Plan

NGNP Program Planning Bases for the Schedule and Cost Estimates





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NGNP PROGRAM PLANNING BASES FOR THE SCHEDULE AND COST **ESTIMATES**

Plan

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Next Generation Nuclear Plant Project

NGNP Program Planning Bases for the Schedule and Cost Estimates

PLN-2970

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Approved by:

Greg Gibbs, Project Director Next Generation Nuclear Plant Project

1D Date

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ABSTRACT

This document provides an update of the NGNP Program Plan Bases for the Schedule and Cost Estimates first issued November 24, 2008. This update is based on status at the end of FY2009 of the R&D, Design and Licensing activities of the Project, the plans going forward for these activities and discussions with the DOE-NE and the NGNP Industry Alliance. In this regard three alternative strategies for completing the NGNP Project are discussed.

- A DOE Strategy that is based on the DOE April 2010 Report to Congress and a schedule of activities for the NGNP Project provided to the INL Project by E-mail in September 2010. The DOE Strategy includes a competitive process during FY12 to establish a cooperative agreement for final design and licensing of the NGNP plant.
- Two INL Project Strategies that are similar to the strategy developed in the original issue of this Program Plan in November 2008. The INL strategies differ by whether one or two designs are carried through preliminary design before a decision is made on which design to complete. The strategy in which two plants are carried through preliminary design is recommended by INL. This was the strategy developed in the November 2008 program plan.

High level schedules, estimates of the Project cost-to-complete beginning in 2011 and cost shares of the government and the private sector are provided for these three alternative strategies.

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1. INTRODUCTION

The Next Generation Nuclear Plant (NGNP) Program [1] was initiated in accordance with the 2005 Energy Policy Act [2] (herein referred to as the EPAct) with an original objective to demonstrate the capability of the High Temperature Gas-cooled Reactor (HTGR) technology for the production of electricity and hydrogen in a plant to be sited at the Idaho National Laboratory (INL). As directed by the EPAct, the NGNP Project was initiated at the INL in 2006 to manage completion of this demonstration. The EPAct also specified that the management of the Project should include INL organizing a consortium of industrial partners (a public-private partnership) that will carry out cost shared research, development, design and construction activities. The EPAct also states that the activities of industrial partners funded by the Project shall be cost-shared in accordance with section 988. This consortium has been achieved via the formation of the NGNP Industry Alliance Limited. [3]

The INL NGNP Project completed pre-conceptual design work in FY07 to define the characteristics of HTGR plants based on prismatic block and pebble bed reactor technologies for electricity and hydrogen production. [4] In FY08 the NGNP Project continued with the Project R&D programs, addressed critical design issues identified in FY07, developed a Project licensing strategy, developed detailed work scopes to complete conceptual designs and prepared the initial revision of this program plan to complete the demonstration Project specified by the EPAct. [5] That program plan provided a high level schedule for the Project that included milestones for initiating the public-private partnership, completing the R&D programs and the licensing strategy and completing conceptual and preliminary design work necessary to support final design, licensing and construction of the HTGR first-of-a-kind (FOAK) plant. The plan also developed a best estimate cost to complete the project, a required funding profile over the Project term and the breakdown of the government and the private sector shares of the Project costs. The EPAct specified an initial plant operating date in 2021. The Project schedule in the original program plan was consistent with the EPAct requirement; resulting in an initial operating date for the FOAK plant by the end of FY21.

The purpose of this document is to revise Revision 0 of this program plan developed in 2008 to account for deviations from that program plan that affect the schedule and cost to complete the NGNP Project. In this revision three alternative strategies for completing the Project that have evolved since the original plan was developed in 2008 are evaluated. The principal difference in the strategies is the process for selecting the design for the NGNP Plant and the scope and schedule for completing conceptual and preliminary design work as follows:

- 1. The DOE Strategy that is based on the DOE April 2010 Report to Congress [16] and a schedule for the activities of this strategy provided to the INL Project by E-mail in September 2010. [6] According to this activity list a competitive process is completed in FY12 to select a plant for final design and licensing.
- 2. An INL Project Strategy similar to that presented in the original issue of this program plan in which two module designs are carried through the preliminary design phase prior to making a decision on which design to complete.
- 3. A modification to the INL Project Strategy that assumes the public-private partnership makes a selection of which design to complete early in the Project so that only one design is carried through the conceptual and preliminary design phases.

2. PROGRAM SCOPE CLARIFICATION

During the period 2008 to the present, the NGNP Project and the HTGR Suppliers collaborated with potential end users of the HTGR technology to understand their energy needs and to formulate functional

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and performance requirements for the HTGR plant that meet these needs. The results of these collaborations indicate that the industry needs are focused on obtaining a secure, non-greenhouse gas emitting supply of energy at a stable price. [8] In general, the nuclear energy supply would best serve these needs as a substitute for the burning of fossil fuels in industrial processes. The areas of interest to the private sector include co-generation supply of electricity, steam and high temperature process heat, production of ammonia and ammonia derivatives, (e.g., fertilizers), production of hydrogen, and conversion of coal to gasoline and diesel. Public sector uses have also been explored in support of DOD requirements for a stand-alone power source as an alternative to the electric grid and for synthetic fuel production. In addition, waste water recovery and desalinization are options for public utility usage. These collaborations also determined that the potential end users and owner/operator of an HTGR plant judge that the NGNP Project should be focused on commissioning the HTGR FOAK module as part of a multiple module plant in an industrial application rather than as a single demonstration plant at the INL. This is judged to be the most effective approach to applying the technology and resolving development, design, siting and licensing risks. The in-depth work and studies to date have provided the focus to clarify and re-align the objectives of the NGNP Project to the supply of steam, electricity and process heat in support of industrial applications rather than the more limited original objective of demonstrating electricity and hydrogen production. It is also through the detailed studies and field work with end-users that installation of the HTGR FOAK module in a multi-module plant is the preferred model for industrial application.

In April 2008 the DOE issued and evaluated expressions of interest (EOI) in pursuing the Project as outlined in the EPACt. [9] Responses to this EOI were received in June 2008. [10] The original program plan of November 2008 was developed to be consistent with responses to the EOI as reviewed by DOE in one-on-one conferences with selected responders. Subsequent to completing the program plan in November 2008 the projected design work has not progressed as outlined in that plan. Detailed design work was suspended in April 2009 by DOE and that suspension was in place until May 2010. Over that period DOE prepared, issued and evaluated proposals for a Financial Offer of Assistance (FOA) to complete a limited scope of conceptual design for the HTGR FOAK module. [11] This resulted in an award to General Atomics to prepare a conceptual design for a HTGR prismatic block reactor based plant. This award was made in May 2010; the conceptual design report is due to be issued December 31, 2010. [12] The DOE and Westinghouse/PBMR Pty (Ltd) team could not reach an agreement to complete a similar study for the pebble bed design. Accordingly, no award was made to develop a conceptual design based on the pebble bed reactor concept.

In this same time frame the Republic of South Africa decided to end support for development of the pebble bed reactor design. [13] The NGNP Project has initiated a task with AREVA to summarize the maturity of the pebble bed reactor designs. [14] This task was ongoing at the time of this writing. The Project is also exploring alternatives for going forward with the pebble bed design.

The public-private partnership has also not been formed.

