE cooperative agreement.
3.	Completed	Secure utility funding commitments.
4.	Completed	Initiate Phase 1--requirements and infrastructure.
5.	Completed	Complete Phase 1.
6.	Completed	Initiate Phase 2--selection of designs on two-track (evolutionary and passive) program.
7.	2/93	Complete Phase 2.
8.	3/93	Initiate Phase 3--develop FOAKE for selected designs.
9.	Ongoing	Maintain support of all parties for the ARC-DOE cooperative agreement.
10.	9/96	Complete FOAKE.

Tie-Ins:

- From Block 2--Level of design detail required for final design approval.
- From Block 3--Design basis for plant designer.
- From Block 4--Description of certified design.
- From Block 5--Site identification and site parameters.
- To/from Block 7--Exchange information on the design basis to support enhanced life-cycle standardization.
- From Block 7--Assistance on the incorporation of operating experience into the design.
- To Block 8--Public announcement of ALWR designs selected for FOAKE funding.
- To Block 9--Provide cost estimates for lead customer financing needs.
- To Block 10--Increased certainty of construction schedules and budgets.
- To/from Block 13--Integration of fuel and plant.

Block 7: Life-Cycle Standardization

Goal:

1. Establish an institutional framework and approach to implement and oversee a model for life-cycle standardization of a family of plants.
2. Develop standardized operational elements to provide a basis for uniformity in appropriate aspects of the organizational structure, administrative controls, and construction, startup, operating and maintenance practices.
3. Develop an approach to maintain the standard design and design intent in all units of a family of plants over their lifetimes.

Responsibilities:

Industry Lead	INPO
Primary	Utilities
Industry Supporting	NUMARC/EPRI-USC/EEI/Plant Designers/ARC-PMB

Milestones:

1.	Completed	Develop a mechanism to address the fundamental issues associated with the approach to startup and operation of a family of standardized plants.
2.	Completed	Review the policies and underlying principles for inputs to standardization and recommend any adjustments.
3.	Completed	Assess the experience with standardization beyond design.
4.	12/92	Review the summary listing of Standardized Operational Elements included in this action plan and recommend adjustments.
5.	12/93	Define the interfacing requirements for standardization beyond design with all phases of plant design, construction and startup leading to operations.
6.	1/94	Develop a model mechanism for maintaining standardization within a family of plants throughout the operational life of the plants.
7.	2/94	Formulate an action plan for prioritization, development, review, validation and finalization of the guidelines and practices.
8.	3/94	Assess the extent of standardization beyond design to be pursued on the basis of expected benefits in terms of operational performance, reliability, efficiency, and economy.
9.	8/94	List appropriate guidelines and practices to be developed for a model family of plants consistent with the above.

Tie-Ins:

- From Block 2--Stable regulatory environment that encourages industry self-improvement initiatives.

- From/to Block 2--Mechanisms for regulatory interface and regulatory acceptance of appropriate aspects of the standardized operational elements.
- From/to Block 3--Evolutionary and passive ALWR Utility Requirements Document submitted to NRC and plant designers as a foundation for the design basis for life-cycle standardization.
- From Block 4--Design input to approaches taken in life-cycle standardization.
- From/to Block 6--Exchange information on the design basis to support enhanced life-cycle standardization.
- To Block 6--Assistance on the incorporation of operating experience into the design.
- To Blocks 2, 3 and 4--Provide input to the ITAAC process.
- From/to Blocks 9 and 10--Enhance the basis for assessment of financial issues.

Block 8: Enhanced Public Acceptance

Goals:

1. Achieve broad U.S. public acceptance of nuclear power.
2. Positively influence local public attitudes, at potential plant sites, on the need for new plants, and encourage attitudes which are conducive to new plant siting, construction and operation.

Responsibilities:

Industry Lead	USCEA
Primary	U.S. Nuclear Industry/DOE/NRC/ Congress/USCEA
Industry Supporting	ANEC/EEI/APPA/NRECA/NUMARC
Regulatory	NRC/State Regulatory Agencies

Milestones:

1. Continue national communications on the benefits of and need for additional nuclear energy plants.
2. Continue communications encouraging a high priority for nuclear energy in U.S. energy policy.
3. Provide communications support for the industry's legislative and regulatory goals, including license renewal, licensing reform, standardization, training, radioactive waste management, certification of new designs and privatization of DOE enrichment facilities, etc.
4. Help achieve significant progress toward studying, selecting and establishing an MRS, a high-level radioactive waste repository, and low-level radioactive waste facilities.
5. Assist applicants for early site permits or combined licenses with local communications programs to build understanding and acceptance prior to siting and construction decisions. Integrate siting communications research into communications programs.
6. Achieve heightened awareness of the need for equitable, predictable treatment of utility investment by state utility regulators.
7. Inform the financial community of the need for, and financial viability of, both today's operating plants and future advanced light water reactors, and financial implications of license renewal, government regulations, and decommissioning on current plants.
8. Provide the technical basis for communication, legislative efforts, and policy development in areas not covered by other industry organizations.
9. Monitor public priorities and acceptance of nuclear energy.
10. Communicate the benefits and features of advanced nuclear energy plants.
11. Provide information to the public, the media, opinion leaders and policymakers on radiation, radioactive waste and safety issues.
12. Communicate performance and benefits of U.S. operating plants overall and in relation to the issues of aging and license renewal.

Tie-Ins:

- Information input to this block is required from all other blocks.
- To Blocks 2, 5, 6, 9, 10, 11, 12, 13 and 14--To encourage actions favorable to nuclear energy.

Block 9: Clarification of Ownership and Financing

Goal:

Analyze and propose structures for the financing, ownership, and operation of nuclear plants which reasonably compensates owners, investors, and, if applicable, vendors and operators.

Responsibilities:

Industry Lead	EEI
Primary	FERC/SEC/Congress/Investment Community
Industry Supporting	ANEC/USCEA/Plant Designers
Regulatory	FERC/SEC/NRC

Milestones:

1.	Completed	Identify and summarize alternative forms of power plant ownership.
2.	Completed	Model and analyze the relative financing costs of alternative ownership forms in the light of periodic assessments of the financial potential for new plants.
3.	Ongoing	Periodically evaluate the potential for financing new nuclear power plants based on the progress of all blocks of the Strategic Plan.
4.	Completed	Identify and attempt to quantify nuclear insurance-related risks and potential liabilities; identification, quantification.
5.	4/93	Review and identify perceived constraints, primarily legal and regulatory, to implementation of the various forms of ownership in view of potential legislative and regulatory changes.
6.	Ongoing	Interview investment/commercial bankers and security analysts on the ability to finance a plant. Periodically keep the investment community informed of Strategic Plan progress.
7.	7/93	Evaluate impact of current and potential ownership forms on site selection, financing/construction alternatives, cost and schedule.
8.	9/93	Identify and evaluate options to formulate contracts for sale of electricity.
9.	3/94	Prepare written report summing up results of the analysis accomplished in Milestones 1 through 8.

Tie-Ins:

- From/to Blocks 2, 10, and 14--Identify legislative, legal, and regulatory constraints.
- From/to Block 5--Evaluate impact of ownership forms on siting.

- From/to Block 6--Evaluate level of confidence achieved in costs and schedules from the completion of FOAKE on risk allocation and its impact on current and potential ownership forms.
- From/to Block 7--Enhanced basis for assessment of financial issues.
- From/to Block 8--Transfer information to enhance public acceptance.
- From Blocks 11 and 12--Transfer information and quantify potential liabilities.
- From/to Block 14--Explore government participation in financing.

Block 10: State Economic Regulatory Issues

Goal:

Achieve support by state regulatory agencies for predictable and stable handling of permitting and financial matters.

Responsibilities:

Industry Lead	EEI
Primary	NARUC
Industry Supporting	USCEA/ANEC/NUMARC/APPA/ NRECA
Government Supporting	Regional states groups (e.g, Southern States Energy Board)
Regulatory	Individual State Regulatory Agencies

Milestones:

1. Ongoing — Protocols regarding rolling prudence.
2. Completed — Preapproval contracting.
3. Completed — Protocols regarding integrated resource planning.
4. Ongoing — Periodic reports to NPOC.

Tie-Ins:

- To Block 2--Coordination with stable and predictable safety regulatory approach.
- To Block 6--Engineering cost estimates to support competitive analysis.
- To Block 7--To enhance the basis for the assessment of financial risk.
- To Block 8--To recognize the full benefits of nuclear energy.
- From/to Block 9--To open up ownership and financing opportunities.
- To Block 11--To increase investor/PUC confidence.
- To Block 14--Coordination with legislative activities and governmental support.

Block 11: High-Level Radioactive Waste

Goal:

Achieve progress with the high-level radioactive waste (spent fuel) disposal system that includes a permanent repository and a temporary monitored retrievable storage (MRS) facility.

Responsibilities:

Industry Lead	EEI-ACORD
Primary	DOE
Industry Supporting	UWASTE/USCEA/NUMARC/EPRI/ ANEC
Regulatory	NRC/EPA/DOT/DOE

Milestones:

1.	Ongoing	Ensure continuing viability of nuclear energy plant on-site storage.
2.	Completed	Reorganization of DOE Office of Civilian Radioactive Waste Management.
3.	Completed	Management and operations (M&O) contractor established.
4.	12/93	Evaluate DOE/NAS study of actinide recycle from utility perspective.
5.	10/97	If Yucca Mountain is found suitable for development as the nation's first high-level nuclear radioactive waste repository, begin licensing process.
6.	1/98	Provide an MRS facility.
7.	2001	Complete the characterization of the Yucca Mountain site.
8.	10/2004	Start construction of repository at Yucca Mountain.
9.	2010	Begin acceptance of spent fuel at repository.

Tie-Ins:

- To Block 1--Expanded on-site fuel storage at current plants.
- To Blocks 8 and 14--Enhance nation's confidence that it can rely on nuclear energy, by achieving progress on high-level radioactive waste management.
- To Blocks 9 and 10--To increase investor and state PUC confidence, by achieving progress on high-level radioactive waste management.

Block 12: Low-Level Radioactive Waste

Goal:

Assure availability of low-level radioactive nuclear plant waste processing and disposal capacity.

Responsibilities:

Industry Lead	EEI-ACORD
Primary	States
Industry Supporting	UWASTE/USCEA/ANEC/NUMARC/ EPRI
Regulatory	NRC/EPA

Milestones:

1. Various — Opening of new state and compact low-level waste disposal sites.
2. Ongoing — Ensure continued availability of nuclear plant on-site storage.
3. Ongoing — Ensure continued access to off-site waste processing facilities.

Tie-Ins:

- To Block 1--On-site storage of low-level waste; minimize low-level radioactive waste volumes.
- To Blocks 8 and 14--Enhance the nation's and government's confidence that it can rely on nuclear energy, by achieving progress on low-level radioactive waste management.
- To Blocks 9 and 10--To increase investor and state PUC confidence by achieving progress in low-level waste management.

Block 13: Adequate, Economic Fuel Supply

Goal:
Assure a continuing stable and economic supply of nuclear fuel.

Responsibilities:

Industry Lead	EEI
Primary	DOE/Private Sector Fuel-Cycle Suppliers/ Converters/Utilities
Industry Supporting	ANEC/USCEA
Regulatory	NRC

Milestones:

1. Ongoing — Continue dependable, economical and reliable nuclear fuel supply by maintaining unrestricted access to uranium supply, conversion and enrichment services, and fuel fabrication on an internationally competitive basis.
2. Completed — Seek fair and effective comprehensive nuclear fuel supply legislation to establish a market-oriented, competitive domestic uranium enrichment enterprise.
3. Ongoing — Support expeditious determination of the technical and commercial viability of the AVLIS enrichment technology, and encourage that the decision to deploy be made solely on sound economic and business principles.
4. Ongoing — Improve the availability of domestic enrichment services at competitive prices by encouraging private enrichment.
5. Ongoing — Evaluate impact on future fuel supply of potential availability of government inventories of natural uranium, LEU, and HEU and assess need for action by industry to facilitate their use.

Tie-Ins:

- To Block 4--To determine if any limitations will impact fuel design.
- To/from Block 6--Integration of fuel and plant.
- To Block 9--To assess the impact of fuel prices as a part of overall plant economics.
- From Blocks 8 and 14--To gain support for predictable fuel supply.

Block 14: Enhanced Governmental Support

Goal:

Enhance governmental support for the necessary institutional framework, including laws, regulations and programs, that encourage the construction and operation of new nuclear plants.

Responsibilities:

Industry Lead	ANEC
Primary	Congress/States/DOE
Industry Supporting	EEI/APPA/USCEA/NUMARC/U.S. Industry

Milestones:

1.	Ongoing	Provide periodic progress reports on utility performance to Congress.
2.	Completed	Recognition of nuclear energy's role included in the National Energy Strategy.
3.	Ongoing	DOE and NRC budget and appropriations.
4.	Completed	Advanced reactors R&D legislation.
5.	Completed	Congressional enactment of legislation to codify and strengthen NRC's combined licensing process.
6.	Ongoing	Clarify regulatory responsibilities among NRC, EPA, and states.
7.	Ongoing	Obtain state legislation to assure adequate economic return for nuclear projects.
8.	Completed	Passage of Uranium Enrichment Enterprise (UEE) restructuring legislation.
9.	Ongoing	Obtain necessary legislation to assure continued progress on high-level radioactive waste facilities; achieve enhanced acceptance in Nevada.
10.	Ongoing	Low-level radioactive waste issues.

Tie-Ins:

- To Block 2--Achieve legislative reinforcement of predictable licensing.
- To Block 4--Encourage adequate appropriations legislation for certification activities.
- To Block 5--Assure continuing support of the siting program by DOE and Congress.
- From Block 8--Assist and support efforts to enhance public acceptance
- To Block 10--Enhance confidence in the financial prudence review through state rate reform legislation.
- To Block 11--Achieve enhanced acceptance of the high-level radioactive waste program in Nevada.

- To Block 12--Monitor and coordinate Congressional activities for equitable resolution of low-level radioactive waste issues.
- To Block 13--Secure passage of UEE restructuring legislation.

SECTION III

SUPPORTING ACTION PLANS

PREFACE

The action plans have been formulated by the industry organization assigned "industry lead" responsibility. The action plan milestones and schedules are keyed to the major milestones, schedules and interrelationships ("tie-ins") identified in the overall Strategic Plan. Implementation of the action plans is the responsibility of the lead organizations with appropriate support from the organizations assigned industry supporting responsibilities. In many building blocks, the resource commitments to complete the block have not been made. In these cases, the lead organization will foster, not necessarily make, those commitments. If resource commitments to implement a block are later made to an organization other than the lead organization, lead responsibility will be turned over to that organization.

ACTION PLAN FOR BUILDING BLOCK #1: CURRENT NUCLEAR PLANT PERFORMANCE

I. Goals and Responsibilities

Goals:

1. Maintain and improve the high safety and reliable performance of operating plants.
2. Improve the economic performance of existing nuclear plants.*

Responsibilities:

Industry Lead	Utilities
Primary	Utilities
Industry Supporting	INPO/EEI/NUMARC/EPRI/Plant Designers
Regulatory	NRC

II. Summary Action Plan

Utilities that hold the license to operate nuclear power plants have the primary responsibility for the safe and reliable operation of their plant(s). Considerable effort has been devoted by utilities to improve their management and operation of nuclear power plants. Recognizing the need to strive for excellence in nuclear plant operations and to accept the need for improvement by peer review, and recognizing the fact that all nuclear utilities are affected by the actions of any one utility, the nuclear industry established the Institute of Nuclear Power Operations (INPO) in 1979. INPO's mission is to promote the highest levels of safety and reliability--to promote excellence--in the operation of nuclear electric generating plants.

The industry also recognizes that a strong and well-managed federal regulator, the Nuclear Regulatory Commission (NRC), is an essential part of the nation's commercial nuclear program. The industry has established the Nuclear Management and Resources Council (NUMARC) to serve as the nuclear power industry's principal mechanism for conveying industry views, concerns, and policies regarding industrywide regulatory issues to the NRC and other government agencies as appropriate.

The Electric Power Research Institute (EPRI) provides leadership and innovation in science and technology to assist the utility industry in furnishing the highest value energy services to its customers. EPRI conducts research and development aimed at providing information, techniques, diagnostic tools, and equipment

* Economic performance of existing nuclear plants is being addressed by the industry separate from this plan.

that will help member utilities optimize operating and maintenance costs, improve their productivity, and extend the life of their existing nuclear generating facilities.

In the years since the TMI accident, the commercial U.S. nuclear utility industry has implemented and progressed well beyond the recommendations in the Kemeny Commission Report in improving operations at its nuclear power plants. Much of this has been accomplished via INPO's cornerstone programs: plant and corporate evaluations, training and accreditation, events analysis and information exchange, and assistance efforts.

- The industry established its own means of evaluating performance at U.S. nuclear plants through INPO. Teams of experienced (both INPO permanent staff and industry loaned employees), augmented by experts from similar plants, perform regular evaluations of every U.S. nuclear station to ensure each plant is operated and maintained to industry standards of excellence.

- In early 1980, an industry event analysis program was initiated by EPRI and jointly developed with INPO to meet an industry need of systematically sharing operating experience among plants. The program, Significant Event Evaluation and Information Network (SEE-IN), provides a formal mechanism through which event information is reported, analyzed, and disseminated. Detailed information on international and domestic nuclear plant events is reviewed by a staff of experts at INPO, including loaned employees from nuclear steam system suppliers and architect/engineers. Significant lessons learned from these events are provided to all U.S. plants, and INPO teams follow up during plant evaluation visits to see that these lessons are implemented. An electronic message system called NUCLEAR NETWORK, which rapidly disseminates this information nationwide and to many other countries, is an integral part of this program.

- Early on, nuclear executives recognized the need for improved, uniform training at nuclear utilities nationwide, a need reinforced by the Kemeny Commission. The utilities also realized a need for formal training of all key craftsmen and technical positions, not just for licensed control room operators. In 1982, an accreditation process was established through INPO to address these needs. Since then the utilities have established training programs for 11 key positions and have met their commitments to accreditation. To formalize these extensive initiatives, the National Academy for Nuclear Training was established under the auspices of INPO. The National Academy is comprised of three elements:

- the training activities, resources, and facilities of the nuclear utility industry,

- the independent National Nuclear Accrediting Board, and

- INPO training and accreditation activities.

Each plant site with accredited training programs is a branch of the National Academy. Utilities must have all training programs accredited at each of their operating nuclear plants to become members of the National Academy. By December 1990, the industry had reached a significant milestone, achieving accreditation for all training programs at every U.S. nuclear station that was operating or planning to operate.

- In 1981, the industry began developing a performance indicator program to provide quantitative evidence of progress in key areas. Not only do the performance indicators allow utilities to gauge their plants' improvements, they also allow the industry as a whole to monitor its progress. In addition, the indicators foster healthy competition among utilities and plants, which inevitably results in better performance. By 1986, each U.S. utility with an operating unit had set 1990 goals for these performance indicators; the individual goals were combined (averaged) to develop overall industry goals.

- By the end of 1990, the industry had achieved an impressive decade of progress as measured by these carefully chosen indicators of overall nuclear plant performance. In addition, the nuclear power industry worldwide, through the World Association of Nuclear Operators (WANO), had agreed upon an enhanced set of performance indicators and definitions based on the mature U.S. program. In 1990, the U.S. nuclear power industry set aggressive goals for 1995 using the new international indicators and definitions.

- Extensive backfitting and system and component upgrades have been accomplished at every nuclear station in response to the Nuclear Regulatory Commission's post-TMI action plan and to industry initiatives. The nuclear steam system suppliers, owners groups, architect/engineers, and the Electric Power Research Institute have participated in this extensive and successful effort.

- Through a variety of exchange programs, U.S. utilities are sharing operating experiences with utilities in many other countries. This international information exchange fosters enhancements in nuclear plant operations on a worldwide basis and provides a means for incorporating international experience in the U.S. base of knowledge.

WANO, formally inaugurated in May 1989, now provides a formal basis for exchanging operating experience with every country that operates nuclear plant(s) for the generation of electricity. WANO was formed in response to the Chernobyl accident, just as INPO was formed in response to TMI. Many international executives have noted that their willingness to form and participate in WANO stems directly from observing the successful results achieved bv the U.S. nuclear utility industry over the past ten years.

The primary emphasis in this block is on continuing to strive for the highest levels of safety and reliability in the operation of nuclear plants. But this effort also yields increased plant generation, improved productivity, and advanced technology, which result in lower operating and maintenance (O&M) costs per MWe produced. It is essential to increasing public and investor confidence in nuclear power that such activities continue to contribute to more efficient plant operations and that the industry strive to improve its productivity and cost-effectiveness so as to maintain the economic competitiveness of nuclear power as compared to the available alternatives. Economic performance of existing nuclear plants is being addressed by the industry separate from this plan.

III. Milestones

1M1	Through the INPO evaluation program, conduct periodic evaluations of nuclear plant performance using performance objectives and criteria, and guidelines based on standards of excellence. Provide objective assessments of plant performance to utility management.	Ongoing
1M2	Through the INPO Significant Event Evaluation and Information Network (SEE-IN) Program, analyze events that occur in nuclear plants worldwide to identify precursors of potentially more serious events. Collect and analyze industry data on nuclear plant operations and equipment reliability, including data and event information received from the World Association of Nuclear Operators. Disseminate this information worldwide and follow up on the effectiveness of corrective actions in U.S. plants.	Ongoing

1M3 Support the activities of the National Academy for Nuclear Training and the independent National Nuclear Accrediting Board. Support continuing accreditation of key industry training programs by maintaining and improving high-quality training for personnel involved in operation, maintenance, support, and management. (Initial accreditation of training programs for all plants (730 programs) was achieved by the end of 1990.)

1M3.1	Reevaluate and achieve accreditation renewal for each program every four years.	Ongoing

1M4	Monitor and provide annual progress reports against the 1995 goals using the uniform set of performance indicators agreed upon for worldwide use by the World Association of Nuclear Operators.	Annually in March
1M5	Annual review of average O&M cost data by EPRI. For the first time since 1979, nuclear plant O&M costs have stabilized.	Annually
1M6	Enhance economic performance of existing operating plants and, as projected, for the operation of new plants.	Ongoing

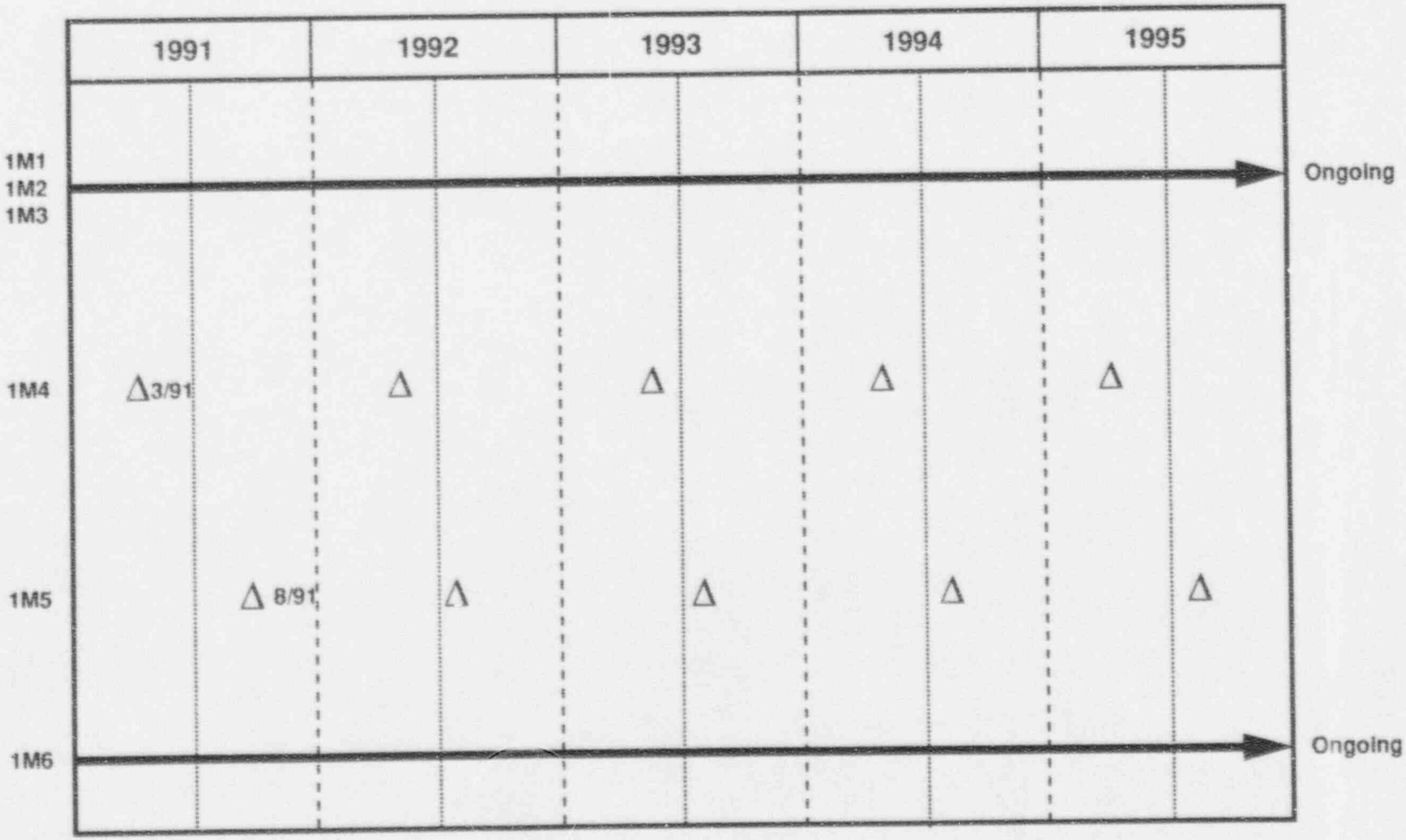
IV. Tie-Ins

1T1 From Blocks 2 and 10--Stable regulatory environment that encourages industry self-improvement initiatives and reinforces utility line management responsibility and authority for safe and reliable plant operation.

1T2 To Block 3--Provide industry operating experience and long-term goals input to ALWR Utility Requirements Document.

1T3 To Blocks 8, 10 and 14--Provide industry performance indicator results for public dissemination.

Schedule Display for Block 1



ACTION PLAN FOR BUILDING BLOCK #2: PREDICTABLE LICENSING AND STABLE REGULATION

I. Goals and Responsibilities

Goals:

1. Assure that regulatory processes are in place for predictable licensing, including design certification, site approval, and combined construction and operating license to allow for construction, startup and commencement of full-power operation of new plants.
2. Assure that a high-quality, stable regulatory process is in place for safety and environmental protection; and encourage industry self-improvement initiatives, instill public confidence, and ensure the reasonable cost of electricity generated by nuclear power plants.
3. Achieve regulatory acceptance of appropriate aspects of standardized operational elements and resolution of related issues associated with life-cycle standardization (Building Block 7).
4. Assure that a predictable and stable process is in place that facilitates economically viable renewal of existing plant operating licenses.*

Responsibilities:

Industry Lead	NUMARC
Primary	NRC
Industry Supporting	ARC/Plant Design Teams/Utilities/EPRI-ALWR Utility Steering Committee (USC)/USCEA/ANEC
Regulatory	NRC
Others	DOE/EPA/FERC/FEMA/State Regulatory Agencies/CEQ

II. Summary Action Plan

The industry actively participated in the development of the 10 CFR Part 52 Rule (titled "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Reactors"), and has engaged in numerous activities, including detailed presentations to the NRC, relative to implementation of the industry's proposed approach, developed by NUMARC with the assistance of the Standardization Oversight Working Group (SOWG), for implementation of that rule. A two-tier approach is being used to facilitate implementation of the rule. Tier 1 would contain a description of the important and salient safety features of the structures, systems and components. The critical plant design features affect-

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* Industrywide efforts to develop a predictable and stable license renewal process are being addressed outside of this plan.

the structures, systems and components. The critical plant design features affecting the safety would be documented, reviewed and approved in the design certification rule. Tier 1 would also contain the corresponding array of Inspections, Tests, Analyses and Acceptance Criteria (ITAAC) which are required to demonstrate that the as-built facility is in conformance with the certified design. Tier 2 would encompass the remainder of design information relating to plant safety which will provide the supporting technical bases for the NRC's final design approval and design certification reviews. Changes to Tier 1 would be accomplished by rulemaking, whereas changes to Tier 2 would be done utilizing a process similar to 10 CFR 50.59.

On February 15, 1991, the Commission issued a Staff Requirements Memorandum (SRM) for SECY-90-377 that provided NRC staff with guidance on a number of issues related to 10 CFR Part 52. The most noteworthy are the level of detail necessary for a standard plant design to be certified, use of a two-tier approach, confirmation that the level of detail is that required to enable the NRC staff to make their safety finding, ITAAC requirements and the change process to be used under Part 52. The Commission approved a graded approach to the level of design detail, that is, the level of detail needed for design certification will vary according to a structure's, system's, or component's safety significance. Regarding ITAAC, the Commission amplified on the purpose of ITAAC as being "to provide reasonable assurance that a plant which references the design is built and will operate in accordance with design certification..." In addition, the Commission stated that ITAAC should not be used to impose additional design requirements.

Under the policy guidance of the NUMARC SOWG, draft point papers delineating the industry's interpretations and recommended implementation approaches on various aspects of 10 CFR Part 52 continue to be developed as necessary for discussion with the NRC. Policy matters addressed by draft NUMARC point papers to date include ITAAC, final design approval (FDA), design certification, plant change process, National Environmental Policy Act (NEPA), sign-as-you-go, as well as COL and preoperational proceedings. It is envisioned that such point papers will continue to serve as input to the bases for detailed procedures or regulatory guides for 10 CFR Part 52

NUMARC, through the SOWG, developed a regulatory definition of a standard design, from a licensing perspective, based on the Statement of Considerations associated with Part 52. The definition states:

> "A standard design is a design that is sufficiently detailed and complete to support certification in accordance with Subpart B* of 10 CFR Part 52,

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* 10 CFR Part 52, Subpart B only refers to the design certification aspects of the licensing process. The site-specific considerations would be discussed at the COL stage and are covered by 10 CFR Part 52, Subpart C.

and which is usable for a multiple number of units or at a multiple number of sites without reopening or repeating the NRC licensing review."

EPRI will continue to work with the NRC to reach agreement on the ALWR Utility Requirements Documents that list the specific safety and economic requirements as well as general specifications for future plant designs. These requirements will be common to all ALWR designs independent of the plant designer. The Commission has agreed that the review of the Requirements Document for passive plants will be completed prior to any decisions being made on the design certification reviews for passive plants. Early generic resolution of major technical issues during the NRC review of the Requirements Document should lead to a more uniform review process for the design certification applications, and contribute to the standardization of future plants and a more predictable and stable licensing environment. Furthermore, the Requirements Document provides a standardized format and framework for designing and procuring future plants.

A common understanding of ITAAC principles continues to be developed, and the detailed formulation of ITAAC is being finalized through development and industry review of the integrated lead plant ITAAC submittal for the GE ABWR. Other vendors are participating in the lead plant ITAAC development and review to incorporate concepts and lessons learned into their respective ITAAC.

Methodologies, working practices and procedures will be developed to put in place a "sign-as-you-go" process, similar to that used in the readiness review of the Vogtle facility, for documenting compliance with the ITAAC requirements as well as traditional Part 50 quality assurance requirements. The objective would be to assure the NRC and the public that a plant is constructed in accordance with the licensing requirements established during the COL review and public hearing. These guidelines will be compatible with the NRC's procedures and working practices.

The NUMARC SOWG will develop a set of general principles to enable a company or consortium of companies to make applications and obtain approval of a COL for the construction and operation of a certified design. The issues, methodologies, general procedures and actions surrounding the COL phase of the regulatory process associated with the licensing, construction and startup of future standardized nuclear plants will be developed and discussed with the NRC.

The industry, through NUMARC and the other industry agencies such as ANEC and USCEA, will address issues needing resolution which involve discussions with the NRC staff, other regulatory agencies, Congress and the public to create a common interpretation and understanding. The aim of this task is to reduce the

impact of overlapping regulatory responsibilities on the industry and achieve a unified stable regulatory environment by:

1. Continuing to work with the various regulatory agencies to ease the burden on the industry of duplicative or conflicting regulation by multiple federal and state agencies.

2. Continuing industry endeavors to correct and resolve the major issues described in NUREG-1395, "Industry Perceptions of the Impact of the U.S. Nuclear Regulatory Commission on Nuclear Power Plant Activities," as well as assisting regulatory agencies such as EPA, FEMA, NRC, etc., in identifying areas of overlapping regulatory responsibilities.

3. Continuing to work with Congress and the public to develop legislative and public support for nuclear power and the need for predictable licensing and regulatory unity.

4. Continuing to work with NRC to define a predictable and stable license renewal process.

NUREG-1395 was prepared in response to the industry concerns over the apparent expansion of the NRC perceived jurisdiction into management and economic aspects of the commercial nuclear industry. The industry associations involved in assisting in the identification and reduction of the impact of regulatory action by multiple agencies will also assess the effectiveness of the action plans put in place to resolve the root causes of these issues.

The industry and its regulators must work in concert to develop and agree on the procedures and working practices to implement Part 52, in a practical and economic manner, while assuring public safety and advancing standardization, within the confines of the law. An important goal of these new regulatory working practices will be to identify and resolve issues at the start of the process and before any construction begins. Predictability and stability are two major factors that not only contribute to plant safety but also will minimize the financial risk associated with construction and operation of future nuclear power plants, thus providing a basis for reestablishing the nuclear option.

III. Milestones

2M1	Obtain NRC agreement, via Commission policy, on the level of design detail required for design certification.	Completed
2M2	Obtain NRC agreement on the scope and content of an ITAAC submittal.	12/92

	2M2.1	Conceptual agreement via Commission policy guidance	Completed
	2M2.2	Agreement on detailed ITAAC formulation via the lead plant submittal	12/92
2M3	Obtain NRC agreement on the scope, content and format of a design certification rulemaking application.		3/93
	2M3.1	Agreement between industry and NRC on resolution of NEPA-SAMDA	Completed
2M4	NUMARC work with EPRI to monitor and support the NRC review processes and schedules so as to achieve the Utility Requirements Document NRC approvals in accordance with the milestones in Block 3:		
	4M1	Final SER on evolutionary plant requirements	Completed
	4M3	Final SER on passive plant requirements	9/93
2M5	NUMARC work with plant designers and NRC to establish an effective design certification process and so as to achieve the FDA and design certification schedule in Block 4:		
	4M-GE15	FDA for GE ABWR	12/92
	4M-GE19	Design certification for GE ABWR	12/93
	4M-ABB-CE15	FDA for System 80+	11/93
	4M-ABB-CE19	Design certification for System 80+	11/94
	4M-W15	FDA for AP 600	7/94
	4M-GE19	FDA for GE SBWR	9/94
	4M-W19	Design certification for AP 600	7/95
	4M-GE19	Design certification for GE SBWR	9/95
2M6	Review siting-related regulations and procedures.		Completed
2M7	Assess amendments to siting regulations and impact on previously approved or evaluated sites.		Completed
2M8	Finalize the programs associated with the early site approval regulations, such as emergency preparedness programs.		Completed
2M9	Develop strategies and methodologies to implement the functions associated with the submittal and approval of a combined construction and operating license (COL).		6/93

2M9.1 Reach agreement with the Commission via policy guidance on the scope, content and general format of a COL application. — 3/94

2M9.2 Reach agreement with the Commission through policy guidance as to the scope and content the license conditions of a COL granted under Part 52. — 3/94

2M9.3 Obtain agreement through Commission policy guidance on the general proceedings associated with the Commission's Preoperational Finding. — 3/94

2M9.4 Develop working practices, procedures and methodologies associated with the "sign-as-you-go" process and obtain NRC concurrence of the process. — 12/93

2M10 Minimize the impact on the nuclear utility industry due to overlap of regulatory responsibilities among NRC, EPA, FEMA, and state safety and environmental regulators. — Ongoing*

2M11 Resolve the root causes of issues identified in NUREG-1395, "Industry Perceptions of the Impact of the U.S. NRC on Nuclear Power Plant Activities," the responses to NRC Generic Letter 90-01, "Request for Voluntary Participation in NRC Regulatory Impact Survey," the issues identified from SECY 90-250, "Survey of NRC Staff Insights on Regulatory Impact," and respond to NRC initiatives related to reducing regulations marginal to safety and cost-ineffective regulatory processes. — Ongoing

2M12 Provide regulatory interface support for Building Block 7 activities to address regulatory acceptance and related issues associated with aspects of life-cycle standardization. — Ongoing

2M13 Establish predictable and stable license renewal process. — Ongoing

2M14 Provide the regulatory interface, and work to ensure the stable and predictable implementation of environmental protection regulations under Part 51. — Ongoing

2M15 Provide regulatory interface coordination and support, as appropriate, for siting activities under Building Block 5. — Ongoing

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* Indicates that this item is an ongoing issue and is a fundamental part of the mission of NUMARC. Specific actions related to this issue are treated separate from this plan.

IV. Tie-Ins

2T1 To Block 1--Stable regulatory environment that encourages industry self-improvement initiatives.

2T2 To Block 4--Define and obtain NRC concurrence to an implementation of 10 CFR Part 52 that permits completion of design certification on schedule.

2T2.1 Input into plant designers' ITAAC documents and designs.

2T2.2 Input to plant designers on level of detail required for design certification.

2T3 To Block 5--Regulatory coordination and support for site approval activities.

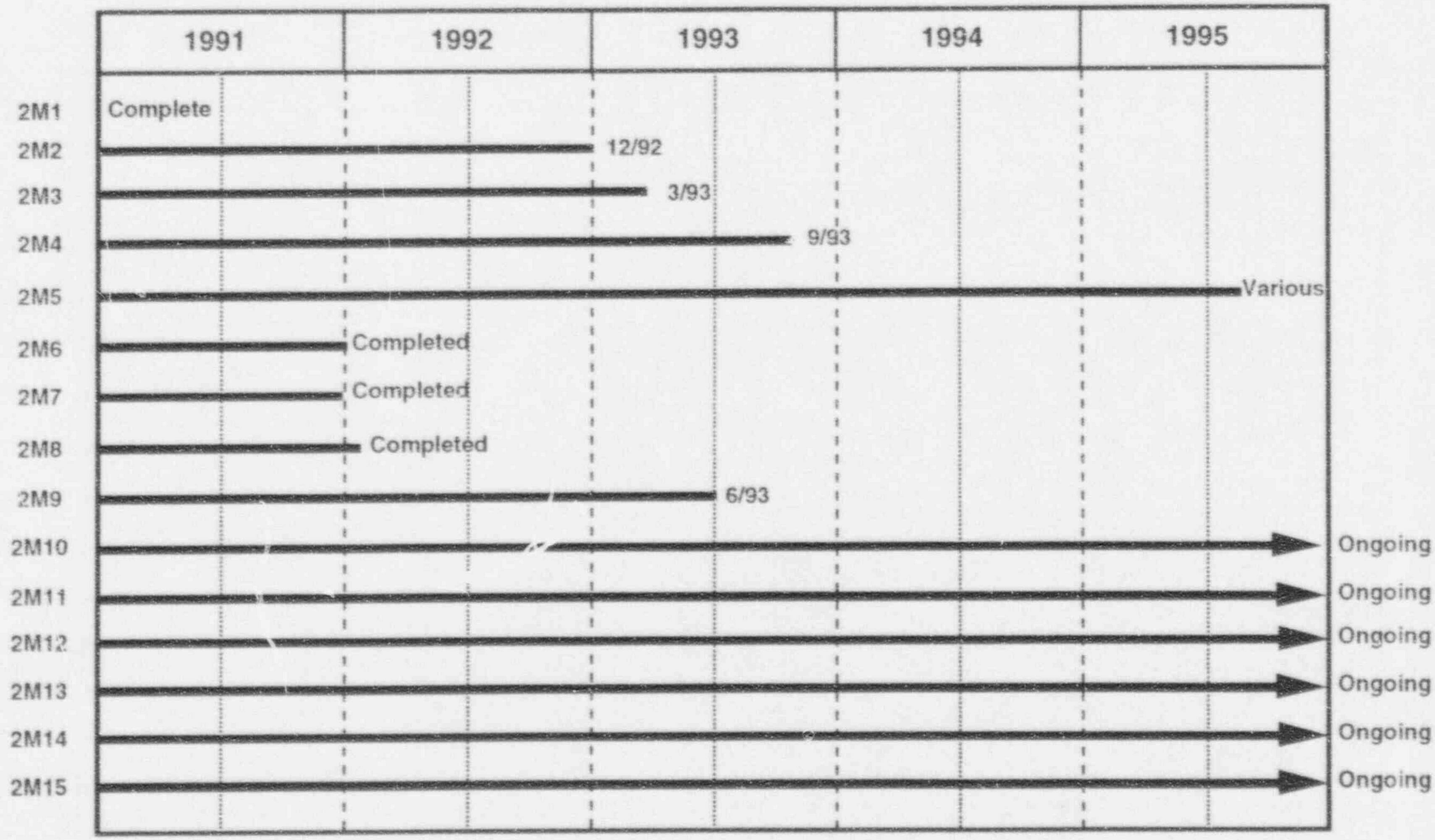
2T4 To Block 6--Closure on issue of level of detail required for design certification.

2T5 To Block 7--(1) Stable regulatory basis for life-cycle standardization; (2) regulatory interface and regulatory acceptance of appropriate aspects of the standardized operational elements.

2T6 To Block 8 --Communications support for legislative actions.

2T7 From/to Block 14--Legislation to support predictable licensing.

Schedule Display for Block 2



ACTION PLAN FOR BUILDING BLOCK #3: ALWR UTILITY REQUIREMENTS

I. Goals and Responsibilities

Goals:

1. Obtain NRC approval of the ALWR Utility Requirements Document.
2. Assure that ALWR designs conform to the full-scope ALWR Utility Requirements Document.

Responsibilities:

Industry Lead	EPRI-USC
Primary	EPRI-USC/Plant Designers
Industry Supporting	NUMARC
Government Supporting	DOE
Regulatory	NRC

II. Summary Action Plan

The Utility Requirements Document for future ALWRs has three primary purposes:

1. to identify the plant safety, reliability, and economic characteristics vital to the owner-operator, reflecting the more than two decades of construction, operating, and maintenance experience with LWRs;

2. to define generic regulatory requirements applicable to ALWRs, and

3. to establish a fundamental level of standardization based on common owner-operator and regulatory requirements (see Position Paper on Standardization, Appendix C).

The EPRI ALWR Program, under the leadership of the ALWR USC, has developed such ALWR Utility Requirements Documents: one set for plants of large output, termed "evolutionary" ALWRs and one set for ALWR plants of mid-size output, with "passive" safety features. These two 13-chapter sets, containing thousands of requirements in combination with an executive summary, comprise three substantial volumes of documentation that have been developed to meet quantitatively the following major goals: a higher level of safety, greater and longer lifetime reliability, substantial simplification, improved economics, and shorter construction times. The ALWR Requirements Document (URD) for Evolutionary Plants was approved by the ALWR USC and was initially transmitted to NRC between 1987 to 1989 on a chapter-by-chapter basis.

