FUTURE LICENSING AND INSPECTION READINESS ASSESSMENT

SEPTEMBER 2001

Attachment

TABLE OF CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

In response to the February 13, 2001, staff requirements memorandum (SRM) for COMJSM-00-0003, "Staff Readiness for New Nuclear Plant Construction and the Pebble Bed Modular Reactor," this report assesses the readiness of the Nuclear Regulatory Commission (NRC) to process future applications for early site permits (ESPs), standard design certifications, and combined licenses (COLs) for commercial nuclear power plants, as well as reactivation of construction at deferred plants. Toward that end, this report provides resource and schedule estimates, without considering budget constraints, for NRC review of actions requested under several licensing scenarios that are believed to be representative of future applications and discusses staff critical skill gaps identified during the assessment. This report also discusses changes to the regulatory infrastructure that the staff is considering to support future licensing reviews, as well as organizational changes that are taking place to prepare for and manage future reactor and site licensing applications.

The overall conclusion of the staff performing the readiness assessment is that the NRC's licensing processes in 10 CFR Part 52 are ready to be used and the NRC is ready to complete new reactor licensing activities currently underway, such as the pre-application reviews for the AP1000 and the Pebble Bed Moderated Reactor (PBMR) and current rulemaking activities for 10 CFR Part 51 and Part 52. Additional work is needed in order to ensure the staff will be ready to effectively carry out its responsibilities associated with the review of ESPs, license applications, and construction of new nuclear power plants, given the potential for significant new licensing activity over the next several years. Staff decisions regarding the relative priorities of new reactor licensing activities will depend largely on the number and timing of industry decisions to pursue new licensing activities. In making its decisions, the staff will remain focused on the agency's Advanced Reactor Policy Statement and the performance goals of maintaining safety, protecting the environment and the common defense and security; increasing public confidence; making NRC activities and decisions more effective, efficient, and realistic; and reducing unnecessary regulatory burden.

Resource and Schedule Estimates

The report provides initial resource estimates for the following licensing scenarios:

- Pre-application review of the Westinghouse AP1000 advanced reactor design (Phase 2)
- Pre-application review of the PBMR design
- Pre-application review of the IRIS design
- Pre-application review of the GT-MHR design
- ESP review of an existing site
- ESP review of a new site
- Design certification for AP1000
- Design certification for IRIS
- COL for a standard certified design
- COL for PBMR
- Licensing of a reactivated plant

In addition, the report provides estimated durations for review of applications for an ESP, a design certification, a COL that references an ESP and a certified design, and a COL for a custom design that references an ESP.

These initial estimates are only the first results in a multi-phased process of establishing detailed schedule and resource estimates for future reactor licensing activities. As formal commitments are received regarding industry plans for new reactor licensing activities and as the staff gains additional knowledge through pre-application reviews and additional assessment work, we will work through the planning, budgeting, and performance management (PBPM) process to identify priorities and allocate resources to those priorities for the coming years. During this process the staff will continue to refine the schedule and resource estimates for each licensing scenario to establish detailed resource-loaded schedules as applications are received.

Skill Gaps

The assessment identified current skill gaps within the Office of Nuclear Reactor Regulation (NRR), the Office of Nuclear Regulatory Research (RES), the Office of Nuclear Materials Safety and Safeguards (NMSS), and the Regions. A skill gap within the agency occurs when individuals with expertise in certain technical areas either (1) are limited in number, working on important agency initiatives in other areas and not currently working in the office where the gap exists; (2) are near retirement or are expected to leave the agency within 6-12 months; or (3) do not exist in the agency.

In NRR, the assessment identified skill gaps in some areas of site safety review (especially in geotechnical areas) and nearly all areas of site environmental review. The assessment also identified skill gaps in the areas of historical and archeological resources and financial analysis (antitrust reviews). In addition, the staff identified skill gaps in the areas of gas reactor technology and new fuel designs. Less prominent weaknesses were identified in the areas of nuclear and chemical engineering, as well as environmental issues related to radiological effluents. A critical skills gap of reactor construction inspectors in the geotechnical area (e.g., geology, hydrology, seismology) was also identified in both NRR and the Regions.

The staff has also identified skill gaps within RES in several key areas. There is a shortage of experts in some key disciplines (e.g., materials engineering) due to their being involved in work related to current plants and a total absence of specialized skills in a few select areas to effectively support the future reactor licensing activities. These areas include fire protection, chemical engineering, metallurgy, high temperature gas-cooled reactor (HTGR) fuel technology, graphite technology, and HTGR accident analysis, including source term analysis.

NMSS and OGC did not identify any skill gaps that would affect the staff's short-term ability to carry out its responsibilities related to support of new reactor licensing activities. If a greater amount of work is realized than is being projected, however, there would be staffing constraints. The staff believes that, in the short term, the agency can obtain many of these skills through contracted technical assistance. Other skill gaps will have to be addressed through ongoing strategic workforce planning initiatives undertaken by the Office of Human Resources (HR). The staff has been working closely with HR to ensure that HR's planning efforts reflect the information gathered through this assessment.

Regulatory and Technical Infrastructure

Over the past few years, the NRC has undertaken a number of regulatory infrastructure (e.g, rule changes) improvements, including the promulgation of the alternative licensing processes in 10 CFR Part 52, that provide a foundation for future licensing activities. Because of these improvements, the current NRC regulatory infrastructure is adequate to support future licensing. However, the staff has identified a number of regulatory infrastructure changes discussed in the attached report that would make future licensing reviews more effective and efficient as well as reduce unnecessary regulatory burden during a licensing review.

Organizational Structure

This report discusses modifications to the current NRC organizational structure that are being implemented to prepare for new license applications. The principal modifications involve creating the NRLPO within NRR to process future plant applications and creating the Advanced Reactor Group (ARG) within the RES to manage the activities associated with pre-application review of the Department of Energy's (DOE) Generation III+ and IV designs and non-light-water-reactor (LWR) advanced designs, and to support NRR in activities related to advanced LWRs. All three major offices involved (NRR, RES, and NMSS) expect to use a matrixed organizational approach to perform the technical work associated with new license activities.

ACKNOWLEDGMENT

The Director of the New Reactor Licensing Project Office (NRLPO) wishes to recognize the efforts of the Future Licensing and Inspection Readiness Assessment (FLIRA) Working Group and the entire staff of NRLPO in the preparation of this assessment. The FLIRA Working Group and the NRLPO staff carried out their assignments in a highly professional and enthusiastic manner. The detailed analyses, projections, and findings of this assessment were prepared by these two groups. The FLIRA Working Group is composed of the following staff members:

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ABBREVIATIONS

ABWR	Advanced Boiling Water Reactor
ACI	American Concrete Institute
ACRS	Advisory Committee on Reactor Safeguards
AISC	American Institute for Steel Construction
ALARA	as low as reasonably achievable
ALWR	Advanced Light-Water Reactor
ANSI	American National Standards Institute
ARG	Advanced Reactor Group
ASCE	American Society of Civil Engineers
ASLB	Atomic Safety and Licensing Board
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
BWR	boiling water reactor
CANDU	Canadian Deuterium Uranium Reactor
CFR	Code of Federal Regulations
CIP	Construction Inspection Program
CIPIMS	Construction Inspection Program Information Management System
CNPP	corporate nuclear performance plan
COL	combined license
CP	construction permit
DAC	design acceptance criteria
DES	draft environmental statement
DET	Division of Engineering Technology
DOE	Department of Energy
DSARE	Division of Systems Analysis and Regulatory Effectiveness
EIS	environmental impact statement
EP	emergency preparedness
ER	environmental report
ESP	early site permit
ESRP	environmental standard review plan
EWG	exempt wholesale generators
FEMA	Federal Emergency Management Agency
FES	final environmental statement
FLIRA	Future Licensing and Inspection Readiness Assessment
FLO	Future Licensing Organization
FOAK	first-of-a-kind
FSAR	final safety analysis report
FTE	full-time employees
FY	fiscal year
GDP	gaseous diffusion plants
GT-MHR	Gas Turbine-Modular Helium Reactor
HLW	high-level waste
HR	Office of Human Resources
HTGR	high temperature gas-cooled reactor

ABBREVIATIONS

IAEA	International Atomic Energy Agency
ICRP	International Council on Radiation Protection
IEEE	Institute of Electrical and Electronics Engineers
IMC	inspection manual chapter
IPE	independent plant examination
IRIS	International Reactor Innovative and Secure
ISO	International Standards Organization
ITAAC	inspections, tests, analyses, and acceptance criteria
LWA	limited work authorization
LWR	light-water reactor
MHTGR	modular high temperature gas-cooled reactor
MOU	memorandum of understanding
MWe	megawatts electric
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NMSS	Office of Nuclear Materials Safety and Safeguards
NOAA	National Oceanic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
NRLPO	New Reactor Licensing Project Office
NRR	Office of Nuclear Reactor Regulation
OL	operating license
ORAT	operational readiness assessment team
PBMR	Pebble Bed Modular Reactor
PIUS	process inherent ultimate safety
PRISM	power reactor innovative small module
PSAR	preliminary safety analysis report
PWR	pressurized water reactor
QA	quality assurance
REAHFB	Regulatory Effectiveness Assessment and Human Factors Branch
RES	Office of Nuclear Regulatory Research
RF	Russian Federation
RSA	Republic of South Africa
SECY	Office of the Secretary of the Commission
SER	safety evaluation report
SNM	special nuclear material
SRM	staff requirements memorandum
SRP	standard review plan
SSC	systems, structures, and components
TEDE	total effective dose equivalent
TVA	Tennessee Valley Authority
USGS	U.S. Geological Survey
WNP-1	Washington Nuclear Project 1 or Energy Northwest Nuclear Project 1

I. INTRODUCTION

On February 13, 2001, the Commission issued a SRM for COMJSM-00-0003, "Staff Readiness for New Nuclear Plant Construction and the Pebble Bed Modular Reactor," directing the staff to "assess its technical, licensing, and inspection capabilities and identify enhancements, if any, that would be necessary to ensure that the agency can effectively carry out its responsibilities associated with an ESP application, a license application, and the construction of a new nuclear power plant." In addition, the staff was directed to "critically assess the regulatory infrastructure supporting both Part 50 and Part 52, and other applicable regulations, and identify where enhancements, if any, are necessary." The Commission further directed the staff to incorporate into its planning the need for early interactions with the Advisory Committee on Reactor Safeguards (ACRS) and to integrate the tasks identified during this effort with the various related activities that are underway. The Commission also directed the staff to provide the Commission with a schedule and resource estimates for completing these tasks, being thoughtful and judicious in committing resources. The Commission stated that the staff should encourage the industry to be as specific as possible about its plans and schedules so that the agency can plan and budget for advanced reactor activities without disrupting other current important initiatives. The Commission also stated that the staff should work with stakeholders to exercise, to the extent appropriate, the NRC's review process and identify potential policy issues that should be addressed by the Commission in a timely manner. This report provides the results of the staff's assessment.

Chapter II of the report provides a discussion of the 10 CFR Part 50 licensing process previously used to process applications, as well as various licensing scenarios based on the alternative licensing processes described in 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

Chapter III discusses future licensing issues related to the fuel cycle and transportation processes.

Chapter IV discusses the regulatory infrastructure needs for new reactor licensing activities, including current rulemakings and additional rulemaking activities related to new reactor licensing that the staff is considering. Chapter IV also identifies guidance documents such as regulatory guides and standard review plans (SRPs) that may need to be revised to assist in the processing of future applications and it addresses the development of a technical infrastructure for advanced technology assessment.

Chapter V presents NRC resource projections for several licensing scenarios and estimates of the resource requirements for the regulatory infrastructure needs described in Chapter IV. The staff analyzed several scenarios that are representative of potential new applications. These scenarios include pre-application reviews for the AP1000, the PBMR, the IRIS and the GT-MHR designs; review of an ESP application; standard design certification review for the AP1000 and IRIS designs; a COL review for a standard certified design and for a custom design (the PBMR and GT-MHR); and reactivation and operation of a plant with a valid CP that is in a deferred status, such as Washington Nuclear Project 1 (WNP-1).

Chapter VI discusses changes to the current organizational structures in NRR and RES to facilitate the review of new reactor license applications.

Conclusions regarding the staff's readiness assessment are provided in Chapter VII.

II. REACTOR LICENSING SCENARIOS

In the past, nuclear power plants were licensed under a two-step licensing process set forth in the Commission's regulations in Title 10 of the *Code of Federal Regulations* (CFR) under Part 50. This process requires both a CP and an OL. However, 10 CFR Part 52 now provides several alternative licensing processes. The licensing processes in both 10 CFR Parts 50 and 52 are described below.

A. 10 CFR Part 50

The licensing process under 10 CFR Part 50 has two review stages (i.e., it is a "two-step" licensing process). First, an application is submitted for a CP that would authorize construction of the proposed facility. The focus of this stage of the NRC staff's review is on the preliminary design of the facility and on the suitability of the proposed site. The second stage of the staff's review involves the evaluation of an OL application in which the staff reviews the final design of the plant, verifies its construction, and inspects the testing, operations, and emergency preparedness (EP) aspects of the review.

An applicant for a CP for a nuclear power plant generally submits the required information in three parts: (1) antitrust information, (2) an environmental report (ER) addressing site suitability, and (3) the preliminary safety analysis report (PSAR). In accordance with 10 CFR 50.33a, the antitrust information must be submitted at least 9, but no more than 36 months prior to the other required information to allow the U.S. Department of Justice and the NRC staff to begin the antitrust review. The ER generally precedes the PSAR by about 6 months. The NRC staff performs the environmental review of the application in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended, to evaluate the potential environmental impacts of the proposed plant.

Although not required, NRC guidance states that a general introductory meeting should be held in the area of the proposed site about 6 to 12 months before the applicant submits the CP. The meeting is held to familiarize the public with the safety and environmental aspects of the proposed application, including the planned location and type of plant, the regulatory process, and the provisions for public participation in the licensing process. In addition, meetings with the applicant that are open to the public are frequently held to exchange information and discuss matters concerning the plant design and construction during the reactor licensing process.

When the NRC receives notification of an applicant's intentions to build a nuclear power plant, a pre-construction permit (pre-CP) inspection program is instituted. The program continues until the issuance of the CP. The pre-CP inspection effort focuses on the applicant's quality assurance (QA) program relative to implementation of ongoing design and procurement activities.

The ACRS reviews each application for a CP for a nuclear power plant and the associated safety evaluation report (SER). In addition, Section 189 of the Atomic Energy Act of 1954, as amended (Act), requires that a public hearing be held before a CP is issued for a nuclear power plant. As soon as practicable after an application has been docketed, the NRC issues a notice

of the hearing in accordance with 10 CFR 2.104(a). The hearing is held after the staff completes its review.

Opportunity is provided for members of the public to participate in the hearing. The public hearing is conducted by a three-member Atomic Safety and Licensing Board (ASLB). The staff's SER and its supplements, the final environmental impact statement (EIS), and staff testimony to address contentions constitute the staff's evidence at the hearing. Depending on the situation, either combined or separate safety and environmental hearings are held. In accordance with 10 CFR 2.786, the Board's initial decision is subject to a discretionary review by the Commission.

The NRC may authorize a licensee to do some work at the site before the CP is issued. This authorization is known as a limited work authorization (LWA). An LWA may be granted only after the licensing board, based on the record developed at a hearing, has (1) made all of the NEPA findings required by the Commission's regulations before issuing a CP, and (2) determined that there is reasonable assurance that the proposed site is a suitable location, from a radiological health and safety standpoint, for a nuclear power reactor of the general size and type proposed. The regulations provide for the authorization of two types of LWAs. One type, authorized under 10 CFR 50.10(e)(1), may authorize site preparation work, installation of temporary construction support facilities, excavation, construction of service facilities, and certain other construction not subject to the QA requirements of Appendix B to 10 CFR Part 50. The second type of LWA, authorized under 10 CFR 50.10(e)(3)(i), may authorize the installation of structural foundations and portions of the safety-related structures up to a level corresponding to plant grade. This type of LWA requires that the licensing board find that there are no unresolved safety issues with respect to these activities, in addition to the other required findings.

A construction inspection program (CIP) is conducted by the NRC. The purpose of the inspection process is to verify the acceptability of the completed plant and conformance with the applicable regulations.

When the construction of the nuclear plant has progressed to the point where final design information and plans for operation are available, the applicant submits the final safety analysis report (FSAR) and an updated ER to support an application for an OL in accordance with 10 CFR 50.34(b) and 10 CFR 51.53, respectively. The FSAR describes the facility's design basis and limits on its operation, and presents an analysis of the structures, systems, and components of the facility as a whole. The FSAR also provides plans for operation and procedures for coping with emergencies. The staff's conclusions on the applicant's offsite emergency plans are based on compliance with 10 CFR 50.47 and the staff's review of the findings from the Federal Emergency Management Agency (FEMA). FEMA reviews the plans to determine whether state and local emergency plans are adequate, and whether there is reasonable assurance that they can be implemented.

The OL for a nuclear reactor will contain technical specifications and an ER. The technical specifications contain, among other things, requirements for testing and operating the facility, and limiting conditions for plant operation. The ER sets forth the particular measures imposed on the plant to protect the environment.

Reactivated Plant Reviews

The 10 CFR Part 50 licensing scenarios examined in this assessment are the licensing of a plant that holds a currently valid CP and is to be reactivated from its deferred status, and the restarting of a plant with an OL. Four plants with CPs in a deferred status are candidates for reactivation: Bellefonte Units 1 and 2, Energy Northwest Nuclear Project 1 (WNP-1), and Watts Bar Unit 2. Browns Ferry Unit 1 has an OL and restarting of this unit, which last operated in 1985, is also considered in this assessment.

Plants with Construction Permits and SECY-89-104

SECY-89-104, "Assessment of Future Licensing Capabilities," discusses the reactivated plant scenario and discusses how the following would be implemented for a reactivated plant: the Commission's Policy on Deferred Plants, recent rule changes, and the Commission's Policy on Severe Accidents. Highlights of this discussion are provided below.

The Commission Policy Statement on Deferred Plants, published on October 14, 1987 (52 FR 38077), stated the Commission's expectation that CP holders would submit certain specific information when construction on a plant is deferred and when plant construction resumes. This information will be used by the staff to determine the status of the plant with respect to reactivated plant licensing. The acceptability of structures, systems, and components important to safety will be determined by the staff based upon the following: (1) staff review of the implementation of the previously approved preservation and maintenance program, (2) staff verification that design changes, modifications, and required corrective actions have been properly implemented, and (3) baseline inspections performed by the staff to verify that FSAR quality and performance commitments have been met.

In addition to performing the above reviews specifically associated with a reactivated plant and completing the review, inspection, and hearings associated with the 10 CFR Part 50 plant licensing process, SECY-89-104 states

> [c]ertain rule changes and the Commission Policy on Severe Accidents are expected to affect the reactivated plant licensing review. The major changes include the Fire Protection Rule, the Hydrogen Rule, the Equipment Qualification Rule, and the Decommissioning Funding Rule.

To the extent that the applications for an OL for WNP-1 and Bellefonte were docketed before these rules were promulgated their applications would need to be updated to reflect these rule changes. Additional resource requirements related to financial qualifications and fitness for duty are similar to those discussed for new custom plant applications are equally valid for a reactivated plant licensing review.

In addition, bulletins and generic letters that have been issued since the time construction was deferred will also have to be addressed. With respect to severe accidents, SECY-89-104 states that licensing applicants for reactivated plants should

perform an Independent Plant Examination (IPE) as outlined in Generic Letter 88-20, and address containment vulnerabilities. As with currently operating reactors this will serve as the mechanism for addressing severe accidents for this licensing scenario.

The additional resource requirements and the potential hearing process impacts involving severe accident considerations will be similar to those discussed for new custom plant applications.

Browns Ferry Unit 1

Section V.G of this report contains background information on this unit. In addition, licensing resource estimates and schedule for reactivating plants with CPs and restarting Browns Ferry Unit 1 are provided in Section V.G.

B. 10 CFR Part 52

10 CFR Part 52 sets forth the processes for review of ESPs, standard design certifications, and COLs for nuclear power facilities licensed under Section 103 of the Atomic Energy Act. These three process alternatives to the two-step process set forth in 10 CFR Part 50 are described below. In addition, the staff can perform a pre-application review of a design to provide early feedback to an applicant on the acceptability of the design and its supporting testing and analysis programs, and to identify potential policy issues for Commission consideration. Also, Appendices M, N, O, and Q to 10 CFR Part 52 set forth the processes for manufacturing licenses, duplicate plant licenses, preliminary and final design approvals, and early review of site suitability issues, respectively. Figure II-1 provides an integrated diagram of the 10 CFR Part 52 licensing processes.

1. Pre-Application Review

The NRC's "Regulation of Advanced Nuclear Power Plants; Statement of Policy (10 CFR Part 50)" (51 FR 24643), established the Commission policy for advanced reactor designs. The Commission's advanced reactor policy statement has three primary objectives:

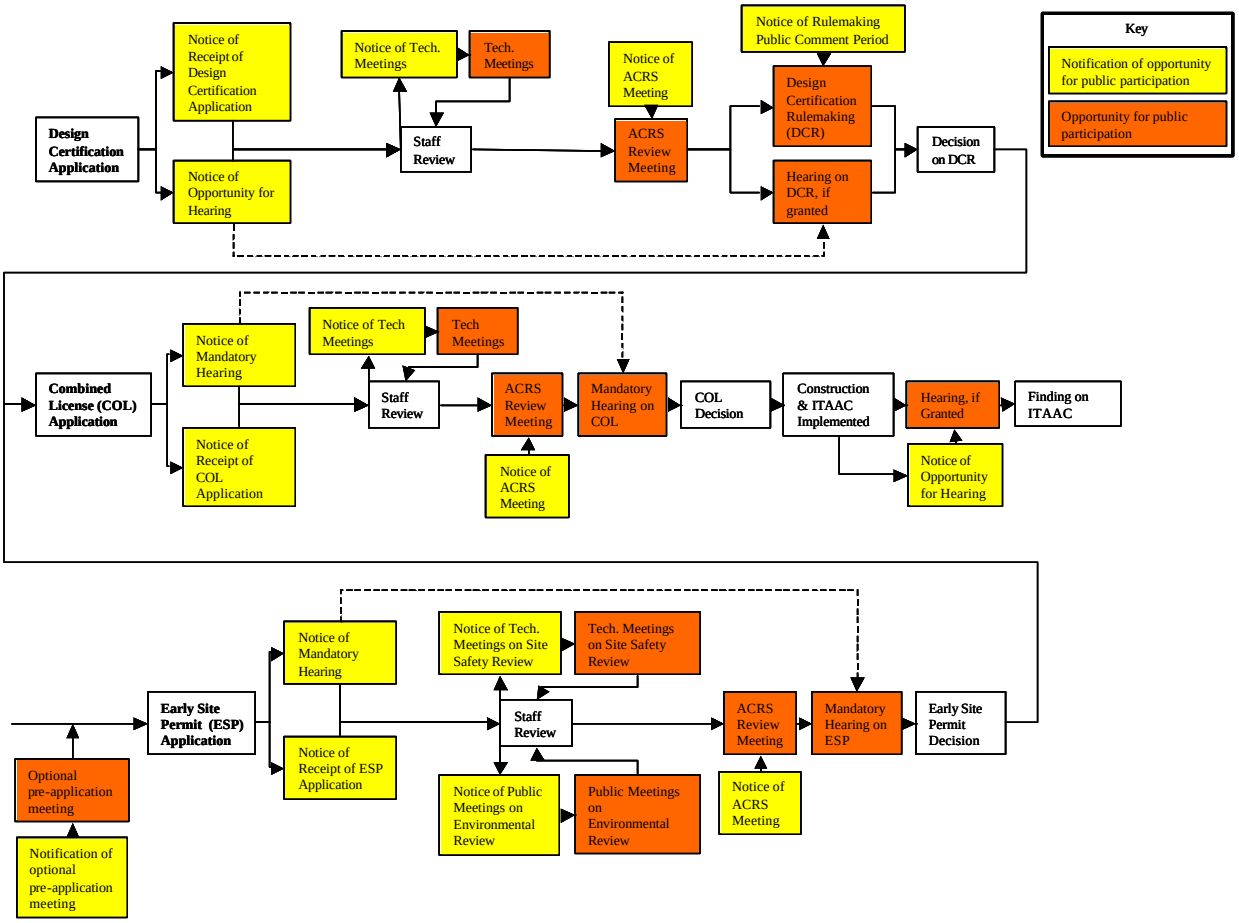
(1) to encourage the earliest possible interaction of applicant, vendors, and government agencies with the NRC;

(2) to provide all interested parties, including the public, with the Commission's views concerning the desired characteristics of advanced reactor designs, and;

(3) to express the Commission's intention to issue timely comment on the implications of such designs for safety and the regulatory process.