An NGNP Industry Alliance Limited (Alliance) comprised of representative potential end users of the technology, representative potential owner-operators of the plant, representative organizations supporting the engineering and development of the technology and the HTGR Suppliers has been formed. This Alliance developed and submitted the Project Implementation Strategy to the DOE Secretary in November 2009. This Strategy included a detailed plan for completing the Project, including initiation of the partnership as soon as practical and proposed cost share provisions. Several follow-on letters have been submitted to DOE and the Congress thus far in 2010 re-iterating the Alliance's commitment to entering into a comprehensive partnership with the DOE. [15] To the time of this writing no action has

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been taken by DOE to initiate this partnership. The steps required to initiate this partnership are discussed later in this report.

3. .PROGRAM PLANNING OBJECTIVES

The following summarizes current objectives for completion of the NGNP Project to support planning for work to be completed prior to a public-private partnership or cooperative agreement being formed. These objectives have been revised from those stated in the 2008 Plan to reflect the current project status. These revisions are based on information considered by INL subsequent to the original issue of this program plan including the DOE April 2010 Report to Congress [16], the DOE's Project Activity Schedule of September 2010, selections from the responses received in June 2008 to the DOE's request for information and expressions of interest, the NGNP Industry Alliance's proposed Project Implementation Strategy submitted to Secretary Chu in November 2009, and discussions with industry representatives.

- 1. Completing Research & Development programs with scopes and in time frames sufficient to support design and licensing activities.
- 2. The EPAct states that design work shall be supported for up to four teams to develop detailed proposals for competitive selection of a single proposal for completing final design. This would take the designs through the preliminary design phase. The three alternative strategies address design work through preliminary as follows:
 - a) The DOE strategy down selects a design at the end of a year long competitive process starting at the beginning of FY12 prior to completing conceptual and preliminary design work. This selection would be made, therefore, at the end of FY12 and engineering work would start in 1Q FY13.
 - b) The INL NGNP Project Strategies propose that either one or two designs be carried through preliminary design. The strategy assumes that the public-private partnership will be initiated at the beginning of FY12. During the design phase potential owner/operators of the FOAK modules, sites, applications, end-users and license applicants would also be identified. Applications for combined construction and operating licenses would be prepared. During this period the selection of which design to carry forward would be made, appropriately, by the owner of the plant and the end-user based upon their industrial application. It is possible that if two designs are under consideration that owners could decide to complete final design, licensing, construction and operation of both designs.

For the INL Strategy it is assumed that preliminary design and licensing progress will be sufficient for:

- Selection by the nuclear plant owner of the design for completion of final design, licensing, construction and commissioning of the NGNP Project HTGR FOAK module.
- A decision by the nuclear plant owner and the site owner (end-user) of whether and where to construct the HTGR FOAK module.

For purposes of planning it has been assumed that preliminary design will be completed for all alternative strategies as necessary to support:

- Achieving the full range of functional and performance capabilities required to meet end user energy supply requirements
- Preparation of Early Site Permit(s) (ESP) and combined license (COL) application(s) for the design(s) in commercial application(s). As noted, this will require identification of

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the owner(s) of the plant(s), the site(s), the industrial application(s) that will be served by the plant(s) and the license applicant(s) during the course of preliminary design.

- 3. Submitting an Early Site Permit (ESP) and a Combined License (COL) application for construction and operation of a HTGR FOAK module as the beginning of a multi-module plant in a commercial application
- 4. Completing the design, licensing, construction, and commissioning of this module for initial operation as soon as practicable.
- 5. Completing inspections and tests during commissioning and the initial operating period required to remove any licensing conditions and permit unrestricted full power operation.

Table 1 compares this revision of the program plan with the November 2008 version including a brief explanation of differences.

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Table 1. Comparison of Revision 0 and Revision 1 Program Plans

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General

The NGNP Program Planning Bases have been updated to include the changes described in the following. These changes are based on information considered by INL subsequent to the original issue including the DOE NGNP Report to Congress dated April 2010, the DOE's Project Activity Schedule dated September 2010, selected responses received in June 2008 to the DOE's request for information and expressions of interest, the NGNP Industry Alliance's proposed Project Implementation Strategy submitted to Secretary Chu in November 2009, and discussions with industry representatives.

Complete preliminary designs for two plants

Complete preliminary designs for one or two plants

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The DOE Project Activities Schedule plan is to compete for the final design and licensing of only one design as the initial part of Phase 2 of the Project. The approach recommended by the INL NGNP Project includes an option to carry either one or two design concepts through preliminary design and then decide on the design based on competition of these more mature designs. This strategy assumes that a public-private partnership will exist and that its participating owners will choose the design(s) to be completed for the FOAK demonstration plant(s) – see following.

Partnership decides which plant to complete

Owner of plant(s) decides which plant(s) to complete

Since an objective of the Project is that the plant(s) ultimately built as an outcome of the Project will be in commercial application(s), it is expected that the cost for construction, commissioning and operation of the plant(s) will be borne by the owner(s). Although it is expected that the owner(s) of the plant(s) will be a part of the public-private partnership a distinction has been made in this revision of the objectives to acknowledge that the owner(s) will ultimately make the decision on whether and which design to construct and operate since they are paying those costs. It should be noted that it is possible that the owner(s) will be a consortium considering the extent and risk of the investment; the government could be a part of that consortium with an equity position or solely a partner in the partnership.

Develop up to 4 ESPs for varying sites and submit for NRC
reviewDevelop one ESP and multiple site hazards analyses for
varying sites

Developing and submitting four ESPs for NRC review is judged no longer necessary. The original objective of this effort was to bound the issues for siting the HTGR technology over the broad range of sites that are characteristic of the industrial market for this technology. This objective is now being fulfilled by site hazard analyses that are currently being performed by the Project over a wide range of sites. ESPs will be prepared for up to two candidate sites and only the ESP(s) for the plant(s) to be taken through final design, licensing, construction and operation would be submitted for NRC review.

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Prepare, submit and complete Design Certification applications for both plants	Design Certification is not being pursued by the Project
In discussions, the HTGR Suppliers have recommended that the Project They judge that the final design, construction and operation of the FOA a certification of the FOAK design; a lengthy and expensive process. In design, construction and operation phases of the Project, or later, whethe would be pursued	not pursue design certification for the first-of-a-kind (FOAK) plant. K plant will identify design changes that could require modification of stead, the Suppliers will make a decision at some point during the final er to pursue certification and the specific design for which certification
Prepare and submit ESP and COLA for one plant	Prepare and submit ESP(s) and COLA(s) for the selected plant(s)
If a strategy similar to that proposed by the INL NGNP Project is follow	red it is possible that the owners may decide to complete two plants.
Cost share based on best available information from DOE on cost share plan	Cost share plan based on revised DOE cost share model derived from discussions with DOE and is compared with the cost-share model proposed by the NGNP Industry Alliance in their Project Implementation Strategy of November 2009.
Cost share comparisons are based on best available information.	
Complete final design, construction and commissioning of one plant in commercial application by end of FY21; the EPAct Goal	Complete final design, construction and commissioning of FOAK module(s) as a part of multi-module plant(s) as soon as practicable
As is discussed later in this report delays in design work have extended	the best estimate schedule to complete the Project beyond the EPAct

goal of 2021.

