

NGNP PHASE I REVIEW

NEAC REACTOR TECHNOLOGY SUBCOMMITTEE

FINAL REPORT

JUNE 15, 2011

EPACT 2005 REQUIREMENTS

- **FIRST PROJECT PHASE REVIEW—On a determination by the Secretary that the appropriate activities under the first project phase under subsection (b)(1) are nearly complete, the Secretary shall request the NERAC to conduct a comprehensive review of the Project and to report to the Secretary the recommendation of the NERAC concerning whether the Project is ready to proceed to the second project phase under subsection (b)(2)**

NGNP PROJECT PHASES

(1) FIRST PHASE.—A first project phase shall be conducted to—

- (A) select and validate the appropriate technology under subsection (a)(1);**
- (B) carry out enabling research, development, and demonstration activities on technologies and components under paragraphs (2) through (4) of subsection (a);**
- (C) determine whether it is appropriate to combine electricity generation and hydrogen production in a single prototype nuclear reactor and plant; and**
- (D) carry out initial design activities for a prototype nuclear reactor and plant, including development of design methods and safety analytical methods and studies under subsection (a)(5)**

(2) SECOND PHASE.—A second project phase shall be conducted to—

- (A) continue appropriate activities under paragraphs (1) through (5) of subsection (a);**
- (B) develop, through a competitive process, a final design for the prototype nuclear reactor and plant;**
- (C) apply for licenses to construct and operate the prototype nuclear reactor from the Nuclear Regulatory Commission; and**
- (D) construct and start up operations of the prototype nuclear reactor and its associated hydrogen or electricity production facilities.**

Scope of Work for Review

- Review Phase I reports in the following areas:
 - Market case and public-private partnership
 - Status of NGNP licensing activities
 - Status of industrial infrastructure for NGNP
 - Status of R&D program and international efforts
- Review of the Conceptual Design Reports
- Assess readiness to move into Phase II
- Provide report to NE-1 and briefings as needed

NEAC Subcommittee Approach

- September 30th Meeting reviewed:
 - Charge and review criteria provided to committee;
 - Background of the NGNP project;
 - Identification of NGNP project requirements to successfully proceed to Phase II ;
 - Perspective of customers, commitment and market case;
 - The current design specifications for the NGNP project.
- November 15th Subcommittee Meeting:
 - NGNP program plan (includes all Phase II activities) decision points, time schedule, cost estimates, and needed products.
 - The NGNP licensing strategy with input from NRC

NEAC Subcommittee Approach

- February 22th Subcommittee Meeting:
 - Review the NGNP PMR design from GA
 - Review PBMR design elements assembled by AREVA
 - Revisit partnership progress with DoE and others
- April 20th Subcommittee Meeting:
 - NGNP R&D Update by INL wrt Fuels, Graphite, Materials, Design and Analysis Tools
 - Revisit partnership progress with DoE and others

STATUS of PHASE I ACTIVITIES

- Select and validate the appropriate hydrogen production technology;
- Determine if it is appropriate to combine electricity and hydrogen production in a single prototype nuclear reactor and plant;

The NGNP role to produce hydrogen, has been expanded by a broader role to produce process heat for a variety of applications (including hydrogen production) as part of the mission. Process heat applications are more general in scope and can significantly expand the market and improve the business case for the NGNP project.

STATUS of PHASE I ACTIVITIES

- Carry out enabling research, development, and demonstration activities on technologies and components:

The R&D program conceived by the is well designed and focused on the necessary key areas. The fuel qualification program is clearly the major task that has the longest lead-time requiring reliable and reproducible fuel manufacture and irradiation behavior. No impediments were identified from technological barriers to continue the project.

As the detailed NNGP design and licensing safety case are developed, additional R&D may be identified to address particular issues; e.g., crosscutting component testing or analysis methods validation to address specific questions.

STATUS of PHASE I ACTIVITIES

- Carry out design activities for a prototype nuclear reactor plant with development of design methods and safety analytical methods and studies

Development of HTGR reactor concepts; i.e., a PMR and PBMR design. In 2010, the PBMR effort was curtailed because its design team disbanded. The PMR submitted a conceptual design report in 2010. Given this development the PMR was more complete, but still needs more detailed design to be sufficient for licensing.

