NUREG-1317

Regulatory Options for Nuclear Plant License Renewal

Draft for Comment

U.S. Nuclear Regulatory Commission

Office of Nuclear Regulatory Research

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ABSTRACT

The NRC is developing regulations for relicensing nuclear power plants. In recognition of the need to resolve the issues affecting public health and safety in a timely manner, the NRC issued a Federal Register notice in November 1986 requesting public comments on the license renewal policy development effort. Fifteen topics of concern have been identified from the public's response to NRC's request. The topics have been categorized as: technological, environmental, and procedural. The review and analysis of these topics have resulted in the characterization of regulatory issues and the identification of ways for dealing with certain issues. This report presents the status of this effort and is being issued for public comment. The comments would help focus on the issues that should be addressed in the proposed rule on license renewal.

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Background and Purpose

The Atomic Energy Act and the implementing regulations of the U.S. Nuclear Regulatory Commission (NRC) permit the renewal of nuclear plant operating licenses upon expiration of their 40-year license term. However, the regulatory process by which license renewal may be accomplished and the requirements for the scope and content of renewal applications are yet to be established. Consistent with the expected schedule of license renewal applications, the NRC is now developing regulations that will ensure the continued safe operation of relicensed power plants. Rather than issuing a policy statement prior to a rule as previously planned, the NRC intends to move directly to rulemaking on a slightly accelerated schedule.

In November 1986, the NRC issued a request for public comments on the license renewal policy development effort and indicated its intent to develop a Commission policy statement. The response has been analyzed and various topics of concern to license renewal have been identified. The review and discussion of those topics and related issues have also resulted in the identification and characterization of ways to address certain issues. This report describes the status of this effort. The purpose of the report is to stimulate further discussion and to obtain comments on the material presented herein. The NRC is considering holding a public meeting to discuss the comments.

Central Regulatory Issue

The central regulatory question in license renewal is: What is an adequate licensing basis for renewing the operating license of a nuclear power plant? The following three alternative licensing bases bracket the reasonable possibilities:

1. The original licensing basis of the plant, as amended.

2. The licensing requirements for plants at the time a renewal application is submitted.

3. A modified licensing basis that supplements, as necessary, the original licensing basis in safety significant areas.

For each of these alternative licensing bases, there could be alternative approaches for implementing the safety review of license renewal applications. The NRC has not yet chosen what the licensing basis or the implementing approach will be. While such a choice may ultimately be a policy judgment, that judgment will rest on what is needed to ensure

the continued adequate protection of the public health and safety. Specific considerations will include the relative merits of new versus old technology and other technical strengths and weaknesses that the alternatives may exhibit.

Alternative 1 offers the lowest threshold for license renewal. It requires the evaluation of the adequacy of the plant against its original licensing basis, as amended through subsequent licensing actions. One implementing approach for this alternative would be to leave the existing licensing basis, the current licensing documentation, and the current level of configuration control in their "as is" condition. The largest drawback of this approach is its dependence upon an outdated and an oftentimes poorly recorded licensing basis. An approach that could partially offset this disadvantage would require thorough updating of the final safety analysis report and associated technical documents (analyses, design criteria, specifications, manuals, procedures, etc.) and thorough checking of the present configuration of the plant to demonstrate conformance to the original licensing basis, as amended.

Alternative 2 presents a much higher threshold for license renewal by requiring the use of current standards for new plants. A drawback of this approach, which requires full conformance to current standards, is that it would potentially require redesign and backfit of many safety features, although not all backfits could be justified on a cost/benefit basis. A more practical implementing approach under this alternative would require plant modification based on a comprehensive and systematic evaluation of the design against current standards and permission for justification of deviations. A probabilistic risk assessment (PRA) could be used to assist in justifying deviations from current requirements.

Alternative 3 represents a middle-ground position. It would involve modifying and supplementing the original licensing basis. The implementing approach could focus on requiring conformance either to standards which are specifically developed to be consistent with the safety goals, or to a subset of current standards that are particularly relevant to the risk-significant aspects of plants requesting license renewal. This alternative could employ a plant-specific PRA that could be used to focus licensing attention on the need for new standards to be applied to critical safety functions and equipment in demonstrating design adequacy or in choosing critical elements of a plant for backfitting.

Each of these alternatives could be formulated to address the licensing design basis of the plant, its physical condition, and the expected aging of its components and structures over the renewal term. In addition to those areas, license renewal decisions by the NRC may be influenced by the adequacy of the operating and maintenance organizations of the utility running the plant. The organization and management of

operating plants have been addressed relatively recently. Thus, it is likely that in the future all plants will be judged against current requirements for operations and maintenance, and perhaps other areas such as emergency preparedness and safeguards. It should not be necessary, therefore, to develop new requirements for these items for license renewal.

Even though organizational and management matters may be controlled by current requirements and new requirements may not be required for license renewal considerations, these matters are important and must be considered by the NRC in making a decision to grant a request for license renewal. For example, if a plant is shut down by the NRC or its owner because of an inability to meet regulatory requirements on operations or maintenance, then any license renewal that had been requested would have to be contingent upon coming back into compliance with current requirements on operations and maintenance. In fact, there are several aspects of safe plant operations that the NRC could consider before granting a license renewal and that might lead to contingencies on such a renewal. In addition to operations and maintenance indicators, these other aspects include licensee evaluation and use of operating experience, as well as the performance of the licensee as measured in the NRC's Systematic Assessment of Licensee Performance program or the NRC's performance indicator program.

Thus, at this time, the NRC is considering a range of approaches for ensuring that the material condition of the plant, the licensing basis of the plant, and the performance of the licensee are adequate to support renewal of the license to operate the plant.

Regulatory Options

The regulatory issues concerning license renewal have been categorized under three topics: technological, environmental review, and procedural. At this time, the issues within the technological and environmental topics have been characterized to a greater degree than others.

The technological topics concern (1) verifying the design adequacy of a plant to be relicensed, and (2) compensating for uncertainties related to plant aging that need to be taken into account in relicensing. The two topics are interrelated. This report provides a limited amount of detail on these topics.

Two options are discussed for verifying that the design basis of a plant is adequate for license renewal: the first involves a detailed assessment of safety-significant components subject to aging; the second is based on a PRA of the plant, which also addresses future plant aging. However, even the best estimates of aging effects on plants will involve uncertainties, given our incomplete understanding of the nature of aging mechanisms. Again, two options are presented here for dealing with such

uncertainties: the first emphasizes monitoring, surveillance, inspection, and maintenance to prevent age-related failures before they occur; the second emphasizes providing adequate safety margins through design modifications or additional safety features. The characteristics of the options for addressing the two technological topics are summarized in Tables ES-1 and ES-2. These options should not be considered as mutually exclusive; rather, their identification at this stage is intended to stimulate further discussion and assist in the evaluation of various elements of an overall regulatory approach.

For addressing the environmental review topic, the NRC is considering the preparation of a generic environmental impact statement. This approach would help address potential environmental issues that are common to several or all plants requesting license renewal. It would also identify major factors that could influence the need for site-specific environmental impact statements in making individual relicensing decisions.

The procedural topics relate to the form of the license renewal process, the timing of renewal applications, and concerns regarding the adequacy or consistency of existing policies and regulations for license renewal. The discussion of these topics in this report is intended to elaborate the issues that need to be resolved.

Public Meeting and Future Steps

After the staff has had an opportunity to review all comments received on this report, it will determine whether a public meeting should be held to discuss issues raised in written comments. The public meeting will address the issues and options presented in this report, as well as the public response to specific questions concerning the content of this report.

Questions that the NRC staff would like readers of this report to consider are:

1. Are there any other regulatory options that should be considered for license renewal?

2. What are the relative merits of each option with regard to ensuring the continued adequate protection of the public health and safety?

3. What are the benefits of requiring a licensee to verify its original licensing design basis, as subsequently amended, as a part of the license renewal process?

4. With regard to each of the technological, environmental, and procedural issues, are there any comments or other information that should be considered in their resolution? Comments submitted in response to the November 6, 1986 Federal Register notice are already being considered and need not be repeated.

5. Is there interest in participating in a public meeting that will discuss the comments received? Which issues should be given priority attention in that meeting, if held?

Concurrent with the publication of this report and with subsequent consideration of comments received, the staff is continuing other activities necessary for performing a regulatory analysis and developing a proposed rule on license renewal.

TABLE ES-1
TWO OPTIONS FOR THE ISSUE ON LICENSING DESIGN BASIS

Issue: How should the NRC determine the design adequacy of a plant for continued operation over the renewal term?

Options	Licensee Activities	Areas Requiring NRC Guidance	Attributes
A. Review of safety-significant components and structures subject to age-related degradation. This option provides for the identification and evaluation of significant effects of aging based on operating history and regulatory guidance provided by the NRC.	1. Identification of safety-significant components, systems and structures. 2. Determination of the effects of aging using operating history and mechanistic models. 3. Evaluation of the safety significance of aging effects and proposal of plant modifications needed.	1. Generic list of items for evaluating the effects of aging. 2. Methodology for evaluating the effects of aging and estimating residual life of components and structures.	1. The scope of the licensee's effort will be identified in advance through the generic list of items for review. 2. This option may not provide a comprehensive list of safety-significant items for the plant.
B. Review of plant using a PRA, with emphasis on future plant aging. This option provides for an integrated assessment of the effects of age-related degradation and risk-based prioritization of items for analysis.	1. Preparation of a plant-specific PRA to assist in identifying and prioritizing safety-significant components, systems, and structures. 2. Estimation of the effects of aging in terms of changes in failure probability, system availability, and risk. 3. Identification of any plant modifications needed to reduce the risk due to continued aging.	1. As in item (2) above. 2. Analytical techniques to incorporate aging effects into PRA, particularly for passive components and structures. 3. Criteria for determining the risk significance of components and structures.	1. PRA provides a tool for understanding system interactions, relative importance of components, and additional risk due to aging. 2. The methodology for incorporating aging effects into a PRA has not been completely developed and verified.

TABLE ES-2
TWO OPTIONS FOR THE ISSUE ON UNCERTAINTIES IN AGE-RELATED DEGRADATION

Issue: What is needed to reduce and manage the uncertainties related to the aging of components, systems, and structures in order to ensure that nuclear plants will continue to operate safely over the renewal term?

Options	Licensee Activities	Areas Requiring NRC Guidance	Attributes
A. Emphasize maintenance, inspection, and reliability assurance. This option provides for the systematic identification and prevention of potentially significant age-related failures.	1. Develop measures for tracking and trending the performance of safety-significant components. 2. Assess historical and current plant performance relative to the reference performance levels. 3. Implement changes to meet reference performance levels. 4. Monitor plant performance to ensure effective management of aging effects.	1. Methodology and criteria for developing performance measures. 2. Monitoring and maintenance programs for age-related degradation. 3. Equipment qualification procedures from an aging perspective.	1. Reduces uncertainties through maintenance and replacement before actual failures occur. 2. Offers flexibility in identifying and implementing corrective actions. 3. Requires additional monitoring and performance trending techniques.
B. Emphasize defense-in-depth against age-related failures. This option would ensure that, given the uncertainties in age-related failures, safety systems will be adequate to meet potential challenges to the plant.	1. Assess the capabilities of safety systems and containment. 2. Identify areas where safety margins may be reduced because of aging effects, and propose equipment upgrades and other design modifications. 3. Ensure that sufficient safety margins exist following proposed replacements or additional safety features.	1. Methodology and criteria for age-related assessments of safety systems and containment. 2. Criteria for acceptable safety margins for safety systems and structures. 3. Design and qualification of new safety features for accident prevention or mitigation.	1. Provides effective and visible safety upgrades. 2. Requires additional analysis of system interactions to assess the impact of design changes.

1. INTRODUCTION

1.1 Background

The NRC has begun to develop nuclear plant license renewal regulations that will ensure the continued safe operation of relicensed power plants, as well as continued compliance with the National Environmental Policy Act (NEPA).

