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May 15, 2013

U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

ATTENTION: Document Control Desk

SUBJECT: R.E. Ginna Nuclear Power Plant
Docket No. 50-244

Resolution Path and Schedule for Generic Safety Issue (GSI)-191 Closure

REFERENCES:

(a) May 4, 2012, Nuclear Energy Institute (NEI) to the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation, Director, Division of Safety Systems – Subject: GSI-191 - Current Status and Recommended Actions for Closure.

(b) December 23, 2010, Staff Requirements – SECY-10-0113 – Closure Options for Generic Safety Issue - 191, Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance.

(c) November 15, 2012, Nuclear Energy Institute (NEI) to the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation, Director, Division of Safety Systems – Subject: GAI-191 – Revised Schedule for Licensee Submittal of Resolution Path.

(d) July 9, 2012, SECY-12-0093 – Closure Options for Generic Safety Issue - 191, Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance.

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REFERENCES (cont.):

(e) October 12, 2011, Pressurized Water Reactor Owners Group (PWROG), Topical Report (TR) WCAP-16793-NP, Revision 2, "Evaluation of Long-Term Core Cooling Considering Particulate Fibrous and Chemical Debris in the Recirculating Fluid."

(f) December 14, 2012, Staff Requirements – SECY-12-0093 – Closure Options for Generic Safety Issue - 191, Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance.

(g) April 8, 2013, Final Safety Evaluation for Pressurized Water Reactor Owners Group Topical Report WCAP-16793-NP, Revision 2, "Evaluation of Long-Term Cooling Considering Particulate Fibrous and Chemical Debris in the Recirculating Fluid"

In Reference (a), the Nuclear Energy Institute (NEI) highlighted the current industry status and recommended actions for closure of Generic Safety Issue (GSI)-191 which were based on licensees providing a docketed submittal to the NRC by December 31, 2012, that would outline a GSI-191 resolution path and schedule pursuant to the Commission direction in Reference (b). By Reference (c), NEI recommended to the NRC that licensees delay submittal of GSI-191 resolution path and schedule until January 31, 2013, or 30 days following placement of both the Commission response to Reference (d) and the NRC staff safety evaluation (SE) of Reference (e). In Reference (f), the Commission approved the staff's recommendation in Reference (d) to allow licensees the flexibility to choose any of the three options discussed in the paper to resolve GSI-191. The Safety Evaluation of Reference (e) was made publicly available by the NRC on April 16, 2013 (Reference (g)). The identification of a resolution path and schedule for the R.E. Ginna Nuclear Power Plant, LLC (Ginna) is described in Enclosure (1).

Regulatory commitments associated with this correspondence are listed in Enclosure (2).

If there are any questions regarding this submittal, please contact Thomas Harding at 585-771-5219 or Thomas.HardingJr@cengllc.com.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 15th day of May 2013.

Sincerely,

Joseph E. Pacher

JPO/

Enclosures: (1) Resolution Option and Implementation Schedule for GSI-191 Closure
(2) List of Regulatory Commitments for GSI-191 Closure

cc: W. M. Dean, NRC
M. C. Thadani, NRC
Resident Inspector, NRC (Ginna LLC)
A. L. Peterson, NYSERDA

ENCLOSURE (1)

RESOLUTION OPTION AND IMPLEMENTATION SCHEDULE FOR GSI-191 CLOSURE

R.E. Ginna Nuclear Power Plant, LLC
May 15, 2013

CONSTELLATION ENERGY NUCLEAR GENERATION GROUP

R. E. GINNA NUCLEAR POWER PLANT, LLC

RESOLUTION OPTION AND IMPLEMENTATION SCHEDULE FOR GSI-191 CLOSURE

Background

Generic Safety Issue – 191, "Assessment of Debris Accumulation in Pressurized-Water Reactor Sump Performance (GSI-191)" remains a long-standing open issue. GSI-191 concluded that debris could clog the containment sump strainers in pressurized water reactors (PWRs), leading to the loss of net positive suction head for the emergency core cooling system (ECCS) and containment spray system (CSS) pumps. The Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors" (ADAMS Accession No. ML042360586), dated September 13, 2004, requesting that licensees address the issues raised by GSI-191. GL 2004-02 was focused on demonstrating compliance with 10 CFR 50.46, Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors.