The staff developed NUREG-1226, "Development and Utilization of the NRC Policy Statement on the Regulation of Advanced Nuclear Power Plants" (issued June 1988), to address public comments received on the advanced reactor policy statement and to provide guidance on advanced reactor design criteria.

Figure II-1 - Part 52 Licensing Processes



In the early 1990s, the NRC conducted pre-application reviews of proposed advanced reactor designs to identify (1) major safety issues that could require Commission policy guidance, (2) major technical issues that the staff could resolve under existing regulations or NRC policy, and (3) the research needed to resolve identified issues. SECY-93-092, "Issues Pertaining to the Advanced Reactor (PRISM, MHTGR, and PIUS) and Canadian Deuterium Uranium Reactor (CANDU) 3 Designs and Their Relationship to Current Regulatory Requirements," April 8, 1993, summarized the issues identified for these reviews.

Based on recent discussions with the nuclear industry, the staff has identified four additional candidate designs for pre-application review in the near future. Two candidates, the Westinghouse AP1000 passive light water reactor (LWR, a larger version of the certified AP600 design) and the Exelon Generation Company gas-cooled PBMR, (based on the Eskom of South Africa PBMR) are currently under review by the staff. The staff expects pre-application review requests for the Westinghouse IRIS design (an integral LWR design) and the Gas Turbine Modular Helium Reactor (GT-MHR) (under development by General Atomics) to be submitted in FY 2002. The estimated review schedules for these pre-application reviews and the resources required to support these schedules are provided in Section V.C of this report.

2. Early Site Permit (ESP)

An application for an ESP is reviewed according to the applicable standards in 10 CFR Part 50 and its appendices and 10 CFR Part 100 as they apply to applications for CPs for nuclear power plants. Approval of an ESP is based on consideration of three key factors to determine whether the site is a suitable location on which to build a nuclear plant. These factors are (1) site safety, (2) EP, and (3) environmental protection. The ESP process is set forth in Subpart A of 10 CFR Part 52.

The application must contain a description and safety assessment of the site on which the facility is to be located. This assessment must contain an analysis and evaluation of the major structures, systems, and components of the facility that bear significantly on the acceptability of the site under the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1). Site characteristics must comply with the siting criteria of 10 CFR Part 100. In addition, the application should describe the following:

(1) the number, type, and thermal power level of the facilities for which the site may be used;

(2) the boundaries of the site;

(3) the proposed general location of each facility on the site;

(4) the anticipated maximum levels of radiological and thermal effluents each facility will produce;

(5) the type of cooling systems, intakes, and outflows that may be associated with each facility;

(6) the seismic, meteorologic, hydrologic, and geologic characteristics of the proposed site;

(7) the location and description of any nearby industrial, military, or transportation facilities and routes; and

(8) the existing and projected future population profile of the area surrounding the site.

10 CFR Part 52 provides two options for satisfying early site EP requirements. The application may either (1) propose major features of the emergency plans, such as the exact sizes of the emergency planning zones, that can be reviewed and approved by NRC in consultation with FEMA in the absence of complete and integrated emergency plans; or (2) propose complete and integrated emergency plans for review and approval by the NRC, in consultation with FEMA, based on the applicable provisions of 10 CFR 50.47.

The application must also include the information required by 10 CFR 52.17(b): (1) to identify physical characteristics unique to the site that could pose a significant impediment to the development of the emergency plans; (2) if the applicant chooses the first option, to describe contacts and arrangements made with local, state, and federal governmental agencies with emergency planning responsibilities, and (3) if the applicant chooses the second option, show that the applicant has made good-faith efforts to obtain from these agencies appropriate certifications with respect to the proposed emergency plans, or that such plans provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency.

In addition, the staff considers the environmental protection aspects of the application in accordance with 10 CFR 51.17(a)(2), and prepares an environmental impact statement (EIS) to describe the results of its review. The application need not include a discussion of the need for power, but must include an evaluation of alternative sites to determine whether there is any obviously superior alternative to the site proposed.

If, after being granted the ESP, an applicant wishes to be able to perform site preparation activities allowed by 10 CFR 50.10(e)(1) and 10 CFR 52.17(c) without first obtaining the separate authorization required by that section, the applicant must propose, in the ESP, a plan for redress of the site in the event that the activities are performed and the site permit expires before it is referenced in an application for a CP or a COL.

An ESP is considered to be a partial CP. Therefore, a mandatory public hearing must be held on the permit application in accordance with 10 CFR 52.21. The requirements for publication of notice of the hearing, the procedures for intervention, and the conduct of the hearing are the same as for a 10 CFR Part 50 CP application. However, depending on which EP option is selected, the hearing complexity may vary, along with support staff resources. In addition, in accordance with 10 CFR 52.23, the application for site approval must be referred to the ACRS, and the ACRS must report to the Commission on those parts of the application which concern safety.

The licensing resource estimates and schedule for an ESP are provided in Section V.D of this report.

3. Standard Design Certification

In accordance with 10 CFR 52.47(a)(i) and 10 CFR 52.48, an application for a standard design certification is reviewed for compliance with the standards set out in 10 CFR Parts 20, 50 (and its appendices), 73, and 100 as they apply to applications for CPs and OLs for nuclear power plants, as they are technically relevant to the design proposed for the facility. The design certification process is set forth in Subpart B of 10 CFR Part 52.

An application for design certification must contain:

(1) the technical information that is required of applicants for CPs and OLs by 10 CFR Parts 20, 50 (and its appendices), 73 and 100, and is technically relevant to the design and not site-specific;

(2) demonstration of compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f);

(3) the site parameters postulated for the design and an analysis and evaluation of the design in terms of the parameters;

(4) proposed technical resolutions of the unresolved safety issues and medium- and high-priority generic safety issues that are identified in the version of NUREG-0933, "A Prioritization of Generic Safety Issues, current on the date 6 months prior to the application and that are technically relevant to the design;

(5) a design-specific probabilistic risk assessment;

(6) proposed tests, inspections, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the tests, inspections, and analyses are performed and the acceptance criteria met, a plant that references the design will be built and will operate in accordance with the design certification;

(7) the interface requirements to be met by those portions of the plant for which the application does not seek certification (these requirements must be sufficiently detailed to allow completion of the final safety analysis and required design-specific probabilistic risk assessment (Item 5));

(8) justification that compliance with the interface requirements is verifiable through inspection, testing (either in the plant or elsewhere), or analysis (the method to be used for verification of interface requirements must be included as part of the required proposed tests, inspections, analyses, and acceptance criteria (item 6)); and

(9) a representative conceptual design for those portions of the plant for which the application does not seek certification, to aid the staff in its review of the final safety analysis and probabilistic risk assessment, and to permit assessment of the adequacy of the interface requirements called for in Item 7 above.

In accordance with 10 CFR 52.47(b)(1), an application for certification of a nuclear power plant design that is an evolutionary advance on current light-water reactor designs must provide an essentially complete nuclear power plant design except for site-specific elements; for example, the service water intake structure and the ultimate heat sink.

In accordance with 10 CFR 52.47(b)(2), an application for certification of a standard design that differs significantly from current LWR designs or that utilizes simplified, inherent, passive, or other innovative means to accomplish its safety functions must provide sufficient information to confirm that:

(1) the performance of each safety feature of the design has been demonstrated through either analysis, appropriate test programs, experience, or a combination thereof;

(2) the interdependent effects among the safety features of the design have been found acceptable by analysis, appropriate test programs, experience, or a combination thereof;

(3) sufficient data exist on the safety features of the design to assess the analytical tools used for safety analyses over a sufficient range of normal operating conditions, transient conditions, and specified accident sequences, including equilibrium core conditions; and

(4) the scope of the design is complete except for site-specific elements, such as the service water intake structure and the ultimate heat sink.

As an alternative to the four items above, certification may be obtained by the acceptable testing of an appropriately sited, full-size prototype of the design over a sufficient range of normal operating conditions, transient conditions, and specified accident sequences, including equilibrium core conditions. If the criterion in item (4) above is not met, the testing of the prototype must demonstrate that the non-certified portion of the plant cannot significantly affect the safe operation of the plant. In either case, the application for final design approval of such a standard design must propose the specific testing necessary to support certification of the design.

In accordance with 10 CFR 52.47(b)(3), an application seeking certification of a modular design must describe the various options for the configuration of the plant and site, including variations in, or sharing of, common systems, interface requirements, and system interactions. The final safety analysis and the probabilistic risk assessment should also account for differences among the various options, including any restrictions that will be necessary during the construction and startup of a given module to ensure the safe operation of any module already operating.

In accordance with 10 CFR 52.53, the Commission refers a copy of the application to the ACRS. The ACRS reports to the Commission on those portions of the application that concern safety.

The NRC may certify and approve a standard plant design, which is independent of a specific site through a rulemaking. In addition to the opportunity for public participation on the design certification rulemaking, the NRC also provides the public with an opportunity to request an informal hearing in accordance with 10 CFR 52.51(b). The issues that are resolved in a design certification rulemaking are subject to a more restrictive change process than issues that are resolved through issuance of a license. In accordance with 10 CFR 52.63(a), the NRC cannot

change the design requirements for a certified design unless the modification is necessary to meet the applicable regulations in effect at the time of the design certification, or to assure adequate protection of the public health and safety.

Industry representatives have identified two near-term candidate designs for standard design certification review:

(1) The Westinghouse AP1000 passive LWR, which is a larger version of the certified AP600 design. The licensing resource estimates and the schedule are provided in Chapter V.E.

(2) The IRIS design, which is an integral-LWR design. The licensing resource estimates and the schedule are provided in Chapter V.E.

4. Combined License

As discussed previously, CPs and OLs are issued separately under 10 CFR Part 50. A combined CP and COL, issued under Subpart C of 10 CFR Part 52, authorizes construction and operation of the facility. In accordance with 10 CFR 52.73, an application for a COL under 10 CFR Part 52 can but need not incorporate by reference a design certification, an ESP, or both. The issues resolved by the design certification rulemaking process and those resolved during the ESP hearing process are precluded from reconsideration at the COL stage. In accordance with 10 CFR 52.81, an application for a COL is reviewed according to the standards set out in 10 CFR Parts 20, 50, 51, 55, 73, and 100 as they apply to applications for CPs and OLs for nuclear power plants, and as those standards are technically relevant to the design proposed for the facility.

In accordance with 10 CFR 52.79(c), the application for a COL must include the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee will perform. The application must also include the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Act and the NRC's regulations. Where the application references a certified standard design, the inspections, tests, analyses, and acceptance criteria for the certified design must apply to those portions of the facility design that are covered by the design certification. In addition, in accordance with 10 CFR 52.79(d), the application must contain emergency plans that provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency at the site.

The application must contain all of the information required by 10 CFR 50.33, “Contents of Applications; General Information,” as that section applies to applicants for CPs and OLs, and 10 CFR 50.33a, “Information requested by the Attorney General for antitrust review,” as that section applies to an applicant for a nuclear power plant CP. The application must also demonstrate compliance with the requirements for training and qualification of nuclear power plant personnel established in 10 CFR 50.120 for the operating phase of the license.

In accordance with 10 CFR 52.79(a)(1), if the application references an ESP, the application need not contain information or analyses submitted to the Commission in connection with the ESP. However, in addition to the information and analyses otherwise required, the application must

include information sufficient to demonstrate that the design of the facility falls within the parameters specified in the ESP and to resolve any other significant environmental issue not considered in any previous proceeding on the site or the design.

In accordance with 10 CFR 52.79(d)(2), if the application does not reference an ESP, or if no emergency plans were approved in connection with the issuance of the permit, the applicant shall make good faith efforts to obtain certifications from the local and state governmental agencies with emergency planning responsibilities that: (1) the proposed emergency plans are practicable, (2) these agencies are committed to participating in any further development of the plans, including any required field demonstrations, and (3) these agencies are committed to executing their responsibilities under the plans in the event of an emergency. The application must contain any certifications that have been obtained. If these certifications cannot be obtained, the application must contain information, including a utility plan, sufficient to show that the proposed plans nonetheless provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency at the site.

If the application does not reference an ESP, in accordance with 10 CFR 52.79(a)(2), the applicant will comply with the requirements of 10 CFR 50.30(f) by including with the application an ER prepared in accordance with the provisions of Subpart A of 10 CFR Part 51.

In accordance with 10 CFR 52.79(b), the application must contain the technically relevant information required of applicants for an OL by 10 CFR 50.34. The FSAR and other required information may incorporate by reference the standard safety analysis report (design control document) for a certified standard design. In particular, an application referencing a certified design must describe those portions of the design that are site-specific, such as the service water intake structure and the ultimate heat sink. An application referencing a certified design must also demonstrate compliance with the interface requirements established for the design under 10 CFR 52.47(a)(1), and have available for audit the procurement specifications and construction and installation specifications in accordance with 10 CFR 52.47(a)(2). If the application does not reference a certified design, the application must comply with the requirements of 10 CFR 52.47(a)(2) for the level of design information, and will contain the technical information required by 10 CFR 52.47(a)(1) (i), (ii), (iv), and (v) and (3), and, if the design is modular, by 10 CFR 52.47(b)(3).

In accordance with 10 CFR 52.87, the Commission refers a copy of the application to the ACRS. The ACRS reports to the Commission on those portions of the application that concern safety.

In accordance with 10 CFR 52.99 and 10 CFR 52.103, after issuing a COL, the Commission will verify that the licensee completed the required inspections, tests, and analyses, and that acceptance criteria were met before the facility can be operated. At appropriate periodic intervals during construction, the NRC will publish notices of the successful completion of the inspections, tests, and analyses in the *Federal Register*. At least 180 days before the date scheduled for initial loading of fuel, the NRC will publish a notice of intended operation of the facility in the *Federal Register*. That notice will provide an opportunity for a hearing on whether the facility as constructed, complies, or on completion, will comply with the acceptance criteria in the license. The NRC will consider a request for a hearing only if the request demonstrates that the licensee has not met the acceptance criteria in the COL.

The licensing resource estimates and schedule for a review of a COL application that references a standard certified design and an ESP are provided in Chapter V.F(1) of this report. The licensing resource estimates and schedule for a review of a COL application that references a custom design (such as the Exelon Generation Company PBMR) and an ESP are provided in Chapter V.F(2) of this report.

III. FUEL CYCLE INFRASTRUCTURE FOR NEW REACTOR LICENSING ACTIVITIES

The following discussion provides an overview of the regulations that govern the fuel cycle process for special nuclear material (SNM) including waste management and transportation. The regulatory areas that may be affected by new licensing activities, and potential staff initiatives to address these activities, are also discussed.

A. 10 CFR Part 40, "Domestic Licensing of Source Material"

The staff is planning to conduct rulemaking on Part 51 to address new reactor licensing activities (refer to Section IV.A of this report for details). Source material is (1) uranium or thorium alone or in any combination in any physical or chemical form or (2) any ore that contains by weight 0.05% or more of uranium or thorium alone or any combination of uranium or thorium. Part 40 of Title 10 of the CFR establishes the requirements for issuing licenses to receive title to, receive, possess, use, transfer, or deliver source materials. Part 40 also governs the long-term custody and care and disposal of byproduct material (uranium and thorium mill tailings and related waste). The requirements of Part 40 also address the physical protection of import, export, and transient shipments of natural uranium.

B. Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions"

The staff reviewed this regulation and has determined that no changes are needed to address new reactor licensing activities. This part contains environmental protection regulations applicable to NRC's domestic licensing and related regulatory functions. Subject to certain limitations described in this part, these regulations implement Section 102(2) of the NEPA of 1969, as amended.

C. Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste

The staff reviewed this regulation and has determined that no changes are needed to address new reactor licensing activities. The regulations in this part establish procedures, criteria, and terms and conditions for the licensing of land disposal facilities intended to contain byproduct, source, and SNM.

D. Part 63, "Disposal of High-Level Radioactive Wastes in a Proposed Geological Repository at Yucca Mountain, Nevada"

The staff reviewed this regulation and has determined that no changes are needed to address new reactor licensing activities. This part prescribes rules governing the licensing of DOE to receive and possess source, special nuclear, and byproduct material at a geologic repository operations area sited, constructed, or operated at Yucca Mountain, Nevada, in accordance with the Nuclear Waste Policy Act of 1982, as amended, and the Energy Policy Act of 1992.

E. Part 70, "Domestic Licensing of Special Nuclear Material"

SNM is typically described as any material enriched with uranium or plutonium. Source material, however, is not included in the definition of SNM. Part 70 of Title 10 of the CFR establishes the requirements for issuing licenses to receive, possess, use, and transfer SNM; and provides the conditions for the issuance of a license. Examples of facilities that require Part 70 licenses are nuclear fuel fabrication facilities and uranium enrichment facilities that use technology other than gaseous diffusion. Gaseous diffusion for uranium enrichment is regulated under 10 CFR Part 76. New fuel fabrication and enrichment facilities, including facilities designed to produce more highly enriched uranium and uranium-plutonium fuels, will have to meet the requirements of 10 CFR Part 70. To address new reactor fuels, rulemaking may be necessary in the future.

F. Part 71, "Packaging and Transportation of Radioactive Material"

The staff reviewed this regulation and has determined that no changes are needed to address new reactor licensing activities. Part 71 of Title 10 of the CFR provides requirements, procedures, and standards for packaging, preparation for shipment, and transportation of licensed material. It provides the requirements for an application for NRC approval of a transportation package and the standards for packages, including lifting and tiedown standards, radiation standards, and requirements for fissile material, irradiated nuclear fuel, and plutonium packages.

Certifications for new transportation packages will be required for the PBMR and may be required for the other advanced reactor designs yet to be design certified. The NMSS assumes that a request for a new transportation package certification will happen in FY2005 or later. Certification of new packages could require minimal rulemaking effort.

G. Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste"

The staff reviewed this regulation and has determined that no changes are needed to address new reactor licensing activities. Part 72 of Title 10 of the CFR establishes requirements, procedures, and criteria for the issuance of licenses to receive, transfer, and possess power reactor spent fuel and other associated radioactive materials in an independent spent fuel storage installation and the terms under which the Commission will issue such a license. Part 72 also establishes the requirements, procedures, and criteria for issuing licenses to DOE to receive, transfer, package, and possess power reactor spent fuel, high-level radioactive waste, and other associated radioactive materials in a monitored retrievable storage installation. The regulations in Part 72 also govern the issuance of Certificates of Compliance approving spent fuel storage cask designs.

If the currently approved spent fuel storage casks listed in Section 214 of Part 72 are not certified to store the new types of reactor spent fuel, new or current casks will have to be certified for that purpose. This would require significant rulemaking efforts.

H. Part 73, "Physical Protection of Plants and Materials"

Part 73 of Title 10 of the CFR establishes the requirements for development and maintenance of a physical protection system for the protection of SNM at sites and in transit and of plants in which the material is used. Because of the general performance-based requirements contained in this regulation, it would not require rulemaking to address new fuel types.

I. Part 74, "Material Control And Accounting of Special Nuclear Material"

The staff reviewed this regulation and has determined that some changes may be needed to address new reactor licensing activities. Part 74 of Title 10 of the CFR establishes requirements for the control and accounting of SNM. Due to the design of PBMR fuel pebbles specific measures for item control for the pebbles of a PBMR may need to be considered. As Part 74 currently stands, exemptions could be used to address new fuel types. However some rulemaking may be necessary**.**

J. Part 75, "Safeguards on Nuclear Material—Implementation of US/IAEA Agreement"

Part 75 of Title 10 of the CFR establishes a system of nuclear material accounting and nuclear material control for implementing, with respect to NRC and Agreement State licensees, the agreement between the United States and the International Atomic Energy Agency (IAEA) for the application of IAEA safeguards in the United States.

Due to the broad nature of the agreement, no changes to this regulation are needed to accommodate the future licensing of reactors.

K. Part 76, "Certification of Gaseous Diffusion Plants"

The staff reviewed this regulation and has determined that no changes are needed to address new reactor licensing activities. Part 76 establishes the requirements for the certification and operation of those portions of the Portsmouth and Paducah GDPs in Piketon, Ohio, and Paducah, Kentucky, respectively, that are leased by the United States Enrichment Corporation. Currently, the Paducah GDP is certified to produce uranium enriched in uranium-235 (U-235) up to 5.5% by weight.

If higher enriched uranium were needed for new nuclear power plants, the current GDPs could apply for a certificate amendment under 10 CFR Part 76 to allow an increase in uranium enrichment level.

L. Part 110, "Export and Import of Nuclear Equipment and Material"

The staff reviewed this regulation and has determined that no changes are needed to address new reactor licensing activities. Part 110 of Title 10 of the CFR concerns the licensing, enforcement, and rulemaking procedures for the import and export of nuclear equipment and material. Part 110 also gives notice that persons may be individually subject to NRC enforcement action for violations of Commission requirements resulting from deliberate individual misconduct. The part also lists material and equipment that are under NRC's import and export authority.

The uranium enrichment requirements for current domestic reactors can be met by the current U.S. fuel fabrication technology. However, due to the unique characteristics of the PBMR design, the PBMR fuel may be made outside of the U.S. and such fuel may have to be imported into the U.S. If such fuel is imported, it will have to meet the import requirements of this part and all other applicable requirements, such as requirements for transportation.

IV. REGULATORY INFRASTRUCTURE FOR NEW REACTOR LICENSING ACTIVITIES

Over the past few years, the NRC has undertaken a number of regulatory infrastructure improvements, including the promulgation of the alternative licensing processes in 10 CFR Part 52, that provide a foundation for future licensing activities. Because of these improvements, the current NRC regulatory infrastructure is adequate to support future licensing. However, the staff has identified a number of regulatory infrastructure changes discussed below that would make future licensing reviews more effective and efficient as well as reducing unnecessary regulatory burden during a licensing review. In addition, the introduction of new reactor technologies will require the staff to consider additional regulatory infrastructure changes to make future licensing reviews of these technologies more effective and efficient.

