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NGNP and Hydrogen Production Preconceptual Design Study

Licensing Risk Reduction Study

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TABLE OF CONTENTS

LIST	Г OF FIG	GURES		6
LIST	Г ОГ ТА	BLES		6
ACF	RONYM	S		7
SUM	IMARY	AND CO	DNCLUSIONS	9
1.	INTRO	DUCTIO	DN	13
2.	LICEN	SING RI	SK-REDUCTION RESULTS	14
2.1	LICE	NSING RI	SK-REDUCTION WORKSHOP	14
2.2	LICE	NSING PR	ROCESS OPTIONS, MILESTONES AND LOGIC	14
	2.2.1	PART 52	2 LICENSING PROCESS OPTIONS	15
		2.2.1.1 2.2.1.2 2.2.1.3 2.2.1.4 2.2.1.5	Early Site Permit Design Certification Combined License Limited Work Authorization Pre-application Program – Policy Issues	15 19 20 22 25
	2.2.2	LICENS 2.2.2.1 2.2.2.2 2.2.2.3 2.2.2.4	SING MILESTONES AND LOGIC NGNP Pre-application Programs NGNP Early Site Permit Application NGNP Combined License Application NGNP Limited Work Authorization Application	27 28 29 33 36
		2.2.2.5	Commercial Plant Design Certification	36
2.3	LICE	NSING SC	CHEDULE SUMMARY	39
2.4	CONT	TENT OF	NGNP PRE-APPLICATION PROGRAMS	43
	2.4.1	BACKG	ROUND	43
	2.4.2	NGNP E	SP PRE-APPLICATION PROGRAM	44
	2.4.3	NGNP C	COL PRE-APPLICATION PROGRAM	45
	2.4.4	NGNP C	COMMERCIAL PLANT DC PRE-APPLICATION PROGRAM	47
	2.4.5	NGNP P	PRE-APPLICATION PROGRAM SUMMARY	47
2.5	BOUN	DARY BI	ETWEEN SAFETY AND NON-SAFETY PORTIONS OF NGNP	49
3.	RECON	MMENDI	ED ACTION ITEMS	52
REF	FERENC	ES		54
APP	PENDICI	ES		A-1

APPENDIX A: MINUTES AND PRESENTATION SLIDES FOR THE LICENSING	
RISK-REDUCTION WORKSHOP	A-1
APPENDIX B: PROCESS STEPS FOR THE PART 52 EARLY SITE PERMIT,	
COMBINED LICENSE, AND DESIGN CERTIFICATION PROCESSES	B-1
APPENDIX C: ISSUES TO BE ADDRESSED DURING THE EARLY SITE	
PERMIT, COMBINED LICENSE, AND DESIGN CERTIFICATION PRE-	
APPLICATION PROGRAMS	C-1

LIST OF FIGURES

Figure SC-1: NGNP Project Licensing Schedule – Overview	10
Figure 2-1: NGNP Early Site Permit - Milestones and Logic	32
Figure 2-2: NGNP Combined License Application – Milestones and Logic	35
Figure 2-3: Commercial Plant Design Certification – Milestones and Logic	38
Figure 2-4: NGNP Estimated Licensing and Startup Schedule – Summary	42
Figure 2-5: Conceptual Approach to NGNP Regulatory Boundary	49

LIST OF TABLES

Table B-1: Generic Schedule for Issuance of An Early Site Permit	B- 1
Table B-2: Generic Schedule for Issuance of A COL	B-7
Table B-3: Generic Schedule for Issuance of A Design Certification For An Evolutionary	
Light Water Reactor	B-13
Table C-1: NGNP Early Site Permit Pre-Application Issues	C-1
Table C-2: NGNP Combined License Pre-application Issues	C-3
Table C-3: NGNP Commercial Plant Design Certification Pre-application Issues	C-13

ACRONYMS

Abbreviation or Acronym	Definition
ACRS	Advisory Committee on Reactor Safeguards
AECL	Atomic Energy of Canada, Limited
APWR	Advanced Pressurized Water Reactor
ASLB	Atomic Safety and Licensing Board
BEA	Battelle Energy Alliance
BOP	Balance of Plant
CANDU	Canadian Deuterium Uranium Reactor
CFR	Code of Federal Regulation
COL	Combined License
DC	Design Certification
DOE	United States Department of Energy
EPZ	Emergency Planning Zone
ER	Environmental Report
ESP	Early Site Permit
FEIS	Final Environmental Impact Statement
FSAR	Final Safety Analysis Report
GA	General Atomics, Inc.
HTGR	High Temperature Gas Reactor
ISG	Interim Staff Guidance
ITAAC	Inspections, Tests, Analysis and Acceptance Criteria
LWA	Limited Work Authorization
LWR	Light Water Reactor

Abbreviation or Acronym	Definition
MHTGR	Modular High Temperature Gas-Cooled Reactor
NEPA	National Environmental Policy Act
NGNP	Next Generation Nuclear Plant
NHSS	Nuclear Heat Supply System
NRC	United States Nuclear Regulatory Commission
NRR	NRC Office of New Reactors
NUREG	Nuclear Regulatory, NRC Staff Report
PBMR	Pebble Bed Modular Reactor
PCS	Power Conversion System
PHP	Process Heat Plant
PRISM	Power Reactor Inherently Safe Module
PSID	Preliminary Safety Information Document
R&D	Research and Development
RAIs	Requests for Additional Information
RTDP	Reactor Technology Development Plan
SECY	Secretary, Letter to the Secretary of the NRC
SER	Safety Evaluation Report
SHTS	Secondary Heat Transfer System
SSAR	Site Safety Analysis Report
SSCs	Structures, Systems, and Components
V&V	Verification and Validation

SUMMARY AND CONCLUSIONS

Licensing is recognized as a major cost and schedule risk for the NGNP project and its follow-on commercial plants and, therefore, this study was conducted to identify the means by which that risk can be reduced. The areas of risk addressed are (1) the regulatory process and logic, (2) project and engineering support of the schedule, and (3) NRC interactions, including pre-application programs and R&D coordination. A workshop was conducted to obtain licensing insights and recommendations from the other Next Generation Nuclear Plant (NGNP) project participants: DOE, BEA, GA, Areva, and Entergy (Section 2.1). The consensus of workshop attendees confirmed that the licensing strategy would be based on 10 CFR Part 52, for which the major elements will be applications for an NGNP Combined License (COL) and Design Certification (DC) of follow-on commercial plants (Section 2.2.1). Early Site Permit (ESP) and Limited Work Authorization (LWA) applications are considered to enable further management of schedule risk and are included in the current strategy, but a final recommendation on their use cannot be made until detailed project schedule studies are completed. Since the NRC has indicated its desire for use of the Part 52 process, pursuit of the specific Part 52 process identified in this study reduces or eliminates the risk of having to change strategies after license applications have been submitted.

The risk of a lengthy NRC review can be positively impacted by planning an aggressive review schedule and then pursuing design development, project management and NRC support necessary to meet that schedule (Section 2.2.2). The United States Nuclear Regulatory Commission (NRC) review must be preceded by an extensive pre-application program that yields a quality application based on the pre-application agreements with NRC on the application contents. This "no surprises" approach is essential to match expectations and reality throughout the review process. The critical engineering interfaces and milestone dates necessary to support the proposed licensing schedule are identified in this study. A high level overview of the schedule is shown in Figure SC-1. It is estimated that 56 months is required from the start of the conceptual design stage to the submittal of the COL application. Based on input from the workshop and review of current NRC experience, it is estimated that the NRC technical review of the COL can be achieved in 36 months and that the subsequent COL public hearing process can be completed in 12 months. Use of the ESP process, while not on the critical path, is recommended with the intent of decreasing staff review effort for the COL application. It is

further recommended that an LWA application be submitted in conjunction with the ESP application and that related reviews and public hearings be pursued such that construction can be started approximately nine months prior to receiving the COL. The proposed schedule includes 12 months for site preparation and excavation prior to the start of construction on safety-related



Figure SC-1: NGNP Project Licensing Schedule – Overview

structures. It is estimated that, after receiving the COL, the time span for construction, fuel load, and startup is 40 months. Further, it is assumed that the conceptual design effort will be started in October 2008. The DC program in support of follow-on commercial plants is scheduled to run approximately concurrent with the NGNP COL and construction programs such that NGNP startup can be factored into the DC final technical review. Commercial plant COL applications that reference the design to be certified can be submitted as soon as the DC application is accepted for review, about October 2016. In addition, there will be feedback from the commercial plant DC program into the NRC COL application review, thereby ensuring that, to the extent practical, the NGNP COL will be a complete precedent for commercial plant projects. As a result, it is anticipated that completion of NGNP plant startup (i.e., the start of operations that deliver products offsite) will be achieved by the end of 2019 and that the commercial plant DC rule will be issued by the end of 2020 (Section 2.3).

Licensing risk can be further reduced through early planning for license application preparation and NRC review thereof (Section 2.4). The currently ongoing Pebble Bed Modular Reactor (PBMR) pre-application program when coordinated or combined with the NGNP preapplication program provides a basis for early resolution of generic High Temperature Gas Reactor (HTGR) issues. It is recommended that the PBMR pre-application issues already under discussion with the NRC be accelerated to support the NGNP fast-track schedule. Further, the prior NRC reviews of HTGR designs (GA's Modular High Temperature Gas-Cooled Reactor – MHTGR and Exelon's PBMR) provide a basis for prompt NRC agreement on the approach to resolving those issues for the NGNP project. Therefore, a critical, base assumption for the ESP, LWA, COL and commercial plant DC applications is that each will be preceded by a substantial pre-application program to get NRC input and alignment on focus topics necessary for preparation of successful applications. The risk of delays due to the research and development of technology necessary for completion of NRC safety reviews can be minimized by ensuring that the NGNP research and development program is coordinated with the needs of the NRC. Specific issues to be addressed in each of the pre-application programs are summarized in this report along with their related interface requirements (Section 2.4).

While the NRC is required to review the safety functions of the nuclear plant, including safety impacts from the process heat plant, the set of safety-related structures, systems and components (SSCs) to be considered by the NRC should be limited and not extend to matters outside the safety performance of the nuclear plant itself. There should be a clear demarcation among: (1) the safety-related SSCs within the NRC review of the Nuclear Heat Supply System, (2) those non-safety-related SSCs that have a function supportive of safety or whose failure could impact safety and (3) those SSCs in the non-safety-related portion of the plant which would not be subject to routine NRC regulatory review and oversight, following initial licensing reviews, to assure there is no material safety relationship. This "regulatory boundary" issue will be better defined during the conceptual and preliminary design phases and is also included as a discussion topic in the COL and DC pre-application programs (Section 2.5).

In order to meet the accelerated schedule summarized above, the following activities should be initiated as soon as possible (see Section 3 for a complete list of proposed actions):

- [1] Initiate NGNP discussions with the NRC and advance the currently ongoing PBMR preapplication discussions onto a fast-track schedule,
- [2] Develop license application specifications and detailed commitment schedules for support of the ESP/LWA, COL and DC applications and their pre-application programs,

- [3] Establish an integrated Regulatory Technology Development Plan which is mutually agreed with by the NRC and which will serve to ensure that the related NGNP technology development programs satisfy regulatory requirements,
- [4] Integrate the fuel qualification program with the NGNP integrated licensing schedule, and
- [5] Establish the industry consortium, DOE funding, and organizational interfaces that create a qualified applicant that can support the ESP/LWA, COL and DC programs.

In regards to implementing the above actions, the most urgent needs are (1) the initiation of early interactions with the NRC, (2) the development of specifications for preparation of the NGNP ESP, LWA and COL applications and (3) confirmation that the engineering design and analysis work schedule supports critical licensing milestones. Diligent support of these activities will aid in ensuring that the aggressive NGNP licensing schedule will be met and that related risks will be properly managed.

1. INTRODUCTION

This study was conducted to identify the means by which licensing schedule risks can be minimized. The areas of risk addressed are (1) the regulatory process and logic, (2) project and engineering support of the schedule, and (3) NRC interactions, including pre-application programs and R&D coordination. Two major assumptions underlying the licensing strategy and schedule are (1) the availability of PBMR design and safety information and documentation and (2) the availability of a proven fuel supply for initial NGNP operation.

Stakeholder input on the above matters was obtained at a workshop that was conducted on January 22, 2008. The minutes of that workshop are included in Appendix A of this report. The licensing strategy described in this report is derived and has evolved from that workshop, and also from the strategy proposed during the pre-conceptual design stage [1]. This expanded licensing strategy is reflected in Section 2 (Licensing Risk-Reduction Results) and related action items are listed in Section 3 (Recommended Action Items).

2. LICENSING RISK-REDUCTION RESULTS

2.1 LICENSING RISK-REDUCTION WORKSHOP

A workshop was conducted in January 2008 to obtain licensing insights and recommendations from the other NGNP project participants: DOE, BEA, GA, Areva, and Entergy. The minutes which include a summary of results, a list of action items, and the presentation slides are presented in Appendix A. The consensus of the workshop attendees on the issues that were discussed is reflected throughout this report. Workshop action items that remain to be closed are included in Section 3.

2.2 LICENSING PROCESS OPTIONS, MILESTONES AND LOGIC

The pre-conceptual design stage studies of the NGNP project addressed whether the most appropriate licensing process would be based on 10 CFR Part 50 or 10 CFR Part 52 of the NRC regulations. The various vendor design teams, working separately during the pre-conceptual design stage, did not arrive at a consensus, as reported in the final report for that work [2]. At the January 2008 NGNP licensing workshop, it was agreed by the majority that the development of the licensing strategy would proceed assuming a 10 CFR Part 52 licensing process, based principally on (1) NRC recent experience and their familiarity with 10 CFR Part 52¹ and (2) the fact that potential commercial plant customers require the increased level of licensing assurance that is provided by 10 CFR Part 52. The basic regulatory characteristics of each of the envisioned licensing process steps are described in Section 2.2.1. Their application to NGNP is described in Section 2.2.2.

¹ NRC preference for using Part 52 is based in part on feedback from the DOE at the NGNP licensing workshop (Appendix A).

2.2.1 Part 52 Licensing Process Options

The basic elements of a licensing process using 10 CFR Part 52 (Early Site Permit - ESP, Design Certification - DC, Combined License² - COL, a Limited Work Authorization - LWA, and pre-application programs) were discussed at the licensing workshop including basic application content, the pros and cons of each element, and their application to the NGNP project.

A COL application, summarized in Sections 2.2.1.3 and 2.2.2.3, is the foundation of the NGNP licensing strategy. It is the most expedient means of obtaining regulatory approval based on pebble bed technology as applied to the specific site for the NGNP project. This approach addresses both the acceptability of the design and its application to a specific site in one process step, and is paralleled by Federal and State approvals of site issues. The ESP and LWA licensing options, also summarized below, are considered in the licensing strategy to enable further management of licensing schedule risk. As site selection, site data and construction schedule detail become available, additional assessments will be made to determine whether the envisioned schedule benefits of ESP and LWA applications will be necessary. As the NGNP ownership consortium develops, it may be beneficial to develop an ESP to progress organizational developments as well as technical requirements covered by the ESP. Coupling the LWA with the ESP may also be advantageous versus a standalone or COL-coupled LWA. These issues should be part of the early pre-application engagement with the NRC.

The basic content requirements of the ESP, DC, COL, and LWA applications are summarized in the following subsections. More detailed requirements and guidance can be found in the 10 CFR Part 52 regulations, Regulatory Guide 1.206 [8] and the Standard Review Plan [9].

2.2.1.1 Early Site Permit

The required content of an ESP application is described in 10 CFR §52.16 (general information) and §52.17 (technical information). According to §52.17, an application for an ESP must contain (1) a site safety analysis report and (2) a complete environmental report per

² Per 10 CFR Part 52, combined license means "a combined construction permit and operating license...."

§51.50(b). In addition, an ESP application may request that an LWA under §50.10 be issued in conjunction with the ESP. Guidance on the format and content of ESP applications is provided in the NRC Review Standard RS-002, "Processing Applications for Early Site Permits" [13] and "Environmental Standard Review Plan" [16].

Per §52.17, the site safety analysis report (SSAR) shall include:

- The number, type, and thermal power level of the facilities for which the site may be used,
- The anticipated maximum levels of radiological and thermal effluents for each facility,
- The type of cooling systems, intakes, and outflows that may be associated with each facility,
- The boundaries of the site,
- The proposed general location of each facility on the site,
- The seismic, meteorological, hydrologic, and geologic characteristics of the proposed site,
- The location and description of any nearby industrial, military, or transportation facilities and routes,
- The existing and projected future population profile of the area surrounding the site,
- A description and safety assessment of the site on which a facility is to be located,
- Information demonstrating that site characteristics are such that adequate security plans and measures can be developed,
- A description of the quality assurance program applied to site-related activities for the future design, fabrication, construction, and testing of the structures, systems, and components of a facility or facilities that may be constructed on the site, and
- An evaluation of the site against applicable sections of the Standard Review Plan (SRP) revision in effect 6 months before the docket date of the application.