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4. PROGRAM PLANNING ACTIVITIES/COST SHARE ARRANGEMENTS

For the purposes of developing the Program Plan including a Project schedule, cost to complete, the required funding profile and government and private sector cost shares for each alternative strategy, the specific Project scope activities listed in Table 2 have been identified. As cited previously, the EPAct specifies that the Project will be funded via an overall cost-sharing model between government and the private sector as defined in Section 988 of the Act. In summary, the EPAct states that at least 50% of the Project cost shall be borne by the private sector unless the terms are modified by the DOE Secretary. Table 2 summarizes assumed provisions of the cost share model for each activity based on:

- A nominal 50/50 government/private sector cost share apportionment. In discussions with the DOE they interpret that this requires that the private sector share be 50% of the Project cost on an annual basis.
- The terms proposed in the NGNP Project Alliance Project Implementation Strategy, November 2009. The Alliance proposes cost share terms that require the Government to fund a larger percentage of the initial design and licensing costs with the private sector assuming the full costs for final design, construction, commissioning and operation of the plant. This shifts the majority of the government share of funding to the early higher risk activities of the Project with the private sector taking ownership of the plant that is ultimately built, including responsibility for those costs associated with construction, initial commissioning and operation.

In either case, cost sharing begins once the public-private partnership or cooperative agreement is in place. As shown later the Alliance terms reduce the overall projected government share of the cost compared with the DOE terms.

The INL Project Strategies assume that the public-private partnership will be in place by the end of FY11 (9/30/2011). In the Project Implementation Strategy, the NGNP Industry Alliance recommends a structure for initiating a working group between government and industry. This working group can enable partnering and program oversight and collaboration to improve overall program management. It is anticipated that the cost share arrangements will ultimately be negotiated as part of developing the terms and conditions of the public-private partnership. The apportionments cited in Table 2 are assumed for the purposes of developing and comparing cost share breakdowns for the government and the private sector for the alternative Project Strategies. Only the 50/50 cost share provisions are used in developing the cost shares for the DOE Strategy.

We are not aware of any other cost share provisions that have been proposed for the NGNP Project.

5. PROJECT SCHEDULE

5.1 DOE Strategy for Completion of the NGNP Project

The DOE Strategy for completing the NGNP Project is based on the DOE April 2010 Report to Congress and an activity schedule provided by DOE in an E-mail to the Project in September 2010. This activity schedule revised the interval and milestone dates of a similar schedule included in the 2010 Report to Congress. This activity schedule is re-produced in Table 3. Figure 1 is a graphical

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representation of the activities and milestones of Table 3 beginning in FY 2010. As shown the DOE Strategy results in an initial operating date for the first HTGR module of 1Q FY23.

There are several elements of the DOE Strategy that likely would extend the schedule presented in Table 3:

- The limited cooperative agreement scope for final design and licensing as stated in the DOE Activity Schedule is not sufficient to support comprehensive private sector partnering and cost sharing. This may limit the responses during the competitive process from credible Teams placing the future of the Project in jeopardy.
- The design delays that have already occurred, (e.g., from April 2009 to late 2010) and the additional delays to accommodate the competitive process, (e.g., January 2011 to October 2012) result in:
 - Difficulty and likely more delays in re-mobilizing design teams at the end of the competitive process
 - Less effective licensing pre-application process because of lack of design information (less certainty); the 4 year NRC COLA review period will likely be longer because of these uncertainties
- The Schedule for design work of 24 months to prepare the COLA is optimistic (at least 18 months short). This would extend the schedule by at least this amount.

INL judges that an extension of the design work for preparation of the COLA by 18 months with an initial operating date of April 2024 is more likely for the DOE Strategy.

5.2 INL Project Strategy

The INL Project Strategies are similar to that developed in the original issue of this Program Plan. They have been modified for this revision of the program plan to account for work completed to date in R&D and Licensing, the results of the DOE FOA partial conceptual design activity in the first quarter of FY11 and the suspension by DOE of design work since FY09 except for that to be completed under the cooperative agreement that resulted from the 2010 FOA. Addressing this latter factor has extended the schedule to complete these strategies out a little over a year from that in the original plan. Figure 2 is a graphical representation of the activities and milestones of the Project's best estimate schedule for these strategies.

The INL Project schedule is applicable whether one or two plants are carried through preliminary design and preparation of ESP(s) and COLA(s). The INL recommends the Strategy which carries two designs through preliminary. This provides options for going forward, options for end user applications and an alternative if a major problem is identified in one of the design options.

The initial operating date for the INL Project Strategies is 3Q FY23. For this schedule to be achieved there are several key milestones that must be met:

• The completion of the conceptual design work which was initiated by the DOE FOA in FY12, and, if applicable, conceptual design on a second module, must begin no later than October 2011 with the objective of completing preliminary design(s) by the end of September 2014. The preliminary design work must be sufficient to support selection of a design and preparation and submittal of a COL application for the selected design. During

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this period ESP application(s) will also be prepared for submittal by the end of September 2014. This work is on the critical path through design, licensing, construction and commissioning to plant operation.

- The periods for completing conceptual and preliminary design by the end of September 2014 assume that this work begins with prior designs, (e.g., MHTGR and NPR for the prismatic reactor design, HTR-Modul or PBMR for the pebble bed design). If this work begins with newer designs the period for completing conceptual and preliminary design will be extended by at least two years.
- During this design phase the prospective owner(s) of the plant(s), the plant site(s), the license applicant(s), the industrial application(s) and end user(s) must be identified to support preparation of the ESP and COL application(s).
- The ESP and COL application(s) must be completed and submitted as scheduled so the NRC review can be initiated as scheduled and completed in time to support site work and construction. Any delay in submitting these applications will result in at least a comparable delay in initial plant operation.
- The Pre-application discussions need to be completed as scheduled to facilitate the review by the NRC of the key issues for which the Project has engaged with NRC through NGNP licensing white paper submittals, and continues to prepare position (white) papers. Failure to continue full engagement with the NRC in these areas may extend the NRC review of the COL application and delay receipt of the COL. Full construction on the plant cannot proceed until the COL is received. Any delay in receiving the COL will result in at least that much delay in the initial operation of the plant.
- Initiating the partnership in the beginning of FY12 is necessary to fully engage the private sector in completing the Project and to maintain the significant interest in the HTGR technology that has been evident in end user members' participation and support of the NGNP Industry Alliance and its activities. The full participation of the partnership is required to:
 - Ensure that the functional and performance requirements for the plants continue to be consistent with private sector needs
 - Bring the full private sector interests to bear in selecting the plant design to complete, to identify the owner, plant site, license applicant, industrial application and end user, and
 - Formulate the cost share provisions and get them in place as early as possible.
- There are several critical points throughout the project when a decision must be made to support going forward with the Project. Each of these decision points includes an off-ramp if the decision at some point is made to not go forward. These are shown with asterisks on the schedule in Figure 2 and include:
 - o Decision of the DOE Secretary to continue with the Project on August 31, 2011
 - Formation of the public-private partnership in the beginning of FY12
 - Selection of the prospective site(s), plant design(s) and license applicant(s) for preparation of COLA(s) and ESP(s) by January 1, 2012
 - Selection by the Owner of the design & site for the HTGR FOAK module by the end of preliminary design September 2014.

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[•] Decision to go forward with construction, commissioning and operation of the HTGR FOAK by the plant owner and the end user.