The Atomic Energy Act of 1954 provides a statutory limit of 40 years for the duration of licenses issued by the NRC to electric utilities that operate commercial nuclear power plants. Until recently, this term started with issuance of the plant construction permit. With construction periods ranging from 3 to 11 years, the productive life of a plant would be significantly less than 40 years.

In 1982, the NRC determined that the 40-year license term could begin with issuance of the operating license, and this became standard practice for the licensing of subsequent commercial nuclear plants. More recently, a few of the earlier plants have been granted license term adjustments or extensions: the expiration date of their initial license has been extended to recover the construction time and allow a full-term operating license of 40 years. Several other plants have already applied for such extensions, and the remainder are expected to follow suit. Based on the assumption that all current operating licenses will be extended to 40-year terms, license expiration schedules range from years 2000-2028.

License renewal for a commercial power plant denotes the NRC's possible future action allowing the plant to operate beyond the initial or extended term of 40 years. Such an action by the NRC is explicitly permitted by the Atomic Energy Act. However, the regulatory requirements for the scope and content of license renewal applications, the criteria for evaluating such applications, and the procedures for submitting and reviewing them are yet to be established.

License renewal by the NRC is obviously a prerequisite to the plant life extension being considered by several licensees. To support plant life extension, the nuclear industry has undertaken studies to evaluate the aging of hardware and its effect on plant reliability and safety. In particular, the industry has formed the Nuclear Plant Life Extension (NUPLEX) Steering Committee. In addition, under the sponsorship of the Electric Power Research Institute (EPRI) and the Department of Energy (DOE), pilot studies have been conducted at two nuclear plants to determine which components and structures could be affected by aging, and how their longevity can be assessed. The industry, as represented by NUPLEX, has stressed the need for early decisions--approximately 12 years prior to license expiration--concerning license renewal and plant life

extension beyond 40 years. This need is based on two assumptions: a typical utility power replacement and planning cycle of 10 years and a period of two years for the NRC's review of license renewal applications.

In light of industry initiatives and in recognition of the need to resolve all issues affecting public health and safety in a timely manner, the NRC has undertaken its effort to develop regulations for license renewal. On November 6, 1986, the NRC issued a request for comments from the public, industry, and other government agencies on the development of a policy for nuclear power plant license renewal (Ref. 1). This request posed several questions, which are listed in Appendix A. These questions are paraphrased below:

1. Timeliness of the policy. To what extent should the NRC proceed now with policy development? By what time should the policy be in place?

2. Timing and length of license renewal requests. What should be the criteria for a timely and sufficient request? What should be the duration of interim operation while the request is under review?

3. Acceptable level of plant safety. How should the NRC use performance-based information and probabilistic risk assessment (PRA) in the application review? Should the plants conform to all regulations in effect at the time of renewal application? Should the intent of renewal be factored into backfitting* considerations?

4. Scope of plant life extension applications. Should renewal be for a specific period of time? Should requirements vary according to duration? Which licensing criteria are not appropriate? To what extent should operating history be considered?

*Backfitting refers to regulatory requirements that are imposed after an operating license has been granted and that were not a condition of the original license. Included are modifications to systems, structures, components, designs, and procedures resulting from changes in the rules or staff guidance interpreting the rules. Formal procedures for analyzing and implementing backfits were implemented in 1985.

5. Technical considerations. Which plant components will require residual lifetime evaluations? What are the major technical parameters and criteria for renewal consideration? What monitoring and maintenance programs are needed to ensure safety? Which are the major "leadtime" monitoring items? How should codes and standards be revised? How should the ongoing investigations and research be coordinated in order to avoid duplication?

6. Resolution of issues. What should be the schedule for the resolution of license renewal issues?

7. Procedural considerations. Should licensing procedures change for renewals? If so, how?

Public comments received in response to the NRC's request have been analyzed. A summary of that analysis is provided in Appendix B. The issues identified through this analysis are technological, environmental, or procedural in nature. These are being addressed by the NRC staff and its contractor, the MITRE Corporation. This effort has also involved identifying and characterizing ways of dealing with these issues, primarily those concerning technology and environment. This report describes the results of the NRC and MITRE effort.

1.2 Definitions

In order to permit discussion on a common basis, a working language needs to be established. Terms used for this purpose are as follows:

1. Alternative regulatory approaches--broad measures available for relicensing nuclear plants in a manner that ensures their continuing operation within acceptable standards for both safety and maintenance of environmental quality.

2. Topics--fifteen areas identified through analysis of public comments in response to the NRC request.

   Topics are further categorized as follows:

   a. Technological--those applying primarily to the components and structures of the nuclear plant and directly affecting safe

operations. This category consists of two topics: licensing design basis* and uncertainties in age-related degradation.**

b. Environmental--a single topic addressing continued compliance with NEPA to ensure the protection of public health and the environment.

c. Procedural--those encompassing some combination of technological, operational, administrative, and legal factors pertaining to the application for license renewal. The specific topics identified are reasonably discrete and mutually exclusive.

3. Issues--areas of controversy or concern associated with each topic.

4. Option--one of several regulatory ways that NRC might deal with a specific issue.

Issues and options associated with different topics may be interrelated. For instance, the issues and options involved in the specific topic of length of renewal term are not independent of those involved in technological topics.

1.3 Purpose and Scope of the Report

The purpose of this report is to present the status of the current work on license renewal. Consensus on options to be recommended as part of an overall regulatory approach for license renewal must evolve after further analyses have been performed. Those analyses will include

*Design basis is the information that describes the physical configuration of the plant, including its components, systems, and structures; it identifies the functions that the components, systems, and structures are to perform and specifies the values of controlling parameters chosen as the reference bounds for design.

**Age-related degradation is the cumulative deleterious effect of changes that occur over time within plant components and structures. Aging may be caused by several mechanisms: internal chemical or physical processes during operation; environmental conditions such as temperature, pressure, and humidity; and stresses arising from service wear, abnormal operating events, testing, and maintenance practices. Since the resulting changes may adversely affect plant safety and reliability, age-related degradation is a continuing concern for any nuclear plant, even during its initial license term.

consideration of public comments received on the material in this report. In particular, comments are solicited on the following set of questions concerning the content of this report:

1. Are there any other regulatory options that should be considered for license renewal?

2. What are the relative merits of each option with regard to ensuring the continued adequate protection of the public health and safety?

3. What are the benefits of requiring a licensee to verify its original licensing design basis, as subsequently amended, as a part of the license renewal process?

4. With regard to each of the technological, environmental, and procedural issues, are there any comments or other information that should be considered in their resolution? Comments submitted in response to the November 6, 1986 Federal Register notice are already being considered and need not be repeated.

5. Is there interest in participating in a public meeting that will discuss the comments received? Which issues should be given priority attention in that meeting, if held?

This set of questions is not exhaustive; therefore, comments on any additional questions raised by this report are welcome. Any additional written comments should be keyed to the specific sections in this document.

Since this is a status report, its scope reflects differences in the degree to which various topics have been developed. The development of technological and environmental topics is more complete than that of the procedural topics. One purpose of inviting comments and stimulating discussion on a broad front is to obtain additional insight and clarification. The results will further guide the development and selection of options and the formulation of draft regulations.

The next section describes the approach used to characterize topics and develop options. The technological and environmental topics and issues are addressed in Sections 3 and 4, respectively. The procedural topics and issues are characterized in Section 5.

1.4 Public Meeting and Future Steps

After the staff has had an opportunity to review all comments received on this report, it will determine whether a public meeting should be held

to discuss issues and concerns raised in written comments. If the staff decides to hold a public meeting, it would be held approximately 4 weeks after the close of the comment period. A notice of dates, times, place, and an agenda will be published in the Federal Register within 10 days after the end of the comment period and will be mailed to all parties submitting written comments.

Concurrent with publication of this report and with subsequent consideration of comments received, the staff is continuing other activities necessary for performing a regulatory analysis and developing a proposed rule on license renewal. It is anticipated that a proposed rule will be published in the Federal Register in the summer or fall of 1989, and that public meetings will be held 2 to 3 months thereafter. It is anticipated that the final rule will be issued in 1991.

2. APPROACH TO DEVELOPMENT OF OPTIONS

This section presents a discussion of the general approach to the development of regulatory options for license renewal. An integral part of this approach is the characterization of topics and issues. This characterization is based on consideration of public comments on the questions posed by the NRC, along with analysis of regulatory needs.

Alternative regulatory approaches for plant license renewal are also presented. Consideration of these approaches provides a framework for describing and characterizing options for addressing the specific license renewal issues.

2.1 Characterization of Topics and Their Relationship to Issues and Options

Figure 2-1 shows a systematic approach for formulating and evaluating options. Work has been completed on items enclosed in solid boxes. The analysis of public comments has resulted in the identification and categorization of topics and the characterization of related issues. Specific options have been formulated for the prospective resolution of technological issues.

The specific topics and their structural relationship to related issues and options are depicted in Figure 2-2. The dashed lines depict potential interrelationships among the issues and options under the various topics.

2.2 Alternative Regulatory Approaches: A Framework for Development of Options

The pursuit of regulations on plant relicensing is basically a matter of answering the question: How can the NRC be assured that a nuclear power plant, if relicensed for operation beyond its original 40-year term, will not endanger public health or safety or the environment? While there are many important procedural and legal aspects to this question, the NRC's answer to the key safety aspects are likely to be embodied in its requirements for the review of the licensing basis and physical condition of the plant to be relicensed. Therefore, the central regulatory question may be phrased as: What is an adequate licensing basis for renewing the operating license of a nuclear power plant?

In the absence of technically valid arguments that nuclear power plants cannot be operated safely beyond their original license term, there is a range of possible relicensing approaches. Each has advantages and disadvantages. The following three alternative licensing bases bracket the reasonable possibilities:

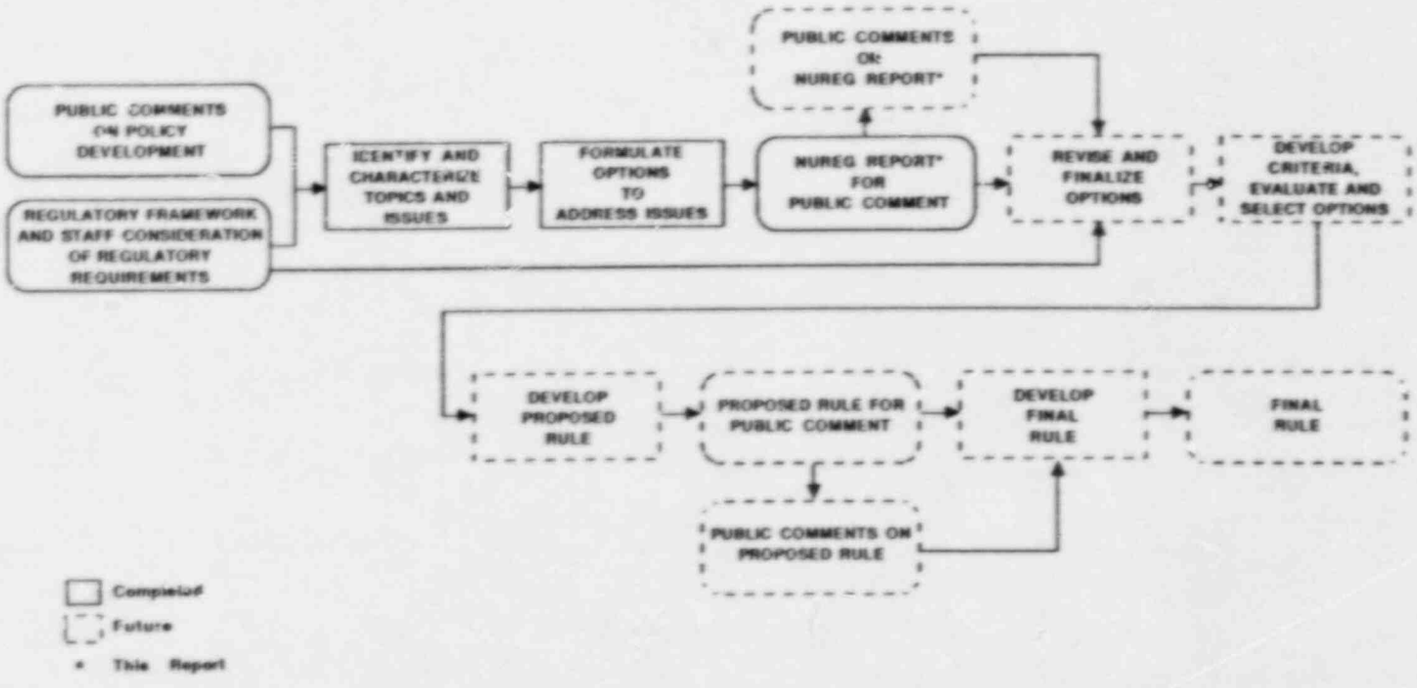

FIGURE 2-1
APPROACH TO THE PROCESS OF DEVELOPING REGULATIONS
FOR RELICENSING NUCLEAR POWER PLANTS

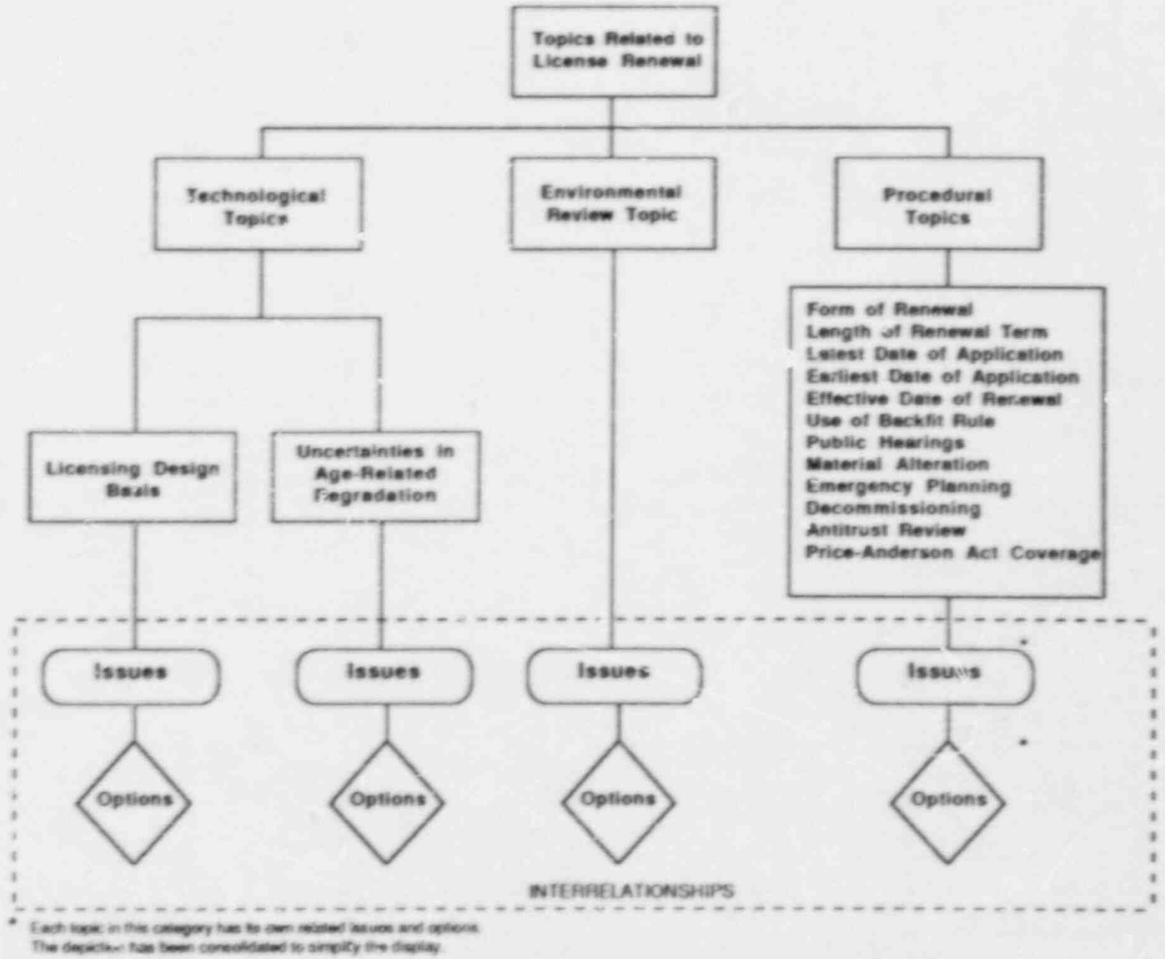

FIGURE 2-2
CATEGORIZATION OF LICENSE RENEWAL TOPICS
AND RELATIONSHIP TO ISSUES AND OPTIONS

1. The original licensing basis of the plant, as amended.

2. The licensing requirements for plants at the time a renewal application is submitted.

3. A modified licensing basis that supplements, as necessary, the original licensing basis in safety significant areas.

For each of these alternative licensing bases, there could be alternative approaches for implementing the safety review of license renewal applications. The NRC has not yet chosen what the licensing basis or the implementing approach will be. Such a choice may ultimately be a policy judgment that will rest on what is needed to ensure the continued adequate protection of the public health and safety. Specific considerations will include the relative merits of new versus old technology and other technical strengths and weaknesses that the alternatives may exhibit.

At one extreme, the NRC could adopt the posture that if a plant is operating satisfactorily on the day before its original license expires, then it can safely be operated beyond that date if it remains in compliance with the following: (1) all requirements applicable to that plant at that time, and (2) all modifications of those requirements that the NRC might, as a result of its normal procedures, subsequently hold to be necessary. This approach would allow continued operation, much as before, relying on normal NRC and licensee operating procedures to disclose and correct any problems that might arise in the future. The largest drawback of this approach is its dependence upon an outdated and an oftentimes poorly recorded licensing basis. At the other extreme is an approach that would require the licensee to demonstrate, de novo, compliance with all regulatory requirements applicable to the startup of a new plant. This relicensing approach could require plant shutdown and extensive plant modifications.

Not surprisingly, there is a spectrum of approaches that lie between the extremes and may embody some features of the extremes in varying degree. An approach that could partially offset the disadvantage of accepting the existing licensing basis in its "as is" condition would require thorough updating of the final safety analysis report and associated technical documents (analyses, design criteria, specifications, manuals, procedures, etc.) and thorough checking of the present configuration of the plant to demonstrate conformance to the original licensing basis, as amended through subsequent licensing actions. A more practical implementing approach to requiring compliance with all regulatory requirements applicable to the startup of a new plant would require plant modification based on an integrated evaluation of the design against current standards and permission for justification of deviations. A PRA

could be used to assist in justifying deviations from current requirements. Still another approach could involve modifying and supplementing the original licensing basis. In implementing this approach, the NRC could focus on requiring conformance either to standards that are specifically developed to be consistent with the safety goals or to a subset of current standards that are particularly relevant to the risk-significant aspects of plants requesting license renewal. This approach could employ a plant-specific PRA that could be used to focus licensing attention on the need for new standards to be applied to critical safety functions and equipment in demonstrating design adequacy or in choosing critical elements of a plant for backfitting.

Another aspect of these approaches requiring additional consideration relates to the choice of analytical techniques for conducting safety reviews and for identifying any necessary plant modifications. A variety of analytical tools are available, ranging from detailed evaluation of aging effects for a particular component to conducting a plant-wide PRA. Some techniques may be better suited to one approach than to another.

Each of these alternatives could be formulated to address the licensing design basis of the plant, its physical condition, and the expected aging of its components and structures over the renewal term. All of the above are presented as possible approaches, not as discrete alternatives from which a choice must be made. Further analysis is needed to determine which of them or, more likely, what combination is best for the NRC to pursue. Each approach involves addressing both technical and procedural issues whose analysis would lead to specific implementable options. The NRC's regulations for relicensing could then be based on the most satisfactory set of those options.

In addition to those areas, license renewal decisions by NRC may be influenced by the adequacy of the operating and maintenance organizations of the utility running the plant. The organization and management of operating plants have been addressed relatively recently. Thus, it is likely that in the future all plants will be judged against current requirements for operations and maintenance and perhaps other areas such as emergency preparedness and safeguards. It should not be necessary, therefore, to develop new requirements for these items for license renewal.

Even though organizational and management matters may be controlled by current requirements and new requirements may not be required for license renewal considerations, these matters are important and must be considered by the NRC in making a decision to grant a request for license renewal. For example, if a plant is shut down by NRC or its owner because of an inability to meet regulatory requirements on operations or maintenance, then any license renewal that had been requested would have to be contingent upon coming back into compliance with current requirements on

operations and maintenance. In fact, there are several aspects of safe plant operations that NRC could consider before granting a license renewal and that might lead to contingencies on such a renewal. In addition to operations and maintenance indicators, these other aspects include licensee evaluation and use of operating experience, as well as the performance of the licensee as measured in NRC's Systematic Assessment of Licensee Performance program or NRC's performance indicator program.

Section 3 starts from this general framework and outlines specific regulatory options for addressing technological topics and issues. After considering the full spectrum of approaches described above, the options were developed on the basis of a narrower range of approaches that reflect the following two underlying premises. The first is that since the licensing design basis of operating plants is continually reviewed as part of the NRC's normal procedures, the plant being considered for relicensing warrants a special review only from the standpoint of plant aging. The second is that the analysis of plant-specific and generic operating data will be adequate to do the following: (1) identify those safety-significant components that are susceptible to age-related degradation, and (2) suggest operating procedures and maintenance, inspection, and replacement schedules that would ensure safe operation in the future. While these premises could change in the future, they form the basis for the following discussion of the technological topics.

3. TECHNOLOGICAL TOPICS

The NRC is responsible for determining that the operation of a nuclear power plant does not result in undue risk to the public or the environment. This is the principal consideration when an operating license is granted for the initial 40-year term, and it is a continuing concern throughout the operating life of a plant. An important factor in making this determination is the NRC's review of the design of the plant. In order to renew the operating license of a nuclear power plant, the NRC must determine that continued age-related degradation of plant components and structures over the renewal term will not compromise the licensing basis of the plant. This determination must take into account the uncertainties involved in predicting the rates and effects of aging. The issues concerning this determination are discussed below under two interrelated topics:

1. Licensing design basis.

2. Uncertainties in age-related degradation.

The first topic concerns verifying the adequacy of the licensing design basis of a plant to be relicensed for an additional term; the second concerns compensating for the uncertainties related to plant aging that need to be taken into account in a relicensing decision. Regulatory options are outlined for each topic. These options are not intended to be mutually exclusive. Final formulation of a regulatory approach to address the technological issues could be based on a combination of varying emphases on the options identified. The identification of options at this stage is intended to stimulate further discussion and assist in the evaluation of various elements of an overall regulatory approach.

3.1 Licensing Design Basis

In granting an initial operating license, the NRC makes a finding of compliance with current regulations, taking into account the 40-year license term. If compliance with current regulations were applied to license renewal, the NRC would have to decide how to interpret its regulations and what criteria to use in carrying out the safety review of a plant seeking to be relicensed. The issue under this topic may be stated as follows:

> How should the NRC determine the design adequacy of a plant for continued operation over the renewal term?

3.1.1 Discussion of Issue

Detailed interpretation of the regulations used by the NRC in carrying out the safety review of nuclear plants is contained in regulatory guidance documents such as the standard review plan, regulatory guides, and branch technical positions. Since the earliest nuclear power plants were designed and built, the regulatory guidance provided by the NRC has evolved to become much more detailed and comprehensive. This evolution is consistent with the increase in safety information resulting from the analysis of nuclear plant operating experience, regulatory research activities, and further development of design codes and standards.