The SSAR need not include material on emergency planning, but may include either (1) proposed major features of the emergency plans including contacts and arrangements made with Federal, State, and local governmental agencies and results thereof or (2) complete emergency plans and corresponding ITAAC. Any physical characteristics of the site that could pose a significant impediment to the development of emergency plans must also be described in the SSAR.

At the ESP stage, the environmental report shall include:

• A description of the proposed action, a statement of its purposes, a description of the

environment affected, and a discussion of, amongst other items, the impacts of the proposed action on the environment,

- An evaluation of alternative sites,
- A description of environmental effects of construction and operation necessary to determine whether there is a superior alternative to the proposed site,
- An analysis that considers and balances the environmental impacts of the proposed action, the impacts of alternative actions, and alternatives for reducing or avoiding adverse impacts,
- A description of the basis for evaluating environmental effects of fuel cycle activities for the nuclear power reactor, including Tables S-3 and S-4 of §51.51 and §51.52, respectively,
- An identification of the procedures for reporting and keeping records of environmental data and any conditions and monitoring requirements for protecting the non-aquatic environment,
- A list of the Federal permits, licenses, approvals and entitlements which must be obtained and the status of compliance with such requirements, and
- Identification of any adverse information, not only information supporting the proposed action.

The specific plant design need not be described at the ESP stage. An applicant may propose to use a plant parameter envelope (PPE) that covers a range of plant environmental considerations (e.g., see Reference [18]). Attachment 2 of the NRC Review Standard RS-002 [13] provides guidance on review of site safety assessments that include a PPE. Section 4.5 of this standard addresses the use of existing information from nearby facilities and the NRC expects that an application for an ESP will rely on previously filed site information to the extent feasible. The underlying assumption is that the information has previously been provided to and reviewed by the NRC. Additionally, the ESP applicant would need to demonstrate that the existing information is applicable to and appropriate for an ESP at the chosen site. In this regard, many types of information used for previous plants will need to be updated for the ESP, including but not limited to population estimates, socioeconomics, endangered and threatened species, and meteorology. Additionally, the ESP will need to account for changes in the environment, such as changes in surface water characteristics and flow. In short, the NRC will not blindly rely upon previous reviews, and will critically evaluate whether the previous reviews are still applicable and valid.

A complete environmental report (ER) is required per 10 CFR §51.50(b). However, under 10 CFR §52.21 and as stated in Section 2 of NRC Review Standard RS-002, consideration

of the need for power, as part of an applicant's ER, is not required at the ESP stage. In addition, consideration of alternative energy sources in the ER is not required at the ESP stage. As with the safety review, the application need not describe the specific plant design in the ER. Attachment 3 of the NRC Review Standard RS-002 provides guidance on review of ERs that include a PPE. In addition, NRC has recently stated [14] that it is in the process of revising its guidance for preparation of ERs [15] and its Environmental SRP [16].

The applicant is not required to describe emergency plans in the ESP application in which case emergency planning would be described in the COL application. If the applicant wants to address issues related to emergency planning prior to submittal of a COL application, pursuant to 10 CFR §52.17(a)(2), the applicant has two options relative to the level of detail of emergency plan information that is submitted. The applicant may fully describe the emergency plan, including complete and integrated information for review by the NRC, or the applicant may elect to propose major features of the emergency plans, in accordance with the pertinent standards of 10 CFR §50.47, and the requirements of Appendix E to 10 CFR Part 50, such as the size and configuration of the emergency planning zones. Regardless of the option chosen, the application needs to contain sufficient information to show that the proposed plans provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency at the site.

In accordance with 10 CFR §52.23, the Advisory Committee on Reactor Safeguards (ACRS) is provided a copy of the ESP application after the application is accepted for docketing. The ACRS reports to the Commission on those portions of the application that concern safety. Presentations are made to the ACRS during the NRC staff's review of the application and preparation of the Safety Evaluation Report (SER). The staff will include the ACRS report in the final SER, along with the staff's responses to the Committee's comments and recommendations.

Under 10 CFR §52.21, a hearing is required for an ESP application. The process is governed by 10 CFR Part 2. The process begins with public notice of the hearing and an opportunity to intervene, which is published in the Federal Register. Once the NRC staff has completed the SER and the EIS, the hearing is conducted. The Commission then issues its decision on the ESP/LWA application.

A discussion of the recommended ESP strategy for the NGNP project can be found in Section 2.2.2.2.

2.2.1.2 Design Certification

The primary benefit of pursuing DC for NGNP follow-on commercial designs is that it can provide NRC technical approval in advance of financial commitment to construct the plant – a benefit of major significance to potential commercial plant customers. According to §52.47 of NRC regulations, an application for DC must include:

- A Final Safety Analysis Report (FSAR), for which the detailed specifications are included in paragraph 52.47(a),
- ITAAC for the design to be certified,
- An environmental report per §51.55,
- A complete nuclear power reactor design which meets the requirements of §50.43(e) [requirements for applications that propose a nuclear reactor design that is significantly different from a light-water-reactor (LWR) design], and
- For a modular nuclear power reactor design, a description and analysis of the possible operating configurations of the reactor modules with common systems, interface requirements and system interactions, including restrictions during construction and startup of a module to ensure the safety of any operating module (see §52.47(c)(3)).

Not all of the information required by 10 CFR §52.47(a) needs to be provided at the time of the application, nor is it practical to do so. Much of the information is contained in separate technical reports that can be submitted to the NRC according to a schedule determined during the pre-application period. For example, the Mitsubishi US-APWR DC provides a recent example in which the applicant and the NRC worked together to arrive at a suitable submittal schedule for the required information. Mitsubishi referenced 12 topical reports that were submitted prior to the formal application and over 35 technical reports that are to be submitted incrementally over the course of the review. Prior to completion of NRC review, any *proposed* design material is to be replaced with detailed design information. Assumptions included in the application are then verified as appropriate for the final approved design. This submittal schedule allowed Mitsubishi time to complete the design during the actual review of the application and allowed Mitsubishi to include NRC review feedback without unnecessary re-design or re-analysis efforts. Such an approach may have merit for a commercial plant DC application that follows an NGNP COL

review, hence, the issue of which information is to be submitted in topical reports and technical documents and the appropriate timing for their submission needs specific discussion with NRC during the NGNP commercial plant DC pre-application period.

The DC review comprises two parts. The first part is a technical review consisting of a series of staff Requests for Additional Information (RAIs) and identification of open items that are described in the draft SER. In accordance with 10 CFR §52.53, the ACRS is provided a copy of the DC application after the application is accepted for docketing. The ACRS reports to the Commission on those portions of the application that concern safety. Presentations are made to the ACRS during the staff's review of the application and preparation of the SER. The staff will include the ACRS report in the final SER, along with the staff's responses to the ACRS comments and recommendations.

The second part is a rulemaking, which follows issuance of the SER, to certify the design. This rulemaking is conducted in accordance with 10 CFR §52.51 (which takes the place of the hearings conducted for ESP and COL applications) and culminates in the issuance of a DC rule for the specific certified design.

A discussion of the recommended DC strategy for the NGNP commercial plant projects can be found in Section 2.2.2.5.

2.2.1.3 Combined License

A COL is the centerpiece of the NGNP licensing strategy. It provides authorization for construction as well as confidence that, when the facility is constructed in accordance with the specified ITAAC, fuel load and startup can be conducted without delay. According to §52.79 and §52.80 of NRC regulations, a COL application that references an ESP must include:

- An FSAR, for which the detailed specifications are included in paragraph 52.79(a) and including:
 - A reference to the ESP and information to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the ESP,
 - A demonstration that the terms and conditions of the ESP will be satisfied by the date of the COL,

- New or additional information that updates or corrects emergency plans or major features thereof if such plans or features were included in the ESP,
- Proposed ITAAC, including those applicable to emergency planning,
- An environmental report in accordance with §51.49 and §51.50(c) if an LWA is requested in conjunction with the COL, and
- The information required by §50.10 if an LWA is requested in conjunction with the COL.

To facilitate NRC review, the COL can be submitted in two parts in accordance with 10 CFR §2.101. For example, if the COL application does not reference an ESP, Part 1 could include information similar to that required for an ESP application (i.e., environmental information) and Part 2 could include all remaining information required for a COL application (i.e., safety descriptions and operational programs). Part 2 would have to be submitted within 18 months of the submission of Part 1. While this two-part approach is permitted by the NRC, it does have some drawbacks. The amount of safety information required to be submitted along with the environmental portion in Part 1 is not insubstantial. Indeed, the NRC determined during review of the Part 1 submission made by Unistar for the Calvert Cliffs Unit 3 COL application that the interplay between the safety and environmental reviews was such that the docketing of the application was delayed. To date, only the Calvert Cliffs COL application has been submitted in two parts (8 months apart). All subsequent COL applications (eight applications through March 31, 2008) have been submitted in a single application.

Alternatively, if the COL applicant wants to request the Commission to conduct an early review and hearing and render an early partial decision on site suitability issues, it can submit its COL application in three parts per 10 CFR §2.101(a-1).

Detailed guidance on what is needed in the COL application is provided in Regulatory Guide 1.206 [8] and in the revised Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants [9]. Additional interim staff guidance has since been issued that provides clarifications on selected sections of RG 1.206 and/or the SRP:

- SRP Section 3.7.1, "Seismic Issues of High Frequency Ground Motion" (COL/DC-ISG-01),
- RG 1.206 Section C.IV.5.1, "Financial Qualifications of Applicants For Combined License Applications" (COL/DC-ISG-02),
- SRP Section 19, "Probabilistic Risk Assessment Information to Support Design

Certification and Combined License Applications," (COL/DC-ISG-03),

- RG 1.206 Section C.IV.6, "Limited Work Authorizations," (COL/ESP-ISG-04), and
- SRP Chapter 11, "Use of the GALE86 Code for Calculation of Routine Radioactive Releases in Gaseous and Liquid Effluents to Support Design Certification and Combined License Applications," (COL/DC-ISG-05).

A discussion of the recommended COL strategy for the NGNP project can be found in Section 2.2.2.3, including the applicability of the LWR documents listed above.

2.2.1.4 Limited Work Authorization

If the applicant desires to commence "construction" prior to receipt of a construction permit or COL, it must obtain an LWA. The LWA process allows applicants for and holders of ESPs and applicants for COLs to request approval to perform certain limited construction activities before the issuance of a COL. The NRC amended the LWA process in October 2007. The major change in the revised LWA rule is a change to the definition of construction, as set forth in 10 CFR §50.10(a). Under the revised rule, construction activities are defined as:

'the driving of piles, subsurface preparation, placement of backfill, concrete, or permanent retaining walls within an excavation, installation of foundations, or in-place assembly, erection, fabrication, or testing, which are for:

- safety-related structures, systems, or components (SSCs) of a facility, as defined in 10 CFR 50.2, "Definitions;"
- SSCs relied upon to mitigate accidents or transients or used in plant emergency operating procedures;
- SSCs whose failure could prevent safety-related SSCs from fulfilling their safety-related function;
- SSCs whose failure could cause a reactor scram or actuation of a safety-related system;
- SSCs necessary to comply with 10 CFR Part 73, "Physical Protection of Plants and Materials;"
- SSCs necessary to comply with 10 CFR 50.48, "Fire protection," and Criterion 3, "Protection and Reactivity Control Systems," of 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants;" and
- onsite emergency facilities, that is, technical support and operations support centers, necessary to comply with 10 CFR 50.47, "Emergency plans," and 10 CFR Part 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities.'

	NGNP and Hydrogen Production Preconceptual Design Study
NGNP-LP1 WEC-LIC	Licensing Risk Reduction Study

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Per NRC definition, construction does not include, and therefore an LWA, construction permit, or COL is not required for, the following:

- *'changes for temporary use of the land for public recreational purposes;*
- site exploration, including necessary borings to determine foundation conditions or other preconstruction monitoring to establish background information related to the suitability of the site, the environmental impacts of construction or operation, or the protection of environmental values;
- preparation of a site for construction of a facility, including clearing of the site, grading, installation of drainage, erosion and other environmental mitigation measures, and construction of temporary roads and borrow areas;
- erection of fences and other access control measures;
- excavation;
- erection of support buildings (such as, construction equipment storage sheds, warehouse and shop facilities, utilities, concrete mixing plants, docking and unloading facilities, and office buildings) for use in connection with the construction of the facility;
- building of service facilities, such as paved roads, parking lots, railroad spurs, exterior utility and lighting systems, potable water systems, sanitary sewerage treatment facilities, and transmission lines;
- procurement or fabrication of components or portions of the proposed facility occurring at other than the final, in-place location at the facility; or
- manufacture of a nuclear power reactor under a manufacturing license under Subpart F, "Manufacturing Licenses," of 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," to be installed at the proposed site and to be part of the proposed facility.'

In general, an LWA application must include:

- A safety analysis report, which includes (1) a description of the activities requested to be performed, (2) design and construction information required for portions of the facility within the scope of the requested LWA, (3) descriptions of the quality assurance program and fitness for duty program, and (4) site information (e.g., geology and seismology) applicable to the LWA activities,
- An environmental report per §51.49 which is in addition to the environmental report required by §51.50 for an ESP or COL application:
 - A statement of the activities proposed to be conducted and the need for those activities and
 - A description of the expected environmental impacts, corresponding proposed mitigation measures, and the basis for rejecting other mitigation measures, and
 - A plan for site redress should the work be terminated by the holder or upon revocation by the NRC.

Activities undertaken under an LWA are entirely at the risk of the applicant, and the redress plan would have to be implemented and completed within 18 months of the decision to not go forward with construction. However, since an LWA is required for only site safety construction, an LWA may benefit the construction schedule so long as the design and analysis has been advanced to the point of allowing NRC to conclude that the requested LWA work is acceptable. Additionally, if the LWA is to be submitted in conjunction with an ESP or a COL application, that intent should be stated to NRC at the same time that the applicant notifies the NRC of its intent to submit the ESP or COL application in order to reduce the risk of a schedule delay [14].

The NRC recently issued for comment new guidance on LWAs, "Interim Staff Guidance on Limited Work Authorizations."[14] Once finalized, this staff guidance is to replace the LWA guidance contained in Section C.IV.6 of Regulatory Guide 1.206. The Interim Staff Guidance provides detailed descriptions of each of the site preparatory activities that are either included as construction or excluded from construction. The guidance also provides clarification of what needs to be in the Environmental Report in order to support the NRC staff's review of an LWA application.

A complete LWA application can be submitted either as part of an ESP or COL or it can be submitted as a stand-alone application. Per 10 CFR §2.101(a)(9), if the LWA application is submitted in conjunction with an ESP application, the LWA application must be submitted as a complete application. If the LWA application is submitted in conjunction with a COL application, the COL application may be submitted in two parts. Part 1 must include the information required per 10 CFR §50.33(a)-(f) and at least the information required for an LWA application. Part 2 must include all other required information and must be submitted no later than 18 months after submission of Part 1. The recently issued Interim Staff Guidance on LWAs [14] provides detailed descriptions of what needs to be included in either a single or phased LWA application. Of the four ESP applications to date, three contained site redress plans and requested approval to carry out certain site preparation work and limited construction activities. Two of these LWA applications (Clinton and North Anna) were submitted with the initial ESP application. However, both the Clinton and North Anna ESPs were approved pursuant to the LWA rule that existed prior to the revision in October 2007, and therefore are of limited applicability to the NGNP project. Of the nine COL applications submitted through March 31, 2008, three (North Anna, Vogtle, and Grand Gulf) reference ESPs, of which the North Anna and Vogtle ESPs included requests for LWAs. Of the other six COL applications, none included requests for an LWA in their initial COL application.

A discussion of the recommended LWA strategy for the NGNP project can be found in Section 2.2.2.4.

2.2.1.5 Pre-application Program – Policy Issues

Engaging with the NRC in advance of a formal license application has been recognized as a useful tool to help manage schedule risks on a project. Pre-application discussions have been encouraged by the NRC as a means for all parties to familiarize themselves with the licensing processes, requirements, and issues that exist for a project, and to come to agreement on the project management activities necessary to achieve a timely and successful licensing project outcome. The basic goal of the pre-application program is that it yields a quality license application based on the pre-application agreements with NRC on the application contents. This "no surprises" approach is essential to match expectations and reality throughout the review process.