At its January 1990 meeting, NPOC endorsed the Utility Requirements Document prepara' JRC review, and the role of the ALWR USC to interface with plant designers ..d NRC on these matters.

A major revision or "roll-up" of the Evolutionary Plant ALWR URD has been completed which incorporates NRC and industry comments and fully integrates the entire document. This revised document was submitted to NRC on September 7, 1990 and there have been four revisions. As of September 1, 1992, the NRC has issued the Final Safety Evaluation Report (SER) on the evolutionary plant ALWR URD.

Based on the evolutionary plant work, an ALWR Requirements Document for the ALWR passive plant has also been developed. It was approved by the ALWR USC and was submitted to NRC on September 7, 1990. This ALWR Passive Plant Requirements Document is a self-standing document which includes many of the requirements established for the evolutionary plant but also stipulates requirements to cover the use of passive means of providing emergency cooling and further major simplifications to support operational simplification. The NRC review of this document has been defined by the NRC Commissioners and the ALWR USC as being the forum for resolution of regulatory issues on ALWR passive plants, prior to the NRC review of a detailed design for certification. The draft SER on the passive plant ALWR URD was issued by NRC in May 1992 with a total of nearly 600 technical issues. Of these, 50% were unresolved issues, 5% were issues requiring confirmatory action, with the remainder deferred until the design certification reviews of the passive plant design. Over one-half of these deferred issues should be addressed during the URD review. The ALWR program responded to all DSER issues in September 1992. NRC does not plan to issue the final SER on the passive plant ALWR URD until September 1993, the SECY 91-161 date. Efforts are continuing to recover as much as possible of the schedule slippage from February 1993 given in the previous version of the this plan. Significant progress has been made in the policy issues associated with the URD. The principal remaining policy issue is the regulatory treatment of nonsafety systems for passive reactors.

A review has been completed of the design information developed by the plant designers for the evolutionary plants, which shows a substantial level of conformance with the Utility Requirements Document. A similar review of the passive plants is being conducted over the next few years to assess conformance with the Utility Requirements Document. It is the industry's intent for passive plants to achieve full conformance.

A similar assessment will be continued through the first-of-a-kind engineering (FOAKE) effort (see Building Block #6) to ensure that the additional design development beyond that required for certification is also in conformance with the ALWR Utility Requirements Document and complies with the NPOC

Position Paper on Standardization. This activity will be conducted for both evolutionary and passive designs over a four-year period from 1992 to 1996.

III. Milestones

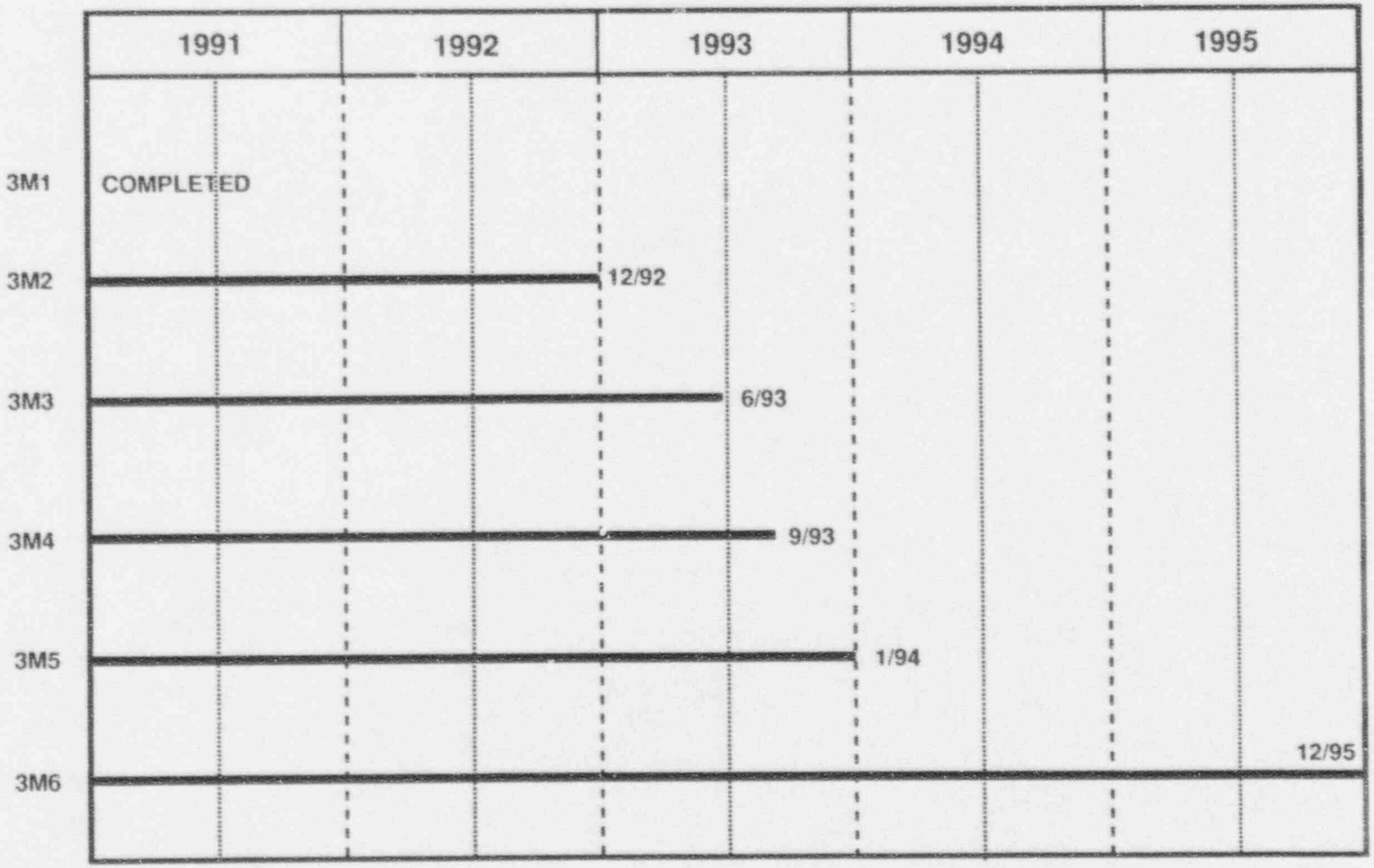
3M1	NRC final SER on evolutionary ALWR Utility Requirements Document.	Complete
3M2	Formal endorsement by utility CEOs of Evolutionary ALWR Utility Requirements Document.	12/92
3M3	NRC final SER on passive ALWR Utility Requirements Document.	9/93
3M4	Assess evolutionary and passive ALWR certification design conformance to the Utility Requirements Document.	6/93
3M5	Formal endorsement by utility CEOs of Passive ALWR Utility Requirements Document.	1/94
3M6	Assess evolutionary and passive ALWR FOAKE design for conformance to the Utility Requirements Document.	12/95

IV. Tie-Ins

3T1	From Block 1--Input of operating experience from current plants to development of ALWR requirements.	Completed
3T2	To Blocks 4, 5, 6 and 7--Evolutionary ALWR Utility Requirements Document (Revision 4) submittal, and Passive ALWR Utility Requirements Document (Revision 3) submittal, to NRC and plant designers as basis for initial design certification submittals to NRC, enveloping siting parameters, FOAKE development, and design basis for life-cycle standardization.	Completed
3T3	To Blocks 4, 5, 6 and 7--NRC final SER on evolutionary ALWR Utility Requirements Document (confirmatory input to augment 3T2).	9/92
3T4	To Blocks 4, 6 and 7--NRC final SER on passive ALWR Utility Requirements Document (confirmatory input to augment 3T2).	9/93

3T5	To Block 4--Assess certification designs for conformance to passive ALWR Utility Requirements Document.	6/93
3T6	To Block 6 --Check of FOAKE design conformance to evolutionary and passive ALWR Utility Requirements Document.	12/95

Schedule Display for Block 3



ACTION PLAN FOR BUILDING BLOCK #4: NRC DESIGN CERTIFICATION

I. Goals and Responsibilities

Goal:

Obtain NRC certification of ALWR designs.

Responsibilities:

Industry Lead	Plant Design Teams
Primary	NRC
Industry Supporting	EPRI-USC/NUMARC/ANEC/USCEA
Government Supporting	DOE
Regulatory	NRC

II. Summary Action Plan

Industry, government and utilities are undertaking a cooperative program to achieve the goal of making advanced light water reactor (ALWR) designs investor-ready and certified by the NRC. The certification efforts and their supporting technology programs are closely coordinated with the EPRI ALWR Program to assure that plant designers' submittals to the NRC are consistent with the ALWR Utility Requirements Document. Funding for this effort is being provided by DOE, individual plant designers, and EPRI and includes significant foreign designer and utility participation. Further, an agreement has been established between DOE, EPRI, and the passive ALWR certification applicants to facilitate the interface and assure this consistency between the individual plant designers' certification designs and the utility requirements.

Major policy issues will be addressed via industry initiatives. Major technical issues will be addressed by the ALWR Utility Requirements Document (see Building Block 3). The required level of detail, the format and content of the ITAACs and the design certification rulemaking, and NEPA design alternative issues will be addressed via the NUMARC Standardization Oversight Working Group (see Building Block 2).

Evolutionary ALWRs

The Advanced BWR (ABWR) is the lead ALWRs under a DOE-sponsored design certification program to demonstrate the NRC's new standard plant licensing process in the United States and to make a certified ALWR available to U.S. utilities. The certification is being obtained for an essentially complete plant and for an envelope of site parameters which encompasses most U.S. sites.

The GE ABWR is a 1350 MWe advanced BWR power plant developed by an international team of BWR manufacturers to respond to the needs of worldwide utilities in the 1990s. It is based upon proven technology and is backed by extensive test and development. It has been adopted as the next generation standard BWR for Japan, and a two-unit lead project is under construction for the Tokyo Electric Power Company. The ABWR has been adapted to U.S. utility needs and conforms to a high degree with the EPRI ALWR Utility Requirements Document. It is expected that the NRC will issue the final design approval in December 1992 and the design certification for the ABWR in December 1993.

ABB-Combustion Engineering's System 80 Plus^{tm} (System 80+) nuclear power plant is a 1300 MWe advanced PWR design developed in compliance with the EPRI ALWR Utility Requirements Document. The design consists of an essentially complete plant. It is based on improvements to the standardized System 80 nuclear steam supply system in operation at Palo Verde Units 1, 2 and 3, and the Duke Power Company P-81 balance-of-plant that was partially constructed at the Cherokee plant site. The System 80/P-81 original design was substantially redesigned to maximize conformance with the ALWR URD. Some elements of the System 80+ design are included in four units currently under construction in South Korea that form the basis of the Korean standardization program. The Combustion Engineering Standard Safety Analysis Report (CESSAR-DC) has been submitted to the NRC and has received a Draft Safety Evaluation Report from the NRC. Final design approval is scheduled for November 1993 and design certification by November 1994.

Passive ALWRs

The term "passive ALWR" refers to a mid-size ALWR (600 MWe) with conventional or evolutionary reactor and auxiliary systems, but with safety systems for emergency cooling and containment heat removal that rely on passive or natural means such as gravity, natural circulation or stored energy.

The Westinghouse AP 600 and General Electric SBWR will be the first passive plants applying for certification under 10 CFR 52. To meet the present plant designer schedules of having the AP 600 certified by July 1995 and the SBWR certified by September 1995, considerable effort and continuing dialogue with the NRC will be required. These schedules are needed to support the NPOC objective of plants on line around the turn of the century.

The current DOE/EPRI/supplier program supports the design effort required to advance passive plant conceptual designs developed in an earlier phase to certified designs. This includes developing plant designs with a level of detail consistent with the requirements of 10 CFR Part 52, completing the tests for demonstrating performance of safety features and the analytical models, completing the required documentation for the design certification submittal (SSAR, PRA and ITAAC), and completing the certification process.

Westinghouse and General Electric have participated in the development of the EPRI ALWR Utility Requirements Document for passive plants. The requirements are continually being compared to the plant designs as a part of their development process. Westinghouse and General Electric intend to work with EPRI and the USC to reach satisfactory resolution with NRC of technical issues through the Utility Requirements Document, and intend to comply with these requirements.

III. Milestones

The milestones for four different ALWRs are being developed by three different vendors. The original NPOC plan listed the milestones by each vendor separately. In an effort to standardize the plan, a set of normalized milestones was developed and applied to each design. The following table presents the set of normalized milestones and the associated dates.

	GE **ABWR**	ABB-CE **System 80+**	W **AP 600**	GE **SBWR**
1. Designer submits initial SSAR to NRC	Completed	Completed	Completed	Completed
2. Designer completes SSAR submittal	Completed	Completed	Completed	Completed
3. NRC completes issuance of all RAIs on SSAR	Completed	Completed	2/93	4/93
4. Designer completes all RAI responses (final round)	Completed	Completed	4/93	6/93
5. NUMARC completes industry guidance on form and content of ITAAC (lead plant concept)	Completed	Completed	Completed	Completed
6. Designer submits proposed ITAAC to NRC	Completed	Completed	12/92	2/93
7. NRC issues final SER on pertinent volume of ALWR Utility Requirements Document	Completed	Completed	9/93	9/93
8. NRC issues draft SER (DSER) on SSAR (minus ITAAC) to Commission, ACRS and vendor	Completed	Completed	10/93	12/93

	GE ABWR	ABB-CE System 80+	W AP 600	GE SBWR
9. NRC issues RAI on ITAAC	Completed	2/93	10/93	12/93
10. Designer completes response to DSER on SSAR	Completed	1/93	12/93	2/94
11. Designer completes response to ITAAC issues	Completed	5/93	1/94	3/94
12. NRC staff submits final SER on SSAR to Commission, ACRS	Completed	7/93	4/94	6/94
13. ACRS letter to Commission with FDA recommendations	10/92	9/93	6/94	8/94
14. NRC issues final SER on SSAR including ITAAC to designer	12/92	11/93	7/94	9/94
15. NRC issues FDA to designer	12/92	11/93	7/94	9/94
(a) (NRC schedule for SER/FDA, per SECY 91-161)	*(12/92)*	*(11/93)*	*(11/94)*	*(1/95)*
16. NRC issues final notice of proposed rulemaking for design certification	12/92	12/93	8/94	10/94
17. Period for comments and request for hearing expires	3/93	3/94	11/94	1/95
18. ASLB hearings complete; hearing record certified to Commission*	11/93	10/94	6/95	8/95
19. Commission issues design certification rule*	12/93	11/94	7/95	9/95
(a) (NRC schedule for design certification rule per SECY 91-161)	*(6/94)*	*(5/95)*	*(5/96)*	*(7/96)*

* These dates are best estimates--with no requests for public hearings, the dates could be earlier and formal hearings could delay the completion of the milestones as much as six months.

IV. Tie-Ins

These tie-ins are generally applicable to all three plant designers. Dates for tie-ins will vary with design.

4T1 From Block 2--NUMARC input to plant designers on resolution with NRC of ITAAC requirements, level of detail required for design certification, and other 10 CFR Part 52 implementation issues.

4T2 From block 3--ALWR utility requirements for the design, with integrated consensus utility requirements for all future ALWR designs and design resolutions of open regulatory issues.

4T3 From/to Block 5--Site parameters for standard design established by NRC-approved ALWR Utility Requirements Document and implemented in design certification.

4T4 To Block 6--Standard plant designs submitted for design certification are the starting point for first-of-a-kind engineering and will influence the approach taken to standardization beyond design certification.

4T5 To Block 7--Design input to approaches taken in life-cycle standardization.

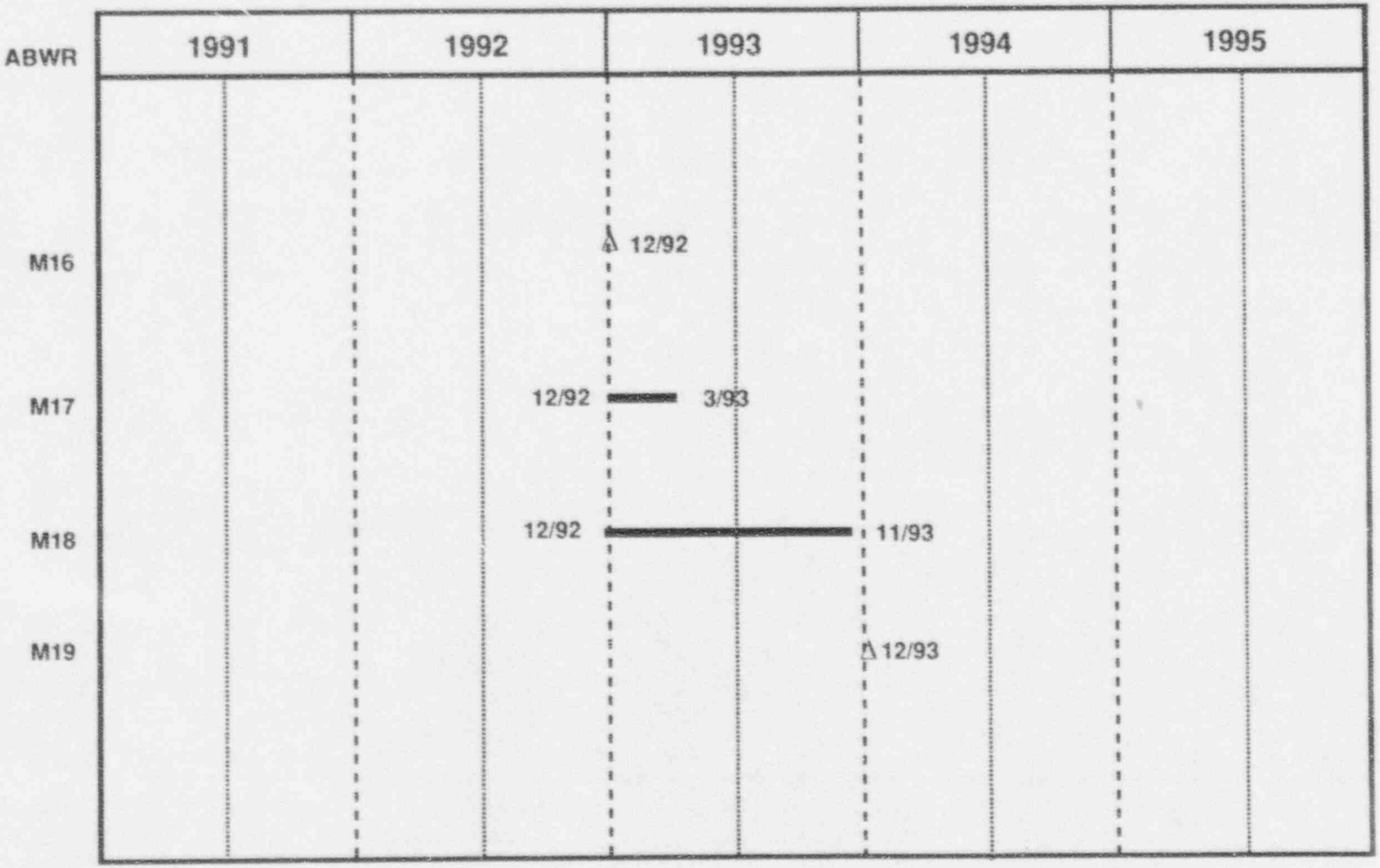
4T6 To Block 8--Individual design descriptions to assist in public communications.

4T7 From Block 13--Designs must consider relationship between fuel design and fuel availability.

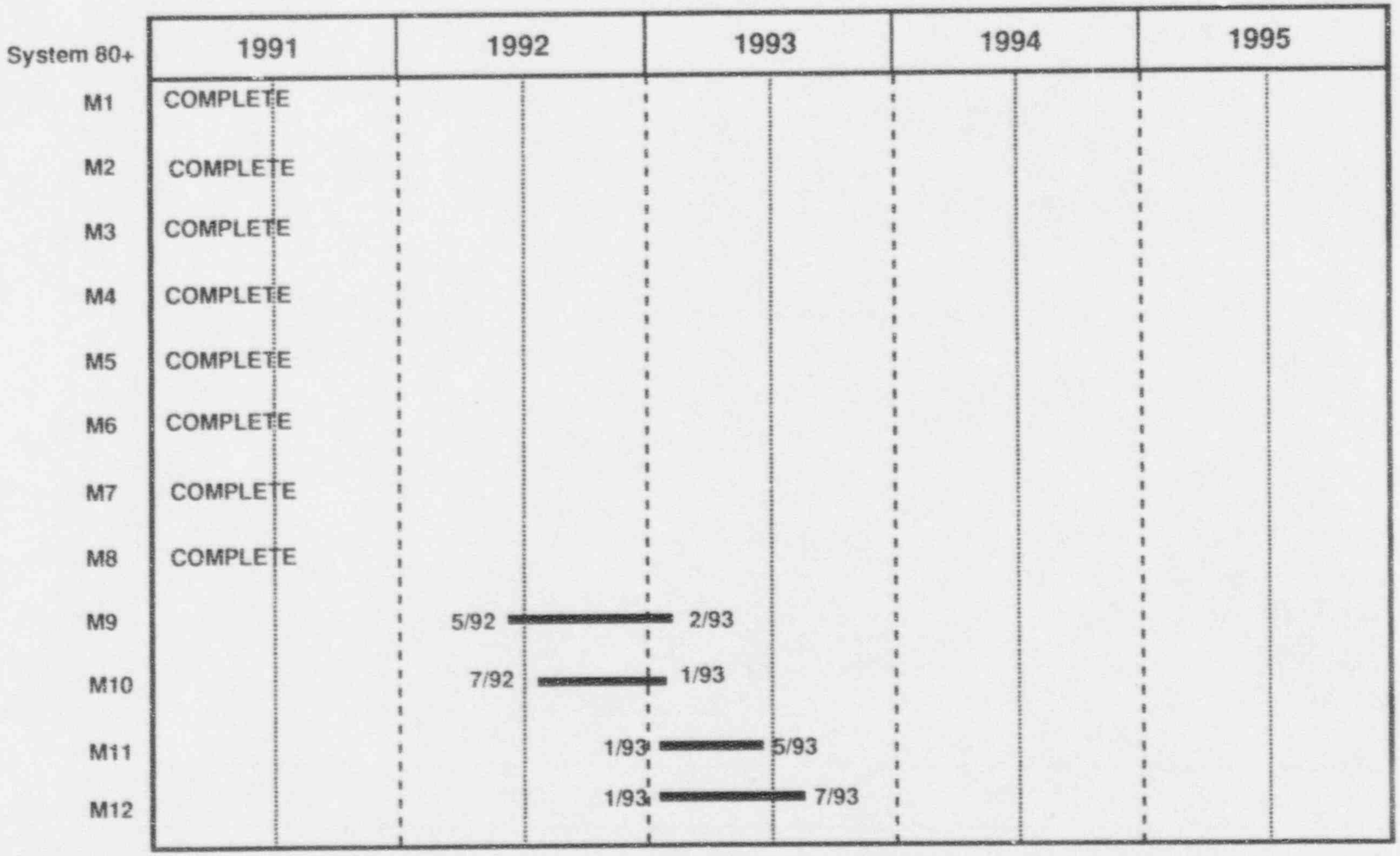
Schedule Display for Block 4 - GE ABWR

ABWR	1991	1992	1993	1994	1995
M1	COMPLETE				
M2	COMPLETE				
M3	COMPLETE				
M4	COMPLETE				
M5	COMPLETE				
M6	COMPLETE				
M7	COMPLETE				
M8	COMPLETE				
M9	COMPLETE				
M10	COMPLETE				
M11	COMPLETE				
M12	COMPLETE				
M13		Δ 10/92			
M14		Δ 12/92			
M15		Δ 12/92			

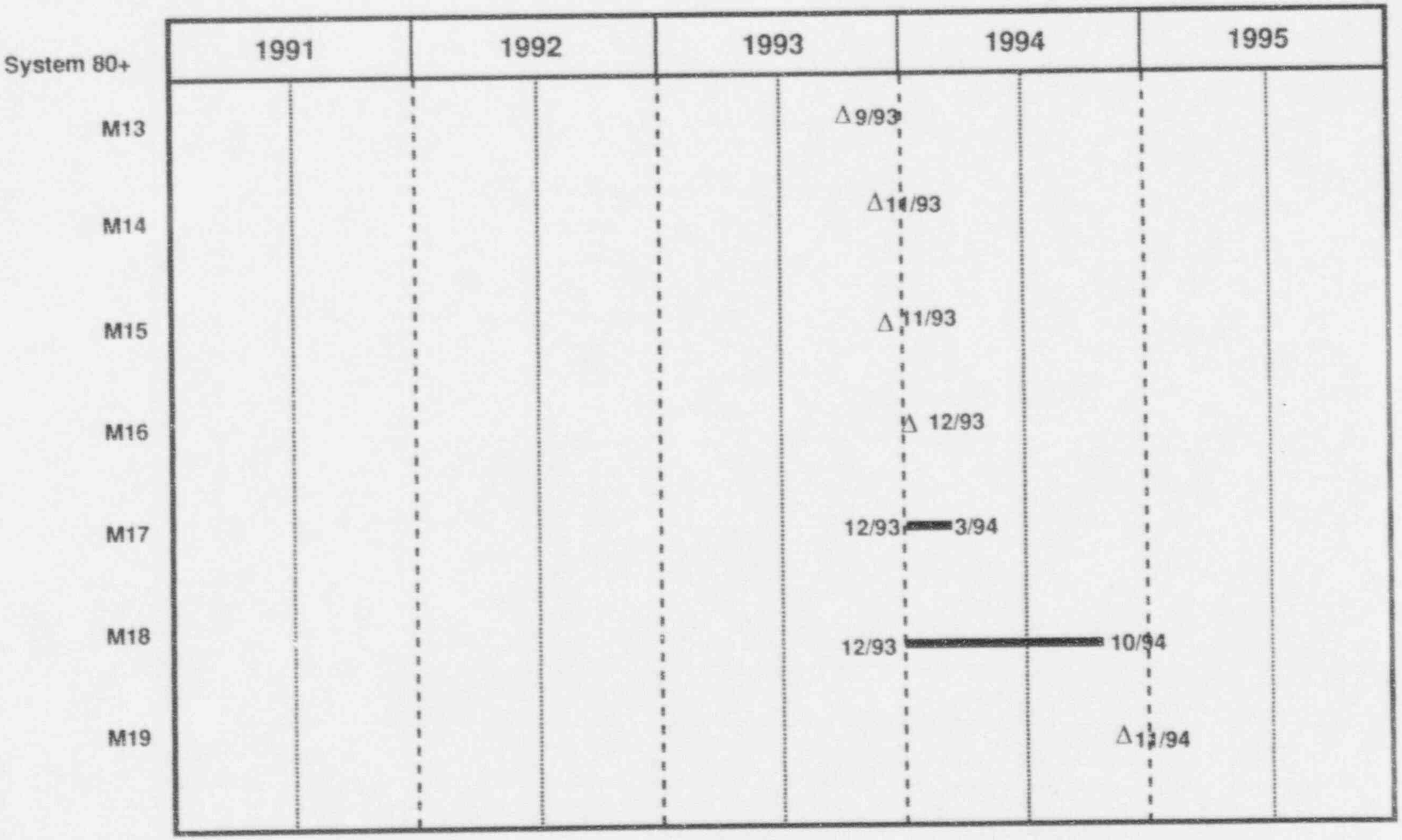
Schedule Display for Block 4 - GE ABWR (Continued)



Schedule Display for Block 4 - ABB-CE System 80+



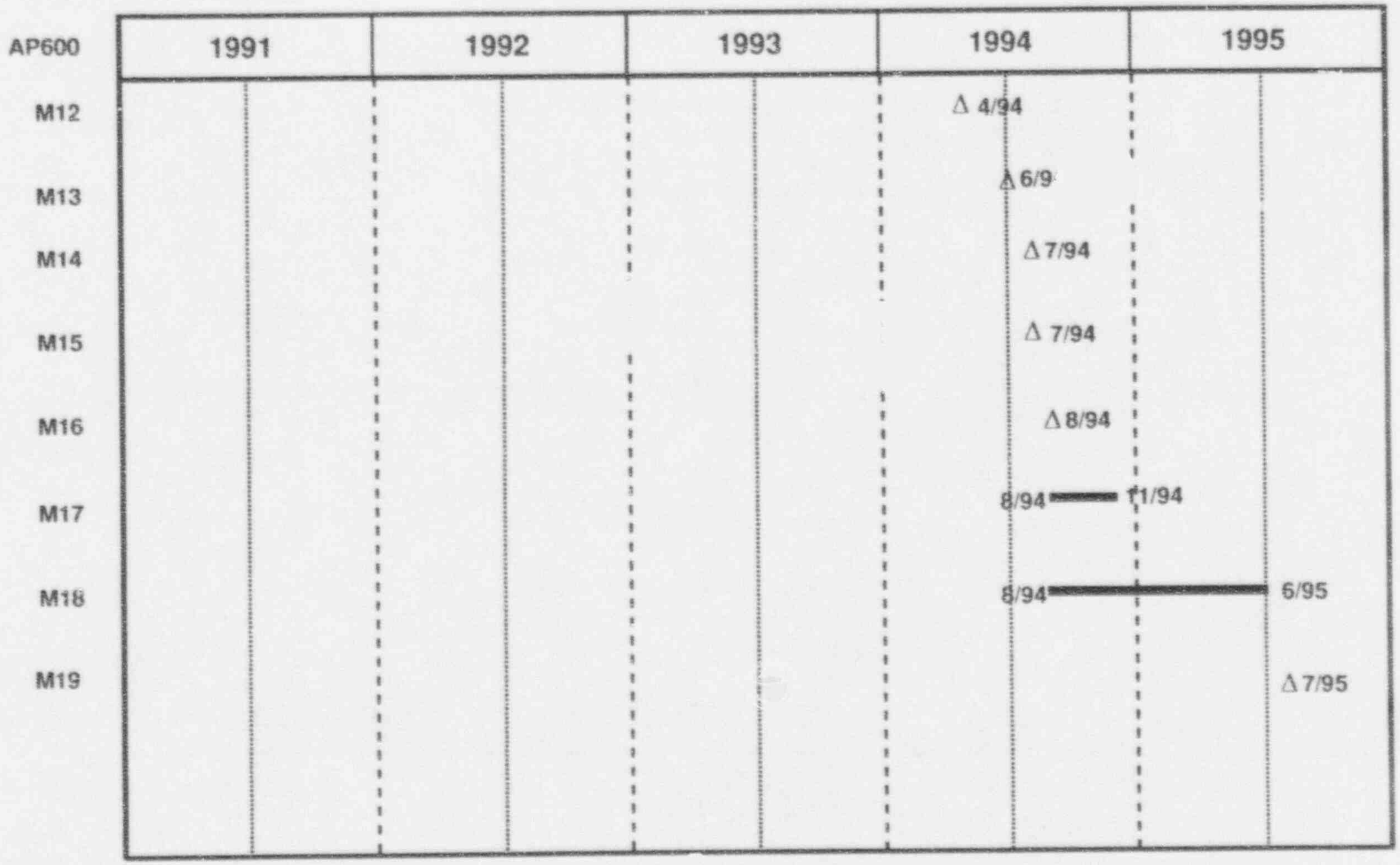
Schedule Display for Block 4 - ABB C-E System 80+ (Continued)



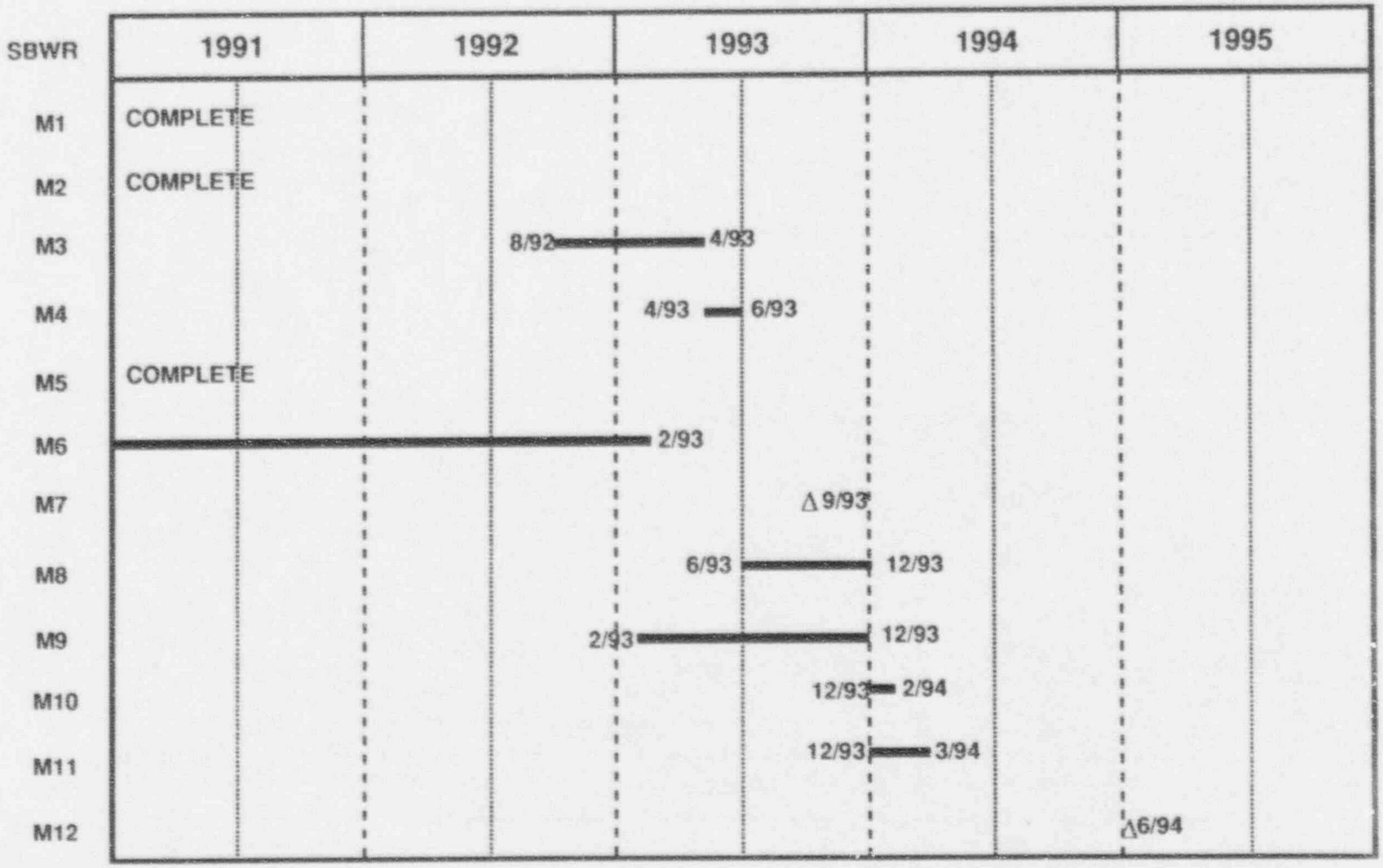
Schedule Display for Block 4 - Westinghouse AP600

AP600	1991	1992	1993	1994	1995
M1	COMPLETE				
M2	COMPLETE				
M3			Δ 2/93		
M4			2/93 — 4/93		
M5	COMPLETE				
M6	———	——— 12/92			
M7			Δ 9/93		
M8		6/92 ———	——— 10/93		
M9		12/92	——— 10/93		
M10			10/93 — 12/93		
M11			10/93 —	1/94	

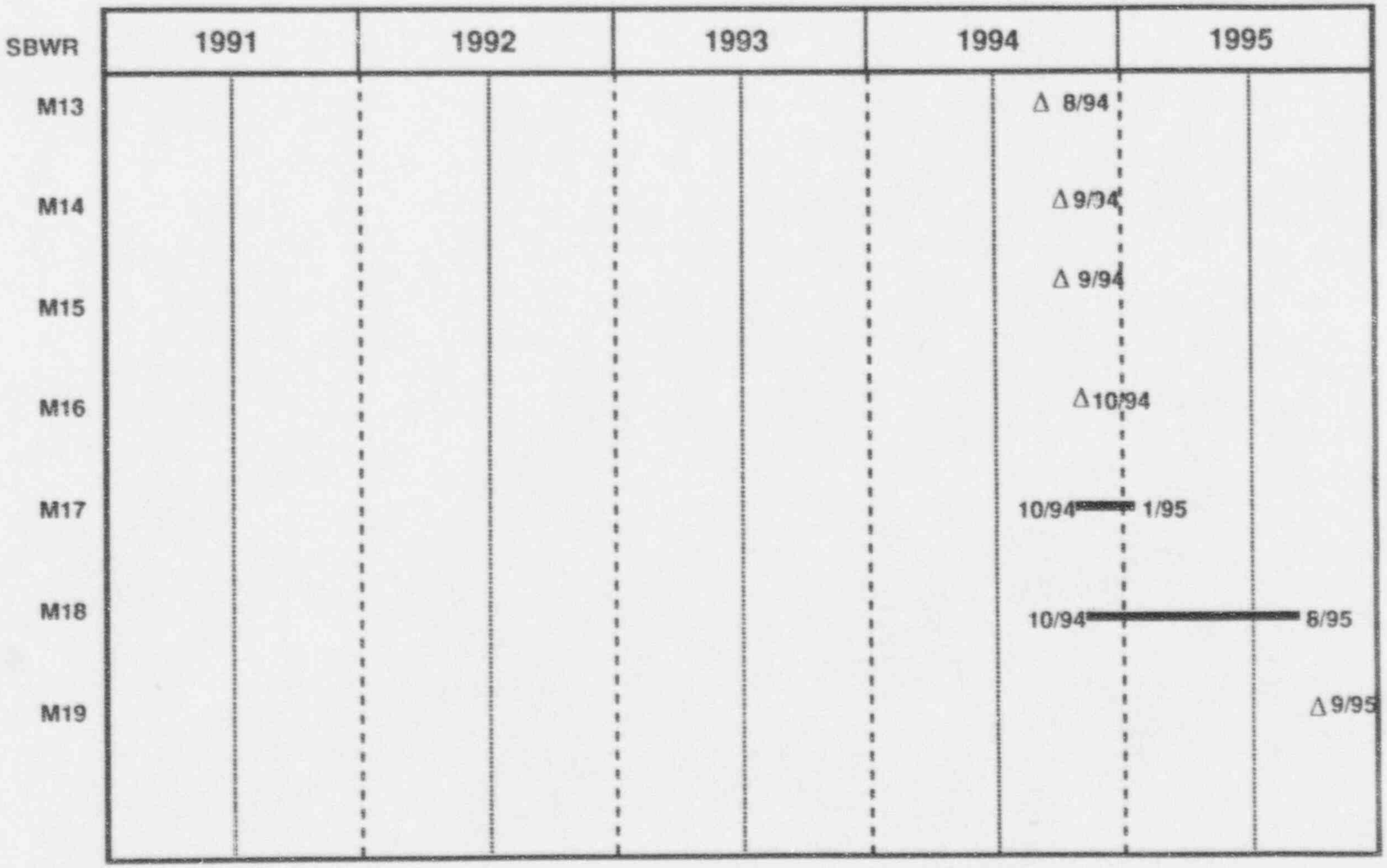
Schedule Display for Block 4 - Westinghouse AP600 (Continued)



Schedule Display for Block 4 - GE SBWR



Schedule Display for Block 4 - GE SBWR (Continued)



ACTION PLAN FOR BUILDING BLOCK #5: SITING

I. Goals and Responsibilities

Goal:

Obtain NRC approval of suitable site(s) for new nuclear plants, either through early site permitting or through submission of an application for a combined construction and operating license and NRC approval to build and operate the plant to a certified design under its standardization rule.

Responsibilities:

Industry Lead	EPRI/NUMARC
Primary	Utilities/ISG
Industry Supporting	ANEC/EEI/USCEA
Government Supporting	DOE
Regulatory	NRC

II. Summary Action Plan and Activity Status

The plan will be implemented in three phases: (1) evaluation (2) selection of preferred site(s) and their sponsors, and (3) pursuit of site(s) approval in the form of an early site permit (ESP) followed by a combined construction and operating license (COL) or, alternately, a COL with a custom site.

Evaluation Phase.

This phase develops and then uses site selection criteria to evaluate suitable site(s), including consideration of sites selected in the DOE program described below. During this phase, work under Building Block 2 will identify any regulatory impacts directed toward identification of potential sites.

DOE has obtained budget approval over the next several years to pursue an ESP jointly with the industry on the condition that the industry would provide an equal amount in cost sharing. DOE issued a request for quotation (RFQ) in July 1990 to initiate this program. In April 1991, three utility-owned organizations, henceforth called the Joint Contractors (JC), in cooperation with EPRI and NUMARC, provided a qualified response to the DOE's RFQ. Initial understandings were reached between the JC and DOE on a cost-shared joint program in mid-1991. The industry-sponsored portion of the joint program began in July 1991. The DOE-sponsored portion of the joint program began in September 1991. The formal agreement was signed in January 1992. The JC response to the DOE RFQ fulfills Milestone 5M2. The initiation of the joint program fulfills Milestone 5M3. Due to the structure of the joint program, several of its activities help

meet specific objectives set forth in Building Block 5. Joint program results will serve as important inputs into Milestones 5M4 through 5M7, and these milestones have been adjusted to take advantage of the inputs from the joint program. The changes made will enhance the deliverables produced and do not impact Building Block 5's overall schedule.

An evaluation will be carried out on the relative merits of utilizing an early site permit, as compared to a COL program with a custom site for initial plant planning. In addition, the requirements spelled out in 10 CFR 52, Subpart A, will be evaluated so as to define a detailed plan for the implementation of the early site permit process. Such a plan would be needed later, even if initial plant(s) siting utilized a COL only.

On completion of the this effort, the industry timing for initiation of formal approval processes, whether for an early site permit or a COL, would be established.

The content of the evaluation phase of the plan is then:

1. Examination of existing sites which contain operating plants, or which have been previously qualified, to verify the adequacy of the site "enveloping" in the ALWR Utility Requirements Documents and the various standard designs which are under review for design certification.

2. Identification of potential sites throughout the country, with and without operating plants, with consideration of the state and local political climate, the viability of obtaining sponsorship, the identification of potential sponsors, and the achievement of standardization through joint sponsorship.

3. In conjunction with the DOE program, detailed definition of the implementation of the early site permit process, including detailed discussions with NRC, to be sure that the requirements are fully understood and can be practically carried out.

4. Evaluation of the relative merits and timing of utilizing the early site permit from the DOE program, utilizing an early site permit from a different site, or deferring to a COL process for a custom site for the initial plants. Another option that will be evaluated is to proceed directly with a COL for one or more lead plants on an already qualified site(s) to get an initial start(s) on nuclear plant construction. Assuming the start is successful, a process could be started to bank sites for the follow-up standardized plants utilizing the early site permit process.