In accordance with the May 4, 2012 Nuclear Energy Institute (NEI) letter to the NRC (ML12142A316), each licensee would submit a resolution option and associated implementation schedule to the NRC, by December 31, 2012. This was modified by the November 21, 2012 letter from the NRC to NEI (ML12326A497) that provided for submittal of the resolution option and associated implementation schedule by January 31, 2013, or 30 days following the NRC making publicly available the final safety evaluation (SE) associated with the review of WCAP-16793, Revision 2, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid," and the Staff Requirements Memorandum (SRM) associated with SECY-12-0093, "Closure Options for Generic Safety Issue – 191, Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance,". SRM-SECY-12-0093 became publicly available on December 17, 2012 (ML12349A378). The SE for WCAP-16793, Revision 2 became publicly available on April 16, 2012 (ML13084A152).

On July 9, 2012 the NRC staff issued SECY-12-0093, "Closure Options for Generic Safety Issue – 191, Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance," presenting three options to the Commission, all of which are considered to be viable paths for resolving GSI-191. These options are: Option 1 – Deterministic, Option 2 – Deterministic or Risk-informed, and Option 3 – Deterministic/Risk-informed. SECY-12-0093 considered and expanded upon the options provided in the May 4, 2012 NEI letter. The options identified in the SECY provide approaches that can be used to address plants with minimal fibrous insulation, low to medium fibrous insulation, and substantial amounts of fibrous insulation. On December 14, 2012, the NRC approved the staff's recommendation in SECY-12-0093 to allow licensees the flexibility to choose any of the three options discussed to resolve Generic Safety Issue – 191.

Introduction

R. E. Ginna Nuclear Power Plant (Ginna) has selected Option 2a based on the determination that completing the previously initiated deterministic resolution strategies will meet the resolution expectations for all aspects of GSI-191 as in Option 2a, as identified in SECY-12-0093. In the event that the Option 2a approach alone does not lead to acceptable results, a risk-informed component will be added to the resolution strategy, which will allow Ginna to achieve resolution through Option 3. To support use of this overall resolution strategy, and continued operation for the period required to complete the necessary analysis and testing, Ginna has evaluated the design and procedural capabilities that exist to identify and mitigate in-vessel blockage, as previous strainer head loss and pump NPSH issues have been resolved deterministically. A description of these detection and mitigative measures are provided later in this document. Additionally, a summary of the existing margins and conservatisms that exist for Ginna are also included in this document.

The following provides the key components for the chosen resolution path option for Ginna.

Characterization of Strainer Head Loss Status

Ginna previously provided the results of strainer head loss testing, including the impact of chemical effects in References 1, 2, 3, 4, and 5. The results of the testing demonstrated acceptable results with regard to allowable ECCS head loss. However, Ginna intends to evaluate reducing the quantity of insulation and aluminum in containment, thereby increasing the margin associated with this aspect of GL 2004-02.

Characterization of Current Containment Fiber Status

From the current debris generation and debris transport analysis, Ginna has determined that approximately 1260 lbs of fibrous debris could be transported to the sump strainers, as documented in Reference 5. Based on previously performed strainer bypass testing, the total quantity of fiber calculated to bypass the strainer is 16.55 lbs. This equates to an approximate 62 g/FA. The fibrous debris sources considered in these analyses include: Transco Thermal Wrap, Temp-Mat, and low density fiberglass. However, as a result of future efforts, as described herein, these bypass quantities are expected to decrease.

Characterization of In-Vessel Effects

Ginna intends to develop the necessary technical bases acceptable to the NRC for addressing in-vessel effects. Ginna intends on utilizing the results of two parallel, but complementary, resolution paths, which together or individually, will provide reasonable assurance that core cooling, required to prevent a significant release of fission products, is assured. Additionally, a third resolution path may be developed and pursued, as a contingency. The three resolution paths are:

1.) Ginna intends to follow the resolution strategy proposed by the Pressurized Water Reactor Owners' Group (PWROG) for establishing in-vessel debris limits for the type of plant design that exists at Ginna. This approach is expected to establish in-vessel debris limits significantly greater than that currently established by WCAP-16793, Rev. 2, and the associated NRC Safety Evaluation (SE).
2.) Ginna intends on performing a thermal hydraulic analysis of vessel internals to credit the use of upper plenum injection (UPI) to disrupt debris bed formation on the bottom nozzles, and the use of safety injection (SI) and two phase flow to disrupt debris bed formation on the top support grid.
3.) Ginna may perform a risk-informed evaluation to resolve in-vessel effects consistent with Option 3. Because the initiating event frequency for breaks that would generate large quantities of fiber debris are very low, the ΔCDF and ΔLERF associated with GSI-191 in-vessel failures are expected to be very small.