NRC regulation 10 CFR §2.101 covers the requirements and procedures for filing applications, including the opportunity for the prospective applicant to meet informally with the NRC staff before filing the application. The "pre-application" process was recognized in the 1980s as a valuable lessons-learned licensing strategy following the protracted licensing reviews that had occurred in the 1970's. In its Statement of Policy on "Regulation of Advanced Nuclear Power Plants," (initially published in 1986 at 51 FR 24643, July 8, 1986, and revised in 1994 at 59 FR 35461, July 12, 1994), the NRC noted:

'To provide for more timely and effective regulation of advanced reactors, the Commission encourages the earliest possible interaction of applicants, vendors, other government agencies, and the NRC to provide for early identification of regulatory requirements for advanced reactors, and to provide all interested parties, including the public, with a timely, independent assessment of the safety characteristics of advanced reactor designs. Such licensing interaction and guidance early in the design process will contribute toward minimizing complexity and adding stability and predictability in the

licensing and regulation of advanced reactors.'

Also:

'While the NRC itself does not develop new designs, the Commission intends to develop the capability for timely assessment and response to innovative and advanced designs that might be presented for NRC review. Prior experience has shown that new reactor designs – even variations of established designs – may involve technical problems that must be solved in order to ensure adequate protection of the public health and safety. The earlier such design problems are identified, the earlier satisfactory resolution can be achieved. Prospective applicants are reminded that, while the NRC will undertake to review and comment on new design concepts, the applicants are responsible for documentation and research necessary to support a specific license application, (NRC research is conducted to provide the technical bases for rulemaking and regulatory decisions, to support licensing and inspection activities, and to increase NRC's understanding of phenomena for which analytical methods are needed in regulatory activities.)

During the initial phase of advanced reactor development, the Commission particularly encourages design innovations that enhance safety and reliability (such as those described above) and that generally depend on technology that is either proven or can be demonstrated by a straightforward technology development program. In the absence of a significant history of operating experience on an advanced concept reactor, plans for innovative use of proven technology and/or new technology development programs should be presented to the NRC for review as early as possible, so that the NRC can assess how the proposed program might influence regulatory requirements.'

More recently, the ACRS and the NRC staff have re-affirmed the importance of establishing understandings with the NRC prior to submittal of license applications and the importance of pre-application meetings [3], [4]. Additionally, Section C.IV.7 of Regulatory Guide 1.206 recommends pre-application activities prior to submitting a COL application, and suggests the scope of such activities. In this instance it is important to note that PBMR (Pty) Ltd initiated a pre-application project in 2005 with NRC to achieve the intended outcomes noted above for their advanced, modular, high-temperature gas reactor design. As a result of this past experience and the current ongoing trend with LWR ESP and COL applications and the PBMR pre-application program, an NGNP pre-application program is viewed as a necessity for the NGNP license applications.

A discussion of the recommended pre-application strategy for the NGNP project can be found in Section 2.2.2.1.

2.2.2 Licensing Milestones and Logic

The basic elements of the licensing process were presented in the pre-conceptual design stage schedule in order to show their interfaces and estimated durations [5]. The goal of that work was to support an NGNP start-of-operation date in 2018. While that goal is further challenged due to the delay in the initiation of the conceptual design stage (from October 2007 to an assumed start date of October 2008), the primary tenet of the current licensing study is to support the earliest possible startup of NGNP.

The duration of the NGNP design and analysis effort, estimated during the preconceptual design stage to be 56 months, was retained in order to provide a schedule envelope for the supporting engineering milestones identified in this study. This period includes about 42 months for conceptual and preliminary design work plus 14 months for completion of the safety analysis. Based on input from the licensing risk-reduction workshop (Appendix A) and review of current NRC experience, it is estimated that the NRC technical review of the COL can be achieved in 36 months and that the subsequent COL public hearing process can be completed in 12 months or less. Based on the tenet of supporting the earliest possible NGNP startup date and the goal of engaging the NRC as soon as possible, it is proposed that an LWA application be submitted in conjunction with the ESP application (see Section 2.2.2.4 for detail), resulting in an approximate 9-month improvement in both the start of construction³ and subsequent completion of plant startup and testing. The time span estimated during the pre-conceptual design stage for completion of construction and plant startup of 40 months was retained for this study.

As discussed in the pre-conceptual licensing strategy [1] and the January 2008 licensing workshop, a DC program for the NGNP commercial plants is included and would run approximately concurrent with COL application review and plant construction and startup in order to benefit from the conclusions and precedents reached on the NGNP-specific design.

³ Actually, supplementing the ESP application with an LWA application could result in a much larger improvement in the start of ... construction (up to about 32 months) if the LWA were the only consideration. For NGNP, however, it is estimated at this time that construction should not start earlier than approximately nine months prior to receipt of the COL; nine months is about the time required for the maximum amount of construction on safetyrelated structures that can be accomplished under the envisioned LWA. It is also noted that the reactor vessel should arrive on site within several months of the start of construction. Hence, nine months is the largest practical improvement in the start of construction, resulting in a positive float of about 23 months (i.e., 32 months less nine months) between receipt of the LWA and the start of construction.

Each of the basic elements of the licensing process and their milestones and logic for the NGNP project are summarized below. One critical action that affects all of the following licensing process elements for NGNP is the timely establishment of the industry consortium, DOE funding, and organizational interfaces that create a qualified applicant that can support the ESP/LWA, COL, and DC programs.

2.2.2.1 NGNP Pre-application Programs

The need for pre-application programs with the NRC is historical and remains valid today, as summarized in Section 2.2.1.5. The NGNP licensing strategy includes a specific preapplication program for both the ESP/LWA and COL applications. In addition, the follow-on commercial plant DC program has its own pre-application stage.

The ESP/LWA pre-application program should begin well before the submittal of the ESP application and it is judged that 24 months would provide adequate time for discussion of major issues such as the use of previous NEPA evaluations.⁴ Allowing nine months to prepare for the pre-application program and 24 months for NRC interactions and preparation of the actual application means the pre-application program would start in May of 2009 and that the ESP application would be submitted about two years later. Allowing 25 months for NRC review (Table B-1, the FEIS and Safety Evaluation Report would be issued by the middle of 2013, and the LWA and ESP would be issued in the third quarter of 2014.

It is judged that the COL pre-application program should begin as soon as possible to ensure continuity of an overall program dialogue with NRC (e.g., as soon as a preliminary safety information document (PSID) can be prepared – which would be about August of 2010). Further, the COL pre-application program should last approximately 24 months beyond the end of the ESP pre-application program in order to allow adequate time for discussions of the NGNP program and COL schedule. This pre-application period would center on review of the PSID and would permit substantial discussions on potentially contentious issues which would, in turn, support the currently scheduled 36-month NRC technical review of the COL application. This

⁴ At an AP1000/ESBWR DC working group meeting on March 22-23, 2007, NRC identified 22 months as the optimum length for a pre-application environmental/siting review.

extended discussion would address, among other critical issues, the review and hearing schedule and the implementation of results from the predecessor Exelon and PBMR design certification pre-application programs (including the size of the EPZ), and correspondingly not be sidetracked by environmental issues that would be addressed in the ESP application. In short, the COL pre-application program should begin by about August of 2010, the COL application should be prepared and submitted by about May of 2013, and - allowing 36 months for technical review plus 12 months for hearings - the COL would be issued about May of 2017.

Similarly, for the commercial plant DC program, a pre-application duration of 24 months was assumed. The commercial plant design and analysis work and the pre-application program are scheduled to begin during the NRC technical review of the COL application to allow for feedback from the development of the DC application into the COL application review. Conversely, requiring the DC review to run approximately concurrently with the NGNP construction and startup work provides time for feedback from NGNP construction and startup into the DC program. Further, requiring the DC technical review to be completed no earlier than the end of NGNP startup and testing (December 2019), results in an NRC review duration about the same as that for the COL application and issuance of the corresponding DC rule by about December of 2020.

One required interface milestone for the initiation of the pre-application programs is:

• Identification of the organization(s) that will sign any correspondence to the NRC on the NGNP project by October 2008. This may be a consortium or an entity acting as a surrogate for the eventual consortium to progress the earliest engagement of the NRC.

2.2.2.2 NGNP Early Site Permit Application

The basic characteristics and contents of an ESP application are summarized in Section 2.2.1.1. While a COL is the heart of the NGNP licensing strategy and NRC regulations allow for the submittal of a COL application without referencing either an ESP or certified design, an ESP application (which can be supplemented by an LWA application) is included in the NGNP strategy because it presents the opportunity for (1) identifying the basic environmental and site safety issues and allows for beginning NRC review of those issues at an earlier point in time, thereby lessening the COL review burden on NRC staff, (2) identifying and resolving the issues

related to the start of site construction as soon as possible and (3) stimulating the resolution of project development and organizational issues. While an ESP application must include a site safety analysis report (SSAR), that SSAR can focus on siting information and present enveloping or postulated safety analysis information - with the detailed final safety analysis being presented in the subsequent COL application.

Another potential benefit of an ESP application for NGNP is that it could act as a content and procedural precedent for follow-on NGNP commercial plants. Each site will likely have its unique issues and the benefits of submitting an ESP application may in fact depend on the specific site selected.⁵ Nonetheless, resolution of gas-reactor ESP issues (e.g., see Table C-1) as part of the NGNP ESP application review would likely be generic and applicable to follow-on commercial plant sites.

It is judged that the benefits of the ESP and LWA applications would be more likely to occur if the ESP application were submitted six months or more before submittal of the COL application. If future detailed NGNP schedule discussions and early discussions with NRC make it apparent that these benefits are not likely, then the ESP and LWA applications could be dropped, the related safety and environmental material would be included in the COL application, and the LWA application could be submitted independently or with the COL application.

The principal steps in reviewing the ESP and LWA applications are shown in Figure 2-1 (a more detailed breakdown of the principal steps is provided in Appendix B). "Lessons Learned" from NRC review of three LWR pilot ESP applications [17]provide insights which should be reviewed and considered when preparing the NGNP ESP application.

Critical interface requirements and milestones for the ESP/LWA program are:

- Plant Parameter Envelope and site selection by May 2009,
- Decision, by June 2009, on whether the ESP will include either a detailed emergency plan, a description of the major features of the emergency plan or neither,
- Agreement with NRC on review schedule and required budget by October 2009,
- Final decision in regards to supplementing the ESP application with an LWA

⁵ For example, the benefits of an ESP application may be more significant if a "greenfield" or Gulf Coast industrial site were selected for NGNP than if NGNP were sited at an Idaho National Laboratory location for which some site characterization and evaluation has already been performed.

application by December 2009 and

- BEA and consortium input and guidance by December 2009 addressing:
 - o Site layout
 - o Seismic, hydrology, and meteorology characteristics
 - Nearby facilities and population profiles
 - Demonstration that adequate security plans can be developed
 - Description of the QA program to be applied to site-related activities
 - Identification of characteristics that could significantly impede the development of emergency plans and mitigating measures
 - Description of the Fitness for Duty program (if an LWA is included).

Corresponding critical documents and milestones are:

- Pre-application ESP/LWA specification agreement by March 2009,
- Environmental Report by March 2011,
- Site Safety Analysis Report by March 2011,
- Application submitted by June 2011,
- NRC Final Environmental Impact Statement issued by June 2013,
- NRC Final Safety Evaluation Report issued by August 2013, and
- ESP and LWA issued by September 2014.

Subsequent critical milestones are:

- Start of construction by August 2016 (this date depends not only on the receipt of the LWA, but also on the judged restriction that construction should start no sooner than about nine months prior to receipt of the COL in May 2017) and
- Arrival of the reactor vessel on site by about January 2017 (about five months after starting construction).

A complete evaluation of the specifications for an ESP application and the related submittals and schedule impacts should be performed in support of the ESP pre-application program. This includes the development of a detailed schedule of engineering commitments. In addition, to ensure that the schedule for all environmental matters is complete, it is recommended that an integrated plan be established for the preparation of all environmental permit applications and their approval by Federal and State agencies.

NGNP-LP1 WEC-LIC

NGNP and Hydrogen Production Preconceptual Design Study

Licensing Risk Reduction Study



Figure 2-1: NGNP Early Site Permit - Milestones and Logic

32 of 55

2.2.2.3 NGNP Combined License Application

The basic characteristics and contents of a COL application are summarized in Section 2.2.1.3. The COL application is the heart of the NGNP licensing strategy and its NRC review schedule is on the critical path for plant startup. The principal steps in the review of a COL application are shown in Figure 2-2 (a more detailed breakdown of each of the principal steps is provided in Appendix B).

Critical interface requirements and milestones for the COL program are:

- Final decision on the NHSS design conditions by May 2009,
- Consortium specifications, input and guidance on long lead equipment orders (e.g., reactor vessel) by September 2009,
- Agreement with NRC on review schedule and estimated budget by October 2009,
- Final decision on the Secondary Heat Transfer System (SHTS), Process Heat Plant (PHP), Power Conversion System (PCS) and Balance of Plant (BOP) conceptual designs by March 2010,
- PSID submittal by August 2010, and
- Placement of the reactor vessel manufacturing order by January 2010.

Corresponding critical documents and milestones are:

- Pre-application COL specification agreement by October 2010,
- Final Safety Analysis Report by December 2012,
- Application submitted by May 2013,
- NRC Final Safety Evaluation Report issued by May 2016, and
- NRC COL issued by May 2017.

The above milestones, in turn, lead to the following construction and startup milestones:

- Start of construction by August 2016 (this date depends not only on the receipt of the LWA, but also on the judged restriction that construction should start no sooner than about nine months prior to receipt of the COL. See Section 2.2.2 for more detail),
- Arrival of the reactor vessel on site by about January 2017 (about five months after starting construction),
- Fuel load permission by about February 2019 and
- Completion of NGNP startup and testing by about December 2019.

As with an ESP, a hearing on the COL application is required and is subject to all applicable procedural requirements contained in 10 CFR Part 2 (see §52.85). The requirements that must be satisfied for issuance for the COL are listed in §52.97.

Generic estimates for a COL application review and issuance are in the range of 44 to 60 months [12]. These estimates take new technology into account, but do not consider specific project factors such as synergy from the current PBMR US DC pre-application program and the regulatory considerations already documented for the MHTGR program of the 1990s and the Exelon PBMR program in the early-2000 timeframe. Hence, based on past documented experience and an extended pre-application effort, it is recommended that the NGNP licensing schedule retain an aggressive 48-month NRC review schedule (36 months for the technical review plus 12 months for the public hearing process) and then pursue achievement of that schedule to the greatest extent possible.

At this time, it is envisioned that the NGNP COL application would be submitted as a "complete" application in accordance with 10 CFR §2.101, principally to avoid the difficulties that occurred with the LWR Calvert Cliffs COL application (see Section 2.2.1.3), however, the option for submitting a two-part COL application should be retained pending future schedule studies and early discussions with NRC staff. In addition, if an ESP approach is not ultimately selected, but nonetheless an early NRC decision is desired on certain site suitability issues, a three-part COL application (see Section 2.2.1.3) can be considered so long as such an application would not encounter the same problems that caused the ESP approach not to be selected.

A complete evaluation of the specifications for a COL application and the related submittals and schedule impacts should be performed in support of the COL pre-application program. This includes the development of a detailed schedule of engineering and manufacturing commitments.

NGNP-LP1 WEC-LIC

Licensing Risk Reduction Study



Figure 2-2: NGNP Combined License Application – Milestones and Logic

2.2.2.4 NGNP Limited Work Authorization Application

The basic characteristics and contents of an LWA application are summarized in Section 2.2.1.4. An LWA is a schedule risk-mitigation option. Non-safety-related site preparation can proceed prior to issuance of an LWA or COL, but the start of construction on safety-related structures, described in Section 2.2.1.4, requires NRC issuance of a construction permit, a COL, or an LWA. Before an LWA can be granted, the related design and analysis (e.g., for the basemat and foundation) will have to be complete enough to support the corresponding NRC review. While an LWA can be submitted to NRC either by itself or in conjunction with an ESP or COL application,⁶ it is recommended that the LWA application be submitted either along with or as a supplement⁷ to the ESP application based on the goal of engaging the NRC as soon as possible on matters critical to the schedule.

While it appears most practical to submit the LWA application in conjunction with the ESP application, future schedule analysis and early discussions with NRC may show that the LWA schedule and the start of construction can be optimized by submitting the LWA application either independently or along with the COL application. A complete evaluation of the specifications for an LWA application and the related submittals and schedule impacts should be performed in support of the ESP/LWA pre-application program. This includes the development of a detailed schedule of engineering commitments a detailed review of the construction schedule.

2.2.2.5 Commercial Plant Design Certification

The basic characteristics and contents of a DC application are summarized in Section 2.2.1.2. Design certification of the NGNP follow-on commercial plants is critical to the commercial success of the NGNP program. As shown in Figure 2-3, design certification for

⁶ An LWA may be submitted concurrent with or following submittal of an ESP or COL application. Since a hearing is required, submitting the LWA application as early as possible is desired. This permits the hearing board the opportunity to establish an early hearing and finding on issues associated with the LWA request, while hearings on other, non-LWA issues may proceed at a later time.