A. Rulemaking Activities

At the time this assessment was initiated, the NRC was pursuing four rulemakings related to future licensing activities. As part of this assessment, the staff identified one other rulemaking related to future licensing activities. These rulemakings are discussed in Section IV.A.1 of this report. In addition, as part of this assessment, the staff has identified other issues related to future licensing activities that could result in rulemaking. These issues are discussed in Section IV.A.2. Resource projections for these activities are discussed in Section V.H of this report.

1. Rulemakings

The NRC is planning to conduct five rulemakings related to future licensing activities: (1) an update to 10 CFR Part 52; (2) a revision to 10 CFR Part 51 to address alternative site reviews; (3) a revision to 10 CFR Part 51, Table S-3 to update environmental data and to address changes in the nuclear industry infrastructure, (4) a revision to 10 CFR Part 51, Table S-4 to update environmental data and to address changes in the industry, and (5) a revision to 10 CFR Part 50, Appendix I to address non-light-water reactors (non-LWRs) and incorporate a new dose calculation methodology.

10 CFR Part 52 Update Rulemaking

Since 10 CFR Part 52 was promulgated in 1989, three standard designs have been certified, demonstrating how the standard design certification process can be implemented.

The staff determined that a rulemaking was necessary to revise 10 CFR Part 52 to incorporate lessons learned from the completed design certification reviews and to incorporate potential improvements to the ESP and COL processes. The rulemaking plan was submitted to the Commission on December 4, 1998, in SECY-98-282, “Part 52 Rulemaking Plan,” and on January 14, 1999, the Commission informed the staff that the Commission did not object to the proposed 10 CFR Part 52 rulemaking plan. The Commission also directed the staff to seek involvement with stakeholders before the proposed rule was presented to the Commission to obviate the need for a public meeting after the proposed rule was issued and to streamline the rulemaking process. The staff issued letters to interested stakeholders on September 9, 1999, to solicit comments. The rulemaking effort to update 10 CFR Part 52 was included in the NRC’s FY

2001 budget. The staff is incorporating the comments and intends to recommend to the Commission a proposed rule in April 2002.

10 CFR Part 51 Alternative Site Review Rulemaking

Alternative site analysis is an important aspect of the NRC's review of proposed nuclear power plant sites. 10 CFR Part 51, the NRC regulations implementing the NEPA, requires consideration of alternatives to proposed actions, but does not mention alternative sites. In addition, 10 CFR 52.17(a)(2) requires that the environment report include an evaluation of alternative sites to determine whether there is any obviously superior alternative to the site proposed. Guidance on the review of alternative sites from an environmental perspective is given in Regulatory Guide 4.2, "Preparation of Environmental Reports for Nuclear Power Plants," issued in July 1976, and in NUREG-1555, "Environmental Standard Review Plan," issued in March 2000.

The issue of what constitutes an adequate alternative site review under NEPA received considerable attention from the NRC and the federal courts in the 1970s, culminating in 1980 in the publication of a proposed rule for alternative site reviews. Shortly thereafter, progress on this issue stopped because of the lack of new nuclear power plant applications. With the prospect of new applications for ESPs and applications for reactors of new designs, it is appropriate for the staff to assess the adequacy of NRC's regulations and regulatory guidance relevant to alternative site reviews. In light of the current evolution of nuclear industry restructuring, nuclear plant owners and operators are considering building and operating merchant plants that may not be rate-regulated by states. The specific purpose for a utility to build a plant to supply power to its service area 30 years ago is different than that of an organization that proposes to build and operate exempt wholesale generators (EWGs) in today's regulatory environment. EWGs are generators authorized by the Federal Energy Regulatory Commission to sell power at wholesale market based rates. Such plants are sometimes called "merchant" plants. The staff believes that clarifying its regulatory criteria for the alternative site review required by NEPA will help reduce licensing uncertainty on this matter, thereby supporting a timely and more efficient review, and may result in a decrease in resource expenditure for the hearings for an ESP or a COL that does not reference an ESP. However, this decrease is difficult to quantify. In addition, The NRC also received a petition for rulemaking from the Nuclear Energy Institute (NEI) which requests the elimination of alternative site reviews. This petition is discussed in section IV.2 and is currently considered a separate activity from the alternative site review rulemaking. As progress is made on both activities, the staff will continue to refine its proposed resolution for the activities. The staff intends to initiate rulemaking in FY2002.

10 CFR Part 51 Tables S-3 and S-4 Rulemakings

Tables S-3 and S-4 of 10 CFR Part 51 were originally promulgated in the early 1970s to generically address the environmental impacts of the uranium fuel cycle for LWRs that are to be considered in environmental analyses for CPs. Revisions to Tables S-3 and S-4 are independent of one another and would be accomplished through two separate rulemakings. Table S-3 is a list of the environmental data to be used in the ER for a construction or ESP application as the basis for evaluating the environmental effects of the front and back ends of the uranium fuel cycle in a LWR. Table S-4 lists the environmental impacts of transportation of unirradiated fuel to, and spent fuel and other radioactive wastes from, a LWR. These impacts are to be used in weighing

the environmental costs of licensing a reactor. Table S-4 can be incorporated into an applicant's ER with no additional analysis if (1) the LWR produces not more than 3800 MW(t) of electrical generation, (2) uranium-235 is enriched to no greater than 4%, (3) burnup is not more than 33 MWD/MTU, (4) irradiated fuel assemblies have cooled at least 90 days prior to transportation, (5) waste other than high-level waste (HLW) is in solid form, and (6) unirradiated fuel is transported to the reactor by truck, irradiated fuel is transported by truck, barge or rail, and wastes other than irradiated fuel are transported from the reactor by truck or rail. Since the tables were last updated, a number of issues have emerged, prompting the staff to initiate rulemaking activities. These issues include:

- consideration of high-burnup fuel and increased enrichments
- consideration of cumulative impacts associated with transportation of HLW in the vicinity of a permanent repository
- consideration of accident analyses
- consideration of health effects
- consideration of economic and socioeconomic issues
- consideration of cumulative impacts
- consideration of changes in cask design
- consideration of occupational doses
- consideration of decommissioning impacts

The staff believes that these rulemakings will help reduce licensing uncertainty on these issues, and therefore, support a timely and more efficient review, and may result in a decrease in resource expenditure for the hearings for such applications; however, this decrease is difficult to quantify. The staff has recently completed scoping of this rulemaking activity and intends to initiate rulemaking in FY2002.

10 CFR Part 50 Appendix I Rulemaking

Pursuant to 10 CFR 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors," a nuclear power reactor license must include technical specifications to impose certain requirements such that radioactive effluents be as low as reasonably achievable (ALARA). Appendix I to 10 CFR Part 50 provides the dose criteria for demonstrating acceptable compliance with the ALARA principle for LWRs. Appendix I is based on the International Council on Radiation Protection 2 (ICRP 2) methodology (i.e., separate whole body and critical organ dose calculations with separate dose criteria for each). When 10 CFR Part 20 was revised in 1994 to incorporate the ICRP 26 methodology (in which external and internal dose contributions are viewed cumulatively as total effective dose equivalent (TEDE)), the Commission decided not to revise Appendix I because it would not be a substantial safety benefit. At that time, the NRC and industry

agreed that Appendix I should be revised to incorporate ICRP 26 methodology if new reactor applications were received. This rulemaking would incorporate ICRP 26 methodology and address non-LWR designs. The staff believes that this rulemaking will help reduce licensing uncertainty on this issue thereby supporting a timely and more efficient review, and may result in a decrease in resource expenditure for the hearings for such an application. However, this decrease is difficult to quantify. The staff intends to initiate rulemaking in FY2002.

2. Other Activities with the Potential to Result in Rulemakings

As part of this assessment, the staff has identified other issues related to future licensing activities which could result in rulemaking.

NEI Petitions for Rulemaking Regarding Part 52

The NRC received two petitions for rulemaking from the NEI on July 19, 2001. The first petition proposed the creation of two new sections to Part 52 to treat as resolved (i.e., not subject to adjudication), for purposes of granting an ESP, any siting and programmatic information that was previously reviewed and approved by the NRC. The second petition requested amendments to 10 CFR 52.17 and 52.18 to eliminate the requirement for an ESP applicant to include, and for the NRC to review, alternatives to the site proposed in an ESP application. The petitioner recommended that the positions proposed in the petitions be included in the proposed Part 52 rule. The staff is currently evaluating these petitions and will develop an appropriate resolution strategy in the near future.

Financial Qualifications and Decommissioning Funding

Discussions with nuclear industry representatives have indicated that the regulations for financial qualifications and decommissioning funding may need to be reviewed because of the possibility of nuclear power plants being built as EWGs (merchant plants).

Decommissioning funding assurance has two major issues. First, new applications will need to state the method by which decommissioning funds will be collected. Second, the current requirements in 10 CFR 50.75 provide methods for determining the required amount of decommissioning funding assurance based on power level and whether the applicant's reactor is a pressurized water reactor (PWR) or a boiling water reactor (BWR). Therefore, if new applications for a commercial nuclear reactor are of a design that is not a PWR or a BWR, new formulas will need to be constructed to determine the proper amount of decommissioning funds to be set aside. The staff will describe these issues in detail and provide recommendations regarding them in a Commission paper to be issued in November 2001 in response to a series of questions raised by Exelon as part of the pre-application review for the PBMR. The staff has assumed that activities to resolve these issues generically will begin after Commission guidance is received in response to the November 2001 Commission paper.

Antitrust Review

Discussions with nuclear industry representatives have indicated that industry believes that the NRC should not be conducting antitrust reviews. The Office of the General Counsel is reviewing this issue and will address it separately.

Nuclear Insurance Requirements for Modular Reactors (Price-Anderson Act)

The Price-Anderson Act is intended to meet two basic objectives. First, to ensure that adequate funds would be available to satisfy liability claims of members of the public in the unlikely event of a very low probability catastrophic nuclear accident. Second, to remove the deterrent to private sector participation in the use of nuclear power presented by the threat of potentially large liability claims if such an accident were to occur.

Discussions with nuclear industry representatives have indicated that these requirements should be reviewed because of the likelihood of modular plants being built. The NRC has had a number of interactions with Congress on this issue. Any legislative changes relative to this issue may result in rulemaking.

Annual Fees for Modular Reactors

The fees applicable to reactors are 10 CFR Part 170 fees for services, and 10 CFR Part 171 annual fees. Part 170 fees recover the NRC's costs for specific services rendered to the identifiable applicants and licensees, including pre-application activities, reviews of applications, inspections (pre- and post-licensing), full cost recovery for project managers, and mandatory hearings. Part 171 annual fees are applicable once an OL is issued. These fees recover the NRC's costs for generic activities and other costs not recovered through Part 170 fees.

Discussions with nuclear industry representatives have indicated that these regulations should be reviewed because of the likelihood of modular plants being built. Industry has requested estimates of the annual fees that will be assessed for modular reactors and information on when Part 171 fees would be charged relative to issuance of a COL under 10 CFR Part 52. The staff will describe these issues in detail and provide recommendations regarding them in a Commission paper to be issued in November 2001 in response to a series of questions raised by Exelon as part of the pre-application review for the PBMR. The staff has assumed that activities to resolve these issues generically will begin after Commission guidance is received in response to the November 2001 Commission paper.

Waste Confidence Rule

Discussions with nuclear industry representatives and other stakeholders have indicated that this regulation should be reviewed because of the likelihood of non-LWR designs being built. The Waste Confidence Rule (10 CFR 51.23) was promulgated in 1984 and amended in 1990 to codify the Commission's generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for reactor operation and to indicate that the Commission believes that at least one mined geologic repository will be available within the first quarter of the twenty-first century to receive such waste. The rule was reviewed in 1999, at which time the Commission indicated that experience and developments since 1990 confirmed the Commission's findings in 1990. The staff is currently evaluating the applicability of the Waste Confidence Rule to non-LWRs. The staff will describe this issue in detail and provide recommendations regarding it in a Commission paper to be issued in November 2001 in response to a series of questions raised by Exelon as part of the pre-application review for the PBMR. The staff has assumed that activities to resolve these

issues generically will begin after Commission guidance is received in response to the November 2001 Commission paper.

Alternative Operator Staffing Approaches

10 CFR 50.54(m) specifies minimum operator staffing requirements. Discussions with the industry have indicated that this regulation should be reviewed because of the likelihood of modular plants being built. The staff will be providing its recommendation regarding this issue in a Commission paper to be issued in November 2001. The staff has assumed that activities to resolve this issue generically will begin after Commission guidance is received in response to the November 2001 Commission paper.

3. Regulatory Infrastructure for Future Reactor Licensing

Although the regulatory improvement initiatives undertaken by the NRC over the past few years provide a foundation for future licensing and inspection activities, the introduction of new reactor designs will require the staff to consider additional regulatory changes to make future licensing reviews more effective and efficient. NEI intends to submit a white paper proposing a risk-informed, performance-based regulatory framework in early 2002. NEI's proposed scope of work for this framework involves the actions needed to develop a conceptual framework of regulations, including general design criteria and general operating criteria. In addition, Exelon has proposed using a licensing approach with several elements similar to the NEI proposal in developing its COL application for the PBMR.

The staff has created a regulatory framework working group that has been chartered to assess options for conducting effective and efficient licensing reviews, including case-by-case reviews with the existing regulations and the development of a new technology-neutral set of regulations. The working group will develop a Commission paper in mid-2002 to provide the Commission with options and recommendations as to how to proceed with this activity. ACRS and stakeholder views will be solicited as part of this activity.

B. Regulatory and Review Guidance

The staff and industry use a number of regulatory and review guidance documents during the preparation and review of various licensing submissions. These documents include regulatory guides, NUREGs, the SRP, and the environmental standard review plan (ESRP). As part of this report, the staff assessed the need to update guidance documents for the licensing of new plants or sites. The primary purpose for issuing new guidance is to incorporate lessons learned from operating and other relevant experience and provide greater stability and predictability in the licensing process by promoting uniformity and consistency in applications and staff reviews. Clear guidance to applicants facilitates both the preparation of documents for staff review and the review itself. Such guidance promotes consistent use of the governing criteria for each application and constitutes management approval of the scope and depth of the reviews.

1. Regulatory Guides and NUREGs

In support of the alternative site review and 10 CFR Part 51, Tables S-3 and S-4 rulemakings discussed in Section IV.A.1, the following regulatory guides would need to be revised:

Regulatory Guide 4.2	“Preparation of Environmental Reports for Nuclear Power Stations”
Regulatory Guide 4.7	“General Site Suitability Criteria for Nuclear Power Stations”

In support of the ESP process described in 10 CFR Part 52, NUREG-0654, “Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants,” will need to be revised.

In support of the 10 CFR Part 50, Appendix I rulemaking discussed in Section IV.A.1, the following regulatory guides would need to be revised.

Regulatory Guide 1.21	“Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants”
Regulatory Guide 1.109	“Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I”
Regulatory Guide 1.111	“Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors”
Regulatory Guide 1.113	“Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I”
Regulatory Guide 4.15	“Quality Assurance for Radiological Monitoring Programs (Normal Operation) —Effluent Streams and the Environment”

The staff has identified a number of other regulatory guides that need to be updated or developed for new reactor licensing:

Regulatory Guide 1.26	“Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants”
Regulatory Guide 1.29	“Seismic Design Qualification”
Regulatory Guide 1.68	“Initial Test Programs”
Regulatory Guide 1.101	“Emergency Planning and Preparedness for Nuclear Power Reactors”
Regulatory Guide 1.XXX	Development of a new regulatory guide to address International Standards Organization (ISO)-9000 specifications related to QA.

The staff has also identified several general areas for which guidance documents will have to be revised or developed because of changes in technology or regulatory practice. These areas include: (1) gas-cooled reactor technology; (2) geology; (3) hydrology; (4) geotechnical; and (5) seismic.

2. Standard Review Plan

Staff effort will be needed to revise existing SRP sections. The staff has identified a number of SRP chapters that should be updated to provide for a more effective and efficient review of future licensing applications:

Chapter 9 "Auxiliary Systems"

Chapter 13 "Conduct of Operations"

Chapter 14 "Initial Test Program and ITAAC - Design Certification"

Chapter 18 "Human Factors Engineering"

The last overall revision of the SRP was issued in 1981. The staff had published a draft revision in 1996 for comment; however, a final revision was not issued.

Following the July 19, 2001, Commission briefing on readiness for new plant applications and construction, the Commission issued an SRM and directed the staff to consider two items in preparing for new reactor licensing. In one of the items, the Commission directed the staff to consider the usefulness of developing a SRP for COL applications.

The staff believes that, in general, sufficient guidance exists to support reviews of future applications. However, as discussed above, several areas will require revision of guidance documents. The industry can continue to use Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," for formatting the applications and the current SRP and the ESRP provide sufficient review guidance. During the review of the certified designs (Advanced Boiling Water Reactor (ABWR), System 80+, and AP600) in the 1990s, the staff used the SRP and additional guidance addressed in SECY-90-016, "Evolutionary Light-Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements" and SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," and the applicable SRMs, to guide the review of these designs.

Unless several new applications for licensing of one class of plant (LWR, HTGR) are proposed, it would not be cost beneficial to complete the update to the SRP and the staff believes that any additional guidance can be developed on a case-by-case basis. As industry plans become definite, the staff will reconsider the need for additional review guidance based on the expected number and type of applications.

In conclusion, the staff does not believe it is necessary to develop an SRP to support a COL review because the review can be done using the review guidance already developed by the staff.

3. Environmental Standard Review Plan

The principal guidance to the staff for conducting an environmental review under 10 CFR Part 50 was addressed in NUREG-0555, "Environmental Standard Review Plans for the Environmental Review of Construction Permit Applications for Nuclear Power Plants." The staff first published this guide in May 1979. This version of the ESRP served as the staff guide for the preparation of the draft environmental statement and the final environmental statement (FES). NUREG-0555 and Regulatory Guide 4.2, “Contents of Environmental Report,” were the basic guidance documents for the staff and applicants with regard to NEPA requirements.

Both SECY-89-104 and SECY-91-041 indicated that the ESRP needed to be updated to reflect more recent understanding of the environmental issues that have emerged through licensing and operating experience. The staff published a revision to NUREG-0555 in October 1999 for public comment (see 65 FR 13798, Notice of Availability: Updated ESRP). The revision was finalized and issued as a new document, NUREG-1555, “Environmental Standard Review Plan,” in March 2000. It reflected input received during the comment period and a previous rulemaking that affected environmental reviews. The body of the final ESRP contains review guidance for new applications. Supplement 1 is specifically devoted to OL renewal issues.

However, the proposed rulemakings to clarify the requirements for the alternative site review and to update Tables S-3 and S-4 will necessitate updating the following sections of the ESRP:

ESRP Section 3.8 “Transportation of Radioactive Materials”

ESRP Section 5.7 “Uranium Fuel Cycle Impacts”

ESRP Section 9.3 “Alternatives to the Proposed Action”

These updates will be completed after the associated rulemakings have been completed.

4. Inspection Manual

Introduction

During this assessment, the staff identified the need to update inspection guidance related to the CIP for reactors and related to other inspections associated with design certification reviews (e.g., QA inspections to support test programs). The amount of effort associated with construction inspection activities greatly exceeds the amount of effort associated with other types of inspection.

Construction Inspection Program

In order to prepare for future applications, the NRC will reactivate the revision effort for the CIP that was suspended in 1994. This effort will include: (1) review and revisions of applicable inspection manual chapters (IMC) to address changes in the regulatory environment, specifically the application of risk information; and (2) development of the associated inspection guidance for inspection of critical attributes for advanced reactor designs. In the past, the NRC divided the CIP

into four phases. The inspection guidance for these four phases was contained in the following IMCs:

- IMC 2511 "Light-water Reactor Inspection Program—Pre-CP Phase"
- IMC 2512 "Light-water Reactor Inspection Program—Construction Phase"
- IMC 2513 "Light-water Reactor Inspection Program—Preoperational Testing and Operational Preparedness Phase"
- IMC 2514 "Light-water Reactor Inspection Program—Startup Testing Phase"

In 1991, the staff started revising the CIP governed by IMC 2512. The CIP revision effort reviewed the need for changes to the other IMCs governing the preoperational inspection program. In a May 1, 2001, SRM response, the staff wrote:

> In order to prepare for future applications NRR will reactivate the CIP revision effort suspended in 1994. This effort will include review and revisions of applicable IMC and development of the associated inspection guidance and training for inspection of critical attributes of construction processes and activities.

The objectives of the CIP revision were to address programmatic weaknesses in the NRC construction inspections that had been identified during the licensing of several plants and to develop an inspection program to meet the needs of evolutionary and advanced reactors. An assumption of the revised CIP was that it could be applied to plants licensed under either 10 CFR Part 50 or Part 52.

Although the CIP revision effort was suspended in 1994, a draft report was written to document the framework for reactivating the CIP to support NRC inspections at a future nuclear power plant. This "Draft Report on the Revised Construction Inspection Program," dated October 1996, was one of two documents that the staff used for guidance in developing the construction inspection input for this paper. The other document was SECY-89-104, "Assessment of Future Licensing Capabilities."

These documents provided information to assist the staff in (1) identifying the work that needs to be done, (2) estimating the resources to perform the work, and (3) identifying the critical skills that will be needed. Although these documents provide guidance the staff will not limit itself to only these documents. As discussed in Section V.H.4 of this report there are several issues that the above documents do not recognize. For example, the documents were written before the staff implemented the new reactor oversight process. Lessons learned from this effort, including the use of risk information, will be reviewed to determine if they can be applied to the CIP.

Chapter V of this paper identifies the work that needs to be done and the estimated resources and critical skills the agency needs to support this work for the following scenarios:

- ESP inspection guidance (Section V.D)
- COL inspection guidance (Section V.F.1)
- PBMR reactor inspection guidance (Section V.F.2)

- inspection guidance for a reactivated plant (Section V.G)
- general inspection guidance applicable to all designs (Section V.H.4)

Other Inspection Efforts

Other inspection-related efforts mainly involve inspection support for standard design certifications in accordance with Subpart B of 10 CFR Part 52. The inspection resource estimates are provided in Section V.E of this paper for the AP1000 and IRIS designs.

5. Codes and Standards

The use of industry consensus standards is fundamental to the NRC's reactor licensing review process. This use is required by the National Technology Transfer and Advancement Act of 1995, unless the use of such standards is inconsistent with applicable law or is otherwise impractical. The acceptance criteria in the SRP subsections extensively use allowable stresses and deformation criteria by referencing the appropriate industry codes and standards. However, the NRC staff has not kept abreast of newer design criteria that were developed by the industry standards-writing bodies because of the low priority of this activity in the past. Since the NRC practice is to use the latest editions of codes and standards that are applicable to various aspects of nuclear plant designs, it is essential that code updates be evaluated under the acceptance criteria of all the general engineering disciplines (e.g., chemical, civil, electrical, material, and mechanical). A number of standards are associated with the following professional societies and institutes: the American National Standards Institute, the American Society of Mechanical Engineers (ASME), the American Society of Civil Engineers, the American Concrete Institute, the American Institute for Steel Construction, the American Society for Testing Materials, and the Institute of Electrical and Electronics Engineers. In conducting licensing reviews, the NRC staff will have to review significant changes in these standards and determine the acceptability and applicability of these changes.