NB: A lower reactor outlet temperatures was identified; e.g., the 700 °C outlet temperature for the PBMR and the 725 °C outlet temperature for PMR concept are both lower than the 750 to 800 °C as suggested from the Industry Alliance

STATUS of PROJECT MANAGEMENT

PROTOTYPE PLANT SITING — The prototype nuclear reactor and associated plant shall be sited at the INL. *However, the business case to optimize NGNP use for process heat applications and electricity indicates that a site in proximity to a wide range of industrial uses is more appropriate. A site at INL will not support a partnership agreement with industry as required by EPACT.*

LICENSING ACTIVITIES – DOE (and its contractor) in collaboration with the NRC has developed a licensing strategy to use 10CFR52 process and submit a combined operating license (COL) and is well underway *This approach requires a detailed design so that the COL can be submitted to the NRC in a timely fashion. Given the limited scope and duration of the current conceptual design activities, it seems unlikely that any vendor could complete a sufficiently detailed design to obtain a license for a NGNP without a partnership with vendor/owner-operator/customer to proceed in detailed design.*

STATUS of PROJECT MANAGEMENT

INDUSTRIAL PARTNERSHIPS AND COST SHARING:

EPACT-2005 directs DOE to have the INL organize a consortium of appropriate industrial partners that will carry out cost-shared research, development, design, and construction activities, and operate facilities, on behalf of the NGNP Project. The activities of industrial partners funded by the Project would be cost-shared in accordance with section 988 of the EPACT; i.e., a 50/50 cost share for the project.

There is no public-private partnership in place to carry this project forward. Currently, no potential customer has indicated a willingness to commit to share in the cost of constructing a first-of-a-kind NGNP with a 50/50 annual cost share.

Moreover, the current reluctance of vendors, owner-operator, and customers to commit to substantial up-front cost sharing in the NGNP development is unlikely to change in the near term.

NB: Other conditions that work against nuclear process heat projects need to be recognized; e.g., short-term natural gas prices, a failure to internalize the social cost of carbon emissions, and the initial capital cost of the first few reactor plants deployed.

STATUS of PROJECT MANAGEMENT

PROJECT PLAN:

The DOE has developed a project plan for the Phase II activities. The plan would issue a call for a public-private partnership to be formed by the end of FY2012. This approach would mean that any additional detailed design activities would occur after the partnership is formed and a cost-share is determined.

Given the absence of a partnership and the limited amount of conceptual design work that will be completed, it does not appear that a COL can be submitted by September 2014, or construction completed by 2021 as defined in the revised project plan.

RECOMMENDATIONS for PATH FORWARD

Based on the review of the NGNP Project, we conclude that the project is not ready for a decision to proceed to the **complete** set of Phase II activities.

But, there is a great potential for NGNP to reduce the carbon footprint associated with process heat for industrial uses, for electricity production in certain applications, and ultimately, for its potential for hydrogen production.

We recommend proceeding with a portion of the Phase II activities suggested in EPACT-2005; i.e., continue with Phase I efforts, initiate a partnership and begin the needed activities required to support NRC licensing.

We recommend that the government continue to support the development of the NGNP at an appropriate level in the next few years to sustain this investment.

Given the constraints imposed by EPACT-2005 and the current lack of potential vendors, owner-operators, and customers willing to make substantial up-front funding commitments for the licensing and construction of a first-of-a-kind NGNP,

We recommend the following:

RECOMMENDATIONS for PATH FORWARD

1] Accelerate the formation of a public-private partnership as soon as practical to obtain end-user input into design activities and fund additional design activities to support this effort. The private sector of this partnership should, as a minimum, include (i) a vendor, (ii) an owner-operator, and (iii) a process heat end user. A phased partnership should be pursued (with cost sharing requirements increased as uncertainties associated with NGNP deployment are reduced).

2] Continue to engage the NRC for necessary licensing activities to ensure that the regulatory framework for this new reactor technology is ready to support commercialization. As noted above, it is expected that DOE would require increased cost sharing from partnership members as these licensing issues are addressed.

RECOMMENDATIONS for PATH FORWARD

3] Expedite NGNP deployment efforts by:

- a) Revise the NGNP program plan to reflect the current situation and sustain progress through appropriate funding levels for a single design concept to move forward.
- b) Complete additional design activities required to support a PSAR level of detail for this single design concept that is selected by the partnership. The partnership would select a concept based on site information and end-user needs.
- c) Focus current research and design efforts on this single concept that will accelerate initial deployment efforts. While high reactor outlet temperatures are desirable for ultimate NGNP applications, issues associated with licensing and deployment must first be addressed.
- d) Remove the EPACT-2005 requirement that the NGNP first-of-a-kind be located at the INL site. Rather, the NGNP should be sited at a location defined by the industrial partnership that will be formed by the end of FY2012.