⁷ The final decision on the timing of the LWA application will be based on detailed project schedule studies during the conceptual design stage. For this current study, it was judged (based on the availability of design and analysis information) that the LWA application could be submitted by May 2012, about one year after the ESP application.
NGNP follow-on commercial plants is scheduled to be conducted approximately concurrently with NRC review of the COL application and NGNP construction and startup in order to (1) benefit from the NRC technical review of the COL application and (2) allow for demonstration of NGNP performance prior to completion of the DC final technical review. This approach also allows for feedback from the DC program into the COL program in order to make the COL and NGNP the best possible demonstrators for follow-on commercial plants.

The more the NHSS portion of the commercial plant resembles the NGNP NHSS, the more efficient the commercial plant regulatory review schedule will be. Considering this and the need to review new information for the commercial plant (e.g., the site envelope), the commercial plant DC review time is expected to be about the same as that for the NGNP.

The principal steps in the development and review of the DC application are shown in Figure 2-3 (a more detailed breakdown of each of the principal steps is provided in Appendix B).

Critical interface requirements and milestones for the DC program are:

- Final decision on specific NHSS design features required for commercialization by December 2013,
- Agreement with NRC on review schedule and estimated budget by December 2014, and
- Final decision on corresponding PHP, PCS, and BOP features including boundary conditions around the design to be certified by December 2014.

Corresponding critical documents and milestones are:

- Pre-application DC specification agreement by November 2014,
- Final Safety Analysis Report by April 2016,
- Application submitted by August 2016 and accepted for review by October 2016,
- NRC Final Safety Evaluation Report issued by December 2019, and
- NRC DC rule issued by December 2020.

A complete evaluation of the specifications for a DC application and the related submittals and schedule impacts should be performed in support of the commercial plant preapplication program. This includes the development of a detailed schedule of engineering commitments.

NGNP-LP1 WEC-LIC

Licensing Risk Reduction Study



Figure 2-3: Commercial Plant Design Certification – Milestones and Logic

38 of 55

2.3 LICENSING SCHEDULE SUMMARY

The critical path to NGNP commercial operation includes NGNP design and analysis, NRC review of the COL application, and plant construction and startup. Figure 2-4 shows the basic elements of the NGNP licensing strategy (from Section 2.2.2) and the order in which they will be executed: NGNP design and analysis, the ESP/LWA program, the COL program, plant construction and startup and the commercial plant DC program. Each of the ESP/LWA, COL, and DC application submittals will be preceded by its own pre-application program.

As indicated in Section 2.2.2, it has been assumed that the NGNP conceptual design stage will be initiated in October of 2008 and will be immediately followed by the preliminary design stage. During the estimated 56-month time span from the beginning of conceptual design stage to the submittal of the COL application, the critical design and safety analysis work should be completed. For example, the NHSS design conditions should be finalized by about May of 2009, specifications for long lead components (e.g., the reactor vessel) should be established by about September 2009, long lead components including the reactor vessel should be ordered by about January 2010,⁸ and the analysis to support preparation of the LWA application should be completed by about May 2012.

The ESP/LWA preparation program starts in October of 2008 and the ESP and LWA are received from the NRC by about September of 2014. Receiving the LWA on this date provides about 23 months positive float relative to the earliest start of construction on safety-related structures (described below), which reduces the risk of delay in the start of construction due to unanticipated NRC review or public hearing issues. Likewise, the COL preparation program starts in May of 2009 and the COL is issued about May 2017. It is noted that the ESP/LWA and the COL pre-application programs start as soon as possible (about May 2009 and August 2010, respectively, as soon as initial planning can be completed) to ensure a continuous overall program dialogue with NRC and the earliest possible resolution of NRC review issues.

⁸ The January 2010 reactor vessel ordering date is based on the milestone that the reactor vessel should arrive at the construction site about January 2017 and the judgment that seven years is needed for manufacturing and shipping. Based on LWR experience, it is expected that a shorter manufacturing/shipping duration might be possible if plate material were used rather than forgings. Since NGNP design conditions (e.g., reactor vessel neutron fluence) will be different that those for LWRs, use of plate material for the NGNP reactor vessel should be investigated.

are:

For NGNP, the schedule proposed herein includes a 12-month span for site preparation and excavation prior to the start of construction on safety-related structures, which itself should occur no sooner than about nine months prior to receipt of the COL, that is, construction on safety-related structures should start no sooner than about August of 2016. The time span estimate for the portion of construction which occurs after receipt of the LWA plus the time span for plant startup is estimated to be 40 months. Hence, as summarized in Figure 2-4, it is estimated that the NGNP plant will be commercially operational (i.e., the start of operations that deliver products offsite) by the end of 2019, 135 months (11 years and 3 months) after the start of the conceptual design stage.

In addition to the licensing of the NGNP plant itself, the program strategy includes Design Certification for follow-on commercial plant projects. The commercial plant design and analysis work and the pre-application program are scheduled to be conducted concurrently with the NRC technical review of the COL application in order to allow for feedback from the development of the DC application into the COL review. The DC application is scheduled for submittal by about August 2016 and NRC acceptance for review by about October 2016, which would then allow potential commercial plant customers to submit a commercial plant COL application referencing the prospective certified design. Further, the requirement that the DC technical review be completed no earlier than the end of NGNP startup and testing (December 2019), results in issuance of the corresponding DC rule by about December of 2020.

The critical decision dates, assumptions and milestones necessary to support the schedule

- Start of the conceptual design stage by October of 2008,
- Program continuity throughout the conceptual design, preliminary design, construction and startup stages,
- Adequate and continuous funding commensurate with efficient commercial project execution practices,
- A final decision on the design conditions for the NGNP Nuclear Heat Supply system by about May of 2009,
- A final decision on the conceptual design of the remainder of the NGNP plant (SHTS, PHP, PCS and BOP) by about March of 2010,
- Required design and analysis documentation from the PBMR South African Demonstration Power Plant being available to support preparation of the NGNP COL application (2010 to 2012 time frame),
- Consortium and DOE support adequate to maintain review priority with the NRC,

- Reactor vessel ordering by about January 2010 and availability on site seven years later, about January 2017, and
- PBMR fuel available on site to support fuel loading by about February 2019.

While it is realized that the above schedule is more aggressive than the 2005 Energy Policy Act target, the linkage between activities in this study is logical, should yield shorter, more efficient execution durations, provides adequate time for all parties to perform their duties and capitalizes on learning and work from the PBMR demonstration program to the maximum extent. Thus, it should be viewed as reasonable and should be maintained as a management planning target until specific evidence or activities occur to invalidate the above underlying decision dates, assumptions or milestones. Furthermore, it is important to remember that the NGNP program is envisioned to be executed by a public-private partnership using modern industrial practices which constantly seek to optimize resource utilization and achieve the earliest times to market. The more aggressive schedule in this report also provides program float against the 2005 Energy Policy Act target for plant operation of September 2021, which should be considered the late date from a planning perspective.

NGNP-LP1 WEC-LIC



Figure 2-4: NGNP Estimated Licensing and Startup Schedule – Summary

42 of 55

2.4 CONTENT OF NGNP PRE-APPLICATION PROGRAMS

Properly planned and executed pre-application programs reduce licensing schedule risk. As summarized in Sections 2.2.1.5 and 2.2.2.1, NGNP pre-application programs are necessarily included in the licensing strategy in order to (1) establish common understandings with the NRC on the contents of the application to be submitted, (2) to address the most critical policy and technical issues and (3) to ensure that the initial application will be acceptable to the NRC staff for docketing.

2.4.1 Background

In the 1980s and early 1990s, the NRC conducted pre-application reviews of several proposed advanced reactor designs that aided in identifying major safety issues for which resolution required Commission policy guidance. Designs such as General Electric's Power Reactor Inherently Safe Module (PRISM) Liquid-Metal Reactor and the General Atomic MHTGR underwent extensive pre-application interactions with the NRC. In the case of the MHTGR, the NRC documented its review findings in NUREG-1338, *Pre-application Safety Evaluation Report for the Modular High-Temperature Gas-Cooled Reactor (MHTGR)*. The reviews conducted for the MHTGR, as well as similar reviews on other advanced reactors (notably, PRISM and the AECL CANDU 3 reactor designs) helped identify the policy issues associated with licensing advanced reactor designs.⁹

During 2001-02, Exelon undertook pre-application discussions with the NRC on the PBMR design as it was configured at that time. This effort is of special interest to the NGNP project since Exelon's program was aimed at essentially the same licensing process: a COL application followed by a DC program. Exelon's interactions included reviews of a proposed licensing approach as well as a series of white papers on legal and financial issues. Exelon summarized its pre-application discussions in a July 22, 2002 letter to NRC [6].

In 2005, PBMR (Pty) Ltd reviewed the Exelon pre-application issues as an initial starting

⁹ For example, see 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 (correction, April 28, 1993), and its associated Staff Requirements Memorandum, SRM-93-092, July 30, 1993.

point from which to identify the issues for discussion during the currently ongoing PBMR design certification pre-application period. The principal objectives for pre-application review of the PBMR design are to identify and clarify key technical and safety issues of particular importance to PBMR design certification and for the NRC to provide an assessment and feedback on the activities proposed by PBMR (Pty) Ltd for the identified issues. Specifically, the PBMR objectives for the results of the pre-application effort are to:

- Identify an acceptable approach to key issues unique to the PBMR design certification application,
- Identify any further development and testing that may be required for PBMR certification in the U.S.,
- Identify the potential benefits and challenges of generic NRC initiatives that are evolving in parallel with the PBMR activities and establish an appropriate program for addressing those issues,
- Early identification of any policy issues with the design certification of PBMR requiring Commission consideration, and
- Identify the required content for the design certification application (DCA) documents for an advanced high temperature gas reactor design.

Two pre-application phases were undertaken. During Phase 1 "Planning," PBMR (Pty) Ltd met with the NRC to discuss key focus areas and to identify a series of white papers that comprise substantive discussions on an agreed-upon list of specific topic, including technical, regulatory and policy issues pertinent to each topic. Phase 2 "Pre-Application Technical Discussions" is currently ongoing. During this phase, PBMR (Pty) Ltd is submitting the series of white papers identified during the Planning Phase and is engaging with the NRC in discussions on each of the focus topics. This PBMR pre-application experience is applicable to the NGNP project and is one of the justifications for an NGNP licensing review schedule that is shorter than generic estimates.

In conclusion, both the previous Exelon COL/DC pre-application program and the currently ongoing PBMR (Pty) pre-application program provide the bases for resolution of related issues on the NGNP project.

2.4.2 NGNP ESP Pre-application Program

The most significant objectives of the ESP pre-application program are (1) the initiation of NGNP overall licensing strategy discussions with NRC staff and (2) the initiation of

discussions on environment-related technical and policy issues that could significantly impact the development of a successful ESP application, whose centerpieces will be the required Environmental Report and safety analysis of the site. As indicated in Section 2.4.1, there is significant history on issues related to gas reactor licensing and a summary list of those issues is provided in Appendix B. The most significant of those historical issues and NGNP-specific issues which should be placed on the "fast track" for discussions with the NRC are:

- Reviewing, updating, and reliance on previous reviews of the NPR site at INL and
- Concurrence on the process steps and schedule for review of the application, including impacts of an LWA.

Future actions required to implement the ESP pre-application program include:

- Initiate the NGNP conceptual design stage by October 2008,
- Complete site selection and establish the Plant Parameter Envelope by about May 2009, and
- Initiate discussions with the NRC by about May 2009, indicating the intent to submit an LWA application.

2.4.3 NGNP COL Pre-application Program

The most significant objective of the COL pre-application program is to initiate discussions on specific technical and policy issues that could significantly impact the development of a successful COL application. As indicated in Section 2.4.1, there is significant history on issues related to gas reactor licensing and a list of those issues is provided in Appendix C. Based on that experience and the current concerns identified by NGNP Team members [7], the following issues should be addressed with NRC on a "fast track" schedule:

Possible Policy Issues:

- Concurrence on the process steps and schedule for review of the application,
- Use of Risk-Informed, Performance-Based Licensing Framework
 - Use of PRA for Advanced Reactor Licensing
 - Selection of Licensing Basis Events
 - o Structures, Systems, and Components (SSCs) Classification
 - o Defense in-Depth severe accident (beyond design basis) definitions,
- Design Basis Threats from External Events
 - o Reactor Building Requirements
 - o Effects of reactor embedment

- Aircraft crash requirements for passive non-LWRs,
- Applicability of requirements of 10 CFR Part 50 for HTGRs, (e.g., General Design Criteria; Appendix K),
- Containment performance requirements for HTGRs, including considerations for filtered, vented concept,
- Establishment of an Emergency Planning Zone of less than 10 miles for HTGRs, and
- Regulatory separation of collocated nuclear and industrial facilities under NRC and EPA jurisdiction

Technical Issues:

- Identification of mechanistic source term for HTGR,
- Significance of air ingress on large or small break design basis accidents and beyond design basis events,
- Required Test Programs for qualification of fuel and materials for operating, abnormal, and accident conditions
 - Fuel Qualification and Manufacturing Assurance
 - o Graphite
 - o High temperature metallic materials in safety function services,
- Classification of Structures, Systems, and Components for a HTGR design and establishment of special treatment requirements for passively safe reactors,
- Methods for verification and validation of analysis methods and required test programs as part of the V&V program,
- Reliability Integrity Management Program for HTGR components,
- Applicable Industry Codes and Standards for HTGR design,
- Human Factors design guidance for reactors with slowly evolving transients and accidents,
- Establish application specification for HTGRs (analog to RG1.206 and NUREG-0800), and
- Establish an integrated Regulatory Technology Development Plan (RTDP) which will serve to ensure that the PBMR and NGNP technology development programs satisfy regulatory requirements. Note: the NRC may determine its own need to conduct selected R&D that will independently confirm Westinghouse NGNP Team results.

Administrative Issues:

- Agree on the schedule for the ESP, LWA and COL technical reviews and public hearing process,
- Schedule the submittal of supporting Topical Reports and reference documents and
- Agree on the means of coordination with and use of results from previous HTGR reviews, including at least the Exelon PBMR program and the ongoing PBMR US DC program.

Future actions required to implement the COL pre-application program include:

- Initiate the NGNP conceptual design stage by October 2008,
- Decide on design conditions for the NGNP NHSS by about May 2009, and
- Develop a PSID which can be submitted to the NRC by approximately August 2010 for the purposes of initiating NGNP pre-application discussions.

2.4.4 NGNP Commercial Plant DC Pre-application Program

The most significant objective of the commercial plant DC pre-application program is to initiate discussions on specific technical and policy issues that could significantly impact the development of a successful DC application. As indicated in Section 2.4.1, there is significant history on issues related to gas reactor licensing and a summary list of those issues is provided in Appendix B. The most significant of those historical issues and NGNP-specific issues which should be placed on the "fast track" for discussions with the NRC are:

- Concurrence on the process steps and schedule for review of the application,
- Operator staffing for multiple modular reactors,
- Integrated risk, and
- Issuance of a design certification safety evaluation report prior commercial operation of the NGNP

Future actions required to implement the DC pre-application program include:

- Initiate the NGNP conceptual design stage by October 2008,
- Decide on specific NHSS design features required for commercialization by December 2013,
- Initiate preparation of the DC application by about May 2014, and
- Begin discussions with the NRC by about September 2014.

2.4.5 NGNP Pre-application Program Summary

While the Exelon PBMR pre-application program was not carried to completion, their discussions on COL- and DC-related issues provided significant bases for staff positions on the similar PBMR design certification pre-application and NGNP project issues.

In a similar manner, the currently ongoing PBMR pre-application program provides the basis for resolution of related issues on the NGNP project and is one of the major reasons why the NGNP project schedule can be met. Based on this synergy and the importance of getting the NGNP to commercial operation at the earliest possible date, it is recommended that discussions

with the NRC on NGNP pre-application programs be initiated as soon as possible and that the PBMR pre-application issues already under discussion with the NRC be accelerated to the NGNP fast-track schedule.

2.5 BOUNDARY BETWEEN SAFETY AND NON-SAFETY PORTIONS OF NGNP

In regards to licensing and regulatory oversight, the NGNP project presents the issue of defining a boundary between the Nuclear Heat Supply System (NHSS) and the remainder of the plant, which includes the Secondary Heat Transfer System (SHTS), the Process Heat Plant (PHP), the Power Conversion System (PCS) and the Balance of Plant (BOP). Whereas the NRC has the regulatory lead over the NHSS and other parts of the plant that impact NHSS safety, it will be necessary to determine which parts or functions of the SHTS, PHP, PCS and BOP impact NHSS nuclear safety and hence are under regulatory oversight by the NRC and which parts or functions should be subject to regulatory oversight by other governmental agencies. Interface requirements between the safety-related and non-safety-related portions of the plant will need to be established. The objective would be to create a boundary between portions of the plant. The NRC has indicated its willingness to consider licensing only the "reactor," which would include analysis of all external threats, as discussed with the ACRS [10]. Figure 2-5 shows a conceptual boundary between safety-related structures, systems, and components (SSCs) of primary interest to the NRC and the remainder of the plant.



