

August 7, 2014

MEMORANDUM TO: Brian W. Sheron, Director
Office of Nuclear Regulatory Research

FROM: Daniel H. Dorman, Acting Director */RA by Jennifer Uhle/*
Office of Nuclear Reactor Regulation

SUBJECT: USER NEED REQUEST ON CHEMICAL EFFECTS RESEARCH TO
SUPPORT GSI-191 RESOLUTION

This memorandum describes the Office of Nuclear Reactor Regulation (NRR) User Need Request (UNR) to the Office of Nuclear Regulatory Research (RES) to provide long term support for the evaluation of chemical effects in pressurized water reactors (PWRs) and boiling water reactors (BWRs).

This request will apply results, as appropriate, from earlier tests sponsored by the Nuclear Regulatory Commission (NRC) and the nuclear industry. This UNR specifies: 1) support to develop the technical basis for NRR to close out responses to Generic Letter 2004-02 by Pressurized Water Reactors Owners Group (PWROG) plants following a deterministic resolution, 2) confirmatory evaluation of new methods to assess chemical effects for plants seeking risk informed resolution, 3) technical assessment of PWROG testing related to potential fuel blockage in the reactor vessel, and 4) evaluation of data, analysis, and methods proposed by the Boiling Water Reactors Owners Group (BWROG) to address chemical effects in boiling water reactor environments.

The goal of this UNR is to obtain technical support for the evaluation of new approaches for assessing chemical and downstream effects in PWRs and BWRs that may be based on either a deterministic or risk-informed approach. This request is for RES to provide input to the technical basis supporting GSI-191 resolution as well as resolution of technical issues associated with methods and analysis proposed by the BWROG.

The NRR contact responsible for this UNR is Mr. Paul Klein in the Division of Engineering. NRR staff has coordinated this UNR with Dr. Tregoning of your staff. The management leads in each of our offices, Patrick Hiland and Brian Thomas, have discussed and agreed with the scope and schedules of the tasks in this request.

Enclosure:
User Need

CONTACT: Paul Klein, NRR/DE
(301) 415-4030

August 11, 2014

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***Via email**

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User Need

Background

Evaluation and analysis of postulated breaks in reactor coolant system (RCS) piping, known as loss-of-coolant accidents (LOCAs), are part of every nuclear power plant's design basis. Hence, nuclear plants are designed and licensed with the expectation that they are able to remove reactor decay heat following a LOCA to prevent core damage. If a LOCA occurs, piping thermal insulation and other materials will be dislodged by the two phase jet emanating from the broken RCS pipe. This debris may transport, via flows resulting from the RCS break or from the containment spray system, to the pool of water that would be present at the bottom of containment following a LOCA. Once transported to the sump pool, the debris could be drawn towards the emergency core cooling system (ECCS) sump strainers, which are designed to prevent debris from entering the ECCS system and the reactor core. Potentially, such debris could clog the strainers, result in loss of reactor core cooling, and ultimately lead to core damage.

Chemical effects are defined as precipitates or other products formed as the result of interactions between plant materials and the environment following a LOCA. When Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors", was issued, the potential impact of chemical effects was uncertain. Since that time, both the NRC and the nuclear industry have sponsored testing that has provided a more extensive knowledge base. Most pressure water reactors (PWRs) have been able to demonstrate acceptable performance of sump strainers while treating chemical effects in a conservative manner. A number of plants can also meet the in-vessel fiber limits described in WCAP-16793-NP-A, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid." These plants have a known path forward to GSI-191 resolution.

There are several nuclear industry initiatives that have prompted this UNR. The PWROG has an ongoing research program (WCAP-17788) to obtain additional margin for fibrous debris transported to the reactor vessel. In addition, South Texas Project (STP) is piloting a risk informed resolution to GSI-191 that includes a risk informed approach to addressing chemical effects. RES staff has some unique expertise in probabilistic related work (e.g., xLPR) that would greatly enhance this review. Additional PWR plants are expected to use the lessons learned from the STP pilot approach to also pursue a risk informed resolution to GSI-191. Finally, the Commission directed the staff (ML09009033) to consider the lessons learned from the analyses of PWR sump performance to determine if BWR sump resolution needs to be revisited. As was stated by the BWROG in a July 2009 letter from Richard Anderson to John Grobe (Agencywide Document Access and Management System Accession No. ML092010500), the BWROG will be evaluating the extent and significance of any chemical effects in a simulated post-LOCA BWR environment. Chemical Effects is Issue #4 of twelve technical issues currently being evaluated by the BWROG (ML110070027), as documented. The scope of RES assistance requested is provided below.