To implement the plan, the Industry Siting Group (ISG) was formed in January 1991. The ISG is a regionally diverse group and includes representatives of utilities who each own or share ownership of a site, representatives of EPRI and NUMARC, and representatives from architect-engineers whose expertise match the needs of the ISG. It is envisioned that representatives of other organizations may also be called upon by the ISG to participate in subcommittees of the ISG as these become defined. The ISG issued its charter in March 1991 and is working in accordance with the charter. In addition, the ISG has agreed to provide technical and licensing advisory expertise to the Joint Contractors for the DOE-industry program. Formation of the ISG fulfills Milestone 5M1.

Selection and Approval Phases.

The selection phase, which will result in the determination of site sponsor(s) and suitable site(s), depends for its success on the results of the evaluation phase. Those results will provide the base from which the decisions and selections are made and the appropriate schedules defined. The approval phase will be the responsibility of the sponsor(s).

During 1991 and 1992, substantive progress has been made on the four major elements of the evaluation phase of the plan. In mid-October 1992, a joint program conference and a follow-on industry workshop was held to communicate the conclusions of the evaluation phase to date and to initiate activities to select candidate sponsor(s) and site(s) for evaluation. A plan for the site selection phase has been developed, which provides suggestions for public participation in the site selection process. Milestones 5M7 and 5M8 have been updated based on this plan.

III. Milestones

5M1	Formation of industry siting group.	Completed
5M2	Response to DOE RFQ is made.	Completed
5M3	Evaluation phase initiated as part of DOE-sponsored early site permit program.	Completed
5M4	Establish timing for initiation of formal approval process.	12/92
5M5	Integrate technical/regulatory schedule and work with communications schedule.	12/92
5M6	Completion of evaluation phase.	12/92
5M7	Initiation of selection phase.	Completed

5M8	Site characterization or review and updating of characteristics of presently approved site(s); completion of the selection phase.	6/93
5M9	Submission of application for site approval.	6/94
5M10	Receipt of site approval from NRC.	1995

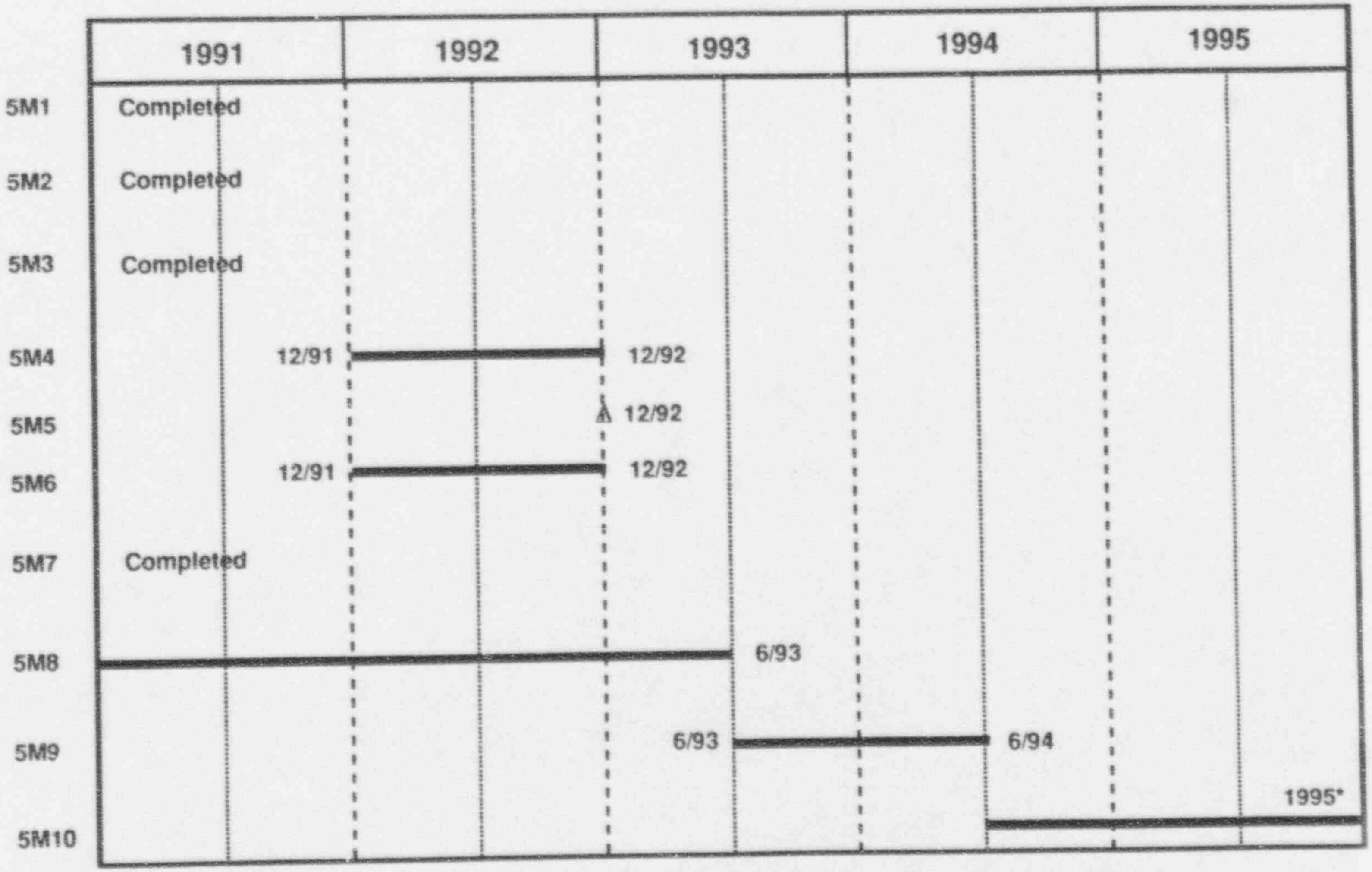
IV. Tie-Ins

5T1 From Block 2--To provide specific experience in implementing NRC's Standardization Rule (10 CFR 52) and to resolve any regulatory issues identified during the site identification activities.

5T2 From Blocks 3, 4, and 6--To assure that the specific site characteristics fall within the enveloping site design parameters of the ALWR Utility Requirements Document and the standard designs being certified.

5T3 To Blocks 8 and 10--To determine timing of actions and coordinate with local communications programs; to address state and local regulatory and economic issues.

Schedule Display for Block 5



*Date could vary depending on whether site is for evolutionary ALWR (certifications anticipated in 1992) or for passive ALWR (certifications anticipated in 1995).

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ACTION PLAN FOR BUILDING BLOCK #6: FIRST-OF-A-KIND ENGINEERING

I. Goals and Responsibilities

Goal:

1. Complete engineering on certified designs in sufficient detail to define firm cost and schedule estimates and prepare for construction of standardized ALWR plants.
2. Ensure that an institutional infrastructure is in place to provide resources and manage completion of detailed design.
3. Define the process to achieve commercial standardization, that is the design standardization beyond that required for certification.

Responsibilities:

Industry Lead	ARC-EPRI
Primary	Potential Owner-Operators/Plant Designers/ AEs/DOE
Industry Supporting	NUMARC/EEI/INPO/USCEA
Others	DOE/NRC

II. Summary Action Plan

First-of-a-kind engineering (FOAKE) encompasses design activities to a level of detail sufficient to support the achievement of commercial standardization. FOAKE is that additional engineering, generally beyond the design certification scope, that is required to bring the entire plant design to essential completion, the utility-defined prerequisite to plant construction. FOAKE does not include equipment procurement, construction, startup, or operational support engineering. FOAKE builds on the ALWR utility requirements completed in Block 3 and on the design certification engineering completed in Block 4. A further objective is to assure that the ability to select from optimal designs is preserved and that competitive forces in the market for nuclear generation supply are maintained. These objectives must be met within the constraints imposed by standardization (see Appendix C) as a fundamental concept for the revitalization of U.S. nuclear power.

Major progress has been made in the implementation of the FOAKE Program. Support of a significant number of utilities to fund and manage the program was determined and arrangements made to utilize the Advanced Reactor Corporation as the corporate vehicle with which to manage the program. In turn, EPRI was asked to set up administrative and technical capability to perform the program management functions.

The overall funding plan for the program is to provide $200 million over a five-year period. One hundred million dollars will be provided th DOE with matching funds of $100 million provided by the industry. Fifty million dollars of the matching $100 million is to be provided by the utilities and at least $50 million from the contractors selected for the FOAKE designs.

The Advanced Reactor Corporation (ARC), the Department of Energy (DOE), and the Electric Power Research Institute (EPRI) have entered into agreements to support the implementation of Building Block 6. Fifty million dollars over a five-year period has been pledged to the program by utilities with actual expenditures contingent on:

1. DOE continuing to expend its share of the funds and conferring management responsibility to the utilities; and

2. NRC's review process holding to a schedule consistent with the FOAKE schedule.

Under the direction of NPOC, a Utility Working Group* was established in the spring of 1991 to develop recommendations for the implementation of Building Block 6. The working group recommended, and NPOC endorsed, a three-phased approach leading to a competitive selection of ALWR designs with which to proceed with FOAKE: a minimum of one evolutionary plant design and one plant design with passive safety features.

The three-phase approach developed by the working group provides for a process that could lead to the organization of family of owner/operators for each selected design. This structure also provides for a logical transition to phases beyond FOAKE, such as construction and operation of the ALWRs.

The phased approach is necessary for a number of reasons. In particular, there is currently insufficient design information and regulatory definition to permit an objective assessment of risks and uncertainties (licensing, technical, etc.). This lack of objective information prevents a utility selection of any of the ALWR designs under development. In addition, additional time is necessary for utilities to establish the elements of an infrastructure that will support the selected designs through procurement, construction, and operation.

By defining a phased approach, the working group has accommodated these considerations, while at the same time providing a schedule for conducting and completing FOAKE that is consistent with the NPOC Strategic Plan.

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* In August, 1991, the working group was reorganized as a subcommittee of the NPOC Ad Hoc Committee.

ARC provides the focus for the industrywide FOAKE program including program management, funding, administration, and design selection. EPRI is the project manager under the ARC-EPRI Memorandum of Understanding. To discharge its responsibilities, ARC has established a committee of utility executives (Project Management Board) to provide the oversight role in the program management and related activities. The PMB is composed of executives from those utilities who have made funding commitments. The vendors, who will be chosen in the Phase 2 competitive bidding, are responsible for the design(s).

The three phases of the program are described subsequently.

III. FOAKE Implementation

Phase 1: Development of FOAKE Requirements and Infrastructure

The first phase comprises the development of information to be used during Phase 2 to prepare and issue requests for proposals. This information helps establish criteria and engineering requirements to assess the scope and cost estimates of FOAKE, the technical and development status of each design under consideration, and their compliance with the ALWR Utility Requirements Document. The information will be used to help assess:

- The technical and licensing risks.
- FOAKE definition.
- The technical features of the designs.

Certain design activities applicable to both evolutionary plant and passive plant FOAKE are also being initiated in Phase 1. These are activities which bear on implementing the commercial design standardization guidelines provided in NPOC's Position Paper on Standardization. These activities are:

a. ASME Code Piping and Support Systems

Objective: To facilitate development of changes in design criteria and practices to improve the safety and reliability of ALWR piping and support systems, as well as to reduce cost and construction time.

b. Equipment Seismic Qualification

Objective: To develop criteria and procedures for experience-based seismic qualification of electrical and mechanical equipment which are consistent with industry standards and demonstrate an acceptable level of safety margin and investment protection, while minimizing plant life-cycle costs.

c. Information Management System (IMS)

Objective: To enable all design information submitted to the plant owner to be received in a format that can be directly entered in the IMS database without editing, translating or other intermediate processing.

d. Commercial-Grade Procurement Guidelines

Objective: To determine which of the high-cost and long lead-time ALWR plant safety-related items can be reasonably procured as commercial-grade and dedicated for use.

This work would continue through and be completed on a schedule supportive of Phase 3 activities.

Phase 1 comprises several elements:

a. Development of information to help define FOAKE scope, and assess cost estimates and risk (technical, licensing, development).

b. Establishment of an infrastructure that can support the standardized designs ultimately selected.

c. Definition of the process for selecting a minimum of two designs when the additional considerations of cost share, royalty revenue to contributing utilities, provisions for cost overruns and schedule delays, etc., are included.

d. Development of the utility oversight structure that would be used during the implementation of Phases 2 and 3.

e Definition and start of design activities applicable to both evolutionary plant and passive plant FOAKE.

Phase 2: <u>Selection of Designs for the Two-Track Program</u>

In the second phase, the Phase 1 criteria are incorporated in a competitive solicitation process that will result in the selection of a minimum of two of the designs, one for each track. Requests for proposals were issued on August 14, 1992. Responses were received by October 9. It is expected that the selection process will be completed by approximately year-end, and contracts executed such that the Phase 3 work can commence in March 1993. The selection process is "market-based" and reflects the extent to which the bids are fully responsive to the requirements of the RFP, the amount of cost sharing by the bidding contractors, and a tally of individual utilities designations of the design(s) they wish their share of the FOAKE fund commitments to be applied to.

Therefore, assuming all bids are equally responsive to the RFP requirements, the number of designs that will be selected in each track will depend on the amount of money identified by the utilities and the vendor bids. Thus, market forces would be a major factor in the selection process.

Phase 3: <u>Development of FOAKE for Each Design</u>

In the third phase, FOAKE is continued to completion for each of the selected designs, and the organizational structure defined in Phase 2 is strengthened to support continued development and implementation beyond the FOAKE scope of activities. As currently envisioned, under ARC, one utility sponsor group will be established for each of the designs selected and will assume a greater responsibility in establishing management direction for the effort. The groups will also develop activities to support the transition to COL application, construction, and operation at completion of the FOAKE effort. Further, the groups will identify the process to achieve standardization in construction of ALWR plants in concert with Building Block 7.

IV. Milestones

6M1	Develop funding plan--Prospective funding sources identified to support the FOAKE effort. (Status: Accomplished)	Completed
6M2	Initiate ARC-DOE cooperative agreement negotiations. Action: ARC, EPRI, Subcommittee of NPOC Ad Hoc Committee	Completed
6M3	Secure utility funding commitments. Action: EPRI	Completed
6M4	Initiate Phase 1: Development of FOAKE requirements and infrastructure. Action: ARC, EPRI, Subcommittee of NPOC Ad Hoc Committee	Completed
6M5	Complete Phase 1 (excluding design-independent activities). Action: ARC-EPRI, DOE	Completed
6M6	Initiate Phase 2: Selection of designs for the two-track program. Action: ARC-EPRI, DOE	Completed
6M7	Complete Phase 2. Action: ARC-EPRI, DOE	2/93

6M8 Initiate Phase 3: Conduct FOAKE for each selected design. 3/93
Action: Plant designers

6M9 Maintain support of all parties for the ARC-DOE cooperative agreement Ongoing
Action: ARC, DOE, EPRI, Utilities

6M10 Complete Phase 3. 9/96
Action: Plant designers

V. Tie-Ins

6T1 From Block 2--Level of design detail. Closure needed on level of detail issue to allow definition of the format and content of the SSAR.

6T2 From Block 3--EPRI design requirements. ALWR Utility Requirements Document provides plant designers with design requirements for ALWR FOAK effort.

6T3 From Block 3--Final NRC-approved utility design requirements. Final ALWR Utility Requirements Documents will be used to check FOAKE work completed since 6T2 and direct the designers on completing FOAKE.

6T4 From Block 4--Description of the certified design. Certified designs from Block 4 provide the basic input to FOAKE effort. Dates vary by design.

6T5 From Block 5--Site identification, site parameters and timing of actions.

6T6 From/to Block 7--Life-cycle standardization. Requirements from Block 7 factored into FOAKE; FOAKE to provide design basis for standardization beyond design.

6T7 To Block 7--Input on O&M Costs. FOAKE will provide design detail to define O&M costs for plant with increased certainty.

6T8 To Block 9--Provide cost estimates for lead customer financing needs.

6T9 To Block 10 --Increased certainty of construction schedules and budgets. Level of construction certainty must be defined and factored into FOAKE.

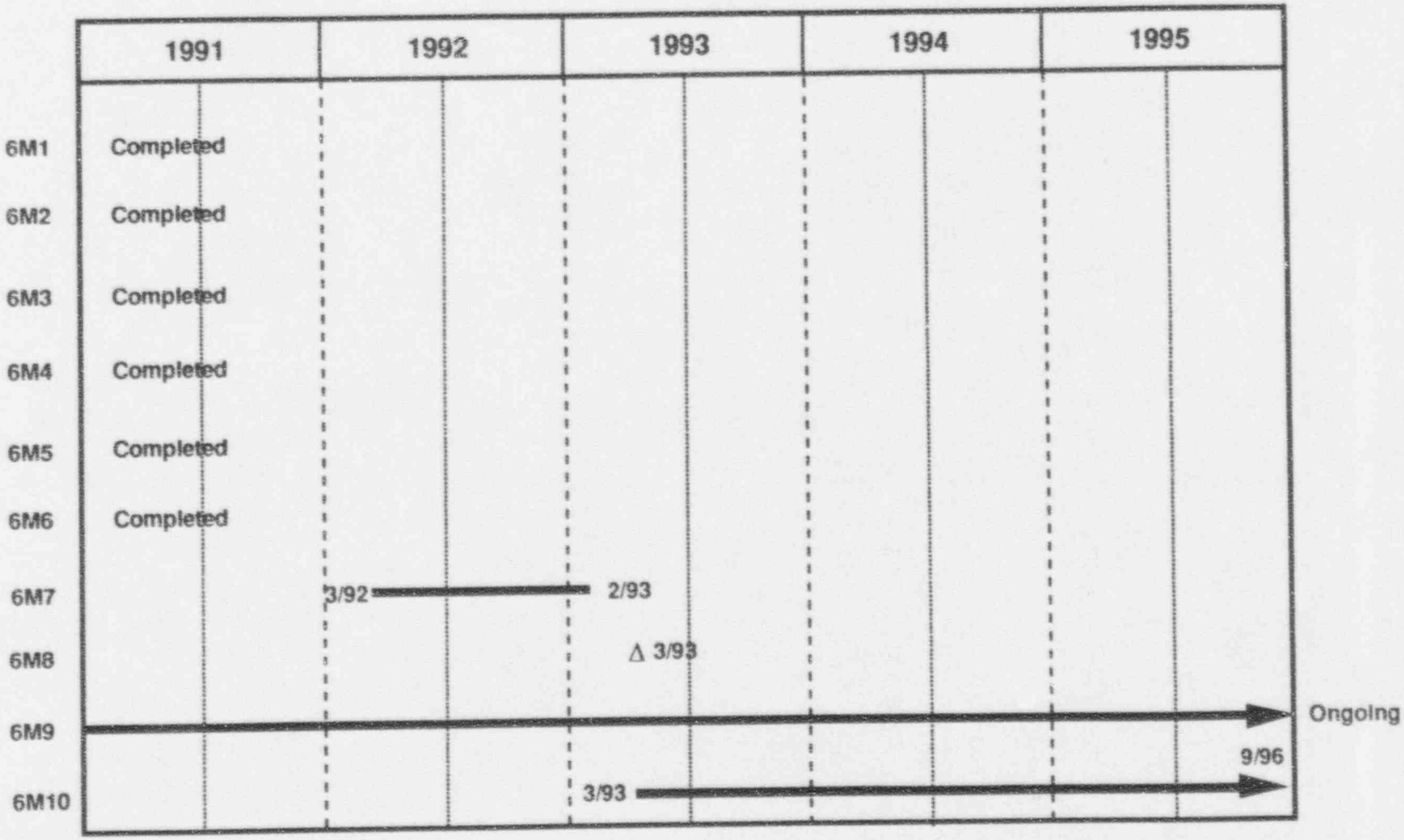
6T10 From/to Block 13--Integration of fuel and plant.

6T11 From Block 7--Assistance on the incorporation of operating experience into the design.

6T12 To Block 8--Public announcement of ALWR designs selected for FOAKE funding.

6T13 From Block 14--Congressional authorization and appropriation for the FOAKE Program.

Schedule Display for Block 6



ACTION PLAN FOR BUILDING BLOCK #7: LIFE-CYCLE STANDARDIZATION

I. Goals and Responsibilities

Goal:

1. Establish an institutional framework and approach to implement and oversee a model for life-cycle standardization of a family of plants.
2. Develop standardized operational elements to provide a basis for uniformity in appropriate aspects of the organizational structure, administrative controls, and construction, startup, operating and maintenance practices.
3. Develop an approach to maintain the standard design and design intent in all units of a family of plants over their lifetimes.

Responsibilities:

Industry Lead	INPO
Primary	Utilities
Industry Supporting	NUMARC/EPRI-USC/EEI/Plant Designers/ ARC-PMB

II. Summary Action Plan

Background:

Building Block 7, entitled "Enhanced Standardization Beyond Design" in the initial November 1990 issue of the NPOC Strategic Plan, encompassed the following goal:

> "Develop and enhance standardization concepts and cooperative arrangements as a means to increase the predictability of construction costs and schedules, and to improve operational reliability and cost."

The NPOC Position Paper on Standardization published in April 1991 addresses the concept of standardization as follows:

> "Nuclear power plant standardization is a life-cycle commitment to uniformity in the design, construction, and operation of a family of nuclear power plants. Rigorous implementation of standardization is expected to achieve the efficiency and economy typically associated with increases in scale or breakthroughs in technology."

Finalization of NPOC's Position Paper on Standardization completed a significant milestone toward the original goal of this building block and necessitated a

restatement of the goal in more specific terms as provided in Section I above. This building block is based on Section 5 of the position paper and addresses standardized elements for operation of a family of plants, regulatory acceptance of appropriate aspects of these elements, and resolution of related issues that impact the standardized operational elements.

Standardized Operational Elements

Standardization beyond design is intended to foster uniformity in startup, operation, maintenance, training, and quality assurance practices that provide a clear benefit in terms of effective operational performance, reliability, efficiency, or economy. To realize the full benefits of standardization beyond design, a set of essential elements consistent with this goal needs to be defined for a family of standardized plants. These elements will include areas such as:

a. Organization Structure
b. Administrative Procedures
c. Technical Procedures
d. Operating Procedures
e. Maintenance Procedures
f. Personnel Qualification
g. Training
h. Performance Standards
i. Logistics Support
j. Operating Experience
k. Configuration Management
l. Quality Programs
m. Emergency Planning
n. Information Data Processing and Records Management
o. Regulatory/Licensing/Engineering Interface

Approach:

It is expected that the approach to development of the standardized operational elements will involve the formation of a steering group and appropriate expert working groups selected from nuclear utilities. It is also anticipated that the actual owner/operators will be heavily involved as this effort proceeds to the level of detailed procedure development.

Interface with the NRC on appropriate aspects of the standardized operational elements will be necessary to achieve regulatory acceptance and to ensure that the regulatory process and associated regulatory decision making does not impact standardization beyond design. In addition, it is recognized that through this effort, elements may be identified that may be directly linked to the regulatory process and/or that may extend beyond the mission of INPO. Such elements may include:

l

a. Technical Specifications
b. Security
c. Operator Licensing
d. Severe Accident Management
e. Cost-Benefit Analyses/Applications
f. Probabilistic Risk Assessment Application
g. Equipment Procurement/Qualification
h. Access Authorization

The regulatory interface and regulatory acceptance of appropriate aspects of the standardized operational elements, as well as the development of elements that extend beyond the mission of INPO, will be addressed by NUMARC, EPRI, or other appropriate industry organizations on a cooperative basis.

III. Milestones

7M1	Develop a mechanism to address the fundamental issues associated with the approach to startup and operation of a family of standardized plants.	Completed
7M2	Utilizing the NPOC Position Paper on Standardization as a basis, review the policies and underlying principles as well as the ALWR Utility Requirements Document Volume I Policies and recommend any adjustments.	Completed Repeat 8/93
7M3	Assess the experience with standardization beyond design in selected current plants both domestically and internationally.	Initial review completed 9/92; subsequent reviews ongoing
7M4	Review the summary listing of Standardized Operational Elements included in this action plan and recommend adjustments.	12/92
7M5	Using the adjusted listing of Standardized Operational Elements as a basis, define the interfacing requirements for standardization beyond design with all phases of plant design, construction and startup leading to operations. This activity should consider all of the operational user's needs including design bases, as-built data, equipment specifications, and test results.	12/93
7M6	Develop a model mechanism for maintaining standardization within a family of plants throughout the operational life of the plants.	1/94

7M7	Formulate an action plan for prioritization, development, review, validation and finalization of the guidelines and practices.	2/94
7M8	Assess the extent of life-cycle standardization to be pursued on the basis of expected benefits in terms of operational performance reliability, efficiency, and economy.	3/94
7M9	List appropriate guidelines and practices to be developed for a model family of plants consistent with the above.	8/94

IV. Tie-Ins

7T1 From Block 2--Stable regulatory environment that encourages industry self-improvement initiatives.

7T2 From/to Block 2--Mechanisms for regulatory interface and regulatory acceptance of appropriate aspects of the standardized operational elements.

7T3 From/to Block 3--Evolutionary and passive ALWR Utility Requirements Document submitted to NRC and plant designers as a foundation for the design basis for standardization beyond design.

7T4 From Block 4--Design input to approaches taken in standardization beyond design.

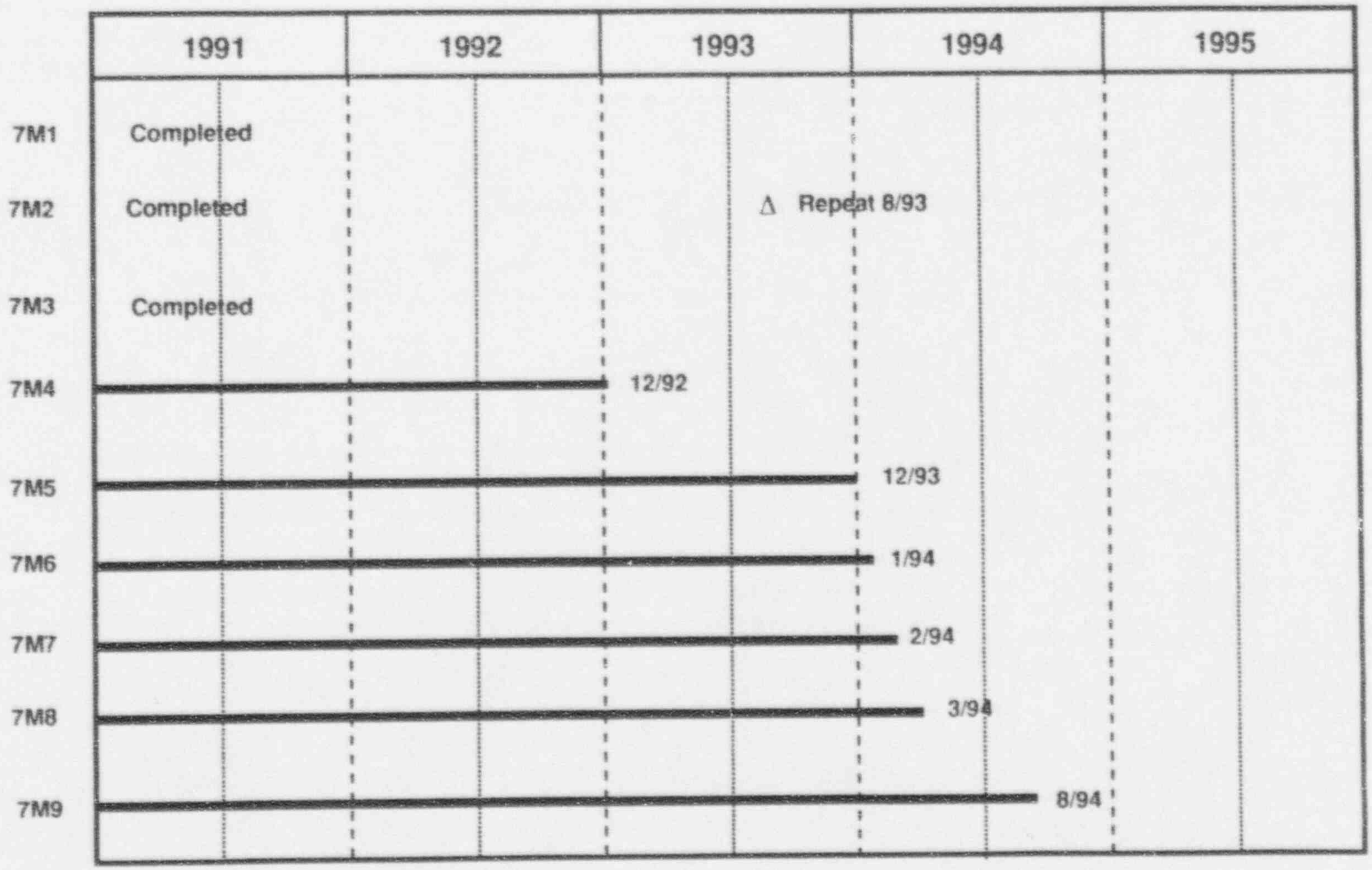
7T5 From/to Block 6--Exchange information on the design basis to support enhanced standardization beyond design.

7T6 To Block 6--Assistance on the incorporation of operating experience into the designs.

7T7 To Blocks 2, 3 and 4--Provide input to the ITAAC process.

7T8 From/to Blocks 9 and 10--Enhance the basis for assessment of financial issues.

Schedule Display for Block 7



ACTION PLAN FOR BUILDING BLOCK #8: ENHANCED PUBLIC ACCEPTANCE

I. Goals and Responsibilities

Goals:

1. Achieve broad U.S. public acceptance of nuclear power.
2. Positively influence local public attitudes, at potential plant sites, on the need for new plants, and encourage attitudes which are conducive to new plant siting, construction and operation.

Responsibilities:

Industry Lead	USCEA
Primary	U.S. Nuclear Industry/DOE/NRC/ Congress/USCEA
Industry Supporting	ANEC/EEI/APPA/NRECA/NUMARC
Regulatory	NRC/State Regulatory Agencies

II. Summary Action Plan

The goals will be achieved by educating and, therefore, persuading the public and opinion leaders, directly and through the media, about the advantages of using nuclear energy to help meet our growing need for electricity in an environmentally beneficial manner.

The fundamental objective is to maintain and broaden public recognition that nuclear energy is a vital part of America's present and future energy mix and is essential to meeting the country's environmental concerns. Major messages include:

- Nuclear energy helps protect the environment and preserve natural resources.

- Nuclear energy is a major source of the electricity necessary for a growing economy and international competitiveness.

- Electrification itself has significant environmental, energy efficiency, and economic benefits.

- Nuclear energy helps reduce U.S. dependence on imported oil from unstable regions;

The coordinated communications effort includes:

- advertising;
- conducting a broad range of media and public outreach programs;
- developing the messages and preparing the materials necessary to achieve support for the industry's regulatory and legislative objectives;
- tracking and analyzing public opinion testing messages and communications approaches, and evaluating advertising effectiveness; and
- working with individual companies to advise on and assist in their regional and local communications efforts.

III. Milestones

8M1 Continue national communications on the benefits of and need for additional nuclear energy plants.

Ongoing communications on the environmental benefits of nuclear energy and electricity, and on nuclear energy's role in energy independence.

8M2 Continue communications encouraging a high priority for nuclear energy in U.S. energy policy.

8M3 Provide communications support for the industry's legislative and regulatory goals, including license renewal, licensing reform, standardization, training, certification of new designs, radioactive waste management and privatization of DOE enrichment facilities, etc.

8M4 Help achieve significant progress toward studying, selecting and establishing an MRS, a high-level radioactive waste repository, and low-level radioactive waste facilities.

8M5 Assist applicants for early site permits or combined construction/operating licenses with local communications programs to build understanding and acceptance prior to siting and construction decisions. Integrate siting communications schedules and work with technical/regulatory schedules and work.

8M6 Achieve heightened awareness of the need for equitable, predictable treatment of utility investment by state utility regulators.

8M7 Inform the financial community of the need for, and financial viability of, both today's operating plants and future advanced light water reactors, and financial implications of license renewal, government regulations, and decommissioning on current plants.

8M8 Provide the technical basis for communications, legislative efforts, and policy development, in areas not covered by other industry organizations, including energy use and supply trends, economic aspects of electricity generation, the nuclear fuel cycle, insurance, decommissioning, international policy, radionuclides/pharmaceuticals, nuclear plant status, and economics of advanced nuclear energy plants.

8M9 Monitor and understand public priorities and acceptance of nuclear energy.

8M10 Communicate the benefits and features of advanced nuclear energy plants.

8M11 Provide information to the public, the media, opinion leaders and policymakers on radiation, radioactive waste and safety issues.

8M12 Communicate performance and benefits of U.S. operating plants overall and in relation to the issues of aging and license renewal.

The data from Block 1, Current Nuclear Plant Performance, on plant safety and reliability and from industry statistics on O&M and capital modifications costs will be summarized and reported publicly. Improved trends in this area are important in achieving public confidence in nuclear power.

IV. Tie-Ins

8T1 General--Information input to this block is required from all other blocks.

8T2 To Block 2--Predictable licensing and stable regulation.
Provide communications support to NUMARC and ANEC in support of respective regulatory and legislative initiatives.

8T3 To Block 5--Siting.
Develop a strategy to assist local communications programs to increase public understanding and acceptance prior to siting and construction decisions.

8T4 To Block 9--Clarification of ownership and financing.
As appropriate, communicate with relevant audiences on ownership/financing options for new plants and on the competitiveness of new nuclear plants.

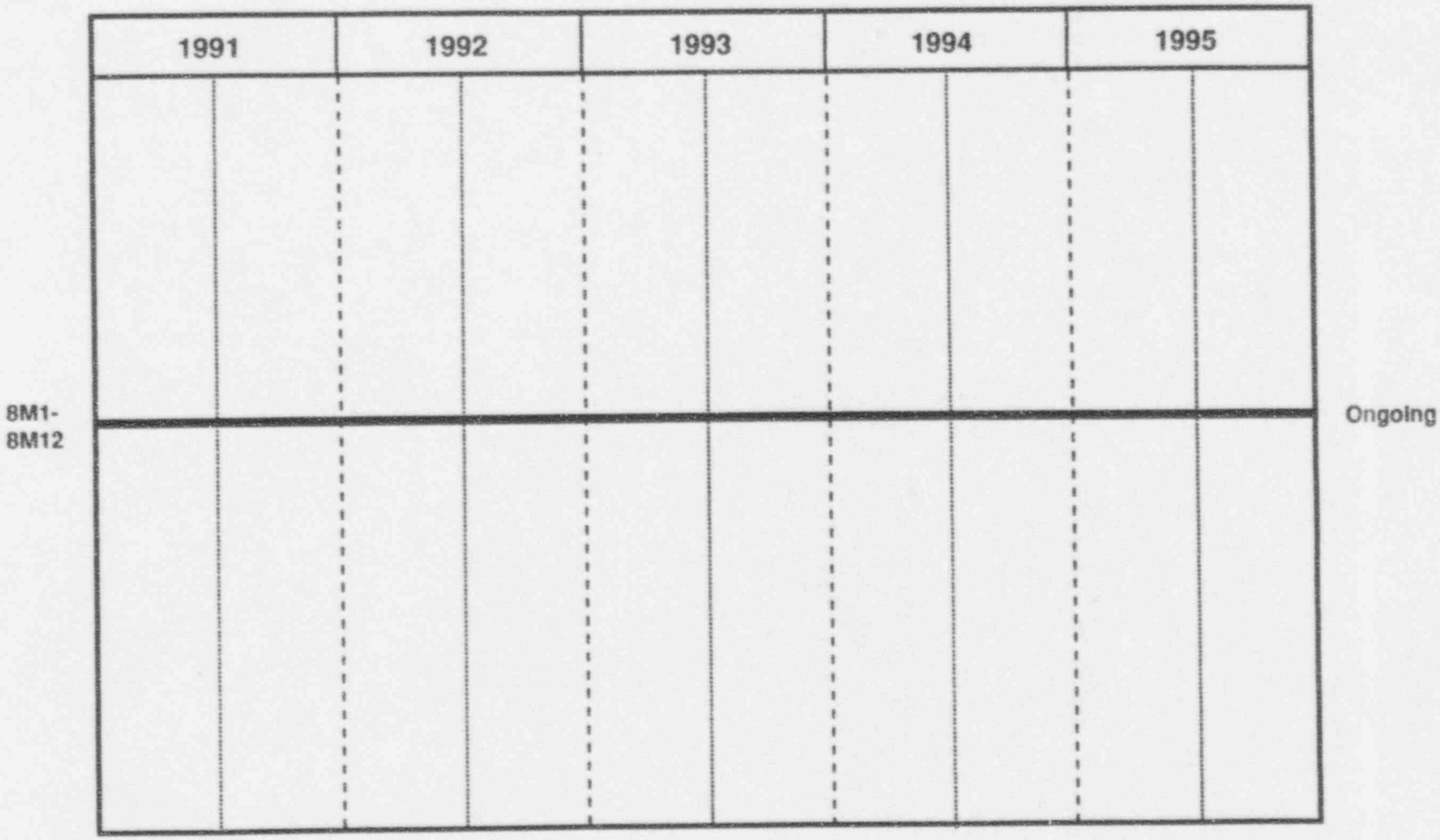
8T5 To Block 10--State economic and regulatory issues.
Support industry lead of EEI with relevant technical information and appropriate media support.

8T6 To Block 11--High-level radioactive waste.
Coordinate with ACORD-EEI on communications concerning the need and safety of a permanent repository, on the safety/viability of existing utility storage of waste, on communications in Nevada supporting Yucca Mountain characterization; coordinate actions in Nevada with ANEC; and conduct state and local information programs at potential MRS sites.

8T7 To Block 12--Low-level radioactive waste.
Provide communications tools regarding low-level waste as disposal sites are opened under state compact process. Provide mechanisms and resources for low-level waste compacts to exchange information and expertise.

8T8 To Block 14--Enhanced governmental support
Serve as the communications arm for industry efforts to secure strong recognition for nuclear in government policies, including license renewal, licensing reform, standardization, waste management, uranium enrichment, adequate funding for advanced reactor R&D, design certification, etc.

Schedule Display for Block 8



ACTION PLAN FOR BUILDING BLOCK #9: CLARIFICATION OF OWNERSHIP AND FINANCING

I. Goals and Responsibilities

Goal:

Analyze and propose structures for the financing, ownership, and operation of nuclear plants which reasonably compensates owners, investors, and, if applicable, vendors and operators.

Responsibilities:

Industry Lead	EEI
Primary	FERC/SEC/Congress/Investment Community
Industry Supporting	ANEC/USCEA/Plant Designers
Regulatory	FERC/SEC/NRC

II. Summary Action Plan

In today's competitive environment and with the regulatory emphasis on least cost planning, the cost of power to the consumer from a nuclear plant will be a very important factor in determining whether or not such a plant will be built. Because nuclear plants are capital intensive, the form of ownership is an important determinant of costs.

Investors demand a return (reward) commensurate with the risk they undertake. The issue in seeking viable scenarios for nuclear plant construction is balancing risks and rewards.

Historically, nuclear plants have either been built by individual utilities or through some form of joint venture under the traditional rate base approach. Other forms of ownership may be appropriate to allow appropriate returns and to reduce risks as well as costs. Alternate forms of ownership may also allow for flexible, competitive pricing. Two recently cited examples which will be relevant are turnkey projects and independent power producers. The inclusion of non-utility owners is another, as is partial government financing.

Each of these options will be characterized and reviewed with regard to their influence on financing, construction, risk mitigation, and regulatory impact. An effort will be made to identify new, innovative approaches to removing perceived barriers. Return of and on investment is subject to a rate regulatory process which is moving toward the integrated resource planning process. Thus, the form of ownership will have to be accepted within this process. Also, success

may involve removing perceived obstacles to innovative financing/ownership arrangements.

Important to owners/investors is insurance as a risk reduction method. Coverage of property, liability, and worker claims, as well as protection against plant outages, will be determined.

Because risk reduction leads to cost reduction, it is imperative in a highly competitive environment that potential risks be identified and addressed in all areas of the project, e.g., engineering, project management, and scheduling.

III. Milestones

9M1	Identify and summarize alternative forms of power plant ownership.	Completed
9M2	Model and analyze the relative financing costs of alternative ownership forms and periodically assess the financial potential for new plants.	Completed
9M3	Periodically (every 18 to 24 months) evaluate the potential for financing new nuclear power plants based on the progress of all blocks of the Strategic Plan.	Ongoing
9M4	Identify and attempt to quantify nuclear insurance-related risks and potential liabilities.	Completed
9M5	Review and identify perceived constraints, primarily legal and regulatory, to implementation of the various forms of ownership. Factor into the review potential legislative and regulatory changes which are currently being debated and addressed.	4/93
9M6	Interview investment/commercial bankers and security analysts on the ability to finance a plant. Keep the investment community informed.	Ongoing
9M7	Evaluate impact of current and potential ownership forms on site selection, financing/construction alternatives, cost and schedule.	7/93
9M8	Identify and evaluate options to formulate contracts for the sale of electricity, if made necessary by the form of ownership.	9/93

9M9 Prepare written report summing up results of the analysis accomplished in Milestones 1 through 8. Define potential hybrid ownership forms which might result from the deliberations in previous milestones. Describe conditions necessary for successful ownership. 3/94

IV. Tie-Ins

9T1 From/to Block 2--Predictable licensing and stable regulation
Review legislative, legal and regulatory constraints to implementation of the various forms of ownership.

9T2 From/to Block 5--Siting
Evaluate impact of current and potential ownership forms on siting, financing/construction alternatives, cost, and schedule.

9T3 From/to Block 6--First-of-a-kind engineering
Evaluate the level of confidence achieved in costs and schedules from the completion of first-of-a-kind engineering on risk allocation and its impact on current and potential ownership forms.

9T4 From/to Block 7--Enhance the assessment of financial issues.

9T5 From/to Block 8--Provide and obtain information to enhance public acceptance.