Consideration of how the NRC will conduct a safety review of the plants requesting license renewal has two aspects. The first is whether the plants to be relicensed should be reviewed again with respect to the current regulatory guidance for licensing. The other aspect concerns the status of the NRC's regulatory guidance for verifying the future operational safety of plant components subject to aging mechanisms such as thermal cycling, corrosion, erosion, and vibration.

Older plants and current regulatory guidance. Although already licensed and operating nuclear plants may not have been comprehensively reviewed with respect to the most current interpretation of regulations, the NRC has regulatory activities and programs to identify safety-significant design and operational deficiencies. Thus, as new regulations and regulatory guidance are developed, the NRC determines whether they apply to plants with operating licenses or if there is a basis for granting regulatory exemptions. The NRC's ongoing regulatory activities include monitoring and evaluating plant operating experience to identify and resolve potential safety problems. Its program on the resolution of generic safety issues addresses a broad range of safety concerns including the availability of decay heat removal and electrical supply systems. Examples of past and future regulatory programs that involve the review of plant design include: (1) Three Mile Island (TMI) Action Plan; (2) Systematic Evaluation Program (SEP); (3) Integrated Safety Assessment Program (ISAP); and (4) Individual Plant Evaluations (IPEs).

In response to the TMI accident, the NRC carried out a number of investigations concerning the adequacy of design features and operating procedures of nuclear plants. The TMI Action Plan required 132 different types of actions, with an average of 90 actions per plant.

The SEP was specifically undertaken by the NRC to achieve the following: to address the evolutionary nature of licensing requirements and developments in plant technology and safety; and to examine potential gaps that occurred between development of the licensing design basis for

the earliest plants and the more recent licensing design basis. Initiated in 1977, the SEP had the following major objectives:

1. To assess the significance of differences between current technical positions on safety issues and those that existed when a particular license was issued.

2. To provide an integrated plant review as a basis for deciding how these differences should be resolved.

3. To provide a documented evaluation of plant safety.

The SEP involved detailed review of the design and operating experience of several older plants. The results of that review showed that for about two-thirds of the safety issues arising from possible deviations of the design basis from current regulatory requirements, the plant met the intent of current criteria or had design features that performed safety functions equivalent to those currently required. For the remaining issues, the NRC required the utilities to undertake hardware or operational changes amounting to a combined total of about 300 specific actions.

In 1984, the NRC initiated the ISAP for additional plants. The ISAP is an expanded version of the SEP; it also includes an implementation plan that prioritizes recommended corrective actions based on plant-specific PPA and operating experience.

As part of the implementation of the severe accident policy, the NRC is considering a requirement for each licensee to carry out an IPE in order to identify severe accident vulnerabilities. The IPE will also address the management of severe accidents.

Through programs such as the SEP and the others mentioned above, the NRC monitors safety issues on a continuous basis, addresses safety concerns, and requires modifications to operating plants as needed. The goal of these ongoing programs is to ensure that the existing licensing design bases of operating plants are adequate, even if they differ from the design bases of new plants. It is assumed in the following discussion that additional analysis, documentation, and review would not be required for revalidating the design basis with respect to all facets of the most current regulatory guidance. Therefore, no options are presented for addressing this aspect of the design basis issue.

Regulatory guidance and aging effects. The second aspect of safety review for relicensing relates to regulatory criteria or standards for assessing and predicting the effects of aging that are significant for future plant safety. The concern is as follows: to determine the remaining safe operating life of a plant requesting license renewal, it is

necessary to examine the plant's design basis from the perspective of its condition at the time of renewal, based on its past operating history. The safety review criteria the NRC might adopt to judge aging effects could affect the design basis of a plant preparing for a renewal term since they may have been designed without the full benefit of current understanding of aging phenomena. For example, the identification of single failure* points in certain passive components or common-mode failures due to age-related degradation could result in design modifications, specification of conditions for renewal, or limitation of the renewal term.

The NRC already has in place regulations and requirements for several selected plant components and procedures. The latter include reactor pressure vessel surveillance; inservice inspection and testing of components such as safety-related pumps and valves; testing and surveillance of containment structures; and qualification of electrical, instrumentation, and control equipment. The NRC also has a comprehensive program (Ref. 2) to develop further regulatory guidance that would be needed to assess the effects of aging in plants to be relicensed. The results of this program would lead to revisions of the current safety review methodology. The program includes the following activities:

1. Developing information concerning which components, systems, and structures are susceptible to aging, particularly those that are important to plant safety.

2. Understanding degradation mechanisms for those components, systems, and structures that are susceptible to aging.

3. Collecting as complete a failure and reliability data base as is practical.

4. Developing methods for evaluating the residual life of components; validating models for failure prediction.

5. Identifying methods of inspection, surveillance, and monitoring to ensure timely detection of aging prior to loss of safety functions.

6. Identifying effective storage, maintenance, repair, and replacement practices to mitigate the rate and extent of aging.

The NRC's regulatory research programs on aging have already identified a number of plant components as being of particular

*A single failure is an occurrence that results in the loss of capability of a system to perform its intended safety functions. Multiple failures resulting from a single occurrence are considered to be a single failure.

significance. These include structures and passive components such as the reactor pressure vessel, reactor coolant piping, and cables; they also include active components such as emergency diesel generators and control rod drive mechanisms. Research into aging phenomena has helped resolve issues related to pressurized thermal shock (PTS) and boiling water reactor pipe cracking. Several aging phenomena appear to be readily manageable as long as the licensee implements appropriate maintenance, test, and inspection activities.

Assessing the condition of a plant's components and structures and licensing the plant for an additional term could require detailed information that would support estimates of remaining safe life or failure probabilities of safety-significant components. Several plant components are designed for a certain number of duty cycles or transients that are not expected to be exceeded during the term of the initial operating license. Other components not so designed require replacement during the operating term. The remaining life of a component will obviously depend upon the age-related degradation modes affecting it, such as fatigue, corrosion, erosion, wear, radiation hardening, and chemical composition changes. The following are examples of information and data that could be used in reviewing the design basis of a plant to be relicensed:

1. Design basis information, such as performance requirements; composition and thickness of materials (for example, weld materials); anticipated number of cycles; and design basis temperatures and pressures.

2. Normal operational transients, including transitions to and from power, primary system heatup and cooldown cycles, reactor trips from power, load runback events, primary system hydrostatic tests, and reactor coolant system (RCS) depressurizations.

3. Unexpected or infrequent transients or events, such as rapid cooldown or heatup transients, step load decreases, safety injection occurrences, loss of offsite power events, seismic events, and inadvertent RCS depressurizations.

4. Test results from initial equipment, system, and materials qualification; accelerated life testing; and in-plant testing.

5. Inspection results from surveillance capsules, ultrasonic testing, dye testing, radiography, visual examinations, ex-vessel neutron monitoring, and nondestructive examinations (NDEs).

6. Component failures, including time-to-failure and time-to-repair histories; root causes; corrective actions; and implications for other components, systems, or structures.

7. Maintenance activities, such as type and frequency of maintenance, replacement intervals, test schedules, and implications of past maintenance practices for safety functions.

The following subsection addresses the regulatory options for taking account of such information in approving the design adequacy of a plant for license renewal.

3.1.2 Discussion of Options

The options outlined here are alternative ways of determining the design adequacy of a plant for continued operation over the license renewal term, taking into account the type of technical information described above in the safety review of applications for license renewal:

A. Review of safety-significant components and structures subject to age-related degradation.

B. Review of the plant using a PRA, with emphasis on future plant aging.

Both options would use the complete body of regulatory guidance on assessing the effects of aging at the time of a license renewal application. Under Option A, the licensee would do the following: assess aging effects on safety-significant aspects of plant design and operation; identify potential problems that could compromise safety during the renewal term; and propose or carry out the necessary plant modifications. Option B is intended to be more comprehensive. It would require the licensee to prepare a PRA explicitly taking into account the effects of continued plant aging. A PRA integrates all plant systems into a framework providing information on component importance, system performance, and overall safety on a plant-specific basis. Therefore, the aspects of the plant identified as significant to risk over the renewal term, and the measures proposed for continued safe operation of the plant, could be different from those under Option A.

The characteristics of the two options are further discussed below, and summarized in Table 3-1.

Option A: Review of safety-significant components and structures subject to age-related degradation.

Licensee Activities. The implementation of this option would require the following licensee activities:

1. Identification of safety-significant components, systems, and structures. The licensee would use NRC guidance and various

TABLE 3-1
TWO OPTIONS FOR THE ISSUE ON LICENSING DESIGN BASIS

Issue: How should the NRC determine the design adequacy of a plant for continued operation over the renewal term?

Options	Licensee Activities	Areas Requiring NRC Guidance	Attributes
A. Review of safety-significant components and structures subject to age-related degradation. This option provides for the identification and evaluation of significant effects of aging based on operating history and regulatory guidance provided by the NRC.	1. Identification of safety significant components, systems and structures. 2. Determination of the effects of aging using operating history and mechanistic models. 3. Evaluation of the safety significance of aging effects and proposal of plant modifications needed.	1. Generic list of items for evaluating the effects of aging. 2. Methodology for evaluating the effects of aging and estimating residual life of components and structures.	1. The scope of the licensee's effort will be identified in advance through the generic list of items for review. 2. This option may not provide a comprehensive list of safety-significant items for the plant.
B. Review of plant using a PRA, with emphasis on future plant aging. This option provides for an integrated assessment of the effects of age-related degradation and risk-based prioritization of items for analysis.	1. Preparation of a plant-specific PRA to assist in identifying and prioritizing safety-significant components, systems, and structures. 2. Estimation of the effects of aging in terms of changes in failure probability, system availability, and risk. 3. Identification of any plant modifications needed to reduce the risk due to continued aging.	1. As in item (2) above. 2. Analytical techniques to incorporate aging effects into PRA, particularly for passive components and structures. 3. Criteria for determining the risk significance of components and structures.	1. PRA provides a tool for understanding system interactions, relative importance of components, and additional risk due to aging. 2. The methodology for incorporating aging effects into a PRA has not been completely developed and verified.

information sources (such as safety analyses, operating experience, insights gained from available PRAs, and expert judgment) to develop a list of items requiring detailed analysis for aging effects. Technical information from vendors of nuclear plant components, as well as reliability data bases maintained by the nuclear industry, would also be important in identifying key operating transients, degradation mechanisms, and affected components.

2. Determination of the effects of aging on the performance of safety-significant items. The NRC and the industry have developed or are developing models for evaluating the residual life of items subject to age-related degradation. Information from the plant's operating history regarding operational loads, environmental conditions, maintenance, inspection, and testing provides a profile of the dominant modes of degradation for components and structures. This information can be translated into estimates of corrosion, creep, fatigue, and embrittlement, using the mechanistic models and information about the design basis. The analysis would be supplemented with tests and measurements to confirm the estimates. Further analysis would determine the effects of aging mechanisms on the integrity or performance of the item.

3. Evaluation of the safety significance of aging effects. The licensee would ensure that the anticipated age-related failures would not compromise safety. Safety analysis methods would identify potential single failure points, common mode failures, and adverse system interactions. Estimates of the residual life of critical components, along with proposed plans for inspection, testing, maintenance, and replacement activities, would be used to justify the proposed term for a renewal license.

NRC Guidance. The following items elaborate the type of guidance the NRC could provide for licensee activities related to the selection and evaluation of safety-significant plant items under this option:

1. Development of a generic list of review items. Using its research on aging and evaluations of operating data, the NRC would develop a list of topics related to the design or operational aspects of plants that have potentially significant safety implications. Since safety significance can be determined accurately only on a plant-by-plant basis, the preparation of this generic list would require careful structuring and formulation. Such a list could then be used by the licensee to determine which of the generic review items selected by the NRC are applicable to the plant. NRC guidance keyed to a generic list of review topics would help

define in advance the physical scope of the plant and the plant history data on which the licensees need to focus their efforts.

