

May 3, 2011

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U.S. Nuclear Regulatory Commission  
Attention: Document Control Desk  
Washington, D.C. 20555

NRC Project #0748

SUBJECT: Contract No. DE-AC07-051D14517 – Next Generation Nuclear Plant Project Submittal –  
NRC Project # 0748 – Supplemental Information to Next Generation Nuclear Plant Project  
Fuel Qualification and Mechanistic Source Terms White Papers

On July 21, 2010, consistent with the Next Generation Nuclear Plant (NGNP) licensing strategy plan, the NGNP Project submitted the following two documents for Nuclear Regulatory Commission (NRC) review: INL/EXT-10-17686, “Next Generation Nuclear Plant – Fuel Qualification White Paper” (Ref. 1); and, INL/EXT-10-17997, “Next Generation Nuclear Plant - Mechanistic Source Terms White Paper” (Ref. 2). The NGNP Fuel Qualification White Paper summarizes the planned fuel qualification approach for the NGNP high temperature gas-cooled reactor (HTGR), including both pebble-bed and prismatic-block design alternatives. Both concepts employ tristructural isotropic (TRISO) fuel particles. The Mechanistic Source Terms (MST) White Paper discusses the approach to source term development, taking into account multiple barriers that are available to the HTGR technology to control radionuclide release. The MST White Paper is, to the extent possible, generic to both reactor design alternatives.

Consistent with recent discussions with the NRC staff, the NGNP Project is providing the following supplemental information to support timely review of the NGNP Fuel Qualification and Mechanistic Source Terms White Papers.

The approach to pebble bed fuel qualification described in the Fuel Qualification White Paper was based upon leveraging the fuel qualification activities planned by Pebble Bed Modular Reactor (PBMR), (Pty) Ltd., in support of the Demonstration Power Plant (DPP) expected to be built in South Africa. While the Fuel Qualification White Paper was being finalized, the DPP project was cancelled. In recognition of this situation, the following statement was included in the introduction section of the Fuel Qualification White Paper.

*Pebble-bed Reactor – The qualification of UO<sub>2</sub> fuel particles is based on a combination of existing German low-enriched uranium (LEU) UO<sub>2</sub> test data and additional testing of fuel replicating the German design and fabrication process. The program for additional testing discussed in this paper was developed primarily to support a demonstration power plant to be constructed in South Africa. That project was recently cancelled, and the pebble-bed testing program may undergo significant changes. As revised testing plans are developed in the near future, they will be described and discussed in the course of revising this paper.*

It was also noted at the beginning of Section 5.2 of the Fuel Qualification White Paper on qualification of pebble fuel that:

*The pebble-bed program in South Africa has been substantially altered during the production of this paper and may undergo additional changes. The material presented here does not reflect these recent changes and can be expected to be significantly revised in the course of discussions with the NRC staff.*

Additionally, following submittal of the white papers, the strategy for fuel acquisition for the NGNP (Ref. 3) was revisited in light of the major change in fabrication options for pebble fuel. The updated strategy does not involve replication of German fuel, the basis for the PBMR (Pty) Ltd. approach, as described in Section 5.2.1 of the Fuel Qualification White Paper on fabrication and process control.

At present, the NGNP Advanced Gas Reactor (AGR) Fuel Development and Qualification Program (Ref. 4) is focused on testing of LEU UCO TRISO fuel particles in compacts such as those used in prismatic HTGRs. However, the near term activities have been adjusted to incorporate scope supporting pebble fuel particles. Specifically, LEU UO<sub>2</sub> TRISO fuel particles generally consistent with the German particle design and produced by Babcock and Wilcox, AREVA and PBMR, (Pty) Ltd. are currently under irradiation in compacts in the AGR-2 test train in the Advanced Test Reactor (ATR) at Idaho National Laboratory.

Building on the ATR irradiations that are currently underway, updated information regarding the revised plan for pebble bed fuel qualification will be provided once that plan is established and those additional details are available. It is expected that the scope and objectives of the revised pebble bed fuel plan will build upon the existing plan (Ref. 4) and be adjusted for pebble bed fuel specific design and service. This would include irradiation and testing of sufficient quantities of fuel to demonstrate that statistical fuel performance requirements (particle failure fractions) are met without relying on the use of historical German data.

With regard to support of mechanistic source terms, a broad set of international experimental results on fission product transport in coated particle fuel has been produced, exchanged, and subjected to international review over several decades. A primary example of data exchange and review is a document produced by the International Atomic Energy Agency (Ref. 5). In general there is considerable overlap in data, allowing comparison of results from parallel tests. The effort required to reproduce this broad set of data would be prohibitive and the data set is considered, by virtue of its extensive international exchange and review, to be sufficiently qualified for use in model development. Fission product transport models used and planned to be used by the NGNP project for source term predictions have been developed with consideration of this international database, including German data, for both the prismatic and pebble designs. The NGNP fuel development and qualification program incorporates testing to generate additional data for the prismatic fuel form for use in model development and validation of fission product transport codes. As noted above, it is expected that a program of comparable scope and objectives would be conducted for a pebble fuel design.

Therefore, the material in Section 5.2 of the Fuel Qualification White Paper should be withheld from review. In addition, the objectives in Section 1.3 and in Section 6 of the Fuel Qualification White Paper related to qualification of pebble fuel based on the PBMR, (Pty) Ltd. approach should be withheld from review. The NGNP Project plans to update both the Fuel Qualification and Mechanistic Source Terms white papers once the pending NRC requests for additional information (RAIs) are satisfactorily addressed.

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If you have any questions, please contact me at (208) 526-6063 or James Kinsey, Director of NGNP Regulatory Affairs, at (208) 569-6751.

Sincerely,



Greg Gibbs, Project Director  
Next Generation Nuclear Plant Project

GH:CN

References:

1. INL/EXT-10-17686, "Next Generation Nuclear Plant – Fuel Qualification White Paper" July 21, 2010, CCN 221270
2. INL/EXT-10-17997, "Next Generation Nuclear Plant - Mechanistic Source Terms White Paper," July 21, 2010, CCN 221271
3. D. Petti, et. al., INL/EXT-07-12441, Rev. 2, "Updated NGNP Fuel Acquisition Strategy," December 2010
4. INL/PLN-3636, "Technical Program Plan for the Next Generation Nuclear Plant/Advanced Gas Reactor Fuel Development and Qualification Program," September 2010
5. IAEA-TECDOC-978, "Fuel Performance and Fission Product Behavior in Gas-Cooled Reactors," November 1997

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