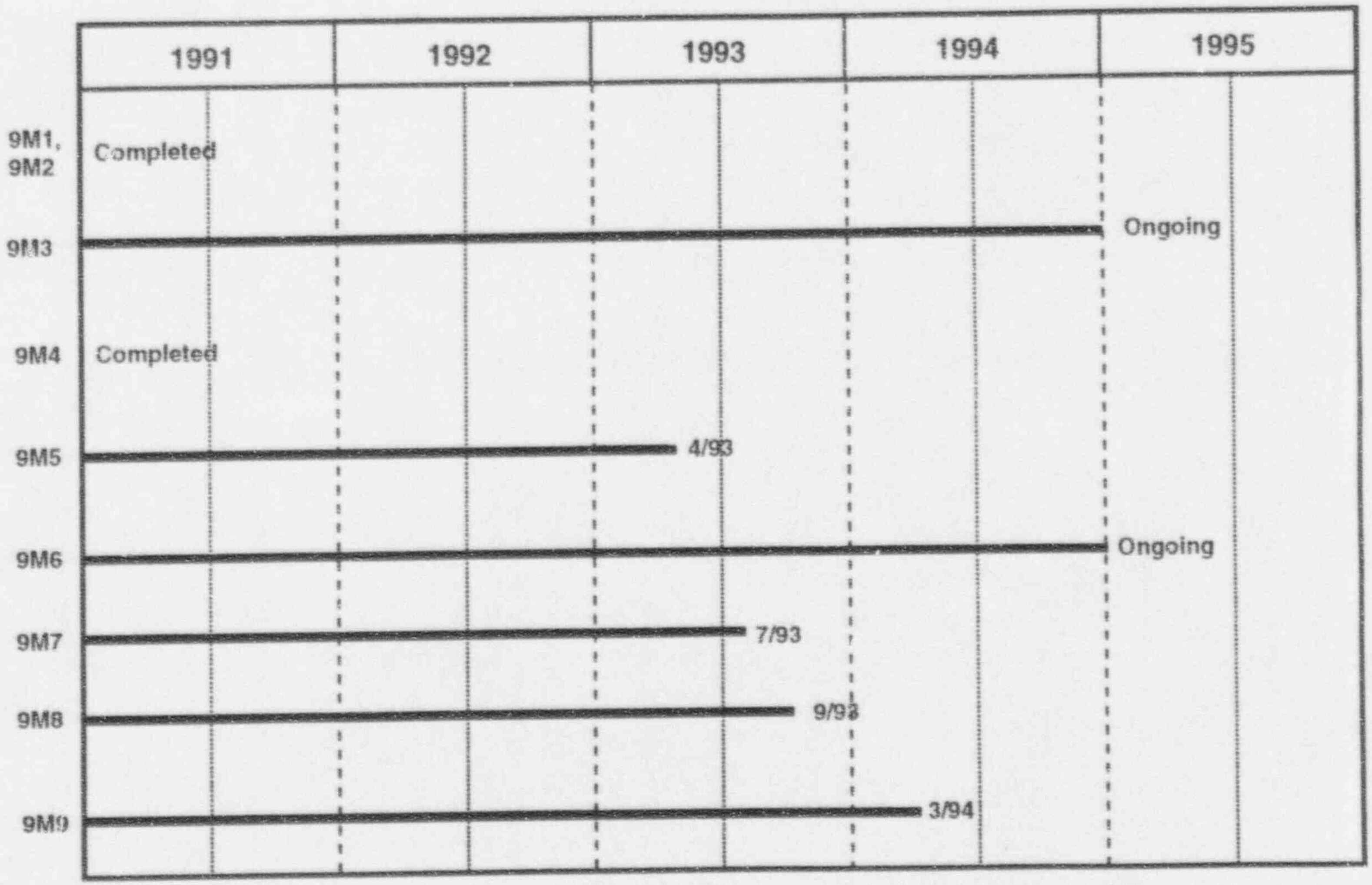
9T6 From/to Block 10--State economic regulatory issues
Review legislative, legal and regulatory constraints to implementation of the various forms of ownership.

9T7 From/to Block 11--High-level radioactive waste--obtain information to provide to the financial community
Identify and attempt to quantify nuclear insurance-related risks and potential liabilities.

9T8 From/to Block 12--Low-level radioactive waste--obtain information to provide to the financial community
Identify and attempt to quantify nuclear insurance-related risks and potential liabilities.

9T9 From/to Block 14--Enhanced governmental support
Review legislative, legal and regulatory constraints to the implementation of the various forms of ownership. Explore government participation in financing.

Schedule Display for Block 9



ACTION PLAN FOR BUILDING BLOCK #10: STATE ECONOMIC REGULATORY ISSUES

I. Goals and Responsibilities

Goal:

Achieve support by state regulatory agencies for predictable and stable handling of permitting and financial matters.

Responsibilities:

Industry Lead	EEI
Primary	NARUC
Industry Supporting	USCEA/ANEC/NUMARC/APPA/ NRECA
Government Supporting	Regional states groups (e.g. Southern States Energy Board)
Regulatory	Individual State Regulatory Agencies

II. Summary Action Plan

The strategy for achieving Building Block 10 goals involves three principal elements. These are:

- Facilitating the adoption of "rolling prudence" or similar cost recovery procedures by state regulatory commissions to reduce the risk of new capital projects, including nuclear projects. ("Rolling prudence" implies a regulatory process that provides for periodic review of the cost and schedule performance of major capital projects).

- Developing generic cost recovery mechanisms which explicitly share risks among utility ratepayers, shareholders, and other investors, and do so appropriately and equitably. These mechanisms would be available for adaptation/modification by parties negotiating "preapproval" contracts.

- Facilitate industry consideration of integrated resource planning (IRP) policies and procedures which will allow existing nuclear plants and ALWR projects to compete fairly and equally against other resource options.

The first element of the strategy (Milestone 10M1) reflects an assumption that rolling prudence procedures can reduce the large financial risks associated with "hindsight prudence" (i.e., regulatory disallowances based on after-the-fact, outcomes-oriented prudence reviews). It focuses on the adoption of regulatory policies affirming rolling prudence. 10M1 also focuses on the development of model planning procedures (10M1.4) which utilities can use as guidance in

proposing situation-specific procedures to implement some form of rolling prudence.

The second element (Milestone 10M2) incorporates requirements involving construction work in progress (CWIP), and the need for flexibility to build nuclear units both within and outside of rate base regulation (e.g., as return-deregulated IPPs). This element assumes that regulators may be reluctant to approve nuclear projects which leave ratepayers exposed to open-ended financial risks (e.g., associated with construction overruns, O&M escalation, decommissioning, waste disposal); equally, that investors will be reluctant to participate without increased certainty concerning rate treatment.

This element seeks to adapt the concept of "preapproval contracting" to meet the needs of nuclear projects. It will develop generic risk-sharing mechanisms which can be adjusted and used to negotiate contracts in specific situations. This element will not specify standard contract terms; rather, it will develop (variable) mechanisms which can be adjusted/calibrated to specific circumstances. Mechanisms will be developed for two types of contracts: one involving traditional rate-based plants, the other for IPP-type projects. The mechanisms will specify the manner and timing of rate recovery for costs incurred at each stage of the plant's life cycle. They will incorporate performance-based incentives and will be designed to be consistent with policies reflecting full, partial, or no CWIP.

The third element (milestone 10M3) incorporates requirements involving the manner in which future capacity needs are established. It assumes that capacity needs will be established in an integrated resource planning (IRP) context, and that regulatory approval for the construction of a nuclear plant will be achieved only upon a showing that the project represents part of the "least-cost" resource mix. This element focuses on regulatory policies needed to ensure that planning is unbiased with respect to the evaluation of supply (including nuclear) resources. It will focus on understanding the implications of alternative IRP policies and practices for evaluating the cost-effectiveness of ALWR plants. Among other important IRP variables, this element will address the use of estimated environmental externalities in characterizing the cost and benefits of competing resource options.

Beyond the foregoing three elements, Block 10 has drafted an action plan for direct contacts with state PUCs. This plan provides for the creation of an In-State Support Team (IST), made up of representatives from Blocks 5, 8, 9, 10 and 14. Upon the request of a utility, and in coordination with potential state contacts on siting (Building Block 5), this plan will be executed to provide coordinated support in making the case for state approval to build an ALWR.

A fourth element would encompass activities associated with overall project management and review.

III. Milestones

10M1	Protocols regarding rolling prudence	Ongoing
	10M1.1 Concept paper describing the attributes of "rolling prudence," identifying examples and discussing pros and cons of rolling prudence.	Completed
	10M1.2 Discussion of the concept of rolling prudence with utilities and regulators.	Ongoing
	10M1.3 Encouragement for the adoption of rolling prudence procedures by state regulatory commissions.	Ongoing
	10M1.4 Development of a model rolling prudence procedure for use by utilities, and implementation assistance in a selected state or region. (Coordinate with model procedure for IRP (10M3.5).	Completed
10M2	Preapproval contracting	Completed
	10M2.1 Identification and development of preapproval contracting mechanisms which define the timing and rate treatment to be accorded costs incurred in all stages of the life cycle of the next-generation nuclear plant. This treatment will assume traditional utility ownership (i.e., a rate based asset), and will allow for full or partial CWIP. It will also incorporate performance-based incentive mechanisms and will provide for explicit sharing of financial risks between ratepayers and shareholders.	Completed
	10M2.2 Identification and development of preapproval contracting elements comparable to those developed in 10M2.1, but assuming nontraditional ownership (e.g., a project-financed IPP developed and owned by a limited partnership).	Completed
10M3	Protocols regarding integrated resource planning	
	10M3.1 Competitive analysis of next-generation nuclear plant. This analysis will evaluate the expected cost characteristics of next generation nuclear technology in comparison to those of other competitive resource options (e.g., combined-cycle natural gas-fired plants).	Completed

10M3.2 Definition of integrated resource planning (IRP) policies and procedures which allow nuclear projects to compete on an equal basis with other resource options. — Completed

10M4 Project management

10M4.1 Quarterly internal project review. Periodic briefing for NPOC on the status of Block 10 activities, addressing progress since the last briefing, and activities planned. — Ongoing

IV. Tie-Ins

10T1 From Block 2--Predictable licensing and stable regulation
Coordination with stable and predictable safety regulatory approach.

10T2 From Block 6--First-of-a-kind engineering
Engineering cost estimates to support competitive analysis.

10T3 From Block 7--Life-cycle standardization
To enhance the assessment of financial risk.

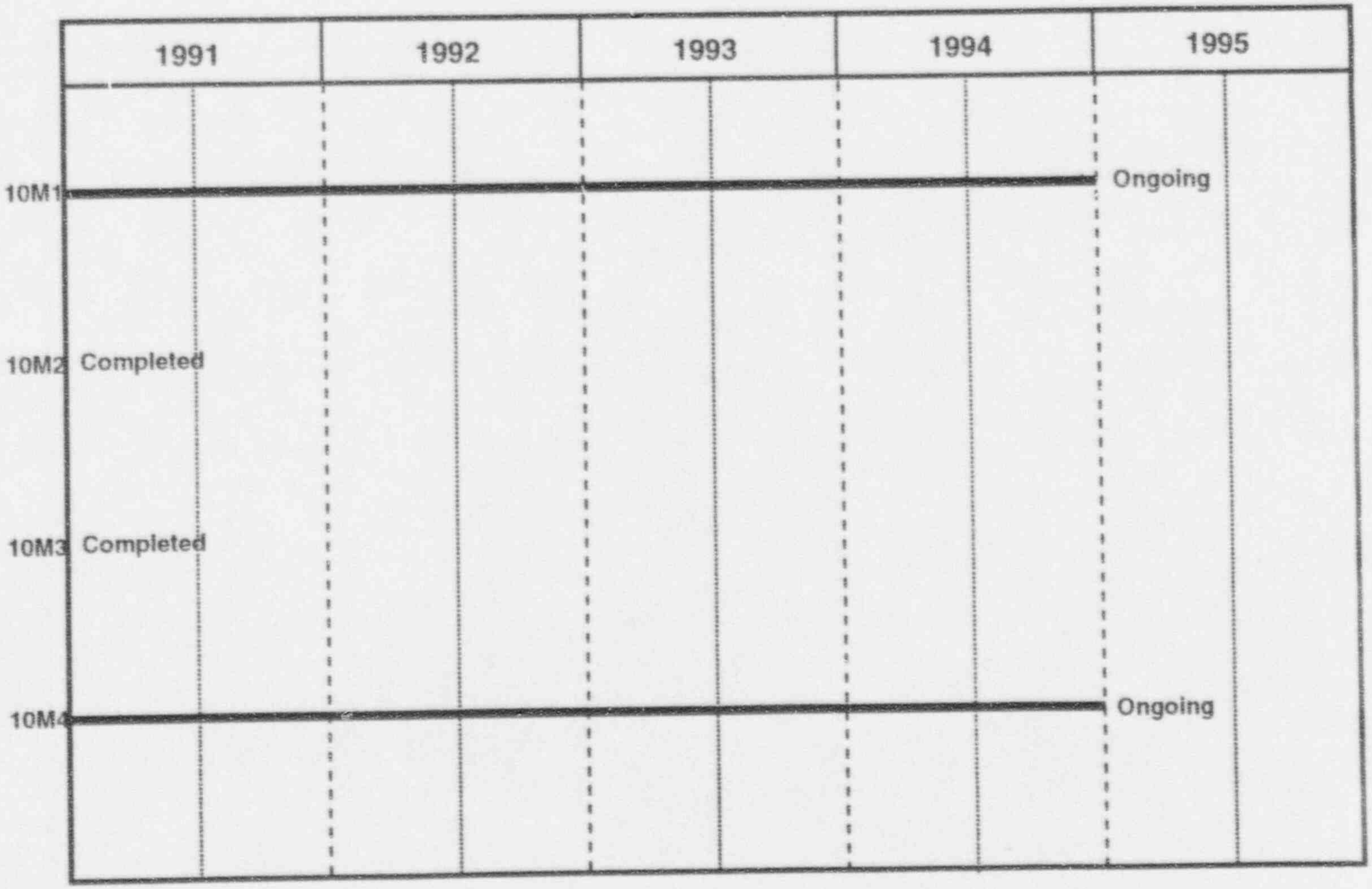
10T4 From/to Block 8--Enhanced public acceptance
To recognize the full benefits of nuclear energy.

10T5 From/to Block 9--Clarification of ownership and financing
To open up ownership and financing opportunities.

10T6 From Block 11 and 12--High-level radioactive waste
To increase investor/PUC confidence.

10T7 From/to Block 14--Enhanced governmental support
Coordination with legislative activities and governmental support.

Schedule Display for Block 10



ACTION PLAN FOR BUILDING BLOCK #11: HIGH-LEVEL RADIOACTIVE WASTE

I. Goals and Responsibilities

Goal:

Achieve progress with the high-level radioactive waste (spent fuel) disposal system that includes a permanent repository and a temporary monitored retrievable storage (MRS) facility.

Responsibilities:

Industry Lead	EEI-ACORD
Primary	DOE
Industry Supporting	UWASTE/USCEA/NUMARC/EPRI/ANEC
Regulatory	NRC/EPA/DOT/DOE

II. Summary Action Plan

Progress toward a safe, environmentally sound, publicly acceptable, cost-effective and timely high-level radioactive waste (spent fuel) disposal system is needed. The Nuclear Waste Policy Act (NWPA) of 1982, as amended, provides a Congressional mandate for the U.S. Department of Energy (DOE) to develop the high-level radioactive waste (spent fuel) disposal system. Progress towards developing a high-level radioactive waste disposal system is important if the nation is to have the confidence to make use of nuclear energy in the future.

For the purposes of this plan, progress towards an operational high-level radioactive waste disposal system is defined as a series of events within the overall high-level radioactive waste system development. It is important to recognize that the goal is to develop the high-level radioactive waste disposal system--not just the repository.

In July 1991, DOE started site characterization work at the Yucca Mountain site in earnest and is making progress on surface investigations at Yucca Mountain. Through court orders and threats of preemption legislation, Nevada has begun to perform its role in a responsible manner. Nevada has issued four key permits that have allowed DOE to proceed with surface-based characterization work. The dispute between DOE and the State of Nevada is not over, and the State has vowed to stop this project and will continue to seek opportunities to thwart the program.

DOE is now conducting the characterization effort in such a way as to identify early any disqualifying features. The first early site-suitability study was completed showing no reason to believe that the site will not be found suitable, but

much more characterization work needs to be done. Reasonable Environmental Protection Agency (EPA) standards must be finalized, along with implementing rules for the NRC requirements. DOE must proceed with excavating the Exploratory Studies Facility (ESF) for underground examinations, because the question of suitability cannot be answered solely by surface-based testing. Budget cuts have delayed the start of the underground work by about one year. A management structure more suitable for the waste program must be established. Congress in the Energy Policy Act of 1992 provided new direction for the basic environmental standards for the Yucca Mountain site by directing EPA to repromulgate disposal standards consistent with the findings and recommendations of the National Academy of Sciences.

Progress by DOE in developing the high-level repository system has not been sufficient. Because of a tight fiscal budget, neither the Administration nor Congress has provided the funds necessary to ensure the timely progress of the program in meeting schedules even though the money necessary already exists in the nuclear waste funds. Efforts are underway by the industry to define ways that DOE's efforts can be improved and industry oversight can be made more effective. Also, specific effort is necessary to assure that adequate funds are made available, as needed, for this characterization of the repository.

A site for a monitored retrievable storage (MRS) facility must be located by the Nuclear Waste Negotiator at a volunteer location, which requires the identification of potential sites and the development of an effective benefits package and reasonable linkages to a repository. While 21 localities have requested financial grants to study the possibility of hosting an MRS, none have reached a stage of active negotiation for the facility. Congress has extended the period for continued effort by the Nuclear Waste Negotiator.

The availability of expanded nuclear energy plant on-site storage must be assured.

The milestones listed below are the responsibility of DOE except for 11M1, nuclear energy plant on-site spent fuel storage, which is an industry, DOE and NRC responsibility. Electric utility industry actions need to be focused and assertive to assure that DOE is held accountable for cost-effective progress on the disposal program.

III. Milestones

11M1	Ensure continuing viability of nuclear energy plant on-site storage.	Ongoing
	11M1.1 Technology demonstrations.	Ongoing

11M1.2	NRC licensing actions.	As needed
11M1.3	HLW program progress.	Ongoing
11M2	Reorganization of DOE Office of Civilian Radioactive Waste Management.	Completed
11M3	Management and operations (M&O) contractor established.	Completed
11M4	Evaluate DOE/NAS study of actinide recycle from the utility perspective.	12/93
11M5	If Yucca Mountain is found to be suitable for development as the nation's first high-level nuclear waste repository, begin licensing process.	10/97
11M5.1	Yucca Mountain site recommended to the President for development as the nation's first nuclear waste geologic repository.	4/2001
11M5.2	Submit license application for Yucca Mountain repository.	10/2001
11M6	Provide an MRS facility.	1/98
11M6.1	Identify and negotiate an acceptable MRS site.	12/93
11M6.2	Submit license application for MRS facility.	7/95
11M6.3	Begin construction of an MRS facility.	1/97
11M6.4	Begin limited operation of the MRS facility.	1/98
11M6.5	Begin full operation of the MRS facility.	7/2000
11M7	Complete the characterization of the Yucca Mountain site.	1/2001
11M7.1	Finalize and implement a satisfactory quality assurance program.	Completed
11M7.2	Gain access to initiate on-site characterization at Yucca Mountain.	Completed
11M7.2.1	Ensure continued site access.	Ongoing
11M7.3	Initiate construction of exploratory facility.	11/93

11M7.4	Determine as early as possible the likely outcome of continued site characterization of the Yucca Mountain site.	1/95

11M8	Start construction of repository at Yucca Mountain.	10/2004
11M9	Begin acceptance of spent fuel at repository.	1/2010

IV. Tie-Ins

11T1 To Block 1--Expanded nuclear energy plant on-site spent fuel storage will be needed in some instances.

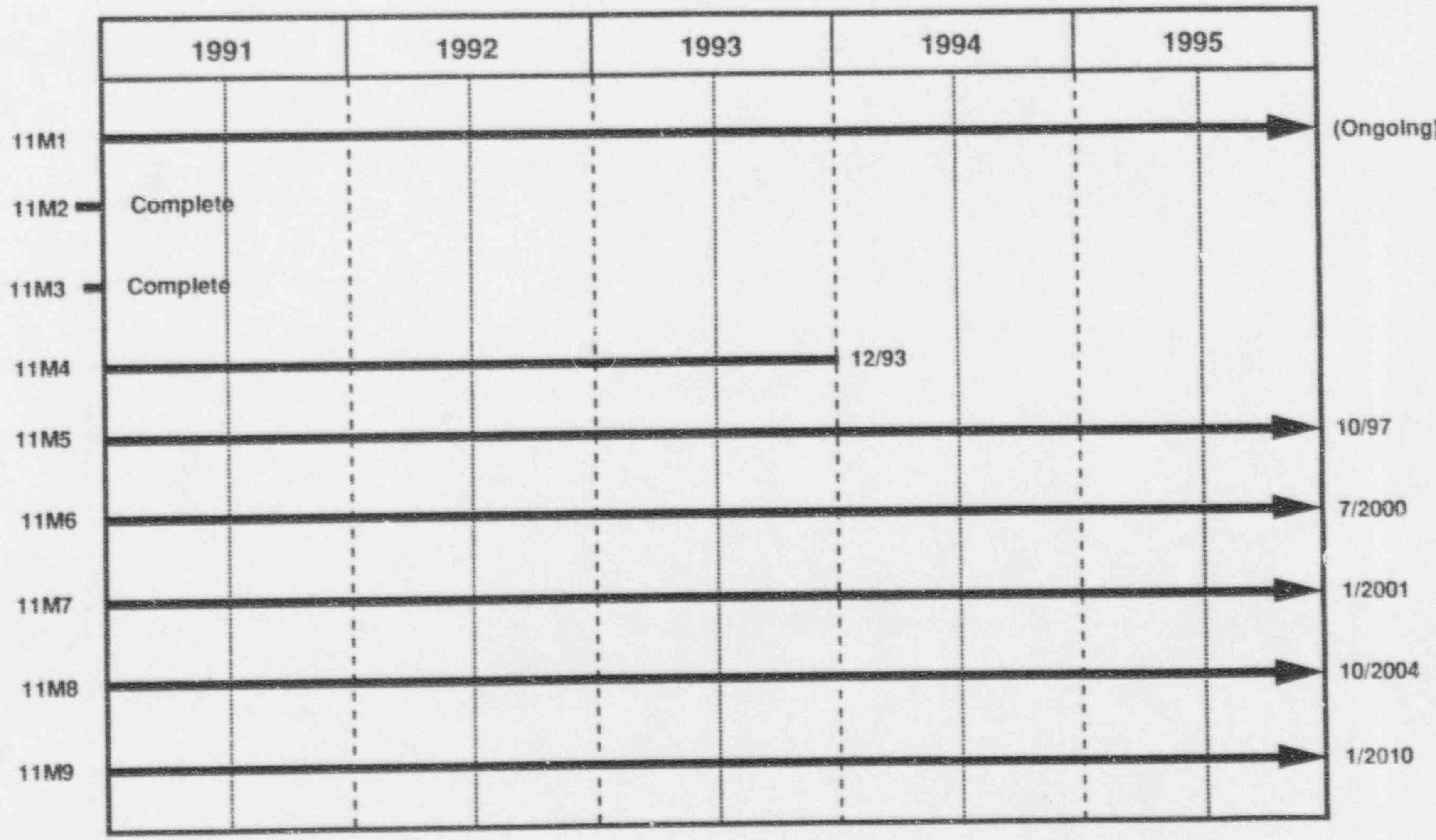
11T2 To Block 8--To enhance the nation's confidence that it can rely on nuclear energy, by achieving the progress in high-level radioactive waste management.

11T3 To Block 9--To enhance investor confidence in nuclear energy by achieving the progress in high-level radioactive waste management.

11T4 To Block 10--To enhance PUC confidence in nuclear energy by achieving the progress in high-level radioactive waste management.

11T5 To Block 14--To enhance governmental confidence in nuclear energy by achieving the progress in high-level radioactive waste management.

Schedule Display for Block 11



ACTION PLAN FOR BUILDING BLOCK #12:
LOW-LEVEL RADIOACTIVE WASTE

I. Goals and Responsibilities

Goal:

Assure availability of low-level radioactive nuclear plant waste processing and disposal capacity.

Responsibilities:

Industry Lead	EEI-ACORD
Primary	States
Industry Supporting	UWASTE/USCEA/ANEC/NUMARC/EPRI
Regulatory	NRC/EPA

II. Summary Action Plan

The Low-Level Waste Act and Amendments provide that the states are primarily responsible for the development of new low-level waste disposal capacity, including mixed waste. Access to the three existing disposal sites may end on January 1, 1993. The states have formed nine regional compacts; four states will "go it alone." Thirteen new disposal sites are planned for development. The law encourages license applications to be submitted by January 1, 1992 and the sites to begin operating in the 1993 to 1996 time frame. The states and compacts have made varying degrees of progress. License applications have been filed for four new disposal sites. No new sites are expected to be operational on January 1, 1993. Many new sites are not expected to open until 1996 or later. Disposal site development costs are significant. Also, the cost of future low-level waste disposal is expected to be substantially higher than current disposal costs.

Milestone 12M1 is primarily the responsibility of the states. Electric utility industry actions are directed at assisting the states and the federal agencies in achieving their milestones. Industry involvement is to monitor site development, become involved in appropriate rulemakings, legislation, and litigation, and provide useful supporting information. Individual utilities, based upon local circumstances, may become more involved in site development efforts.

In June 1992, the U.S. Supreme Court ruled that the take title provision of the Low-Level Radioactive Waste Policy Act is unconstitutional while upholding the fundamental components of the act.

South Carolina has approved a plan to keep the Barnwell low-level waste disposal site open beyond 1992 as a revenue source for the state. Southeast Compact generators will have access until 1996 and outside generators will have access at

least until mid-1994. However, the disposal charges are substantial and access is conditional.

III. Milestones

12M1	Opening of new state and compact low-level waste disposal sites.		
	12M1.1	States join regional compacts or plan for their own disposal facilities.	Completed
	12M1.2	Compacts designate a host state or each single state develops a siting procedure	Completed
	12M1.3	States/compacts file license application or certify that they can manage low-level waste generated after January 1, 1992.	Completed
	12M1.4	States and compacts file license application.	Completed
	12M1.5	Barnwell, Beatty and Richland may close to out-of-region generators.	1/93
	12M1.6	States/compacts provide disposal capacity or surcharges are returned to generators.	1/93
	12M1.7	Resolve issues associated with the management of commercial mixed waste.	1/93
12M2	Ensure continued availability of nuclear plant on-site storage.		Ongoing
12M3	Ensure continued access to off-site waste processing facilities.		Ongoing

IV. Tie-Ins

12T1 To Block 1--To promote continued safe nuclear plant operation to ensure minimization of low-level radioactive waste volumes. On-site storage of low-level radioactive waste.

12T2 To Block 8--To enhance the nation's confidence that it can rely on nuclear energy by communicating the progress in low-level radioactive waste management. To facilitate improved communications and the

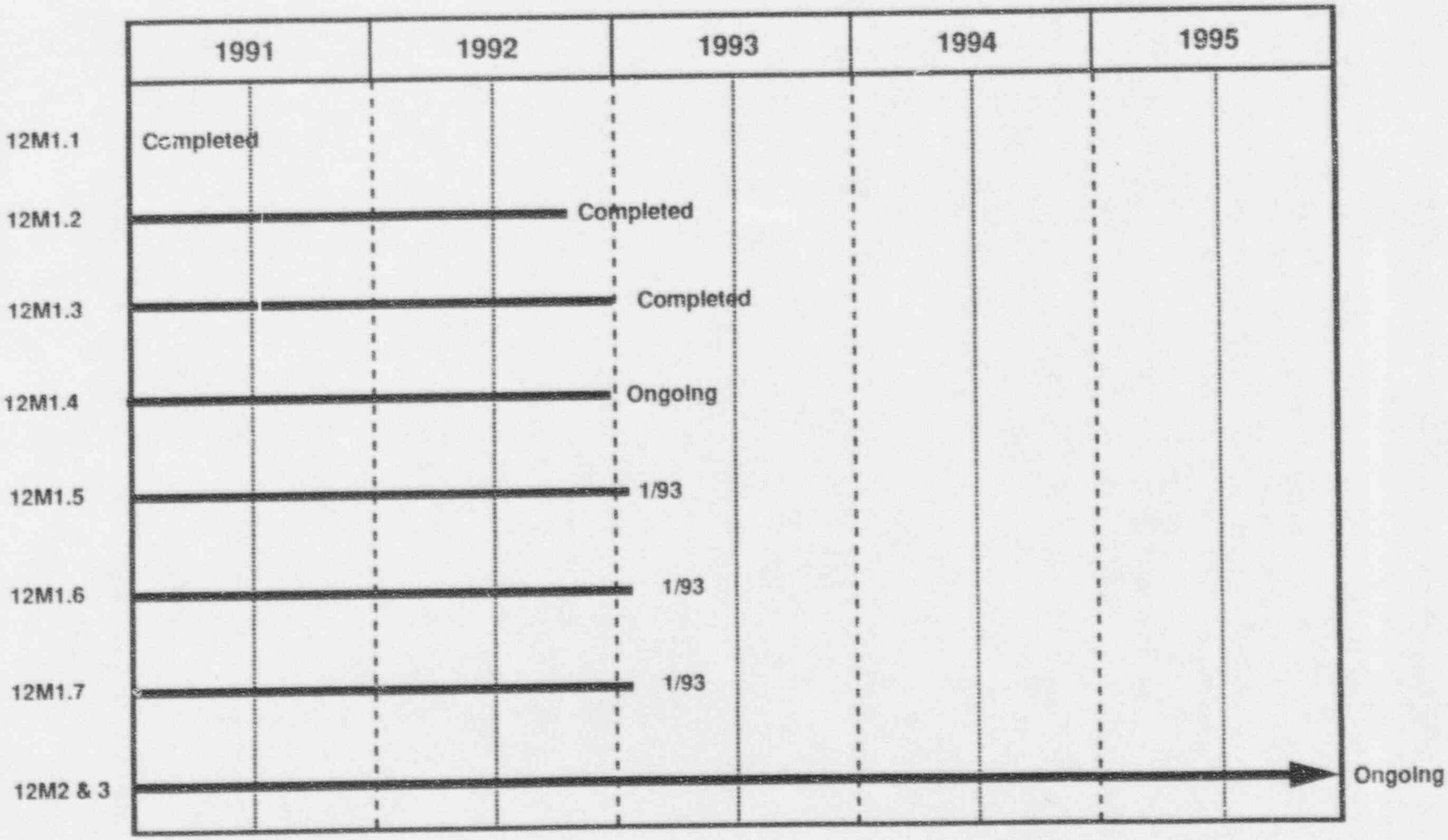
use of information/educational resources by waste generators across the nation.

11T3 To Block 9--To enhance investor confidence in nuclear energy by achieving the progress in low-level radioactive waste management.

11T4 To Block 10--To enhance PUC confidence in nuclear energy by achieving the progress in low-level radioactive waste management.

12T5 To Block 14--To enhance governmental confidence in nuclear energy by achieving the progress in low-level radioactive waste management.

Schedule Display for Block 12



ACTION PLAN FOR BUILDING BLOCK #13: ADEQUATE, ECONOMIC FUEL SUPPLY

I. Goals and Responsibilities

Goal:

Assure a continuing stable and economic supply of nuclear fuel.

Responsibilities:

Industry Lead	EEI
Primary	DOE/Private Sector Fuel-Cycle Suppliers/ Converters/Utilities
Industry Supporting	ANEC/USCEA
Regulatory	NRC

II. Summary Action Plan

The action plan pertaining to adequate, economic fuel supply for new nuclear energy plants addresses new issues as efforts continue to maintain open, free-market access to uranium, uranium enrichment, and other nuclear fuel products and services.

Significant progress was made in 1992 when the Congress passed national energy policy legislation. As part of this legislative package, Congress approved the formation of a new government corporation to take over operation of DOE's uranium enrichment facilities and market their services. This legislation will allow the new corporation to be more flexible and more internationally competitive than the old DOE Uranium Enrichment Enterprise (UEE). Now that legislation has been achieved, the startup and eventual operational success of the new corporation will be an important component of an adequate economic fuel supply. Despite this progress, the legislation calls for the industry to assume new costs for the future decontamination and decommissioning (D&D) of DOE's enrichment facilities.

While the energy legislation grants exclusive rights for the new corporation to the Atomic Vapor Laser Isotope Separation (AVLIS) technology, DOE's advanced enrichment technology program has suffered significant reductions in its budget. Despite important technical progress during the last year, AVLIS's commercial potential has yet to be adequately assessed. In addition, further clarification is needed as to how the technology might be transferred from government laboratories and who might best deploy it.

As the debate over the fate of the federal enrichment business continued, the market uncertainty has impacted the progress toward establishing private sector

enrichment services in the United States. Once the issues related to the UEE are settled, it is believed that the effort to encourage private enrichment ventures will lead to greater choice and flexibility for industry consumers.

Since the last update of this plan, the Union of Soviet Socialist Republics disintegrated, and with its passing, the long-fought Cold War ended. These historic events have led to the presence of Russia and other former Soviet republics as significant participants in the nuclear fuel market. The products of the Soviet Union's considerable nuclear infrastructure have now become available to western consumers--particularly uranium and uranium enrichment services. Nuclear fuel products are now the third largest cash export from the Commonwealth of Independent States (CIS). Further, the sale of nuclear fuel products to America and Europe help assure that such materials will not find their way to less stable parts of the world. Recent investigations by the U.S. Department of Commerce and the International Trade Commission on whether the CIS is dumping nuclear fuel products on the U.S. market demonstrates that a tremendous challenge lays before the industry: how to assure that the CIS has access to U.S. markets while not unfairly impacting any internationally competitive domestic producers.

A related issue which has arisen recently is the eventual commercial use and immobilization of high enriched uranium (HEU) from American and Soviet inventories. Clearly, diluting HEU and using it as fuel in commercial reactors is the best way to assure that this material is immobilized. The challenge is to bring such materials into the world market without undue disruption. On August 31, 1992, President Bush announced a tentative plan for the U.S. Government to purchase HEU recovered from Russian's dismantled nuclear warheads and to convert the HEU to commercial fuel. While it must be left to governments to determine the schedule of the release of this material to the commercial market, this plan must recognize the potential benefits and challenges resulting from the future availability of HEU.

The industry must continue to work to maintain the low cost of nuclear fuel and continue to encourage competition in the international enrichment and uranium markets. Maintaining a diverse, competitive fuel market will minimize future costs and maximize flexibility for the next generation of nuclear energy plants.

III. Milestones

13M1	Continue dependable, economical and reliable nuclear fuel supply by maintaining unrestricted access to uranium supply, conversion and enrichment services, and fuel fabrication on an internationally competitive basis.	Ongoing

13M2	Seek fair and effective comprehensive nuclear fuel supply legislation to establish a market-oriented, competitive domestic uranium enrichment enterprise.	Completed
13M2.1	Evaluate need for industry activities to assure success of new government enrichment corporation.	Ongoing
13M3	Support expeditious determination of the technical and commercial viability of the AVLIS enrichment technology, and encourage that the decision to deploy be made solely on sound economic and business principles.	Ongoing
13M4	Improve the availability of domestic enrichment services at competitive prices by encouraging private enrichment.	Ongoing
13M5	Evaluate in conjunction with DOE the impact on future fuel supply of potential availability of government inventories of natural uranium, LEU, and HEU and assess need for action by industry to facilitate their use.	Ongoing

IV. Tie-Ins

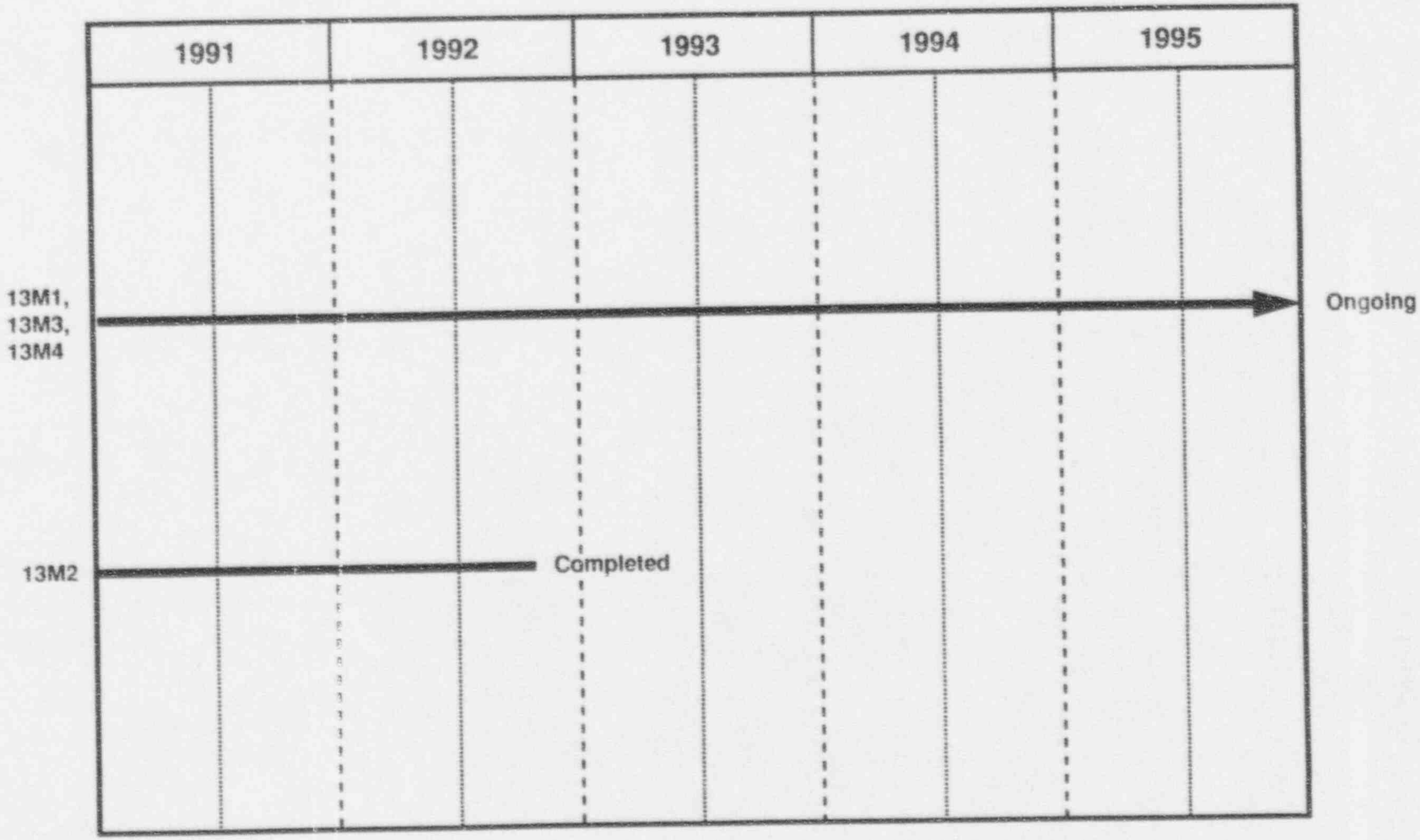
13T1 To Block 4--To determine if any limitations will impact fuel design.

13T2 To/from Block 6--Integration of fuel and plant.

13T3 To Block 9--To assess the impact of fuel prices as a part of overall plant economics.

13T4 To Blocks 8 and 14--To gain support for predictable fuel supply.

Schedule Display for Block 13



ACTION PLAN FOR BUILDING BLOCK #14: ENHANCED GOVERNMENTAL SUPPORT

I. Goals and Responsibilities

Goal:

Enhance governmental support for the necessary institutional framework, including laws, regulations and programs, that encourage the construction and operation of new nuclear plants.

Responsibilities:

Industry Lead	ANEC
Primary	Congress/States/DOE
Industry Supporting	EEI/APPA/USCEA/NUMARC/ U.S. Industry

II. Summary Action Plan

Nuclear energy is an extremely important national option that must remain available to help meet environmental and energy security objectives; however, because of the highly regulated nature of nuclear energy, a strong partnership between the public and private sector is necessary to ensure the continued availability and success of the nuclear energy program. To ensure that the private sector can prudently invest its resources and capital into nuclear energy research, development and commercialization, the Congress and Administration must signal its support. This manifestation will come from the adequate joint funding of R&D programs, and sound energy policies that allow nuclear energy compete on a level playing field with lesser regulated energy sources.

The elements of the action plan for enhanced government support are:

a. Enhance governmental support of nuclear energy with Congress by disseminating information on utility progress on operating performance; promote understanding of radiation, safety and waste issues with federal and state government officials.

b. Encourage a strong recognition of nuclear energy's role included in the National Energy Strategy and the National Energy Policy Act of 1992.

c. Encourage adequate Congressional appropriations for DOE and NRC activities in support of advanced reactor programs needed to implement the Strategic Plan.

d. Secure passage of favorable legislation in support of advanced reactors R&D program.

e. Secure Congressional enactment of legislation to codify and strengthen NRC's combined licensing process (included in the National Energy Policy Act of 1992).

f. Clarify regulatory authorities and responsibilities among NRC, EPA and states on safety and environmental issues.

g. Encourage state rate reform to provide adequate and predictable rate of return for nuclear energy plant projects.

h. Seek passage of legislation to restructure the DOE uranium enrichment enterprise (UEE) to operate in a more business-like manner in order to provide competitively priced uranium enrichment services, and to resolve satisfactorily the funding issue for the decontamination and decommissioning of DOE's uranium enrichment facilities (enacted in the National Energy Policy Act of 1992).

i. Encourage progress on the high-level waste disposal system and seek legislation authorizing off-budget financing for the nuclear waste program.

III. Milestones

14M1	Provide periodic progress reports on performance by utilities to Congress.	Ongoing
14M2	National Energy Strategy and the National Energy Policy Act of 1992.	Completed
14M3	DOE and NRC budget and appropriations.	Ongoing
14M4	Advanced Reactor R&D legislation.	Completed
14M5	Congressional enactment of legislation to codify and strengthen NRC's combined licensing process.	Completed
14M6	Clarify regulatory responsibilities among NRC, EPA, and states.	Ongoing
14M7	Obtain state legislation to assure adequate economic return for nuclear energy projects.	Ongoing

14M8	Passage of Uranium Enrichment Enterprise (UEE) restructuring legislation.	Completed
14M9	Obtain necessary legislation to assure continued progress on high-level radioactive waste facilities and achieve enhanced acceptance within the State of Nevada.	Ongoing
14M10	Low-level radioactive waste issues.	Ongoing

IV. <u>Tie-Ins</u>

14T1 From Block 1--Provide progress reports on performance improvements.

14T2 To Block 2--Achieve legislation reinforcement of predictable licensing.

14T3 To Block 4--Encourage adequate appropriations legislation for certification activities.

14T4 To Block 5--Assure continuing support of the siting program by DOE and Congress.

14T5 To Block 6--Encourage continuing Congressional support for first-of-a-kind engineering.

14T6 From Block 8--Assist and support efforts to enhance public acceptance.

14T7 To Block 10--Enhance confidence in the financial prudence review through state rate reform legislation.

14T8 To Block 11--Achieve enhanced acceptance of the HLW program in Nevada.

14T9 To Block 12--Monitor and coordinate Congressional activities for favorable resolution of LLW issues.

14T10 To Block 13--Passage of Uranium Enrichment Enterprise (UEE) restructuring legislation.