Licensing Basis Commitments

Ginna has a Regulatory Commitment to provide the NRC with the results of evaluations of in-vessel downstream effects within 90 days of issuance of the NRC's Safety Evaluation for WCAP-16793-NP, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid." As a result of the remaining open questions associated with GL 2004-02 for Ginna, and the information contained within this submittal, the previously established Regulatory Commitment is considered to be closed based on the intended direction to be taken, as described in this submittal. New Regulatory Commitments as a result of this submittal are provided in Attachment 2 for Ginna.

Ginna currently has a commitment to provide the NRC with conformation that all calcium silicate insulation within the zone of influence (ZOI) of the most limiting break location conforms to the standards established for the Ontario Power Generation (OPG) testing, i.e., insulation banding spaced no more than 6" apart. The calcium silicate insulation banding modification was completed during the Fall 2012 refueling outage. All calcium silicate insulation within or near the steam generator and pressurizer cubicles is banded with a band spacing less than 6".

Ginna does not currently have any other open commitments within the Ginna commitment management system to provide additional updates or information to the NRC regarding GL 2004-02.

Resolution Schedule

Ginna will achieve closure of GSI-191 and address GL 2004-02 per the following schedule:

- Ginna intends to reduce the overall impact on strainer head loss and in-vessel effects (September 30, 2014):
    - Identify insulation and aluminum that can be removed from containment.

- Revise 3-D CAD model, debris generation, transport, and chemical effects analyses, for revised insulation and aluminum loading.
- Perform Strainer Bypass Testing.

- Ginna intends to follow a resolution strategy and methodology for completion of the in-vessel downstream effects aspect of this approach. This resolution strategy and methodology will be aligned with the effort being taken by the PWROG for resolving this issue. Ginna will submit a schedule for closure within 60 days following the date that the results of the PWROG testing efforts are available.

- In parallel with the above, an independent effort will be undertaken by Ginna to perform a thermal hydraulic analysis of vessel internals with the intention of showing the use of upper plenum injection (UPI) to disrupt debris bed formation on the bottom nozzles, and the use of safety injection (SI) and two phase flow to disrupt debris bed formation on the top support grid. (December 31, 2014)

- If Ginna determines that the proposed testing and analysis resolution path (above) alone will not lead to acceptable results, then an alternate resolution path will be discussed with the NRC to gain acceptance of the proposed path and to establish an acceptable completion schedule. This resolution path may be consistent with risk-informed methods developed for Option 3. Discussions with the NRC will be initiated within 60 days of receipt of the PWROG testing results, or completion of thermal hydraulic analysis of vessel internals, as described above, whichever is later.

Summary of Actions Completed for GL 2004-02

To support closure of GSI-191 and to address GL 2004-02, Ginna has completed the following actions:

- Performed comprehensive debris generation and debris transport analyses in accordance with approved methods presented in NEI 04-07 (Reference 6).

- Performed walk downs to sample and characterize latent debris, including other debris sources, e.g., labels, tags, containment liner seals, etc.

- Performed as-built verification walk downs of insulation in containment.

- Replaced the original sump screen that consisted of a simple geometry that had a filtering surface area of 110 ft^2, with nominal 1/2 in. x 1 1/2 in. rectangular openings, with complex geometry strainers having a filtering surface area of 4087.5 ft^2, with nominal 1/16 in. circular openings.

- Installed debris interceptors beneath and along side of the sump strainer modules to provide pre-filtering of debris for the back side of the strainer modules.

- Completed ex-vessel downstream effects analysis in accordance with approved methods presented in WCAP-16406-P, Revision 1 (Reference 7).

- Completed net positive suction head and debris bed de-aeration analyses (References 8 and 9).

- Installed stainless steel Sure-Hold bands, on 6" centers, to all calcium silicate insulation within or near the steam generator and pressurizer cubicles.

Summary of Margins and Conservatisms for Completed Actions For GL 2004-02

The following provides a summary description of the margins and conservatisms associated with the resolution actions taken to date. These margins and conservatisms provide support for the extension of time required to address GL 2004-02 for Ginna. The complexity of the issues underlying GL 2004-02 has resulted in significant levels of margin being incorporated into the related analyses, design and testing of containment sump strainers and the impact of post-LOCA debris on plant equipment. Margin is needed to address newly discovered issues and in mitigating any potential unknowns or uncertainties. However, embedded in all supporting analyses, design, and testing is layer upon layer of conservatism. In recognition of the compounding nature of these conservatisms and the need for a holistic review of compliance with GL 2004-02, the following is offered to facilitate the NRC's review and conclusion that Ginna has sufficient ECCS pump NPSH margin available and that significant conservatisms exists to ensure core blockage does not occur.