Figure 2-5: Conceptual Approach to NGNP Regulatory Boundary

The NGNP project will implement a risk-informed, performance-based approach to the design and safety analysis process to provide assurance that safety-related SSCs and their functions are properly identified (see the presentation slides included in Appendix A for more detail). SSCs are classified as either safety-related or non-safety-related, where safety-related means they have special treatment requirements to assure their accident mitigation capability and their accident prevention reliability. "Non-safety-related" means that those SSCs can be designed using non-nuclear conventional methods. This classification of SSCs drives the design, procurement, and operational requirements during future project stages and is critical to both plant safety and plant cost. While it is recognized that compliance with safety and regulatory requirements is paramount to the success of NGNP, it is also recognized that significant costcontrol benefits can be obtained by minimizing the number of safety-related SSCs. Further, identifying a clear boundary between safety and non-safety SSCs would allow the implementation of cost-effective structural design and construction techniques (e.g., concrete structures and modularization for safety-related SSCs and steel structures and modularization for non-safety-related SSCs).

Nonetheless, it is realized that NRC will review those portions of the non-safety-related design that impact safety. Examples of non-safety-related designs that impact safety include, but are not limited to, fire protection, security features, radwaste systems, and electrical power systems. The industrial portions of the plant, however, will be subject to only the standard regulatory oversight for the industrial application linked to the NHSS.

In summary, there should be a clear demarcation among: (1) the safety-related SSCs within the NRC review of the Nuclear Heat Supply System, (2) those non-safety-related SSCs that have a function supportive of safety or whose failure could impact safety and (3) those SSCs in the non-safety-related portion of the plant which would not be subject to routine NRC regulatory review and oversight, following initial licensing reviews, to assure there is no material safety relationship. For NGNP it is envisioned that (1) the NRC would license the NHSS (the left side of Figure 2-5) including assurance that proper interface requirements had been provided against all hazards from outside the NHSS and, therefore, (2) the portion of the plant outside the NHSS (the right side of Figure 2-5) would not be subject to NRC regulatory review and oversight following initial licensing reviews so long as the interface requirements were met.

Once the regulatory boundary is defined, it will be necessary to evaluate the relationship

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of this boundary to the plant security boundary, considering the specific design basis threats. In addition, the boundary may be different for the follow-on commercial plants relative to the NGNP as a result of different arrangements and functions of SSCs outside the NHSS licensing boundary.

This issue will be addressed further during the NGNP conceptual and preliminary design stages. Specific related tasks which will be addressed include:

- Engineering and analysis to:
 - Identify NGNP LBEs
 - Classify SSCs
- Identification of potential "cross over" regulations [11], e.g., those related to:
 - Control of both plants from a single control room and the need for remote shutdown capability for the non-safety-related portions of the plant
 - Protection of nuclear plant personnel from specific external hazards coming from the non-safety-related portions of the plant
 - Limitations on radioactive releases and
- Discussion with the NRC during the COL pre-application program.

The design and safety requirements that result from the above actions should be specified in such a manner that they become precedents for follow-on NGNP commercial plants.

3. RECOMMENDED ACTION ITEMS

The licensing strategy should be further developed, including the activities listed below. The first five action items are considered to be the most important because they have significant impact on the licensing schedule and management of related risks; they should be initiated as soon as possible. The remaining action items are required for the development of effective project plans and, while not as critical as the first five actions, should be initiated during the NGNP conceptual design stage. Each action item below includes a parenthetical reference to the source of the action item in this report.

- 1. Initiate NGNP discussions with the NRC and advance the currently ongoing PBMR preapplication discussions onto a fast-track schedule (*Section 2.4.5*) including:
 - 1.1 Establish a process for obtaining firm NRC commitments ("approvals") that carry more precedence than "general understandings" this may entail the identification and early submittal of a limited set of "topical reports" in advance of the COL and/or ESP applications such topical reports already receive formal NRC review and approval under established procedures (*Appendix A, Action Item 7*),
 - 1.2 Engage with NRC and get written down the pre-application process that could be used for NGNP (*Appendix A, Action Item 8*),
 - 1.3 Initiate early engagement with the NRC on the issue of regulatory requirements applicability or "gap" analysis (*Appendix A, Action Item 9*),
 - 1.4 Identification of potential "cross over" regulations (Section 2.5),
- 2. Develop license application specifications and detailed commitment schedules for support of the ESP/LWA, COL and DC applications and their pre-application programs (*Section 2.2.2*),
- 3. Establish an integrated Regulatory Technology Development Plan which is mutually agreed with by the NRC and which will serve to ensure that the related NGNP technology development programs satisfy regulatory requirements (Section 2.4.3),
- 4. Integrate the fuel qualification program schedule with the NGNP integrated licensing schedule, including examination (with BEA) of the differences in fuel design qualification and manufacturing assurance programs for each fuel type to see whether there are basic differences in licensing schedules or logic (*Appendix A, Action Item 6*),
- 5. Establish the industry consortium, DOE funding, and organizational interfaces that create a qualified applicant that can support the ESP/LWA, COL and DC programs (*Section 2.2.2*),

- 6. Establish an integrated plan for the preparation of all environmental permit applications and their approval by Federal and State agencies (Section 2.2.2.2),
- 7. Evaluate the policy and schedule implications of the existing LWR Tier 1/Tier 2 construct when used with the HTGR fuel designs (*Appendix A, Action Item 5*),
- 8. Monitor/communicate industry position on DBT/aircraft crash rulemaking relative to NGNP licensing strategy. Identify areas of departure between LWR and HTGR approaches having impact on NRC rulemaking (*Appendix A, Action Item 10*),
- 9. Establish whether there are non-NRC policy issues, e.g. of EPA concern (Appendix A, Action Item 11),
- 10. Provide clarification of position vis-à-vis the NRC current list of policy issues for non-LWRs (Appendix A, Action Item 12),
- 11. Review list of PBMR white papers for highlighting by the industry consortium (*Appendix A*, *Action Item 13*), and
- 12. Ensure engineering design and analysis programs specifically address the work needed to establish the regulatory review and oversight boundary (*Section 2.5*).

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- [13] "Processing Applications for Early Site Permits," NRC Review Standard Change Notice

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- [18] "Resolution of Early Site Permit Topic 6 (ESP-6), Use of Plant Parameter Envelope (PPE) Approach," NRC letter to the Nuclear Energy Institute, dated February 5, 2003.

APPENDICES

APPENDIX A: MINUTES AND PRESENTATION SLIDES FOR THE LICENSING RISK-REDUCTION WORKSHOP

NGNP Workshop -Licensing Risk Reduction

January 22, 2008





Westinghouse NGNP Team



I.A - Agenda Review:

Ι.	8:30 - 8:45	Introduction
II.	8:45 – 9:05	Project Schedule and Alliance Strategy (BEA)
III.	9:05 – 9:20	Advantages of Part 52 vs. Part 50
IV.	9:20 – 10:35	Part 52 ESP/LWA/COL/DC Application Strategy Options and Schedule
$ \rightarrow $	10:35 – 10:45	Break
V.	10:45 - 11:00	Status of Licensing Strategy Development by DOE-NRC Working Group (DOE)
VI.	11:00 - 12:00	NGNP Pre-application Program Scope
	12:00 – 12:45	Lunch – Catered
VI	12:45 – 2:30	NGNP Pre-application Program Scope
VĮI.	2:30 - 3:00	NGNP Licensing Schedule
	3:00 - 3:10	Break
VIII.	3:10 – 4:00	Considerations in Establishing the DC Licensing Boundary
IX.	4:00 – 4:15	Coordination with DOE-NRC Licensing Strategy Development Working Group
Х.	4:15 – 4:30	Closing

NGNP Licensing Workshop - January 22, 2008





- I.B Logistics
 - Safety topic
 - Safety exit
 - Restrooms
 - Internet access and laptops
 - Phone calling, copying, and faxing





- I.C Overview of Licensing Risk-Reduction Study
 - Conduct Licensing Workshop
 - Establish Content of NGNP Pre-application Program
 - Advance NGNP Licensing Strategy
 - Propose Licensing Milestones and Logic
 - Revise Licensing Schedule
 - Support DOE-NRC Licensing Strategy Development





- I.D Workshop Objectives:
 - Gain an improved mutual understanding of the drivers, issues, options, prerequisites, and schedules for the NGNP licensing strategy.
 - Review bases for and concur on use of Part 52.
 - Get BEA's input on establishment of the licensing boundary.
 - Identify issues necessary to be resolved for a final licensing strategy.





- I.E Workshop Discussion Format:
 - 1. Issue or question to be answered
 - 2. Background information, what we think we know, or possible answer
 - 3. Discussion
 - 4. Summary of discussion, including options and conclusions
 - 5. Action items or path forward





II. Project Schedule and Alliance Strategy

• 20-minute discussion





III. Advantages of Part 52 vs. Part 50

- Question:
 - Should NGNP be licensed through a Part 50 or Part 52 process?
- Background:
 - BEA PCDR indicates lack of concurrence on use of Part 52, for example:
 - Section 7.3 Licensing Conclusions
 - Appendix C Licensing paper; Executive Summary
 - Skip to next section on Part 52 options, or
 - Reconsider and update
 - Part 50 drivers (following slide)
 - Part 52 drivers (following slide)





III. Advantages of Part 52 vs. Part 50...

Part 50 Drivers (partial list):

Pros:

- Well-known process
- Could potentially start regulatory review with less design detail than for a Part 52 application.
- NRC can issue a construction permit prior to completion of separate effects tests.

Cons:

- Exposed to NRC review and public hearings at both CP and OL stages
- Not known if past experience would be applicable today.
- NRC would require more detail at the CP stage today vs. past experience.





III. Advantages of Part 52 vs. Part 50...

Part 52 Drivers (partial list):

Pros:

- Reasonably well understood.
- Avoids exposure to dual NRC reviews and public hearings.
- NRC strongly favors the Part 52 process for new reactors.
- Uses pre-application to sort out HTGR requirements and key issues
- Design safety can be reviewed through either a DC or COL application.
- Potential commercial plant customers want the security of NRC approval prior to commitment to construction funding.

Cons:

- Not proven for an HTGR design.
- Review time required by NRC may be longer than for a Part 50 CP.
- May require more complete design and licensing submittals than for Part 50 to start construction.





III. Advantages of Part 52 vs. Part 50...

• Discussion:

• Summary:

• Action Items:





IV. Part 52 – ESP/LWA/COL/DC Options and Schedule Impacts

- Issue: Identify and evaluate various options available under Part 52 leading to COL for NGNP and DC for the commercial plant
- Background to be addressed on following slides:
 - IV.A Licensing schedule as part of the integrated project schedule
 - IV.B ESP application
 - Contents
 - Pros and cons
 - IV.C Limited Work Authorization (LWA) application
 - Contents
 - Pros and cons
 - IV.D DOE/BEA support of ESP and LWA applications
 - IV.E DC application (commercial plant)
 - Pros and cons
 - Schedule impacts
 - DC concurrent (in parallel) with COL
 - DC starting during COL review (short lag)
 - DC starting after COL review (long lag)
 - IV.F Prismatic Design DC and COLA Timing





IV. Part 52 – ESP/LWA/COL/DC Options and Schedule Impacts ...

IV.A - WEC PCDR project schedule:



NGNP Licensing Workshop - January 22, 2008

Slide 13





- IV.B ESP application:
- ESP content:
 - Shall include Site Safety Analysis Report (SSAR):
 - Facility characteristics and site layout
 - Seismic, hydrology, and meteorology characteristics
 - Nearby facilities and population profiles
 - Safety assessment of structures, systems, and components (SSCs) that bear on site acceptability in regards to radiological consequences
 - (continued on next slide)





- IV.B ESP application...
- ESP content...
 - Shall include Site Safety Analysis Report (SSAR).....
 - Demonstration that adequate security plans can be developed
 - Description of the QA program to be applied to safety-related activities
 - Evaluation against applicable sections of the Standard Review Plan
 - Identification of characteristics that could significantly impede the development of emergency plans and mitigating measures.





- IV.B ESP application...
- ESP content...
 - SSAR <u>may</u> propose:
 - Major features of Emergency Plans including:
 - arrangements with Federal, State, and Local officials
 - **OR:** Complete and integrated Emergency Plans, including:
 - corresponding ITAAC
 - arrangements with Federal, State, and Local officials
 - Shall include complete Environmental Report per 10 CFR 51.50(b)
 - May include a Limited Work Authorization (LWA)




- IV.B ESP application...
- Pros:
 - An ESP could allow the NRC to begin its review for NGNP earlier than if site issues were covered in the COL application.
 - An ESP for NGNP would be a content and procedural precedent for follow-on NGNP commercial plants.

- Cons:
 - If ESP application cannot be submitted at least six months prior to the COL application, there will likely be little or no benefit to an ESP.





- IV.C Limited Work Authorization (LWA) application (for work on safety-related structures)
- LWA content:
 - Activities requested to be performed
 - Design and construction information for scope of LWA
 - Safety analysis of the site and design as it pertains to LWA scope; and description of Fitness for Duty and QA programs for LWA activities.
 - Environmental report per 10 CFR 51.49
 - Activities proposed under the LWA
 - Statement on need for those activities
 - Environmental impacts and mitigation measures
 - Plan for site redress if LWA dropped or not permitted to go forward





- IV.C Limited Work Authorization (LWA) application...
- Pros:
 - Authorization is required for construction work with a reasonable nexus to safety or security, for example:
 - Pile driving,
 - Foundation work,
 - Concrete placement
 - An LWA for "safety-related" site preparation may benefit the construction schedule, so long as the safety analysis has advanced to the point of allowing NRC to conclude that such work is acceptable.

- Cons:
 - In the revised regulation, "non-safety" site preparation work no longer requires NRC approval, for example:
 - Clearing,
 - Grading,
 - Temporary and service buildings,
 - Excavation,
 - Fabrication of components





- IV.D DOE/BEA support of ESP and LWA applications
- ESP and LWA applications would require input and/or agreement from DOE/BEA in the following areas:
 - Site layout
 - Seismic, hydrology, and meteorology characteristics
 - Nearby facilities and population profiles
 - Demonstration that adequate security plans can be developed
 - Description of the QA program to be applied to safety-related activities
 - Identification of characteristics that could significantly impede the development of emergency plans and mitigating measures
 - Emergency plans
 - QA program
 - LWA activities and site redress plan
 - Safety analysis of LWA activities
 - Fitness for Duty program





WEC PCDR Licensing Schedule Relative to PBMR Pre-Application Program



WEC PCDR Estimates: --Pre-application phase (~56 months duration) --Early Site Permit (~21 months review)

-Combined License (~36 months duration)

PBMR DC PRE-APP REVIEW

NGNP ENGR & PREL SAFETY ANALYSIS

NGNP ESP / LWA PRE-APP REVIEW

NGNP ESP / LWA REVIEW

NGNP COL PRE-APP REVIEW

NGNP COL REVIEW





- IV.E DC application (commercial plant):
- Pros:
 - Establishes early
 precedent for NGNP
 commercial plants.
 - Has value independent of NGNP.

- Cons:
 - Additional effort to establish design for site parameters.