C. Development of Technical Infrastructure for Advanced Technology Assessment

For the NRC to be able to conduct effective and efficient reviews of the new reactor designs, it is planned to conduct research and testing to provide NRC with an independent capability to judge the safety of the proposed design and confirm information submitted by applicants. Such an approach has been used in the past and contributes to the quality, thoroughness and timeliness of the staff review. At the June 2001 ACRS Workshop on advanced reactors, the Committee advocated this point, which was strongly supported by the stakeholders. It is expected that the research related to HTGR fuel performance and qualifications, high temperature materials and graphite behavior, and thermal-hydraulic and core heat-up in the HTGR as well as research to confirm the performance of innovative advanced LWR features will be needed. The existing thermal-hydraulic and analytical codes may also have to be modified to address design-specific features and phenomena in the new reactors. The research performed; however, would vary from reactor design to design. Therefore, for each reactor type, an important objective of the pre-

application review phase is to identify the areas where research should be focused and the resources that would be required to support these activities.

For HTGRs, the fuel is the key safety feature of the design. Research on pebble fuel performance including fuel behavior during heat-up, and fission product release and transport from the irradiated fuel would be useful to confirm the performance of this key aspect of the design. The existing codes used for analysis of the LWRs can, in some cases, be adapted for the HTGR. However, they would need modification, including the capability to model air and water ingress. For accident analysis for the HTGR, it is expected that fission product release and transport can also be modeled by using the existing codes, with some modifications. Use of different materials and significantly different environmental conditions than the LWRs support the usefulness of materials engineering research to support the review of the advanced reactors. The high-temperature operating conditions, the use of graphite as the moderator and reactor-core structure material, and the use of helium gas as the coolant, raise unique issues with respect to the long-term performance, age related degradations and aging management, and structural integrity aspects of safety components, which could be explored via research. Additionally, much data can be obtained through international cooperation. For example, countries such as Japan, China and the Netherlands have been extensively involved in the HTGR fuel qualification research. Significant experience and data exists in other countries (e.g., Germany, China, and UK) in high-temperature applications and graphite technology. The use of cooperative research arrangements will be a key factor in developing research plans.

For AP-1000 and IRIS, the need for confirmatory research at various facilities may be necessary and resources have been included in this report for such thermal-hydraulic testing. The existing codes may have to be assessed for the conditions of operations of these reactor designs and to identify any needed improvements in NRC's thermal-hydraulic codes.

D. Fuel Cycle and Transportation Regulatory Infrastructure

The staff has reviewed the applicability of the fuel cycle and transportation regulations (see Section III of this report) and regulatory guidance to the advanced reactor licensing process. Based on this review, the staff has concluded that some changes to the previously discussed fuel cycle and transportation regulations will be needed to accommodate the advanced reactor licensing process. Similarly, new or revised regulatory guides may be needed for fuel cycle and transportation regulation. In the near term, fuel cycle and transportation matters will need to be addressed to support changes to 10 CFR 51.51 and 51.52 (Tables S-3 and S-4) and the 10 CFR 51.23 Waste Confidence Rule. NMSS has interest in and will likely expend resources to support the 10 CFR Part 51 rulemaking to address alternative site reviews, the 10 CFR Part 50 Appendix I rulemaking, and the financial qualifications and decommissioning funding activities. Certifications for new transportation packages will be required for the PBMR and may be required for other advanced reactor designs. A request for certification for a new transportation package for the PBMR is expected no sooner than FY 2005. In the future, it may be prudent to perform rulemaking for other regulations, namely Parts 70, 71, 72, and 74, rather than using license amendments and exemptions to address new reactor fuels.

V. RESOURCE AND SCHEDULE PROJECTIONS FOR FUTURE LICENSING REVIEWS

While developing its estimates of the schedules and resources required to conduct the reviews discussed in this report, the staff considered (1) the results of a critical skills and resources survey taken of the staff in August 2001 to support this assessment (see Section V.B of this report), (2) industry plans and proposed schedules as discussed in public meetings and correspondence, (3) its past experience with licensing reviews; (4) the effect of complex issues on these reviews; and (5) estimates from previous resource and schedule evaluations.

This chapter summarizes the schedules and resources (direct costs only) required for the technical reviews, inspections, and legal activities to support future licensing activities and includes staff effort and contracted technical assistance. The resource estimates are for direct effort only and do not include items such as management and administrative support, information technology needs, and training. These assessment efforts are only the first step in a multi-phase process of establishing detailed schedule and resource estimates for new reactor licensing activities. The staff will have a much better understanding of resource needs once (1) it is closer to completing the ongoing pre-application reviews, (2) it has had sufficient time to completely formulate the policy issues associated with new reactor licensing, and (3) it can better define the changes to the regulatory infrastructure that are necessary to support future licensing activities. As the nuclear industry finalizes its plans, the staff will continue to refine the schedule and resource estimates for each licensing scenario in order to establish detailed resource-loaded schedules. The staff believes that this effort is necessary to provide an appropriate level of information to support the NRC's planning, budgeting, and performance management process.

A. Background, Estimated Schedules, and Other Assumptions

1. Historical Background

To provide context for the estimates that are provided in this report, the staff researched resource expenditures for other activities that were similar in scope. The two broad reviews that the staff believed could provide context are the reviews of the standard designs that were certified in accordance with 10 CFR Part 52 in the 1990s and license renewal reviews that have been performed more recently. The following is a discussion of the resources that were used for these reviews.

- Certified Designs

  Section II.B of this report discusses the 10 CFR Part 52 licensing processes. Three designs have been certified in accordance with Subpart B of 10 CFR Part 52 and each one is codified in an appendix to 10 CFR Part 52. These designs and the staff resources expended to review and certify the designs are:

  - U.S. ABWR, which required approximately 100 full-time employees (FTE);

  - System 80+ PWR, which required approximately 75 FTE; and

  - AP600 PWR, which required approximately 130 FTE.

The U.S. ABWR was the first design to be certified and uses a single-cycle, forced circulation, BWR with a rated power of 1300 megawatts electric (MWe). The design incorporates features of the BWR designs in Europe, Japan, and the United States, and uses improved electronics, computer, turbine, and fuel technology. Improvements include the use of internal recirculation pumps, control rod drives that can be controlled by a screw mechanism rather than a step process, microprocessor-based digital control and logic systems, and digital safety systems. The design also includes safety enhancements such as containment over-pressure protection, passive core debris flooding capability, an independent water makeup system, three emergency diesels, and a combustion turbine as an alternate power source. Because the design was the first implementation of the 10 CFR Part 52, Subpart B process, it required more resources than the System 80+ review and certification, which was the second evolutionary LWR design to be certified.

The System 80+ design uses a 1300 MWe PWR. It is based upon evolutionary improvements to the standard Combustion Engineering System 80 nuclear steam supply system and a balance-of-plant design developed by Duke Power Company. The System 80+ design has a safety depressurization system for the reactor, a combustion turbine as an alternate AC power source, and an in-containment refueling water storage tank to enhance the safety and reliability of the reactor system.

The AP600 is a 600 MWe advanced PWR that incorporates passive safety systems and simplified system designs. The passive systems use natural driving forces without active pumps, diesels, and other support systems after actuation. Use of redundant, non-safety-related, active equipment and systems minimizes unnecessary use of safety-related systems. The AP600 was the first “passive” advanced LWR reviewed by the NRC. Because of the unique features of the AP600, additional evaluation was required than was necessary for the other certified designs. For example, Westinghouse was required to provide additional information in accordance with the provisions of 10 CFR 52.47(b)(2)(i), which contains additional requirements for plants that use simplified, inherent, passive, or other innovative means to accomplish its safety functions. Because of this requirement, Westinghouse conducted integral and separate effects testing programs from which the applicant derived data to support the AP600 code development program. The staff’s inspection and evaluation of these special programs required resources that were not required for the ABWR or the System 80+ because of the evolutionary nature of those designs. Although some contract support was used during the ABWR and System 80+ reviews, $5.5 million was expended for contract support for the AP600 because of the need for specialized expertise to review the unique design features of the plant, and to evaluate the testing and code development efforts necessary to support the design certification.

- License Renewal Reviews

The license renewal process proceeds along two tracks, one for technical reviews of safety issues (10 CFR Part 54) and another for environmental issues (10 CFR Part 51). An applicant must provide the NRC an evaluation that addresses the technical aspects of plant aging and describes the ways those effects will be managed. It must also prepare an evaluation of the potential impact on the environment if the plant operates for another 20

years. The NRC reviews the application and verifies the safety evaluations through inspections.

The Calvert Cliffs and Oconee license renewal reviews each required approximately 20 FTE and $350,000 in contractor support. This expenditure is the total of the safety and environmental reviews. Although the scope of the safety review for a license renewal application is much more limited than the scope of a safety review for a design certification performed in accordance with Subpart B of 10 CFR Part 52, the staff used these historical resource expenditures for license renewal to gauge the resource estimates that are provided in later sections of this report.

2. Schedule Estimates

The following is a discussion of the activity-specific assumptions used when developing the estimated review schedules for an ESP, a design certification, and a COL. As stated previously, while developing these schedules, the staff considered (1) industry plans and proposed schedules as discussed in public meetings and correspondence, (2) its past experience with licensing reviews, and (3) estimates from previous evaluations (SECY-89-104, "Assessment of Future Licensing Capabilities," dated April 3, 1989, SECY-91-041, "Early Site Permit Review Readiness," dated February 13, 1991, and SECY-91-161, "Schedules for the Advanced Reactor Reviews and Regulatory Guidance Revisions," dated May 31, 1991), and other similar resource estimates. Although other possible combinations exist for which the staff could receive a licensing application, the staff has evaluated only those scenarios identified by nuclear industry representatives as the most likely to be submitted in the near future.

The schedule estimates are nominal values. All schedules are dependent on resource availability. If resources are limited, activity durations will be extended. In addition, no attempt has been made to integrate the schedule of one project with that of the other projects identified in this paper. Although some review activities can be performed in parallel with each other, other work (such as the review by the ACRS or an ASLB hearing) must be performed serially in a particular order. Durations of specific time periods for certain activities, such as comment periods required by the NEPA process, were also accounted for in the schedule estimates.

- ESP Schedule Assumptions

  Before receipt of an ESP application, the staff expects there will be a 6-12 month interaction with the applicant to discuss its preparations for the application and to inform the public of the staff's plans for review of the applicant's proposal. The staff estimates that the review of an ESP application will take approximately 30 months from submittal to granting of the permit, depending on the quality of the application and complexity of the issues. This report provides a bounding estimate of what resources are required to perform an ESP review for a new site. Adjustments will need to be made to account for a number of other factors, including (1) the extent of previous site reviews, and (2) the extent to which emergency planning issues are addressed by the applicant at the ESP stage. For example, the review schedule for an ESP for a site that has not been previously reviewed may take longer than that for review of a site where a draft or final EIS and safety

evaluation report (SER) has been issued in connection with a CP review.[1] Similarly, the extent to which emergency planning issues are addressed at the ESP stage could range from an application where the applicant only addresses major impediments to developing an emergency plan and establishes state and local contacts (this is the minimum required by 10 CFR Part 52) to an application for a ESP where an emergency plan is already implemented for a operating reactor on the site.

- Design Certification Schedule Assumptions

  The staff estimates that the review of a design certification application will take 42–60 months from submittal to the granting of the certification, depending on the uniqueness of the design, whether there is a need for testing and the extent of the testing program, and whether policy matters need to be addressed. The staff's previous reviews of the ABWR, System 80+, and AP600 took approximately 7 years each to complete, but there were many complicating factors, including initial submittal of incomplete applications, first implementation of the design certification review process, complex technical and policy matters that needed to be resolved, review of unique design features, and implementation and evaluation of testing programs. The staff believes that a design certification review of an evolutionary LWR design will require less time to complete than the review of a design that differs significantly from an evolutionary LWR.

- COL Schedule Assumptions

  The staff estimates that the review of a COL that references a certified design and an ESP will take about 27 months to complete from submittal to granting of the license. The staff's review scope will be limited to the review of (1) the acceptability of the design of systems, structures, and components (SSCs) for which only the design acceptance criteria (DAC) were approved during the design certification review; (2) the acceptability of the design of site-specific SSCs (intake structure, cooling towers, etc.) in relation to the site interface requirements; (3) the acceptability of licensee programs (organization, security, training, EP); and (4) the compliance of the site interface requirements of the design certification with the bounding parameters of the ESP.

  The staff estimates that the review of a COL that references an ESP only (a custom design) could take 33–60 months to complete, depending on the uniqueness of the design, whether there is a need for testing and the extent of the testing program, and whether policy matters need to be addressed. The staff will also need to verify the compliance of the site interface requirements of the custom design with the bounding parameters of the ESP.

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[1]Although applicable information from previous reviews can be referenced in an ESP application, the application is a new submittal and must address new data and apply new, more accurate modeling techniques in the application. Also, the evaluation must conform with the regulations that are current at the time of submittal, such as Appendix S to 10 CFR Part 50, *Earthquake Engineering Criteria for Nuclear Power Plants.* Therefore, the review of an ESP may require the equivalent resource expenditure as a review of a greenfield site.

3. Other Assumptions

While developing its schedule and resource estimates for future licensing activities, the staff identified key assumptions governing the conduct of the review. The following is a discussion of the assumptions used during the staff's estimation of review schedules and resources required to complete future licensing reviews. Deviation from these assumptions could significantly affect the estimates for these reviews.

- Applications

  Applications will be complete, high-quality submittals supported by sufficient research and development (where necessary), and any followup submittals will provide sufficient information to address the staff's concerns. The staff assumes that all required testing and code development will be completed in time to support the application, and that the pre-application reviews discussed in this paper will have been successfully completed with no remaining open policy or technical issues, or only a limited number of issues remain with a clear path to resolution identified to support future licensing activities. In addition, the staff assumes that multiple contentions will be propounded in a proceeding, but that only a few issues will require an evidentiary hearing to resolve.

- NRC Organizational Structure

  The staff assumes that the NRC organizational structure necessary to support these reviews will be in place and fully staffed at the time of the application. Although the staff will assign a dedicated project manager to coordinate the review of a specific licensing project, the staff assumes that the technical review staff will not be dedicated solely to these projects, but will work in the current matrixed organization of the NRC. Although the staff assumes a high priority will be assigned to these projects and experienced senior reviewers will be assigned to these tasks, the staff assumes it will need to integrate the review of future licensing activities with other work within the agency.

  As discussed previously, the schedule and resource estimates are nominal values. The staff assumed that the NRC will have the personnel necessary to perform the activities identified in this paper, and that necessary training will be completed, where needed. For near-term reviews, the staff expects to rely on contractor assistance, where necessary, to provide particular skills needed to review the applications. In some cases, sources of contractor assistance have been identified (DOE laboratories to support environmental reviews, U.S. Geological Survey (USGS) to provide geotechnical support). However, there are a limited number of both staff and contractor personnel with skills in certain technical disciplines, such as those necessary to support gas reactor technology reviews. The staff is evaluating ways to develop expertise in these areas. Staff initiatives to fill these skill gaps are discussed in Section V.B of this report.

- Pre-Submittal Activities

  The staff assumes that the preparatory activities identified throughout this paper will be completed or will be at a stage in the review process sufficient to support future licensing

activities. These activities include completing the supporting rulemakings, the regulatory guidance updates, the CIP update, and any code development or other techncial infrastructure activities identified in this paper. In addition, any policy issues will be resolved or nearly resolved by the time of the application.

B. Critical Skills

As part of the assessment of the NRC's technical, inspection, and licensing capabilities, the working group surveyed the staff to identify "gaps" in areas of critical skills needed to perform future reviews related to new reactor licensing activities. A skill gap within the agency occurs when individuals with expertise in certain technical areas either (1) are limited in number, work on specific assignments in important agency initiatives in other areas (spent fuel repository review, for instance), and not currently working in the office where the gap exists; (2) are near retirement or are expected to leave the agency within 6-12 months; or (3) do not exist in the agency.

The working group first identified the group of critical skills necessary to perform these reviews provided in the list below.

Site Safety
meteorology
hydrology
geography
geology
geotechnical engineering
seismology
demography
site analysis (external hazards analysis)

Site Environmental
aquatic ecology
land use analysis
terrestrial ecology
air quality
water use hydrology
socioeconomics/environmental justice
environmental engineering
historical and archeological resources
environmental project management

Radiological Engineering
operational radiation protection
radiological effluent environmental issues
accident analysis (onsite & offsite dose assessment)
emergency preparedness

Systems Engineering
reactor systems
plant systems
containment systems

Systems Engineering
electrical systems
PRA analysts
severe accident assessment
nuclear engineering
thermal/hydraulics and codes
nuclear physics
instrumentation & controls
technical specifications

General Engineering & Quality Assurance
mechanical engineering
fire protection
chemical engineering
structural engineering
materials engineering & metallurgy
human factors engineering
quality assurance
training and assessment
maintenance (D-RAP)
Safeguards/Security Analysis

Financial Analysis
antitrust
financial qualification
regional & environmental economics

New Reactor Designs
gas reactor technology
graphite technology
high burnup fuel

The working group then gathered information from the three main review offices (NRR, RES, and NMSS) and the Regions to identify skill areas where the NRC had very few resources or no resources with these critical skills.

1. Technical Skills

Within NRR, the assessment identified current skill gaps in many areas of the site safety review and in nearly all areas of site environmental review. In addition, the assessment identified skill gaps in the area of financial analysis (antitrust reviews). Both NRR and RES identified skill gaps in the areas of gas reactor technology and new fuel designs. Less prominent weaknesses were identified in the areas of radiological effluent environmental issues and nuclear and chemical engineering. The staff believes that in the short term many of these skills can be obtained through contracted technical assistance. Other skill gaps will have to be addressed through the HR ongoing strategic workforce planning initiatives (see Section V.B.3 of this report). The program office staff has been working closely with HR to ensure that the information gathered through this assessment is reflected in HR's planning efforts.

In the environmental area, the assessment identified skill gaps in the areas of terrestrial ecology, land use, air quality, historical and archeological resources, environmental justice, socioeconomics, and environmental engineering. The staff is proposing to perform reviews for ESPs and COLs apportioned with a split of 60% contractor resources and 40% staff resources. Consistent with the current strategy for implementing the environmental protection program for other significant programs (e.g., license renewal), NRR continues to expand the breadth and depth of in-house environmental specialists through recruitment and reassignments. The environmental review teams will be supported by experts from DOE national laboratories.

In the early 1980s, NRR disbanded the site analysis staff recognizing that no new plant application had been received for several years and none were imminent. Starting with the ESRP update effort in the mid-1990s, the staff developed a relationship with the DOE national laboratories to provide access to environmental specialists to assist NRR in the environmental reviews for the operating plant and license renewal programs. Through these relationships, NRR now has a group of about 140 contract specialists available for environmental reviews familiar with the NRC regulatory framework. NRR has also established the contractual infrastructure to gain access to the resources when needed for the various programs.

The staff expects to conduct its environmental review activities for ESP reviews in a manner similar to its work for license renewal reviews; i.e., staff the project with an environmental project manager and a core group of NRC staff (about 40% of the overall effort) with the national laboratories providing a Project Team Leader and the experts (about 60% of the effort). Because the current industry interest may or may not come to fruition, NRR does not intend to reestablish an environmental review group with the full range of technical experts until it is evident that multiple applications are expected over an extended period of time.

For the site safety review, the NRR assessment identified skill gaps in the areas of hydrology, geology, geography, demography, and site external hazards analysis, as well as less prominent weaknesses in the areas of meteorology, geotechnical engineering, and seismology. In past licensing reviews where the staff did not have expertise in a particular area of the geosciences,

the staff has contracted with USGS advisors and private consultants for technical assistance. At one time, the NRC had an interagency agreement with the USGS. The staff has been meeting with senior officials at the USGS to lay the groundwork for putting in place a Memorandum of Understanding (MOU) between the two agencies in anticipation of ESP applications.

If, in the future, multiple ESP applications are expected over several years, the staff would likely need to hire a geologist, a geotechnical engineer, and a hydrologist. Additional help could be obtained through the US Army Corps of Engineers on surface water hydrology and the National Oceanic and Atmospheric Administration (NOAA) on meteorology. The review of site-specific demographic information for the license renewal activities is currently being conducted through technical assistance from national laboratories. For the near term, the staff expects that demographic reviews for future reactors will continue to be conducted through contracted technical assistance or through interagency agreements.

The staff has also identified skill gaps within RES in several key areas. There is a shortage of experts in some key disciplines (e.g., materials engineering) due to staff working on activities related to current LWRs and a total absence of specialized skills in a few select areas to effectively support the future reactor licensing activities. These areas include fire protection, chemical engineering, metallurgy, HTGR fuel technology, graphite technology, and HTGR accident analysis, including source term analysis. The staff believes, in the near-term, that some of the required skills can be obtained through contracted assistance.

NMSS did not identify any skill gaps that would affect the staff's short-term ability to carry out its responsibilities related to support of new reactor licensing activities. If a greater amount of work is realized than is being projected, however, there would be staffing constraints. A similar approach to that described above could be used to acquire short-term technical assistance and longer-term staff specialists. Critical staff specialties include nuclear criticality safety, thermal and structural engineering, and material control and accounting.

2. Construction Inspection Reactivation Skills

The staff performed a separate critical skills survey of the regions and headquarters to determine if there are any critical skills that may be lacking to support inspection activities related to new reactor licensing. Analysis of the critical skills assessment results is complicated by the following factors:

- The level of construction/reactivation activity is uncertain. Because of this uncertainty, contractors may be used in the short term to supplement NRC resources.

- It is uncertain where, if at all, construction or reactivation activity will resume. Options that are contained in this report include (1) constructing the PBMR, (2) completing WNP-1, Bellefonte or Watts Bar Unit 2, and (3) restarting Browns Ferry 1. The critical skills assessment at this point did not ask for an assessment of whether or not any of the resources would be willing to move to a construction/reactivation site.

- The organizational structure has not been identified. An example of an organizational structure that has been discussed is a "virtual center of excellence." If this organizational

structure is used, inspectors may be matrixed to an “inspection” organization on a temporary basis. This option for staffing would allow one region to use resources from other regions or headquarters to support inspections.

Some of the results of the critical skills survey for the CIP are consistent with the results identified above for the NRR and RES. Specifically, the results of the survey indicated the following:

- There is a skill gap in the area of gas reactor technology. The staff does possess construction inspection experience with LWRs; however, there is a critical skills gap with gas-cooled construction inspection experience. Training and hiring could be used to fill this gap.

- The NRR assessment discussed above in the site safety review area also applies to inspection activities. Specifically, a critical skills gap of reactor construction inspectors in the geotechnical area (e.g., geology, hydrology, seismology) was identified. The options discussed above to fill the NRR gap could also apply to the construction inspection gap. In addition, the construction inspection experience being developed for the HLW repository is another potential source for these resources.

Some of the results of the critical skills survey are unique to the CIP including the following:

- The construction inspection critical skills are not evenly distributed between headquarters and the regions, and there is also an uneven distribution between each region. This results in some regions or headquarters lacking critical skills, but other regions having the skills.