Schedule Display for Block 14

	1991	1992	1993	1994	1995	
14M1	Δ	Δ	Δ	Δ	Δ	
14M2	Completed					
14M3	Δ	Δ	Δ	Δ	Δ	
14M4	Completed					
14M5	Completed					
14M6, 7, 9, and 10	→	→	→	→	→	Ongoing
14M8	Completed					

APPENDIX A

GLOSSARY

APPENDIX A
GLOSSARY

ABWR	Advanced Boiling Water Reactor (GE evolutionary design)
ACRS	Advisory Committee on Reactor Safeguards (part of NRC)
AE	Architect-Engineer
ALWR	Advanced Light Water Reactor
AP 600	Advanced Passive 600 (Westinghouse passive design)
APWR	Advanced Pressurized Water Reactor
BWR	Boiling Water Reactor
CEO	Chief Executive Officer
CFR	Code of Federal Regulations
COL	Combined Operating License
COO	Chief Operating Officer
CWIP	Construction Work in Progress
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FDA	Final Design Approval (NRC)
FEMA	U.S. Federal Emergency Management Agency
FERC	U.S. Federal Energy Regulatory Commission
FOAKE	First-of-a-Kind Engineering
FSAR	Final Safety Analysis Report (Industry)
FSER	Final Safety Evaluation Report (NRC)
HLW	High-Level Waste
IPP	Independent Power Producer
IRP	Integrated Resource Planning
ISI	In-Service Inspection
ITAAC	Inspections, Tests, Analyses, and Acceptance Criteria
LLW	Low-Level Waste
LWR	Light Water Reactor
MRS	Monitored Retrievable Storage
MWe	Megawatt (electric)
NEPA	National Environmental Policy Act

NES	National Energy Strategy (prepared by DOE)
NRC	U.S. Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
NWPA	Nuclear Waste Policy Act
O&M	Operations and Maintenance
PRA	Probabilistic Risk Assessment
PSC	Public Service Commission
PUC	Public Utility Commission
PWR	Pressurized Water Reactor
QA	Quality Assurance
RCS	Reactor Coolant System
RFQ	Request for Quotation
SAMDA	Severe Accident Mitigation Design Alternative
SBWR	Simplified Boiling Water Reactor (GE passive design)
SEC	U.S. Securities and Exchange Commission
SECY	NRC Staff Document to NRC Commissioners
SEE-IN	Significant Event Evaluation and Information Network
SER	Safety Evaluation Report
SRM	Staff Requirements Memorandum
SSAR	Standard Safety Analysis Report
System 80+	Combustion Engineering evolutionary design
TMI	Three Mile Island
UEE	Uranium Enrichment Enterprise

APPENDIX B

IDENTIFICATION OF INDUSTRY ORGANIZATIONS

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IDENTIFICATION OF INDUSTRY ORGANIZATIONS

NPOC	Nuclear Power Oversight Committee

NPOC is composed of senior executives representing the following utility organizations, plus at-large representatives of reactor supplier, architect-engineer, and utility companies:

ANEC	American Nuclear Energy Council
APPA	American Public Power Association
EEI	Edison Electric Institute
EPRI	Electric Power Research Institute
INPO	Institute of Nuclear Power Operations
NRECA	National Rural Electric Cooperative Association
NUMARC	Nuclear Management and Resources Council
USCEA	U. S. Council for Energy Awareness

Other industry organizations or committees referred to in the NPOC Strategic Plan:

ACORD	American Committee on Radwaste Disposal (subcommittee to NPOC, staff support by EEI)
ARC	The Advanced Reactor Corporation
ISG	Industry Siting Group
PMB	Project Manager Board of ARC (oversees FOAKE Program)
SOWG	Standardization Oversight Working Group (oversees NUMARC activities on standardization)
UMB	Utility Management Board of ARC (slated to coordinate technical building blocks)

USC	Utility Steering Committee (oversees EPRI ALWR Program)
USGs	Utility Sponsor Groups (oversee the implementation of FOAKE designs)
UWASTE	Utility Nuclear Waste and Transportation Program (administered by EEI)
WANO	World Association of Nuclear Operators

APPENDIX C

POSITION PAPER ON STANDARDIZATION

POSITION PAPER
ON STANDARDIZATION

NUCLEAR POWER
OVERSIGHT COMMITTEE

April 1991

Updated October 1992

MESSAGE FROM THE CHAIRMAN

There is a strong conviction within the industry, DOE, NRC, the Congress, and the public that future nuclear power plants should be standardized. The NPOC Strategic Plan* clearly articulates that "The industry's fundamental objective in these processes is to achieve standardization." This position paper is intended to provide guidance to implement such standardization within families of plants.

Standardization is being pursued from complementary fronts: from the NRC and from the industry. The NRC, through its 10 CFR Part 52 certification, is promoting standardization of the safety-related aspects of nuclear power plants. This certification process allows full and meaningful public participation early in the program. The industry, by its efforts to standardize to the full extent of the guidance provided in this position paper, will also benefit the public through more cost-effective electricity rates.

It is recognized that the industry faces challenges in making this commitment to a high degree of standardization. It is much more difficult to achieve standardization in the United States with its large and diverse industry than in other countries with a monolithic nuclear industry. This standardization position paper is intended to serve as a reference for the work set forth in the NPOC Strategic Plan and as a model to guide the industry in implementing families of standardized plants.

At the same time, we all understand that the owners of a family of plants will make the ultimate decisions and that each company will determine how it participates in such a standardized family approach. Nevertheless, NPOC strongly encourages that you support the guidance provided in this position paper as we move forward.

Sherwood H. Smith, Jr.

Sherwood H. Smith, Jr.

Chairman
Nuclear Power Oversight Committee
and
Chairman, President & Chief Executive Officer
Carolina Power & Light Company

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* "Strategic Plan for Building New Nuclear Power Plants," prepared by the Nuclear Power Oversight Committee, November 1990.

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SECTION 1

STANDARDIZATION POLICY STATEMENT

INTRODUCTION

The "NPOC Strategic Plan for Building New Nuclear Plants"* creates a framework within which new standardized nuclear plants may be built. The Strategic Plan is an expression of the nuclear energy industry's serious intent to create the necessary conditions for new plant construction and operation. The industry has assembled a comprehensive, integrated list of actions that must be taken before new plants will be built and assigns responsibility for managing the various issues and sets timetables and milestones against which we must measure progress.

One of the key elements of the Strategic Plan is a comprehensive industry commitment to standardization: through the Utility Requirements Document, design certification, combined license, first-of-a-kind engineering, equipment procurement, construction, operation and maintenance of nuclear power plants. For many years, the U.S. nuclear power industry has recognized the significant economic advantages which would have accrued if it had been possible to build nuclear power plants to standard designs. The most obvious example of the success of standardization can be found in France. We have achieved standardization on a smaller scale in the United States, such as in the SNUPPS, Byron-Braidwood and Palo Verde projects, and recognize the clear advantages of its large-scale implementation in the future.

The NPOC plan proposes four stages of standardization in advanced light water reactors (ALWRs). The first stage is established by the ALWR Utility Requirements Document which specifies owner/operator requirements at a functional level covering all elements of plant design and construction, and many aspects of operations and maintenance. This document provides a major step towards standardization, because it represents a consensus of future customers on design features for ALWRs of both the large-size evolutionary type and the medium-size passive type. Through submission of the document to NRC for review and approval, it is expected that agreement will be reached with the industry on the resolution of generic safety issues that will provide a basis for NRC design certification. The document also describes the owner/operator requirements in design features such as layout, availability goals, instrumentation and control capability, human factors, balance-of-plant design, radiation control and capital and operating costs.

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* "Strategic Plan for Building New Nuclear Power Plants," prepared by the Nuclear Power Oversight Committee, November 1990.

The second stage of standardization is that achieved in the NRC design certification. This certification level includes requirements, design criteria and bases, functional descriptions and performance requirements for systems to assure plant safety. The level of detail will vary based on the safety significance of the component or system and includes the design information necessary for the NRC to make its final safety determinations.

The third stage of standardization, commercial standardization, carries the design to a level of completion beyond that required for design certification to enable the industry to achieve potential increases in efficiency and economy. As such, it addresses design decisions beyond the regulations and provides for the design standardization achieved outside of the regulatory scope. Industry commitment to achieve those economic benefits in combination with modern design and construction techniques and practices will permit an economically optimum attainment of commercial standardization.

The final stage of standardization is life-cycle standardization. A standardized approach is being developed in construction practices, operations, maintenance, training, and procurement practices. This area creates the ground rules and organizational entities that would maintain standardization throughout the life of the plant. Commitment to such ground rules and organizational entities will ensure that the optimum economical and technical benefits of standardization will be achieved and maintained during the plant operating life.

This comprehensive standardization program enables the NRC to proceed with design certification with the confidence that standardization beyond the regulations will be achieved. This confidence should answer the question of design detail required for design certification, and demonstrate that the NRC should require no further regulatory review beyond that required by 10 CFR Part 52. The cooperative efforts of NRC and industry to achieve standardization in their respective spheres of responsibility should achieve dramatic savings in time and capital, and permit new nuclear plant operation in time to meet the urgent demands for increased baseload capacity by the year 2000.

POLICY STATEMENT

Based on these principles of standardization cited in the NPOC plan, the Ad Hoc Committee for the NPOC Strategic Plan agreed to develop a comprehensive policy statement for standardization. The following policy statement outlines the overall industry commitment to standardization:

> Nuclear power plant standardization is a life-cycle commitment to the uniformity in the design, construction and operation of a family of nuclear power plants. Rigorous implementation of standardization is expected to achieve the efficiency and economy typically associated with increases in scale or breakthroughs in technology.

BENEFITS

The benefits of standardization in this context include the following:

1. Early definition of requirements to ensure regulatory stability and eliminate unnecessary changes.

2. Timely, systematic and thorough resolution of design, construction, operation and related regulatory problems.

3. Optimization of design to improve constructibility, reliability, operability, and maintainability.

4. More simple and uniform designs that are easier to construct and operate leading to more efficient and effective regulatory oversight and enhanced public confidence.

5. Focused and efficient application of technical and financial resources.

6. An expanded resource base that enhances support capabilities for design, manufacturing, construction, installation, inspection, testing, operation, maintenance and replacement parts.

7. Maximized learning from past experience and accelerated experience feedback.

All of the above benefits should make new nuclear power plants viable, cost-competitive sources of electricity as well as contribute to safety.

UNDERLYING PRINCIPLES

The following principles will be applied for each family of standardized plants:

- Standardization will be maintained throughout the life cycle of the family of standardized plants. An owner/operator structure will be established with clear mechanisms for maintaining standardization including a formal process for the review of proposed deviations.

- Elements of standardization within systems, structures and components needed for safety will be subject to regulatory acceptance. Elements of standardization of safety systems and standardization within systems required for reliable power generation will be maintained by all the owner/ operators of a family of standardized plants or by the organizational entity established and charged with that responsibility by all the owner/operators of that family.

- The site-independent features of the plant design will be transferable, without alteration, to any site within the design envelope for the family of plants.

- Layouts of major systems and components will be identical. Plant layout should preclude the use of shared equipment between units.

- System functional requirements will be identical, with siting consideration as the only acceptable reason for differences.

- Major structural, mechanical, electrical, or I&C components (including installed spares) essential to nuclear safety or reliable power generation will be identical for the site-independent plant features.

- Functional, physical, and interface requirements for other components will be identical. The specifications should identify critical design characteristics to allow selection of the component that best meets the requirements and allow qualified substitutions without modifying essential identical components.

- Each plant within a family will be built to construction drawings and specifications that are identical to the extent noted above. It is recognized that construction drawing and specification differences will arise due to site-specific requirements and variations within acceptable construction tolerances.

- Permanent modifications to site-independent features of systems, structures, or components essential to nuclear safety or reliable power generation will be made consistent with the limitations of Part 52 and the design certification rulemaking and only after review and approval of the organizational entity established and charged with that responsibility by all the owner/ operators of a family of standardized plants. Such review and approval by the family of plants may be deferred in the case of an emergency modification. However, modifications to replace failed or obsolete components should maintain standardization or, if necessary, be planned so as to recover standardization as the same components are replaced in the other plants within the family.

- Based on the principles cited above, life-cycle standardization will be implemented in such areas as training, maintenance and operating procedures, quality assurance, licensing, spare parts management and outage management.

FULL UTILITY PARTICIPATION--THE KEY TO SUCCESS

The benefits of standardization can be maximized by early and broad utility involvement and a life-cycle commitment. The fact that broad utility industry participation will be required throughout the process will help assure strong industry commitment to the detailed design choices that are necessary to achieve standardization. The commitment to standardization, once made, will not be compromised.

Although standardization reduces an individual utility's flexibility, that concern is diminished by the high degree of "buy-in" achieved during the design process. Nevertheless, NPOC believes that the overall benefits of standardization far outweigh the potential disadvantages.

SUPPORTING INFORMATION

The following sections expand on the four stages of standardization: Standardization of Utility Requirements (Section 2), Standardization of Design Certification and Standardized Licensing (Section 3), Commercial Standardization (Section 4), and Life-Cycle Standardization (Section 5). Each section provides a concise definition, underlying principles and benefits for each phase.

SECTION 2

STANDARDIZATION OF UTILITY REQUIREMENTS

DEFINITION

A fundamental step in achieving standardization is the definition of owner/operator requirements, Building Block #3 of the NPOC Strategic Plan. Since it is a commonly agreed goal that nuclear power plant design should provide for effective operation and maintenance, the designers' experience must be augmented by the plant operators' extensive field experience if that goal is to be achieved. For this reason, the industry, through EPRI, has developed a three-volume Utility Requirements Document which specifies owner/operator design requirements for future advanced light water reactors (ALWRs) based on the more than 1400 reactor years of light water experience in the United States and 4,000 reactor years worldwide.

The three volumes specify Policy and Top-Tier Requirements, Evolutionary Plant Requirements, and Passive Plant Requirements. The document addresses the entire plant design, including power generation systems, reactor coolant system and reactor nonsafety auxiliary systems, reactor systems, engineered safety systems, building design and arrangement, fueling and refueling, plant cooling water systems, site support systems, man-machine interface systems, electric power systems, radioactive waste processing systems, and turbine generator systems. The Utility Requirements Document provides the technical foundation to achieve utility-customer driven standardization, which has never been available before in the United States.

UNDERLYING PRINCIPLES

The utility requirements are intended to produce a safe, reliable and economical plant, through reliance on fundamentally sound design principles including:

- Simplicity of design,
- Specification of substantial design margins,
- Utilization of proven technology, and
- Strong emphasis on human factors and man-machine interface.

Some examples of the design features which result from these principles are:

- Safety and Investment protection beyond regulatory requirements through increased thermal margin ($\geq$15%), greater prevention of a degraded core

condition ($\leq 10^{-5}$ per reactor year), and increased measures to mitigate against a severe accident ($\leq 10^{-6}$ per reactor year of significant radiation release to the environment), and other requirements.

- Lifetime reliability by requiring 87% average plant availability over a 60-year design life achieved through many specific requirements bearing on materials selection, component reliability, and layouts for maintenance.

- Operational simplicity by requiring a forgiving plant response for operators and applying human factors throughout the design.

- Economics by requiring simpler designs and layouts, modularization, and a high percentage (90%) of completion of design documentation before start of construction of the first plant.

BENEFITS

The following benefits will result from adherence to the utility requirements.

Sound Basis for Standardization. Since the utility requirements are developed from the broad experience base of proven technologies, enforce the principle of simplification and improve engineering margin, invoke a comprehensive reactor safety philosophy, and cover the entire power generation block of the plants, the utility requirements can be used as a basis for standardization with confidence that plants built to meet the Requirements Document will operate reliably, economically and safely. There should be little concern that major changes in systems or components will be required. Further, since they represent a broad consensus of U.S. and international utility executives behind the thousands of design choices selected, there should be little concern that major changes in systems or components would be requested by future owner/operators.

Additional Confidence for Regulatory Stability. All volumes of the Requirements Document have been submitted to the NRC for review and approval. The various plant design organizations are supporting review of these requirements with the NRC to help ensure an industry consensus. Safety issues within them are being discussed with the NRC to achieve industry/NRC agreement on the major regulatory questions prior to design and construction. This agreement and NRC approval of the Utility Requirements Document assure the industry that a plant designed to comply with the Requirements Document will be licensable and not likely to be subject to later changes through regulatory actions. Further, if at any time during the life cycle of the plant significant safety questions did arise, they could be resolved more consistently within the context of the already approved Requirements Document criteria embodied within the design certifications, thus preserving standardization within a family of plants.

Firm Basis for Life-Cycle Economics of Standardized Plants. Because the Requirements Document is based on extensive operating experience and meets the objectives of simplification and increased engineering margin, owners of the plants of a given family will be able to extend these concepts and take advantage of resulting standardized designs as the foundation for "life-cycle standardization." These include areas such as training, maintenance, operating procedures, quality assurance requirements, spare parts management and outage management, see Section 5. The financial as well as technical advantages of extending standardization into these areas would be significant.

Enhanced Operability and Maintainability. Because the Requirements Document is a self-consistent body of knowledge covering the entire power generation portion of the plant, it will serve as an initial basis to optimize operability and maintainability in a mutual way among owners of a family of plants throughout the lives of the plants.

SECTION 3

STANDARDIZATION THROUGH DESIGN CERTIFICATION AND LICENSING

DEFINITION

10 CFR Part 52 establishes a licensing process for standardized designs to be certified by the NRC which is addressed in Building Blocks #2 and #4 of the NPOC Strategic Plan. In Part 52, the Commission approved the following definition:

> A standard design is a design that is sufficiently detailed and complete to support certification in accordance with Subpart B of 10 CFR Part 52, and which is usable for a multiple number of units or at a multiple number of sites without reopening or repeating the NRC licensing review.

This definition only applies to the NRC certification of standard designs. Site-specific and operational considerations are addressed by the NRC during the COL stage of plant licensing. The industry definition of standardization presented in Section 1 expands upon the NRC definition to encompass the facets of a nuclear power plant that affect its cost competitiveness as a source of electrical power.

UNDERLYING PRINCIPLES

a. In certifying a design, the Commission will resolve all safety issues at the time of certification, whether or not raised in a public hearing. These issues will only be open for challenge in a subsequent proceeding if significant changes have been made to that portion of the design which was certified.

b. The design certification process will standardize the functional and major physical features associated with the safety aspects of a nuclear power plant with a level of detail equivalent to a contemporary FSAR minus as-built, as-procured, and site-specific details.

c. The submittal for certification will include preliminary technical specifications and a design-specific (with generic data) probabilistic risk assessment (PRA) along with the inspection, tests, analyses, and acceptance criteria (ITAAC) that will be the basis of determining constructed facility conformance with the certified design.

d. Stability in the design will be attained because of restrictions on change imposed by Part 52 on both the NRC and the industry once a design certification has been issued.

e. The level of design detail submitted for an NRC certification review is limited to that necessary for safety determinations. The economic success of standardization requires the avoidance of the time-consuming and costly regulatory review of engineering details outside of governing regulations.

f. Design certification completes the first step in a standardized licensing process leading to a combined license (COL), plant construction and authorization to operate. The overall process is as follows:

   i. Design Certification Process: This segment includes NRC review and public hearings focused on the standard plant design as described in the Standard Safety Analysis Report (FSAR minus as-built, as-procured information and site-unique details), the proposed ITAAC, the design QAP, technical specifications, the design-specific (with generic data) probabilistic risk assessment (PRA), and the NEPA assessment relative to SAMDAs. The NRC issues a final design approval, accepts the ITAAC, and proceeds with rulemaking. All safety issues associated with the design will be resolved at this stage except those, if any, related to site-specific features. The design would be the same for all plants licensed with the certified design, thus promoting standardization.

   ii. Combined License (COL) Application and Issuance: A combined license application adds to a certified design those site-specific design and operational considerations required by Part 52. The COL applications which may reference an early site permit will address emergency planning, environmental and financial qualification issues. NRC review and public hearings would focus only on site-specific and operational licensing issues. The referenced certified design would only be open to challenge during the COL stage if the applicant has requested an exemption or amendment to the certified design. Once the license has been issued, construction can commence.

   iii. Construction verification for future plants will be accomplished by a "sign-as-you-go" process, similar to that used in the Vogtle readiness review, encompassing both traditional Part 50 quality assurance verifications and ITAAC compliance. The licensee must demonstrate that all ITAAC have been met, proving facility conformance with the certified design. No deviations are allowed from the ITAAC without an amendment or exemption to the license. ITAAC compliance is the sole basis for the Commission's Preoperational Findings, unless significant new safety issues are identified.

   iv. When construction is completed, the Commission will make their Preoperational Finding that the plant has been built in accordance with the certified design and the combined license by assuring that all required inspections, tests and analyses have been performed and that

the associated acceptance criteria have been met. The plant would then receive authorization to load fuel and proceed to power testing and commercial operation.

BENEFITS

The benefits of standardization through the design certification stage are:

a. All generic safety issues will be resolved before a COL application is filed and are not subject to contention during COL proceedings or thereafter.

b. A design certified by the NRC will be available for review by prospective customers.

c. There will be higher confidence in the quotations received in the bidding process from NSSS vendors, architect/engineers and constructors.

d. Investor confidence will be improved so that reasonable plant financing can be attained for detailed plant design and construction.

The benefits of the standardized licensing process are:

a. All safety issues for the standardized design will have been resolved prior to plant construction, such that these issues will not be subject to NRC review or hearing contentions after construction is completed and the plant is awaiting authorization to operate.

b. Design change restrictions are placed on both the NRC and industry allowing plant construction to proceed on schedule and within budget.

c. Inspections, tests, analyses, and acceptance criteria are approved by NRC prior to beginning construction, leading to investor and owner/operator confidence in a stable and predictable process for operation at the completion of construction.

d. Enhanced public confidence in the program will result from an improved regulatory process and more effective oversight activities.

SECTION 4

COMMERCIAL STANDARDIZATION

DEFINITION

The third phase of standardization in the NPOC Strategic Plan, called commercial or design standardization, will help enable the industry to achieve the efficiency and economy of commercial nuclear power. Commercial standardization expands the level of design standardization achieved under design certification (Section 3), in that it addresses design decisions beyond regulatory requirements and provides design standardization outside the regulatory scope.

Commercial standardization is the engineering, including procurement engineering, which can be performed generically and applied directly to all plants referencing the same design certification. Simply stated, commercial standardization begins with the level of design detail required for design certification and concludes with the level of design detail where site-specific and project-specific characteristics control. Since the level of detail required for design certification will vary based on the safety significance of the system or structure, it follows that the starting point for commercial standardization will also vary by system or structure. Commercial standardization includes all of the engineering needed to complete the nonrecurring engineering tasks for a family of plants. It will include procurement, construction, and installation specification details beyond those required for design certification, including function, fit, and form details for standardized equipment. Prior to beginning construction, some recurring engineering must be completed to account for site-specific and project-specific items. Site-specific differences are minimized by employing a "site-envelope" design approach that bounds most U.S. sites; therefore, site differences should not significantly reduce the degree of standardization.*

Commercial standardization is an important element of "first-of-a-kind engineering" described in Block 6 of the Strategic Plan. The other key element of Block 6 is recurring engineering. The relationship between these two elements and their impact on standardization is discussed in Appendix A.

Engineering required to achieve commercial standardization starts at the end point for design certification, extends through all of first-of-a-kind engineering and through physical design performed after procurement of components.

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* For sites outside the design envelope, site-specific analyses and/or design changes must be accomplished.

UNDERLYING PRINCIPLES

Approach

Standardization of the design will be achieved in a phased manner as the design develops and the commercial standardization engineering is completed. As commercial standardization engineering commences, industry commitment to standardization will be formalized by establishing the industry ground rules and organizational entities that will control and maintain, within legal constraints such as antitrust limitations, design and operational standardization beyond the requirements of Part 52. Commercial standardization will be achieved through the industry's commitment to achieve broad consensus for the design of the first plant of each certified design, and to duplicate that first plant's design details to the extent permitted by site and project differences, as well as lessons learned from construction, startup testing and operating experience.

Envelope for Function, Fit and Form

Major equipment essential to safety or power generation will be identical (see Section 1). Physical characteristics of other equipment and bulk commodities will be investigated to determine an appropriate range of physical parameters, which will accommodate equipment from several suppliers but remain within the design certification requirements. These physical characteristics will be used to establish an envelope for use in designing the details of foundations, service connections, and supporting systems. The established envelope conditions will be included in the purchase specifications for all equipment on a function, fit, and form basis.

These envelopes will allow for sufficient variations in noncritical parameters to ensure that the design will be applicable for more than one supplier while meeting the function, fit and form requirements. Necessary flexibility to accommodate changes in equipment availability is maintained until a project commitment is made and equipment suppliers are put under contract. Continued flexibility will also be provided to accommodate obsolescence, availability, adverse operating experience, excessive pricing, and significantly improved technology. The allowable variation will be restricted sufficiently to ensure that all future plants will look and function as identical units. If the initial project commitment were to involve an option for a family of identical plants, options for identical equipment would also be obtained by the owner/operators.

Level of Design Detail in Commercial Standardization

To achieve commercial standardization, building designs will be essentially completed. Since commercial standardization engineering adds detail to the level of engineering established for certification, the detailed building arrangement will conform in all aspects to the certified design. Placement of major

equipment, the routing of major piping, and other major services will be detailed in conformance with the elements of the certified design. Rebar requirements will be established for both the nuclear and turbine island buildings, consistent with the layouts and stress analyses of the design. This level of detail will apply equally to most sites and will permit accurate estimates of all building commodities. Equipment purchase specifications will be prepared for all major equipment. Additional discussion is provided in Appendix A.

Percent Design Completion

It is estimated that engineering performed to achieve commercial standardization, when combined with design certification engineering will result in a range of 40 to 60% of the design drawings. At this point, the plant design will be taken to its practical limit for generic design standardization, and design details up to this limit will be fixed. This level of design document completion corresponds to approximately 80% design completion. The addition of site-specific engineering will produce a 90% completion of plant design, the ALWR utility requirement prerequisite to placement of first concrete. Additional discussion is provided in Appendix A.

Realization of Commercial Standardization

Commercial standardization engineering can proceed beyond the level of detail required for design certification, in parallel with design certification rulemaking. However, care must be taken not to complete this engineering too early, since engineering changes driven by design changes occurring early in the certification effort could result in major reengineering of the details and a significant increase in the overall cost of the plant. In the past, such iterative designing in parallel with the licensing effort has been a significant factor in making the engineering costs for nuclear power stations excessively high. In view of these considerations, some of the commercial standardization engineering effort should await a final design approval (FDA) of the design. Work related to major component design, balance of plant, and module construction/assembly can be undertaken prior to the issuance of the FDA.

BENEFITS

Economic Benefits

The benefits of commercial standardization are overwhelmingly financial. Experience, as well as recent cost analysis of ALWR designs and construction scenarios, clearly indicate the need to achieve a very high level of design standardization of future nuclear power in order to remain competitive with other baseload generation options. Since nuclear power is capital-intensive, reduction in design, licensing, and construction costs will significantly enhance nuclear power's cost competitiveness.

Regulatory Stability

A comprehensive commercial standardization program also benefits the industry by demonstrating to the NRC and the investment community that the industry is committed to attaining the full economic and safety benefits of standardization beyond that embodied in Part 52. This commitment should answer the question of design detail required for design certification. This commitment, when combined with the licensing process of Part 52, will enhance cost-competitiveness and safety of certified designs.

Investor Confidence

The first-of-a-kind engineering activity, in addition to establishing the baseline for commercial standardization, provides sufficient engineering detail to provide a good cost estimate and construction schedule for a standardized plant, key requirements of the NPOC Strategic Plan. It is this segment of post-certification engineering that will provide the greatest financial risk reduction for the owner/operators. As plant design proceeds and the technical uncertainties are reduced, the incentives for using standardized detailed designs for future customers and sites will become even greater.

Optimum Choices for Site-Specific Issues

In order to achieve the full benefits of standardization, the industry will control and minimize the number of design changes required to accommodate site-unique features or project-specific preferences. There are many considerations such as licensing, cost, and scheduling to be evaluated in determining to what extent site-unique differences affect standard plant design. The industry will implement practices that will optimize the scope of design that can be standardized, based on overall life-cycle economic considerations, and practical recognition of those features which must remain site-unique. The development of such industry practices is discussed in Section 5.

SECTION 5

LIFE-CYCLE STANDARDIZATION

DEFINITION

Life-cycle standardization is intended to establish (1) the institutional framework to oversee standardization over the life of the plant and (2) uniformity in appropriate elements of the organizational structure, administrative controls, and operating and maintenance practices that provide a clear benefit in terms of operational performance, reliability, efficiency, or economy of scale. This includes maintaining the standard design and design intent in all units of a family of plants over their lifetimes. The development of life-cycle standardization is described in Building Block 7 of the Strategic Plan.

Many of the elements of this section will apply to the construction phase of the standardized plants to achieve benefits of standardization. Standard construction techniques are treated to some degree in the ALWR Utility Requirements Document (Section 2) and commercial standardization (Section 4). Organizational elements will be addressed by the industry as the construction process proceeds after commercial standardization is completed. The remainder of this section is focused on the operating phase.

UNDERLYING PRINCIPLES

a. The ability to standardize practices related to operational performance, reliability, and efficiency is dependent upon a strict adherence to maintaining life-cycle standardization among all plants in a "family."

b. Industry-developed source documents exist that relate to standardized nuclear power station operation. This situation is analogous to the way in which the ALWR Utility Requirements Document relates to standardized design. As such, existing INPO performance objectives and criteria, as well as other selected industry guidelines, provide an up-to-date, field-tested framework for development of standardized approaches.

c. The processes or practices important to operational performance, plant configuration management, efficiency, and economy of scale are consistent among all plants in a family.

d. Changes to standardized elements of organizational structure, administrative controls, and operating practices, or to the plant configuration that provide a clear benefit in terms of operational performance, efficiency, or reliability will be implemented uniformly at all plants in the family. Before implementation, permanent changes will be reviewed and approved

through a process to be established by the owners of a family of plants. Temporary changes made for good cause will be reviewed for permanency and applicability to the entire family as soon as practicable.

e. Life-cycle standardization will be implemented in such a way as to strengthen line management's ability to establish priorities and to direct plant activities on matters affecting safety, operational performance, reliability, and efficiency.

f. Life-cycle standardization will accelerate the learning process through the sharing of experiences and better identification of root causes of problems, particularly where nuclear safety is involved. Standardization will require careful scrutiny and control of proposed changes. This control must be exercised in such a manner that does not discourage beneficial changes that arise from the accelerated learning process.

BENEFITS

Benefits are expected to accrue in the areas of operational performance, reliability, and efficiency because of the development and implementation of standardized policies and practices. The following are examples:

a. Management Practices

  i. Strengthened management direction will be achieved via uniform and clearly defined lines of responsibility and accountability for nuclear plant operation, maintenance, training, technical support, and other support activities.

  ii. Decision making will be enhanced through the combined expertise and experience of the entire family.

  iii. Enhanced management capability for monitoring and assessment, including early identification and correction of problems is expected, based on application of consistent policies, procedures, and work control processes.

  iv. Standardized performance measures generated at the family of plants will have a common basis for comparison. Emulation and mutual support to meet the performance measures will be the natural result of standardization.

  v. Longer-term projection and planning for major work and modifications will be facilitated by standardization.

b. Uniform training will improve effectiveness and efficiency resulting in improved personnel knowledge, abilities, and performance, and lower costs for development and implementation. The following are examples:

   i. Training programs, once developed, can be applied uniformly to all plants in the family.

   ii. Plants within a family can share the cost and use of standardized control room simulators, mock-ups and laboratories without compromising the effectiveness of training. Also, other training facilities can be readily shared and/or duplicated.

c. Sharing of operating experience from a broader, more uniform family of plants will accelerate learning and strengthen corrective actions.

d. Plant support by vendors will also be strengthened by lifetime involvement in installation, testing, performance, and maintenance of plant components. Economies of scale in maintaining components can be achieved through shared inventories, standard technical documentation, contracts, and spare parts procurement.

e. Standardized approach to outage management will facilitate safer, shorter and more effective outages due to practices such as the following:

   i. Standard contracts with long-term vendors.

   ii. Standard design modification packages and installation procedures.

   iii. Standard tasks and schedules.

ELEMENTS

Life-cycle standardization is intended to foster uniformity in operation, maintenance, training and quality assurance practices that provide a clear benefit in terms of operational performance, reliability, efficiency and economy of scale. To realize the full benefits of standardization beyond design, a set of essential elements consistent with the underlying principles described above will be defined. These elements will include areas such as:

a. Organizational Structure

   A standard baseline organizational model, that defines the plant line management positions, functions, responsibilities, and accountabilities down to the first-line supervisory position will be developed. This model will also identify organizational interfaces among a family of plants, between line management and individual or common support groups, and with other

industry organizations. The model will also define typical staffing levels and supervisor-to-worker ratios. The models will include provision for individual talents and strengths, local organized labor considerations, etc.

b. Administrative Procedures

Standardized administrative procedures will be developed to control essential activities. Examples include control room activities, conduct of maintenance, communication and the use of nomenclature/terminology , the control of plant work, and temporary modifications to plant equipment.

c. Technical Procedures

Certain technical procedures related to the operation, maintenance, testing, and monitoring of standardized plant systems and equipment will be identical. Procedures in this category include analytical procedures as well as operating and preventive and corrective maintenance procedures.

It is recognized that there may be a need for temporary changes; however, the goal is to minimize temporary changes and return changes to their standardized conditions as soon as possible unless it is beneficial to make these changes permanent for the family of plants.

d. Personnel Qualification

Personnel qualifications will be based on standardized educational, training, and experience requirements. Methods for selection and professional development of supervisors and managers will also be standardized. Standard position descriptions that support the organizational model will be developed.

e. Training

Training programs will be standardized. The method of implementing this training will be in accordance with standardized policies that define the conduct of classroom, simulator, laboratory, and on-the-job training.

f. Performance Standards

Uniform standards of performance will be developed to address activities that affect the design, construction, and operational performance of the plant. Examples of these activities include the conduct of operation and maintenance, procedure use and adherence, quality of work, material condition, and housekeeping.

g. Logistics Support

Logistical support will be established for standardized hardware within a family of plants. This support includes procurement and sharing of expertise, spare parts inventories, and other resources.

h. Operating Experience

Operating experience programs will be standardized. Methods of investigating, developing, disseminating, and implementing lessons learned from operating experience will be applied uniformly at all members of a family of plants.

i. Configuration Management

Configuration management programs for each family of plants will be standardized among the plant owners, with the assistance of the NSSS vendor and the architect/engineer (A/E). Any plant-specific or temporary deviations from the standard plant will be accounted for in the on-site configuration management program for each individual plant.

It is recognized that there may be a need for temporary changes; however, the goal is to minimize temporary changes and return changes to their standardized conditions as soon as possible unless it is beneficial to make these changes permanent for the family of plants.

j. Quality Assurance

Quality assurance/quality control programs and organizations will be identical and will be based on a common quality assurance plan. Quality functions will be integrated into line management to the maximum extent feasible.

k. Regulatory/Licensing Interface

Regulatory interface will be conducted jointly for those issues generic to a family of plants. To the maximum extent possible, the family of plants will act directly with the NRC on issues arising from regulatory activities as a family. However, each plant owner retains full responsibility for safe plant operation, and the NRC retains authority to interact with individual plants as prescribed by their licenses.

MANAGEMENT AND IMPLEMENTATION

To achieve and perpetuate the level of standardization intended, a mechanism will be created by the owner/operators of a family of plants for coordination and control of activities. The individual plant owners, the NSSS vendors, and the A/Es involved must all be participants. Such a mechanism must be sufficient to attain the objectives of the above elements.

APPENDIX A

ELEMENTS OF ENGINEERING DETAIL

The elements of engineering detail for a standard ALWR's conformance to the Utility Requirements Document, design certification, commercial standardization, and recurring engineering phases are provided in this appendix.

Utility Requirements Document Conformance [Section 2]

The ALWR Utility Requirements Document provides specific guidance on fundamental utility principles which strongly influence design requirements. The key policies of the Utility Requirements Document, as embodied in Volume 1, are: simplification, design margin, human factors, safety, design basis versus safety margin, regulatory stabilization, standardization, proven technology, maintainability, constructibility, quality assurance, economics, sabotage protection and good neighbor. Conformance to these principles will provide a firm foundation for the ultimate design of the future ALWRs. Conformance to the detailed engineering requirements provided in Volumes II and III will establish the engineering approach for systems and functions within the scope of design certification. However, because the ALWR Requirements Document contains extensive utility requirements well beyond the regulatory scope, it will also form the basis for much of commercial standardization and life-cycle standardization.

Design Certification Engineering [Section 3]

To achieve NRC certification, plant designs will be completed to the level of detail necessary to demonstrate conformance to applicable regulatory guidance. Additionally, information normally contained in certain procurement, construction, and installation specifications must be available for audit, if necessary, for NRC to make a safety determination. This level of design will provide all critical design specifications and criteria, plant general arrangements, major equipment location, P&IDs, one-line electrical drawings, pipe and cable tray routing and QA requirements, for those systems affecting plant safety. Definition will be provided for those inspections, tests, analyses and acceptance criteria (ITAAC) that are necessary to demonstrate that the nuclear power facility is built according to its licensing basis.

The engineering performed for design certification is being developed to be directly applicable to most U.S. site conditions including seismic and meteorological. This certified design will be available for use without change to all sites whose characteristics are within the design envelope. This level of detail required for design certification will contribute to a high degree of standardization, even before commercial standardization efforts begin. For example,

fixing the general plant arrangements for both the nuclear island and turbine island will provide a major step in ensuring standardization. Specifying the other critical parameters will further ensure a high degree of standardization throughout the entire plant at the design certification stage.

Design certification engineering complements commercial standardization in that it serves as the starting point for further industry standardization. NRC review of design information beyond the point necessary for it to make its final safety determination, for the sole purpose of encouraging standardization, is not appropriate, nor is it necessary given the comprehensive industry commercial standardization program to achieve standardization beyond the regulatory scope.

It is estimated that engineering performed for design certification will result in approximately 60% of plant design being completed. This design effort will be focused on the safety-related systems and structures.

Commercial Standardization Engineering [Section 4]

The following discussion summarizes the level of detail that will be achieved under commercial standardization, independent of equipment supplier or site conditions.

The routing of all major piping (with diameter of two inches or greater) within the buildings will be developed. Preliminary stress analysis will be performed and pipe supports will be located. Anchors and embedments will be located and designed.

Power cables will be sized on the basis of the equipment functional requirements. Cable routing will be established, and cable trays located and sized, including compliance with cable separation criteria in conformance with the certified design. Instrument cables will be routed to major termination cabinets; however, terminations to specific pieces of equipment will await selection of equipment suppliers. Instrument types should be identified and areas reserved on racks for mounting.

In support of the purchase and construction specifications, quality assurance requirements will be established for all equipment, commodities and for their installation. These requirements will be in sufficient detail to define the requirements for the QA plans, surveillance programs, audits, record retention, equipment identification, document submittal, and disposition of deviations. Detailed construction schedules will be developed to show required sequencing, required deliveries for equipment and commodities, and required availability for site cranes and construction equipment. Detailed schedules will also be developed for all phases of engineering, plant turnover and startup of the standard plant.

Recurring Engineering

The recurring engineering portion of plant design is controlled by site-specific and project-specific considerations. The final design details can proceed when a project is committed and equipment suppliers are selected for the first plant or family of plants. In this phase, the generic analyses will be fine-tuned to ensure that the detailed design with the selected equipment meets all of the design requirements. Detailed construction drawings will be completed. This stage will result in a fully documented design. This design could be applicable to one unit or a family of plants depending on utility alliances, timing of orders, and the selection of constructors and equipment suppliers.

After selection of equipment, the piping analyses will be finalized to ensure that the detailed design meets all of the design requirements with the selected equipment. Additional analysis will be performed for the small-diameter piping and instrument tubing and the supports will be engineered.

Structural drawings will be finalized during this phase. Rebar details will be finalized. Construction and equipment installation procedures and QA plans will be prepared incorporating vendor information. Designs will be generated for electrical terminations, cooling water connections and other services.

Pipe fabrication data will be prepared incorporating the routing and other requirements from the design. Connections to yard piping will be finalized as the site-unique engineering was carried out in parallel with the plant standard design.

The recurring engineering phase also includes completion of most site-specific design details. In commercial standardization engineering, trade-off decisions must be made to determine those features that will be standardized and those, if any, which will require redesign to accommodate site-unique conditions.

An example of a standard versus site-unique decision is related to the circulating water system and condenser design. Large site-unique differences exist in cooling water source temperatures. To accommodate an envelope of typical sites, one standardized design solution is to (1) size the condenser shell for the highest reference cooling water temperature, (2) keep the number of circulating water pumps constant, (3) vary the circulating water pump and piping size, and (4) reduce the number of tubes in the condenser to allow for lower cooling water temperatures. This solution allows the use of standard turbine building layouts and standard pump operation modes with little impact on plant physical arrangements. This solution does not provide the lowest equipment cost for specific sites with lower cooling water temperatures, but could produce economic benefits considerably greater than those resulting from site-specific optimization.

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EPRI-ALWR Meeting

June 22, 1989
Room 2F-17

EPRI-ALWR Program
Hydrogen Generation
DBA source term assumptions
Hardened Vents

(Attendees: Ed Kintner, Bud Fey, Pat McDonald, John Taylor, Jack Bryant, Tom Murley, Wayne Houston, Charlie Miller, Ashok Tadani plus approximately 50 people in the room.)

Kintner

- No nuclear utility is now talking seriously about another nuclear plant. There will be no new plants ordered unless there are major changes in acceptable plant designs.

- The industry does support EPRI's work to develop new, simpler plant designs with reduced risks, improved based on 15 or 20 years' experience. U.S. utilities have spent $200 million on such development.

- EPRI does not see any positive response coming back to it from the agency/staff on its work in ALWR development.

- EPRI has saved severe accidents until last in the course of its design development--they focused first on basic good engineering design that should help reduce the likelihood/consequence of severe accidents--all that is in the initial submittals to staff. Those basic design developments provide:

  o increased thermal margin
  o more robust containment
  etc.

Objective -- reduce core damage frequency by a factor of 10.

- EPRI thinks NRC should look on this effort as having done a service for the agency.

- Major impediment is the way NRC approaches regulation and licensing. NRC/US is the only regulatory regime that requires emergency planning and a public display of the agency's safety criticism of the industry.

Fundamental Issues to ALWR Program

As of last month, EPRI dealt with approximately 7,000 comments from utilities, AEs, vendors on the EPRI requirements document. EPRI now wants to:

Meeting Objectives

- o discuss and resolve technical issues in Ch. 5
- o set stage for continuing discussions

SOURCE TERM AND RELATED ISSUES

Murley

No one disagrees that future plants need to be safer and must appear safer. But on some things, EPRI wants to do less than current regs. require. Murley is concerned about EPRI criticism of EP requirements and is wary that EPRI will ask for too much.

EPRI

EPRI will evaluate the technical basis for 10 mi. EPZ but won't ask for reduction yet. EPRI does disagree with NRC requirements on hydrogen.

