June 7, 2011

Mr. Jim Kinsey
Director, Regulatory Affairs
Next Generation Nuclear Plant Project
Idaho National Laboratory
P.O. Box 1625
2525 North Fremont Ave
Idaho Falls, ID 83415

SUBJECT: NEXT GENERATION NUCLEAR PLANT - REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 002 REGARDING NGNP FUEL QUALIFICATION AND MECHANISTIC SOURCE TERM

Dear Mr. Kinsey:

By letter dated July 21, 2010, Idaho National Laboratory (INL), Next Generation Nuclear Plant (NGNP) Project, submitted white papers, CCN 221270 and CCN 22171, "Fuel Qualification and Mechanistic Source Terms," requesting that the Nuclear Regulatory Commission (NRC) staff review these documents to facilitate resolution of key design, safety, and licensing issues.

The NRC staff has identified that additional information is needed to continue portions of the review and the requests for additional information (RAIs) are contained in the enclosures to this letter. It is likely that additional questions on these topics will be generated once NRC contractor staff has reviewed these submittals.

Each RAI in the enclosures opens with a concise statement of the information being requested and adds comments as needed to clarify content and context. Many RAIs are cross referenced to related RAIs on the same or other white paper topics. It is expected that responses to interrelated RAIs will be duly coordinated and that sets of related RAIs may best be addressed in combination by a single integrated response.

To facilitate cross referencing, each RAI number is preceded by letters identifying its white paper topic as follows: FQ - Fuel Qualification, MST - Mechanistic Source Terms, LBE - Licensing Basis Event Selection, HTM - High Temperature Materials, etc. It bears noting in particular that each FQ RAI is echoed as a corresponding MST RAI. This reflects the recognition that FQ is a largely subtopic of MST in the context of NGNP.

Each RAI statement is followed by a series of coded notes to facilitate follow-up:

- Notes in parentheses map the RAI's context to specified white paper sections, pages, etc.

- Notes in curly brackets provide cross referencing to related RAIs. For example, RAI FQ-1 on the Fuel Qualification White Paper is followed by the code {(MST-1), FQ-4 (MST-5), FQ-5

(MST-6)}. This code cross references RAI FQ-1 to its echoed RAI MST-1, the related RAIs FQ-4 and FQ-5, and their respective echoed RAIs MST-5 and MST-6.

- Notes in square brackets, e.g., [1(b)-ii, 2-ii], link each RAI to the respective white paper's stated review outcome objectives, as paraphrased and numbered below for reference:

Fuel Qualification - Review Outcome Objectives

The primary issues for which NRC feedback is requested include:

1. *Plans established in Section 5 for qualification of the UO_2 pebble fuel type are generally acceptable. These plans call for (a) utilizing German data for normal operation irradiation, and transient/accident heat-up conditions, and (b) performing additional confirmatory irradiation and safety tests on fuel manufactured at a qualified facility to statistically strengthen the performance database and demonstrate that the fuel performs at least as well as the German fuel upon which the UO_2 pebble fuel design is based.*

2. *Plans established in Section 5 for qualification of the uranium oxycarbide (UCO) prismatic fuel type are generally acceptable based on the Advanced Gas Reactor (AGR) Fuel Development and Qualification Program.*

Other activities and information may be necessary to support the qualification of both pebble-bed UO_2 and prismatic UCO fuels. Therefore, it is requested that the NRC review either:

i. *Confirm that the plans presented in this paper are generally acceptable, or*

ii. *Identify any additional information or testing needed to demonstrate adequate NGNP fuel performance.*

Mechanistic Source Terms - Review Outcome Objectives

Issues for Resolution

It is requested that NRC reviewers either confirm that the plans for addressing the respective issues summarized below are generally acceptable, or identify additional information needs of the NRC or any areas in which the NRC believes that plans will not be sufficient to address applicable regulatory requirements and guidance:

1. *Agreement that the definition of event specific mechanistic source terms for the high temperature gas-cooled reactors (HTGR) is acceptable.*

2. *Agreement that the approach to calculate event specific mechanistic source terms for the HTGR technology is acceptable, subject to validation of the design methods and supporting data that form the bases of the calculations.*