Debris Generation Analysis:

There are significant conservatisms in the performance of a debris generation calculation that complies with the NEI 04-07 Guidance Report (GR) and its associated SER. The debris generation calculation provides the estimate of the quantity and characteristics of debris that could potentially be generated by a hypothetical high energy pipe break inside the Ginna containment (Reference 10). The following layers of conservatisms are noted:

- The limiting break is controlled by a unique combination of break size and location that make it highly improbable. The likelihood of a large rupture in PWR coolant piping is less than $1x10^{-5}$ per year. Estimates for the frequency of a full double ended rupture of the main coolant piping are on the order of $1x10^{-8}$ per year. Smaller piping ruptures, while still unlikely, provide a better measure of expected behavior.

- Break opening time is instantaneous. The non-physical assumption of an instantaneous opening of a full double ended rupture leads to a significant overestimation of the debris generation potential for a postulated break. Even conservative estimates of minimum break opening times for large bore piping preclude formation of damaging pressure waves. The wide recognition that a large RCS pipe is more likely to leak and be detected by the plant's leakage monitoring systems long before cracks grow to unstable sizes is referred to as leak before break (LBB) and is an accepted part of regulatory compliance with GDC 4 for most, if not all, PWRs.

- A non-prototypic spherical zone of influence is used to maximize the affected volume surrounding the postulated break. While dependent on postulated break characteristics, the zone of destruction around the break will generally be focused in a single direction, significantly limiting the "zone" of materials subjected to break forces.

- The ZOI radii derived in the SER to the GR were based on the ANS/ANSI jet model. Comparison of the computational fluid dynamics (CFD) ZOI radii derived by the Boiling Water Reactor Owners Group (BWROG) demonstrated that the ZOI radii for low destruction pressures such as for low density fiberglass (e.g. Nukon) are significantly lower than those derived by the ANS/ANSI jet model. This is expected since the ANS/ANSI jet model predicts an unrealistic long isobar elongation at lower pressures since the jet centerline pressure equation of the ANS/ANSI jet model is inherently unbounded. The use of the ANS/ANSI jet model adds another layer of conservatism to the derivation of the ZOI radii used in the Ginna calculation.

- The Ginna debris generation calculation did not employ refinements such as shadowing by large components. These refinements were not evoked in order to ensure conservatism in the calculation of debris generated in a postulated ZOI. Not implementing refinements such as shadowing adds another layer of conservatism in the calculation of the quantity of debris from a ZOI.

- The Ginna debris generation calculation adopted a four category debris size distribution for insulation debris based on the methodology provided in the SER to the GR. The implementation of the four size distribution methodology used by Ginna is conservative since the curve fits to the destruction data were conservatively performed (Reference 10). The conservatism of the debris size distribution provides for another layer of conservatism in the quantification of the debris quantities reaching the ECCS sump.

- The Ginna debris generation calculation addressed the latent debris quantification by evoking the plant specific latent debris quantification performed in conjunction with the GSI-191 walkdown. This quantification employed conservatisms in the estimation of the surface areas and the measurement of the weight in the sample. The quantification of the latent debris walkdown was further increased by approximately 160% to account for uncertainties associated with latent debris on surfaces not accounted for in the walkdown. Additionally, the latent debris quantification evoked the conservative latent debris categorization provided in the SER to the GR. The use of the walkdown report to estimate the latent debris in containment, the use of the latent debris categorization of the SER to the GR and the additional 160% margin provides for another layer of conservatism in the quantification of the debris quantities reaching the ECCS sump.

Debris Transport Analysis:

Similar to the debris generation calculation, there are significant conservatisms in the performance of a debris transport calculation that complies with the NEI 04-07 GR and its associated SER. The debris transport calculation (Reference 11) provides the estimate of the fraction of each type and size of debris that could potentially be transported to the ECCS sump strainer in the Ginna containment (Reference 12). The following layers of conservatisms are noted:

- During the blowdown phase, significant quantities of fine and small piece debris would be blown to regions shielded from the containment sprays. The Ginna debris transport calculation conservatively neglects this phenomenon, and does not credit the retention of debris lodged in miscellaneous structures during the blowdown phase.

- Similarly, during the washdown phase, no credit was taken for the holdup of small pieces of debris on the concrete floors in upper containment. The only credit taken for debris retention is for debris washed to inactive cavities. Any retention of fine debris is conservatively neglected.