Ch.5 - ALWR Safety Systems (given to Staff 1/88)

- o ALWR design basis defined:
  licensing design basis (NRC requirements)
  performance design basis (EPRI's additional or different requirements)

- o Severe accident protection

- o Treatment of source terms

Defines initiating events and then emphasizes:

- o core damage preventive measures

- o mitigative measures

  10^{-6} 25 rem dose at site boundary standard

- o increased margins, simple design

Murley - NRC will not have any problem with that kind of thing but....

(Murley keeps bringing up EPZ reduction -- he clearly thinks there should be no EPZ reduction and is distrustful of EPRI/industry the whole way along here.)

Kintner does say that EPRI/industry thinks EP should be eliminated and that regulatory barriers have to come down before any utility buys another plant.

Source Term Issues

- o Timing of fission product release -- not instantaneous; will take an hour.
- o Fraction of fission products released.
- o Chemical form of iodine.
- o Fraction of iodine released to containment.
- o Fission product removal.

Purpose of source Term Discussion

- o Provide supporting information in design.
- o Prepare for changing source term at some time and for getting a better source term soon.
- *o Suggest reconsideration of licensing design basis source term in light of current knowledge and the need to base design on more correct assumptions.

(Murley is combative -- here he pointedly questions -- does EPRI need a new source term to meet dose limits with its new designs? EPRI says-not necessarily.)

N Murley says that NRC will consider new source term for beyond DBA but it will require a rule change for a new source term for use in Part 100 licensing analysis.

On Murley's question re need for a new source term for these designs to meet NRC regulations:

- o EPRI says they could save a lot of money in the design and get a lot of flexibility in the things they can do in design if a more realistic source term were used for the DBA/regulatory analysis.

(Murley says ok - he just wants that clarified.)

*Charlie Miller points out that if more realistic source term is used, it will impact the way the staff views the design (i.e. staff will get tougher - maybe - on the way it reviews and approves other things).

THIS (new source term info.) IS ALL NEW. IT HAS NEVER BEEN RAISED BEFORE

TID 14844/R.G. 1.3, 1.4/SRP

100% nobles, 25% iodine and 1% solids go into containment immediately at time of accident initiation; no mitigation systems can be credited for calculating site boundary doses.

EPRI will only suggest here changes to the reg. guide and SRP assumptions, not changes to the Part 100 stuff. (They do point out that Part 100 only says that TID 14844 serves as a "point of departure" for calculations.)

1. Timing of fission product release from fuel:

   - EPRI proposes that release into containment not begin for one hour after initiation of event and takes some time (TID-14844 say instantaneous).

   - Tests and TMI-2 accident show that EPRI's proposed time is about right. Analysis shows that for EPRI ALWR, clad is not even ruptured for approx. one hour.

   - Release rate of fission products once clad damaged -- tests show that release is not instantaneous but is gradual and takes 1/2 hour.

   What EPRI wants from NRC:

   Approval for the licensing analyses -- fission product release to containment starts one hour after accident (as opposed to instantaneously as called for by R.G. 1.3); would, e.g., allow the elimination of large RCS and containment valves (e.g. MSIV) that must completely close in 10 sec. -- such valves are unreliable and require much maintenance.

2. Fraction of radionuclide release from core is different (for some things - less; for others more) from TID-14844 assumptions.

   - TMI-2 accident and experiments show fuel release fractions are different (e.g. noble gas release < TID-14844; iodine about the same as TID-14844, solid < TID-14844).

   What EPRI wants from NRC:

      Approval to develop and use an ALWR alternative fuel release fraction in the licensing analysis (would deviate from SRP).

Les Rubenstein notes that the staff did not allow this in ABWR review simply because of timing -- staff will be willing to discuss development of this for other ALWRs.

3. Chemical form of iodine (if an iodide, it stays in solution or plates out and is not available for release from containment). (RG 1.3 assumes 91% of iodine released to contain is elemental form).

   - Elemental iodine release is lower than RG 1.3 requirement.

   - TMI-2 accident showed most (98%) of iodine released to containment was in form of iodide, not elemental iodine.

   - STEP tests indicate that most iodine released was iodide form.

   What EPRI wants from NRC:

   Approval to use an iodine chemical form assumption (that iodine is in particulate iodide form and only 2% elemental) for the ALWR licensing source term.

4. Fraction of iodine released to and suspended in containment and available for release outside containment is significantly lower than that assumed in TID-14844/RG 1.3 (25% per TID-14844).

   - TMI-2 accident and many gas pathway tests show approx. 5% of iodine release from fuel got into containment.

   What EPRI wants from NRC:

   Approval to develop and use a lower iodine containment release/suspension number for the licensing source term.

	TID 14844/RG 1.3	EPRI Proposal
Nobles	100%	75%
Iodine	25%	10%
Cs	0%	10%
Te	0%	4%

   In many of these, EPRI is asking that NRC and EPRI work together, look at the data and reach agreement on new source term numbers for use in licensing ALWR.

5. Revaporization -- fission products released and deposited on RCS surfaces could revaporize 24-48 hrs. after accident due to decay heat, etc. and thus get released into RCS and containment. TID-14844 does not consider this.

Need to consider in coming up with new source term. (Murley grabs onto this one (apparently because it could increase source term) and asks what should be done about it.)

6. Fission Product Aerosol removal from containment atmosphere -- removal mechanisms are well understood and data/tests show that aerosol removal from containment is much higher (factor of 10 to 100) than SRP assumptions.

What EPRI wants from NRC:

Nothing right now but approval to develop and use more realistic aerosol removal coefficients in the ALWR licensing source term. (Themis Speis says staff has already revised the SRP to account for this -- EPRI and staff need to talk.)

(EPRI makes a big point -- no U.S. utility is going to buy a plant that does not satisfy the EPRI guidelines -- implies too that GEABWR is out ahead of the EPRI guidelines, is not complying with them (they are not developed yet), and will not be bought by any U.S. utility. NRC should not be devoting resources to the certification of a plant that will only be sold overseas per EPRI.)

Hydrogen Generation

1. Hydrogen-generated -- amount of clad oxidized (NRC position -- 100% active fuel cladding reacts; EPRI claims there is no technical basis for this.)

   o EPRI designates 75% active fuel cladding oxidation as licensing design basis for ALWR.

   o TMI-2 accident showed 50%; improved computer codes, validated against LOFT and TMI accident, predict around 50%.

What EPRI wants from NRC:

Approval of use of 75% (rather than 100% as required by current regs.) in licensing calculations and amendment to regs. to allow it and allow use of a whole spectrum of H generation rates in the PRA-severe accident analysis.

2. Prevention of Hydrogen Detonation

- o Current NRC regulation requirement -- H concentration must be <10% to avoid detonation.

- o Tests show that to be overly conservative for ALWR (e.g. 13% dry H mixture is not detonable in containment based on new test work). Staff does note that some of the tests do not fully support these numbers.

What EPRI wants from NRC:

- o Complete review and approval of use of 13% H concentration limit (rather than 10%) in licensing ALWR.

Containment Venting/Performance

Because of the ALWR design features which prevent and mitigate accidents, EPRI thinks:

1. a conditional containment failure probability (CCFP) requirement (e.g. 10^{-1}) is unnecessary; and

2. containment vent requirement is unnecessary and unworkable.

(ALWR will meet NRC safety goal -- 10^{-6} frequency of large release events, etc. with margin per EPRI without a conditional containment failure probability requirement or venting provisions.)

(Murley jumps in again -- if you don't want CCFP, what containment design criteria do you want?

EPRI says it makes more sense to prevent accidents or mitigate consequences than to try to harden containment.)

Re containment venting:

Utilities don't think it is a desirable feature - just not publicly acceptable:

a. should meet containment strength problem straight on; make containment stronger, don't relieve pressure via release to environment; and

b. venting not publicly acceptable -- at time of actual accident, public authorities won't allow venting.

What EPRI wants from NRC:

- o Resolve CCFP and venting issues on a generic basis via rule for the entire industry; don't require CCFP or venting.

Murley asks -- how about a requirement that containment survive for 40 hours after accident?

EPRI thinks that makes more sense -- would like to explore.

Future Issues:

EPRI has initiated work to reduce EPZ; and

probably will ask for EPZ reduction for passive plants (Stello originally suggested this in 5/88).

Overall:

1. EPRI would like generic NRC approval of these generic principles in Ch. 5 of the EPRI design document which would then be applied in individual certifications for the ALWR.

2. EPRI urges some staff action on Ch. 5 of EPRI design requirements document. (Accident analysis standards.) Staff has had it 18 months and nothing has happened.

3. John Taylor

   - o Nationwide, utilities have backed this program and directed EPRI to get a resolution of safety issues before any utility will buy another nuclear plant.

   - o Development of the requirement document is EPRI's way of doing this.

   - o NRC has committed (Chairman) to review that and approve it if acceptable.

   - o Utilities will not consider another nuclear plant until the safety design requirements are approved by NRC.

   - o EPRI is having a problem with GE on the GEABWR - EPRI has speeded some of its work, delayed other work, to accommodate GEABWR. But now, NRC's review and approval of the EPRI design requirements document has been set aside so that staff can review and move forward on GEABWR certification.

     Taylor says that if the EPRI requirement document review is not restarted, it may have to tell utilities that their objectives can't be met and the program should be abandoned.

     EPRI asks for a Draft SER to get the process back on track.

(Murley says staff will do it -- can issue a DSER on Ch. 5 in a month -- it will have open items but that will get process going again.

On the other hand, NRC has an obligation to accept, review and act on whatever application it gets.)

Taylor -- U.S. utility's interests should take priority over GEABWR being done for Japanese or CANDU review for Canadian vendors.

Murley -- We are obliged to work on what we get under our regulations.

6-22-89

Attendee	Organization
W. Long	NRR
J. A. MURPHY	RES
T. P. Speis	RES
L. SOFFER	RES
F. ELTAWILA	RES
CG TINKLER	NRR
J. G. PARTLOW	NRR
L S RUBENSTEIN	NRR
Gary M Holahan	NRR/DRSP
Susan T. Gray	EPRI
R. B. McDonald	Ala/GA Power Co
C W Fay	WISCONSIN ELEC PWR Co
CHARLES W. JACKSON	CON EDISON
ED KINTNER	GPU N.
JOHN TAYLOR	EPRI
Karl Stahlkopf	EPRI
Jack DeVine	EPRI
Dave Leaver	Tenera
BILL SUGNET	EPRI
HELEN NICOLARAS PASTIS	NRR/NRC
Joe Quirk	GE
R. B. BRADBURY	STONE & WEBSTER
Regis Matzie	COMBUSTION ENGINEERING
George Davis	COMBUSTION ENGINEERING
Roy Woods	RES
Margo Barron	Ebasco

Eve Fotopoulos	SERCH Licensing, Bechtel
Chong Lewe	NUS Corporation
Rabi Singh	NRR
STEPHEN ADDITON	TENERA
MARTIN PLYS	FAUSKE AND ASSOCIATES, INC.
Walt Pasedag	DOE
Albert Machiels	EPRI/NUMARC
Ray Ng	Numarc
JACK BERGA	EPRI
MICHAEL H. SHANNON	WESTINGHOUSE ELECTRIC CORP.
T.J. Kenyon	NRC/NRR
R.J. SERBU	NRC/NRR/DREP
R.W. Wright	RES/AEB
Pat Worthington	RES/AEB
Ralph Meyer	RES/AEB
Brad Hardin	RES/DRA/ARGIB
Thomas King	RES/DRA/ARGIB
JERRY N. Wilson	NRC/RES/ARGIB
DAVID SHUM	NRC/NRR/SPLB
Thomas J. WALKER	RES/DSR/AEB
J.S. Wermiel	NRR/DEST/SPLB
Ralph Architzel	NRR/DEST/SPLB
Frank Miraglia	NRR/ADT
FRANK C. SKOPEC	NRR/DEST/RPB
J. GRAY	NRC/OCM/JC
K. Connaughton	NRC/OCM/JC

THOMAS H. COX	NRR/PMAS
Wm. A. Taylor	OEDO
Charles Miller	NRR/PDSNP
TOM MURLEY	NRR
ASHOK THADANI	NRR
R Wayne Houston	RES

EPRI

DISCUSSION OF SOURCE TERM AND RELATED ISSUES

Presented by the
Advanced Light Water Reactor Program

to

Director, Office of Nuclear Reactor Regulation

June 22, 1989

Meeting Objectives

- Discuss and resolve technical issues of immediate importance to the ALWR
- Set the foundation for continuing ALWR work on Source Term and related topics
- Enhance communication / coordination on overall program

Agenda for ALWR Program Meeting with NRC
June 22, 1989

Introductory Remarks 1:00 PM

Program Issues 1:15 PM

- ALWR Program role
- Regulatory significance of requirements
- Impact of ALWR Program on design
- Action requested of NRC

Source Term and Related Issues 1:45 PM

This portion of the agenda is intended to provide a technical basis for proposed ALWR requirements and potential future requirements, utilizing a logical, technically based approach to source term regulation. For each of the following subject areas, a technical position and technical basis will be presented along with the implications to the ALWR design and the NRC action requested:

- Timing of Fission Product Release from Fuel
- Magnitude of Fission Product Release from Fuel
- Fission Product Chemical Form
- Iodine Release Fraction to Containment Atmosphere
- Aerosol Removal from Containment Atmosphere
- Amount of Fuel Clad Oxidized (Hydrogen Generation)
- Hydrogen Concentration Necessary for Detonation
- Containment Vent/Overpressure Protection

Potential Future Issues 4:15 PM

- Passive plant work
- Technical basis for change in EPZ requirements
- Continued source term improvements

Closing Discussion 4:45 PM

Adjourn

The ALWR Program Concept

Basic Premises

- A Consensus Process, involving utilities, vendors and regulators, is essential
- Standardization is a key objective - we all benefit from it
- Utilities must lead the way
  - they represent the U.S. licensees of future reactors
  - they have the experience and technical know-how
  - they hold ultimate responsibility for safe and efficient operation of nuclear units

The ALWR Program Concept
(continued)

Requirements Document Role

- It defines technical plane for standardization
- It documents the consensus achieved among:
  - Utilities
  - Vendors
  - NRC (on licensing matters)
- It serves as a vehicle for resolution of design and regulatory issues
- It sets the technical foundation for the more detailed plant-specific engineering, design and licensing work to follow

The ALWR is a <u>Better</u> Plant

- A coherent, whole plant design
- A basis for standardization among vendors and users

It incorporates design improvements established and agreed upon by the industry - utilities and vendors - at their initiative

The ALWR Is A Better Plant

ALWR Requirements exceed NRC regs, in many cases. Examples:

- Alternate AC Power Supply
- 600°F limit on PWR hot leg temperature
- 15% core thermal margin
- Improved reactor vessel fabrication
- In-containment refueling water storage tank
- Higher Pressure RHR
- Designed-in Bleed / Feed cooling
- Cavity / drywell flooding

These requirements are the result of 3+ years of consensus building among utilities and vendors

ALWR PROGRAM SAFETY APPROACH

Chapter 5 Policy Statements

- ALWR Design Bases:
  - licensing design basis
  - performance design basis
  - risk evaluation basis
- Severe Accident Protection
- ALWR Treatment of Source Term Issues

DEFENSE-IN-DEPTH

ACCIDENT RESISTANCE	• SIMPLIFICATION • DESIGN MARGIN • BEST MATERIALS • LONGER RESPONSE TIME		
	LICENSING DESIGN BASIS	**PERFORMANCE DESIGN BASIS**	**RISK EVALUATION BASIS**
CORE DAMAGE PREVENTION	• SAFETY SYSTEMS TO PREVENT CORE DAMAGE AS REQUIRED BY REGULATIONS • NRC APPROVED METHODS AND CRITERIA	• ADDITIONAL MARGIN AGAINST CORE DAMAGE FOR INVESTMENT PROTECTION • DESIGNER/UTILITY SPECIFIED METHODS AND CRITERIA	• UTILITY SPECIFIED PRA METHODS AND CRITERIA
MITIGATION	• CONTAINMENT SYSTEMS TO MITIGATE ACCIDENTS AS REQUIRED BY REGULATIONS		• CONSIDER SEVERE ACCIDENT NEEDS IN CONTAINMENT ARRANGEMENT • MEET NRC SEVERE ACCIDENT POLICY STATEMENT

Figure 3-1. ALWR Safety with Relationship of Defense-In-Depth and Design Bases

Severe Accident Protection

Three Key Elements:

1. Design to meet applicable Regulatory Requirements
   - covers licensing design basis
   - provides significant margin
2. Emphasize core damage prevention
   - target core damage frequency, $\leq$ 10 E -5/reactor year
   - provide additional preventive features to protect utility investment
3. Analyze dominant SA sequences to show sufficient margin:
   - conservative design (e.g., containment design pressure)
   - investment protection features (e.g., increased RCS inventory)
   - plant features that aid in SA mitigation (e.g., cavity area/arrangement/flooding; RCS vent valves)
   - realistic, mechanistic evaluations including non-safety related equipment

ALWR Core Damage Frequency Criterion

- In addition to meeting all other licensing design basis requirements, The ALWR must achieve a mean annual CDF $\leq$ 1 x 10 E -5

  This goal is:

  - Believed to be a factor of 5 to 10 better than most current plants
  - Sufficiently low for protection of utility investment

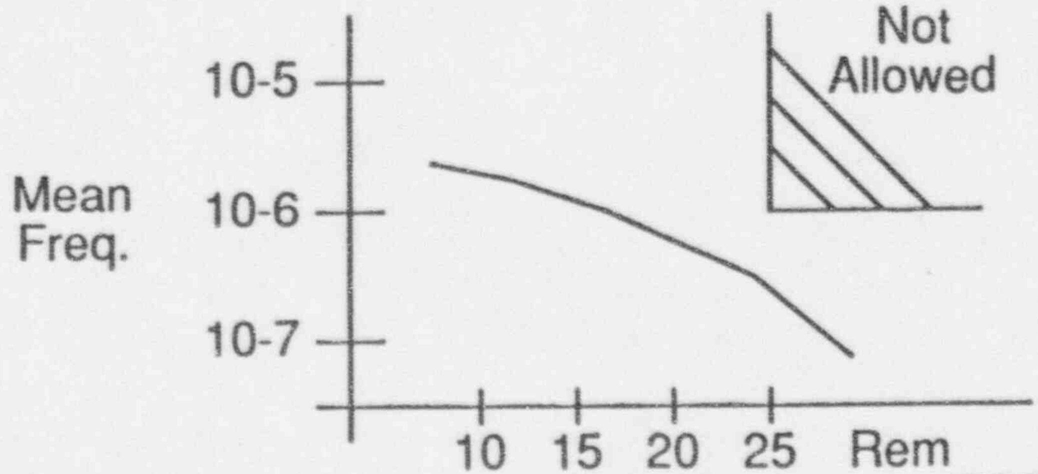
- Function-level PRA models are being developed for ALWRs
- Work to date indicates that the ALWR requirements specified to date will result in a plant that is very likely to meet or surpass the 1 x 10 E -5 target value

ALWR Public Safety Criterion

- Additional check beyond meeting other licensing design basis requirements
- Site boundary (0.5 mi.) whole body dose shall be less than 25 Rem for accident sequences whose cumulative frequency (mean value) exceeds 1 x 10 E -6 per reactor year
- This criterion is viewed as an extremely demanding target worth reaching for, and is considered to be more conservative than current safety goal policy

Demonstration Method

- Perform PRA, obtain Release Categories and mean frequency for each
- Perform CRAC-type calculation for each Release Category, obtain spectrum of whole-body doses at 0.5 mi dependent on weather (and its conditional probability)
- Use results to construct CCDF "risk curve" for dose at 0.5 miles
- No points on curve allowed to exceed both mean frequency of 10-6/reactor year and 25 Rem



Outline of Technical Discussion

- Timing of fission product release from fuel
- Fraction of fission products released from core
- Chemical form of iodine
- Fraction of iodine which is released to and suspended in the containment atmosphere
- Fission product aerosol removal from containment atmosphere
- Amount of fuel clad oxidized (hydrogen generation)
- Hydrogen concentration criteria to prevent detonation
- Containment vent/overpressure protection

Purpose of Source Term Discussion

- Provide supporting information for key ALWR Chapter 5 requirements
- Provide technical basis for potential future requirements
- Propose reconsideration of licensing design basis source term in light of current knowledge and the need to base design requirements on more correct assumptions

TID 14844 and Related Regulatory Guidance

TID 14844

Release to containment atmosphere

- 100% of nobles
- 50% of iodine, of which 1/2 is assumed to instantaneously plate out

Release to containment sump

- 1% of everything else (NUREG 0737 interpretation)

Timing of release: Instantaneous at time of accident initiation

R.G. 1.3, 1.4

Chemical form of iodine: 91% elemental
5% particulate
4% organic

R.G. also specifies noble and iodine release fraction to containment and timing of release

SRP

Aerosol removal from containment atmosphere

$\lambda = 4\ hr^{-1}$ 0 - 1 hours

$\lambda = 0.4\ hr^{-1}$ > 1 hour

Outline of Technical Discussion

- **<u>Timing of fission product release from fuel</u>**
- Fraction of fission products released from core
- Chemical form of iodine
- Fraction of iodine which is released to and suspended in the containment atmosphere
- Fission product aerosol removal from containment atmosphere
- Amount of fuel clad oxidized (hydrogen generation)
- Hydrogen concentration criteria to prevent detonation
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Timing of Fission Product Release from the Fuel

- Release of a large source term into containment for any accident considered credible will not begin for one hour or more after accident initiation, due to time necessary for coolant boiloff and fuel heatup
- Fission product release from that point on will not be instantaneous, but rather will occur over a period of time

Technical Basis

- Analysis of a spectrum of accident sequences indicates that the fuel does not reach temperatures at which fission product release begins until about one hour or more after accident initiation for any ALWR accident considered credible. (Accident sequences less than about 10^{-8} per year are not considered credible.)
- SFD tests demonstrated the time dependence of fission product release from the fuel for all radionuclide groups
- TMI-2 also demonstrated the time dependence, since the core was at high temperatures until well after the 200+ minute ECCS quench, and released about 50% of the high volatiles

Analysis of Time of Start of Release from Fuel

- Based on best-estimate analyses of a complete spectrum of accident sequences in existing LWRs, core uncovery occurs at a time greater than 60 minutes after scram for all but nine sequences.
- For those nine sequences, accounting for the effect of ALWR design requirements shows that:
  - several are not applicable to the ALWR
  - for the balance, the timing of coolant boiloff and core heatup is such that release from the fuel to the RCS will begin no sooner than about 60 minutes after scram.

Time to Start to Uncover the Core and Start of Peak Clad Rupture for Selected Severe Accident Sequences

PLANT		SEQUENCE	TIME TO UNCOVER CORE (min)	PEAK ROD CLAD RUPTURE[1] (min)
BWR Sequences				
Peach Bottom	AE	Large Recirc. LOCA, No ECCS	Precluded by ALWR Design	
Grand Gulf	S_2E	Small LOCA, No ECCS	Precluded by ALWR Design	
Limerick	TPE	Transient LOCA, Stuck Open Relief or Safety	37.0	65
Grand Gulf	T_1 QUV	Transient w/Injection Failure	30.0	57
Grand Gulf	TQUV	Transient w/failures of Aux Feed, HPIC, RCIC	47.0	> 70
PWR Sequences				
Surry	S_2D	Small LOCA, No ECCS	28.0	57
Sequoyah	S_2D	Small LOCA, No ECCS	48.0	> 60
Bellefonte	TLMB'	LOSP, w/Failures of Conversion System, Aux Feed, Secondary Side Depressurization	30.0	See note (2)
Oconee	TLMB'	LOSP, w/Failures of Conversion System, Aux Feed, Secondary Side Depressurization	41.0	See note (2)

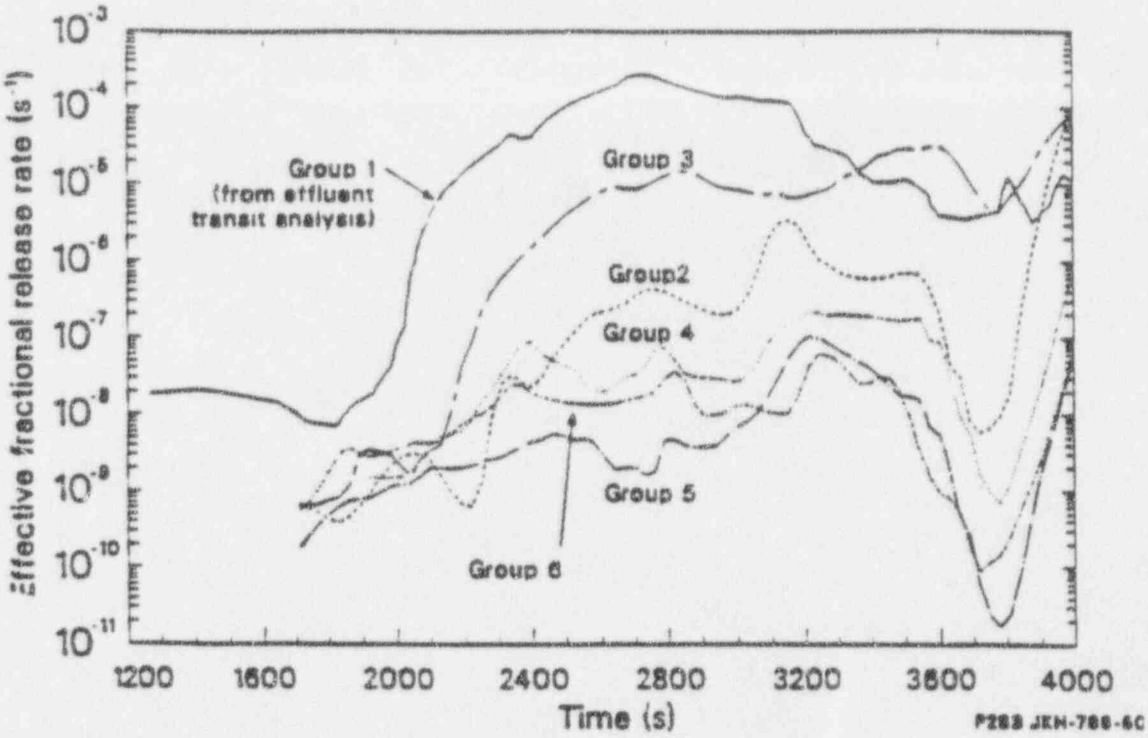
(1) Assumed to be 1700°F for BWR and 1300°F for PWR

(2) Time to core uncovery for loss of all feedwater is ≥ 2 hours for ALWR. Therefore, these sequences do not apply.

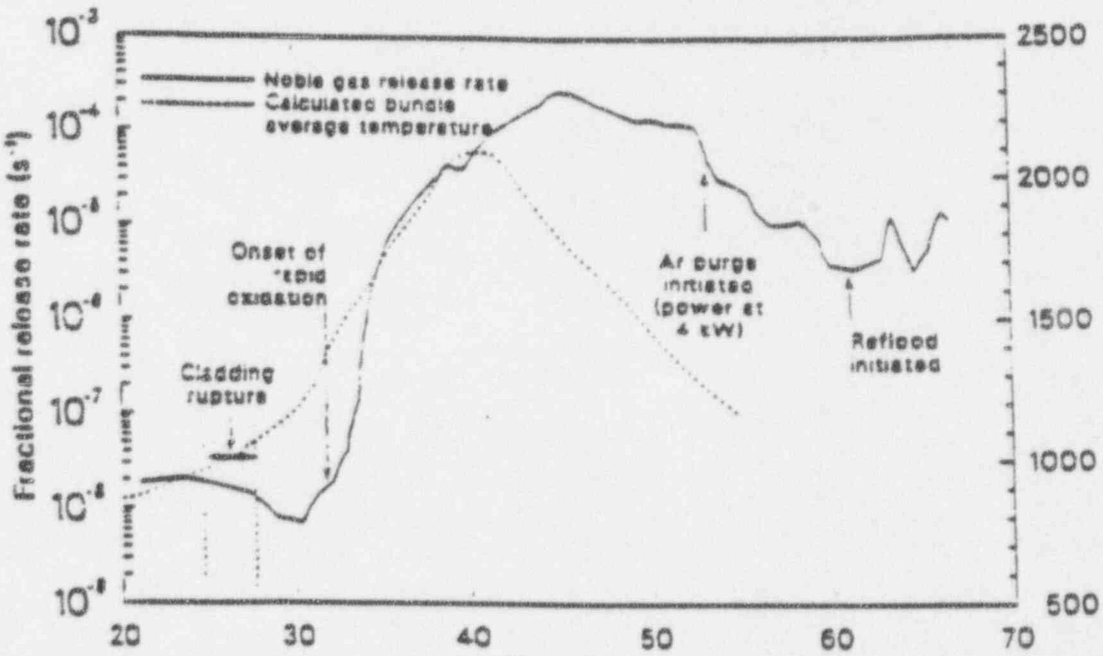
EPRI ALWR Program

ELEMENTAL GROUPING AND RADIONUCLIDES USED FOR THE SFD 1-1

Number	Family	Elements	Isotopes Used for Evaluation
1	Noble Gases	Kr, Xe	^{85m}Kr, ^{87}Kr, ^{88}Kr, ^{135}Xe, ^{137}Xe, ^{138}Xe
2	Halogens	Br, I	^{84}Br, ^{131}I, ^{132}I, ^{133}I, ^{134}I, ^{135}I
3	Alkali Metals	Rb, Cs	^{88}Rb, ^{89}Rb, ^{90}Rb, ^{138}Cs, ^{139}Cs
4	Chalcogens	Se, Sb, Te	^{131}Te, ^{132}Te, ^{133}Te, ^{133m}Te, ^{134}Te
5	Alkaline Earths	Sr, Ba	^{91}Sr, ^{92}Sr, ^{139}Ba
6	Rare Earths Noble Metals and Other Low Volatility Elements	Y, Zr, Nb, Mo, Tc Ru, Rh, Pd, La, Ce, Pr, Nd, Pm, Sm, and Eu	^{91m}Y, ^{93}Y, ^{101}Mo, ^{101}Tc.



SFD 1-1 Best Estimate Effective Fractional Release Rates



Fraction Release Rate of Noble Gas
Measured During the SFD 1-1 Test Compared To The
Temperature History and Key Events.

Resulting Actions

1. ALWR Program stated in Requirements Document, Chapter 5 that LDB fission product release from the fuel should be assumed to not occur until about 1 hour after accident initiation.

   NRC Action Requested - Approve in Chapter 5 DSER

2. ALWR designers to take advantage of the fact that containment isolation valve and leakage control system designs do not have to act instantaneously and therefore can be optimized for other design functions

   NRC Action Requested - None Necessary

3. ALWR Program will work with NRC to develop an ALWR alternative to R.G. 1.3, 1.4 for fission product release timing

   NRC Action Requested - Agreement to Work with ALWR Program to Develop an ALWR Alternative

Outline of Technical Discussion

- Timing of fission product release from fuel
- **<u>Fraction of fission products released from core</u>**
- Chemical form of iodine
- Fraction of iodine which is released to and suspended in the containment atmosphere
- Fission product aerosol removal from containment atmosphere
- Amount of fuel clad oxidized (hydrogen generation)
- Hydrogen concentration criteria to prevent detonation
- Containment vent/overpressure protection

Fraction of Fission Products Released from Core

The magnitude of fission product release from the core for any accident considered credible is inconsistent with the TID 14844 assumption

Technical Basis

- In-pile experiments (SFD, STEP) and the TMI-2 accident evaluation measured noble gas, cesium, and iodine release from the fuel over a range up to 50% (with one point at 75%)
- SFD tests and the TMI-2 accident evaluation measured >1% for the release of several medium volatiles
- SFD tests and the TMI-2 accident evaluation measured low volatile release from the fuel, under 0.1%

SFD Test Results on Fuel Release Fractions

Element	SFD-ST	SFD 1-1	SFD 1-3	SFD 1-4
Noble Gas	~ 0.50	0.026 to 0.093	0.08 to 0.19	0.23 to 0.44
Iodine	0.51	0.12	0.18	0.26
Cesium	0.32	0.09	0.18	0.44 to 0.56
Tellurium	0.40	0.01	0.01 to 0.09	0.03
Barium	0.01	0.006	0.004	0.008
Cerium	< 0.0001	0.0001	-----	-----
Ruthenium	0.0002	0.0002	-----	-----
Strontium	< 0.0001	-----	-----	-----
Actinides	-----	-----	$<10^{-6}$	$<10^{-6}$
% Zr Oxidized	79%	27%	22%	32%

EPRI ALWR Program

TMI-2 Results on Core Release Fractions

Isotope	Fraction of Core Inventory Released
^{85}Kr	0.54
^{129}I	0.55
^{137}Cs	0.47
^{132}Te	0.06
^{90}Sr	0.0002 [(1)]
^{106}Ru	0.005
^{125}Sb	0.036
^{144}Ce	0.0001
^{154}Eu	Insignificant
^{155}Eu	Insignificant

(1) Leaching from damaged core after reflood increased Sr release to 0.02 two months after the accident

EPRI ALWR Program

STEP Test Results on Fuel Release Fraction

Test	Noble Release Fraction
STEP - 1	0.75
STEP - 2	0.25

The STEP - 1 release fraction of 0.75 was high because of the high clad oxidation (92%) and the time at high temperatures compared to STEP -2

Resulting Action

1. ALWR Program will work with NRC to develop an ALWR alternative to the "licensing basis source term TID 14844" as described in NRC letter to E. Kintner, November, 1988

   Proposed ALWR fuel release fractions for consideration:

Elements	Proposed ALWR Release from Fuel
Nobles	75%
I	75%
Cs, Rb	75%
Te, Sb	40%
Sr, Ba	1%
Ru	1%
La	0.1%

NRC Action Requested - Agree to Work with ALWR Program to Develop ALWR Alternative

Outline of Technical Discussion

- Timing of fission product release from fuel
- Fraction of fission products released from core
- **Chemical form of iodine**
- Fraction of iodine which is released to and suspended in the containment atmosphere
- Fission product aerosol removal from containment atmosphere
- Amount of fuel clad oxidized (hydrogen generation)
- Hydrogen concentration criteria to prevent detonation
- Containment vent/overpressure protection

Chemical Form of Iodine

For any accident considered credible, the R. G. 1.3, 1.4 assumption that 91% of the iodine released to containment is in elemental form is high, by an order of magnitude or more. Similarly, the assumption that 4% of the iodine is organic is overstated.

Technical Basis

- The TMI-2 accident evaluation measured 97% of the iodine in solution as iodide
- The STEP tests, SFD tests, and LOFT FP-2 test all indicated that iodine behaved as an aerosol
- The TMI-2 accident evaluation measured <.03% of the iodine core inventory as organic.

TMI-2 CHEMICAL SPECIES ANALYSIS RESULTS

Iodine Species in Solution as of March 1981	^{129}I concentration (g/ml)
Iodide (CsI or HI)	0.030 (97%)
Iodate (IO_3)	0.0006 (1.5%)
Elemental (I_2)	0.0006 (1.5%)
Total Iodine	0.031 (100%)

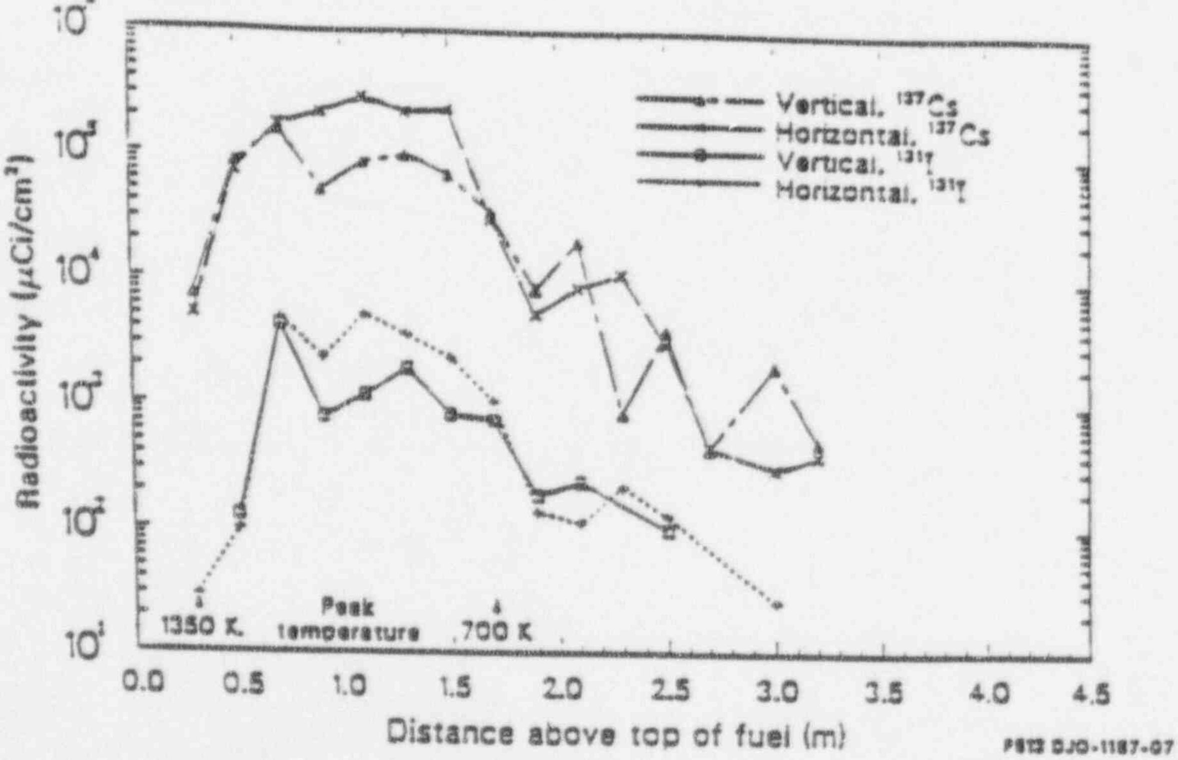
An analysis of how these species could have been produced concludes that fission product iodine entered the water primarily as iodide and not as elemental iodine.

STEP Test Results

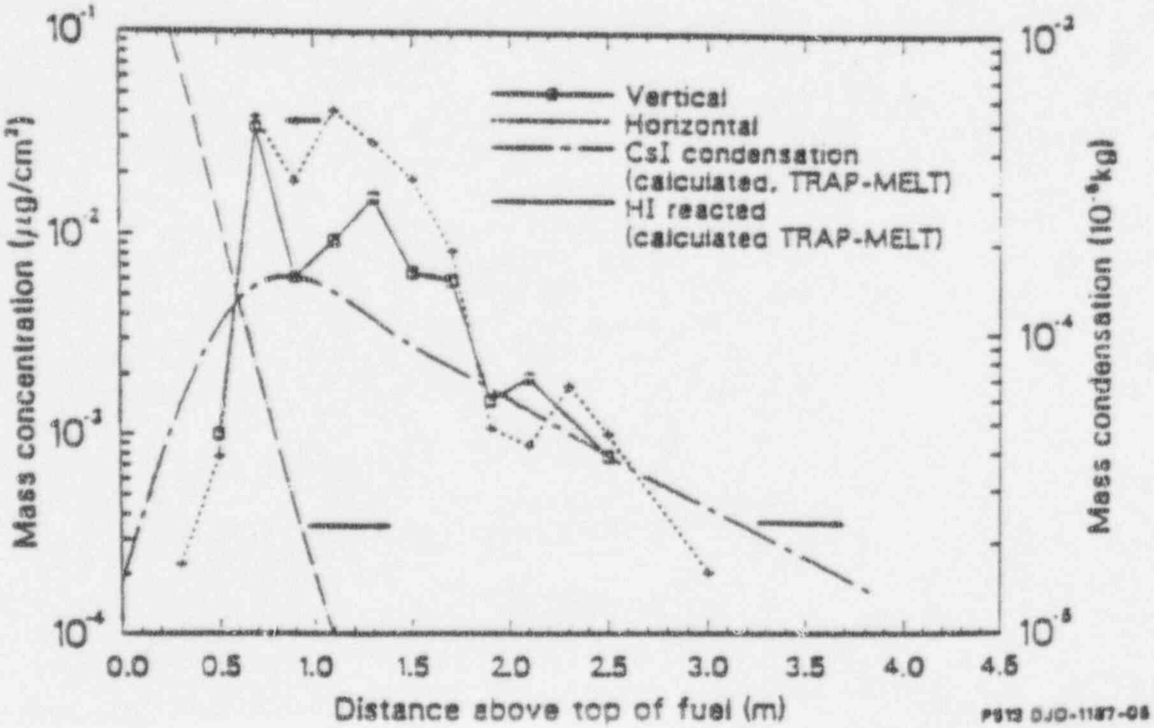
- Fission product iodine, collocated with cesium, was found with some frequency on stainless steel sample coupons and in canisters
- Also, iodine was found collocated with cesium and silver
- The amount of free iodine (i.e., not collocated with cesium) was small
- The STEP report authors presumed from the STEP test results that CsI was the principal iodine-containing species, although this could not be established with certainty due to measurement difficulties from the small size and inhomogeneity of the deposits

SFD Test Results

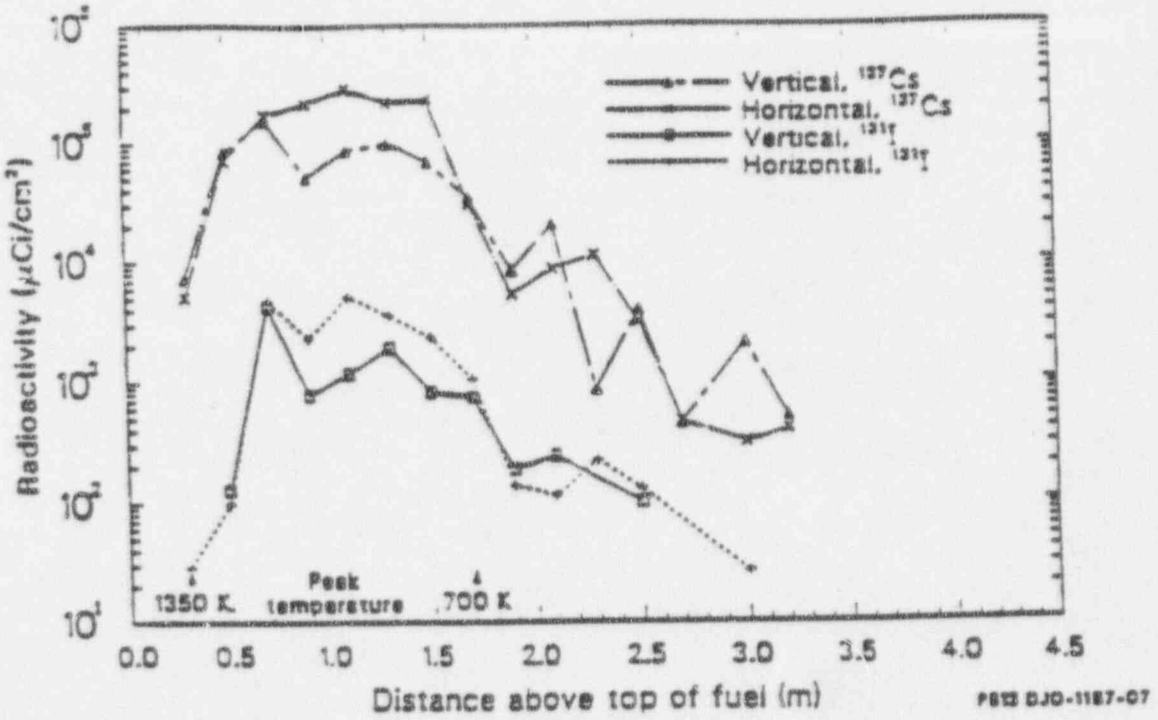
- Deposition patterns of Cs and I fission products were very similar, suggesting similar deposition mechanisms or chemical association
- Both species displayed enhanced concentrations on horizontal surfaces, suggesting a strong association with aerosol particles and settling or impaction as a dominant deposition mechanism
- Analysis of the liquid portions of grab samples and collection tank liquid indicated a predominance of iodine in iodide form
- Calculations predict the dominant chemical form of cesium to be CsOH, and of iodine to be HI in hot bundle regions, converting quickly to CsI in cooler regions
- The observed behavior of iodine in the SFD tests is consistent with that predicted for CsI, but is inconsistent with the assumption that the iodine was elemental or hydrogen iodide



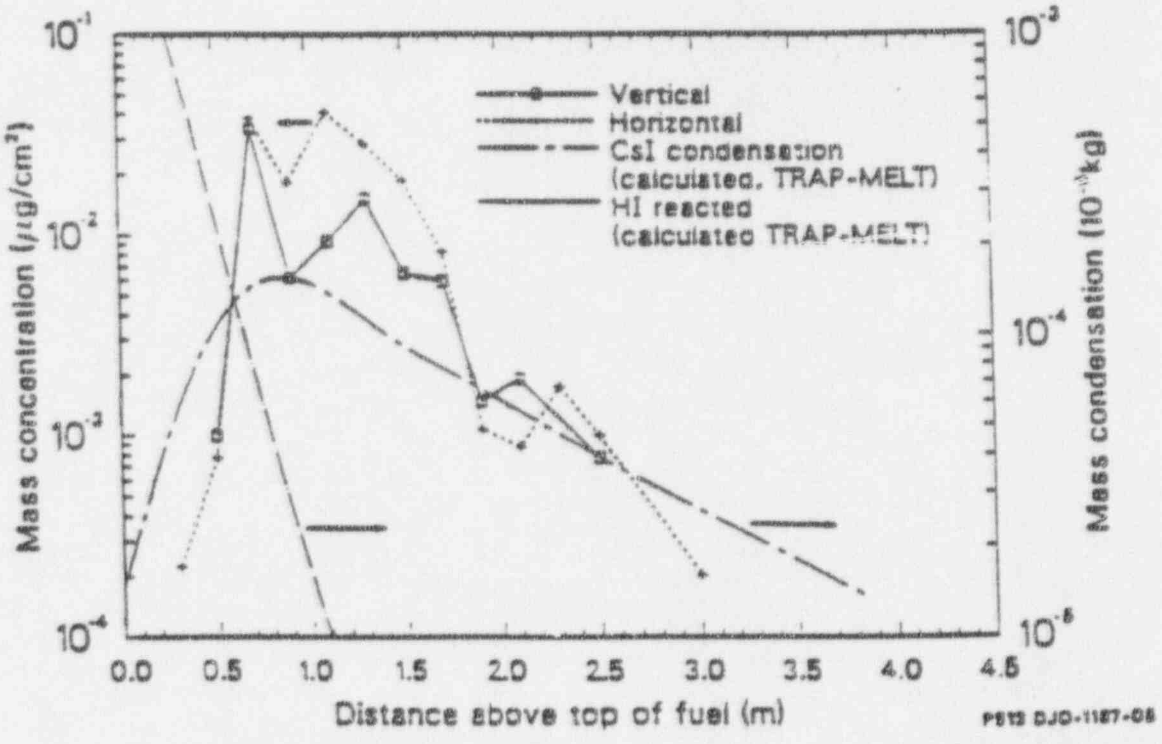
Deposition of Iodine and Cesium Measured on Horizontal and Vertical Surfaces Above Fuel Bundle After Test SFD 1-3.