2. Evaluation of aging effects. As already noted, the NRC is currently revising its safety review procedures to include explicitly the assessment of aging effects. Considerable information already exists on safety-significant plant components, methods to assess their residual life, and appropriate inspection and surveillance procedures needed for safety assurance. In particular, the NRC review of aging effects would have to consider both single failure points within passive components or structures and common mode failures, which may be areas requiring further safety review criteria.

Option B: Review of the plant using a PRA, with emphasis on future plant aging.

The motivation for requiring the licensee to carry out a plant-specific PRA is to account for the effects of aging as they relate to interactions between systems system reliability, and the prioritization of items requiring analysis or review for a particular plant. The detailed analysis required to assess the effects of aging, such as fatigue due to thermal cycling and stress corrosion cracking, would be carried out where appropriate on all risk-significant items using the same methods as in Option A. However, the PRA provides a tool for expressing the effects of aging in terms of changes in failure probability, system availability, and risk.

Licensee Activities. The implementation of this option would require the following licensee activities:

1. Preparation of a PRA to identify risk-significant components and structures. In preparing the PRA, the licensee would compile information such as that indicated in Section 3.1.1 and carry out a failure modes and effects analysis especially to address age-related degradation of plant components and structures. Several measures of risk importance are available to focus attention on those components which are the most significant contributors to risk. Plant-specific variations in design or operating history that could alter the selection of risk-significant components would be an integral part of this approach.

2. Estimation of the effects of aging in terms of changes in system availability and risk. To be useful in this context, the standard procedures for performing a PRA would have to be modified to better account for the effects of aging. For active components such as pumps, valves, or circuit breakers, the impact of aging

would be translated into changes in failure rate as a function of time. The failure rate would depend on several factors, such as operational loads, environmental stressors, and maintenance intervals. For passive structures and components such as piping and vessels, the lack of sufficient failure data makes it difficult to use current PRA techniques to identify their contribution to risk. However, analyses could be carried out to estimate uncertainties due to inadequate data.

3. Demonstration of minimal increase in risk due to continued aging over the renewal term. The PRA would be used to develop optimal intervals for maintenance, testing, and inspection. The licensee would develop an approach for reducing the risk due to identified weaknesses in design or operation. The PRA would be used as a supplemental tool in determining the value of alternative proposed modifications for managing age-related degradation.

NRC Guidance. In addition to the regulatory guidance that the NRC could provide on identifying and evaluating aging effects on components, the preparation of an adequate PRA would require further guidance:

> Examples of areas requiring NRC attention are as follows: (1) the identification of risk-significant plant items, and (2) the data and methods to be used in PRAs to account for increased probabilities of component failure due to age-related degradation. The NRC has in the past issued guidance for preparing a PRA, and it continues to support improvements in PRA techniques. New methods to account for plant aging, and to better handle uncertainties and common mode failures, will enhance the quality of PRAs and increase confidence in applying them. Improvements are also being made in the quality and amount of component failure data collected for components in nuclear plants.

3.2 Uncertainties in Age-Related Degradation

Uncertainties in age-related degradation of components and structures arise from our lack of complete understanding of the nature, effects, and rate of aging and degradation processes. In addition to the normal aging of components, operations and maintenance practices also influence the rate of aging. Therefore, another topic of concern in developing a regulatory approach for license renewal relates to compensating for the uncertainties involved in characterizing and anticipating aging effects. The issue under this topic may be stated as follows:

> What is needed to reduce and manage the uncertainties related to the aging of systems, components, and structures in order to ensure that nuclear plants will continue to operate safely over the renewal term?

3.2.1 Discussion of Issue

As discussed under the previous topic, determination of the adequacy of a plant for continued operation over a renewal term will require current understanding of aging phenomena. The best estimates of component failure probabilities will have uncertainties that will depend on the amount of data available to support assumptions concerning aging mechanisms and the availability and validity of analytical models for predicting age-related failures.

Many factors complicate assessment of the contribution of aging effects to the residual life and usage factor* of various safety-significant plant components and structures. Factors such as the following are sources of uncertainties:

1. Differences in design codes and standards for components of different vintage.

2. Inadequacy of past measurements and records.

3. Limitations in the applicability of time-dependent models for quantifying the contribution of aging to overall system, component, or structure failure.

4. Inadequacy of detection, inspection, surveillance, and maintenance methods for aging components and structures.

5. Inadequacies in identifying and implementing the required adjustments to the operations and management of an aging plant.

Older plants comply to design codes and standards that may have been subsequently revised. For example, early steam generator design practice did not require fatigue evaluation. Assessment of the steam generator's useful life will require such an evaluation, along with the analysis of past records on tube plugging and sleeving.

The inadequacy of past measurements and records could arise from differences in requirements for different vintage plants. Several types of transients may not have been considered in the design basis of primary systems. These include certain hydrostatic tests, turbine runback events, inadvertent depressurizations, and safety injections. Furthermore, the degree of component degradation depends upon the number and kind of transients experienced, as well as upon the magnitude of key operating

*Usage factor is defined as the fraction of design life that has been consumed because of transients experienced.

parameters for the component during each transient. Complete information may not be available for every plant transient that has been experienced.

The ability to predict future failures accurately and to assess the contribution of aging to overall risk also depends on the availability of time-dependent models for quantifying aging effects. Several analytical assessments treat all failures as random, an approach that tends to underestimate risks due to aging significantly. While work in this area is progressing the applicability of the methods developed so far has not been demonstrated fully for many critical components, systems, and structures.

The ongoing NRC and industry programs on plant aging and life extension have identified other areas requiring more research and data. These areas include the following: (1) standardization of inservice inspection programs for identifying deterioration mechanisms and quantification of their effects on concrete components; (2) improved NDE techniques for more accurate quantitative flaw characterization; (3) characterization of thermal aging of cast stainless steel; and (4) feasibility of vessel annealing and replacement.

Plant operations and maintenance practices can themselves impact the rate and nature of aging. Aging can be accelerated by inadequate maintenance, improper or too frequent testing, or excessive cycling from routine and abnormal operations. Similarly, past events, such as those resulting in water hammer, intrusion of heat and humidity, or excessive vibrations, can aggravate normal aging.

Another major area of uncertainty regarding future plant safety pertains to the identification and implementation of various adjustments in operations and management practices needed for managing an aging plant. The effects of age-related degradation on plant operation are numerous. Plant aging necessitates increasingly more extensive inspection, repair, and replacement activities. Aging effects could also influence spare parts inventory management. As plants continue to age, the problem of spare parts availability, especially for older components, becomes more serious. The unavailability of parts could force licensees to rely heavily on repair, instead of replacement, of components. Maintenance work backlogs require attention as well. Increased levels of maintenance increase the potential for personnel errors and unanticipated transients, as well as personnel exposure to radiation. Operator training is another area of concern. The level of operator knowledge and training relative to potential age-related limitations of plant components can influence response to off-normal conditions.

Given these and other concerns, regulatory decisions on relicensing may have to be made in light of uncertainties associated with age-related degradation and without the benefit of definitive technical criteria and

specific regulatory positions on all age-related concerns. If the technical information is insufficient, the NRC may have to take conservative positions in its development of license renewal regulations. The options discussed below consider ways of emphasizing aging management for controlling the uncertainties involved in the data, models, and aging itself and reducing their impact on plant safety. A common characteristic of both options is the development of, and technical justification for, a quality assurance program that ensures continued safe operation of the plant.

3.2.2 Discussion of Options

The following two options are presented as alternative ways of controlling the uncertainties involved in age-related degradation and keeping the risk over the renewal term at an acceptable level:

A. Emphasize maintenance, inspection, and reliability assurance.

B. Emphasize defense-in-depth against age-related failures.

The two options are not mutually exclusive, although one relies more on preventing failures while the other emphasizes equipment upgrades or addition of new safety system features to provide additional defense against age-related failures. Both options are currently used for ensuring the safety of nuclear power plants.

The characteristics of the above options are discussed below and summarized in Table 3-2.

Option A: Emphasize maintenance, inspection, and reliability assurance.

This option would help ensure that age-related failures that could impact safety significantly would be identified systematically and appropriate measures taken for their prevention. The emphasis placed on monitoring, inspection, surveillance, and maintenance of safety-significant plant components would reduce the potential impact of uncertainties due to age-related degradation.

Licensee Activities. The implementation of this option would require the following licensee activities:

1. Development of measures for tracking and trending the performance of safety-significant components according to NRC guidelines. The licensee would propose a desired level of performance, which would be consistent with an acceptable level of plant safety and would be tailored to specific plant configuration and conditions. For active systems and components, the performance level could be

TABLE 3-2
TWO OPTIONS FOR THE ISSUE ON UNCERTAINTIES IN AGE-RELATED DEGRADATION

Issue: What is needed to reduce and manage the uncertainties related to the aging of components, systems, and structures in order to ensure that nuclear plants will continue to operate safely over the renewal term?

Options	Licensee Activities	Areas Requiring NRC Guidance	Attributes
A. Emphasize maintenance, inspection, and reliability assurance. This option provides for the systematic identification and prevention of potentially significant age-related failures.	1. Develop measures for tracking and trending the performance of safety-significant components. 2. Assess historical and current plant performance relative to the reference performance levels. 3. Implement changes to meet reference performance levels. 4. Monitor plant performance to ensure effective management of aging effects.	1. Methodology and criteria for developing performance measures. 2. Monitoring and maintenance programs for age-related degradation. 3. Equipment qualification procedures from an aging perspective.	1. Reduces uncertainties through maintenance and replacement before actual failures occur. 2. Offers flexibility in identifying and implementing corrective actions. 3. Requires additional monitoring and performance trending techniques.
B. Emphasize defense-in-depth against age-related failures. This option would ensure that, given the uncertainties in age-related failures, safety systems will be adequate to meet potential challenges to the plant.	1. Assess the capabilities of safety systems and containment. 2. Identify areas where safety margins may be reduced because of aging effects, and propose equipment upgrades and other design modifications. 3. Ensure that sufficient safety margins exist following proposed replacements or additional safety features.	1. Methodology and criteria for age-related assessments of safety systems and containment. 2. Criteria for acceptable safety margins for safety systems and structures. 3. Design and qualification of new safety features for accident prevention or mitigation.	1. Provides effective and visible safety upgrades. 2. Requires additional analysis of system interactions to assess the impact of design changes.

measured in terms of availability. However, for passive components or structures, a more appropriate performance measure might be the assurance of functional capability throughout the renewal term, through estimates of the residual life of a component or structure.

2. Assessment of historical and current plant performance relative to reference performance levels. This assessment would be based on the results of analysis carried out to determine the adequacy of the licensing design basis from the point of view of plant aging over the renewal term. The analysis of each safety-significant item would have included an explicit examination of the following aspects of aging: (a) dominant modes of degradation; (b) environmental conditions and operational loads; and (c) current condition and expected rate of future change.

3. Implementation of changes to meet reference performance levels. The licensee would implement or propose solutions to any identified discrepancies between expected performance and reference performance levels. These solutions could include the replacement of equipment and improvements to plant operational and management practices in areas such as the following:

   a. Preventive maintenance.

   b. Outage planning and replacement and refurbishment strategy.

   c. Evaluation of degradation resulting from past events.

   d. Maintenance and repair backlog.

   e. Management of spare parts inventory.

   f. Investigation of failures due to equipment aging and degradation.

   g. Training of operations and maintenance personnel to detect and manage age-related degradation.