Finally, there must be continuity in DOE funding, (i.e., a mechanism must be in place to ensure annual appropriations that meet the Project needs). In this regard, the funding profiles judged by the Project that are necessary to support the Project's strategies for carrying one or two designs through preliminary design are summarized in a later section of this report. A DOE Strategy funding profile is also summarized based on the DOE Activities of September 2010 and discussions with DOE-NE. The DOE proposed funding in 2011 and 2012 do not cover the costs judged by the Project necessary to support activities other than reduced R&D. This is another potential deterrent in being able to achieve the Project best estimate schedule.

5.3 Comparing the Schedules

Figure 3 is a high level comparison of key milestones in the DOE Project schedule with the INL Project Schedule. The 6 month difference in the initial operating dates stems from the 42 month period that is provided in the INL Project Schedule to allow for completion of sufficient design work to prepare the COLA. Based on discussions with some of the HTGR Suppliers this period includes:

- One year to complete conceptual design work started by the DOE FOA cooperative agreement that will result in a conceptual design report by the end of December 2010.
- Two years to complete preliminary design including completing final design of safety related systems
- Six months after completion of preliminary design to complete preparation of the COLA.

This time frame compares with the 24 months of the DOE Project Schedule. There is only a 6 months difference in the initial start date of the two schedules because preparation work to support preparation of the COLA starts a year later in the DOE Strategy than in the INL Strategy.



Figure 1. DOE Activity Schedule of September 2010

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Figure 2. INL Project Strategy Schedule.

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Figure 3. A High Level Comparison of the DOE Schedule with the INL Project Strategy Schedule

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Table 2. NGNP s	pecific Projec	scope activities	and the DOE an	d Private Sector	cost share arrangements.
	. ,				

	Anticipated Cost Share Arrangements			
	DOE 50	/50 Cost	Alliance Cost Share	
	Share Terms		Terms	
Activity				
	DOE Cost Share	Private Sector Cost Share	DOE Cost Share	Private Sector Cost Share
Perform a competitive process to select the design to go forward with the Project				
Form the Public Private Partnership or select successful bidder to continue the project	N/A	N/A	N/A	N/A
Complete Conceptual Design of one or two nuclear HTGR systems and the balance of plant configuration sufficient to meet the full range of end user functional and performance requirements. The assumption that this work can be completed in one year is based on starting with existing plant designs, (e.g., MHTGR, NPR, HTR-Modul, PBMR). Starting with a newer design would add at least a year to complete conceptual design	100%	0%	100%	0%
Preliminary Design of one or two nuclear HTGR systems. and the balance of plant configurations sufficient to meet the full range of end user functional and performance requirements. As discussed below this work scope will also include preparing ESP and COL application(s) for the plant(s). This will require identifying the nuclear plant owner(s), site(s), plant requirements, industrial application(s) and end user(s) and license applicant(s) for the plant(s). The assumption that this work can be completed in two years is based on starting with existing plant designs, (e.g., MHTGR, NPR, HTR-Modul, PBMR). Starting with a newer design would add at least a year to complete preliminary design.	50%	50%	80%	20%
Continuing the Pre-application discussions with the NRC including disposition of submitted white papers on key issues, completion of the regulatory gap analysis, and resolution of requests for additional information. This effort was started in FY09. Costs for this activity include NRC fees. It is assumed that the pre-application discussions will be complete by the time the COLA is submitted.	100% up to partner- ship; 50% there-after	0% up to partner- ship; 50% there-after	100%	0%
Preparing Early Site Permit(s) (ESP) for the plant design(s) during preliminary design work. The ESP(s) will focus on work necessary to validate the site(s) for the HTGR plant(s) and to develop emergency planning to the extent supported by development of the design(s). The ESP for the selected plant will be submitted at the end of Preliminary Design.	50%	50%	100%	0%

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	Anticipated Cost Share Arrangements				
Activity	DOE 50/50 Cost Share Terms Terms				
	DOE Cost Share	Private Sector Cost Share	DOE Cost Share	Private Sector Cost Share	
Preparing Combined Operating License (COL) application(s) for the plant design(s) during preliminary design work. Work on the COL application for the selected plant will continue for six months after the completion of preliminary design; at which time it will be submitted.	50%	50%	100%	0%	
Preparing and submitting state, local and EPA permit applications and coordinating with the state, local and EPA offices to obtain necessary permits for initiating site work.	50%	50%	0%	100%	
NRC review of the ESP and COL applications. About 2-1/2 to 3 years is assumed for the reviews and issue of the ESP. It is assumed that the COL application review will take 4 years (consistent with the estimates developed in the DOE-NRC Licensing Strategy). Issue of the COL is required to begin full construction activity. Since the ESP will be submitted 6 months before the COL application, the total time for NRC review is 4-1/2 years.	50%	50%	100%	0%	
Design engineering support to respond to NRC RAIs and other activities during the review process.	50%	50%	80%	20%	
Completing the final design of the selected plant. The majority of final design will take place in the first four years of this activity. Final design is shown as extending throughout construction to support resolution of field changes. The end date for final design is, therefore, not specific.	50%	50%	0%	100%	
Procurement of components, systems and commodities for the HTGR plant construction. This is started early in the final design phase to cover long lead items such as the reactor pressure vessel. Recent experience indicates that early commitment to a date for the RPV, for example, is required because of significant schedule backups in the large foundarys and fabrication shops. The end date of procurement will depend on the detail construction schedule so is not specific in this high level schedule.	50%	50%	0%	100%	
Construction and commissioning of the selected plant. This includes early site work.	50%	50%	0%	100%	
NRC reviews during construction, commissioning and ITAAC closure prior to initial fuel load and initial plant operation.	50%	50%	0%	100%	

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	Anticipated Cost Share Arrangements				
Activity	DOE 50 Share	/50 Cost Terms	Alliance Cost Share Terms		
	DOE Cost Share	Private Sector Cost Share	DOE Cost Share	Private Sector Cost Share	
"Owner's cost" including Project Management, interfaces between the DOE and the Private Sector within the Private- Public-Partnership, cost and schedule tracking and progress reporting, project and personnel management, Project Engineering (e.g., engineering required to provide Owner's Engineer functions), coordination with the NRC, State and Local governments.	100% up to partner - ship and 50% there- after	0% up to partner-ship and 50% there-after	80%	20%	
Initial Operating Period including the inspections and tests needed to resolve licensing conditions to permit unrestricted full power operation. It is assumed that all of the costs will be borne by the private sector. It is also assumed that the plant will generate revenue which will accrue to the private sector and offset the costs.	50%	50%	0%	100%	
NGNP Research and Development Programs for fuel. graphite and high temperature material qualification and validation of analytic methods in support of the Project	80%	20%	100%	0%	

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Table 3.	DOE NGNP	Project A	Activity	Schedule	Submitted	to the	Project	Septembe	r 2010
		5	2				5	1	

Date	Activity	Туре
2005-08/31/2011	Phase 1	Activity
08/2009	Select and validate appropriate hydrogen production technology (high-temperature electrolysis was selected)	Critical Decision Point
2005–2022	Carry out enabling R&D and demonstration activities	Activity
2005–2009	Carry out initial design activities for a prototype reactor and plant	Activity
9/18/2009	Issue FOA for competition to complete conceptual designs	Milestone
11/16/2009	Receive responses to FOA	Milestone
05/25/2010	Issue award under the FOA	Milestone
05/26/2010 - 12/15/2010	Complete conceptual design report	Activity
12/31/2010	Detailed conceptual design report due to DOE	Milestone
09/30/2010 - 4/30/2011	Conduct NEAC review	Activity
05/15/2011	NEAC recommendation to the Secretary on proceeding to Phase 2	Milestone
05/31/2011	Submit NEAC report to Congress	Milestone
08/31/2011	Secretary of Energy's announcement on path forward to Phase 2	Critical Decision Point
09/01/2011-2022	Phase 2*	Activity
10/01/2011– 09/30/2012	Competition process for Phase 2 Award*	Activity
10/01/2012	Sign cooperative agreement for final design and licensing*	Milestone
10/02/2012– 09/29/2014	Prepare COLA*	Activity
09/30/2014	Submit COLA*	Milestone
10/01/2014– 09/30/2018	The NRC to review COLA*	Activity
10/01/2018	The NRC to issue COL*	Milestone
2018	Start of construction*	Milestone
2021–2022	NRC inspections, tests, analysis, acceptance criteria*	Activity
2022	NGNP operational*	Milestone

* Dependent on Secretarial Decision

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INITIATING THE PUBLIC-PRIVATE PARTNERSHIP 6.