- Many of the people possessing construction inspection skills are in the later part of their careers, and relocation of these people to another region or a construction site may not be an option (e.g., the results indicated that some of the people possessing these skills would choose to retire instead of relocate).

- Staff possessing reactor construction inspection skills are not currently using this skill, and therefore would have to be reassigned from the reactor oversight program. To a certain extent, reassignment may be possible but because the CIP represents new work, at some point, resources will need to be reassessed. Resource estimates for the CIP are discussed later in this chapter.

- The skills survey identified personnel that possess some of the critical skills, but they were not counted because they lacked previous construction inspection experience. If needed, these people could be used in the CIP with additional training and on-the-job experience.

As stated above, it is uncertain where and to what extent construction or reactivation of nuclear plants will occur. This uncertainty, coupled with the uneven spread of construction inspection capability and the age of the inspectors possessing this capability, presents an organizational challenge. As stated in Section V.F of this report, the staff is currently considering several organizational structures for the CIP. In the near term, as stated in Section V.H, of this report, the staff believes that the CIP should be updated. As industry plans regarding construction and

reactivation are finalized, the staff will determine which organizational model is the most effective and efficient to carry out the program. The results of the critical skills survey will be used in this determination.

3. Strategies to Fill Skill Gaps

As part of the agency's ongoing workforce planning effort, HR is developing and implementing strategies to address workforce issues. The staff is identifying and addressing skill gaps across the agency to ensure that the appropriate staff is available for the NRC to fulfill its mission and any new regulatory responsibilities. Some of the strategies identified to date include:

- Increasing compensation as necessary to stay competitive in acquiring and retaining skills and competencies vital to our mission
- Hiring highly skilled and knowledgeable employees prior to the departure of experienced, technical staff to facilitate knowledge transfer
- Increasing the number of entry-level interns and cooperative education students hired
- Granting Waivers of Dual Compensation Limitations[2], where appropriate
- Utilizing retention allowances, where appropriate
- Utilizing recruitment bonuses, where appropriate
- Expanding recruitment outreach programs

The agency will use these strategies, and identify new strategies, to retain and recruit staff with critical technical skills and to maintain a diverse workforce. The use of other strategies, such as developing a comprehensive advanced reactor technology training program and moving people within the agency to where their skills are most needed, will be discussed with HR as industry plans become formalized and the staff can more accurately assess its resource needs for new reactor licensing reviews.

C. Pre-Application Reviews

[2]Under current statutes, federal civilian retirees will have their salary reduced by the amount of their annuity when reemployed by the federal government, unless an exception is approved. This reduction is required by dual compensation laws 5 U.S.C. 8344 and 8468. These laws apply to federal jobs in the legislative, executive, and judicial branches. However, federal agencies may request authority to waive the salary reduction in special and unusual circumstances. The law limits waivers to positions for which there is exceptional difficulty recruiting or retaining a qualified employee and to temporary employment while the authority is necessary due to an emergency involving a direct threat to life or property or other unusual circumstances.

Consistent with Commission guidance and the NRC's Advanced Reactor Policy, the NRC encourages pre-application dialog with potential applicants to help identify key issues before an actual application is submitted. At present, the NRC is conducting pre-application reviews of the PBMR and the AP1000 designs. On the basis of recent industry information, the staff expects General Atomics and Westinghouse to request pre-application reviews of the GT-MHR design in early FY 2002 and of the IRIS design in mid-FY 2002, respectively. This section presents the staff's resource and schedule estimates for the pre-application reviews for these four designs.

In addition to the applicable assumptions discussed in Section V.A(3) of this report, the staff has considered the following key assumptions in estimating the skills and resources required to support the new reactor pre-application review:

- The resources and skills will be dedicated to each review.
- USDOE funding support will be available only for the PBMR review and only in FY 2002 for review of generic HTGR design issues.

A summary of the resource estimates for the currently identified pre-application reviews is given in the table below. The bases for these estimates follow.

Table V.C-1 Pre-application Review Resources Estimates

	FTE			Contract
	Licensing	**Research**	**Total**	**$K**
AP1000	2		2	$0
PBMR	5	6	11[1]	$700[1]
GT-MHR	4	12	16	$1900
IRIS	3	12	15	$1,500[2]

[1] These estimates include approximately 2 FTE and $500K of DOE funding in FY 2002 through a reimbursable agreement.

[2] Assumes NRC initiates thermal-hydraulic code modification and confirmatory experimental work during the pre-application phase. Also assumes no DOE support for experimental work.

1. AP1000

In May 2000, Westinghouse requested the NRC to support a 3-phase review for the AP1000 design. The results of each review phase would provide Westinghouse with sufficient information to determine whether to proceed to the next phase. Phase 1, or the scoping phase of the review, consisted of the staff identifying key review assumptions, and technical and policy issues that the NRC staff would evaluate during the Phase 2 feasibility review. The staff was also requested to provide Westinghouse with an estimate of the NRC resources and review schedule that would be needed to perform the feasibility review. The staff completed its Phase 1 review in July 2000.

In an August 28, 2000 letter, Westinghouse stated that they desired to proceed with Phase 2, which will provide the applicant with sufficient pre-application information to determine the technical and economic feasibility of seeking a design certification for the AP1000 (Phase 3). In that letter, Westinghouse requested that the NRC proceed with the Phase 2 review of the AP1000 to address the following issues:

- Applicability of the AP600 test program to the AP1000 design
- Applicability of the AP600 analysis codes to the AP1000 design
- Acceptability of the AP1000 DAC
- Acceptability of certain exemptions for the AP1000 design

This section addresses the resources and schedule necessary to complete that effort. The estimates provide for resources in the identified technical areas of the pre-application review and for project management within NRR.

Phase 2 is expected to be completed by early 2002. Resources for Phase 3 work (design certification) are addressed in Section V.E of this report.

The staff estimates that approximately 2.0 FTE are required to complete Phase 2 of the AP1000 pre-application review.

2. Pebble Bed Modular Reactor (PBMR)

The PBMR is a 110-MWe modular HTGR that uses helium as a coolant. It is expected that multiple modules will be developed at a single site. The PBMR design is under development in the Republic of South Africa (RSA) and is being considered for licensing in the United States by Exelon Generation, USA. In a letter dated December 5, 2000, Exelon requested the NRC staff to conduct a pre-application review of the PBMR design and technology for possible licensing in the United States. Following the Commission approval of an April 25, 2001 staff proposal (SECY-01-0070), a pre-application review effort began. Since then, the staff has been conducting periodic topical meetings with Exelon, DOE, and interested stakeholders to discuss various key licensing, technical, and design issues.

There are certain innovative aspects of design, technology, and operating characteristics that are unique to the PBMR; therefore, the PBMR licensing approach is expected to be different than that for the conventional and the advanced LWRs. To license a PBMR in the United States in a timely and efficient manner, it is imperative to identify and resolve the key design, safety, licensing, and policy issues applicable to the design before a COL application is submitted. The unique PBMR design-specific issues and policy matters need evaluation, and many of them warrant Commission consideration. The staff is applying its previous experience from the licensing of Fort St. Vrain, the design certification of the evolutionary and passive LWRs, and the earlier review of the DOE-supported MHTGR to achieve timely identification and resolution of the key PBMR design, safety, and licensing issues.

Research Resources

DOE, in an interagency agreement dated March 22, 2001, agreed to fund a portion of the NRC efforts to assess the safety and technology of the HTGRs. The staff's pre-application review efforts, partly supported by DOE, will involve design and technology assessment, regulatory framework, and regulatory assessment activities. The staff expects that the NRC assessment of the PBMR design and technology will provide a fundamental input to DOE in evaluating its advanced reactor program. The resources expected from DOE are not included in the staff's resource estimates.

Consistent with the Commission guidance and the NRC's Advanced Reactor Policy, the NRC encourages pre-application dialog with the industry so as to help identify key issues before the actual review begins. During the pre-application phase, in frequent interactions with Exelon, the staff plans to gather information; identify key technical and licensing issues; develop plans for resolution of the key PBMR-related design, safety, and licensing issues; prepare papers identifying key policy issues and provide recommendations for Commission consideration and approval.

Contractor Technical Assistance

For pre-application review, contractor assistance may be needed to assess design, safety, and technical issues and to formulate their resolution. Contractor support may also be needed to conduct sensitivity studies. Additionally, highly specialized expertise (e.g., graphite technology) may be needed in selected areas where the NRC may have little or no skills.

Licensing Resources

In March 2001, NRR project managers were assigned to the PBMR pre-application review. These project managers have several roles related to the PBMR pre-application, including:

- coordination of the NRC's response to nine legal and financial position papers submitted by Exelon relating to merchant generating companies and modular plant issues, and preparation of a Commission paper discussing the staff's positions on these issues

- project management of an interoffice working group assessing the feasibility of Exelon's proposed licensing approach and preparation of a Commission paper discussing the staff's position on Exelon's approach

- coordination of NRR activities in support of RES related to HTGR technology and policy issues. NRR technical and policy staff are also involved in these activities.

To support the RES pre-application efforts and to prepare NRR staff to review a COL application and/or design certification for the PBMR, NRR resources will be required in FY 2002 and FY 2003 with expertise in the areas of HTGR fuel, graphite technology, high temperature materials, analytical codes, prototype testing, radiological consequences, emergency planning, human performance/operator staffing, digital instrumentation and control, control room design, and PRA.

The contracted technical assistance estimate reflects work that is applicable to both the PBMR and GT-MHR.

3. International Reactor Innovative and Secure (IRIS)

During its meetings with the staff earlier this year, Westinghouse expressed an interest in the NRC conducting a formal pre-application review of its IRIS design. The design, development, and funding for IRIS involve a consortium of domestic and foreign entities led by Westinghouse, which is leading the overall coordination and licensing-related interactions with the staff.

IRIS is a 100-300 MWe modular LWR design that uses LWR technology, augmented by enhanced safety features. Westinghouse indicates that it will request the staff to initiate a pre-application review of the IRIS design in FY 2002, with a goal of obtaining a design certification by the year 2008, supporting initial deployment between the years 2010 and 2015. Westinghouse has also indicated an interest in early interaction with the staff on a planned near-term test program that is expected to start in FY 2002. The short-term goals of this program include conducting a selected group of tests. Westinghouse does not plan to build a prototype, but has indicated an interest in early feedback from both the NRC staff and the ACRS on the IRIS design. The staff believes that these tests are imperative to the efficient and successful licensing of the IRIS design in the United States.

Research Resources

During the pre-application review, RES will initiate discussions with Westinghouse on safety issues and research needs, including Westinghouse's plans for testing in support of the IRIS design. RES will also initiate modifications of NRC's thermal-hydraulic codes to be able to independently assess IRIS, including confirmatory experimental work in support of code development.

Contractor Technical Assistance

The staff will need contractor technical assistance to effectively support the IRIS review process and to conduct the required research and selected tests. The estimates for additional contractor technical assistance are reflected in Table V.C-1, assuming that no DOE funding support will be available. These estimates include contractor support for IRIS pre-application review, including conducting some independent testing.

Licensing Resources

The IRIS pre-application review will require fewer NRR resources than the PBMR or GT-MHR pre-application reviews because the IRIS design is based on LWR technology, which is more familiar to the staff than HTGR technology. In addition, there is much information available from the many years of LWR operational experience, including fuel performance. However, contracted technical assistance resources will be higher because the staff may require integral and separate effects testing of thermal-hydraulic phenomena.

4. Gas Turbine - Modular Helium Reactor (GT-MHR)

General Atomics' GT-MHR design is an approximately 300-MWt helium reactor design based on HTGR technology. International HTGR experience, particularly with Dragon in the United Kingdom, AVR and THTR in the Federal Republic of Germany, and domestic experience with Peach Bottom Unit 1 and Fort St. Vrain offer General Atomics an extensive technological and operational basis on which to capitalize. Similar to the PBMR, the GT-MHR design uses helium as the coolant and employs refractory fuel. The principle difference is that the ceramic-coated particles in the GT-MHR design are contained in fuel compacts that are inserted in graphite fuel elements instead of pebbles.

International collaboration on GT-MHR design work is being performed in the Russian Federation (RF) under a joint U.S./RF agreement, and is jointly sponsored by DOE and the RF (Minatom), and supported by Japan and the European Union. The GT-MHR conceptual design has been completed and the preliminary design is due to be completed in early 2002. General Atomics believes that plant construction can begin within 5 years. In June 2001, during a meeting with the staff and also at the ACRS Workshop, General Atomics outlined a commercial program that would be initiated after the international program is complete. Recent discussions with industry representatives indicate that a pre-application review for the GT-MHR could begin in 2002.

As part of the GT-MHR safety and licensing assessment activities, General Atomics plans to interact with the staff extensively to identify any additional licensing, technical, and design issues; to obtain staff feedback and guidance; and to identify any significant policy issues that may need Commission consideration. This effort would consist of developing a licensing plan, completing a safety analysis and risk assessment, and preparing a safety analysis report. General Atomics plans to request the staff to conduct an in-depth review of the GT-MHR design. Early ACRS input will also be sought. The GT-MHR pre-application review phase is expected to include a review of the conceptual design, which will cause the review to be more extensive than that for the PBMR; hence, greater resources will be required.

Research Resources

The staff has used the RES skill and resource estimates for the ongoing PBMR pre-application review as a reference for estimating the corresponding requirements for the GT-MHR. Some of the PBMR-related contractor efforts will also apply to the GT-MHR; however, because of the anticipated detailed design review, the GT-MHR resources are estimated to be higher.

In addition to the periodic information exchange meetings with General Atomics and interested stakeholders, the staff will draw upon its PBMR pre-application review experience, the MHTGR review experience, the Peach Bottom Unit 1 and Fort St. Vrain licensing experience, collective international HTGR experience, and the staff's previous efforts related to the evolutionary and passive LWR design certification reviews. Additional specialized skills and resources will be required to support the GT-MHR review.

Contractor Technical Assistance

Resources required beyond the currently available staff expertise will have to be provided by contractor technical assistance. If the industry adheres to the projected schedules, there may be

concurrent reviews of more than one reactor design, and the RES skills will have to be augmented by contractor technical assistance. Table V.C-1 contains estimates of the required contracted technical assistance to effectively and efficiently conduct an in-depth GT-MHR pre-application design review.

Licensing Resources for GT-MHR

To support the RES pre-application efforts and to prepare NRR staff to review a COL application or design certification for the GT-MHR, NRR resources will be required with expertise in the areas of HTGR fuel, graphite technology, high temperature materials, analytical codes, post-irradiation testing program, prototype testing, radiological consequences, emergency planning, human performance/operator staffing, digital instrumentation and control, control room design, and PRA. The contracted technical assistance estimates for the PBMR reflect work that will also apply to the GT-MHR.

D. ESP Reviews

An ESP is a Commission approval of a particular site to build a class (or multiple classes) of nuclear power plants independent of the facility review. Primarily, the ESP process allows for early consideration of site suitability issues. Under the ESP process, litigation relating to these issues could be resolved before the applicant invests a significant amount of capital.

The staff will undertake a three-part review based on information furnished by the ESP applicant pursuant to 10 CFR 52.17. These three parts are the site safety, the EP, and the site environmental review. While preparing its resource estimates for an ESP application review, the staff considered resource requirements to support review in these three areas, and the other related areas of site redress, project management, hearings, and inspection. A brief discussion of the resources required to perform the reviews is provided in the following sections. Table V.D-1 summarizes ESP review resource requirements.

Table V.D-1 ESP Resources Estimates

	Case 1: Existing Site		Case 2: New Site	
	Staff FTE	Contractor $K	Staff FTE	Contractor $K
Technical Review	12	$1,700	15	$2,100
Inspection	4		4	
Legal Review	4		5	
Total	20	$1,700	24	$2,100

The staff estimates that the review of an ESP application will take approximately 30 months from submittal to the granting of the license, depending on the type of application and complexity of the issues.

1. Technical Resources

The estimates in Table V.D-1 consist of resources dedicated to the following areas.

Site Safety Review

The safety review encompasses those characteristics and phenomena associated with the site and vicinity that may affect plant operation (that is, cause a malfunction) or, in the worst case, initiate a major core damage accident. The site safety review conducted by the staff addresses (1) geography and demography; (2) nearby industrial, transportation, and military facilities; (3) meteorology; (4) hydrology; and (5) geology and seismology. The staff publishes the results of this review in a SER.

The resources required for a site safety review have been estimated to be similar to those expended to perform a site safety and offsite radiological review during both the CP and the OL phases of previously reviewed facilities. The staff expects to augment the expertise of the staff to support the site safety review by obtaining technical assistance from geoscience specialists.

EP Review

As part of the NRC review of an ESP application, the NRC is required to make a finding with regard to site EP planning. 10 CFR Part 52 provides two options for satisfying ESP EP requirements. The first option allows the applicant to propose major features of the emergency plans, such as the exact sizes of the emergency planning zones, that can be reviewed and approved by the NRC in consultation with FEMA in the absence of complete and integrated emergency plans. Under the first option, the applicant must describe contacts and arrangements made with local, state, and federal governmental agencies with emergency planning responsibilities. The second option is for the applicant to propose complete and integrated emergency plans for review and approval by the NRC, in consultation with FEMA. Under this option, the applicant must show that it made good-faith efforts to obtain appropriate certifications with respect to the proposed emergency plans from local, state, and federal governmental agencies with emergency planning responsibilities, or that the proposed emergency plans provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. Under both options, the application must identify physical characteristics unique to the site that could pose a significant impediment to developing emergency plans.

For the EP portion of the site review, the staff assumed that the applicant would submit general EP information in accordance with the first option of 10 CFR 52.17(b). Because this option only requires establishing that the site is amenable to EP, review resources for the site permit have been estimated to be one-third of what the total EP review would require.

Environmental Review

Also, as part of the NRC review, the staff is required to examine the impacts of the proposed plant on the environment. Although the specific type or design of the plant may not be known at the time of the ESP review, 10 CFR 52.17 requires the applicant to submit information that the staff can use to evaluate the environmental effects of construction and operation of a reactor or

reactors that have characteristics that fall within the postulated site parameters. Parameters specified in 10 CFR 52.17 include the number, type, and thermal power level of the facilities for which the site may be used; the site boundary; the proposed general location of facilities within such boundaries; the anticipated maximum radiological and thermal effluent each facility will produce; and the type of cooling systems, intakes, and outflows of each facility. The staff will evaluate this and other relevant information to prepare an EIS pursuant to the NEPA in accordance with the applicable provisions of 10 CFR Part 51. The staff will address such matters as the effects of land and water use, the effects of the cooling system, and radiological effects of normal operation and of credible postulated accidents. Also, the staff's analysis will evaluate population data, environmental justice issues, and other related information.

The site environmental review has been assumed to be similar to the environmental review at the CP phase of previously reviewed reactors. In addition, the staff considered recent experience with performing environmental reviews to support license renewal. However, in the case of these recent license renewal reviews, much of the work to address generic environmental impacts was performed previously, and the staff only evaluated site-specific environmental impacts of the operating plants. Therefore, the staff believes that additional resources, compared to those necessary for environmental review of a license renewal application, will be required to complete its review of the environmental impacts of the construction and operation of a nuclear plant to support an ESP review. Additional environmental review expertise is necessary to augment the technical expertise of the staff to support the environmental review. This expertise could be obtained from technical assistance contractors whose work would be managed and reviewed by the NRC environmental and site specialists.

Site Redress Review

10 CFR 52.17(c) allows an applicant to obtain authorization to begin site preparation activities, provided a site redress plan is submitted with the ESP application. Review of the site redress plan will constitute a small portion of the review resources necessary for the entire ESP review.

2. Project Management Support

A full-time project manager will be required to coordinate the review effort of the staff and the hearings activities. In addition, to ensure a smooth transition to a COL review, ESP project management will continue to be necessary for some time following completion of the ESP review.

3. ESP Inspection Resources

The ESP inspections will be done in accordance with IMC 2511, “Light-water Reactor Inspection Program - pre-CP phase” as discussed in Section V.H.4 of this report. As stated previously, the IMC 2511 focus is on QA programs and their implementation; site preparations, including installation of services, support facilities, and non-safety-related systems, structures, and components; and environmental protection considerations. The pre-CP phase should be completed at about the same time a plant’s COL or CP is issued.

The staff estimates that 4.0 FTE will be needed to support inspection activities for each ESP application that is submitted and that ESP inspection activities will span a period of approximately

3 years. This time may also be extended if a LWA is granted and work performed under the LWA exceeds the ESP application review period. 10 CFR 52.25(a) discusses when an LWA is allowed. This section references 10 CFR 50.10(e)(1), which allows the director of NRR to authorize site preparation work, installation of temporary construction support facilities, excavation for nuclear and nonnuclear facilities, construction of service facilities, and construction of structures, systems, and components that do not prevent or mitigate the consequences of postulated accidents under certain conditions.

If an LWA is granted, additional inspection resources will be needed to support these inspection activities. These inspections would be performed in accordance with the guidance contained in IMC 2511 and the associated inspection procedures. The staff does not know at this point if an LWA will be requested by an applicant, if it will be granted, and, if one is granted, the extent of work that will be performed. Therefore, the staff has not estimated inspection resources for this effort. When and if this information becomes available, the inspection resources will be adjusted.

Currently, the staff is assuming one ESP in FY 2002, two in FY 2003, and one in FY 2004 based, in part, on industry information. Some of the inspection activities will occur prior to submittal of ESP applications. For example, NRC guidance documents contain the following assumptions regarding CPs which may also be applicable to ESPs:

- A meeting will be held near the site about 1 year before a CP application is submitted.

- Some inspection activities will occur before a CP application is submitted.

All ESP inspection activities will be coordinated from the NRC regional office that has jurisdiction over the proposed site. The region will be provided resources from headquarters and other regions on a priority basis to support these inspections. For the first year, the staff assumes 0.5 FTE will be required to support the pre-application meetings and 0.5 FTE to support other inspection activities. The 0.5 FTE estimate for the public meetings is based on the public meeting experience associated with license renewal applications. These public meetings are supported by headquarters as well as regional staff. Several members of the staff provide presentations during these meetings and there is much coordination involved in arranging these meetings in the area of the proposed site.

4. Litigation and Legal Support Resources

The ESP process requires a hearing, which is currently subject to the procedures contained in Subpart G of 10 CFR Part 2. The complexity and length of the hearing will depend, in part, on the level of emergency planning information in the applicant's submittal. In the case of a site for which a CP was previously issued, the complexity and the length of hearing may also depend on the extent to which parties in the ESP hearing may be bound by the results of the previous adjudicatory hearing. Resource estimates for support by OGC are about 4-5 FTE, depending on whether the site is an existing or new site.

E. Design Certification Reviews

Design certification results in a rule issued by the Commission deeming a design of a nuclear

power plant acceptable for incorporation by reference in individual license applications, and provides that the certified design can be relied upon by the staff, the ACRS, and the hearing boards in their reviews of any such applications. In making findings for issuing a COL or OL, in an individual licensing proceeding on an application that references a certified design, the Commission must treat as resolved those matters resolved in connection with issuing the certification.