   The following are some examples of changes that emphasize the preventive approach:

   a. Replace selected components if there is already indication of significant deterioration due to aging or if the components are expected to age significantly in the future.

b. Reduce the maintenance interval, and improve the quality of maintenance.

c. Change the testing procedures or intervals if the tests accelerate degradation.

d. Alter the environmental conditions or operational loads to reduce the rate of aging. This could include reducing neutron fluence near critical structures; changing the configuration of equipment or pipes or adding supports to reduce vibration; or changing water chemistry to reduce stress-corrosion cracking.

4. Monitoring the condition of safety-significant items. The licensee would develop a program to check the assumptions applied in the analysis of aging effects and to monitor key parameters of safety-significant items. This would ensure that the plant would not experience degradation at a faster rate than predicted. The licensee would check assumptions directly with tests and inspections, as in the following examples: (a) ultrasonic tests could be performed to check the level of stress-corrosion cracking; (b) failure times and repair times of active components could be used to check availability; and (c) the number of scrams and other normal transients could be recorded. Other items may be more difficult to check directly so that in some cases aggregate measures of performance would be appropriate. For example, the number of items in the maintenance backlog is one measure of the effectiveness of the maintenance program. The program would also emphasize condition-monitoring schemes that would provide the means to recognize component degradation and determine failure mechanisms that cause equipment deterioration. The program would be structured to identify and resolve problems arising from the analysis of monitoring data. It could be patterned after the recommendations of an ongoing NRC project that is defining the tasks and technology necessary for an operational reliability program at nuclear power plants.

NRC Guidance. The areas requiring NRC guidance for implementing this option are outlined below:

1. Criteria on the development of reference performance measures by the licensee. For each area of concern, the NRC could identify factors to consider in establishing reasonable measures for tracking and trending performance at the system or component level. This would help ensure uniformity in the scope and depth of such licensee efforts. The reference performance levels would be consistent with the Commission's safety goals policy.

2. Monitoring and maintenance programs. The NRC would provide criteria for licensee's monitoring and maintenance programs for preventing failures due to age-related degradation.

3. Equipment qualification from the standpoint of aging. The licensee's implementation of changes to meet established performance levels could require equipment qualification from an aging perspective.

Option B: Emphasize defense-in-depth against age-related failures.

This option would help ensure that safety systems and accident mitigation measures will be adequate to meet the potential challenges from age-related failures. In an aging plant, age-related degradation processes are expected to increase failure frequencies of components, systems, and structures; however, the exact source, mode, and frequency of equipment failures will continue to be uncertain. This option attempts to reduce these uncertainties by emphasizing the availability and effectiveness of plant safety systems, containment, and other mitigative design and operational measures.

Licensee Activities. The implementation of this option would require the following licensee activities:

1. Assessment of capabilities of safety systems and containment. This would include assessing the capabilities of safety systems and the reactor containment to protect the plant against potential challenges brought about by age-related failures.

2. Identification of components and structures where safety margins may be reduced or compromised because of aging effects. This would include consideration of the effects of reduced safety margins* on overall plant performance. Emphasis would be on plant modifications, upgrades, and additional safety features to prevent an accident or mitigate its effects. The licensee would assess the degree of improvement in overall plant safety through proposed replacements, modifications, upgrades, or additional safety features. This would ensure that the plant would have ample protection against the higher frequency and greater diversity of challenges that could result from age-related failures.

3. Assurance of safety margins. Continued monitoring of safety margins could include the implementation of a combination of

*Safety margin is the difference between an operating limit as established by design for a given parameter, e.g., stress limits and cyclic loads, and the value of that parameter once a component or structure is placed in operation.

activities such as (a) inspection and testing; (b) on-line monitoring of component condition; (c) recording of experienced transients and relating their contribution to component degradation; and (d) estimating the degradation rate based on anticipated future operation.

NRC Guidance. The areas requiring NRC guidance for implementing this option are outlined below:

1. Methodology and standards for age-related assessments of safety systems and containment. NRC guidance in this area would focus on the development of a systematic approach for assessing the capabilities of present safety systems and containment in view of uncertainties in predicting and characterizing age-related failures. The NRC aging research program intends to carry out studies that would support the resolution of generic safety issues where aging may be of concern. The results of these studies would be taken into account in formulating such guidance.

2. Guidance on acceptable safety margins. The NRC would develop criteria that would define the acceptable safety margins for relicensed plants.

3. Guidance on new safety features for accident prevention or mitigation. The NRC has carried out considerable regulatory research on the feasibility of improving plant safety through features such as passive decay heat removal systems, primary depressurization, and filter-vented containments. The NRC would provide criteria for evaluating the need for such additional design modifications, as well as guidance on their test and qualification.

4. ENVIRONMENTAL REVIEW TOPIC

The National Environmental Policy Act (NEPA) of 1969 places the responsibility for meeting national environmental preservation goals upon each Federal agency for the activities that it regulates. There are a number of issues that must be dealt with in the development of license renewal regulations and regulatory guidance for ensuring an efficient approach for NEPA compliance.

4.1 Forms of NEPA Compliance

The NRC regulations given in 10 CFR Part 51 implement the provisions of NEPA. These regulations also include criteria for determining the need for an environmental impact statement (EIS) or an environmental assessment (EA). The regulation (10 CFR 51.20[b][2]) currently requires an EIS or a supplement to an existing EIS for each decision on the renewal of a full-power operating license for a nuclear plant. An issue is whether regulations that would permit using an EA to determine the need for an EIS would provide more efficient implementation of NEPA provisions for license renewal.

The efficacy of the EA approach will depend upon the nature of the environmental impacts that can be anticipated from extended operations of nuclear power plants. Further study is required for determining the potential types and magnitude of environmental impacts that may be anticipated before a determination can be made on using an EA in each license renewal action. If the scope and magnitude of environmental impacts are generally insignificant, then an EA would be an efficient approach. If, however, essentially all nuclear plants would require an EIS and EIS supplement, developing two NEPA documents (the EA and an EIS/EIS supplement) would likely be inefficient. In either case, the applicant will have to provide an environmental report containing adequate data and analyses that would allow the NRC to perform a NEPA review of a license renewal request.

Another issue is whether the scope and magnitude of potential environmental impacts can be more efficiently studied and analyzed by a generic environmental impact statement (GEIS). The GEIS would address the various environmental issues common to all license renewal applications. The GEIS would also define the nature of possible plant-specific environmental impacts and provide guidance on their treatment in individual license renewal applications.

By identifying and assessing common environmental issues, the GEIS would provide a framework for subsequent site-specific environmental

analyses, whether an EA or an EIS. This framework would include guidelines for determining when an EA would be sufficient and when a site-specific EIS would be required. Under 10 CFR Part 51, Subpart A, which adopts Council on Environmental Quality regulations, a site-specific EA or EIS subsequent to the GEIS ". . . need only summarize the issues discussed in the broader statement and incorporate discussions from the broader statement by reference and shall concentrate on the issues specific to the subsequent action . . .". Thus, any subsequent EA or EIS need not repeat the analyses covered in the GEIS.

4.2 Selecting an Efficient Form of NEPA Compliance

The NRC is considering the preparation of a GEIS. The fundamental question is whether a GEIS would provide the reasonable basis for a more narrowly focused NEPA analysis in individual license renewal actions. There are a number of associated considerations in answering this question. A central question is: What is the extent to which potential environmental impacts can be identified and enveloped? This question, in turn, depends upon the extent to which potential changes in equipment, structures, and operations associated with license renewal can be anticipated. Other considerations involve the extent to which the following can be accounted for in a generic environmental impact analysis: (1) differences in plant type, site, and vicinity; (2) availability of data; and (3) appropriateness of analytical methods such as severe accident consequences models.

5. PROCEDURAL TOPICS

This section provides a description of a set of topics pertinent to license renewal that involve a multiplicity of technological, administrative, and legal factors. These topics relate to broad areas of concern, including the procedures for license renewal, the timing of applications, and the applicability of current NRC regulatory policies and practices. Each topic is discussed below, with varying degrees of emphasis on the issues and options that could influence regulatory positions.

5.1 Form of License Renewal

The form of license renewal concerns the process by which the NRC will permit continued operation of a nuclear power plant beyond the statutory maximum term of 40 years for its initial license. This process is a principal concern in that it potentially could provide the framework for resolving other topics of both a technical and procedural nature.

Section 103(c) of the Atomic Energy Act (AEA) of 1954 and the NRC's implementing regulation 10 CFR 50.51 explicitly permit the renewal of a nuclear plant operating license, but provide little guidance concerning the process by which renewal may be accomplished. The issue, therefore, is how the renewal process should be treated. One option to the renewal process may use existing procedures for granting an initial operating license, that is, treat a license renewal application as a request for a new license. Another option may treat renewals as amendments to existing licenses. This option also has the advantage of using existing procedures, but raises the issue of whether the amendment would extend the initial license term beyond the 40-year statutory license term limit. A third option may promulgate a set of regulatory procedures developed especially for license renewal. In adopting this option, the NRC could address adequately those issues unique to relicensing by emulating the desired aspects of the well-established licensing processes for new licenses and amendments.

5.2 Length of Renewal Term

A major concern relative to this topic is the flexibility permitted by the NRC in determining the duration of the license renewal term. Such decisions must balance many complex and substantive factors. These factors include statutory, technical, and administrative policy concerns, which are briefly addressed below.

Statutory authorization under Section 103(c) of the AEA allows the NRC to issue operating licenses for a "specific period, as determined by the Commission, but not exceeding forty years . . . ." This language appears to limit the term of any license, including a renewal, to 40 years. However, it is reasonably clear under Section 105(c) that the NRC is not

constrained to grant all nuclear plants a fixed license term of 40 years. The NRC may decide, either as a technical or policy matter or on a case-by-case basis, that a 40-year renewal term is too long. Decisions on the lengths of renewal terms cannot be based solely on statutory provisions, but must also consider technical and administrative policy issues.

Technical concerns, such as the present and projected physical conditions of the plant, will influence the maximum feasible renewal term for a particular plant. Estimates of the remaining safe operating life of a plant will depend upon plant-specific operating history, hardware changes, and aging management programs that may be implemented. Uncertainties in analyzing the effects of aging over a period of 40 years also should be considered in establishing a renewal term.

Administrative policies of the NRC will seek to establish an efficient review process. For example, it may be desirable to specify a minimum renewal term so as not to overburden the regulatory system with frequent requests by licensees for further renewals.

5.3 Latest Date for Renewal Application

Latest date for renewal application concerns the deadline for filing a complete application prior to expiration of the initial license. This date has been established by the timely renewal doctrine (10 CFR 2.109). This doctrine states that a licensee may continue to operate a nuclear facility until a decision has been made on license renewal if the renewal application has been made at least 30 days prior to license expiration. However, based on past regulatory experience, it is generally agreed that a thorough review of a full-power license renewal application may not be accomplished within such a short time period. Initial efforts toward defining the technical information and review requirements suggest that a period of 1-2 years reflects more accurately the time necessary for the NRC's review of a renewal application.

Another aspect of the latest date for a renewal application is the deadline for the alternative to license renewal--decommissioning. The deadline for submitting a license renewal application should be coordinated with that for decommissioning. The topic of regulations for decommissioning and their potential effect on license renewal are addressed in Section 5.10.

5.4 Earliest Date for Renewal Application

The topic of earliest date for renewal application concerns how far in advance of license termination the NRC would begin review of a renewal request. This topic includes issues of planning for replacement capacity by the licensee and the allocation of NRC staff resources for license renewal review. These and other issues are briefly addressed below.

In response to the NRC request for public comments, licensees indicated a need for renewal decisions from 10 to 12 years prior to license expiration. This period would allow ample time for planning refurbishment of the nuclear plant if the license is granted or replacement capacity if it is denied. The NUPLEX response suggests that no limit be set on the earliest date for submission of a license application and the start of NRC review.