- The water draining from the RCS breach was assumed to do so without encountering any structures before reaching the containment pool. This is a conservative assumption since any impact with structures would dissipate the momentum of the water and decrease the turbulent energy in the pool.

- The transport analysis assumes that all transported debris would accumulate on the strainer. However, the height of the replacement strainer is such that most debris transported along the floor is not likely to lift off of the floor onto the strainer.

- No credit was taken for the unique configuration of the Ginna sump strainer location and the installed debris interceptors. The majority of the Ginna sump strainers are installed along the perimeter of the fuel transfer canal wall. Debris interceptors, constructed of the same perforated plate as used in the strainer modules, serve as a barrier to debris impacting the back side of the strainer modules. The debris that impacts the back side of the strainers would flow over the top of the strainer module. As demonstrated through strainer head loss testing, this reduces the quantity of debris that impacts approximately 40% of the installed strainer surface area.

- It was conservatively assumed that all latent debris is in the containment pool at the beginning of recirculation. This is a conservative assumption since no credit is taken for debris remaining on structures and equipment above the pool water level or transport to inactive cavities.

Head Loss and NPSH Calculations (Reference 8):

There are significant conservatisms in the performance of the ECCS pump NPSH calculation for identifying the sump strainer head loss margin. The following layers of conservatisms are noted:

- No credit for containment over-pressure has been taken, thereby, preserving additional ECCS pump NPSH margin. The additional NPSH margin that this alone provides ranges from approximately 86 ft at switchover to sump recirculation for the LBLOCA to approximately 17 ft later in the SBLOCA, when less flow and therefore less NPSH is required.

- The strainer central duct and connecting channel head loss was taken from the most remote point from the containment sump. This value was applied to the entire sump strainer, when in reality portions of the sump strainer closer to the containment sump would experience a lower head loss than that calculated. For example, five of the sixteen strainer modules sit directly on the sump cover. These strainer modules would have no head loss due to connecting channels.

- The NPSH calculation uses strainer head loss for the LBLOCA, but recirculation pool depth for the SBLOCA, thereby conservatively bounding both breaks.

- The flow coefficient of the RHR flow control valves, HCV-624 and HCV-625, used in the NPSH calculation is conservatively applied at its upper limit based on testing, which increases the NPSH that is required.

- Values for pump NPSHR are taken for cold water conditions (<100 °F). This results in larger NPSHR values than that for actual water temperatures. However, the vapor pressure is taken at the saturation temperature (212 °F) of a depressurized containment. These assumptions maximize NPSHR while minimizing NPSHA.

- The RCS was assumed to be fully depressurized for LBLOCA cases resulting in the highest possible RHR flow rate.

- For SBLOCA cases, when the RHR system is incapable of providing adequate flow to the RCS, the minimum pressure allowable for the restarting of high head SI pumps following sump switchover is assumed. These assumptions allow for the minimum back pressure during both the LBLOCA and SBLOCA scenarios resulting in maximum flow.

- The original vendor non-degraded pump head curve was used. This is conservative, because degraded pump head results in a drop in flow rate.

- By maximizing the RHR pump flow rate, the NPSH required is maximized. The maximum flow rate from the ProtoFlo analysis is less than the 2300 gpm used in testing, which ensures that the flow related losses due to a clogged strainer is conservative.

- The NPSH margin was determined to be 0.75 ft WC for the LBLOCA, and 0.82 ft WC for the SBLOCA.

Chemical Effects Analysis:

The Ginna chemical effects analysis (Reference 13) was performed in accordance with WCAP-16530 that includes multiple levels of conservatism:

- WCAP 16530 relies largely upon short term release rates (hours) for the determination of long term releases (30 days). Long term release rates of constituent materials are expected to be one to two orders of magnitude lower than that predicted by design basis models due to surface passivation and formation of surface films.

- 100% of chemical species of interest are assumed to precipitate. These precipitates are further assumed to be present at the beginning of the event when flow margins are at a minimum. When solubility limits are taken into account, the predicted precipitation is reduced by 1-2 orders of magnitude. Further, precipitates will form during periods when flow margins are greater.

- The current models call for chemical precipitate formation in a form readily transported to the sump screen. A significant portion of precipitate formation will occur on large surface areas in containment and settled debris, and will not be readily transported to the strainer.

Strainer Head Loss Testing:

The quantity of debris used in strainer head loss testing (Reference 14) exceeded that predicted to be generated for any given break location. The specific conservative debris quantities utilized in head loss testing are as follows:

- The largest quantity of each debris type, regardless of break location, was used in the head loss testing. This was done to ensure that the testing bounds all debris sources for all break locations. As a result, the quantity of fiber and particulate used in testing is greater than that determined to transport to the sump for any single break location.