An application for a standard design certification is reviewed for compliance with the standards set out in 10 CFR Parts 20, 50 (and its appendices), 73, and 100 as they apply to applications for CPs and OLs for nuclear power plants, as those standards are technically relevant to the design proposed for the facility. The design certification process is set forth in Subpart B of 10 CFR Part 52. Once the application is submitted, the review process consists of completing an acceptance review, conducting the technical review that results in a SER, and conducting a rulemaking to certify the design. Brief discussions of the resources estimated to perform design certification reviews for the AP1000 and IRIS designs are provided in the following sections, including tables summarizing overall resource requirements. The resources required for the pre-application activities for these designs are discussed in Section V.C of this report. The staff estimates that the review of a design certification application will take 42–60 months from submittal to the granting of the certification, depending on the uniqueness of the design, whether there is a need for testing and the extent of the testing program, and whether policy matters need to be addressed. The Commission has provided for a hearing during a rulemaking to certify a design.

1. AP1000

During discussions with the staff, Westinghouse has indicated that about 80% of the AP1000 design is similar to the AP600 design. Although the NRC staff needs to verify and conduct its reviews in any additional areas as necessary, this commonality between the AP600 and AP1000 designs lends itself to an efficient review requiring less staff time and resources to complete than a standard design certification review would normally require.

Total estimated resources for the AP1000 design certification are given in Table V.E-1. The bases for these estimates follow.

Table V.E-1 AP1000 Design Certification Resource Estimates

	Staff FTE	Contract $K
Technical Review	23	$500
Research	5	$1,000
QA Review	1	
Legal Review	1	
Total	30	$1,500

AP1000 Technical Resources

During the design certification stage, the major technical review effort is expected to be focused on engineering and system design aspects of the application. However, whether or not there is any intervention by interested stakeholders and the nature of the intervention will determine the amount of technical resources that will be needed to support the NRC staff position in any hearing that may follow.

The staff concludes that the skills necessary to conduct the design certification review of the AP1000 exist within the NRC. However, additional contractor support will be necessary to support a limited number of engineering audits and confirmatory analyses to support staff safety conclusions.

AP1000 Design Certification Inspection Resources

As stated earlier in Section IV.B.4, inspections to support the review for standard design certifications in accordance with Subpart B of 10 CFR Part 52 will need to be conducted. These implementation inspections of the applicant's QA programs will be performed to determine whether design and testing activities conducted to support design certification were performed under the pertinent provisions of a 10 CFR Part 50, Appendix B QA (QA) program. These implementation inspections of design and test controls will be performed at the applicant's and/or designer's offices and at the applicable design certification test facilities. The staff expects most of the activities associated with these design certification inspections to be centered in NRC headquarters with support from the regions as needed.

The staff believes that the design certification inspection activities related to design control and testing should be centered in a headquarters inspection group in NRR. Because the physical location of design offices and testing facilities is separate from the site, the staff believes that a centralized location for inspection resources would provide economies relative to the number of inspectors that would have to be maintained and provide consistency for how these inspections would be implemented.

The following is a list of the types of inspection and review skills that will be necessary to perform such inspections. Personnel with these skills will be chosen from various headquarters offices, such as NRR, RES, and NMSS.

- inspection team leader
- QA program implementation inspections
- reactor system reviews
- containment system reviews
- civil/structural/seismic reviews
- electrical/instrumentation and control reviews
- thermal-hydraulic computer code validation reviews
- qualification test program reviews (to validate safety analysis computer codes)

Because the staff has already conducted inspections of Westinghouse's QA program to support the certification of the AP600, inspection efforts directed toward the AP1000 design review will not

be as resource intensive as new custom designs. The staff estimates that 1.0 FTE will be needed to support inspection activities for an application to certify the AP1000, and that additional inspection activities will span a period of approximately 18 months. This is based on the following assumptions:

- No new qualification testing will be required for the AP1000.
- QA and design inspection activities will occur at the applicant's and/or designer's offices.

AP1000 Litigation and Legal Support Resources

The design certification process is a rule that is currently subject to the procedures contained in Subpart H of 10 CFR Part 2. As such, the rulemaking procedure provides for notice and comment, and an opportunity for an informal hearing before the ASLB. The ASLB may also request authority from the Commission to use procedures such as direct and cross examination, or may request the Commission to convene a formal hearing under the procedures contained in Subpart G of 10 CFR Part 2. If held, the length of the hearing will depend, in part, on the number and complexity of the accepted contentions before the Board. The resource estimates for support of the AP1000 design certification review by OGC are about 1 FTE.

2. International Reactor Innovative and Secure (IRIS)

The IRIS design is an integral LWR, with all the reactor coolant piping and heat transport system (helical steam generators) located inside the reactor vessel. The IRIS fuel cycle is expected to be on the order of 4 to 5 years. Longer term plans include a higher enriched fuel design with up to an 8-year refueling cycle. However, resources for reviewing these issues have not been estimated in this assessment.

The IRIS nuclear power plant design is considered to be an evolutionary change from current LWR designs. However, some features of IRIS that differ significantly from current LWR designs will increase the complexity of the staff's review.

Total estimated resources for the IRIS design certification are given in Table V.E-2. The bases for these estimates follow.

Table V.E-2 IRIS Design Certification Resource Estimates

	Staff FTE	Contract $K
Technical Review	53	$2,600
Research	22	$3,000
QA Review	3	
Legal Review	1	
Total	79	$5,600

IRIS Technical Resources

Although IRIS is a LWR, it contains some unique design features (for example, the helical steam generators) that will require additional technical resources beyond those that would be needed for certification of a more traditional LWR. Staff resources are needed to review these unique components as they impact analyses methods for transients and accident evaluation, the PRA, and the proposed inspections, test, analyses, and acceptance criteria (ITAAC). The ITAAC must be sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that references the design is built and will operate in accordance with the design certification. In addition, the review of the testing and surveillance intervals proposed for IRIS's 4 to 5 year refueling cycle will require more resources than a traditional LWR.

The staff will need to review the interface requirements to be met by those portions of the plant for which the application does not seek certification. The staff will also need to review the justification that compliance with the interface requirements is verifiable through inspection, testing (either in the plant or elsewhere), or analysis.

IRIS Inspection Resources

Because the staff lacks information regarding the design, the QA program to be used, and the extent of certification testing to be performed for the IRIS design, it is difficult to project the extent and quantity of inspections necessary at this time. Therefore, the staff believes that these inspections should be performed early during the design certification process to enable the staff to conduct a thorough review when appropriate design and testing information is current and available for review. The reason for the inspections and the critical skills needed to perform the inspections are similar to those contained in the AP1000 inspection resources above.

The staff estimates that 3.0 FTE will be needed to support inspection activities for the first application that is submitted and that inspection activities will span a period of approximately 36 months. This is based on the following assumptions:

- Meetings will be held with the applicant and/or designer to obtain a basic understanding of the design and QA processes used in developing the design and application.

- QA and design inspection activities will occur at the applicant's and/or designer's offices.

- Qualification test inspection activities will occur at test facilities away from the construction site.

IRIS Litigation and Legal Support Resources

The design certification process is a rule that is currently subject to the procedures contained in Subpart H of 10 CFR Part 2. As such, the rulemaking procedure provides for notice and comment, and an opportunity for an informal hearing before the ASLB. The ASLB may also request authority from the Commission to use procedures such as direct and cross examination, or

may request the Commission to convene a formal hearing under the procedures contained in Subpart G of 10 CFR Part 2. If held, the length of the hearing will depend, in part, on the number and complexity of the accepted contentions before the board. The resource estimates for support of the IRIS design certification review by OGC are about 1 FTE.

F. Combined License Reviews

Subpart C of 10 CFR Part 52 authorizes the issuance of combined CPs and conditional COLs. A COL is designed to ensure that all of the licensing issues associated with a nuclear power plant are addressed before construction begins. The review process for a COL application would be similar in many respects to the review of a CP application and an OL application submitted under 10 CFR Part 50. The safety review, however, would consider the final plant design rather than a preliminary design. ACRS review of the application is required and an antitrust review by the Attorney General is also required. An environmental review of the application and a hearing are also required.

There are a number of ways an applicant could submit a COL application. An applicant for a COL may, but need not, reference an ESP or a design certification, or both. The staff's review of a COL application that references an ESP or design certification would be greatly simplified, because major technical issues would have been already resolved through the referenced certified design rule or the ESP. The amount of review time and resources required to complete the review would be reduced because the efforts associated with resolving these issues would already have been expended during the certification or ESP reviews. The hearings associated with these reviews would also have been completed, thus reducing potential staff effort to support hearings for the COL application.

For the purposes of this resource assessment, the staff has chosen to address the resources required to review the most likely licensing scenarios based on input from the industry. The following is a discussion of the resources required to review (1) a COL that references both a certified design and an ESP, and (2) a COL for a PBMR that only references an ESP. For the second case, a range of staff estimates are provided, reflecting uncertainty in the level of effort required to assess the new reactor technology.

1. Standard Certified Design With an ESP

The staff estimates that the review of a COL that references a certified design and an ESP would require less time and resources than any other type of COL application. The staff estimates that the review of this type of COL would take about 27 months to complete. The scope of the staff's review will be limited to:

- the design of SSCs for which only DAC were approved during the design certification review
- site-specific SSCs (intake structure, cooling towers, etc.) in which the staff must confirm the acceptability of the design compared against the site interface requirements
- licensee programs (organization, security, training programs, EP)

- the compliance of the site interface requirements of the design certification with bounding parameters of the ESP

Resource estimates are also provided for construction inspection activities before reactor operations. Total resources for this case are shown in Table V.F-1. The bases for these estimates follow. CIP resources include efforts to develop procedures for first-of-a-kind (FOAK) implementation of a particular certified design. As discussed below, these resources would not be required for subsequent applications of that design.

Table V.F-1 Resources for COL Resource Estimates
Standard Design with ESP

	Staff FTE	Contract $K
Technical Review	19	$1,100
Legal	4	
COL Total	**23**	**$1,100**
Construction Inspection		
FOAK Procedure Development	10	
Implementation	55	

Technical Resources

Skills needed to conduct this type of COL review exist within NRR, although a review of a COL referencing a certified gas-cooled reactor design or certified design of a reactor with unique characteristics may require additional expertise. However, the staff concludes that this expertise will likely have been acquired during an associated pre-application review (if conducted) or during the design certification review of such designs.

Contracted technical assistance will likely be needed in the areas of systems engineering, radiological engineering, general engineering and QA, safeguards/security analysis, EP analysis, financial analysis, and hearing support.

Inspection Resources

This section provides estimates of inspection resources associated with a COL. The estimates include resources that will be needed from the start of construction activities through the startup testing phase of the pre-operational inspection program. That is, the estimates include inspection resources governed by IMCs 2512, 2513, and 2514.

The draft report on the revised CIP makes a recommendation that an NRC project team be established well before onsite construction actually begins (this need was identified on the basis of past nuclear power plant construction experience). The report recommends the formation of three groups: a resident inspection office, the cognizant regional office, and a project directorate in

headquarters. Based on the compressed schedules and heavy reliance on modular construction since the draft report on the revised CIP was issued, the staff believes that these teams should be formed as soon as a COL application is received. In addition, because of the compressed schedules and heavy reliance on modular construction, the group's composition and responsibilities may need to be modified from the draft report. At this point, the staff does not have enough information to determine the best organizational structure for this activity. The staff has, however, provided resource estimates for the activity. As more information becomes available about potential COL applications and needed generic improvements to IMC 2512 discussed in Section V.H of this report, the staff will assess and determine the best organizational structure to perform these tasks. The following is a high-level discussion of the types of activities that will need to be performed to support a COL.

- An onsite inspection office would be established at the start of construction and would implement the CIP for the plant. During the earliest phases of plant construction, the resident inspection office would operate from either the cognizant regional office or NRC headquarters, and would shift to the site when the pace of activities required significant inspection coverage. The office would consist of 6 to 12 technical staff, plus administrative support, who would rotate on- and off-site according to the needs for different types of expertise to verify satisfactory completion of various phases of plant construction. The following personnel would provide the core of the resident inspection office staff, and would be augmented by specialist inspectors:

  - Senior Construction Site Representative
  - Site Chief Structural Inspector
  - Site Chief Mechanical Inspector
  - Site Chief Electrical and Instrumentation Inspector
  - Construction Site Scheduler

- The cognizant regional office or headquarters would oversee the implementation of the onsite inspection program and would provide inspection resources and other technical support as necessary. The regional or headquarters organization for construction could, for example, be a task force consisting of a manager working with a technical staff of project engineers, and inspectors of varying disciplines.

- A group in headquarters or the regions would oversee licensing aspects of plant construction. The staff would be responsible for taking the lead in activating the CIP for the plant (i.e., develop the detailed inspection procedures that would be used to perform construction-related inspections). The group would also coordinate the inspections for the modules and large components that could be fabricated after a COL application is submitted but before the COL application is approved. Because the physical location of this manufacturing is separate from the site and because of the potential amount of off-site manufacturing, the staff believes that this aspect of the program will involve organizational challenges. The staff will make decisions about the organizational structure when more information becomes available as to the near-term extent of construction-related activities.

- SECY-94-294 also discussed the need to perform engineering design verifications. In this Commission paper, the staff states that design descriptions and functional system

> drawings available for review during the design certification and COL application phases are adequate for licensing reviews and final safety determinations, but not for actual construction or construction inspection activities. The staff states that it will inspect and review the adequacy of licensee design engineering early in a construction project, possibly beginning soon after receipt of a licensing application. FOAK engineering for the lead plant of each certified design will be assessed during these inspections.

Inspection Resource Estimates From SECY-89-104

SECY-89-104 provides resource estimates for inspections for a base case licensing scenario using a budget model, a custom plant design, and a standard plant design. The model used for the base case evolved over 10 years and was used by the former Office of Inspection and Enforcement to predict regional manpower for reactor construction inspection. The regional inspection resource projection for all three cases was in the range of 46 to 52 FTE spread over a construction period of 13 years. SECY 89-104 also notes that the resources needed for OL issuance has shown a steadily increasing trend. It states the following in this area:

> [C]onsidering the OLs issued in recent years, resources well above those estimated for the base case were required for both licensing and inspection at some plants that encountered problems stemming from design/construction errors, allegation resolution, and/or protracted hearings. It should be expected that in the future, improvements will be made to avoid or minimize these problems, but it is likely that there will still be some plants that encounter these types of problems[.]

In SECY-89-104, the staff estimates that 15 FTE would be needed for resolution of design/construction errors, allegations, and emergency planning issues. With the new combined licensing process, the staff expects that the issues associated with emergency planning would be settled during the review of the COL application. However, the resources associated with resolving design/construction errors and allegations will most likely be expended later in the construction phase after the COL is issued. The Commission paper divided the 15 FTE in half between licensing and inspection. For the purposes of this report, the staff assumed that 10 FTE will be needed for these issues during the COL phase and, of those 10 FTE, approximately 5 will be inspection related.

SECY-89-104 provides guidance which is consistent with the assumptions that are made in the draft report on the revised CIP. That is, given the schedule and the amount of staffing assumed in the report, the total expenditure of resources to support inspection activities would be approximately 50 FTE, which does not include the 5 FTE for inspection resources related to design/construction errors and allegations.

Development of Inspection Procedures

As stated earlier, the staff expects that the general provisions and guidance of IMC 2512 would be completed before a COL application is received. Once a COL application is received, detailed work to develop the inspection procedures for the application would start. The staff expects that once the inspection procedures are developed for a certified design, the inspection procedures would not have to be developed again. Therefore, the cost associated with this inspection

procedure development would be a one-time cost. The cost of updating the inspection procedures for subsequent applications would be minimal. The staff estimates that approximately 10 FTE would be needed to develop the detailed inspection procedures for each LWR design and 12 FTE for a gas-cooled design. As discussed in Section V.H of this report, the staff intends to dedicate resources early during the CIP revision activities to determine the effect gas-cooled reactor technology will have on the program. However, at this point the staff believes that for the first application more FTE will be needed to update the inspection procedures for a gas-cooled reactor than for an LWR.

Along with resources from the Division of Inspection Program Management Inspection Program Branch, engineering resources from the Division of Systems Safety and Analysis, and the Division of Engineering will be needed to help in the development of these inspection procedures. Depending on the organizational model that is chosen, regional resources may also be needed to develop inspection procedures. Regardless, the inspection procedure development will be consistent with the Inspection Manual Chapter (IMC) development. As with the IMC, lessons learned from the revised reactor oversight process, including the use of risk information, will be reviewed to determine if they can be applied to the development of the construction inspection procedures. Inspection procedures used to support inspection of modular construction and fabrication of large components will also need to be developed.

COL Inspection Schedule

Given the short schedules being proposed by some applicants, the staff has developed inspection resource estimates based on a 6 year schedule from the time that a COL application is submitted until commercial operation. Although some schedules may be compressed, the staff does not believe that compressing schedules will save inspection resources. This belief is based on the fact that regardless of the schedule the staff would be performing the same inspections.

Resources

The staff estimates that 65 FTE will be needed to support inspection from the start of construction activities through the startup testing phase of the pre-operational inspection program. This estimate includes the following assumptions:

- 50 FTE will be needed to support direct inspections, which is consistent with the assumptions of SECY-89-104 and the draft report on the CIP

- 5 FTE has been allocated for inspection related to resolving design/construction errors and allegations

- 10 FTE will be needed to develop the detailed inspection procedures associated with a COL application for an LWR. This is a one-time cost that would not be applied to subsequent applications referencing the same design. The staff estimates that 12 FTE will be needed to develop the inspection procedures associated with a gas-cooled reactor.

- the staff assumes these resources would be spent at a constant rate through a period of 6 years. In earlier years emphasis would be on detailed inspection procedure development, while in later years the emphasis would be on performing inspections. If a COL application assumes a different schedule, these same resources would be allocated according to the schedule.

Litigation and Legal Support Resources

The COL process requires a hearing, which is currently subject to the procedures contained in Subpart G of 10 CFR Part 2. The length of the hearing will depend, in part, on the number and complexity of the accepted contentions before the board. The staff estimates that the litigation and legal support resources required by OGC for a COL review will be about 4 FTE.

2. Custom Design With an ESP - PBMR

The PBMR design is a modular gas-cooled, low-power reactor design. In its May 25, 2001, letter, Exelon indicated that it intends to submit a COL application for a PBMR, referencing only an ESP. A COL application that includes a custom plant design will require a review similar to that of a design certification application. The review of an application for a COL under 10 CFR Part 52 will require evaluation of the plant design, site interfaces, EP, antitrust considerations, financial qualifications, and utility qualifications (including fitness-for-duty program), as well as hearings support. Once the application is submitted, the review process consists of completing an acceptance review, conducting the technical review that results in a SER, and litigating the application during a hearing. The staff will also need to verify the compliance of the site interface requirements of the custom design with the bounding parameters of the ESP. Because the PBMR differs significantly from LWR designs, it is likely that more resources will be expended for the technical review, depending on the uniqueness of the design, whether there is a need for testing and the extent of the testing program, and whether policy matters need to be addressed. As discussed later in this section it is more difficult to determine if the inspection resources for a PBMR design will differ significantly from LWR designs. This section addresses the resources necessary for the staff to review such an application. In general, the staff estimates that the review of a COL that references an ESP and a custom design could take 33–60 months to complete, depending on the factors listed above.
Resource estimates are also provided for construction inspection activities during the construction of up to 10 modules on a site. Total resources for this case are shown in Table V.F-2. The bases for these estimates follow. CIP resources include efforts to develop procedures for FOAK implementation of a particular certified design. As discussed below, these resources would not be required for subsequent applications of that design.

Table V.F-2 COL Resource Estimates
Custom Design (PBMR) with ESP

	Staff FTE		**Contract $K**	
	FTE-Lo	FTE-Hi	$K-Lo	$K-Hi
Technical Review	55	94	$3,700	$4,000
COL QA Inspection	4	4		
Research	33	33	$4,500	$4,500
Legal Review	5	5		
COL Total	**97**	**136**	**$8,200**	**$8,500**
Construction Inspection				
FOAK Procedure Development	12	12		
Implementation	55	55		

Technical Resources

The technical resource estimates in Table V.F-2 were developed using lessons learned from the review of the three certified designs, and then estimating the additional resources that would be needed to address the unique features of the PBMR. Section V.C of this report discusses the technical resources that will be needed to perform a pre-application review of the PBMR. SECY-01-0070 provides a plan for the pre-application activities that involves technology assessment, regulatory framework, and regulatory process assessment activities. As part of the regulatory framework and regulatory process assessment activities, the staff states in SECY-01-0070 that it will become familiar with the PBMR design, assess regulatory requirements applicable to the PBMR and Exelon's proposed approach to licensing, and identify key licensing issues and regulatory policy issues needing resolution.

Because the pre-application activities are not complete, it is difficult at this time to estimate the resource needs to perform a technical review for the PBMR. Based on early discussions with Exelon, the staff has developed a range of estimates for the PBMR technical review. Once the results of the PBMR pre-application review are known the staff will be able to better estimate the cost of performing a PBMR review.

Inspection Resources

The matters identified in Exelon's May 25, 2001, letter that affect the staff's estimates of needed inspection resources include:

- Exelon indicated that it may submit an application for a COL for a PBMR facility consisting of up to 10 PBMR modules. This application may be submitted in late 2002 or early 2003, when the design of the PBMR is sufficiently complete.

- Exelon will not be referencing a certified design in its COL application. Its application will include a FSAR and a proposed set of ITAAC.

- Exelon proposed that the COL be issued in April 2005, with the ITAAC being certified for the first module in December 2006

- Exelon expects that construction of up to 10 PBMR modules will be completed at staggered intervals. After the first module is completed, the remaining modules would be staggered at 6-month intervals initially, working towards 3 month intervals.

- Exelon states that some ITAAC may require type testing and a finding of satisfaction of those ITAAC would be equally applicable to all modules.

- Some ITAAC may be in the form of DAC.

- Some ITAAC may apply to common facilities (e.g., the structures associated with the common control room).

- Some ITAAC may apply to construction activities that are conducted simultaneously for

one or more modules (e.g., Exelon may decide to complete substantial foundation work for all modules at the same time).

Exelon's information differs from that postulated for the COL inspection resources discussed in Section V.F.1 of this report in several key areas, including the following:

- The PBMR scenario was not considered in the draft report on the revised CIP. The draft report on the revised CIP assumed that at the time of a COL application, the staff would have a set of ITAAC that had been approved and could be used to develop the detailed inspection procedures for the plant. Although ITAAC will be supplied with the application, the staff may decide to defer work on the detailed procedures pending resolution of issues associated with the ITAAC.

- The PBMR scenario is compressed in some respects from the COL scenario discussed earlier. Exelon is proposing 4 years from the COL application until ITAAC for the first module will be met. Although Exelon does not provide a schedule from completion of the ITAAC to commercial operation, if 6 months is assumed for this time period, the schedule is still 18 months shorter than the schedule provided in the COL scenario discussed in Section V.F.1 of this report. Exelon does state that existing modules would be brought on line in a staggered fashion. Assuming that the average time would be 4 months for the 9 follow on modules, an additional 3 years of construction activity would be occurring at the site for an overall time of approximately 7 years from the time of the COL application until the ITAAC for the last module were met.