Reasons for limiting the length of time between renewal application submittal and initiation of the renewal term stem from data requirements for assessing plant aging. Analyses of plant aging would rely on operating history and maintenance data from previous years. Renewal requests far in advance of the end of the initial license term would exclude plant operating data of later years from these analyses. The analyses will be more reliable as the number of years in the data base increases. In addition, the uncertainties in the analysis of the effects of aging would be larger for projections further into the future.

5.5 Effective Date of Renewal

The topic of effective date of renewal concerns the date on which the license renewal is to begin and the date on which the initial operating license is to end. A license renewal could be granted to begin at the end of the original license ("tack-on" renewal) or to take effect immediately upon favorable action by the NRC ("supersession" renewal), requiring the licensee to surrender the original license. Tack-on renewal generally provides the licensee with greater operating flexibility but poses major regulatory issues of conditional regulatory requirements, enforcement of such requirements, and changes in licensing basis during the interim years of operation under the original license. Supersession renewal may provide the licensee greater confidence in committing resources needed for plant refurbishments, but may not allow as flexible a response to changing economic conditions. The industry has requested that the regulations be developed so that the licensee has the flexibility to choose between tack-on and supersession. The issue is, therefore, under what conditions, if any, could license renewal become effective several years in advance of license expiration.

5.6 Use of the Backfit Rule

The topic of the backfit rule and its relationship to license renewal policy stems from the general requirements for backfit decisions as stated in 10 CFR 50.109. Backfit decisions are made based on analysis of potential safety benefits over the remaining life of the plant.

One issue concerning the backfit rule is whether the intended renewal term should be included in calculating the costs and safety benefits of

backfits. If the renewal term is not included in backfit decisions made prior to expiration of the initial license, should these decisions be reviewed upon approval? For example, the safety benefits of a backfit could be larger relative to the costs if the renewal term were included. It is possible that a decision could be made to require the backfit if the renewal term were included, but not otherwise.

Another issue related to the backfit rule is its applicability to plant upgrades required for renewals. The option developed by the NRC for reviewing the safety of plants seeking to be relicensed, and for placing any additional requirements to ensure the continued safety of aging plants, could depend on whether the backfit rule is applied in its current form.

5.7 Public Hearings

The topic of public hearings is coupled with that of the form of license renewal. Several questions arise concerning requirements for hearings under different forms of renewal. Four such questions are addressed below.

The first question is whether there is any right under the AEA to a hearing on license renewal decisions. Under Section 189 of the AEA, an opportunity for hearing is required "in any proceeding . . . for the granting, suspending, revoking, or amending of any license . . . ." An opportunity for hearing is clearly required if the NRC decides to extend the term of an operating license through amendment. Although Section 189 makes no reference to "renewals" of licenses, legal precedents suggest that renewals may be treated as amendments for purposes of the hearing requirements. Therefore, it may be that an opportunity for hearing is required for renewing an existing license.

The second question is the timing of any necessary hearing. A grant of a new operating license (and by implication a renewal) requires a hearing prior to issuance. On the other hand, under the Sholly amendment to Section 189(a), amendments to an existing operating license do not require a hearing prior to issuance if there is an NRC finding of no significant hazards consideration. Thus, the issue is whether license renewal can be considered to have no significant hazards. If so, then provisions of the Sholly amendment for notice of opportunity for hearings following a renewal decision may be appropriate.

If a hearing must be held, the third question concerns the nature of such hearings. The NRC currently employs the formal adjudicatory procedures required by the Administrative Procedures Act in its construction permit and operating license hearings. However, there is a question, based on previous litigation against the NRC, of whether hearings for license renewal or amendment to extend operation of a nuclear plant must be subject to these procedures. If there is no such statutory requirement, the NRC can devise

more informal procedures for conducting any hearing on license renewal required by Section 189.

The final question is what issues may be litigated in any hearing. Resolution of this question will impact the efficiency of the hearing process. For example, if the NRC issues substantive standards for assessing license renewal applications by appropriate rulemaking, then the technical feasibility of license renewal may not be litigated at each hearing.

5.8 Material Alteration

License renewal may require refurbishment, replacement, or design and new construction at a nuclear power plant. Such alterations may be proposed by the licensee to extend operations beyond the initial 40-year license term or required by the NRC as a condition for license renewal. Thus, there may be a need for the licensee to engage in construction activities.

Section 185 of the AEA requires that a construction permit be obtained in order to "modify" a nuclear power plant. As a matter of practice, the NRC has not required licensees to obtain construction permits for routine maintenance, replacement, or upgrading. However, under 10 CFR 50.92, if a proposed amendment involves a "material alteration of a licensed facility," a construction permit must be issued before the issuance of the amendment. Thus, a licensee's efforts to bring the facility into conformance with applicable standards for obtaining license renewal may require a construction permit.

If a construction permit is required, there may be several implications. First, a public hearing is required under Section 189 of the AEA. Second, there may be antitrust and Price-Anderson Act considerations as discussed in Sections 5.11 and 5.12, respectively. Finally, should NRC deny the renewal request, there may be an effect on the decommissioning process as discussed in Section 5.10.

5.9 Emergency Planning

The emergency planning and preparedness requirements for initial operating licenses are described in 10 CFR 50.47 and 10 CFR Part 50, Appendix E. These provisions require emergency preparedness exercises within two years before the issuance of a full-power operating license. An exercise that tests the licensee's onsite emergency plan is required within one year before issuance of a full-power operating license. The regulations also require onsite exercises to be conducted annually. Offsite exercises are to be conducted biennially, with opportunity for full or partial participation by State and local government authorities within the plume exposure pathway emergency planning zone (EPZ). At least once every seven

years, all States and local governments within the plume exposure pathway EPZ for a given site are expected to participate fully in an offsite exercise for the power reactor site.

The topic of emergency planning can be divided into two areas of concern. First, does license renewal present technical concerns or risks that are different enough from those attributable to the initial term of operation so that the NRC's emergency preparedness requirements in 10 CFR 50.47 should be modified to account for those differences? Second, does license renewal represent an appropriate point for mandatory review of the provisions for emergency preparedness--regardless of whether emergency preparedness requirements have been modified for plants seeking license renewal? These are primarily technical and policy questions; their importance depends upon the adequacy of the current provisions for emergency preparedness exercises and periodic updates of emergency plans with respect to license renewal.

5.10 Decommissioning

At the end of the initial operating license term, the licensee may either implement plans for decommissioning or continue operations based on successful license renewal. These two alternatives introduce the potential for decommissioning and license renewal regulations to interact, as discussed below.

Regulations for decommissioning may impact license renewal activities. A rule for submission of an application for license termination and decommissioning plans no later than one year prior to license expiration was issued on June 27, 1988 (Ref. 3). This requirement should be taken into consideration in determining the latest date for renewal application.

Conversely, regulations for license renewal may impact decommissioning activities. Decommissioning is governed by 10 CFR 50.82, which sets forth standards for obtaining permission to terminate a license. The potential for interaction between license renewal and decommissioning exists where the NRC rejects a licensee's application for renewal, or alternatively, where the licensee decides to withdraw an application for renewal. Under these circumstances, it is not clear whether the licensee would be expected to submit an application for termination and decommissioning plans. The NRC's requirements for decommissioning appear to be open to interpretation since 10 CFR 50.82 by its terms applies only to voluntary termination and relinquishment of a license. For example, it could be contended that the NRC's refusal to approve extended operation results in an involuntary termination of the operating license. Moreover, the licensee may be unprepared to submit plans for decommissioning since it had previously committed itself to continued operation.

These discussions underscore the need for consistency between decommissioning and license renewal regulations.

5.11 Antitrust Review

Section 105 of the AEA (as amended December 19, 1970) sets forth the antitrust provisions applicable to nuclear plant licensing. Under Section 105(c)(2), an antitrust review by the Attorney General of the United States is required of any "application for a license to construct or operate a . . . production facility" received after 1970. Plants with pre-enactment applications were grandfathered from this review. License renewal raises the question of whether a license to extend operation beyond the 40-year statutory limit is a "license to operate," thereby requiring antitrust review. Even if one determines that a renewal or amendment is a "license to operate" for purposes of Section 105(c)(2), that Section also provides as follows: for those facilities issued a construction permit under Section 103 of the AEA (and thus already subject to a previous antitrust review), no new antitrust review is necessary unless "significant changes in the licensee's activities or proposed activities" have occurred subsequent to the Attorney General's previous review. Thus a new antitrust review may not be required, although a mechanism, such as a Federal Register notice, may be needed to identify potential antitrust problems on a plant-specific basis.

5.12 Price-Anderson Act Coverage

Sections 170 and 11 of the AEA, commonly referred to as the Price-Anderson Act, concern liability insurance in the event of an accident with offsite consequences. The Act establishes a ceiling on liability for facilities issued construction permits between August 30, 1954, and August 1, 1987.

One concern regarding Price-Anderson coverage in the context of license renewal is whether coverage extends throughout the renewal term. Since the coverage is tied to the date of issuance of the construction permit and does not distinguish among the various licenses issued following construction, the license renewal term would be covered. Furthermore, the last sentence of Section 170(c) appears to extend indemnification to a renewed or amended operating license as long as the facility had a construction permit by August 1, 1987.

Another concern is whether indemnification applies to the period of interim operation after the existing license expires, when the licensee has applied for renewal, but the NRC has not made a decision on the application. However, provisions of the Act specify that indemnity continues even while the reactor is not allowed to operate or is in the process of being decommissioned. Indemnity agreement is terminated when the reactor is dismantled or all radioactive material has been removed from the site.

Thus, Price-Anderson coverage does not appear to be a significant license renewal issue.

REFERENCES

1. U.S. Nuclear Regulatory Commission (USNRC), "Request for Comments on Development of Policy for Nuclear Power Plant License Renewal," Federal Register, Vol. 51, No. 215, 40334, November 6, 1986.

2. USNRC, "Nuclear Plant Aging Research (NPAR) Program Plan," NUREG-1144, Revision 1, September 1987.

3. USNRC, "General Requirements for Decommissioning Nuclear Facilities," Federal Register, Vol. 53, No. 123, 24018, June 27, 1988.

APPENDIX A

LIST OF QUESTIONS FROM THE NRC SOLICITATION OF PUBLIC COMMENTS

The NRC solicitation of public comments (51 FR 40334, November 1986) consisted of seven questions concerning various aspects of license renewal policy development, under which a total of 21 detailed questions were asked. These are listed below.

1. Timeliness of Policy

   (a) To what extent should the NRC proceed at this time in defining the regulatory policy which would be applicable to requests by utilities to extend the operational life of commercial light-water power reactors beyond the current 40-year operating license period?

   (b) Is an effort by the Commission to formulate such a policy well in advance of the expiration of operating licenses appropriate?

   (c) When must such a policy be in place? What is the basis for this time?

   (d) To what extent are the individual reactor licenses or industry groups acting on behalf of licensees actively planning at this time to request NRC permission for extended operation beyond the expiration of power reactor licenses?

2. Timing and Length of License Extension Requests

   (a) What criteria should be applied to judge that a request for license extension is both timely and sufficient?

   (b) Current regulations do not define a time limit beyond the initial 40-year term for which plants could operate while being considered for license extension. Should there be such a limitation? If so, what should the limiting period beyond the 40-year term be during which a plant could continue operation while undergoing license extension review?

3. Acceptable Level of Plant Safety

   (a) In addition to NRC's current requirements, how should the NRC incorporate performance-based information coupled with insights derived from probabilistic risk assessment into the decision making process?

(b) Should plants applying for life extension be required to demonstrate conformance to regulations in effect on the date of the extension application? On what basis should a licensee not have to demonstrate continued conformance with applicable rules and regulations?

(c) Should the intent to operate in excess of a 40-year operating period be factored into current and future benefit/cost analyses and safety findings for backfitting considerations? If not, why not?

4. Scope of Plant Life Extension Applications

(a) Should a life extension application be for a specific period of time? If so, for what length should it be? Should the Commission specify varying requirements based on the period requested for life extension?