- The maximum quantity of calcium silicate debris determined to be generated by any break location was determined to be 142.6 kg, of which 20.0 kg (~14%) is predicted to be consumed in precipitant generation. The quantity of particulate used in head loss testing was not reduced by the quantity of calcium silicate consumed in precipitant generation.

- The quantity of degraded phenolic coatings (chips) used in strainer head loss testing was increased by approximately 4 times the scaled quantity that was determined to transport to the sump. Similarly, the quantity of phenolic coatings (fines) was increased by approximately 1 ½ times.

- The quantity of degraded IOZ coatings (fines) used in strainer head loss testing was increased by approximately 4 times the scaled quantity that was determined to transport to the sump.

- The quantity of Thermal Wrap fines used in strainer head loss testing was increased by approximately 7% above the scaled quantity that was determined to transport to the sump.

- The quantity of Temp Mat fines used in strainer head loss testing was increased by approximately 7% above the scaled quantity that was determined to transport to the sump.

- All debris that settled on the floor of the test flume was mechanically agitated to re-suspend the debris in order to maximize the debris presented to the face of the test strainer, and therefore maximize the strainer head loss.

- The quantity of latent debris used in testing reflects an increase of 160% above the quantity determined to be in containment.

- Fibrous debris classification for intact pieces was taken as "large" pieces in the testing.

- RHR pump flow rates used in testing (2300 gpm) bound all pump flow rates. Calculated flows for the case that yields the minimum NPSH for the ECCS pumps (approximately 1850 gpm) are 24% less than the flow utilized during testing. This represents additional margin for strainer head loss testing, and vortexing/flashing evaluations.

- During head loss testing, fiber fines produced by erosion are assumed to arrive at the strainer at time t = 0, instead of hours or days later when flow margin is greater. Fiber fines created by erosion will arrive at the strainer over a period of hours or even days. A significant portion of these fines will arrive after flow margin has increased to the point where additional strainer head loss can be readily accommodated.

- During head loss testing, a full 30 day chemical precipitate load is assumed to arrive at the strainer at the earliest possible time with no credit for settling or nucleation on containment surfaces. The quantity of precipitate arriving at the strainer is expected to be significantly lower than tested amounts. In addition the precipitate is expected to arrive or form in the debris bed gradually and the resultant head loss would be compensated by increased head loss margins.

- During head loss testing, all fiber and particulate debris is collected on the strainer prior to addition of chemical precipitates. The chemical precipitate coating on the debris bed observed in head loss testing is not prototypical. In reality it would be less uniform than that achieved during testing since some fiber and particulate debris would arrive along with the precipitates, or the precipitates would form in the debris bed, producing a less uniform deposit. A less uniform deposition of precipitates would yield a lower strainer head loss.

- During head loss testing, repeated attempts are made to get debris that has settled in the immediate vicinity of the strainer back onto the strainer. The conservatism of debris transport calculations is clearly demonstrated in testing where non-prototypic agitation must be employed to prevent natural settling of debris. Much of the debris that is predicted to transport to the strainer will settle in the immediate vicinity of the strainer and not become part of the strainer debris bed.

Summary of Defense-In-Depth (DID) Measures

The following describes the plant specific design features and procedural capabilities that exist for detecting and mitigating a fuel blockage condition. (Defense-in-depth measures for strainer blockage are not addressed, since current conservative strainer debris loading does not adversely impact strainer head loss, pump NPSH, or pump flow.) Although these measures are not expected to be required based on the very low probability of an event that would result in significant quantities of debris being transported to the reactor vessel that would inhibit the necessary cooling of the fuel, they do provide additional assurance that the health and safety of the public would be maintained. These measures provide support for the extension of time required to completely address GL 2004-02 for Ginna.

- Prevention of Inadequate Reactor Core Flow

  Inadequate reactor core flow can be prevented, to the extent possible, by controlling the conditions that lead to the normal core cooling flow path becoming impeded (blocked) and is not allowing sufficient cooling water flow to reach the core. Actions that can be used to reduce the likelihood of inadequate reactor core flow are:

  - Controlling (Reducing) Core Flow
  - Transfer to cold leg injection or combined UPI / cold leg injection flow paths
  - Refilling the RWST

  Controlling (Reducing) Core Flow – Current guidance in the EOPs delays the need for switching to recirculation by managing pump operation and flows. The EOPs stop both RHR pumps, one containment spray pump, and one safety injection pump, as early in the progression of events as possible. The EOPs secure both containment spray pumps prior to the RWST being depleted and the onset of recirculation. Likewise, managing pump operation and flows during recirculation reduces the debris impact on the sump strainers, and therefore the likelihood of flow blockage to the core. Current guidance in the EOPs instruct Operators to start one, instead of two, RHR pumps, upon recirculation initiation. Additionally, current guidance in the EOPs for responding to sump strainer blockage requires that Operations consult with the plant engineering staff to determine the optimum safety injection alignment and flows.