- In Section V.F.1 of this report, the staff discusses engineering design verifications. In SECY-94-294, the staff states that it will inspect and review the adequacy of licensee design engineering early in a construction project, possibly beginning soon after receipt of a licensing application. FOAK engineering for the lead plant of each certified design will be assessed during these inspections. In the case of the PBMR, the detailed design engineering may not be completed at the time of the COL application. These inspections may therefore need to be deferred until the detailed engineering is completed.

- Because Exelon will not be referencing a certified design in its expected COL application, 4 FTE were added in Table V.F-2 for COL inspection. As discussed in the V.E of this report for the design certification reviews, an implementation inspection of the applicant's QA programs will be performed to determine whether design and testing activities conducted to support the application were performed under the provisions of a 10 CFR Part 50, Appendix B QA program.

The staff is also lacking information regarding the design in several areas, including the following:

- Because the design is a gas-cooled reactor, the detailed inspection procedures that will need to be developed could vary significantly from the inspection procedures used for LWRs. One area where the staff is lacking information is the use of codes and standards that are referenced in the inspection procedures. The ASME Code Section III, Subsection NH, "Class 1 Components in Elevated Temperature Service," and Section XI, Division 2, "Rules for Inspection and Testing of Components of Gas-Cooled Plants," were developed

some time ago. They were developed during the time period when the Clinch River Breeder Reactor was under review and were maintained until several years ago. The ASME has indicated during several recent meetings that they are considering these standards and LWR standards relative to design, construction, inservice inspections, and inservice testing to see what is needed and possible for the PBMR and other designs. There are also standards from other organizations that may need to be updated for inspection guidance.

The revision of the inspection procedures from an LWR framework to a gas-cooled reactor framework would require resources in addition to those assumed in the COL resource estimates above. However, mitigating this increase in resources is Exelon's contention that the PBMR is a much simpler design and would not require the number of inspections that an LWR requires. Because details of the design have not been provided, it is difficult to determine which way the resources will be driven for the inspection program. However, as discussed in Section V.F.1 of this report, the staff does believe that 12 FTE will be needed to develop the detailed inspection procedures for a gas-cooled reactor compared to 10 FTE for an LWR.

- The staff does not know the extent to which the PBMR design will rely on off-site fabrication of large components and the time frames for the fabrication of components such as the reactor vessel. Typically, such manufacturing would be done before a COL is granted. In an August 9, 2001 letter, Exelon stated that major component procurement, which may involve offsite fabrication, could begin as early as 24 months before construction, however, Exelon envisions such procurement 18 months before construction. Exelon also states that PBMR construction is expected to begin immediately following COL approval.

As stated above, there are several differences and unknowns between inspection resources for the PBMR and those identified for the COL inspection resources contained in Section V.F.1 of this report. However, the staff continues to believe that it is prudent to establish the project teams at the resource levels mentioned in Section V.F.1 when a COL application is received. This would allow the inspection procedures that would be used early in the process to be updated as soon as possible. In addition, inspection activities are expected to occur before a COL is issued.

Therefore, pending new information, the staff assumes 67 FTE will be needed to support inspection from the start of construction activities for the first module through the startup testing phase of the preoperational inspection program for the 10th PBMR module consistent with the COL resources estimated in Section V.F.1 of this report. The staff assumes that these resources would be expended at a constant rate over the period of construction inspection activities[3]. This does not recognize that resource use may go down over time because after the inspection procedures are developed for the first module, they would only need to be updated for subsequent

[3] The staff defines the period of construction inspection activities as the time from COL application to the time that the startup test program for the 10th PBMR module is completed, or approximately 7 years based on information contained in Exelon's May 25, 2001, letter.

modules. In addition, as stated in an August 23, 2001, letter to James Muntz from Sam Collins some ITAAC (i.e., type testing) may be satisfied by a single finding that is applicable to all PBMR modules for which that ITAAC applies. Therefore, these ITAAC would only have to be met once.

Research Resources

After the PBMR pre-application review, RES will be developing independent tools and data and conducting confirmatory research to support the PBMR COL application, while also supporting NRR and NMSS, as necessary.

Litigation and Legal Support Resources

The COL process requires a hearing, which is currently subject to the procedures contained in Subpart G of 10 CFR Part 2. The length of the hearing will depend, in part, on the number and complexity of the accepted contentions before the board. The staff estimates that the litigation and legal support resources required by OGC for a COL review of the PBMR are approximately 5 FTE.

3. GT-MHR

The staff did not estimate resource needs to review an application for a COL for the GT-MHR because the staff did not have information that General Atomics was considering such an application until well after the staff had completed its resource analysis.

However, the staff believes that the resource needs to review a COL application that references an ESP for the GT-MHR would be of the same magnitude as the resources needed to review the same type of application for a PBMR, as discussed above.

G. Reactivated Plant Reviews

The five plants discussed in this section are candidates for reactivation. Four of these plants have CPs that are in effect and one plant has an OL. The plants with CPs are Watts Bar Unit 2, Bellefonte Units 1 and 2, and Energy Northwest Nuclear Project 1 (WNP-1). The plant with an OL is Browns Ferry Unit 1. This section of the report discusses the resources to support the licensing review and inspection activities if a decision is made to complete or restart these units. The background regarding the status of these units is provided before the discussion of resource estimates is provided. The overall estimates for reactivated plant reviews are included in the Table V.G-1 below.

Table V.G-1 Reactivated Plant Resource Estimates

Plant with Construction Permit

	Staff FTE	Contract $K
Technical Review	39	$1,700
Inspection	40	
Legal	6	

Total	85	$1,700

Browns Ferry Unit 1

Technical Review	12	
Inspection	19	
Total	31	

1. Background - Plants With Construction Permits

According to the Nuclear News World List of Nuclear Power Plants, dated March 2001, the construction for Watts Bar Unit 2 is approximately 61% complete, Bellefonte Unit 1 is approximately 88% complete, and Bellefonte Unit 2 is approximately 57% complete. During a May 3, 2001, meeting, Energy Northwest stated that WNP-1 construction was approximately 65% complete. The status of construction of these units is within the range assumed for the resource estimates that were developed for SECY-89-104.

The staff did not develop SERs to support an OL for Bellefonte 1 and 2 and WNP-1. Watts Bar Unit 2 does have an OL SER because it was considered in conjunction with the licensing of Unit 1.

SECY-89-104 provides resource estimates for reactivating a plant in the construction phase. In addition, Generic Letter 87-15, "Policy Statement on Deferred Plants," provides guidance in this area. The policy statement was developed to provide the Commission's position regarding the QA requirements, particularly the maintenance, preservation, and documentation requirements for deferred plants, and to state how new regulatory staff positions will be applied to deferred plants that are reactivated. In addition, Section B.2 of the policy statement provides measures that should be considered for reactivation or transfer of ownership of terminated plants.

Current Status - WNP-1

In a letter dated December 21, 1999, Energy Northwest requested that the CP for WNP-1 be terminated. Before the staff took action to terminate the CP, Energy Northwest retracted its request in a letter dated April 9, 2001. In this letter, Energy Northwest also requested an amendment to the CP to extend the latest completion date to June 1, 2011 and to change the permit holder's name from the Washington Public Power Supply System to Energy Northwest. Energy Northwest made this decision based on the increase in the electrical load in the Pacific Northwest and because of requests from some of its stakeholders to conduct a viability study on completing the unit. During a May 3, 2001, meeting, Energy Northwest provided the staff with an overview of the viability study. Energy Northwest expects the viability study to be publicly released in the Fall of 2001. A decision on whether or not to complete the units is expected to be made 3 to 18 months after the public release of the report.

In an Energy Daily article dated September 14, 2001, a 4.2 billion dollar cost estimate is provided for completing WNP-1. This cost estimate was provided in a public meeting to an ad-hoc meeting of the Energy Northwest Board of Directors. The full Board is scheduled to be briefed on the estimates at the end of September 2001 and will be asked to determine whether or not to proceed with an external review board to assess completing WNP-1. The development of an interim cost

estimate and the possible formation of an external review board are part of the viability study described to the staff in the May 3, 2001, meeting with Energy Northwest.

Current Status - Bellefonte Units 1 and 2 and Watts Bar Unit 2

In a letter dated July 14, 2000, the Tennessee Valley Authority (TVA) confirmed that it considered Bellefonte Units 1 and 2 and Watts Bar Unit 2 in a deferred status. TVA also stated that its integrated resource plan - Energy Vision 2020 - identified the need for a flexible range of options and alternatives required to meet, among other things, the Tennessee Valley region's base-load power supply needs through the year 2020. TVA further stated that until the decisions on generating options to meet future load forecasts are finalized, it intended to keep these units in a deferred status. On October 24, 2000, the NRC issued an order extending the CP for Watts Bar Unit 2 to December 31, 2010. In a July 11, 2001, letter, TVA requested that the CPs for Bellefonte Units 1 and 2 be extended to October 1, 2011 and October 1, 2014, respectively. The staff is currently reviewing this request.

Background - Browns Ferry Unit 1

TVA is the holder of OLs for three nuclear power units at the Browns Ferry site. In March 1985, TVA voluntarily shut down Units 1 and 3 because of questions relating to primary containment isolation testing at Unit 1 and reactor water level instrumentation at Unit 3. Unit 2 was in a refueling outage, but TVA voluntarily decided not to restart the unit as scheduled because other questions and concerns arose about the adequacy of TVA's nuclear program. In September 1985, the NRC requested TVA to submit its plans for correcting problems and improving the performance of its overall nuclear program and of Browns Ferry. The Commission did not order TVA to obtain its approval before restarting the plants because of prior verbal agreement between TVA and NRC to that effect; however, TVA was required, pursuant to 10 CFR 50.54(f), to inform the NRC if it intended to change this commitment. In late 1985, TVA submitted its corporate nuclear performance plan (CNPP) to address weaknesses in the TVA corporate nuclear program. The CNPP was followed by the Browns Ferry Nuclear Performance Plan to address site-specific weaknesses and to resolve additional concerns raised by the NRC. These plans formed the regulatory framework for the restart of Unit 2.

In July 1987, the NRC concluded that organizational, staffing, and programmatic improvements already in place or under way would resolve the problems at the corporate level. In January 1991, the NRC concluded that TVA's commitments and corrective action programs for Unit 2 were acceptable, and in April 1991, the Commission approved Unit 2 restart. Unit 2 restarted May 24, 1991.

TVA submitted its corrective action plan for returning Units 1 and 3 to service in 1991, and generally used the same methods, criteria, and technical positions for Unit 3 that were approved for the restart of Unit 2. In February 1992, an NRC Restart Panel was formed in accordance with NRC Inspection Manual Chapter (IMC) 0350. TVA completed the recovery of Browns Ferry Unit 3 in 1995, and the Commission authorized the regional administrator to approve restart of Unit 3 upon completion of certain open issues. The NRC administrator for Region II issued restart approval on November 19, 1995.

In April 1996, TVA requested removal of Browns Ferry Unit 1 as a Category 3 plant from the NRC's list of problem plants. TVA stated that no decision had been reached on the long-term operational status of Unit 1. The unit is defueled and is being maintained in layup status. Those shared systems that support operation of Units 2 and 3 continue to be kept in service. TVA noted that there were no plans at that time for equipment refurbishing or recovery activities at Unit 1. TVA committed to inform the NRC immediately of a decision to return Unit 1 to service, to implement the same programs used for the Unit 3 recovery, and to not restart Unit 1 without prior Commission approval. Unit 1 was removed from the list of problem plants on June 21, 1996.

2. Technical Resources

Plants With CPs

Technical or licensing resources will vary depending on whether or not an OL SER has been issued. In the case of Bellefonte 1 and 2 and WNP-1, an OL SER has not been issued. In SECY-89-104, the staff estimates 34 FTE will be needed to complete a licensing review of a reactivated plant without an ASLB decision, and that 15 FTE of technical assistance will be needed to support the review. The 15 FTE of technical assistance is needed to support both licensing and construction inspections. For the purposes of this report, the staff assumes that this technical assistance would be split evenly between these two areas. Therefore, the total FTE needed to support the licensing review based on information contained in SECY-89-104 is approximately 40 FTE. The staff performed an updated assessment of the numbers contained in SECY-89-104 in a survey of the staff requesting estimates for completing the licensing review of a WNP-1 type plant. The updated assessment results are provided in the Table V.G-1.

Until further information is obtained, the staff assumes that these FTE would be spent at a constant rate over a 5-year period or approximately 8 FTE per year starting the year a plant is reactivated. When and if the plants are reactivated, a detailed schedule for the review and updated estimates will be developed. A time frame of less than 5 years to perform the review is achievable; however, this schedule would not have much of an impact on the overall resource estimates but would result in more FTE per year being spent (e.g., assuming a 3-year review period would result in an expenditure of over 13 FTE per year).

Watts Bar Unit 2

Watts Bar Unit 2 has both an OL SER and a FES because it was considered in conjunction with the licensing of Unit 1. The SER for Watts Bar was written for Units 1 and 2. There were 20 SER supplements written for the plants. Supplements 5 through 20 concentrated on the 29 corrective action programs that the licensee adopted and the closure of the residual open items from the SER and previous supplements (1 through 4). The corrective action review performed by the staff and documented in the SER and inspection reports concentrated on Unit 1 activities. The staff believes that the SER and supplements would have to be reviewed if Watts Bar Unit 2 were reactivated to determine what, if any, changes would need to be made to address how the corrective action programs were applied to Unit 2.

To support the licensing of Unit 1, the staff updated the FES in 1995. Specifically, the staff issued NUREG-0498, Supplement 1, “Final Environmental Statement Related to the Operation of Watts

Bar Nuclear Plant, Units 1 and 2," in April 1995. The staff believes that this FES would need to be reviewed if Watts Bar Unit 2 were to be completed to assess the impact of any changes to the environment around the unit, and any changes to environmental regulations and guidance that could affect the conclusions in the FES.

Based on the above, fewer overall resources should be needed to perform the licensing review for Watts Bar Unit 2 than for the other deferred units. However, determining the actual reduction in resources, if any, is difficult. This is due mainly to the fact that the real percentage of completion of Unit 2 is speculative at best; experience from Unit 1 shows that much of the already completed work (such as electric cabling, pipe hangers, duct hangers, welding, etc.) needed to be redone or justified to be acceptable. For such rework, while the staff had previously approved the Unit 1-specific corrective programs, the staff and TVA would have to jointly evaluate if and how these programs are applicable to Unit 2. Further, the staff expended significant resources inspecting the implementation of corrective programs. Such inspections were over and beyond normal inspections for a plant under construction. Because of the uncertainty regarding the results of the reviews discussed above, it is difficult to provide an overall resource estimate. The staff believes that the above reviews would take approximately 4 FTE initially. Further resource estimates would be developed based on the results of the reviews.

Browns Ferry Unit 1

Because of the unique status of Browns Ferry Unit 1, the technical resources needed to perform the review are included in the inspection resource section below.

3. Inspection Resources

Plants With CPs

As stated above, SECY-89-104 estimates 35 FTE for inspection resources for a reactivated plant. In this SECY, the staff assumed 15 FTE would be needed for technical assistance. The staff assumes that this FTE would be split evenly between licensing and inspection resources. The staff also assumed 5 to 6 years for completion of construction and assumes varying resources based on the year of construction. Because each plant that falls into this category is unique, providing overall resource estimates is difficult. As stated in the Policy Statement on Deferred Plants, the licensee must submit a letter to the director of NRR at least 120 days before plant construction is expected to resume.

The staff assumes that the inspection procedures that were used for licensing past plants could be used for plants in this category. The staff may want to take advantage of the revisions to the IMCs described in Section V.H.4 of this report. Pending specific information for a reactivated plant and assuming that a revision to the IMCs and inspection procedures is not needed, the staff estimates that 40 FTE for inspection resources would be needed over a 5-year period. This estimate includes provisions to perform initial inspections associated with the deferred plant policy statement. The staff assumes in SECY-89-104 that initially a 5-person team would be required for 4 months for resolution of issues and documentation associated with reactivating a deferred plant.

Unlike the resource estimates for the licensing review, which were developed for two different

scenarios, the inspection resources are not tied to the status of the SER or FES. Instead, they are tied to the status of the construction of the unit. Because all four plants in this scenario are within the same range of percent complete, the staff believes that the resource estimates summarized in Table V.G-1 can be used as a starting point in developing the detailed resource estimates should a plant be completed.

Browns Ferry Unit 1

The staff based its resource estimates in Table V.G-1 on the experience gained during the restart of Browns Ferry Unit 3. While developing the resource estimates, the staff made the following assumptions:

- The staff assumes that the Unit 1 recovery would take a minimum of 60 months.
- NRR will review the startup test program (assumed to be similar to Unit 3).
- The staff will develop a Unit 1 Commission paper similar to the Unit 3 paper (SECY-95-264).
- An operational readiness assessment team (ORAT) will be formed before Unit 1 restart. The resource estimates in the table assume this ORAT will be formed in NRR with assistance from the region. If this ORAT is performed solely by Region II, some of the NRR resources below would be reallocated to Region II.
- Contractor assistance may be needed for the ORAT.
- The resource estimates include briefings to the ACRS and Commission as for the Unit 2 and 3 restarts.

Based on the above, the staff believes that approximately 19 FTE would be associated with inspection efforts and 12 FTE would be associated with review of the restart plan, project management, and technical review of commitments and modifications not yet completed for Unit 1. These resource estimates are preliminary in nature and would be updated based on details provided by TVA if it were to decide to restart Unit 1. Although these resource estimates were based on information obtained from the restart of Unit 3, there are several factors that could cause these resource estimates to increase. For example, the current condition of Unit 1 is not similar to the condition of Unit 3 when efforts were initiated to restart that unit. Also, TVA may decide to do more non-destructive examination inspections of the reactor vessel and recirculation piping for Unit 1 based on its condition than were done for Unit 3 prior to its restart. This might result in a more prolonged review and more inspections for Unit 1 restart than for Unit 3. The staff would expect TVA to supply information regarding the differences, if any, in the approach to restarting Unit 1 from the restart activities associated with Unit 3 if it decided to restart Unit 1. The staff could then assess the impact on the above resource estimates.

Regardless, for long-term estimating, the staff assumes that the resources would be spread over a 5-year period. If an assumption is made that the resource estimates are evenly distributed over this period, approximately 6 FTE per year would be expended.

4. Contractor Technical Assistance

As discussed above, the staff intends to use contract technical assistance should a plant be reactivated. For example, the staff assumes that about 5 FTE in technical assistance would be needed for the licensing review and that at least 7 to 8 FTE in technical assistance money would be used for the construction inspection effort. These estimates were included in the FTE estimates provided in licensing and inspection sections discussed above.

5. Litigation and Legal Support Resources

Although a hearing is not required, the Commission may hold a hearing on the OL review in accordance with the provisions of 10 CFR 50.58. The length of the hearing will depend, in part, on the number and complexity of the accepted contentions before the board. The staff estimates that the litigation and legal support resources required by OGC for an OL review are about 5 FTE.

H. Regulatory Infrastructure Activities

Chapter IV of this report discusses the regulatory infrastructure changes necessary to support future licensing activities. Over the past few years, the NRC has undertaken a number of regulatory infrastructure improvements, including the promulgation of the alternative licensing processes in 10 CFR Part 52, that provide a foundation for future licensing activities. Because of these improvements, the current NRC regulatory infrastructure is adequate to support future licensing. However, the staff has identified a number of regulatory infrastructure changes discussed below that would make future licensing reviews more effective and efficient as well as reducing unnecessary burden during a licensing review. The discussion in this section addresses the resource projections associated with those regulatory infrastructure changes. Table V.H-1 provides a summary of the estimated resources to implement the identified regulatory changes.

1. Regulatory Changes

Resource estimates to support regulatory changes are given in the following table.

Table V.H-1 Estimated Resources for Regulatory Changes

Regulatory Change	Staff FTE	Contract $K
10 CFR Part 52 Update Rulemaking	1	$0
10 CFR Part 51 Alternative Sites Rulemaking	3	$0
10 CFR Part 51 Table S-3 Rulemaking	4	$700
10 CFR Part 51 Table S-4 Rulemaking	4	$700
10 CFR Part 50 Appendix I Rulemaking	5	$1,100
NEI Petitions	2	$0
Financial Qualifications/Decommissioning Funding	1	$0
Antitrust Review	1	$0

Nuclear Insurance Requirements for Modular Reactors	1	$0
Annual Fees for Modular Reactors	1	$0
Waste Confidence Rule	1	$0
Alternative Operator Staffing Approaches	3	$0
Regulatory Framework to Address Future Designs	26	$2,600

10 CFR Part 52 Update Rulemaking

The rulemaking effort to update 10 CFR Part 52 was included in the NRC's FY 2001 budget. The resources required to complete this effort are approximately 1 FTE over a period of one year.

10 CFR Part 51 Alternative Site Review Rulemaking

The rulemaking effort to address the alternative site review requirements of 10 CFR Part 51 is discussed in a December 18, 2000, memorandum from William D. Travers to the Commission in which the staff reprioritized this rulemaking from "Low" to "High" to support initiation of rulemaking in mid-FY 2002. The resources required to complete this effort are approximately 3 FTE over a two year period.

10 CFR Part 51 Tables S-3 and S-4 Rulemakings

The rulemaking effort to update Tables S-3 and S-4 of 10 CFR Part 51 will address issues that have emerged since the tables were last updated. The staff estimates that it will require approximately 8 FTE and $1400K to complete both of these rulemakings over a three-year period.

10 CFR Part 50 Appendix I Rulemaking

The rulemaking effort to update Appendix I of 10 CFR Part 50 will incorporate revised dose calculation methodology. The resources required to complete this effort are approximately 5 FTE and $1,100K over a three year period.

NEI Petitions for Rulemaking Regarding 10 CFR Part 52

Two NEI petitions for rulemaking for 10 CFR Part 52 were received on July 19, 2001. The staff is currently evaluating these petitions and will develop an appropriate resolution strategy in the near future. The resources required to complete this effort are approximately 2 FTE over a two year period.

Financial Qualifications and Decommissioning Funding

This review activity was initiated after discussions with the industry indicated that these regulations need to be reviewed because nuclear power plants could be built and operated as merchant plants. The staff will describe these issues in detail and provide recommendations regarding them in a Commission paper to be issued in November 2001 in response to a series of questions raised by Exelon as part of the pre-application review for the PBMR. The staff has assumed that activities to resolve these issues generically will require 1 FTE over a duration of 2

years and that the activity will begin after Commission guidance is received in response to the November 2001 Commission paper. This estimate will be revised (as necessary) at that time.

Antitrust Review

Discussions with nuclear industry representatives have indicated that industry believes that the NRC should not be conducting antitrust reviews. The Office of General Counsel is reviewing this issue, and will address it separately. The staff has assumed that activities to resolve these issues generically will require 1 FTE over a duration of 2 years and that the activity will begin after Commission guidance is received. This estimate will be revised (as necessary) at that time.

Nuclear Insurance Requirements for Modular Reactors (Price-Anderson Act)

A review of insurance requirements for modular reactors was initiated after discussions with the industry indicated that these regulations should be reviewed because of the likelihood of modular plants being built. The NRC has had a number of interactions with Congress on this issue. Any legislative changes relative to this issue may result in rulemaking. For resource estimation purposes, the staff has assumed that activities to resolve this issue generically will require 1 FTE over a duration of 2 years.