The INL Project Strategy assumes that the public-private partnership is initiated at the beginning of FY12. The DOE Strategy enters into a cooperative agreement with the successful team to complete final design and licensing as the culmination of a competitive process held in FY12. The INL Project Strategy assumes an earlier initiation of the partnership for several reasons:

- The partnership provides a framework in which major decisions can be made, for example, on establishing go-forward and off-ramp criteria
- The partnership will establish the terms and conditions for cost sharing •
- An early comprehensive partnership ensures that future financial partners have a formal • framework for the project in which they will invest
- Initiation of the partnership and agreement on the terms and conditions begins to build confidence • in the future financial partners of the government commitment to support completion of the Project

To achieve initiating the partnership in the beginning of FY12, the process for its initiation must begin as soon as possible. The steps necessary for its initiation include:

- Preparation and issue of a Financial Offer of Assistance (FOA) for the partnership. A Draft of such an FOA has been provided to DOE-NE
- Review and evaluation of responses from credible Teams to the FOA ٠
- Selection of the Team(s) for the partnership •
- Negotiation of terms and conditions •

It is expected that this process will take between 9 and 12 months to complete. If the process were initiated within the month it would be near completion at the time the DOE Secretary is to announce the decision on the future of the Project. There would be no obligation prior to that time by either the government or the private sector except to go-forward with the partnership when the Secretary decides to enter into Phase 2 of the Project. Assuming that the terms and conditions have been successfully negotiated the partnership would then be in place.

To achieve an adequate partnership the FOA must have the following attributes:

- It must cover the entire Project, including design, licensing, construction and initial operation •
- Accordingly it must extends for the life of the Project; currently ~15 years •
- It shall define: •
 - The management structure for the Project
 - The roles of government and private sector in partnership 0
 - Major decision points and criteria for those decision points, (e.g., selection of design to 0 be completed; site for preparation of COLA; decision to construct; acceptable economic results to support decisions, private sector investor consortium requirements)

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- The approach for including all credible private sector participants end-users, owners, investors, nuclear system suppliers, fuel suppliers, equipment suppliers
- Details cost sharing model including recovery of investment considerations
- Finally, it must establish requirements for continued and assured funding for federal and nonfederal cost sharing, (e.g., as cited previously, a mechanism must be established to ensure necessary annual appropriations that match the annual funding requirements).

7. ESTIMATE of COST to COMPLETE

7.1 Elements of the Estimate

The following summarize the basic elements of the estimate to complete and the bases for the 2010 estimate. These estimates are essentially independent of the strategy used to complete the project.

7.1.1 Project Management & Owners Costs

Project management costs were broken out of each of the remaining elements of the cost estimate and a rate of \sim 9% of the total of the remaining elements was assessed throughout the Project. This is a representative value based on experience to-date and estimates made in the pre-conceptual design work in FY07. As the design progresses and better schedules are developed and resource loaded this estimate will be revised as necessary.

7.1.2 Research and Development

The NGNP Project R&D program has four parts [17]:

- <u>Fuel</u> -- Qualification of TRISO-coated fuel performance and production and fission product transport mechanisms through extensive irradiation and post-irradiation testing
- <u>Graphite</u> -- Development of Code (ASTM & ASME) sections for characterizing and establishing production methods, design processes and design limits for core graphite and completing irradiation and post-irradiation testing to qualify graphite
- <u>High Temperature Materials</u> -- Completing testing required to develop and extend ASME Code cases for high temperature metallic materials to be used in the HTGR
- <u>Methods</u> -- Development and verification and validation of thermal, hydraulic, structural and physics codes used in the design of the HTGR

The planning and budgets for these phases of the program are updated on an annual bases. They are summarized as follows for 2011-2025:

Program	FY10 Estimate, \$M (2009\$)
Fuel	238
Graphite	99
High Temperature Materials	28
Design Methods and Validation	97
Total	452

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For planning purposed, R&D is assumed to continue under the schedules developed in the R&D Program Plans independent of the strategy, (i.e., DOE Strategy or INL Project Strategy) completed.

7.1.3 Design

The design effort has been characterized in three phases – Conceptual, Preliminary and Final. The estimates for this effort have evolved from the initial estimates developed in the pre-conceptual design work in FY07, which assumed that the HTGR would support production of electricity and hydrogen in a demonstration plant to be located at the Idaho National Laboratory. In the subsequent years, as cited previously, the evaluations by the Project and the Suppliers of HTGR technology to identify the energy needs of potential end users have revised the objective of the Project to develop a module design that will supply steam, electricity and high temperature gas for use in a wide range of industrial facilities. Additionally, it has been assumed that the initial module designs operated by the Project would be in an industrial application. These revisions of the objectives of the Project led to modification of the costs for completing design work.

Depending on the strategy, one or two plant designs will be carried through preliminary design.

- Under the DOE Strategy one design will be carried through the design phases. This design would be selected prior to completing these design phases using a competitive process that completes at the end of FY12.
- For the INL Project Strategies one or two module designs will be carried through preliminary design. At the end of preliminary design, if two designs were in play, a decision would then be made on which design to complete final design, licensing, construction, commissioning and operation.

The total design costs for each alternative strategy, therefore, include conceptual design for one or two plants, preliminary design for one or two plants and final design for one plant.

Under the cooperative agreement that resulted from the DOE FOA ~\$20M will have been spent by the end of CY10 on conceptual design of one of the plants. Accordingly, the cost to complete for this plant will be lower by \$20M.

The following summarize the FY10 estimates for this work over the period 2011-2022. Note that the costs for "Design #2" do not apply for those alternative strategies in which only one design is carried through the conceptual and preliminary design phases.

Itom	FY10 Estimate, \$M (2009\$)		
Item	Design #1	Design #2	
Complete Conceptual Design ^a	84	104	
Preliminary Design	182	182	
Final Design	296		

^a This estimate accounts for the ~20M supplied by the DOE FOA to initiate conceptual design in FY10

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The DOE Strategy assumes that the conceptual design work completed under the FOA cooperative agreement is sufficient. Accordingly, this strategy cost includes only preliminary and final design work. This reduces the design costs for this strategy compared with the INL single plant strategy by \$84M, (i.e., the conceptual design cost after accounting for the work done under the FOA cooperative agreement). However, preliminary design work would not be started until FY13. It is assumed that general engineering work would be completed by the NGNP Project over this period. Based on discussions with DOE, \$16M (2009\$) has been assumed for this engineering work in the latter part of FY11 and FY12.