IV.E... DC + COLA Timing Options

NGNP OPTIONS FOR TIMING OF DC AND COL APPLICATIONS



Slide 23





• IV.F - Prismatic Design - DC and COLA Timing

Licensing strategy and timing for a prismatic design





• Discussion:

• Summary:

• Action Items:





V. Status of DOE-NRC Strategy Working Group

• 15-minute discussion





• VI.A - PBMR DC Pre-application Status

- Question: What is the value of ongoing PBMR Design Certification pre-application program?
- Background:





*Schedule as of September 2007

ID	Task Name	2006	2007	Ord	2008	0++ +	2009	2010	
1	Preapplication Phase 1 Planning			Gal 4		Gar	Logond		
5	Preapplication Phase 2 Interactions					ų.	Legend		
6	Familiarization Session #1			1			Substan	ntial Gene	ric Value
7	Familiarization Session #2								
8	Licensing Approach	200000000000000000000000000000000000000					Contribu	uting valu	Ie
9	Submit WP on PRA Approach	۲	Submitted			L			
10	Submit WP on LBE Selection	۲		T					
11	Submit WP on SSC Classification	۲	Submitted						
12	Submit WP on Defense-in-Depth Approach		Submitted						
13	NRC Meeting on Licensing Approach	۲							
14	Fuel								
15	Submit WP on Fuel Performance Envelope and Test Program			•	Submitted				
16	Submit WP on Radionuclide Release from the Fuel			1	•				
17	Codes & Standards		*********						
18	Submit WP on Metallics			٠	Final Review				
19	Submit WP on Ceramics				•				
20	Submit WP on Reliability Integrity Management Program				•				
21	Submit WP on Electrical and I&C Systems			1	•				
22	Safety Analysis Codes V&V		9//////////////////////////////////////			Collecters)		on and an and the section of section of the section	
23	Submit WP on EM Development and Assessment Process			4	Submitted				
24	Submit WP on PIRT Comparisons			•					
25	Submit WP on PBMR Test Program			•					
26	Submit WP on Systems Response Modeling			•					
27	Submit WP on Fuel Response Modeling			1	•				
28	Submit WP on Source Terms, Releases Modeling				•				
29	Application Framework Definition			1					
30	Submit WP on Design Certification Application Specification			•					
31	Submit WP on Single vs. Multi-Module Certification				•				
32	Submit WP on Physical Security Protection by Design				•				
33	Application Preparation								
34	PRA Development								
35	QAPD Development]				
36	FSAR Development								Team
37	Application Submittal and Review		_				•		i cum



VI.A - PBMR DC Pre-application Program

Exelon / Other Issues List:

Technical Items that exclude owner issues:

- Fuel Design and Qualification
- Materials Qualification, Codes and Standards
- Analytical Codes V&V
- Core Design and Heat Removal
- Air and Water Ingress
- Radiological Source Term
- In-service Inspection / Testing

Additional HTGR Issues that are generic that PBMR will engage in with Industry

- Containment
- Prototype Testing
- Security
- Licensing Approach / Framework
 - Deterministic and Probabilistic processes
 - Regulatory Guide Compliance
 - Identification of new RG for HTGR
 - New policy or rulemakings needed



Gray = In PBMR work Blue = Other Potential NGNP Work



VI.A - PBMR DC Pre-application Program

Exelon / Other Issues List:

Other issues dealt with by Exelon that are of interest to owners and should be brought to the NRC by Utility Owners include:

- Decommissioning Funding
- Anti-Trust Reviews
- Decommissioning Cost
- Fees
- Multi-module License Type / Durations
- Operator Staffing
- Price Anderson Insurance
- Fuel Cycle and Transportation

Issues raised by Exelon that are not being addressed:

- Safeguards
- Control Room Design
- Operational Modes and States
- Control Room HFE / Staffing
- Spent Fuel Characteristics





- Benefits of PBMR Pre-application to NGNP:
 - Earlier NRC Staff development and education on HTGR design
 - Many key technical issues put on the table that benefit the HTGR community and NGNP testing and licensing work
 - Regulations and supporting practices of NRC get substantially tested against a real design
 - policy and exemption requirements defined early
 - licensing framework substantially established
 - Many topical reports could be applicable to NGNP
 - The PBMR DC application specification would be the basis for writing the NGNP applications
 - Accelerate NGNP engagement with NRC to a schedule supporting the 2018 operation date for NGNP





VI.B - NGNP ESP with LWA Pre-application

- Issue:
 - Identify critical-path pre-application issues and engineering prerequisites.
- Background:
 - Site selection
 - Confirm INL as site for Conceptual Design phase
 - Confirm availability of site characterization data
 - Outline ESP / LWA content
 - Site safety analysis report
 - Required content
 - Emergency planning (optional)
 - Environmental report
 - LWA request & redress plan
 - NRC format & content guidance for ESP/LWA
 - 10 CFR 52.17, 50.10, 51.45-51.50
 - Environmental SRP (NUREG-1555)
 - NRC Review Standard #RS-002
 - LWR ESP lessons learned





VI.B - NGNP ESP with LWA Pre-application....

- Discussion:
- Summary:
 - Critical path issues
 - Engineering prerequisites
- Action Items:





- Issue:
 - Identify critical-path pre-application issues and engineering prerequisites
- Background:
 - Design to be certified
 - Nuclear heat source system and building
 - Design input and issue resolutions from PBMR US DC program
 - NGNP-specific issues
 - Fuel qualification
 - Design of Intermediate Heat Exchanger
 - Site hazards
 - NRC format and content guidance
 - 10 CFR 52.47
 - RG 1.206
 - NRO Instruction #NRO-REG-100, Acceptance Reviews, dated 9/26/07
 - Standard Review Plan (NUREG-0800)





VI.C - NGNP DC Pre-application....

- Discussion:
- Summary:
 - Critical path issues
 - Engineering prerequisites
- Action Items:





- Issue:
 - Identify critical-path pre-application issues and engineering prerequisites
- Background:
 - NGNP site and operations issues
 - Format & content guidance
 - 10 CFR 52.79, 50.10, 51.45-51.50
 - NEI Report 04-01
 - RG 1.206
 - NRO Instruction #NRO-REG-100, Acceptance Reviews, dated 9/26/07
 - LWR COLA lessons learned
 - Standard Review Plan (NUREG-0800)





- Discussion:
- Summary:
 - Critical path issues
 - Engineering prerequisites
- Action Items:





- Question:
 - What is the order of the Part 52 applications and what is the corresponding schedule?
- Background:







NGNP SCHEDULE GOING INTO CONCEPTUAL DESIGN STAGE







VII. NGNP Licensing Schedule...

• Discussion:

• Summary:

• Action Items:





VIII. Establishing the Licensing Boundary for Design Certification

- Question:
 - How can a limited licensing boundary be established in view of the NRC mandate to review structures, systems, and components that impact safety?
- Background:
 - NGNP's licensing boundary role for the follow-on commercial plants
 - Licensing boundary drivers in the NGNP life-cycle
 - Licensing boundary for Design Certification
 - Relation of licensing boundary to security boundaries





VIII. Establishing the Licensing Boundary for Design Certification

NGNP Role for the Licensing Boundary of Follow-on Commercial Plants:

- Focus on the safety risk-significant envelope of SSCs is a win-win for the regulator and the owner-operator-user
- Designer has motivation to provide innovation in the design and arrangement of SSCs that protect the public safety
- Modular HTGRs safety design based on radionuclide retention at the source within multiple, independent barriers
- NGNP will implement and demonstrate the safety design approach to provide greater certainty that the follow-on plant licensing boundary envelopes the risk-significant SSCs







VIII. Establishing the Licensing Boundary for Design Certification

Licensing Boundary Drivers in the Design Phase

- The subset of Structures, Systems and Components (SSCs) within the licensing boundary are those that are relied on during Design Basis Events (DBEs) to:
 - Mitigate accidents that are not expected in the life of the plant
 - Prevent high-consequence accidents not expected during the lifetimes of a fleet of plants
- During the design phase, a comprehensive set of events are selected and the subset of SSCs are chosen:
 - For an enveloping site (weather, seismicity, and process hazards and proximity) more limiting than the NGNP
 - With consideration for the NGNP if desired to test different design options (e.g., for H₂ production)





Licensing Boundary Drivers in the Design Phase...

- Ideally, the SSCs are classified as either Safety-Related or Not Safety-Related, where:
 - Not Safety-Related means they can be designed as a non-nuclear, conventional SSC
 - Safety-Related means they have special treatment requirements to assure capability for accident mitigation and reliability for accident prevention
- However, there may be special cases where an SSC is classified as Not Safety-Related but with some special treatment requirements
- The licensing boundary selected in the design process drives the requirements during all subsequent design phases





Typical Special Treatment Requirements during the Life-Cycle Phases

- Design requirements for SSC capabilities to mitigate specific DBEs
- Numerical targets for SSC reliability & availability to perform safety functions
- Design requirements for independence, redundancy, and diversity
- Design requirements for safety margins and design conservatism
- Codes and Standards for design, material procurement, fabrication, construction, and operation
- Seismic design basis
- Seismic qualification testing
- Equipment qualification testing
- Quality Assurance and Quality Control
- Operational performance monitoring
- Operational controls
- Technical specifications
- Materials surveillance testing
- Pre-service and In-service inspection
- Pre-service and In-service testing





Conceptual Approaches to Licensing Boundary

• Square or Rectangular Donut







VIII. Establishing the Licensing Boundary for Design Certification...

- The objective is to capture the minimum envelope of SSCs relied on to meet the regulatory requirements for the design events within the design certification
- Level of design detail required for non-LWRs is higher 10 CFR 52.47(c)(2):
 - An application for certification of a nuclear power reactor design that differs significantly from the light-water reactor designs described in paragraph (c)(1) of this section or uses simplified, inherent, passive, or other innovative means to accomplish its safety functions must provide an essentially complete nuclear power reactor design except for site-specific elements such as the service water intake structure and the ultimate heat sink, and must meet the requirements of 10 CFR 50.43(e);
- Minimization of ITAAC is also an important driver
- Ideally would like security boundary to be as close to licensing boundary---depends on DBT and associated evaluations

NGNP Licensing Workshop - January 22, 2008

Slide 47





VIII. Establishing the Licensing Boundary for Design Certification...

• Discussion:

• Summary:

• Action Items:



IX. Coordination with DOE-NRC Working Group IX. Coordination with DOE-NRC Working Group

- Question:
 - What are the implications of this workshop for the DOE-NRC strategy development working group?
- Background:
 - Energy Policy Act 2005, Section 644, Nuclear Regulatory Commission:

(b) LICENSING STRATEGY.—Not later than 3 years after the date of enactment of this Act, the Secretary and the Chairman of the Nuclear Regulatory Commission shall jointly submit to the appropriate committees of the Senate and the House of Representatives a licensing strategy for the prototype nuclear reactor, including—





• Discussion:

• Summary:

• Action Items:

- Other discussion (if any)
- Was this workshop useful and should it be repeated during the Conceptual Design stage?
- WEC Team will issue meeting minutes

APPENDIX B: PROCESS STEPS FOR THE PART 52 EARLY SITE PERMIT, COMBINED LICENSE, AND DESIGN CERTIFICATION PROCESSES

The total elapsed time stated for each row of the following tables is the estimated time elapsed upon accomplishment of the activity for that row relative to submittal of the corresponding application.

Task No.	Task Name	Total Time	Reference				
		Elapsed (months)					
1	Submit ESP Application to NRC	0					
2	NRC Docketing Process						
2.1	NRC issues notice of receipt of ESP application	1	Experience with ESPs to date.				
2.2	NRC issues notice of docketing	2	10 CFR § 2.101(a)(2) states that the docketing review should generally be complete within 30- 60 days of submission of the application.				
3	NRC Environmental Scoping Process						
3.1	NRC issues notice of intent to prepare an EIS for the ESP and its intent to conduct a public scoping meeting	3	10 CFR §§ 51.26 and 51.27(a). No time limits are provided for notice of intent to prepare an EIS, but this notice has normally been published within one month of docketing of ESP applications.				
3.2	NRC staff conducts public scoping meeting for the EIS	4	10 CFR §§ 51.27 and 51.28. No time limits are provided, but this meeting has normally been held within 3-weeks of the meeting notice.				

Table B-1: Generic Schedule for Issuance of An Early Site Permit
Task No	Task Name	Total Time	Reference
110.		Elapsed (months)	
3.3	NRC staff completes scoping process	5	10 CFR § 51.29. No time limits are provided, but for ESP applications the scoping period has normally been closed within 60 days of notice of the environmental scoping meeting.
4	Ruling on Petitions to Intervene		
4.1	NRC issues notice of hearing and opportunity to intervene	3	10 CFR § 2.104. No time limits are provided, but for ESP applications the notices have normally been issued within 1 month of docketing.
4.2	Petitioners submit petitions to intervene	5	10 CFR § 2.309(b). Petitions are due 60-days after publication of notice of opportunity for hearing.
4.3	NRC staff and applicant file answers to petitions	6	10 CFR § 2.309(h). Answers are due 25 days after filing of the petitions to intervene.
4.4	Petitioners file reply to answers	6	10 CFR § 2.309(h). Replies are due 7 days after filing of the answers to the petitions to intervene.
4.5	Licensing Board holds prehearing conference	7	Experience with ESP applications.
4.6	Licensing Board issues order on the petitions	8	10 CFR Part 2, Appendix B states that the order should be issued within 140 days of the hearing notice.
4.7	Licensing Board issues initial hearing schedule	10	10 CFR Part 2, Appendix B states that the schedule should be issued within 55 days of the order on the petitions to intervene.

Task No	Task Name	Total Time	Reference
110.		Elapsed (months)	
5	Parties make mandatory discovery disclosures	9	10 CFR § 2.336. Disclosures are due within 30 days of issuance of Licensing Board order on petitions to intervene. There is also a duty to update disclosures as new information and documents become available.
6	NRC Environmental Review		
6.1	NRC staff issues last of RAIs on Environmental Report	7	Environmental RAIs have normally been issued within 7-8 months of docketing of the ESP applications. This time was significantly shorter (3 months) for the Vogtle ESP.
6.2	Applicant submits last responses to RAIs	8	NRC would like responses to RAIs within 30 days.
6.3	NRC staff issues draft EIS (DEIS)	15	10 CFR §§ 51.70 - 51.74. No time limits are provided but the draft EISs have generally been issued within 7-8 months after the applicant has responded to the environmental RAIs.
6.4	NRC staff conducts public meeting on DEIS	17	Meeting has generally been held within 6 weeks of publication of draft EIS.
6.5	Applicant and public submit comments on DEIS	18	10 CFR § 51.73. A minimum 45-day comment period is required. NRC has announced that it will use a 60-day comment period.
6.6	NRC staff issues final EIS (FEIS)	25	The NRC is allotting 7 months for this activity for the Vogtle ESP application after public comments. It took longer for the other ESP applications.
7	NRC Safety Review		
7.1	NRC staff issues last of RAIs on safety issues	8	Safety RAIs have normally been issued within 4-11 months of docketing of the ESP applications. This 6-month estimate is based on the Vogtle ESP.

Task	Task Name	Total Time	Reference
N0.		Elapsed (months)	
7.2	Applicant submits last responses to RAIs	9	NRC would like responses to RAIs within 30 days.
7.3	NRC staff issues SER with open items	13	The draft SER has generally been issued within 7-8 months after issuance of the safety RAIs for the ESP applications. This 5-month estimate is based on the Vogtle ESP.
7.4	ACRS holds subcommittee and full committee meetings on SER with open items	15	ACRS meetings have generally been held within about 2 months of issuance of draft SER.
7.5	ACRS issues letter on SER	15	ACRS letter has generally been issued within two weeks of the full ACRS meeting.
7.6	Applicant submits responses to open items	16	For most of the ESP applications, the applicant has responded within about 3 months of issuance of the draft SER.
7.7	NRC staff issues FSER	20	The FSER has generally been issued within 4 months of receiving responses to open items on the ESP applications.
7.8	ACRS holds subcommittee and full committee meetings	21	The full ACRS meeting on the final SER has generally been held within one month of the FSER.
7.9	ACRS issues final letter on FSER	21	10 CFR § 52.23. No time limits are provided but the ACRS letter has generally been issued within two weeks of the full ACRS meeting.
7.10	NRC staff issues NUREG with FSER	23	The NUREG with the FSER has generally been issued within about 3 months of staff issuance of the FSER. Note: At the DCWG meeting on 6/13/07, the NRC staff stated that the FEIS would be issued at 25 months after filing of the COL application.

Task	Task Name	Total Time	Reference
190.		Elapsed (months)	
8	Summary Disposition		
8.1	Applicant submits motions for summary disposition	15	10 CFR § 2.1205. 10 CFR Part 2, Appendix B states that motions for summary disposition are due within 115 days of the SER and EIS. However, motions are usually filed earlier, but after the draft EIS and SER with open items.
8.2	Intervenors and NRC staff file responses to motions for summary disposition	16	10 CFR § 1205. Responses are due 20 days after the motions.
8.3	Licensing Board rules on motions for summary disposition	19	Licensing Boards typically take several months to issue decisions on motions for summary disposition.
9	Hearings		
9.1	Intervenors file late contentions based upon FSER and FEIS	26	10 CFR Part 2, Appendix B states that late contentions should be filed within 30 days of the SER and EIS.
9.2	Licensing Board issues order on late contentions	28	10 CFR Part 2, Appendix B states that the order on late contentions should be issued within 85 days of the SER and EIS.
9.3	Parties submit written statements of position and prefiled testimony	30	10 CFR Part 2, Appendix B states that written testimony should be filed within 155 days of the SER and EIS.
9.4	Parties submit responses and rebuttal testimony	31	10 CFR § 2.1207 states that responses and rebuttal testimony shall be filed 20 days after filing of the prefiled testimony.
9.5	Parties submit proposed questions for Licensing Board to ask on prefiled testimony	31	10 CFR § 2.1207 states that proposed questions shall be filed 20 days after filing of the prefiled testimony.
9.6	Parties submit proposed questions for Licensing Board to ask on rebuttal testimony	31	10 CFR § 2.1207 states that proposed questions on rebuttal testimony shall be filed within 7 days of the rebuttal testimony.