Enclosure

Description of Scope and Tasks

Task 1 – Deterministic GSI-191 Resolution

Description: Provide the technical basis to support NRR in evaluation of Owners' Group topical reports or licensee test results for the chemical effects evaluation submitted by licensees pursuing closure of GSI-191 using the deterministic path 1 or 2A outlined in SECY 12-0093 (Closure Options for GSI-191). Support will include, as needed, evaluating issues identified during NRR's review of industry submittals to provide technical bases to support NRR's disposition of these issues, conducting audits of reference documentation, witnessing vendor chemical effects tests and evaluating associated test protocols.

Deliverables: Technical Letter Report(s) (TLRs) will be prepared which summarize the research support provided for this task. Due dates for these TLRs will be established by mutual documented agreement between the NRR/Division of Engineering (DE) and the RES contacts, based on the size and technical complexity of the individual documents. Level of effort is estimated to be 0.1 full-time employees (FTE) per fiscal year for this task, for a total of 0.25 FTE.

Period of Performance: July 2014 through December 2016.

Task 2 - Risk Informed GSI-191 Resolution

Description: Provide technical support for the chemical effects evaluation for the STP pilot application and other follow-on licensee applications pursuing a risk-informed (path 2B or 3 outlined in SECY 12-0093) resolution of GSI-191. Technical support will consist of, as needed, evaluating methods and data proposed by licensees, performing confirmatory analyses, conducting audits of reference documentation, providing technical input for generating requests for additional information, and providing technical input for developing NRC staff review guidance documents.

Deliverables: TLRs will be prepared which summarize the research support provided for this task. Due dates for these TLRs will be established by a mutual documented agreement between the NRR/DE and the RES contacts, based on the size and technical complexity of the individual documents. Level of effort is estimated to be 0.08 FTE for each plant pursuing this option. For resource allocation purposes, it is assumed that 3 plants will pursue this option for a total of approximately 0.25 FTE.

Period of Performance: July 2014 through December 2016.

Task 3 – Generic PWROG Test Program Evaluations

Provide research analyses to support the review of generic PWR industry evaluations related to chemical and downstream effects. For example, one current PWROG program (WCAP 17788) is attempting to demonstrate that fibrous debris amounts greater than approved in WCAP-16793-NP-A will not lead to blockages that unacceptably inhibit long term core cooling.

Deliverables: TLRs will be prepared which summarize the research support provided for this task. Due dates for these TLRs will be established by a mutual documented agreement between the NRR/DE and the RES contacts, based on the size and technical complexity of the individual documents. For resource allocation purposes, the level of effort for this task is estimated to be 0.25 FTE.

Period of Performance: July 2014 through December 2016.

Task 4 – BWROG Chemical Effects Evaluation

Description: Provide research assistance to NRR for the staff's review of BWROG proposals to evaluate chemical effects in BWR environments. This research assistance will include, as appropriate, traveling with NRR staff to observe testing at licensee's facilities, and/or conducting confirmatory analyses of methods proposed to address chemical effects. Also, RES will provide technical support as-needed for the evaluation of test protocols and results.

Deliverables: TLRs will be prepared which summarize the research support provided for this task. Due dates for these TLRs will be established by mutual documented agreement between the NRR/DE and the RES contacts, based on the size and technical complexity of the individual documents. The level of effort is anticipated to be 0.08 FTE for each evaluation. For resource allocation purposes, it is assumed that 3 evaluations will be performed for a total of approximately 0.25 FTE.

Period of Performance: October 2014 through December 2018.

Intended Use of RES Products

Support provided through this user need will assist NRR's review of generic and plant specific chemical effects evaluations for both PWRs and BWRs. This support will also assist NRR in developing guidance documents for performing risk-informed chemical effects evaluations.

Priority

Based on discussions between NRR and RES staff, this request for assistance was determined to be a high priority. My staff has used this priority value in their discussions with members of your staff to determine whether your office can support our schedule requirements.