Under the INL Project Strategies conceptual and preliminary design work is assumed to initiate in October 2011 to be complete by the end of September 2014. For these strategies the conceptual and preliminary design costs summarized above are assumed to be expended over this period.

Process Heat Applications

In FY08 a decision was made to support development of the hydrogen processes and the heat transport system with emphasis on intermediate heat exchanger design required for process heat applications. This effort also includes evaluating the technical and economic viability of integrating the HTGR technology with conventional industrial processes, (e.g., hydrogen production using steam methane reforming). [18] In FY10 continuing effort on hydrogen process development was focused on the high temperature steam electrolysis process on the basis of recommendations from an expert panel review of the prospective processes. [19] The program addressing the heat transport system includes collaboration with university partners for testing of heat exchanger designs and fabrication techniques. The estimate to complete the full program of Process Heat Applications including demonstrations is ~\$200M (2009\$) over the 2011 to 2022 time frame.

7.1.4 Licensing

The licensing cost estimate to complete includes the following effort as part of the NGNP Licensing Plan [20]. This effort is assumed to continue under the schedule developed in the Licensing Plan independent of which strategy is completed.

- <u>Pre-Application</u> Continuing with the current pre-application activities in which key issues affecting the licensing of the HTGR technology are discussed and resolved with the NRC. In this period the Project will support disposition of submitted licensing White Papers covering these issues, as summarized in the NGNP Licensing Plan, (e.g., Fuel Qualification, Mechanistic Source Terms, Licensing Basis Event Selection, Classification of Structures, Systems and Components, Multiple Module Applications, PRA). The objective in submittal and discussions of these white papers with the NRC is to obtain agreement with the NRC that the approach to be taken by the Project in addressing these areas is acceptable. During the later COL application review process, the NRC will review how these issues have been addressed specifically in the COL application and supporting documents as part of the process for approving the design and issuing a COL.
- <u>ESP</u> -- Preparing Early Site Permit (ESP) application(s) for the plant design(s) during the preliminary design work.
- <u>COLA</u> Preparing Combined Operating License (COL) application(s) for the plant design(s). The COLA(s) will be prepared using a modification of Reg. Guide 1.206 that will establish a COLA writer's guide for high temperature gas cooled reactors. The revised writer's guide will be developed by the NGNP Project and the NRC during the pre-application period.

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- <u>COLA Review</u> The Partnership (Applicant) will support the NRC review and approval of the COLA for the selected plant through the receipt of a COL. This will include responding to requests for additional information (RAIs) and resolving open issues. Some of these may be identified and characterized through associated NRC license conditions imposed during initial plant operation.
- <u>Initial operation</u> -- The license conditions developed during the COLA review period that require operation of the plant to close to achieve unrestricted full power operation will be closed through monitoring of performance, special tests (if required) and special inspections (if required).

The following summarize the FY10 estimate to complete this effort. These estimates include NRC fees.

Item	ESP and COLAs prepared for Two Plants FY10 Estimate, \$M (2009\$)	ESP and COLA prepared for One Plant FY10 Estimate, \$M (2009\$)
Pre-Application	45	30
ESP & COLA Prep	153	69
ESP & COLA Review by NRC	108	108
Support during construction & Initial		37
operation	37	
State & local permitting	3	3
Totals	345	246

7.1.5 **Procurement and Construction**

The costs for procurement of equipment and material and construction labor were developed assuming that the first of a kind module would have a rating of 600 MWth supplying steam and electricity to an industrial facility. These costs are developed from reconciliation of the several cost estimates developed during the FY07 pre-conceptual design work, modifications to those estimates made over the subsequent three years wherein the objectives for the plant were re-defined and historical cost estimates for similar plants, (e.g, the Modular High Temperature Gas-cooled Reactor plant developed for the DOE by General Atomics in the late 1980s.).

The following summarizes the FY10 estimate for procurement and construction of a single HTGR FOAK module as part of a multiple module plant in a commercial application:

Item	FY10 Estimate, \$M (2009\$)
Procurement	1,099
Construction Labor	628
Totals	1,727

The costs and durations for completion of procurement and construction are the same independent of which strategy is completed. The dates for completing procurement and construction are different for the DOE Strategy and the INL Project Strategies as shown in Figures 1, 2 and 3.

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7.1.6 Commissioning

Startup testing and commissioning of the plant for initial startup are estimated to cost \$54M (2009\$) based on estimates developed for this work during the FY07 pre-conceptual design work.

7.1.7 Initial Operation

The costs for the initial three year operating period include normal fixed and variable O&M, refueling and special inspections and tests. These costs are offset by revenues generated during the three year initial operating period. The following table summarizes the cost estimates for this period. The revenues are discussed below.

Item	Cost Estimate, \$M (2009\$)
Maintain License & Permits	21
Environment, Health & Safety	30
Security	30
Training	9
Operate the plant	41
Maintain the plant	39
Shutdowns & Inspections	37
Refueling	118
Plant Modifications	53
Waste Management	44
Total	422

Revenues for the three year operating period are based on sales of electricity at the net rating of the plant (212Mwe for a 600 Mwt Plant) and capacity factors of 40%, 70% & 55%, respectively. The first year capacity factor assumes typical first-of-a-kind startup problems and an extended period for increase in power to full power as licensing conditions imposed during the NRC reviews during construction are resolved. The second year includes some testing. The third year includes a three month inspection period and plant refueling. A total revenue of 264M (2009) is estimated using a delivered electricity price of -886/MWhe.

These costs are applied only to the INL Project Strategy. In discussions with the DOE these are not covered in the DOE Strategy.

7.2 Total Project Cost Estimate

The following summarizes the FY10 NGNP Project estimate for each element of the NGNP Project cost for the three alternative strategies. Note that because the DOE Strategy does not include the costs associated with the initial three year operating period of the first HTGR plant, this reduces the total cost of that strategy relative to the INL Project Strategies by ~\$150M. The total engineering costs for the DOE Strategy is lower than the INL Project Strategy for the single plant alternative since it does not include any additional conceptual design work. The total costs range from ~\$3.4B to ~\$4.0B depending on the strategy.

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Item	One Plant Design DOE Strategy Estimate to Complete \$M (2009\$)	Two Plant Design INL Project Strategy Estimate to Complete \$M (2009\$)	One Plant Design INL Project Strategy Estimate to Complete \$M (2009\$)
Project Management / Owners Costs	\$286	\$341	\$306
R&D	\$452	\$452	\$452
Engineering	\$493	\$848	\$562
Licensing	\$246	\$345	\$246
Procurement & Construction	\$1,727	\$1,727	\$1,727
Startup & Test	\$54	\$54	\$54
Process Heat Applications	\$201	\$201	\$201
Initial Operation & Inspections	\$0	\$158	\$158
Total	\$3,459	\$4,127	\$3,707

Table 4. Summary of NONF Floject Estimate to Complete by Activity	Table 4. Summary	of NGNP I	Project	Estimate to	Complete by	v Activity ^b
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8. FUNDING PROFILES and COST SHARE BREAKDOWNS

The following figures and tables summarize the required funding and cost share profiles for the three alternative strategies. The costs used to develop the funding profiles and the cost shares for each strategy are in constant 2009\$. They are based principally on cost estimating work performed as part of the pre-conceptual design work in FY-07 modified as required to reflect the changes in the plant functional and performance requirements in FY08 and FY09. These are gross estimates used for the planning purposes of this paper. They will be refined as the Project progresses.