Task	Task Name	Total	Reference
No.		Elapsed (months)	
9.7	Hearings commence	31	10 CFR Part 2, Appendix B states that hearings should commence within 175 days of the SER and EIS.
9.8	Hearings close	32	One month is a reasonable period for a contested hearing, unless the Licensing Board allows cross-examination.
9.9	Parties file proposed findings of fact and conclusions of law	33	10 CFR § 2.1209 provides for a 30 day period for submitting proposed findings of fact and conclusions of law.
9.10	Licensing Board issues initial decision and authorizes issuance of ESP	35	10 CFR Part 2, Appendix B states that the initial decision should be issued within 90 days after close of the hearings.
10	NRC staff issues ESP	36	10 CFR § 2.340(c) states that the license should be issued within 10 days after the initial decision.

Task	Task Name	Total Time	Reference
INO.		Elapsed (months)	
1	Submit COL Application to NRC	0	
2	NRC Docketing Process		
2.1	NRC issues notice of receipt of COLA	1	Experience with COLAs to date
2.2	NRC issues notice of docketing	2	NRO-REG-100, §2.
			10 CFR § 2.101(a)(2) states that the docketing review should generally be complete within 30- 60 days of submission of the application.
3	NRC Environmental Scoping Process		
3.1	NRC issues notice of intent to prepare an EIS for the COL and its intent to conduct a public scoping meeting	3	10 CFR §§ 51.26 and 51.27(a). No time limits are provided for notice of intent to prepare an EIS, but this notice has normally been published about one month after docketing of ESP applications.
3.2	NRC staff conducts public scoping meeting for the EIS	4	10 CFR §§ 51.27 and 51.28. No time limits are provided, but this meeting has normally been held within 3-weeks of the meeting notice.
3.3	NRC staff completes scoping process	5	10 CFR § 51.29. No time limits are provided, but for ESP applications the scoping period has normally been closed within 60 days of notice of the environmental scoping meeting.

Table B-2: Generic Schedule for Issuance of A COL¹⁰

¹⁰ This schedule reflects the presentation made by the NRC at the DCWG meeting on Jan. 30-31, 2008.

Task	Task Name	Total Time	Reference
N0.		Elapsed (months)	
4	Ruling on Petitions to Intervene		
4.1	NRC issues notice of hearing and opportunity to intervene	3	10 CFR § 2.104. No time limits are provided, but for ESP applications the notices have normally been issued within 1 month of docketing.
4.2	Petitioners submit petitions to intervene	5	10 CFR § 2.309(b). Petitions are due 60- days after publication of notice of opportunity for hearing.
4.3	NRC staff and applicant file answers to petitions	6	10 CFR § 2.309(h). Answers are due 25 days after filing of the petitions to intervene.
4.4	Petitioners file reply to answers	6	10 CFR § 2.309(h). Replies are due 7 days after filing of the answers to the petitions to intervene.
4.5	Licensing Board holds prehearing conference	7	Experience with ESP applications
4.6	Licensing Board issues order on the petitions	8	10 CFR Part 2, Appendix B states that the order should be issued within 140 days of the hearing notice.
4.7	Licensing Board issues initial hearing schedule	10	10 CFR Part 2, Appendix B states that the schedule should be issued within 55 days of the order on the petitions to intervene.
5	Parties make mandatory discovery disclosures	9	10 CFR § 2.336. Disclosures are due within 30 days of issuance of Licensing Board order on petitions to intervene. There is also a duty to update disclosures as new information and documents become available.

Task	Task Name	Total Time	Reference
N0.		Elapsed (months)	
6	NRC Environmental Review		
6.1	NRC staff issues last of RAIs on Environmental Report	10	Environmental RAIs have normally been issued within 7-8 months of docketing of the ESP applications.
6.2	Applicant submits last responses to RAIs	11	NRC would like responses to RAIs within 30 days.
6.3	NRC staff issues draft EIS (DEIS)	19	10 CFR §§ 51.70 - 51.74. No time limits are provided but the draft EISs have generally been issued within 7-8 months after the applicant has responded to the environmental RAIs.
6.4	NRC staff conducts public meeting on DEIS	20	Meeting has generally been held within 6 weeks of publication of draft EIS.
6.5	Applicant and public submit comments on DEIS	21	10 CFR § 51.73. A minimum 45-day comment period is required. NRC has announced that it will use a 60-day comment period.
6.6	NRC staff issues final EIS (FEIS)	26	The NRC is allotting 7 months for this activity for the Vogtle ESP application. It took longer for the other ESP applications. This estimate is based upon the NRC estimated review time of 24 months from the date of docketing.
7	NRC Safety Review		
7.1	NRC staff issues last of RAIs on safety issues	11	Safety RAIs have normally been issued within 4-11 months of docketing of the ESP applications.
7.2	Applicant submits last responses to RAIs	12	NRC would like responses to RAIs within 30 days.

Task	Task Name	Total Time	Reference
No.		Elapsed (months)	
7.3	NRC staff issues SER with open items	20	The draft SER has generally been issued within 7-8 months after issuance of the safety RAIs for the ESP applications. The additional period here reflects an NRC "management reserve."
7.4	ACRS holds subcommittee and full committee meetings on SER with open items	22	ACRS meetings have generally been held within 2 months of issuance of draft SER.
7.5	ACRS issues letter on SER	22	ACRS letter has generally been issued within two weeks of the full ACRS meeting.
7.6	Applicant submits responses to open items	24	For most of the ESP applications, the applicant has responded within about 3 months of issuance of the draft SER.
7.7	NRC staff issues FSER	30	The FSER has generally been issued within 4 months of receiving responses to open items on the ESP applications. The additional period here reflects an NRC management reserve.
7.8	ACRS holds subcommittee and full committee meetings	31	The full ACRS meeting on the final SER has generally been held within one month of the FSER.
7.9	ACRS issues final letter on FSER	32	10 CFR § 52.87. No time limits are provided but the ACRS letter has generally been issued within two weeks of the full ACRS meeting.
7.10	NRC staff issues NUREG with FSER	33	The NUREG with the FSER has generally been issued within about 3 months of staff issuance of the FSER.

Task	Task Name	Total Time	Reference
N0.		Elapsed (months)	
8	Summary Disposition		
8.1	Applicant submits motions for summary disposition	21	10 CFR § 2.1205. No time period is specified. However, motions are usually filed after the draft EIS and SER with open items.
8.2	Intervenors and NRC staff file responses to motions for summary disposition	22	10 CFR § 52.87. Reponses are due 20 after the motions.
8.3	Licensing Board rules on motions for summary disposition	26	Licensing Boards typically take several months to issue decisions on motions for summary disposition.
9	Hearings		
9.1	Intervenors file late contentions based upon FSER and FEIS	34	10 CFR Part 2, Appendix B states that late contentions should be filed within 30 days of the SER and EIS.
9.2	Licensing Board issues order on late contentions	36	10 CFR Part 2, Appendix B states that the order on late contentions should be issued within 85 days of the SER and EIS.
9.3	Parties submit written statements of position and prefiled testimony	38	10 CFR Part 2, Appendix B states that written testimony should be filed within 155 days of the SER and EIS.
9.4	Parties submit responses and rebuttal testimony	39	10 CFR § 2.1207 states that responses and rebuttal testimony shall be filed 20 days after filing of the pre
9.5	Parties submit proposed questions for Licensing Board to ask on prefiled testimony	39	10 CFR § 2.1207 states that proposed questions shall be filed 20 days after filing of the pre
9.6	Parties submit proposed questions for Licensing Board to ask on rebuttal testimony	39	10 CFR § 2.1207 states that proposed questions on rebuttal testimony shall be filed within 7 days of the rebuttal testimony.

Task	Task Name	Total Time	Reference
No.		Elapsed (months)	
9.7	Hearings commence	39	10 CFR Part 2, Appendix B states that hearings should commence within 175 days of the SER and EIS.
9.8	Hearings close	40	One month is a reasonable period for a contested hearing, unless the Licensing Board allows cross-examination.
9.9	Parties file proposed findings of fact and conclusions of law	41	10 CFR § 2.1209 provides for a 30 day period for submitting proposed findings of fact and conclusions of law.
9.10	Licensing Board issues initial decision and authorizes issuance of COL	43	10 CFR Part 2, Appendix B states that the initial decision should be issued within 90 days after close of the hearings.
10	NRC staff issues COL	44	10 CFR §2.340(c) states that the license should be issued within 10 days after the initial decision.

Table B-3: Generic Schedule for Issuance of A Design Certification For An Evolutionary Light Water Reactor¹¹

Task No.	Task Name	Total Time	Reference
100		Elapsed (months)	
1	Submit DC Application to NRC	0	
2	NRC Docketing Process		
2.1	NRC issues notice of receipt of DC application	1	Experience with DC applications to date.
2.2	NRC issues notice of docketing	2	See NRO-REG-100. The EPR DC application was recently docketed about 2 1/2 months after submission, and the APWR was just docketed after 2 months of review.
3	NRC Safety Review		The NRC has stated that the safety review for DC applications should follow the safety reviews for COL applications.
3.1	NRC staff issues last of RAIs on safety issues	9	Experience with schedules for ESPs, Rev. 16 of the AP1000, and Bellefonte COL.
3.2	Applicant submits last responses to RAIs	10	NRC would like responses to RAIs within 30 days.

¹¹ This schedule is based upon NRC staff's nominal 30 month schedule for review and approval of a LWR design. The NRC has not issued a nominal schedule for review of a non-LWR. However, SECY-01-0188 states: "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." This SECY also states: "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."

Task	Task Name	Total Time	Reference
No.		Elapsed (months)	
3.3	NRC staff issues SER with open items	17	Experience with schedules for ESPs, Rev. 16 of the AP1000, and Bellefonte COL.
3.4	ACRS holds subcommittee and full committee meetings on SER with open items	19	ACRS meetings have generally been held within 2 months of issuance of draft SER.
3.5	ACRS issues letter on SER	19	ACRS letter has generally been issued within two weeks of the full ACRS meeting.
3.6	Applicant submits responses to open items	20	Experience with schedules for ESPs, Rev. 16 of the AP1000, and Bellefonte COL.
3.7	NRC staff issues FSER	24	The FSER has generally been issued within 4 months of receiving responses to open items on the ESP applications.
3.8	ACRS holds subcommittee and full committee meetings	25	The full ACRS meeting on the final SER has generally been held within one month of the FSER.
3.9	ACRS issues final letter on FSER	26	10 CFR § 52.53. No time limits are provided but the ACRS letter has generally been issued within two weeks of the full ACRS meeting.
3.10	NRC staff issues NUREG with FSER	29	The NUREG with the FSER has generally been issued within about 3 months of staff issuance of the FSER.
4	Kulemaking		The rulemaking should take approximately 12 months after the FSER is issued.
4.1	Commission issues proposed rule	33	The NRC took 7 months to issue the proposed rule for the AP1000.
4.2	End of comment period on proposed rule	36	The NRC allowed 2 ¹ / ₂ months for comments on the proposed rule for the AP1000.

Task No.	Task Name	Total Time Elapsed (months)	Reference
4.3	NRC issues final rule	42	The NRC took about 6 months to issue the final rule after the close of the comment period for the AP1000.

APPENDIX C: ISSUES TO BE ADDRESSED DURING THE EARLY SITE PERMIT, COMBINED LICENSE, AND DESIGN CERTIFICATION PRE-APPLICATION PROGRAMS

Issue	Description	Proposed Project	Contributors
		Stage for Resolution	$(\mathbf{S}, \mathbf{P}, \mathbf{O}, \mathbf{B}, \mathbf{N})^1$
Fuel cycle (waste	The PBMR fuel waste characteristics are different than LWR spent	Final Design	P, B, N
impacts) and	fuel. NRC regulations 10 CFR 51.51, "Uranium Fuel Cycle		
transportation	Environmental Data" and 10 CFR 5 1.52, "Environmental Effects of		
	Transportation of Fuel and Waste" address LWRs but not HTGRs.		
	Additionally, confirmation is needed that 10 CFR 51.23 "Temporary		
	storage of spent fuel after cessation of reactor operation -generic		
	determination of no significant environmental impact," applies to		
	NGNP. [Exelon 2h, Exelon 11, and SECY-02-0180]		
Reliance on previous	The site work performed in the 1990s for the New Production Reactor	Conceptual Design	P, N
reviews of the NPR	project should be applicable to the NGNP project, but the NRC needs		
site at INL	to concur on its applicability and the extent to which the NGNP		
	review will be facilitated by the NPR work. [DOE/EIS-0144, Draft		
	Environmental Impact Statement (EIS) for the Siting, Construction		
	and Operation of New Production Reactor Capacity, Mar 1991; see		
	also Review Standard RS-002, Section 4.5, "Use of Existing		
	Information From Nearby Facilities for ESP Applications", Revision		
	0, March 2006]		
Site Security	The NGNP consortium plans for site security should be described in	Preliminary Design	S, P, O, B, N
	order to determine whether there are any issues that need special		
	attention. [SECY-06-0204, SECY-07-0167]		
1. $S = Site Owner, P =$	Plant Owner, $O = Operator$, $B = EPCM/BOP$ designer, $N = NHSS$ design	ner	

Table C-1: NGNP Early Site Permit Pre-Application Issues

C-1 of C-14

Licensing Risk Reduction Study

Issue	Description	Proposed Project Stage for Resolution	Contributors (S, P, O, B, N) ¹
ESP application content	In order to ensure that the ESP application is acceptable to the NRC when it is submitted, the contents and general level of detail should be discussed and agreed upon during pre-application, including the Site Safety Analysis Report, the Environmental Report, and a description of emergency planning (either high-level or detailed descriptions) [NRC Review Standard RS-002].	Conceptual Design	Ν
LWA Content	If the Westinghouse NGNP Team proceeds with an LWA application in conjunction with the ESP application, guidance will be needed from NRC staff on the level of detail necessary for the safety analysis to support the requested advance work (e.g., foundations for safety- related structures). [COL/ESP ISG-4 and Regulatory Guide 1.206, section C.IV.6]	Preliminary Design	P, N
1. $S = Site Owner, P =$	Plant Owner, O = Operator, B = EPCM/BOP designer, N = NHSS design	ner	

C-2 of C-14

Issue	Description	Proposed Project	Contributors
		Stage for Resolution	$(\mathbf{S}, \mathbf{P}, \mathbf{O}, \mathbf{B}, \mathbf{N})^{T}$
Source term,	NRC policy on the use of PBMR scenario-specific source terms	Conceptual Design	P, B, N
commentent, El Z	atmospheric dispersal) needs to be addressed. The PBMR confinement		
	is designed specifically for a high temperature gas-cooled reactor.		
	NRC policy regarding containment design needs to be assessed		
	regarding its applicability to gas-cooled reactors, and the PBMR		
	design. The impact of the source term and confinement approach on a		
	and SECY-04-0103 E Planning ITAAC for a non-I WR - NEL04-01		
	Rev E, SECY-07-0039 Use of scenario-specific source terms - SECY-		
	03-047]		
Prototype testing	NRC has just revised its regulations (10 CFR 52) to address, in part,	Preliminary Design	P, N
	prototype testing for advanced reactors. The NGNP project plans to base its COL application on separate affects tests and R&D, but not		
	prototype testing per 10 CFR 52. NRC input should be obtained.		
	[Exelon 12 and SECY-02-0180]		
Price Anderson Act	The Westinghouse NGNP Team needs to determine how the Price-	Final Design	S, P
applicability	Anderson Act applies to non-electrical generation plants and gain		
	NRC concurrence. [Exelon 2a and SECY-02-0180]		
Anti-Trust Review	CLOSED – Not needed per Sec. 625 of the Energy Policy Act of 2005		
Application review	10 CFR Part 170 addresses NRC review fees for license application	Final Design	Р
fee	reviews. Agreement is needed with the NRC on the extent of fees for		
	review of the NGNP applications, considering the possibility of an		
	exemption for work that supports NRC long-range development of		
	their HTGR experience and R&D. [Exelon – Area 2]		
1. $S = Site Owner, P = 1$	Plant Owner, O = Operator, B = EPCM/BOP designer, N = NHSS designed	er	