Comparison of Test SFD 1-3 Measured and Calculated Iodine Behavior



Deposition of Iodine and Cesium Measured on Horizontal and Vertical Surfaces Above Fuel Bundle After Test SFD 1-3.



Comparison of Test SFD 1-3 Measured and Calculated Iodine Behavior

LOFT FP-2 Test Results

- Prior to reflood, most of the fission product iodine released was deposited in the upper plenum. This suggests that the iodine behaved as an aerosol during the dry portion of the accident

Boron Chemistry Effect

- Boric acid can react with CsI to produce HI
- For TMI-2, it is not possible to distinguish between CsI and HI. The behavior of iodine in SFD tests is consistent with that expected of CsI, but inconsistent with HI. However, PBF did not use boric acid.
- HI is more volatile than CsI, but is much more chemically reactive with structural material, including aerosols, and would be expected to be removed with aerosols or dissolved in water.
- Although CsI is considered the more likely iodine form, any HI which exists will tend to be either removed along with aerosols or scrubbed

Data on Organic Iodide

- The TMI-2 accident evaluation indicates that the peak airborne iodine was 0.03% of the core inventory, and that ≥80% of that small amount was organic
- Since any organic that was formed would be gaseous and reside in the containment atmosphere, it follows that organic iodine was < .03% of the core inventory at TMI-2
- Elemental iodine (I_2) and low pH are known to be required to produce organic iodine
- Since little elemental iodine is expected and ALWR requirements specify pH control, the fraction of iodine which is organic will therefore be very small

Resulting Action

1. ALWR Program stated in Chapter 5 that the vast majority of iodine is particulate

   NRC Action Requested - Approve in Chapter 5 DSER

2. ALWR Program will work with NRC to develop an ALWR alternative to the current R.G. 1.3, 1.4 chemical form for iodine

   Proposed ALWR chemical form of iodine released to containment for consideration:

Iodine Form	Existing R.G.	Proposed ALWR
Elemental	91%	2%
Particulate	5%	97%
Organic	4%	1%

   NRC Action Requested - Agree to Work with ALWR Program to Develop ALWR Alternative

Outline of Technical Discussion

- Timing of fission product release from fuel
- Fraction of fission products released from core
- Chemical form of iodine
- **Fraction of iodine which is released to and suspended in the containment atmosphere**
- Fission product aerosol removal from containment atmosphere
- Amount of fuel clad oxidized (hydrogen generation)
- Hydrogen concentration criteria to prevent detonation
- Containment vent/overpressure protection

Iodine Release to the Containment Atmosphere

The fraction of iodine which is released from the RCS and which becomes suspended in containment and available for leakage to the environment for any accident sequence considered credible is significantly lower than assumed in TID 14844

Technical Basis

- The TMI-2 accident evaluation measured peak airborne iodine in containment as .03% of core inventory (liquid pathway)
- The LOFT FP-2 test resulted in about 5% of the iodine released from the fuel escaping the upper plenum (gaseous pathway)
- In all SFD tests, <1% (gaseous pathway) of I and Cs were measured in the collection tank

Technical Basis
(continued)

- The LACE tests measured significant aerosol retention in pipes, on the order of 70% or higher for prototypic core materials. Further, LACE suggests that much of the aerosol released from the RCS is immediately deposited on containment surfaces.
- The Marviken Aerosol Transport Tests showed that for prototypic core materials which would be aerosolized in a severe accident, ~74% of the aerosol was retained in the RCS

TMI-2 FRACTION OF IODINE CORE INVENTORY AIRBORNE IN CONTAINMENT

Time of Sample	^{131}I Airborne Fraction
3 days after accident	.00005
July '79	.0003
May 1980	.00002

LOFT FP-2 IODINE RELEASE DATA
PRIOR TO REFLOOD
(FRACTION OF IODINE RELEASED FROM FUEL)

Isotope	RCS	Collection Tank	Upper Plenum	Low Pressure Injection Line
^{131}I	0.33	0.03	0.6	0.02

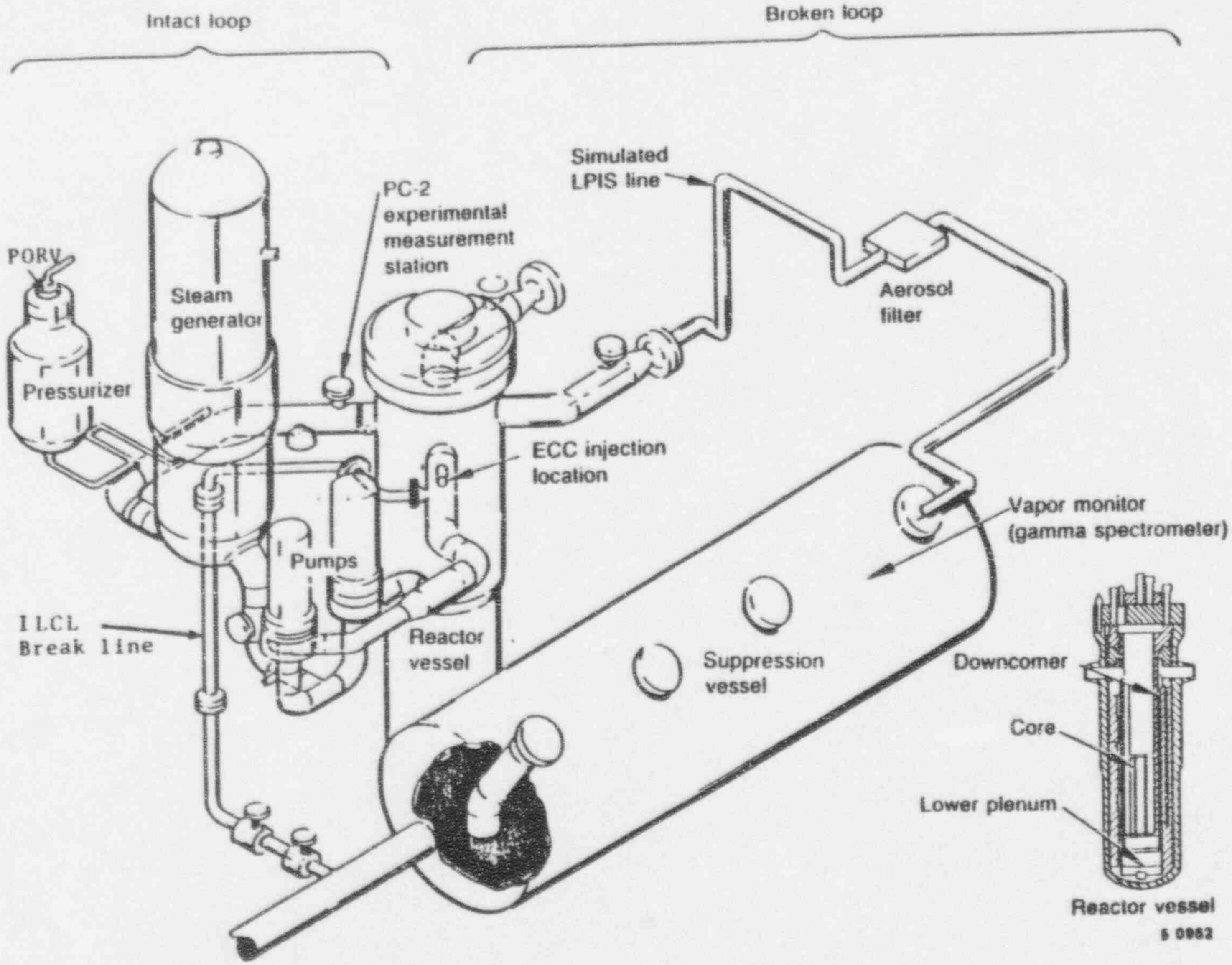
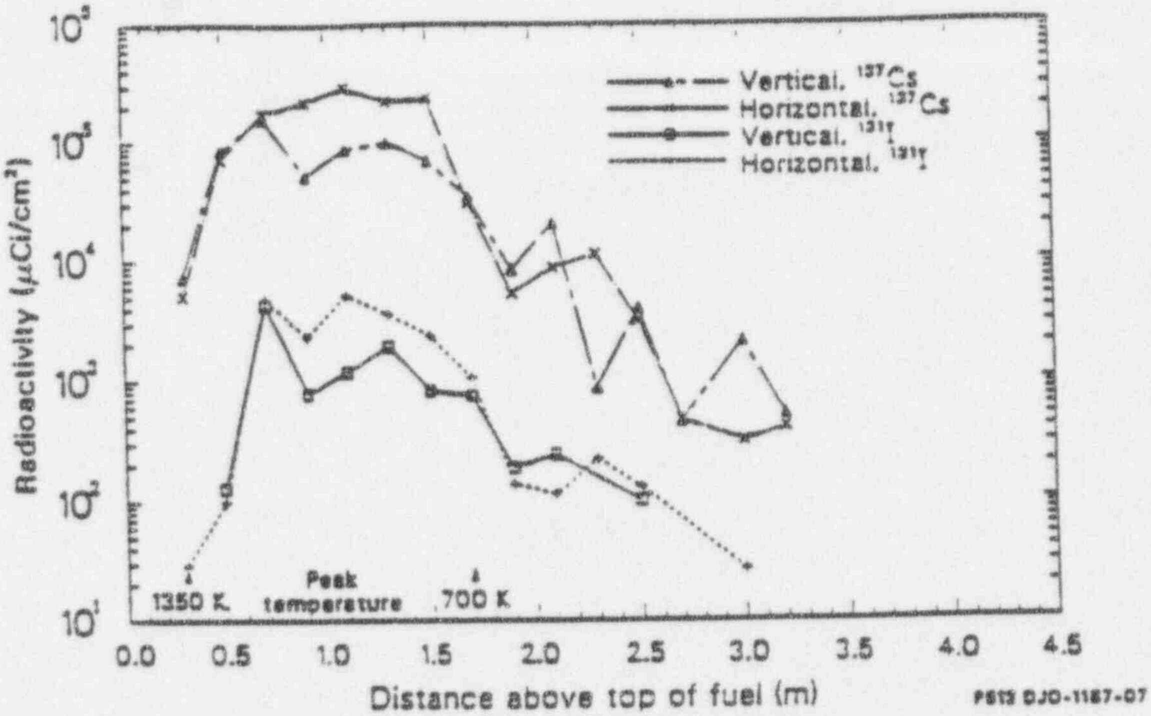


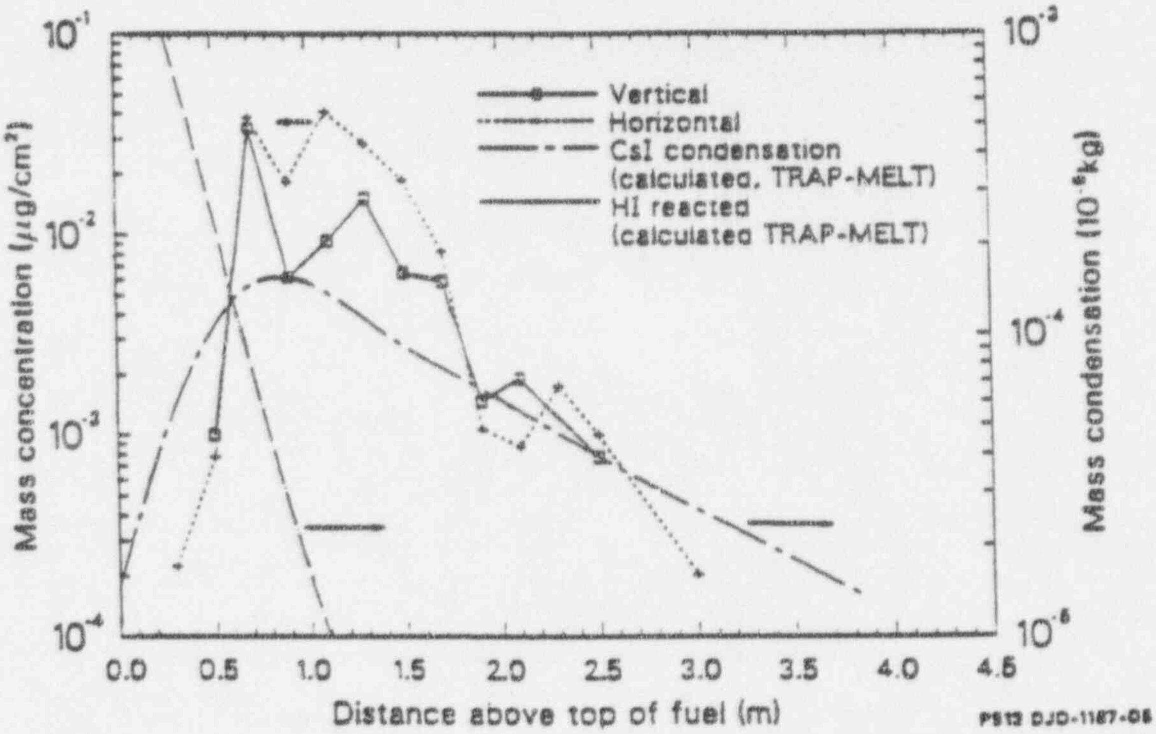
Figure 3. Axonometric view of the LOFT primary coolant system.

SFD Results

- In all SFD tests prior to reflood (i. e, while a gaseous pathway existed), <1% of iodine and cesium were measured in the collection tank
- Negligible quantities of less volatile species were measured
- Fission products deposited readily on effluent line surfaces, being concentrated in regions close to the fuel bundle
- Most of the released Cs and Te deposited within the first few meters in both SFD 1-3 and SFD 1-4



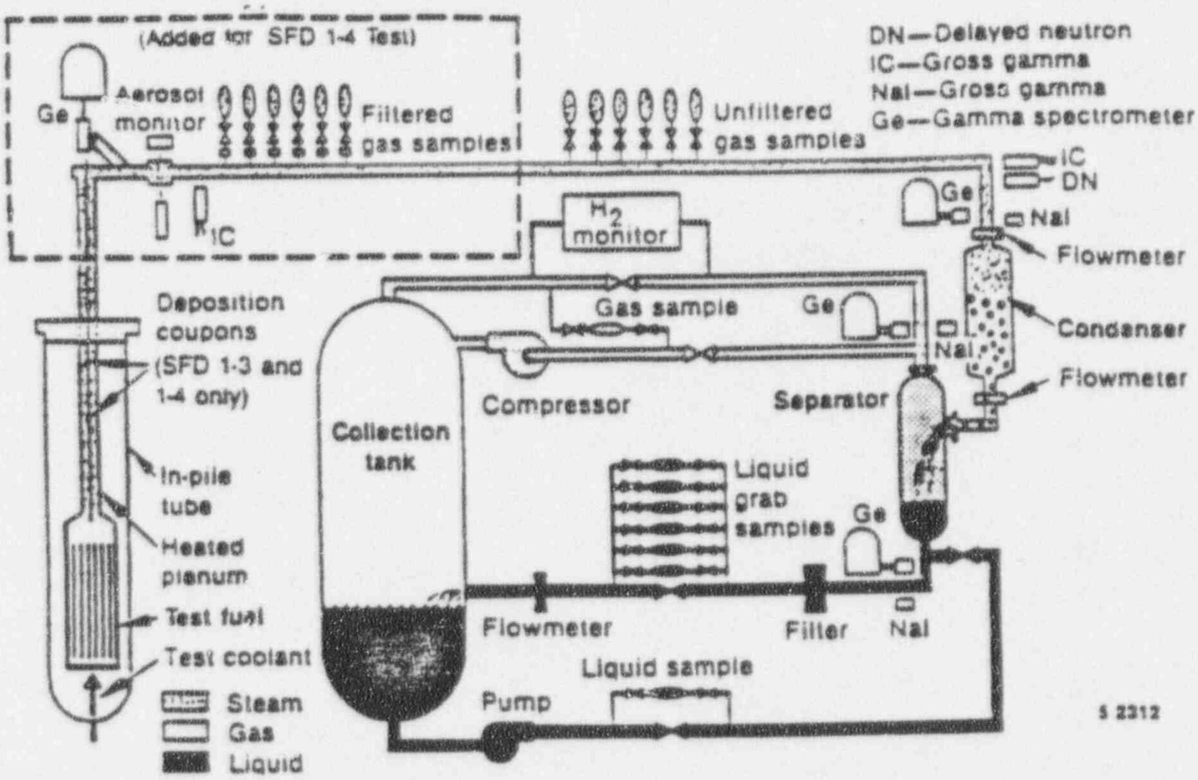
Deposition of Iodine and Cesium Measured on Horizontal and Vertical Surfaces Above Fuel Bundle After Test SFD 1-3.



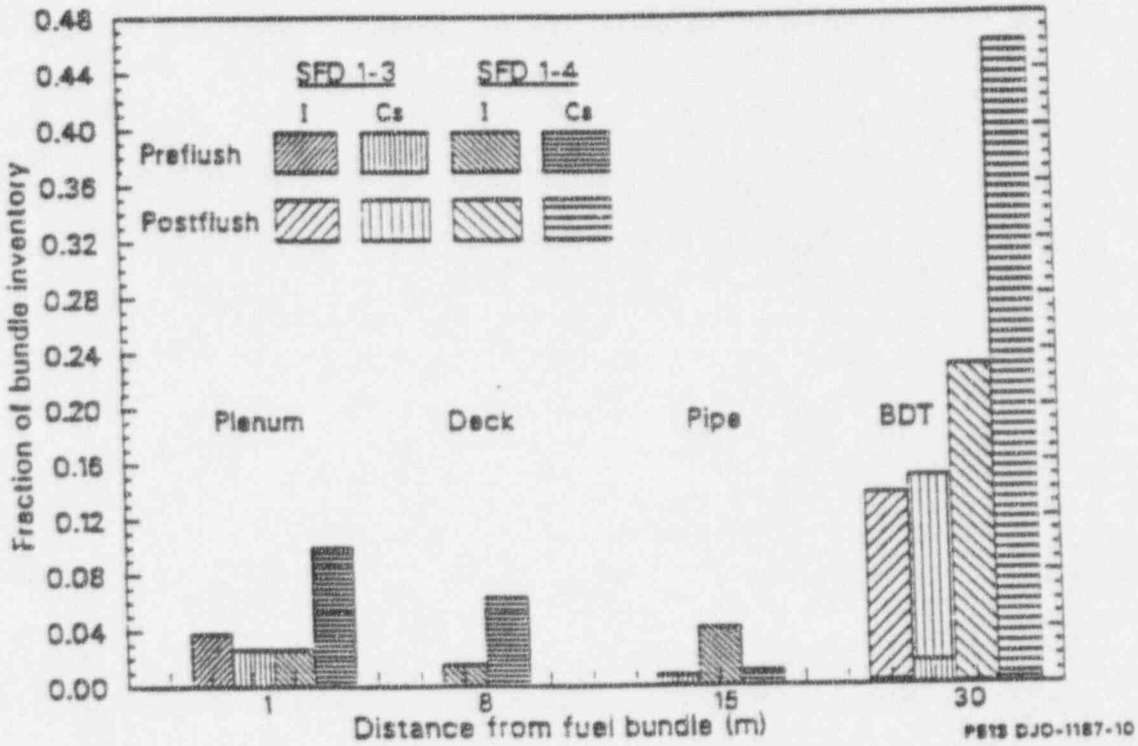
Comparison of Test SFD 1-3 Measured and Calculated Iodine Behavior

SFD 1-3 and SFD 1-4 Iodine Transport

- Aerosol effects in SFD 1-4 are believed to have caused Cs and I to be transported to locations ~15 m downstream in the effluent line. This was not observed in SFD 1-3.
- The basic difference between SFD 1-3 and 1-4 was the presence of Ag-In-Cd control rods in SFD 1-4. A chemical interaction with iodine and cadmium or tin in the aerosol, or a physical interaction with the greater aerosol surface area could have explained the downstream behavior.
- The implication of this iodine aerosol transport when extrapolated to commercial reactor scale should be investigated



Schematic diagram of the PBF Test Effluent Sampling and Monitoring System



Comparison of iodine and cesium deposition measured after Tests SFD 1-3 and 1

Lace Test Results

Test	Velocity (m/s)	Soluble Mass Fraction	Fraction Retained in Piping	Fraction Immediately Deposited on Building Surface
CB 1 (1)	100	1.0	58%	80%
CB 2 (1)	91	0.067	53%	80%
CB 3 (1)	97	0	15%	40%
LA 1 (2)	97	0.42	98%	----
LA 3A (2)	75	0.18	>70%	----
LA 3B (2)	24	0.12	>66%	----
LA 3C (2)	23	0.38	>70%	----

(1) Used non-prototypic aerosols NaOH and $Al(OH)_3$

(2) Used prototypic aerosols CsOH and MnO

EPRI ALWR Program

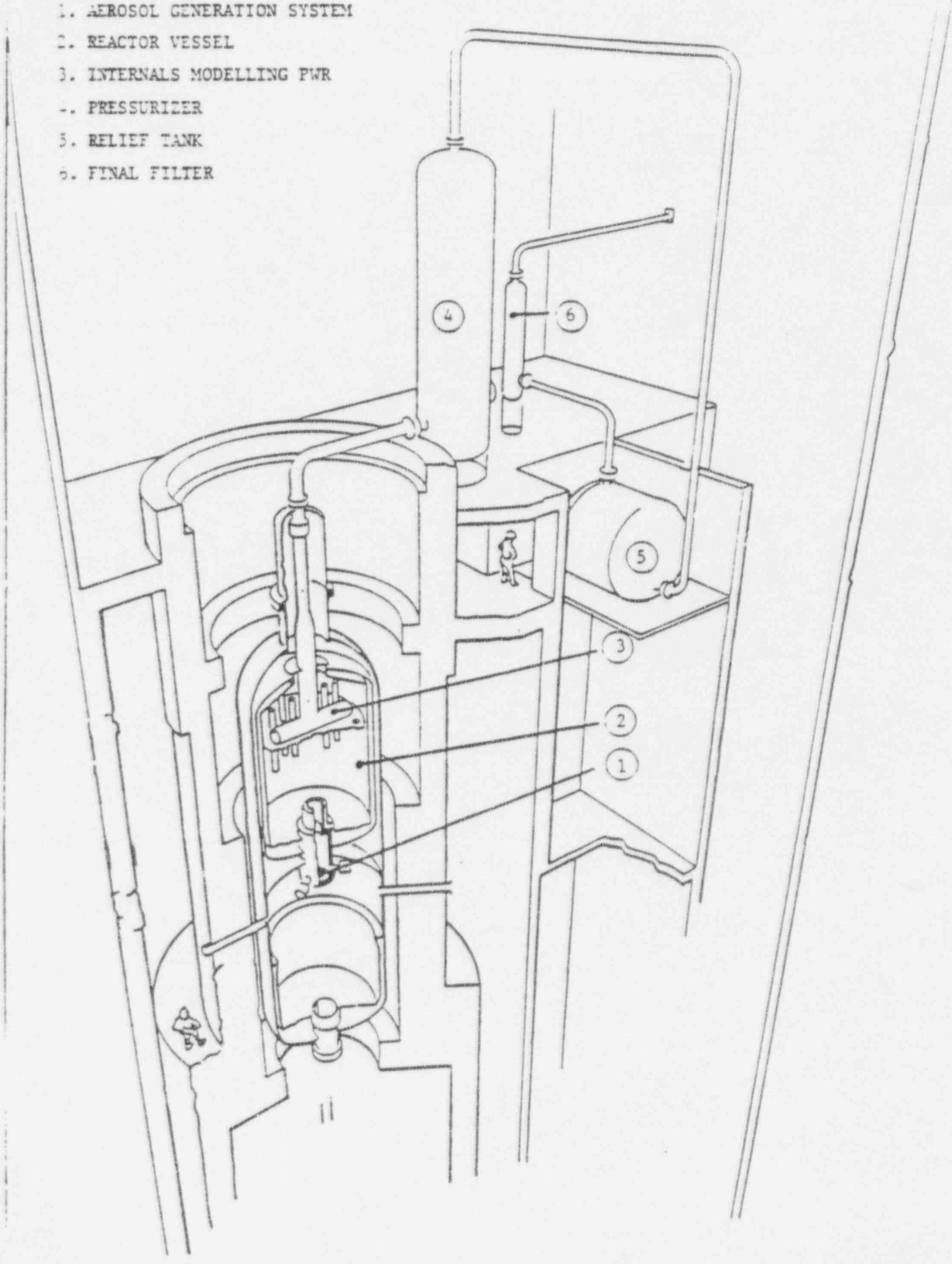


Fig 3:3 Test facility arrangement for Tests 4 and 7

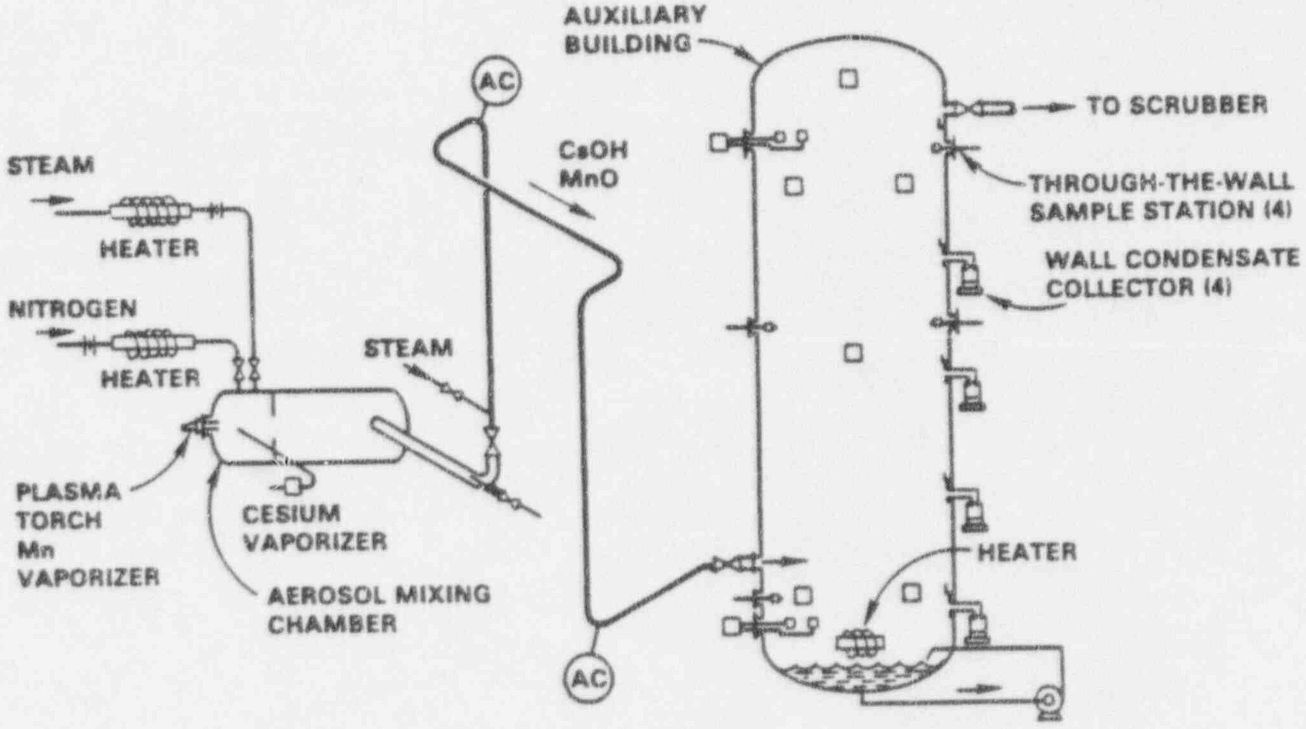


Figure 3(b). Location of instrumentation for test LA1.

Revaporization

- Fission products released in-vessel will likely be deposited on upper plenum and RCS piping, from which they may slowly revaporize depending on the accident scenario
- Revaporization is not likely to be an important contributor to the source term early in the accident

Resulting Action

1. No actions to date. ALWR Program will work with NRC to develop an ALWR alternative to this aspect of the licensing source term

   Proposed ALWR fractions of the core inventory suspended in containment atmosphere and available for leakage to environment:

Elements	Existing TID	Proposed ALWR
Nobles	100%	75%
Iodine	25%	10%
Cs, Rb	0%	10%
Te, Sb	0%	4%

Outline of Technical Discussion

- Timing of fission product release from fuel
- Fraction of fission products released from core
- Chemical form of iodine
- Fraction of iodine which is released to and suspended in the containment atmosphere
- **Fission product aerosol removal from containment atmosphere**
- Amount of fuel clad oxidized (hydrogen generation)
- Hydrogen concentration criteria to prevent detonation
- Containment vent/overpressure protection

Fission Product Aerosol Removal from Containment Atmosphere

Removal mechanisms for fission product aerosols in the containment atmosphere are well understood, and the associated removal rates are much larger than assumed in regulatory guidance

Technical Basis

- Aerosol experiments including LACE, DEMONA, and MARVIKEN have clearly established the existence of aerosol removal mechanisms and the ability to make reasonable predictions of their effects

- The LACE project concluded that removal mechanisms which must be considered in addition to gravitational settling are:

  - Diffusiophoresis (steam condensation driven flux to surfaces)

  - hygroscopicity (rapid growth in size and resultant settling due to water attraction to hygroscopic aerosols).

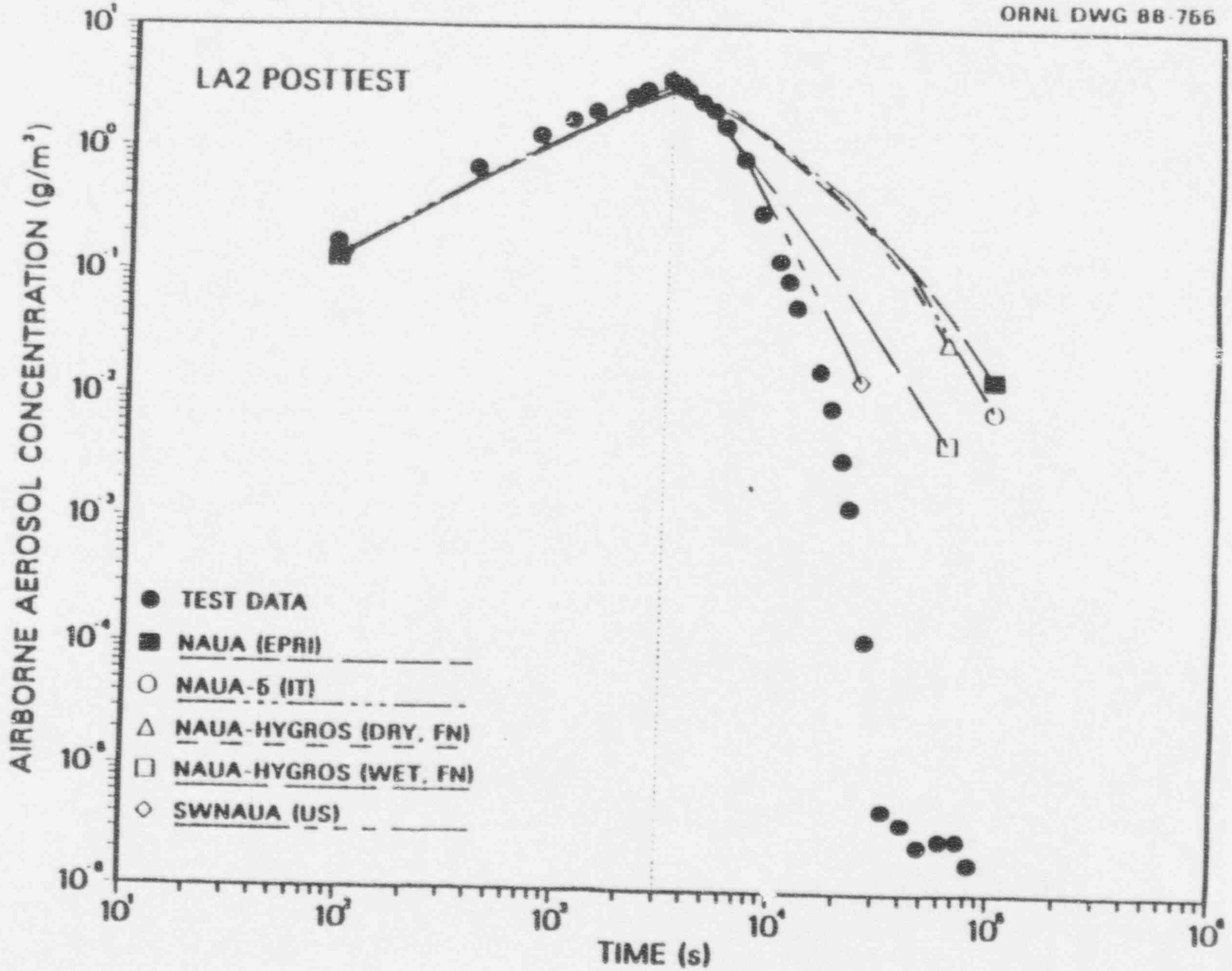
All of these are in addition to spray impaction

Particulate Removal Coefficients

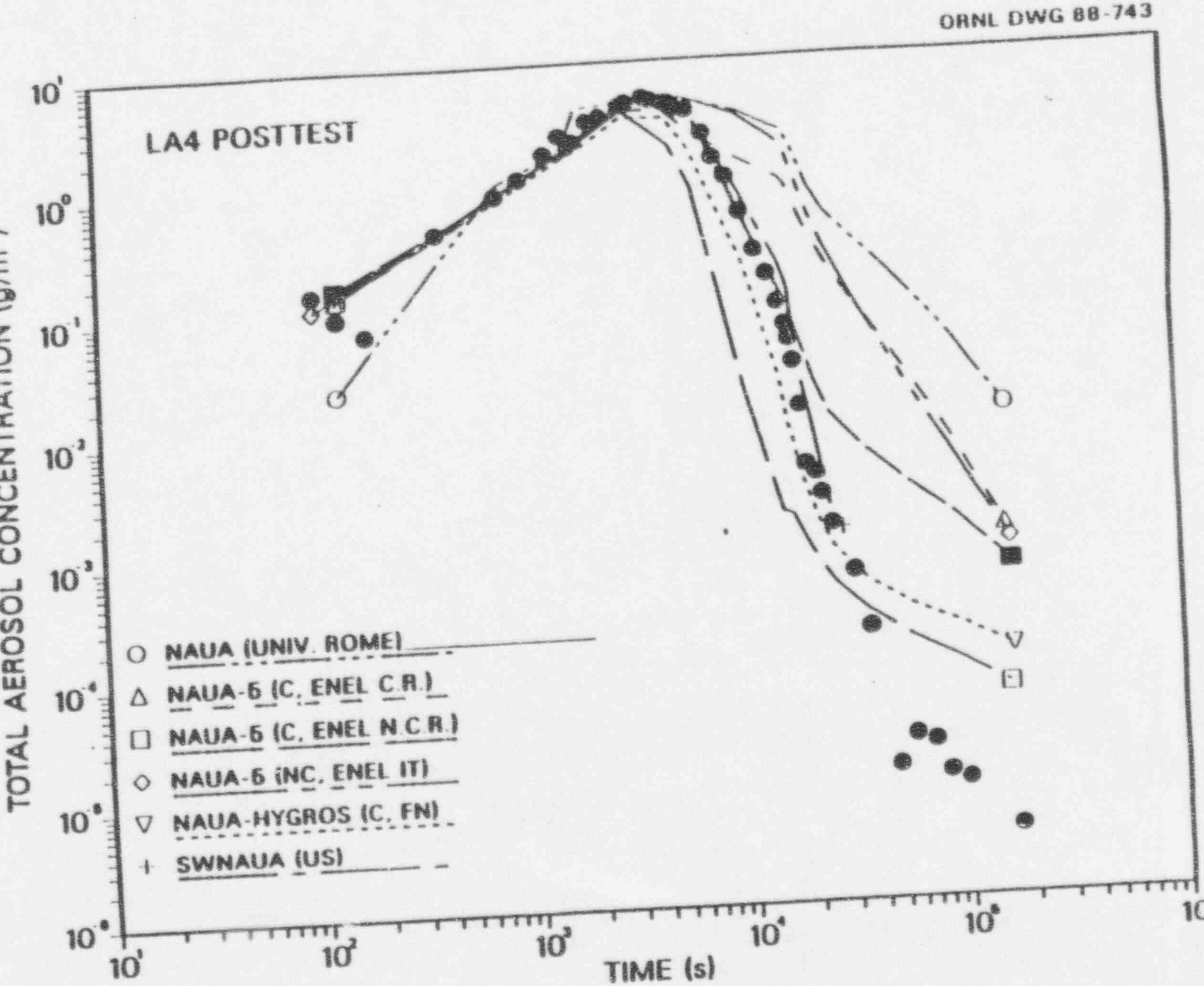
Time (hr)	SRP 6.5.2 (hr^{-1}) [1]	Realistic Removal (hr^{-1}) [2]
0.01	~ 4	~ 100
0.5	~ 4	~ 50
1.0	~ 0.4	~ 3.5
2.0	~ 0.4	~ 1.0

(1) Considers only spray removal

(2) Considers spray removal, gravitational settling, diffusiophoresis, and hygroscopicity



ORNL DWG 88-766
LA2 POSTTEST
AIRBORNE AEROSOL CONCENTRATION (g/m³)
TIME (s)
TEST DATA
NAUA (EPRI)
NAUA-5 (IT)
NAUA-HYGROS (DRY, FN)
NAUA-HYGROS (WET, FN)
SWNAUA (US)



ORNL DWG 88-743
LA4 POSTTEST
TOTAL AEROSOL CONCENTRATION (g/m³)
TIME (s)
10¹
10⁰
10⁻¹
10⁻²
10⁻³
10⁻⁴
10⁻⁵
10⁻⁶
10¹
10²
10³
10⁴
10⁵
10⁶
NAUA (UNIV. ROME)
NAUA-5 (C. ENEL C.R.)
NAUA-5 (C. ENEL N.C.R.)
NAUA-5 (NC. ENEL IT)
NAUA-HYGROS (C. FN)
SWNAUA (US)

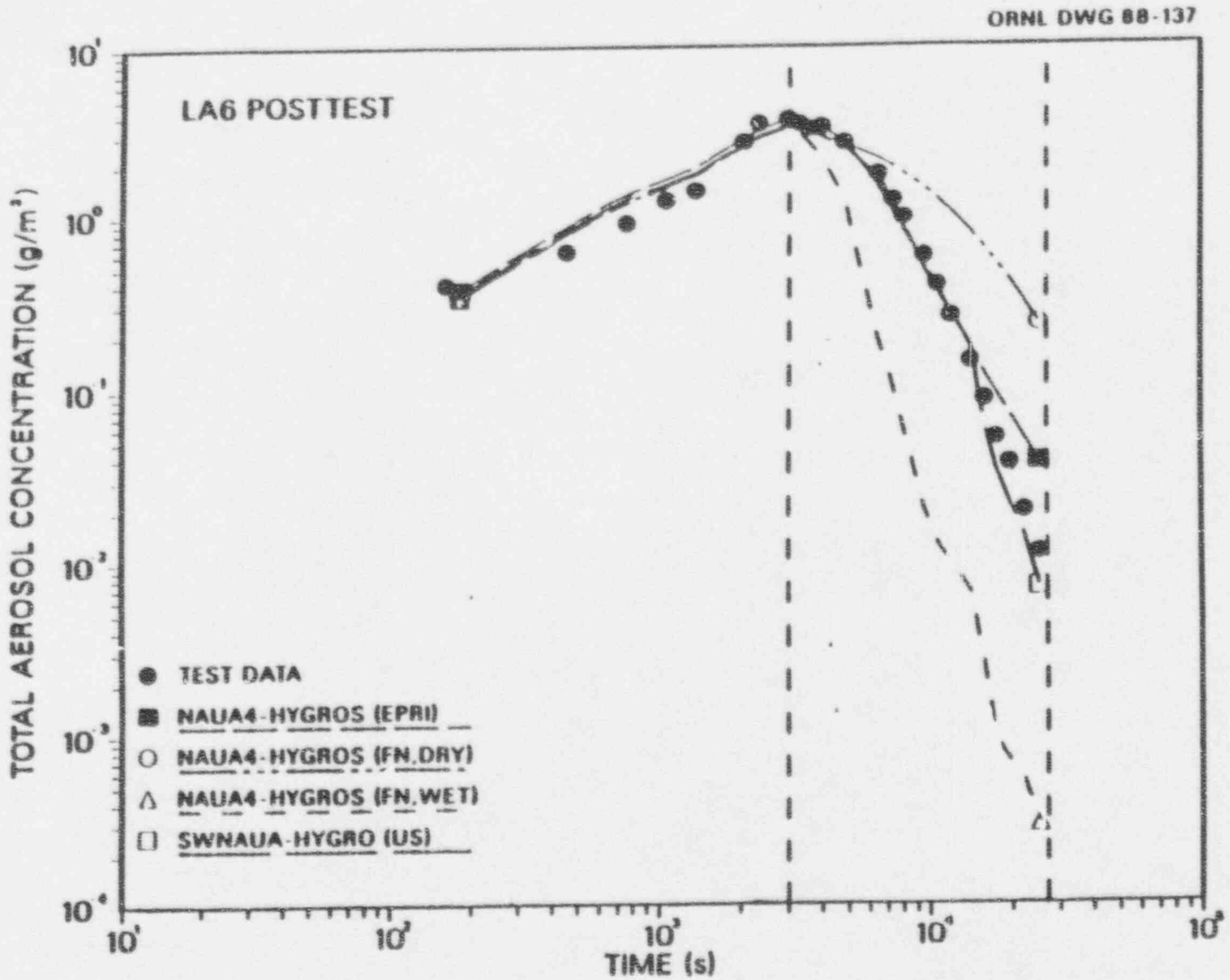


Fig. 7. LA6 posttest results: airborne total aerosol concentration vs time, for NAUA calculations.