  Transfer to cold leg injection or combined UPI / cold leg injection flow paths - For breaks sizes that result in early RCS depressurization, the normal coolant path to the core is through upper plenum injection (UPI). In the event that the upper core grid becomes blocked, re-initiation of high pressure safety injection, through the cold leg, offers an alternate flow path to the core (similar to EOP direction to mitigate boron precipitation). This has the potential to disturb the developed debris bed on the upper core grid, allowing for adequate core cooling and subsequent UPI. For breaks sizes that do not lead to early RCS depressurization, depressurization of RCS is initiated to allow for RHR injection flow to the upper plenum. This has the potential to disturb the developed debris bed on the lower nozzles, allowing for adequate core cooling and subsequent re-initiation of high pressure safety injection.

Refilling the RWST – Guidance exists in the EOPs for providing makeup to the RWST in order to extend the time the ECCS pumps can take suction from the RWST. There are a number of water sources and pumps that can be used to replenish the RWST.

- Detection of Inadequate Reactor Core Flow

Multiple methods exist for detection of a core blockage condition, as manifested by an inadequate reactor coolant system (RCS) inventory or inadequate RCS and core heat removal condition. The primary methods include core exit thermocouples (CET) and reactor vessel level indication system (RVLIS). This monitoring is initiated early in the event in the EOPs through the Critical Safety Function Status Trees that is performed continuously after completion of diagnosis of the event and when plant conditions are frequently changing, and every 10 to 20 minutes if plant conditions are not frequently changing and a Red or Orange path does not exist. Emergency Response Personnel in the Technical Support Center (TSC) or Emergency Operations Facility (EOF) will also maintain oversight of plant status through review of the Plant Process Computer System (PPCS), which includes both CET and RVLIS data. An additional method for detection of a core blockage condition includes monitoring of containment radiation levels by the TSC or EOF staff and/or if an alarm setpoint is reached, resulting in an alarm in the control room.

As part of operator training, the operating crew demonstrates the ability to detect increases in CET temperature indication, to monitor and understand the implications of decreasing reactor vessel water level, and to identify and monitor degrading core conditions; and to appropriately transition within the EOP framework to mitigate the condition.

- Mitigation of Inadequate Reactor Core Flow

Upon identification of an inadequate RCS inventory or core heat removal condition, the EOPs or SAMGs direct the operators to take actions to restore cooling flow to the RCS including:

  - Re-initiation of high pressure safety injection
  - Rapid secondary depressurization to depressurize RCS
  - RCP restart and/or opening PRZR PORVs
  - Flood containment

For breaks sizes that result in early RCS depressurization, the normal coolant path to the core is through upper plenum injection (UPI). In the event that the upper core grid becomes blocked, re-initiation of high pressure safety injection, through the cold leg, offers an alternate flow path to the core (similar to EOP direction to mitigate boron precipitation). This has the potential to disturb the developed debris bed on the upper core grid, allowing for adequate core cooling and subsequent UPI.

For breaks sizes that do not lead to early RCS depressurization, depressurization of the RCS is initiated to allow for RHR injection flow to the upper plenum. This has the potential to disturb the developed debris bed on the lower nozzles, allowing for adequate core cooling and subsequent re-initiation of high pressure safety injection.

If high pressure injection cannot be established or is ineffective in restoring adequate core cooling, and if secondary depressurization is not possible or ineffective due to a loss of secondary heat sink, for example, then starting the RCPs will provide forced two phase flow through the core and temporarily improve core cooling and has the potential to disturb the developed debris bed on the lower nozzles and upper core grid. The operator must still take action to establish a makeup source of water to the RCS to restore adequate long term cooling. The operator must, therefore, reduce RCS pressure in order for the SI accumulators and/or RHR pumps to inject. This may be achieved by opening all available RCS vent paths to containment, i.e., PRZR PORVs, head vents, etc.

Severe Accident Mitigation Guidelines (SAMG) provide additional guidance and actions for addressing inadequate core flow conditions. The SAMGs are used by the technical support staff in the Technical Support Center (TSC) to evaluate alternative courses of action for a degrading condition. The SAMGs will provide for flooding containment above the reactor vessel hot and cold leg nozzles (and the break location) to provide for convective circulation cooling of the reactor.