(b) Which, if any, of NRC's licensing criteria are not appropriate for the purpose of reviewing plant life extension requests?

(c) How and to what extent should the prior operating history of the plant be factored into considerations for license extensions?

5. Technical Considerations for Plant Life Extension

(a) Which comments and structures will require residual lifetime evaluations in consideration for license extensions? What are the criteria for the selection of these components and structures?

(b) What are the major technical parameters and criteria which should be considered in NRC review to permit power reactor operation beyond the expiration of licenses?

(c) What additional monitoring and maintenance programs will be needed to assure safety during extended life?

(d) Which of these technical factors, including degradation processes and methods for detecting such degradation, are major "leadtime" items requiring data accumulation over the years prior to expiration of power reactor licenses?

(e) How should codes and standards be revised to support license extension?

(f) What investigations and research have been or are going on that address nuclear plant life extension? What mechanisms should be established to assure timely information exchange with the NRC to encourage communication, early consideration and avoid duplication?

6. Schedule for Resolution of Issues

(a) What overall schedule is appropriate to achieve major milestones and for resolution of the issues relative to nuclear plant license extension?

7. Procedural Considerations

(a) Should there be any procedural changes regarding future operating license extensions and current treatment of initial operating license applications? If so, what changes should be made?

(b) Please be as specific as possible, e.g., identify the specific procedural requirement and describe how it should be changed; identify whether such change can be accomplished under the current provisions of applicable statutes or whether it would involve a statutory change.

APPENDIX B

SUMMARY OF PUBLIC COMMENTS ON THE DEVELOPMENT OF A LICENSE RENEWAL POLICY FOR NUCLEAR POWER PLANTS

B.1 INTRODUCTION

The United States Nuclear Regulatory Commission (NRC) is developing regulations for the renewal of operating licenses (OLs) for nuclear power plants beyond their present 40-year term. In support of this initiative, the NRC solicited comments from the public on various issues that will require timely resolution. The solicitation of comments was published in the Federal Register (51 FR 40334) on 6 November 1986 and the extended comment period closed on 2 February 1987.

Fifty-eight (58) written responses were received and docketed by NRC under Proposed Rule PR-50. Comments were provided from a cross section of the U.S. electric utility industry, public interest groups, private citizens, independent consultants, and government agencies. Table B-1 summarizes the number of respondents in each of these five general categories. Detailed comments are contained in document SECY-87-179, "Status of Staff Activities to Develop a License Renewal Policy, Regulations, and Licensing Guidance and to Report on Public Comments." This document is available at the NRC Public Document Room.

B.2 NATURE OF RESPONSES

As evidenced in Table B-1, the majority of responses were received from the nuclear power industry (74 percent). In general, the industry consensus was represented by the Atomic Industrial Forum (AIF) and the Nuclear Plant Life Extension (NUPLEX) Steering Committee, which provided detailed responses. Over half of the industry respondents stated their support of the AIF and NUPLEX positions with little or no additional commentary. On some questions, however, individual industry respondents expressed other viewpoints on such issues as the scope and use of plant performance historical data in license renewals, the extent to which risk assessment should be used in identifying aging-related safety concerns, and the durations of license renewal periods.

Non-industry perspectives were limited: government agencies, public interest groups, individuals, and independent consultants comprised only slightly more than one quarter of the respondents. The three government agencies providing comments were: the U.S. Department of Energy, the U.S. Department of the Interior (U.S. Geological Survey), and the State of Wisconsin Public Service Commission. The Department of Energy response closely paralleled the industry position as stated in the NUPLEX comments. The Geological Survey provided a brief statement on the need to update ground-water data and uses around nuclear plants for license renewals, and the Wisconsin Public Service Commission provided detailed responses to several of the NRC solicitation questions. Two public interest groups provided written comments. One, Ecology Alert, stated its opposition to license renewal, and the other group, Ohio Citizens for Responsible Energy

TABLE B-1
SUMMARY OF RESPONDENTS AND AFFILIATIONS

NRC Request for Public Comments on Nuclear Power
Plant License Renewal

Respondent Category	Number
• Private Citizens	7
• Public Interest Groups	2
• Government Agencies	
- Federal Government	2
- Public Utility Commissions (State)	1
• Independent Consultants	3
• Nuclear Power Industry	
- Nuclear Utilities/Parent Companies	31
- Industry Groups (AIF, NUPLEX)	2
- NSSS Vendors	2
- Owners Groups	2
- Industry/Society Codes & Standards Committees	2
- A/E Constructors	2
- Law Firms Representing Utility Companies	2
Total	58 Respondents

(OCRE), provided detailed comments. In general, OCRE supported the concept of license renewal, but advocated a cautious approach on timing, technical, and procedural issues. Of the ten individuals commenting, six were opposed to license renewal, while the others clearly favored renewal or provided responses to specific questions without expressing an overall position on renewal.

B.3 DETAILED RESPONSES TO THE NRC SOLICITATION

The NRC solicitation was comprised of 21 questions under seven general issue headings (Appendix A). The following subsections summarize the detailed responses received in each of the seven issue categories.

1. Timeliness of Policy. The consensus of those favoring license renewal (including non-industry respondents) was that NRC should proceed immediately to establish a renewal policy by the late 1980's and detailed regulations by the early 1990's (1993). One utility industry respondent stated that NRC need only affirm a licensing policy based on the existing amendment process. Eight utilities stated their intent to apply for renewals; the remaining industry respondents were awaiting NRC regulations and results of aging research studies.

2. Timing and Length of License Extension Requests. Industry responses on the issue of renewal application timing favor maximum flexibility: filing of applications should be allowed at any time up to one year before license expiration. Non-industry respondents felt that applications should be required "well in advance" of expiration; additional comments included a five-year minimum to allow for "adequate public involvement" in the renewal process and a three-year "probationary" period before renewals.

   Concerning the question of "sufficiency" of renewal applications, industry respondents stated that NRC regulations should determine requirements for the application, but that the focus of the application should be limited to aging of plant safety items. The public interest group, OCRE, commented that sufficiency should entail a full-scope review (using standard review plan methodology) comparable to that given for the original operating license.

   On the question of interim, or postexpiration, operation during renewal review, industry cited the Administrative Procedures Act for continuance of a licensed activity and stated that safe operation was ensured through routine NRC inspection and enforcement. Non-industry viewpoints included OCRE, which stated that a two-year maximum should be imposed to avoid "frustration and

delay" of the renewal process. An individual respondent raised the issues of legality of interim operation and Price-Anderson implications of "unlicensed" operation.

3. Acceptable Level of Plant Safety. There was a consensus among all respondents that previous plant performance data and risk assessment should be considered in the renewal process. Differences arose in the scope and degree of application. Among industry respondents, most felt that performance history should be limited to demonstrating conformance with the original license requirements, and that new performance-based criteria be strictly limited to evaluation of safety-significant aging effects. However, a few industry respondents commented that the full 25-30 year performance history be considered and that management and personnel factors be included.

   Comments on the use of probabilistic risk assessment (PRA) were in general agreement among both industry and non-industry respondents: it should be used as an "adjunct" to screen plant items for safety significance of aging only. Several commenters also raised the issue of data validity in qualifying a PRA value.

   On the question of conformance to regulations in effect on the date of renewal application, industry and non-industry viewpoints contrasted sharply. Industry respondents strongly felt that satisfaction of the original licensing basis should be the major concern and that any new requirements should be subject to backfit considerations. OCRE and an individual commenter felt that plants should be required to meet all regulations in place at the time of renewal application. Concerning the consideration of extended plant life in generic backfit decisions, all respondents commented that this should not be a factor until renewal applications have been filed: that "intent" is impossible to determine in advance.

4. Scope of Plant Life Extensions. On the issue of license renewal durations, industry supported maximum flexibility: renewal duration should be chosen by the licensee for any period up to a 40-year maximum. Of the two non-industry respondents, OCRE stated that renewals should be for a maximum of 10-15 years, and a single individual stated that the licensee should choose the duration.

   Concerning the nature of requirements for renewals and their possible dependence on duration, industry representatives affirmed the position of conformance with the licensing basis as the major criterion and that this should not vary substantially with renewal duration. Non-industry viewpoints ranged from "all NRC licensing criteria are appropriate" (OCRE) to "no major new investigations"

(Wisconsin Public Service Comm.). In addition, OCRE stated that technical standards for renewals should be driven by results of aging research.

5. Technical Considerations for Plant Life Extension. The industry consensus on technical considerations was that: (a) only "safety significant" plant items subject to aging effects should be reviewed, (b) any parameters and criteria applied be limited to evaluating operating license compliance, (c) adequate plant monitoring and maintenance programs addressing aging effects were already in place, and (d) existing codes and standards were generally adequate and aging-related revisions should be limited in scope and determined by aging research results. Non-industry respondents commented that further aging studies were needed to identify technical requirements for renewals and that establishment of requirements was premature at this time.

   On the question of aging research coordination, industry favored early coordination and information transfer with the NRC. OCRE expressed the need for NRC to adequately fund independent research to avoid a potential industry bias in research results.

6. Schedule for Resolution of Issues. Industry respondents commented that NRC should: (a) issue a final policy on renewals by 1988, (b) issue definitive guidance by 1993, and (c) complete review of the first renewal by 1995. One non-industry respondent (OCRE) stated that all issues should be resolved five years before the first license expiration, and another individual stated that setting a schedule was premature and that aging studies should drive the policy development schedule.

7. Procedural Considerations. Two sets of recommendations were provided: one from industry and one from a public interest group (OCRE). Industry's position was that major changes were not required in the current body of regulations and that NRC need only affirm certain aspects of its current procedures for license renewals:

   - Utilize the license amendment process
   - Consider only aging degradation of safety-significant items
   - Licensee to choose "tack-on" or "supersession" renewal
   - Environmental assessments to determine need for impact statements

- Significant hazards determination to decide need for public hearings

- Filing deadline to be one year before operating license expiration

OCRE provided the following procedural recommendations:

- Treat renewals in the same manner as the original operating license (FSAR, SRPs)

- Resolve apparent conflict between the Administrative Procedures Act and Atomic Energy Act on continuing a licensed activity during "renewal review" versus "no significant hazard" finding

- Authorize Atomic Safety and Licensing Boards to call their own witnesses and raise significant safety issues

- Allow reopening of hearings after initial decisions

- Abolish limitations on "discovery and subpoena" against NRC staff and consultants

- Repeal Backfit Rule

B.4 FURTHER ISSUES

Other issues raised in the public comments were:

Decommissioning: How should decommissioning be accommodated in the context of license renewal?

High-Level Waste: How should the increasing inventory of high-level waste be accommodated? Should renewal policy development and "national" disposal policy be linked?

Interim Operation: What are the Price-Anderson implications of interim operation during the review of renewal applications?

Public Interest Groups: Should "intervenors" be provided with public funding to allow equal access to expert witnesses in licensing proceedings?

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12. SUPPLEMENTARY NOTES

13. ABSTRACT (200 words or less)

The NRC is developing regulations for relicensing nuclear power plants. In recognition of the need to resolve the issues affecting public health and safety in a timely manner, the NRC issued a Federal Register notice in November 1986 requesting public comments on the license renewal policy development effort. Fifteen topics of concern have been identified from the public's request. The topics have been categorized as: technological, environmental, and procedural. The review and analysis of these topics have resulted in the characterization of regulatory issues and the identification of ways for dealing with certain issues. This report presents the status of this effort and is being issued for public comment. The comments would help focus on the issues that should be addressed in the proposed rule on license renewal.

14. DOCUMENT ANALYSIS - a. KEYWORDS/DESCRIPTORS

License Renewal Nuclear Power Plants

b. IDENTIFIERS/OPEN-ENDED TERMS

15. AVAILABILITY STATEMENT

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16. SECURITY CLASSIFICATION

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