Resulting Action

1. To determine allowable containment leak rates, ALWR Program has made 10CFR100 calculations utilizing realistic aerosol removal

   NRC Action Requested - None

2. ALWR Program will work with NRC to develop an ALWR alternative to the SRP for particulate removal

   NRC Action Requested - Revise SRP accordingly

Outline of Technical Discussion

- Timing of fission product release from fuel
- Fraction of fission products released from core
- Chemical form of iodine
- Fraction of iodine which is released to and suspended in the containment atmosphere
- Fission product aerosol removal from containment atmosphere
- **Amount of fuel clad oxidized (hydrogen generation)**
- Hydrogen concentration criteria to prevent detonation
- Containment vent/overpressure protection

Cladding Oxidation / H2 Generation

Synopsis

- The NRC position (100% active fuel cladding reacted) has been established without a documented technical basis
- ALWR Requirements Document Chapter 5, based on analyses by the DOE ARSAP Program, specifies 75% active fuel cladding as the Licensing Design Basis (LDB) requirement for a degraded core that is reflooded and recovered in vessel. [This is consistent with the 9/1/82 Statement of Considerations for 10CFR50.34(f)]
- The ALWR Risk Evaluation Basis (REB) requires that the PRA realistically account for the effects of metal oxidation, both in-vessel and ex-vessel, and H2 production and combustion for the spectrum of Severe Accidents

Cladding Oxidation / H2 Generation

Technical Basis - Summary

- TMI 2 experience at about 50%
- MAAP-DOE
  - improved code -- previous "core blockage" model not used
  - Validated against LOFT FP-2, TMI
  - Compared to SCDAP/RELAP
  - Spectrum of cases run, including reflood of damaged core

Characteristics of LDB vs. REB Requirements for Hydrogen Control

Licensing Design Basis	Risk Evaluation Basis
Meet regulatory criteria (including EPRI optimization issues)	Meet 10^{-6} / 25 Rem
Deterministic analysis using conservative methods	Use PRA and best-estimate deterministic analysis
Degraded core in-vessel with reflood	Consider in-vessel and ex-vessel hydrogen, including potential for core concrete attack
Must provide appropriate margin	Utilize the margin which exists from the LDB

Cladding Oxidation / H2 Generation

Technical Basis

- The only directly applicable experimental result is the TMI-2 accident
- The TMI-2 accident was very severe for hydrogen generation. The overheated core was exposed to steam for a long time, and then reflooded.
- TMI 2 resulted in hydrogen generation equivalent to about 50% active fuel cladding oxidation

Cladding Oxidation / H2 Generation

<u>Technical Basis (cont'd)</u>

- The other existing experimental results are only partially representative of core damage accidents in large power reactors, and cannot be applied directly, since boundary conditions for flow, power, and heat loss differ
- These other results can be used to benchmark analytical tools
- MAAP-DOE (**improved** code--blockage model developed in IDCOR **<u>not used</u>**) model validation has been performed for
  - LOFT FP-2 test
  - TMI 2 accident

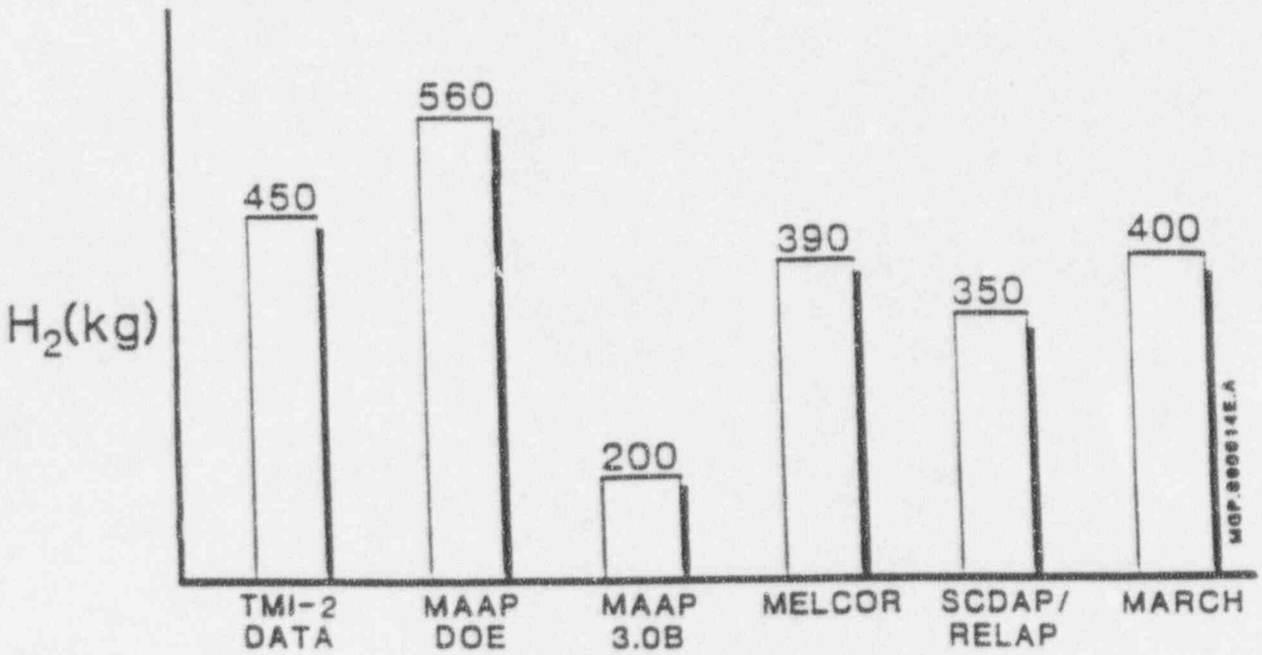


Figure 2-1 Comparison of TMI-2 hydrogen generation data with model predictions.

Table 2-3. MAAP-DOE ALWR APPLICATION MATRIX
SUMMARY OF CASES ANALYZED

Sequence Type (Basis)[1][2]	Operator Initiated Depressurization[3]		Recovery of Core Injection[4][5][6]			
	Yes	No	t_1	t_2	t_3	No
1. Large LOCA (REB)		X				X
2. Large LOCA (LDB)		X	X			
3. Large LOCA (LDB)		X		X		
4. Medium LOCA (REB)		X				X
5. Small LOCA (REB)		X				X
6. Small LOCA (LDB)		X			X	
7. Small LOCA (REB)	X					X
8. Small LOCA (LDB)	X		X			
9. Small LOCA (LDB)	X			X		
10. Small LOCA (LDB)	X				X	
11. SBO (REB)		X				X
12. SBO (LDB)		X	X			
13. SBO (LDB)		X			X	
14. SBO (REB)	X					X
15. SBO (LDB)	X		X			
16. SBO (REB)	X				X	

Notes:
1) Basis: Licensing design basis (LDB) or Risk Evaluation Basis (REB)
2) All LOCA cases include loss of all injection
3) Depressurization by operator action at steam generator dryout
4) t_1 recovery at core uncovery
5) t_2 recovery within 1/2 hour of core uncovery
6) t_3 recovery at 1 hour after core uncovery

Cladding Oxidation / H2 Generation

Technical Basis - Licensing Design Basis (LDB)

- MAAP-DOE has been applied to a spectrum of ALWR Licensing Design Basis (LDB) cases with reflooding and recovery of the core in vessel
- Results show hydrogen generation up to 43% equivalent active fuel clad oxidation, depending on the case

Table 2-4 Licensing Design Basis: MAAP-DOE Results Summary for In-Vessel (Recovery Cases)

Sequence Number	Sequence Type	Time (Sec) of S/G Dryout[1]	Time (Sec) of Core Uncovery	% Active[2] Cladding Oxidized
2	Large LOCA	NA	119	0.0%
3	Large LOCA	NA	119	3.3%
6	Small LOCA	3629	4741	43.2%
8	Small LOCA	3629	4351	0%
9	Small LOCA	3629	4351	0%
10	Small LOCA	3629	4351	0%
12	SBO	4801	6708	0%
13	SBO	4801	6708	2.0%
15	SBO	4801	6099	0%

(1) S/G = Steam generator

(2) Active clad defined as zirconium inventory in cladding within core boundary. Calculation utilizes total zirconium inventory.

Cladding Oxidation / H2 Generation

Technical Basis - Risk Evaluation Basis (REB)

- A spectrum of cases without recovery has also been analyzed
- The hydrogen production for all but one of these cases, including in-vessel, oxidation at the time of vessel failure, core-concrete interaction prior to cavity flooding, and long term relocation of core material remaining in vessel ranged from 58% to 75% equivalent active fuel cladding oxidation
- One sensitivity case, where cladding oxidation is enhanced as accumulator water is very slowly released, produced about 100% equivalent active fuel cladding oxidation
- This type of sequence is avoided by ALWR Safety Depressurization and Vent System that provides rapid depressurization

for Ex-Vessel (No Recovery) Cases

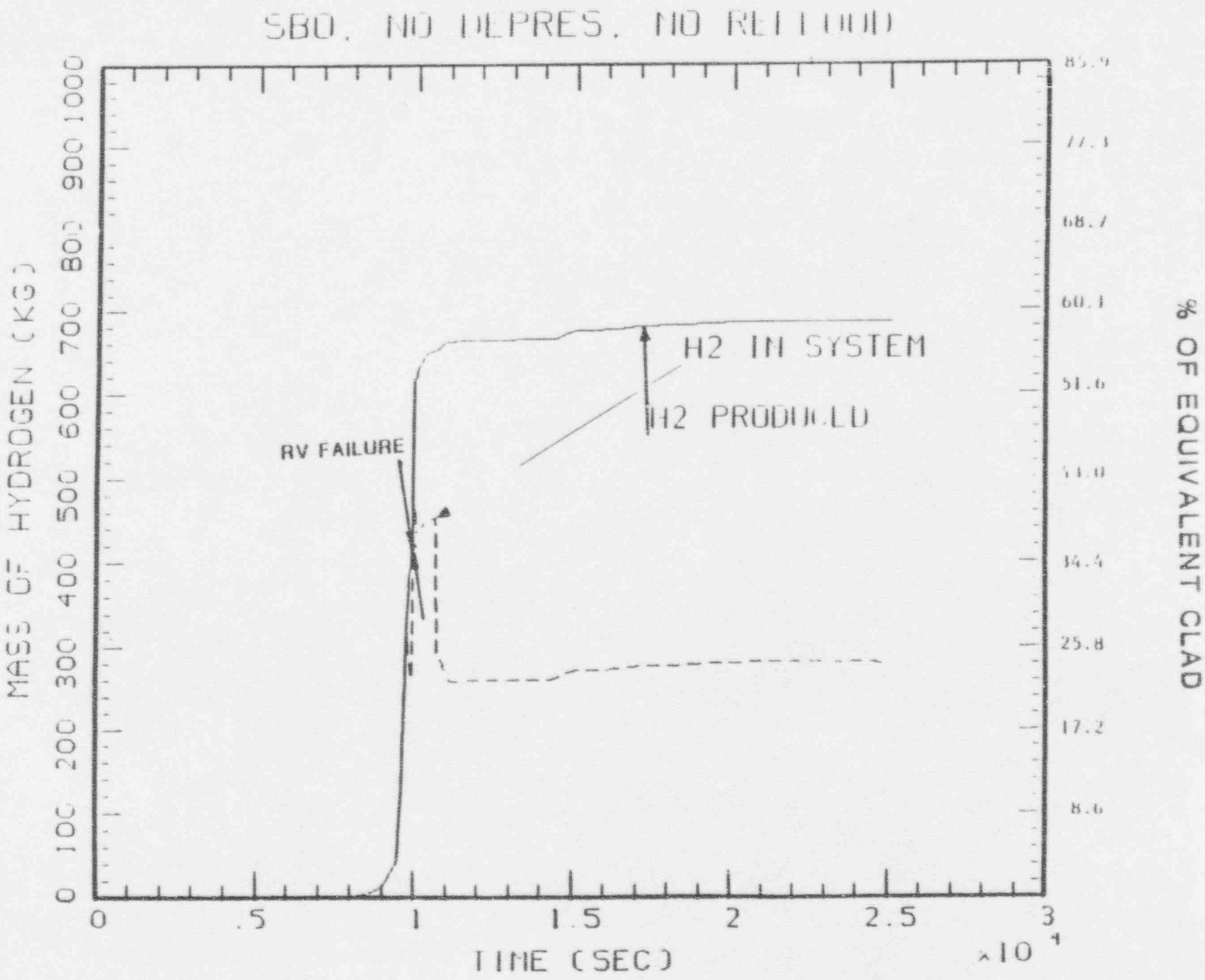
Sequence Number	Sequence Type[1]	Core Uncovery (Sec)	Vessel Failure (Sec)	Hydrogen Contributions[4]				
				In-Vessel Before VF	DCH	CCI[3]	In-Vessel After VF	Long Term Relocation[2]
1	Large LOCA	119	3070	37.4%	0%	9.7%	2.2%	11.6%
4	Medium LOCA	1087	7234	38.8%	0%	0%	10.0%	10.9%
5	Small LOCA	4741	7510	43.9%	11.4%	0%	8.3%	8.7%
7	Small LOCA	4351	13197	50.2%	0%	0.1%	3.9%	10.2%
11	SBO	6708	9952	35.1%	18.9%	0%	4.4%	9.5%
14	SBO	5831	14533	40.5%	0%	3.0%	2.7%	11.9%
16	SBO	6099	12180	61.3%	0%	0%	5.6%	8.2%

(1) All cases assumed a dry cavity at vessel failure, conservatively delaying the effects of cavity flooding from the IRWST for one hour to bound the best-estimate range.

(2) Long term relocation refers to the continued core heatup after vessel failure and relocation of debris from the vessel to the water pool in the cavity. The relocation is modeled as debris droplets which are quenched in the pool. Hydrogen is produced during the droplets falling through the steam rich cavity and their quenching in the cavity's water pool.

(3) Concrete attack was calculated when dry debris conditions were predicted up to one hour after vessel failure pending effective cavity flooding by the IRWST.

(4) Hydrogen contributions are reported as percent of active fuel cladding oxidized.


SBO, NO DEPRES, NO REFLOOD
MASS OF HYDROGEN (KG)
0
100
200
300
400
500
600
700
800
900
1000
TIME (SEC)
0
.5
1
1.5
2
2.5
3
x10⁴
% OF EQUIVALENT CLAD
85.9
77.3
68.7
60.1
51.6
34.4
25.8
17.2
8.6
RV FAILURE
H2 IN SYSTEM
H2 PRODUCED

Cladding Oxidation / H2 Generation

Action Requested

- NRC complete review of ALWR Chapter 5 Hydrogen requirements and supporting analyses, including comparisons and case studies described above, and accept 75% active fuel cladding oxidation as the deterministic LDB requirement, together with REB requirement to include effects of all hydrogen generation and combustion in meeting the 10-6 / 25 Rem
- NRC consider how to accept the ALWR position within the framework of current regulations

Outline of Technical Discussion

- Timing of fission product release from fuel
- Fraction of fission products released from core
- Chemical form of iodine
- Fraction of iodine which is released to and suspended in the containment atmosphere
- Fission product aerosol removal from containment atmosphere
- Amount of fuel clad oxidized (hydrogen generation)
- **Hydrogen concentration criteria to prevent detonation**
- Containment vent/overpressure protection

Prevention of Hydrogen Detonation

Synopsis

- Test data shows the current NRC position -- that hydrogen concentration must be below 10% to avoid detonability -- to be overly conservative for ALWRs

Prevention of Hydrogen Detonation

Technical Basis - Summary

- 13% dry H2 mixture not detonable for ALWR conditions
  - Trigger energies about two orders of magnitude higher than the largest ignition source in a reactor containment are required to initiate a detonation in a confined 13% H2 mixture
  - Tests on 13% dry H2 demonstrated no significant flame acceleration
  - Tests on a mixture of 13% H2 and 27% steam demonstrated no significant flame acceleration
- The largest ignition sources in reactor containments are three orders of magnitude less than that necesary to trigger detonation by energy deposition in an unconfined space
- ALWR Requirements Document eliminates geometry conducive to DDT; experimental results show large margin to DDT for 13% H2 mixture in an ALWR containment

Prevention of Hydrogen Detonation

Technical Basis - Intrinsic Detonability

- "Detonation limits" are dependent on both thermodynamic conditions and geometry
- Detonability is related to an intrinsic mixture property: The detonation cell width, λ
- The detonation cell width depends upon the hydrogen and oxygen concentrations (equivalence ratio), the steam concentration, and temperature

Prevention of Hydrogen Detonation

Technical Basis - Intrinsic Detonability

- Detonations are highly improbable when the detonation cell width exceeds the geometric scale:

  $\lambda \geq \Pi D$ Tube

  $\lambda \geq D/6.5$ Open Region

- Example: If the cell width is 1 meter, a tube less than 0.3 M diameter cannot sustain a detonation, and an open space less than 6.5 M cannot sustain a detonation

Prevention of Hydrogen Detonation

Technical Basis - Effects of Steam on Intrinsic Detonability

- Steam is expected in ALWR containments during severe accidents - significant primary system inventory loss must precede hydrogen generation
- The cell width λ for 13% dry H2 increases by a factor of 10 with 10% steam, by a factor of 25 with 20% steam, and by a factor of 125 with 30% steam
- Steam concentrations greater than 20% are expected (with or without sprays) yielding a cell size near 25 meters requiring an open space of 162 M diameter
- Therefore, for realistic ALWR cases, a 13% H2 mixture is not intrinsically detonable

Prevention of Hydrogen Detonation

Technical Basis - Experimental Data on Detonability

- VGES tests at SNL with and without fans conducted for 13% dry H2 deflagrations (tests B-69 to B-74), show no significant flame acceleration
- In NTS test P-20, H2 = 12.9%, H20 = 27.8%, a deflagration with no significant flame acceleration was observed
- In NTS test P-21, H2 = 13.2%, H20 = 27.4%, with fans and sprays to induce turbulence, the flame speed was only twice that of test P-20
- These are equivalent to 18% hydrogen in dry air

Prevention of Hydrogen Detonation

<u>Technical Basis - Initiation Energy</u>

- The energy required to initiate a detonation is about ten orders of magnitude greater than that to initiate a deflagration -- so it is highly probable that a deflagration will be initiated prior to a detonation
- Because large energy sources (triggers) do not exist in a containment, direct initiation of detonations is highly improbable

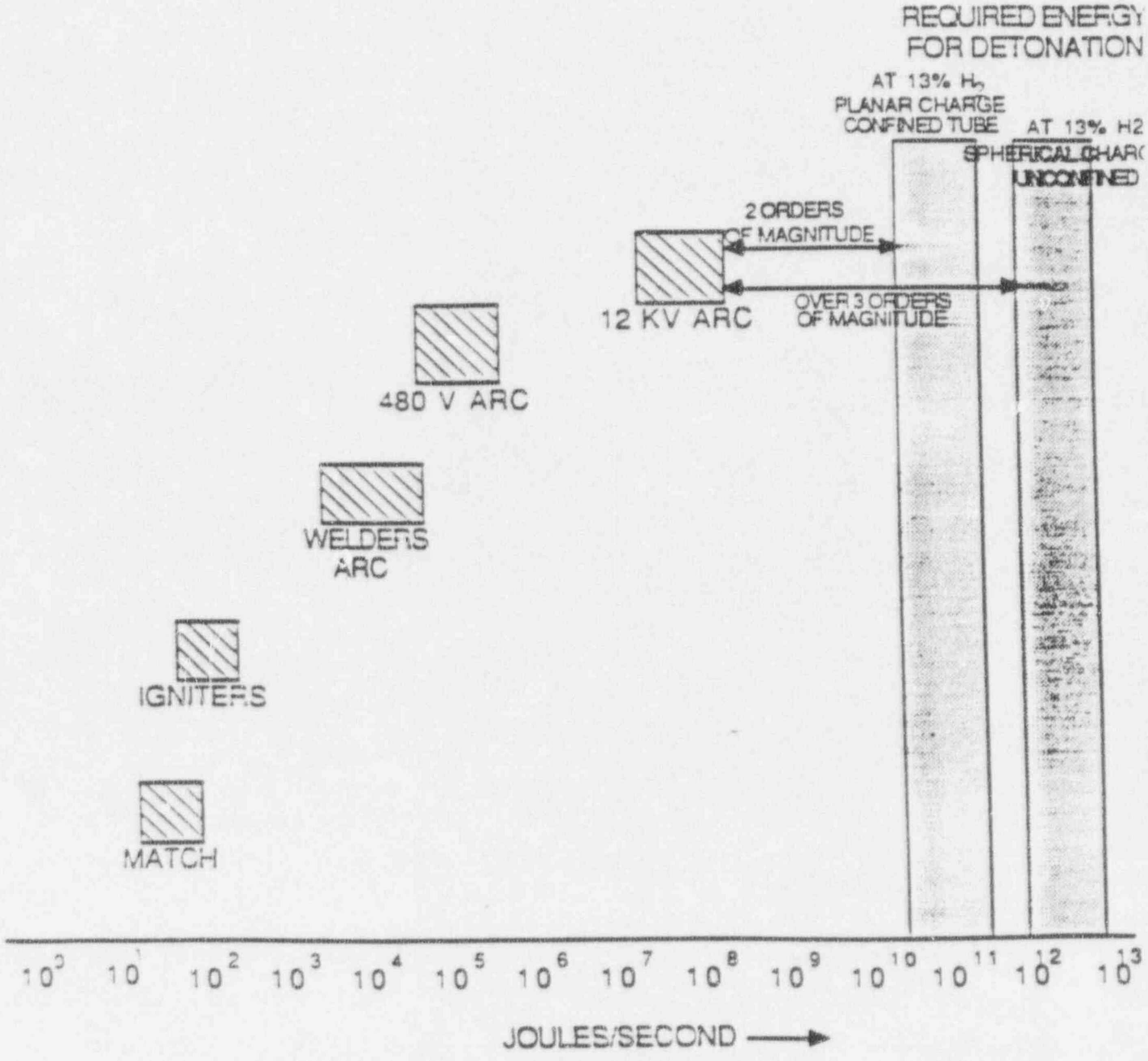


Figure 2-16 Comparison of ignition source energies with sources required for detonation.

Prevention of Hydrogen Detonation

Technical Basis - Initiation by DDT

- Deflagration-to-detonation transition, DDT, has been observed to date at a minimum of 15% hydrogen using ideally arranged obstacles to enhance flame acceleration for an unvented 1.8 M x 2.4 M channel, 30 M long
- Experimental evidence indicates that the channel size can be scaled up for lower hydrogen concentrations to judge the potential for DDT - by using the ratio of detonation cell widths

Prevention of Hydrogen Detonation

Technical Basis - Initiation by DDT

- Scaling the unvented DDT results for 15% H2 in dry air to 13% in dry air (scale factor of 5) implies that a 9 M x 12 M unvented channel at least 30 meters long with ideally arranged obstacles would be necessary for DDT
- Scaling the unvented DDT results for 15% H2 in dry air to 15% H2 with 20% steam (scale factor of 25) implies a channel cross section 45 M x 60 M
- ALWR requirements call for venting large channels
- Scaling the vented DDT results for 20% H2 in dry air to 13% H2 in dry air (scale factor of 40) implies a channel cross section about 70 M for DDT (even larger with steam)
- Since real containment regions are vented, and realistic cases will include steam, the 13% criterion provides significant margin to the H2 concentration required for DDT in an ALWR containment

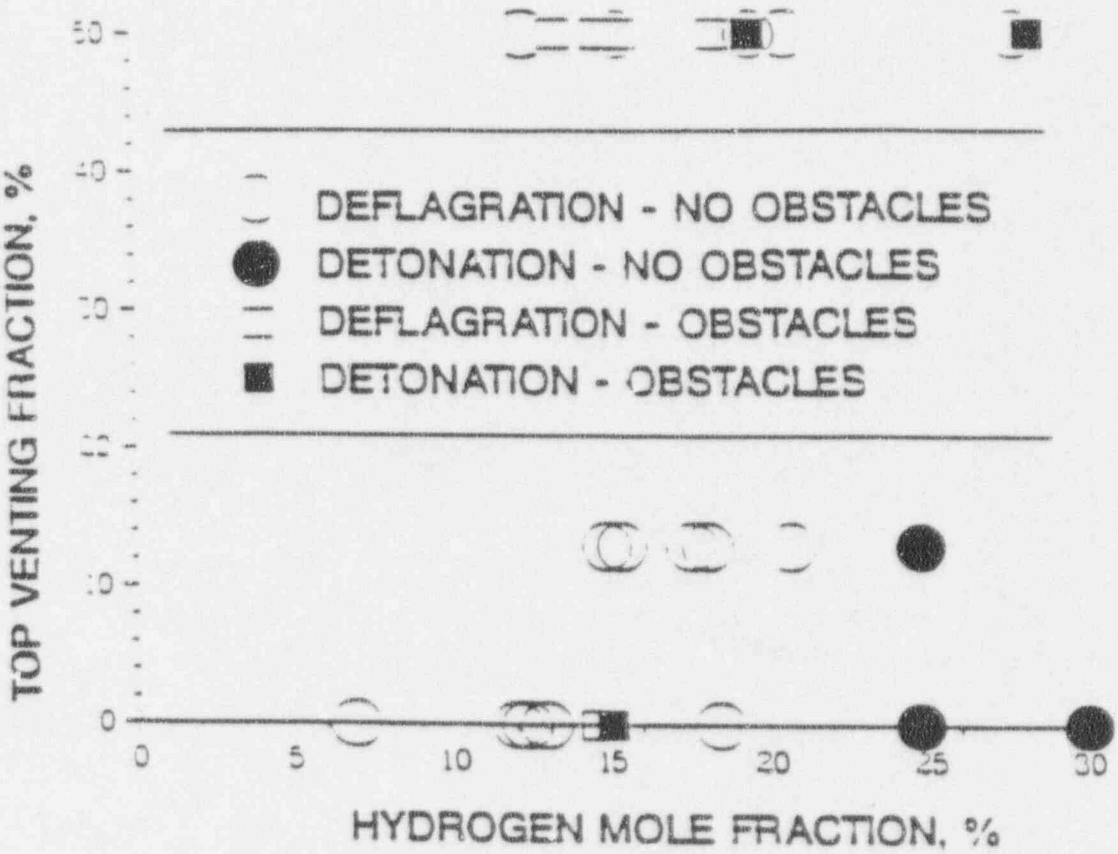


Figure 2-17 FLAME apparatus DDT results (reproduced from Reference 43).

Prevention of Hydrogen Detonation

Technical Basis - Design Features to Prevent DDT

- Specific features to promote mixing and to avoid deflagration-to-detonation transition shall be provided in containment arrangement, including:
  - Avoiding small, enclosed spaces with a hydrogen source (Chapter 6, Paragraph 4.3.2.5)
  - Providing transverse vents along the length of tubular enclosures (Chapter 6, Paragraph 4.3.2.5)
  - Avoiding obstacles in the flow paths of tubular enclosures (Chapter 6, Paragraph 4.3.2.5)
  - Use of gratings vs. solid floors (Chapter 6, Paragraph 4.3.2.5)
  - Use of vented compartments (Chapter 6, Paragraphs 4.3.2.5, 4.3.4.6)

Prevention of Hydrogen Detonation

Action Requested

- NRC complete review and accept the ALWR criterion that containment mixtures of 13% H2 or less are sufficient to avoid detonability
- NRC consider how to accept the ALWR position within the framework of current regulations

Outline of Technical Discussion

- Timing of fission product release from fuel
- Fraction of fission products released from core
- Chemical form of iodine
- Fraction of iodine which is released to and suspended in the containment atmosphere
- Fission product aerosol removal from containment atmosphere
- Amount of fuel clad oxidized (hydrogen generation)
- Hydrogen concentration criteria to prevent detonation
- **Containment vent/overpressure protection**

Containment Performance

Synopsis

- The ALWR requirements, as presently formulated, provide an excellent and balanced measure of accident prevention and mitigation.
- A conditional containment failure probability (CCFP) criterion would be an unnecessary and counterproductive regulatory requirement for ALWR.
- Containment vent for severe accident protection is an unnecessary, undesirable and potentially unworkable design feature.

ALWR Requirements for Public Protection

- Extensive accident prevention features, to meet regulatory and investment protection objectives.
- Rugged containment required, regardless of calculated core damage frequency.
- Features for improved accident mitigation capability.

ALWR Requirements for Improved Mitigation Capability

- Depressurization capability, preventing direct containment heating.
- Cavity configuration to capture, contain and cool core debris.
- Cavity flooding capability, via direct path from proximate (in-containment) water source.

Extensive ALWR Accident Prevention Features

- Significant reduction in transient initiation frequency: LOSP frequency reduced by >x10; scram frequency requirement < 1/year (RCS design, load rejection, independent diverse reserve transformer, spurious MSIV closure will not cause scram, BOP improvements, etc.)
- Improved reliability and diversity of on-site AC sources: large AAC; third EDG for third safety division (BWR)
- Improved redundancy and capacity of on-site DC sources; long term, diverse SBO coping capacity.
- Improved DHR system reliability (three independent safety divisions (BWR); redundant SIS, AFW, and CCW trains within safety divisions (BWR); higher pressure RHR, improved depressurization capability
- Improved support system reliability (service water, CCW, separation of safety and non-safety systems)

Extensive ALWR Accident Prevention Features (Cont'd)

- Improved BOP reliability and availability; improved main condenser, heat sink availability. Simplified, more reliable feed/condensate systems.
- Preliminary indications are that CDF contribution from internal sequences will be at or below 10^{-6}, based on ALWR improvements.
  - ALWR safety study of RD chapters 1-5, including sensitivity studies for potential improvements in subsequent chapters
  - preliminary vendor ALWR PRA results
  - expected NUREG-1150 results for current BWR, adjusted for ALWR improvements

Extensive ALWR Preventive Features (Cont'd)

- CDF contribution from external events has been addressed in ALWR design. Significant improvement anticipated over current plants.
  - Fire, seismic, sabotage requirements
  - Beneficial effects from internal event improvements.

ALWR Will Meet NRC Safety Goal, With Margin, Via Existing Requirements

- NRC policy calls for $<10^{-6}$ frequency of events that would cause "large release" (interpreted as potentially causing early fatality off site)
- ALWR public safety criterion is more stringent. 25 Rem is a low dose, causing no observable health effects.

Conditional Containment Failure Probability

- CCFP not needed to meet any established NRC requirement.
- CCFP is a complex and unclear concept, and therefore impractical to implement.
  - -- calculation is vulnerable to misinterpretation or manipulation (note that ALWR probabilistic requirements are cumulative)
  - -- could be a disincentive to CDF reduction
  - -- see example

CCFP Examples

- The following examples illustrate why the CCFP concept has not been applied in the ALWR Requirements.
- Consider a design with five prominent severe accident sequences:

Sequence	CDF	CCFP	Release Freq.
Sequence A	5x10E-6	.001	5x10E-9
Sequence B	2x10E-6	.1	2x10E-7
Sequence C	1x10E-6	.1	1x10E-7
Sequence D	5x10E-7	.4	2x10E-7
Sequence E	2x10E-7	.5	1x10E-7
Total	8.7x10E-6		6.1x10E-7

- Such a design would not satisify a CCFP criterion for each sequence unless the "cut-off" were about 1x10E-6 (similar to the ALWR public safety criterion), or "creative partitioning" were employed.

CCFP Examples (Con't)

- Such a design could show a CCFP <0.1 for all sequences, on the average:

$$\frac{6.1 \times 10E\text{-}7}{8.7 \times 10E\text{-}6} < 0.1$$

- Consider, however, that the plant designer or owner applied a design feature or accident management strategy that reduced the frequency of sequences A, B, and C, so that:

Sequence	CDF	CCFP	Release Freq.
Sequence A	5x10E-7	.001	5x10E-10
Sequence B	2x10E-7	.1	2x10E-8
Sequence C	1x10E-7	.1	1x10E-8
Sequence D	5x10E-7	.4	2x10E-7
Sequence E	2x10E-7	.5	1x10E-7
Total	1.5x10E-6		3.3x10E-7

CCFP Examples (Cont'd)

- Even though the CDF has been reduced, in this case the average CCFP would increase to:

$$\frac{3.3 \times 10E\text{-}7}{1.5 \times 10E\text{-}6} = .22$$

- Thus a requirement to maintain a low average CCFP is a **disincentive** to reducing core damage frequency.

Containment Vent/Overpressure Protection

- For a well-designed containment, a vent should not be necessary to meet ALWR top tier requirements, or any established NRC standard or goal.
- ALWR utilities consider containment vent to be philosophically undesirable:
  - -- SA venting is not considered mitigation - it is an engineered failure of the last barrier in the defense-in-depth system.
  - -- Any credible sequence which threatens containment integrity should be attacked frontally

Containment Vent/Overpressure Protection (cont'd)

- Containment vent is considered institutionally undesirable and potentially unworkable.
  - -- Public acceptance of a vented containment system may be poor. Licensing difficulties, court challenges, and delays could result.
  - -- In an actual event, there would likely be major objection to use of the venting system.

Resulting Action

- Issues like CCFP and containment vent must be resolved on a generic, industry-wide basis.
- NRC Action requested: raise these issues and work toward their resolution as part of ALWR Requirement Document Chapter 5 review, before plant-by-plant certification.

Potential Future Issues

1. Continued Source Term improvements
2. Technical basis for EPZ reduction
3. Passive Plant Utility Requirements and Design Concepts

Examples of Design Requirements Affected by the LDB Source Term

<u>PWR</u>

Containment isolation time

Containment design leak rate

Containment spray system design

Containment mixing rate

ECCS leakage control outside containment

Auxiliary building fission product control systems

Access requirements

Post accident sampling system

EQ

CR habitability

EPZ Reduction

- ALWR Program has recently initiated an exploratory effort to evaluate feasibility of a reduction in EPZ requirements, particularly for the Passive Plant. Reasons:
  - Passive ALWR safety analyses results will likely technically warrant consideration of EPZ reduction
  - USC sees major operational and public acceptance benefits to this step
  - EDO strongly encouraged ALWR Program to consider this step in May, 1988 (quid pro quo for safety improvements)
  - International Partners strongly support an attempt to demonstrate feasibility of ALWR EPZ reduction

Summary

- The ALWR will be a fundamentally better plant
- Strong utility consensus exists to standardize future plants around ALWR Requirements
- Strong industry (Utilities, Vendors, NUMARC) consensus exists to resolve severe accident and other ALWR regulatory issues via the ALWR Process. (i.e., NRC reviews and approves ALWR requirements; vendor-specific design certifications are based on those established generic principles and requirements)
- Solid technical basis exists for ALWR Program approach to severe accidents -- more realistic, more mechanistic, but still conservative. Based on two decades of ALWR operating experience and extensive severe accident research.

Summary of Actions Needed

- Renewed commitment to ALWR Requirements Document process. Accelerate Requirement Document reviews. Issue Chapter 5 DSER. Utilize process as basis for generic resolution of all ALWR design issues.
- Work to establish more realistic ALWR source terms for both risk evaluation and licensing design basis. Seek mutually acceptable regulatory modifications:
  - alternatives applicable to ALWR
  - focus on SRPs and Reg. Guides where possible
- Reevaluate current regulatory basis for hydrogen control an containment venting. Evaluate and approve ALWR Program technical positions on these issues

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July 28, 1989

Ken:

Earlier this week, you and I discussed the EPRI Design Requirements Document and the significance of this initiative from a regulatory perspective -- focusing, in particular, on whether the issues that are being discussed and the decisions that are being made in the Requirements Document will establish the course that the staff intends to take on safety issues in its subsequent review of individual advanced designs.

I promised to get you additional references on the question of whether the Requirements Document will address and resolve safety issues for future reactor designs that, in turn, will govern the staff in its subsequent review of specific designs. I've gone back and reviewed my files on this question and, while there is considerable information on this topic, the best summary of the significance of the Requirements Document from a regulatory standpoint is set forth NUREG-1197, "Advanced Light Water Reactor Program."

I've attached a high-lighted copy of the Executive Summary. The salient points, in my view, are three:

1. The Requirements Document will define licensing requirements for future reactors (requirements that are set forth in considerable detail and not just limited to top-tier requirements);

2. The licensing requirements in the Requirements Document will be approved by the NRC; and

3. Once the Requirements Document is approved by the NRC, individual designs will be evaluated against the Requirements Document to determine whether each such design has appropriately implemented those requirements.

For these reasons, as I indicated in our earlier discussions, I view the Requirements Document as having a much more significant impact on the question of safety standards for future reactors than anything else we are doing -- and it is for this reason that I think the Commission should be more closely involved in the process for review and approval of the Requirements Document.

Jim

EXECUTIVE SUMMARY

To address the need for a viable nuclear power generation option, the Electric Power Research Institute (EPRI), as directed by its ALWR Utility Steering Committee, embarked on the EPRI/Industry Advanced Light Water Reactor (ALWR) Program. It is EPRI's objective for the ALWR Program to develop improved LWR designs and to work with the staff in this closely coordinated effort to bring about stabilized regulatory and utility industry requirements for future LWR plant designs.

The output of the ALWR Program includes a utility-reviewed and Nuclear Regulatory Commission (NRC) approved Requirements Document for future nuclear power plants. The Requirements Document is to consist of 13 chapters and is to be applicable to both PWRs and BWRs of 400 MWe to 1350 MWe. The Requirements Document will define both licensing and utility requirements for a facility that is: (1) less subject to accidents; (2) more tolerant of operating transients; (3) simplified compared to current plants with respect to constructability, maintainability, and operability; (4) based on fully proven technology; (5) lower in lifetime costs than current plants; and (6) reduce, relative to previous plants, the probability and consequences of accidents that could endanger the safety of in-plant personnel or the general public, cause radioactive release, or damage plant equipment. It is intended that the ALWR Requirements Document will be prepared by EPRI and reviewed by both the utilities and the nuclear industry, and that the licensing requirement aspects will be approved by the NRC.

The following are considered to be the major components of the program management and review methodology for the ALWR Program.

(1) The ALWR Program provides a mechanism for establishing a standard baseline of regulatory and industry requirements for the total plant in the Requirements Document which appropriately address current regulatory requirements including resolution of applicable generic safety and licensing issues. The licensing process for a plant utilizing the Requirements Document primarily consists of a demonstration that the plant requirements have been appropriately implemented at an acceptable site and considering factors beyond the scope of the Requirements Document.

(2) A process for treating current and new generic safety issues has been implemented consistent with the intent of establishing the foundation of regulatory requirements for the ALWR. This process is consistent with NUREG-0933 and is closely coordinated with pertinent procedures in NUREG-0933. As a result, two separate and distinct processes have been developed.

   (a) For current issues, the resolution proposed for all applicable generic safety and licensing issues is included in the Requirements Document.

   (b) For issues identified after July 1, 1986, appropriate requirements will be identified after their resolution if one or more of the following criteria are satisfied.

(ii) Would the offsite radiological consequences dose requirements established in the Requirements Document be exceeded as a result of this issue?

(iii) Would the Commission's safety goals be exceeded as a result of this issue?

(3) Technically supportable alternatives to current regulatory requirements, called "plant optimization subjects," have been identified for application to the ALWR Program. These alternatives are proposed to achieve the program goals and are identified in the Requirements Document. Review of the plant optimization subjects is considered a part of the Requirements Document review.

(4) The NRC staff review of the Requirements Document will be documented in an SER. Assuming the Requirements Document meets staff approval, that approval will include the following: The staff has reviewed the Requirements Document and finds that it contains the necessary requirements that, if properly translated into a design in accordance with current practice and licensing guidance, it will generate a nuclear power plant design which will have all the attributes required by NRC regulations to assure there is no undue risk to the public health and safety as required by the regulations. The SER will, where appropriate, state that the Requirements Document has provided resolution for generic safety and licensing issues consistent with the level of detail provided. The SER will also document the acceptability of alternative approaches to current regulatory requirements identified in the Requirements Document. The SER will provide that approval, including assurance that non-safety subjects such as "constructability" are not in conflict with regulations, and therefore are acceptable.

(5) The schedule for EPRI submittal and NRC review of the Requirements Document is shown in Table 1-2.