Depending on the strategy, at the completion of preliminary design when a single plant has been selected and a decision is made to go forward with the project (end of FY14) a total of \$673M to \$975M would have been expended on the Project. If the DOE 50/50 cost share terms are in place and the public-private partnership is in place by the beginning of FY12, the government share of that cost would be \$438M to \$825M; the private sector share would be \$203M to \$382M. If the Alliance cost share terms are in place for the INL Project Strategies the government share would be \$438M to \$586M and the private sector share would be \$91M to \$150M.

^b It should be noted that the values shown to three significant digits in this table and following tables is an artifact of the computer program used to develop the funding profiles and the tables. The presentation of values to three significant figures is not intended to portray that level of confidence in these values. The individual values may not sum to the total due to round-off.

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As summarized in Table 4, the total Project cost to complete is estimated at~\$3.4B to ~\$4B (2009\$) depending on the strategy. Tables 5 to 9 summarize the annual funding profiles and the breakdown in the estimated government and private sector shares of the total Project costs for the three strategies.

- For the DOE proposed 50/50 cost share terms the government share is estimated at ~1.9B to~\$2.2B or ~55% of the total.
- For the Alliance proposed cost share terms the government share of the total costs is estimated at ~\$1.1B to ~\$1.5B or 30% to 37% of the total. In this case, the private sector share of ~\$2.5B includes the full cost for final design, construction, commissioning and initial operation of the plant.

The increase in the government share stems primarily from the government sharing in the cost of constructing and operating the plant

Figures 4 through 8 summarize the estimated government and private sector funding requirements by year for the period 2011-2025 (2009\$) for the three strategies. Both cost share terms are shown for the INL Project Strategies. Only the DOE 50/50 cost share terms are shown for the DOE Strategy.

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20. NGNP Licensing Plan (June, 2009)

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Table 5. DOE Strategy, Single Plant Design

NGNP Project Annual Funding Requirements by Project Cost Element, DOE Proposed 50/50 Cost Share (Does not include plant initial operating period 4/2024-4/2027; 2011 and 2012 funding based on appropriation of \$103M versus \$85M)

ltem	Cost to Complete (2010 - 2024) 2009\$	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Project Management (2009\$)	286	8	8	21	21	14	18	29	44	44	37	31	10
Research & Development (2009\$)	452	59	57	65	68	76	37	26	18	16	16	14	0
Engineering (2009\$)	494	7	8	91	91	30	59	74	74	30	15	15	0
Non-Selected Plant Design thru Preliminary	0	0	0	0	0	0	0	0	0	0	0	0	0
Licensing (2009\$)	246	6	6	43	43	27	28	28	27	9	9	9	9
Procurement (2009\$)	1,099	0	0	0	0	0	52	173	326	362	157	29	0
Construction Labor (2009\$)	628	0	0	0	0	0	0	12	30	59	188	251	88
S/U Test (2009\$)	54	0	0	0	0	0	0	0	0	0	21	21	12
Initial Operations (2009\$)	0	0	0	0	0	0	0	0	0	0	0	0	0
Income during Initial Operations (2009\$)	0	0	0	0	0	0	0	0	0	0	0	0	0
Process Heat Application (2009\$)	201	14	17	35	35	26	24	14	14	8	7	7	0
Project Total Estimate, (2009\$)	3,459	93	97	255	258	173	218	357	533	528	451	379	118
Project Accumulative (2009\$)	.,	93	190	445	703	876	1,094	1,451	1,983	2,511	2,962	3,340	3,459
Government Funding (2009\$) Government Funding Accumulative	1,946 0	93 93	97 190	169 358	150 508	109 617	120 737	186 924	272 1195	268 1464	230 1694	193 1887	59 1946
Private Sector Funding (2009\$) Private Sector Funding Accumulative	1,512 0	0	0	86 86	109 195	64 259	98 357	170 527	261 788	259 1047	221 1268	185 1453	59 1512

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Table 6. INL Project Strategy, Single Plant DesignNGNP Annual Funding Requirements by Project Cost Element, DOE Proposed 50/50 Cost Share

ltem	Cost to Complete (2010 - 2024) 2009\$	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Project Management (2009\$)	306	7	10	20	18	21	15	15	28	37	42	35	31	9	-1	3	16
						=			10	10	10						
Research & Development (2009\$)	452	59	57	65	68	76	37	26	18	16	16	14	0	0	0	0	0
Selected Plant Design (2009\$)	562	0	21	109	68	98	59	74	74	30	15	9	6	0	0	0	0
Non-Selected Plant Design thru Preliminary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Licensing (2009\$)	246	6	13	20	34	31	19	28	33	29	4	5	5	5	5	5	4
Procurement (2009\$)	1,099	0	0	0	0	0	26	26	162	301	362	168	55	0	0	0	0
Construction Labor (2009\$)	628	0	0	0	0	0	0	0	12	30	59	188	251	88	0	0	0
S/U Test (2009\$)	54	0	0	0	0	0	0	0	0	0	0	0	21	21	12	0	0
Initial Operations (2009\$)	422	0	0	0	0	0	0	0	0	0	0	0	0	17	59	123	223
Income during Initial Operations (2009\$)	-264	0	0	0	0	0	0	0	0	0	0	0	0	-26	-92	-92	-53
Process Heat Application (2009\$)	201	14	17	35	35	26	24	14	14	8	7	7	0	0	0	0	0
Project Total Estimate, (2009\$)	3,707	86	118	248	223	252	179	183	340	449	505	428	369	115	-17	39	190
Project Accumulative (2009\$)		86	204	452	675	927	1,106	1,289	1,629	2,078	2,583	3,011	3,381	3,495	3,478	3,517	3,707
Covernment Funding (2000¢)	2.045	90	70	442	422	140	404	400	475	220	057	249	405	67		20	05
Government Funding (2009\$)	2,015	86	162	306	438	586	687	787	962	229	257	218 1667	1851	57	-9 1900	20 1920	95 2015
		00	102			000	007	101	302	1131	1440	1007	1001	1303	1300	1520	2010
Private Sector Funding (2009\$)	1,693	0	42	105	91	103	79	84	165	220	248	210	185	57	-9	20	95
Private Sector Funding Accumulative	0	0	42	147	238	341	419	503	667	887	1135	1345	1530	1587	1578	1598	1693