Annual Fees for Modular Reactors

A review of these fee requirements was initiated after the industry indicated that these regulations should be reviewed because of the likelihood of modular plants being built. Industry has requested estimates of the annual fees that will be assessed for modular reactors. The staff will describe these issues in detail and provide recommendations regarding them in a Commission paper to be issued in November 2001 in response to a series of questions raised by Exelon as part of the pre-application review for the PBMR. The staff has assumed that activities to resolve these issues generically will require 1 FTE over a duration of 2 years and that the activity will begin after Commission guidance is received in response to the November 2001 Commission paper. This estimate will be revised (as necessary) at that time.

Waste Confidence Rule

A review of this rule was initiated because the industry indicated that these regulations should be reviewed because of the likelihood of building reactors that do not use LWR technology. The staff will describe these issues in detail and provide recommendations regarding them in a Commission paper to be issued in November 2001 in response to a series of questions raised by Exelon as part of the pre-application review for the PBMR. The staff has assumed that activities to resolve these issues generically will require 1 FTE over a duration of 2 years and that the activity will begin after Commission guidance is received in response to the November 2001 Commission paper. This estimate will be revised (as necessary) at that time.

Alternative Operator Staffing Approaches

10 CFR 50.54(m) specifies minimum operator staffing requirements. Discussions with the industry have indicated that this regulation should be reviewed because of the likelihood of modular plants

being built. The staff will be providing its recommendation regarding this issue in a Commission paper to be issued in November 2001. The staff has assumed that activities to resolve this issue generically will begin after Commission guidance is received in response to the November 2001 Commission paper. The resources required to complete this effort are approximately 3 FTE over a two year period.

Regulatory Framework To Address Future Designs

This activity was initiated by a proposal by NEI that the NRC should replace deterministic regulations with risk-informed, performance-based regulations for future plants, where appropriate. The NEI has stated that it intends to submit a white paper for this initiative in early 2002. The staff's estimate of 26 FTE and $2600K over a duration of four years includes sufficient resources for a rulemaking of significant complexity. The staff has created a regulatory framework working group, which has been chartered to develop a Commission paper in mid-2002 to provide the Commission with options and recommendations as to how to proceed with this activity. Until the Commission feedback is received and the scope of NEI's white paper is understood, the estimate for this task will be highly uncertain.

2. Regulatory Guides and Guidance Document Updates

The staff concludes that regulatory guides and associated guidance documents should be updated to support new licensing activities. These documents have various revision dates but most have not been updated since the 1970s.

Table V.H-2 provides a summary of technical resources to implement the changes to the regulatory guidance to support review of future applications that are under consideration.

Table V.H-2 Estimated Resources for Regulatory Guidance Updates

Regulatory Guidance Document Type		**Staff FTE**	**Contract $K**
Regulatory guide and NUREG	Associated with Rulemaking	4	$1,100
	Not Associated with Rulemaking	9	$800
Standard review plan	Not Associated with Rulemaking	2	$200
Environmental standard review plan	Associated with Rulemaking	2	$0

Regulatory Guide and NUREG Updates

The staff identified 17 regulatory guides and NUREGs requiring revision or development as part of this assessment. Eight of these revisions are associated with identified rulemakings. The resources required to complete this effort are approximately 13 FTE and $1,900K over a four-year period.

SRP Updates

The last major full scale revision of the SRP was in 1981. The staff identified five SRP chapters

requiring revision as part of this assessment. These revisions are not associated with identified rulemakings. The resources required to complete this effort are approximately 2 FTE and $200K over a four year period.

ESRP Updates

The ESRP was revised in March 2000. However, the staff identified three ESRP sections requiring revision as part of this assessment. These revisions are associated with identified rulemakings. The resources required to complete this effort are approximately 2 FTE over a four year period.

3. Generic Regulatory Technology

The staff has also identified the need for resources for generic regulatory technology development to support new reactor reviews. These resources are needed to provide the tools and information necessary for staff assessment of new technologies.

This effort would entail developing independent analytical tools and data, and evaluating other generic and technology-specific issues. Examples of generic items include development of PRA methodology for HTGR designs; development of or modifications to the existing thermal-hydraulic and analytical codes; development of experimental data (e.g., fuel and thermal-hydraulic testing); assessment of high-temperature materials performance; and consideration of advanced instrumentation and control (I&C) issues. Examples of the technology-specific issues are HTGR TRISO fuel qualification by independent testing, high-temperature material performance and graphite technology-related issues. Those related to advanced LWRs include fuel design and thermal-hydraulic phenomena. If the industry adheres to the projected schedules for the pre-application and/or licensing reviews of new reactor designs - PBMR, GT-MHR, AP1000 and IRIS - much work may have to be conducted in parallel. RES skills will have to be augmented by contractor technical assistance.

Table V.H-3 Estimated Resources for Generic Regulatory Technology

	Staff FTE	**Contract $K**
PRA technology development	5	$1,600
new technology (I&C, materials, etc.)	17	$12,000
code modelling and assessment	21	$7,500
HTGR fuel testing	8	$10,000
thermal-hydraulic experimental data	14	$7,000

Details of various HTGR- and ALWR-related efforts are as follows:

HTGR-related Contractor Technical Assistance

Many of the considerations discussed elsewhere in this report in the context of PBMR are also

applicable to the GT-MHR. The infrastructure work that the staff is considering is directed toward providing NRC with the capability for independent assessments of applicant submittals without total reliance on industry data.

Analytical Tools

Fuel is the key safety feature of the HTGR design. Research is planned to assess pebble fuel performance including fuel behavior during core heat up, and fission product release and transport from the irradiated fuel. Existing analytical codes would be modified to model the plant response to accidents, including air and moisture intrusion. Additionally, high-temperature material performance and graphite technology related issues would also need to be addressed.

Facilities

The ability of TRISO-coated particle fuel to reliably retain fission products over a wide range of conditions is of fundamental importance to all HTGR designs. Currently, several National Laboratories have capabilities for performing experiments on HTGR fuel to measure fission product release as a function of temperature. Facilities that can irradiate HGTR fuel also exist; however, some modifications to the existing facilities may be warranted.

Cooperation

NRC may obtain data on HTGR operating experience and research, including fuel qualification, through international collaboration. In this respect, cooperation with various countries (e.g, Germany, Japan, China and UK) will be a key factor in developing the research plans. There are some similarities in the PBMR and the GT-MHR design and fuel, therefore, many of the considerations for PBMR may also be applicable to the GT-MHR.

ALWR-related Contractor Technical Assistance

The staff plans on using contractor technical assistance to effectively support the IRIS and AP1000 reviews. The estimates include support for IRIS pre-application review, conducting anticipatory and confirmatory research, and possibly conducting some independent testing. These estimates assume that NRC will conduct research and some selected tests during the pre-application phase, and no DOE funding will be available.

Analytical Tools

For both AP1000 and IRIS, the existing thermal-hydraulic codes may have to be assessed for the conditions of operation of these reactor designs and to identify needed improvements in the NRC codes.

Facilities

Both for AP1000 and IRIS , confirmatory research at various facilities may be necessary and resources have been included in this report for thermal-hydraulic testing.

Cooperation

It is possible that DOE may sponsor some testing relevant to ALWRs. If so, NRC will explore cooperating in these activities to leverage resources.

4. Construction Inspection Program (CIP) Update

In order to prepare for future applications, the NRC will reactivate the revision effort for the CIP that was suspended in 1994. This effort will include review and revisions of applicable IMC and development of the associated inspection guidance for inspection of critical attributes for advanced reactor designs. The purpose of this section is to identify the resource needs associated with updating the general guidance governing the preoperational inspection phase for nuclear power plants. The IMCs involved in this phase are Chapters 2511, 2512, 2513, and 2514. Below is a discussion regarding each IMC. The staff has made the following assumptions regarding the updating of this inspection guidance:

- The general guidance contained in the IMC can be revised in such a fashion that they will be applicable to both gas-cooled reactors and LWRs (specific inspection guidance that is found in the detailed inspection procedures will have to be developed separately for gas-cooled reactors).

- The IMC can be revised in such a fashion that they will be applicable to those applying for a CP and OL in accordance with 10 CFR Part 50 and a COL in accordance with 10 CFR Part 52.

- The updating of the IMC will be managed from NRC headquarters with resources being allocated to each region so that each region can participate in the process and advise headquarters.

Overall estimated resources for updating and revising the CIP guidance are given in the following table.

Table V.H-4 CIP Development Resources

	Staff FTE	**Contractor $K**
IMC 2511	6	$0
IMC 2512	20	$800
IMC 2513 and IMC 2514	1	$0

The discussion below describes what work the staff anticipates performing for this effort.

IMC 2511 Pre-CP Phase

For future plants, this program is expected to be similar in scope and applicability to the previous IMC 2511 program for site characterization and preparation activities. The pre-CP inspection program's focus will be on QA programs and implementation; site preparations, including installation of services, support facilities, and non-safety-related systems, structures, and components; and environmental protection requirements. Inspections of activities authorized by an early ESP would be conducted under this program. The pre-CP program should be completed at about the same time as a plant's COL or CP is issued.

In the draft revised CIP report (see Section IV.B of this report), the authors recommend that when the NRC staff reactivates the preoperational inspection programs for a future plant, a "zero-based" review of the IMC 2511 inspection program be performed. Since the draft report was issued, IMC 2511 has been removed from the active list of IMC. As discussed in the ESP activities portion of this report (section V.D), this IMC will need to be updated to support pre-ESP activities. Based on information from potential applicants, the staff estimates that the first inspections will be performed in January 2002 for the first ESP application. Therefore, resources in the short term would be dedicated to updating this IMC on an expedited basis to support the ESP schedule. This would include revising the inspection procedures associated with this IMC. IMC 2511 contains a table with recommended time frames for the performance of individual inspection procedures. The inspection procedures would be revised based on their position in this table (i.e., inspection procedures that will be used early will be the first ones to be revised) in order to have the inspection procedures developed and in place before they are needed.

As part of the overall effort to revise IMC 2511, the staff will assess whether the guidance will need to be updated based on details provided in the ESP and whether risk insights can be used to inform the update. For example, if an existing nuclear site is chosen, the staff may need to address if and how the new site activities authorized under a LWA (see Section V.D.3) will be inspected to determine their impact on the operating plant.

The staff estimates that 6 FTE will be needed over a 2-year period to perform a "zero-based" review and to update the guidance contained in IMC 2511 and the associated inspection procedures.

IMC 2512 - Construction Inspection Phase

The draft revised CIP report provides detailed recommendations regarding this phase of preoperational inspections. The report describes the processes and assumptions that should be used while developing a revised CIP, and provides a draft revision to IMC 2512. The revised CIP provides enhanced guidance and capabilities for the gathering, recording, and reporting of construction inspection information. The improvements suggested in the report center on the use of a systems-based inspection planning methodology, computerization of the inspection program, and a continuous onsite inspection presence throughout plant construction.

Draft Report on the Revised CIP

The draft report on the revised CIP provides background information, including the history of the

CIP, lessons learned, and the expected licensing and construction environment. The report was written at the time the NRC was developing policy for implementing 10 CFR Part 52 and was written to accommodate licensing under either 10 CFR Part 50 or Part 52. The report also assumes the following regarding the expected construction environment:

- Future nuclear power plants are likely to be built more rapidly than their predecessors.
- A construction inspection program information management system (CIPIMS) was partially developed to provide the capability to record inspection information in a retrievable and repeatable format. This work can be used as a starting point when the CIP is reactivated.
- The detailed engineering design will be essentially complete by the start of construction.
- Modular construction techniques will be used to allow several different fabrication activities to be performed in parallel away from the immediate construction site.
- Fabrication of plant modules and major components is expected to begin well before COL issuance.

The draft report on the revised CIP does not recognize the following issues that will need to be addressed in any update to the guidance contained in IMC 2512:

- The IMC guidance was written for LWRs. It therefore does not recognize issues associated with gas-cooled reactors such as the PBMR.
- Although the report recognizes that future reactors will be built more rapidly than in the past, the authors did not assume the schedules proposed by some applicants. The report authors assumed a time frame of 48 months from the first concrete pour until fuel load. Westinghouse assumed that the AP600 could be built in approximately 36 months. In a letter dated May 25, 2001, Exelon proposes a 20-month schedule to construct the first PBMR module, starting in April 2005.
- The revised CIP identifies some methods for incorporating PRA insights into construction inspection, but states that these methods should be developed further when the CIP is reactivated. The report was also written before the current reactor oversight process was implemented. Lessons learned from this effort need to be reviewed to determine if they can be applied to the CIP.
- The report does not recognize the custom plant scenario. An example of this scenario is identified in Exelon's May 25, 2001, letter regarding the PBMR. Under this scenario, Exelon will submit a COL application in accordance with 10 CFR Part 52, but will not be referencing a certified design. The authors of the CIP report assumed that a COL applicant would reference a certified design complete with an approved set of ITAAC. Although a proposed set of ITAAC will be submitted with the COL application, these ITAAC will not have been approved and the staff may need to delay work on the detailed inspection procedures to support review of the ITAAC.

- The report does not incorporate lessons learned from the certification of three standard designs or recognize inspection challenges associated with DAC that are a part of some of these designs. At the time the draft report on the revised CIP was written, the ITAAC format and content were in the initial stage of development. The report references SECY-94-294, "Construction Inspection and ITAAC Verification." This Commission paper provided a matrix for how inspections would be performed for the high-pressure core flooder system for the ABWR. The staff believes this matrix needs to be updated as part of the general effort to update IMC 2512. The staff believes that similar matrices should be developed for sample systems for the System 80+ and the AP600. This would allow the staff to determine the general requirements for inspection procedures. Detailed revision of the inspection procedures would be done if and when a COL application is received for these plants.

- The matrix and guidance that was provided in SECY-94-294 are consistent with Attachment 3 of the draft report on the revised CIP. Attachment 3 of the draft report on the revised CIP provides an overview for the construction inspection procedure format and content for the detailed procedures used by the inspectors in accordance with the general provisions of IMC 2512. This attachment with its sample revised inspection procedures would also be updated as part of the effort to update the general provisions of IMC 2512.

The draft report on the revised CIP also provides a discussion of the actions associated with future CIP reactivation and a list of outstanding policy issues that need to be resolved. These issues, along with the issues identified above will have to be considered as this inspection manual chapter is updated.

During the general update of IMC 2512, a scoping effort would be performed to determine the impact on the inspection procedures associated with IMC 2512. One general impact that was noted regarding the inspection procedures associated with IMC 2512 was the effect of 10 CFR Part 52 and its provisions regarding inspections, tests, analyses, and acceptance criteria (ITAAC). The scoping effort would be used to determine the extent of changes that would be necessary to the inspection procedures to accommodate this change. This effort will be done in parallel with the IMC 2512 revision.

Most of the updating to the inspection procedures would be done when a COL application is received. Unlike the inspection procedure contained in IMC 2511, some of the inspection procedures found in IMC 2512 are unique to either a BWR or a PWR. Updating these inspection procedures before knowing the type of reactor to be built would not be an efficient use of resources. Additionally, if a gas-cooled reactor were to be built, some inspection procedures unique to this technology would most likely need to be developed. The staff intends to perform a general review and update of the construction inspection guidance in the near term and the detailed inspection procedures after a COL application is received.

10 CFR Section 52.79(c) requires that the COL application include ITAAC that, if met, are necessary and sufficient to demonstrate that the facility has been constructed and will operate in conformity with the COL, the Atomic Energy Act of 1954, and the Commission's regulations. Conformance with the ITAAC must be demonstrated before the reactor is operated. Therefore, the ITAAC and the NRC inspections associated with ITAAC end at fuel load. However,

preoperational inspection programs would continue through the preoperational testing phase and the startup testing phase. Because IMC 2512 is envisioned to provide all the guidance related to ITAAC, inspection procedures found in IMC 2513 that would verify ITAAC completion would be moved to IMC 2512. This is recognized in the draft revised CIP report, and the proposed reassignment of inspection procedures for IMCs 2511, 2512, 2513, and 2514 is provided in Attachment 2 of the draft revised CIP report.

While developing the resource estimates associated with the May 1, 2001, SRM response, the staff assumed that actual construction inspection activities would start after 2005. Therefore, the staff assumed that there would be sufficient time to allow a gradual increase in the resources needed to revise the CIP. However, in its May 25, 2001, letter, Exelon states that it intends to provide the staff with a COL application in late 2002 or early 2003 for the PBMR, along with a request that the COL be issued in April 2005. Ideally, the staff believes it would be most efficient to update generic inspection guidance found in IMC 2512 before a COL application is submitted. The detailed inspection procedures would begin to be revised when a COL application is received. Therefore, the staff believes that it needs to start work on updating the general provisions of IMC 2512 in FY 2002.

It is estimated that 20 FTE and $800K will be needed to review and update IMC 2512.

IMC 2513 - Preoperational Testing Phase and IMC 2514 - Startup Test Phase

IMC 2513 inspections will start during the last part of the construction phase and will continue through low-power testing. Inspections will remain similar to those included in the latest version of IMC 2513, with the major exception being those inspections that would verify ITAAC completion. The operational readiness team inspections performed under this program will focus on management oversight, QA program and program implementation for operations, plant procedures, operations, maintenance, plant support, and operator licensing. Aside from identifying IMC 2513 inspections that would apply to the revised CIP, the preoperational testing inspection program was not revised as part of the CIP revision project.

IMC 2514 inspections will start at fuel load or OL issuance, as applicable, and end when the plant enters the operational phase, at which point the reactor oversight program will be implemented at the plant. The startup testing inspection program is expected to be similar in scope and content to the existing IMC 2514 program, although some revisions will likely be needed to accommodate evolutionary or advanced reactor designs.

Although IMC 2513 and IMC 2514 will likely not be needed until the FY 2005 time frame based on current information, the staff intends to perform a preliminary review of these IMCs to determine whether revisions to the guidance are necessary. This review would concentrate on lessons learned from the revised reactor oversight process for possible inclusion in the guidance contained in IMCs 2513 and 2514.

The staff estimates that a high-level overview of these IMCs will take 1 FTE over a 2-year period. This would allow time in FY 2004 to update this guidance if needed in order to support inspections in the FY 2005 time frame.

Organizational Structure

Based on the near-term work, the staff intends to establish a CIP Section within the Inspection Program Branch of NRR in the short term to manage the effort for updating the general guidance described above. As discussed in this section, resources will be allocated to the regions to assist and advise the CIP Section in this process.

VI. ORGANIZATIONAL CHANGES

This chapter addresses recent and potential changes to the agency's current organization that would facilitate the safety and environmental reviews of future license applications.

A. NRR Organizational Changes

To prepare for and manage future reactor and site licensing applications, the Future Licensing Organization (FLO) was established as a temporary organization in NRR in March 2001. In July 2001, the organization was permanently established as the New Reactor Licensing Project Office (NRLPO). NRLPO reports directly to the Associate Director for Inspection and Programs. The current staffing of NRLPO was established through details and rotational assignments of staff experienced in regulatory programs, including the design certification process. NRR is in the process of permanently staffing NRLPO. The staff expects to complete these efforts by the end of calendar year 2001. The permanent staff of NRLPO will consist of a director, deputy director, a secretary, a senior policy analyst, and eight project managers. They will manage and coordinate the overall safety and environmental project management for new site and reactor licensing activities.

NRLPO will use a matrix approach to capitalize on technical expertise across the office. The Division of Engineering will provide engineering support for new site and reactor licensing reviews. The Division of Systems Safety and Analysis will provide systems support, and support in the areas of accident analysis and PRA. The Division of Inspection Program Management will provide support in the areas of radiological reviews, human factors, QA, security and safeguards, and inspection programs. The Division of Regulatory Improvement Programs will provide support for environmental and financial reviews, as well as support in the rulemaking area.

As industry plans are formally established, it may become necessary for the staff to implement organizational changes and expedited recruiting for special skills to accommodate a significant number of applications that are expected to be under review in the future.

B. Organizational Changes to Support the CIP

The Inspection Program Branch within the Division of Inspection Program Management will lead the review and update the inspection guidance contained in IMC 2511 and IMC 2512. The regions will also participate in this update. During the updating of this guidance, the staff will assess long-term organizational changes that may be needed to support the CIP. As stated in Section V.F of this report, there is currently not enough information to determine whether the organizational model recommended in the draft report on the revised CIP is the best organizational model in today's environment.

The staff also needs to assess the best organizational model to inspect the following activities: modular offsite fabrication, large component manufacturing, and engineering design verification. The staff will consider the number of plants expected to be under construction, the workload, and the results of the critical skills survey in assessing possible organizational changes.

C. RES Organizational Changes

The Office of Nuclear Regulatory Research (RES) has established an Advanced Reactor Group (ARG) in the Regulatory Effectiveness Assessment and Human Factors Branch (REAHFB) in the Division of Systems Analysis and Regulatory Effectiveness (DSARE). ARG will serve as a focal point for RES advanced reactor activities. ARG is under the supervision of a branch chief, and includes a senior level advisor and three project managers.

Responsibilities of ARG include managing, in coordination with NRR and NMSS, pre-application activities for DOE's Generation III+ and IV designs and non-light-water-reactor advanced designs, and supporting NRR in activities related to advanced LWRs. Current activities include conducting a pre-application review of Exelon's PBMR design, in accordance with SECY-01-0070, "Plan for Pre-Application Activities on the Pebble Bed Modular Reactor," dated April 25, 2001, and interfacing with the DOE on the Generation IV reactor program.

Like NRR, ARG will use a matrix approach to capitalize on technical expertise across the office and to advance RES expertise in evolving technology. The REAHFB DSARE will support human factor reviews, and the Safety Margins and Systems Analysis Branch will provide technical support on thermal-hydraulic, fuel performance, and severe accident analysis for advanced system designs. PRA and licensing framework support will be provided by the Division of Risk Analysis and Applications; support on material issues, including the high-temperature performance of SSCs, in the Division of Engineering Technology (DET); and support on instrumentation and control systems for advanced designs will be provided by the Engineering Research Applications Branch in DET.

VII. Conclusions

The overall conclusion of the staff performing the readiness assessment is that the NRC's licensing processes in 10 CFR Part 52 are ready to be used and the NRC is ready to complete new reactor licensing activities currently underway, such as the pre-application reviews for the AP1000 and the Pebble Bed Modular Reactor (PBMR) and current rulemaking activities for 10 CFR Part 51 and Part 52. Additional work is needed in order to ensure the staff will be ready to effectively carry out its responsibilities associated with the review of ESPs, license applications, and construction of new nuclear power plants, given the potential for significant new licensing activity over the next several years. If upcoming industry decisions result in several request for review of applications for ESPs, design certifications, COLs, or reactivation of construction at deferred plants, the staff may not be able to meet the industry's proposed schedules with the level of resources identified in the attached report. The schedule and resource estimates in this report do not reflect any staff consideration of resource restraints imposed on the agency. Staff decisions regarding the relative priorities of new reactor licensing activities will depend largely on the number and timing of industry decisions to pursue new licensing activities. In making these decisions, the staff will remain focused on the agency's Advanced Reactor Policy and its performance goals of maintaining safety, protecting the environment and the common defense and security; increasing public confidence; making NRC activities and decisions more effective, efficient, and realistic; and reducing unnecessary regulatory burden.