   Specifically, this approach analyzes a functional containment comprising several barriers that limit the release of radionuclides to the environment (defined herein as the source term) for each postulated event, including normal operating conditions, abnormal

operating conditions and accident conditions. The multiple barriers include individual fuel particle kernels and coatings, the fuel matrix and fuel element graphite, the helium pressure boundary (primary circuit), and a vented low-pressure reactor building. Design methods for determining radionuclide source terms, which include analytical tools used to calculate the performance of each of these barriers during radionuclide transport under event-specific conditions, are defined and supported by testing and analysis. These analytical tools are applied in calculations for normal operating conditions, abnormal operating conditions, DBA conditions, and DBDA conditions:

(a) Generation and transport of each radiologically significant species of fission product from the fuel kernel, through the TRISO particle coatings and fuel element graphite and into the reactor coolant as a function of as-manufactured quality of the TRISO fuel coatings (including heavy metal contamination) and postulated in-service and accident condition coating failure rates as a function of fuel bumup, power level, temperature (including time at temperature), and, where applicable, air and water contamination.

(b) The concentration and form of each radiologically significant species of radionuclide in the primary circuit (those released from the fuel elements) under steady-state full power and temperature operating conditions, including circulating activity and plateout of condensable radionuclides on primary circuit components; the effects of dust generation, fallout, and radionuclide absorption; radionuclide half-life; and operation of the helium purification system.

(c) The concentration and form of each radiologically significant species of radionuclide in helium released from the helium pressure boundary under depressurization events as a function of time considering the location and time-dependent rate of coolant release, reentrainment of accumulated dust, liftoff of plated-out radionuclides, and the effects of time-dependent air and/or moisture ingress on these parameters.

(d) The effects of radionuclide form, condensation, settling, vent-path configuration, and vent filtering, if any, on the time-dependent calculation of radionuclide transport through the reactor building and the source term release to the atmosphere for each event.

3. Agreement on the acceptability of the approach of the planned fission product transport tests of NGNP/AGR Fuel Development and Qualification Program, as supplemented by the existing irradiation and post-irradiation heating data bases, to validate these fission product transport analytical tools.

Several RAIs refer to two prior information requests issued informally to INL in April 2010 concerning the applicability of AGR test results to NGNP and to TEV-1022, the INL report issued in partial response to those requests in September 2010. For continuity, those earlier requests and comments have been incorporated as noted in the enclosed sets of RAIs.

By letter dated May 3, 2011, INL provided supplemental information on the NGNP Project's evolving approaches to pebble-bed fuel qualification and testing. While the staff understands that such ongoing evolutions will call for substantial revisions to affected portions of the white papers, the enclosed RAIs nevertheless largely reflect the information and objectives presented

in the white papers as submitted. It is expected that the Project's RAI responses will note such evolutions where appropriate.

Should you have questions, please contact me at (301) 415-1470 or Joseph.Williams@nrc.gov.

Sincerely,

/RA/

Joseph F. Williams, Sr. Project Manager
Advanced Reactor Branch 1
Advanced Reactor Program
Office of New Reactors

Project No.: 0748

Enclosures:
1. Request for Additional Information on NGNP Fuel Qualification White Paper
2. Request for Additional Information on NGNP Mechanistic Source Terms White Paper

in the white papers as submitted. It is expected that the Project's RAI responses will note such evolutions where appropriate.

Should you have questions, please contact me at (301) 415-1470 or Joseph.Williams@nrc.gov.

Sincerely,

/RA/

Joseph F. Williams, Sr. Project Manager
Advanced Reactor Branch 1
Advanced Reactor Program
Office of New Reactors

Project No.: 0748

Enclosures:
1. Request for Additional Information on NGNP Fuel Qualification White Paper
2. Request for Additional Information on NGNP Mechanistic Source Terms White Paper

Distribution:
JWilliams, NRO
NRO_ARP_ARB1

ADAMS Accession No.: ML111530271 (pkg) **NRO-002**

OFFICE	PM:NRO/ARP/ ARB1	PM:NRO/ARP/ ARB1	PM:NRO/ARP/ ARB1	BC:NRO/ARP/ ARB1
NAME	JShea	DCarlson	JWilliams	TKevern
DATE	06/06/2011	06/06/2011	06/07/2011	06/07/2011

*Approval captured electronically in the electronic RAI system.

OFFICIAL RECORD COPY