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Table 7. INL Project Strategy, Single Plant DesignNGNP Annual Funding Requirements by Project Cost Element, Alliance Proposed Cost Share

ltem	Cost to Complete (2010 - 2024) 2009\$	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Project Management (2009\$)	306	7	10	20	18	21	15	15	28	37	42	35	31	9	-1	3	16
Research & Development (2009\$)	452	59	57	65	68	76	37	26	18	16	16	14	0	0	0	0	0
Selected Blant Design (2000\$)	560	0	21	100	69	00	50	74	74	20	15	0	6	0	0	0	0
	302	0	21	103	00	30	39	74	74	- 50	15	3	0	0	0	0	0
Non-Selected Plant Design thru Preliminary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			10				10					_	_	_	_		
Licensing (2009\$)	246	6	13	20	34	31	19	28	33	29	4	5	5	5	5	5	4
Procurement (2009\$)	1,099	0	0	0	0	0	26	26	162	301	362	168	55	0	0	0	0
	, í																
Construction Labor (2009\$)	628	0	0	0	0	0	0	0	12	30	59	188	251	88	0	0	0
							_	_	_								
S/U Test (2009\$)	54	0	0	0	0	0	0	0	0	0	0	0	21	21	12	0	0
Initial Operations (2008\$)	422	0	0	0	0	0	0	0	0	0	0	0	0	17	50	123	223
	744	0	0	0	0	0	0	0	0	0	0	0	0	17		125	225
Income during Initial Operations (2009\$)	-264	0	0	0	0	0	0	0	0	0	0	0	0	-26	-92	-92	-53
															_		
Process Heat Application (2009\$)	201	14	17	35	35	26	24	14	14	8	7	7	0	0	0	0	0
Project Total Estimate. (2009\$)	3.707	86	118	248	223	252	179	183	340	449	505	428	369	115	-17	39	190
Project Accumulative (2009\$)		86	204	452	675	927	1,106	1,289	1,629	2,078	2,583	3,011	3,381	3,495	3,478	3,517	3,707
Government Funding (2009\$)	1,142	86	106	209	187	191	80	71	74	41	43	38	15	2	0	0	0
Government Funding Accumulative	0	86	192	401	588	779	859	929	1003	1044	1086	1124	1139	1142	1142	1142	1142
Drivete Sector Euroding (2000\$)	2 500	0	42	20	20	64	00	442	2000	400	400	200	254	440	47	20	400
Private Sector Funding (2009)	2,500	0	13	51	30	148	247	360	626	1035	402 1497	1887	2241	2354	2337	2376	2566
i invate dector i unung Accumulative	0	0	15	31	07	140	241	000	020	1000	1431	1007	2241	2004	2007	23/0	2300

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Table 8. INL Project Strategy, Two Plant DesignNGNP Annual Funding Requirements by Project Cost Element, DOE Proposed 50/50 Cost Share

ltem	Cost to Complete (2010 - 2024) 2009\$	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Project Management (2009\$)	341	7	13	33	28	29	15	15	28	37	42	35	31	9	-1	3	16
									10	10	10						
Research & Development (2009\$)	452	59	57	65	68	76	37	26	18	16	16	14	0	0	0	0	0
Selected Plant Design (2009\$)	562	0	21	109	68	98	59	74	74	30	15	9	6	0	0	0	0
Non-Selected Plant Design thru Preliminary	286	0	26	124	68	68	0	0	0	0	0	0	0	0	0	0	0
Licensing (2009\$)	345	8	23	38	69	58	26	28	33	29	4	5	5	5	5	5	4
Procurement (2009\$)	1,099	0	0	0	0	0	26	26	162	301	362	168	55	0	0	0	0
Construction Labor (2009\$)	628	0	0	0	0	0	0	0	12	30	59	188	251	88	0	0	0
S/U Test (2009\$)	54	0	0	0	0	0	0	0	0	0	0	0	21	21	12	0	0
Initial Operations (2009\$)	422	0	0	0	0	0	0	0	0	0	0	0	0	17	59	123	223
Income during Initial Operations (2009\$)	-264	0	0	0	0	0	0	0	0	0	0	0	0	-26	-92	-92	-53
Process Heat Application (2009\$)	201	14	17	35	35	26	24	14	14	8	7	7	0	0	0	0	0
Project Total Estimate. (2009\$)	4.127	88	157	403	335	355	188	183	340	449	505	428	369	115	-17	39	190
Project Accumulative (2009\$)		88	245	648	983	1,338	1,526	1,709	2,048	2,498	3,003	3,431	3,800	3,915	3,898	3,937	4,127
Government Funding (2009\$)	2.225	88	96	221	188	200	105	100	175	229	257	218	185	57	-9	20	95
Government Funding Accumulative	0	88	184	404	592	793	898	997	1172	1402	1659	1877	2062	2119	2111	2130	2225
Private Sector Funding (2009\$)	1,902	0	61	182	147	155	83	84	165	220	248	210	185	57	-9	20	95
Private Sector Funding Accumulative	0	0	61	243	391	545	628	712	876	1096	1344	1554	1738	1796	1787	1807	1902

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Table 9. INL Project Strategy, Two Plant DesignNGNP Annual Funding Requirements by Project Cost Element, Alliance Proposed Cost Share

ltem	Cost to Complete (2010 - 2024) 2009\$	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Project Management (2009\$)	341	7	13	33	28	29	15	15	28	37	42	35	31	9	-1	3	16
Research & Development (2009\$)	452	59	57	65	68	76	37	26	18	16	16	14	0	0	0	0	0
Selected Plant Design (2009\$)	562	0	21	109	68	98	59	74	74	30	15	9	6	0	0	0	0
	002	Ū	21	100	00	00	00	14		00	10	0	0	U U	Ū	Ū	Ŭ
Non-Selected Plant Design thru Preliminary	286	0	26	124	68	68	0	0	0	0	0	0	0	0	0	0	0
	0.45	•		10	70	50	40				<u> </u>		_	_	-	_	
Licensing (2009\$)	345	9	24	40	70	59	19	28	33	29	4	5	5	5	5	5	4
Procurement (2009\$)	1,099	0	0	0	0	0	26	26	162	301	362	168	55	0	0	0	0
Construction Labor (2009\$)	628	0	0	0	0	0	0	0	12	30	59	188	251	88	0	0	0
		_													10		
S/U Test (2009\$)	54	0	0	0	0	0	0	0	0	0	0	0	21	21	12	0	0
Initial Operations (2009\$)	422	0	0	0	0	0	0	0	0	0	0	0	0	17	59	123	223
Income during Initial Operations (2009\$)	-264	0	0	0	0	0	0	0	0	0	0	0	0	-26	-92	-92	-53
Process Heat Application (2009\$)	201	14	17	35	35	26	24	14	14	8	7	7	0	0	0	0	0
······································										-			-	-	-	-	-
Project Total Estimate, (2009\$)	4,127	89	159	404	337	357	179	183	340	449	505	428	369	115	-17	39	190
Project Accumulative (2009\$)		89	248	653	990	1,346	1,526	1,709	2,048	2,498	3,003	3,431	3,800	3,915	3,898	3,937	4,127
Covernment Funding (2009\$)	1 / 82	80	140	224	280	276	80	71	74	41	43	29	15		0	-	-
Government Funding Accumulative	0	89	229	563	843	1119	1199	1269	1343	1384	1426	1464	1479	1482	1482	1482	1482
					- +0			00				. 704			02		
Private Sector Funding (2009\$)	2,645	0	19	70	57	81	99	113	266	409	462	390	354	112	-17	39	190
Private Sector Funding Accumulative	0	0	19	89	147	227	327	439	705	1114	1576	1966	2321	2433	2416	2455	2645

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Figure 4. Government and private sector funding requirements by year for the DOE 50/50 Cost Share Terms – **DOE Strategy, Single Plant Design**





Figure 5. Government and private sector funding requirements by year for the DOE 50/50 Cost Share Terms – **INL Project Strategy, One Plant Design**





Figure 6 – Government and private sector funding requirements by year for the Alliance Cost Share Terms – **INL Project Strategy, Single Plant Design**





Figure 7. Government and private sector funding requirements by year for the DOE 50/50 Cost Share Terms – INL Project Strategy, Two Plant Designs (through preliminary design)





Figure 8 – Government and private sector funding requirements by year for the Alliance Cost Share Terms – INL Project Strategy, Two Plant Designs (through preliminary design)