Although these measures are not expected to be required based on the very low probability of an event that would result in significant quantities of debris being transported to the reactor vessel that would inhibit the necessary cooling of the fuel, they do provide additional assurance that the health and safety of the public would be maintained. These measures provide support for the extension of time required to completely address GL 2004-02 for Ginna.

Conclusion

Ginna expects that the GSI-191 resolution path for Ginna is acceptable, based on the information provided in this document. The execution of the actions identified in this document will result in successful resolution of GSI-191 and closure of GL 2004-02.

References:

1. Letter from John Carlin (Ginna LLC) to Document Control Desk (NRC), dated February 29, 2008, Supplementary Response to Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"
2. Letter from John Carlin (Ginna LLC) to Document Control Desk (NRC), dated July 25, 2008, Second Supplemental Response to Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"

3. Letter from John Carlin (Ginna LLC) to Document Control Desk (NRC), dated June 2, 2009, Third Supplemental Response to Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"
4. Letter from John Carlin (Ginna LLC) to Document Control Desk (NRC), dated April 6, 2010, Request for Additional Information Regarding Generic Letter 2004-02
5. Letter from John Carlin (Ginna LLC) to Document Control Desk (NRC), dated October 26, 2010, Response to Commitments Regarding Generic Letter 2004-02 Specific to Debris Transport Analysis and Strainer Head-loss Testing
6. NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology," Revision 0
7. WCAP-16406-P, Revision 1, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191"
8. DA-ME-2005-085, "NPSH for ECCS Pumps During Injection and Sump Recirculation," Rev. 2
9. ALION-CAL-GINNA-7730-01, "Post-LOCA Void Fraction Downstream of the Ginna Containment Sump Strainer," Revision 0
10. Calculation ALION-CAL-CONS-3237-02, "Ginna Reactor Building GSI-191 Debris Generation Calculation", Revision 2a, December 1, 2010.
11. Calculation ALION-CAL-GINNA-4376-03, "Ginna GSI-191 Debris Transport Calculation", Revision 3, June 8, 2010.
12. Alion Document ALION-REP-ALION-2806-01, "Insulation Debris Size Distribution for use in GSI-191 Resolution", Revision 3
13. CN-SEE-I-07-16, "R. E. Ginna GSI-191 Chemical Effects Evaluation," Revision 2
14. 680/41 565, "Chemical Effects Head Loss Test Report," Revision 0

ENCLOSURE (2)

LIST OF REGULATORY COMMITMENTS FOR GSI-191 CLOSURE

CONSTELLATION ENERGY NUCLEAR GENERATION GROUP

R. E. GINNA NUCLEAR POWER PLANT, LLC

LIST OF REGULATORY COMMITMENTS FOR GSI-191 CLOSURE

The following table identifies those actions committed to in this document by R. E. Ginna Nuclear Power Plant. Any other statements in this submittal are provided for informational purposes and are not considered to be regulatory commitments. Direct questions regarding these commitments to Mr. Thomas Harding at (585) 771-5219 or Thomas.HardingJr@cengllc.com.

COMMITMENT	COMPLETION DATE
Reduce the overall impact on strainer head loss and in-vessel effects o Identify insulation and aluminum that can be removed from containment. o Revise 3-D CAD model, debris generation, transport, and chemical effects analyses, for revised insulation and aluminum loading. o Perform Strainer Bypass Testing.	September 30, 2014
Ginna will follow a resolution strategy and methodology for completion of the in-vessel downstream effects aspect of this approach. This resolution strategy and methodology will be aligned with the effort being taken by the PWROG for resolving this issue. Ginna will submit a schedule for closure within 60 days following the date that the results of the PWROG testing efforts are available.	60 days following the PWROG testing results
Ginna will perform a thermal hydraulic analysis of vessel internals with the intension of showing the use of upper plenum injection (UPI) to disrupt debris bed formation on the bottom nozzles, and the use of safety injection (SI) and two phase flow to disrupt debris bed formation on the top support grid.	December 31, 2014
If Ginna determines that the proposed testing and analysis resolution path alone will not lead to acceptable results, then an alternate resolution path will be discussed with the NRC to gain acceptance of the proposed path and to establish an acceptable completion schedule. This resolution path may be consistent with risk-informed methods developed for Option 3.	60 days following PWROG testing results or completion of thermal hydraulic analysis of vessel internals, whichever is later.