Table C-2: NGNP Combined License Pre-application Issues

C-3 of C-14

Issue	Description	Proposed Project Stage for Resolution	Contributors (S, P, O, B, N) ¹
Annual fees	The NRC staff needs to confirm its position that as a result of the Omnibus Budget Reconciliation Act of 1990, no further change is needed to the 10 CFR 171 fee rule to address the assessment of "fair and equitable" annual fees for modular facilities. [Exelon 2b and SECY-02-0180]	Final Design	P
Decommissioning cost and funding	Confirmation is needed from the NRC that positions stated in SECY- 02-0189 will be applicable to the NGNP project. Alternatives should be discussed. Non-electric-utility applicants are not allowed to use the sinking fund option exclusively (uniform series of payments). The staff recommends in SECY-02-0180 that the NRC require non- electric-utility applicants to use the other options provided in 10 CFR §50.75 to fund decommissioning costs. The staff does not recommend that the regulations be modified to allow additional alternatives for decommissioning funding. 10 CFR §50.75 identifies decommissioning cost estimates for PWRs and BWRs, but not for HTGRs. The staff needs to confirm its position that the staff will accept a minimum decommissioning cost estimate specifically for the PBMR [or NGNP] if the applicant can technically justify this estimate. [Exelon 2e, 2d and SECY-02-0180]	Final Design	S, P
Safeguards	The passive safety features, routine re-circulation of fuel and online fueling and de-fuelling capabilities could pose new safeguards questions that needed to be addressed. [Exelon 9]	Conceptual Design	Р, В
Waste Management	The NGNP approach to waste management should be described and NRC should provide feedback on issues that need attention in the COL application. [NUREG-1555, "SRP for Environmental Reviews for Nuclear Power Plants,"section 5.5, "Environmental Impacts of Waste"., latest revision]	Conceptual Design	P, O, B

Issue	Description	Proposed Project Stage for Resolution	Contributors (S. P. O. B. N) ¹
Safety boundary for NGNP and regulatory oversight during operation.	The NRC has the regulatory lead over the NHSS and other parts of the plant that impact NHSS safety, it will be necessary to determine which parts or functions of the PHP, PCS and BOP impact NHSS nuclear safety and hence are under regulatory oversight by the NRC and which parts or functions should be subject to regulatory oversight by other governmental agencies. [Appendix A and Section 2.5]	Preliminary Design	P, B, N
EP zone reduction	The NGNP design and analysis are expected to justify a reduced EPZ, equal to the exclusion area boundary. The interaction of this EPZ with that for the ATR needs to be addressed, including regulatory control. Note: "§50.47(c)(2) Generally, the plume exposure pathway EPZ for nuclear power plants shall consist of an area about 10 miles (16 km) in radius and the ingestion pathway EPZ shall consist of an area about 50 miles (80 km) in radius. The exact size and configuration of the EPZs surrounding a particular nuclear power reactor shall be determined in relation to local emergency response needs and capabilities as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. The size of the EPZs also may be determined on a case-by-case basis for gas-cooled nuclear reactors and for reactors with an authorized power level less than 250 MW thermal. The plans for the ingestion pathway shall focus on such actions as are appropriate to protect the food ingestion pathway." [10 CFR §50.47(c)(2); see also SECY-03-0047, SECY-04-0157, SECY-05-0130, and SECY-06-0007; NUREG-1860, Vol 1. Section 9.3]	Preliminary Design	P, O, B, N
Fuel qualification	The use of PBMR designed fuel for initial plant startup is critical to the aggressive NGNP startup schedule, however, the corresponding fuel qualification program needs to be established and agreed upon. [Exelon – Area 3]	Conceptual Design	P, N
1. $S = Site Owner, P = 1$	Plant Owner, O = Operator, B = EPCM/BOP designer, N = NHSS designed	er	

Issue	Description	Proposed Project Stage for Resolution	Contributors (S, P, O, B, N) ¹
PRA Approach	The NRC and the Westinghouse NGNP Team should review and agree on the applicability of the PBMR white paper to the NGNP project. Reference: PBMR (Pty) Ltd, "U.S. Design Certification – Probabilistic Risk Assessment Approach for The Pebble Bed Modular Reactor," June 13, 2006 (Submitted to the U.S. Nuclear Regulatory Commission in PBMR (Pty) Ltd Letter USDC20060613-1, 6-13-2006)	Conceptual Design	P, N
Licensing Basis Events and Design Basis Accidents	The NRC and the Westinghouse NGNP Team should review and agree on the applicability of the PBMR white paper to the NGNP project. Reference: PBMR (Pty) Ltd, "U.S. Design Certification – Licensing Basis Event Selection For The Pebble Bed Modular Reactor," June 30, 2006 (Submitted to the U.S. Nuclear Regulatory Commission in PBMR (Pty) Ltd Letter USDC20060703-1, Dated July 3, 2006)	Conceptual Design	P, N
Safety classification of structures, systems and components	The NRC and the Westinghouse NGNP Team should review and agree on the applicability of the PBMR white paper to the NGNP project. Reference: PBMR (Pty) Ltd, "U.S. Design Certification – Safety Classification Of Structures, Systems, And Components For The Pebble Bed Modular Reactor," August 24, 2006 (Submitted to the U.S. Nuclear Regulatory Commission in PBMR (Pty) Ltd Letter USDC20060828-1, Dated August 28, 2006)	Conceptual Design	P, N
Defense-in-Depth	The NRC and the Westinghouse NGNP Team should review and agree on the applicability of the PBMR white paper to the NGNP project. Reference: PBMR (Pty) Ltd, "U.S. Design Certification – Defense-In- Depth Approach For The Pebble Bed Modular Reactor," December 11, 2006 (Submitted to the U.S. Nuclear Regulatory Commission in PBMR (Pty) Ltd Letter USDC20061213-1, Dated December 13, 2006)	Conceptual Design	P, N

Issue	Description	Proposed Project	Contributors
Fuel design and qualification	The NRC and the Westinghouse NGNP Team should review and agree on the applicability of the PBMR white paper to the NGNP project. Reference: PBMR (Pty) Ltd, "U.S. Design Certification – PBMR Fuel Performance Envelope and Test Program, Revision 1, October 2, 2007 (Submitted to the U.S. Nuclear Regulatory Commission in PBMR (Pty) Ltd Letter USDC20071015-1, Dated October 15, 2007)	Conceptual Design	P, N
Analytical code V&V	The NRC and the Westinghouse NGNP Team should review and agree on the applicability of the PBMR white paper to the NGNP project. Reference: PBMR (Pty) Ltd, "U.S. Design Certification – Evaluation Model Development and Assessment Process (EMDAP) For The Pebble Bed Modular Reactor," November 14, 2007, Revision 1 (Submitted to the U.S. Nuclear Regulatory Commission in PBMR (Pty) Ltd Letter USDC20071126-1, Dated November 26, 2007)	Conceptual Design	P, N
High temperature materials - metallics	The NRC and the Westinghouse NGNP Team should review and agree on the applicability of the PBMR white paper to NGNP. Reference: PBMR (Pty) Ltd, "U.S. Design Certification – High Temperature Materials - Metallics," (To Be Submitted to the U.S. Nuclear Regulatory Commission in PBMR (Pty) Ltd Letter USDC2008XXX-X, Dated XXXXXXX, 2008)	Conceptual Design	P, N
High temperature materials – ceramics, including graphite qualification	The NRC and the Westinghouse NGNP Team should review and agree on the applicability of the PBMR white paper to the NGNP project. Reference: PBMR (Pty) Ltd, "U.S. Design Certification – High Temperature Materials - Ceramics," (To Be Submitted to the U.S. Nuclear Regulatory Commission in PBMR (Pty) Ltd Letter USDC2008XXX-X, Dated XXXXXXX, 2008)	Conceptual Design	P, N

Issue	Description	Proposed Project Stage for Resolution	Contributors (S, P, O, B, N) ¹
Accident analysis source term	Since the NGNP pebble fuel is fundamentally different from NRC LWR experience and since the NGNP project is implementing risk- informed, performance based design and analysis methods, the Westinghouse NGNP Team needs to describe its approach to generation of the source term to be used in the PRA analyses and the relationship of that source term to the deterministic safety analysis. [10 CFR §52.47(a)(2)(iv) and §52.79(1)(vi)]; see also SECY-03-0047, SECY-04-0157, SECY-05-0130, and SECY-06-0007; NUREG-1860, Vol 1. Section 9.3]	Conceptual Design	P, N
Qualification of fuel from a foreign supplier	Since it is likely that the fuel for initial NGNP operation will be produced in the Republic of South Africa, the NRC staff needs to establish procedures for reviews to provide confidence that the fuel is manufactured and qualified consistent with design and manufacturing specifications. [Exelon – Area 3]	Preliminary Design	P, N
Digital I&C	The NRC staff needs to provide feedback on PBMR methods for design and qualification of digital I&C equipment, considering its the draft NUREG dated September 2007, SECY-08-0033, interim staff guidance for cyber security and its Task Working Groups on Digital I&C. [Revision 1 of the NRC Digital Instrumentation and Control Project Plan (March 14, 2008), see also SECY-08-0033.]	Preliminary Design	P, N
Operating controls and monitoring	Since the design and monitoring and control of the NGNP will be different from NRC LWR experience, the staff needs to provide feedback on the methods and criteria for designing the PBMR/NGNP control and monitoring systems. [Exelon - Area 13]	Preliminary Design	P, N

Issue	Description	Proposed Project Stage for Resolution	Contributors (S, P, O, B, N) ¹
In-service Inspection & Testing	Inspection intervals and maintenance requirements for NGNP are expected to be significantly less than for LWRs; staff feedback is needed in regards to PBMR methods for determining NGNP inspection and maintenance requirements. [Exelon – Area 15; 10 CFR §50.55a; see also Regulatory Guide 1.147, Revision 15, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," October 2007]	Preliminary Design	P, N
Design basis threats from external events	Physical security is a consideration for the Westinghouse NGNP Team from the beginning of the design, but concurrence is needed from the NRC staff that the NGNP design approach, including reactor building requirements, embedment depth, and aircraft crash requirements for non-LWRs), satisfies current NRC positions [SECY-06-0204 and SECY-07-0167]	Conceptual Design	P, B, N
Core Design and Heat Removal	The NGNP is designed to use inherent characteristics and passive systems for removal of heat during accident conditions. NRC feedback on the NGNP approach to redundancy and defense-in-depth is needed early in the design process. [see Interim Staff Guidance: Rev 1, on Diversity and Defense-in-Depth, DI&C-ISG-02, September 26, 2007]	Conceptual Design	P, N
1. $S = Site Owner, P = 1$	Plant Owner, O = Operator, B = EPCM/BOP designer, N = NHSS designed	er	

Issue	Description	Proposed Project	Contributors
		Stage for Resolution	$(\mathbf{S}, \mathbf{P}, \mathbf{O}, \mathbf{B}, \mathbf{N})^1$
Postulated fission product releases (e.g., due to air and/or water ingress)	NGNP is designed to ensure that the worst-case accidents do not result in unacceptable heat-up of the fuel and supporting core structures. NRC concurrence is needed on the design and analysis approach being used for design basis and severe accident analyses. NGNP and NRC need to agree on the approach to resolving their requirement (from the referenced regulations) that "The fission product release assumed for this evaluation should be based upon a major accident, hypothesized for purposes of site analysis or postulated from considerations of possible accidental events. These accidents have generally been assumed to result in substantial meltdown of the core with subsequent release into the containment of appreciable quantities of fission products". [10 CFR §52.47(a)(2)(iv) and §52.79(1)(vi)]	Conceptual Design	P, N
Topical reports for design and analysis methods	Feedback is needed from NRC staff on NGNP scope and schedule for submitting topical reports and other references for the COL application, including those prepared and reviewed for the Demonstration Power Plant in South Africa. [see NRC letter to Westinghouse dated June 15, 2004, subject: Guidance on Pre- Submittal Meeting on Topical Reports; see also NRC letter to NEI dated March 13, 2008, subject: Request for Prioritization of Topical Report Reviews and List of Planned Topical Report Submittals for FY2008 and FY2009; and NRC memorandum dated March 28, 2008 noticing an April 11, 2008 meeting with industry regarding process improvements which enhance the efficiency of the NRC Topical Report process]	Conceptual Design	P, N
1. $S = Site Owner, P = 1$	Plant Owner, O = Operator, B = EPCM/BOP designer, N = NHSS designed	er	

Issue	Description	Proposed Project	Contributors
		Stage for Resolution	$(\mathbf{S}, \mathbf{P}, \mathbf{O}, \mathbf{B}, \mathbf{N})^1$
Identification of	Current NRC regulations are based significantly on LWR experience	Conceptual Design	P, N
applicable regulations	of the past four decades. Based on early reviews, much of the existing		
and gaps	regulation base and guidance is applicable to HTGR designs, however,		
	the current set of regulations and guidance needs to be reviewed for		
	applicability. NRC feedback on the filtering process used for NGNP		
	is needed during pre-application meetings. NRC then will have to		
	agree on the Westinghouse NGNP Team assessment of (1) compliance		
	with NRC guidance (RGs, SRP, NUREGs, etc.), (2) new regulatory		
	guides needed for HTGRs subsequent to NGNP, (3) new rulemakings		
	needed subsequent to NGNP, and (4) new policies. [Exelon – Area 6]		
Reliability Integrity	The design and risk assessment of the NGNP includes assumptions on	Preliminary Design	P,N
Management program	the integrity of major structures, systems and components over the		
	operating life of the plant. These SSCs and related assumptions must		
	be monitored and maintained and NRC staff concurrence is needed on		
	the NGNP program for managing the integrity and reliability of these		
	components. [USDC Pre-application White Paper, "Safety		
	Classification of Structures, Systems, and Components for the Pebble		
	Bed Modular Reactor", Revision 1]		
Applicable Codes &	It is the intent of the NGNP project to use existing applicable codes	Conceptual Design	P, N
Standards for HTGR	and standards to the extent practical, but some industry standards		
designs.	either do not exist or need confirmation. The NRC staff and the		
	Westinghouse NGNP Team need to concur on the approach to		
	identifying the codes and standards that need revisions or		
	development. [Exelon – Area 6]		
1. S = Site Owner, P = Plant Owner, O = Operator, B = EPCM/BOP designer, N = NHSS designer			

Issue	Description	Proposed Project Stage for Resolution	Contributors (S, P, O, B, N) ¹
Human Factors guidance	The NGNP is designed such that transients and accidents evolve more slowly that those in LWRs and human factors considerations may not be the same for both reactor types. Therefore, the Westinghouse NGNP Team needs NRC concurrence on the development of human factors engineering methods and guidance (e.g., for the control room). [DI&C-ISG-05, Digital Instrumentation and Controls: Task Working Group #5: Highly-Integrated Control Rooms—Human Factors Issues (HICR—HF)]	Conceptual Design	P, N
1. S = Site Owner, P = Plant Owner, O = Operator, B = EPCM/BOP designer, N = NHSS designer			

Issue	Description	Proposed Project Stage for Resolution	Contributors (S, P, O, B, N) ¹
Multi-module certification	The Westinghouse NGNP Team and NRC need to discuss and come to concurrence on the requirements for the DC application for certification of a design that may be constructed single- or multiple- module configurations (e.g., one, two, or four module plants).	Preliminary Design	P, N
Operator staffing for multiple modular reactors	The Westinghouse NGNP Team needs a determination as to whether a modular facility should be allowed to control more than two reactors from one control room and operate with a control room staffing complement that is less than would be required for individual reactors. [Exelon 2g and SECY-02-0180]	Conceptual Design	P, N
Integrated risk	In evaluating risk assessments for compliance with the Commission's Safety Goals, the staff's practice for large reactors has been to assess risk on an individual reactor basis. However, for smaller modular reactors where approximately 8 modules would be required to produce the power of one large reactor, the matter of treating each reactor separately needs to be re-evaluated. [SECY-04-0103, NUREG-1860]	Conceptual Design	Ν
Commercial plant safety boundary and regulatory oversight during operation.	This issue is closely related to the "safety boundary" issue listed in Table C-2 for the COL application. While it is desired to have the COL application review be the demonstrator for the DC application, any application specific differences should be discussed during the pre-application meetings. [Appendix A and Section 2.5]	Preliminary Design	P, N
1. $S = Site Owner, P = Plant Owner, O = Operator, B = EPCM/BOP designer, N = NHSS designer$			

Table C-3: NGNP Commercial Plant Design Certification Pre-application Issues

C-13 of C-14

Licensing Risk Reduction Study

Issue	Description	Proposed Project Stage for Resolution	Contributors (S, P, O, B, N) ¹
Conduct of the commercial plant DC program in concert with the NGNP COL technical review.	Obtain NRC feedback on the (1) current plan to start the commercial plant DC pre-application program near the end of the NGNP COL technical review and then complete the DC technical review within several months of having completed NGNP startup and (2) the underlying assumptions that NGNP is based on the PBMR technology, that PBMR is a good demonstrator for NGNP, that the commercial plant design is close to that of NGNP, and that NRC resources are available.	Conceptual Design	P, N
1. S = Site Owner, P = Plant Owner, O = Operator, B = EPCM/BOP designer, N = NHSS designer			

C-14 of C-14