ENCLOSURE 4

M200071

Response to Request for Additional Information eRAI 9730 Supplement 1

Licensing Topical Report NEDC-33910P, Revision 0, BWRX-300 Reactor Pressure Vessel Isolation and Overpressure Protection

Non-Proprietary Information

PROPRIETARY INFORMATION NOTICE

This is a non-proprietary version of the Response to Request for Additional Information eRAI 9730, Supplement 1, Licensing Topical Report NEDC-33910P, Revision 0, BWRX-300 Reactor Pressure Vessel Isolation and Overpressure Protection, from which the proprietary information has been removed. The header of each page in this enclosure carries the notation "Non-Proprietary Information." Portions of the enclosure that have been removed are indicated by an open and closed bracket as shown here [[ ]].

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eRAI No.: 9730
Date of eRAI Issue: 04/09/20

NRC Question 03.09.06-1

Section 2.1.2 in NEDC-33910 describes the Isolation Condenser System (ICS) for the BWRX-300 nuclear power plant. This section indicates that the ICS includes [[ ]]. To support the NRC staff review of NEDC-33910P [sic] and its conformance to 10 CFR Part 50, Appendix A, GDC 1, 2, 4, 35 and 37 for the IC condensate return valves, the NRC staff requests that GEH describe the following:

(a) Any first of a kind (FOAK) features,

(b) Valve and actuator types,

(c) Valve size,

(d) Qualification, such as compliance with ASME Standard QME-1-2007 (or later edition) as accepted in NRC Regulatory Guide 1.100,

(e) Plans for valve and actuator diversity,

(f) Incorporation of lessons learned from international operating experience where ICS valves failed to open as designed,

(g) Accessibility for inservice testing (IST) activities in accordance with 10 CFR 50.55a,

(h) Design features to avoid thermal binding or pressure locking of the valves, and

(i) OM Code leakage classification.

If any of this information is not available at this time, the staff requests that GEH indicate its plans to provide this information during future licensing activities for the BWRX-300 nuclear power plant.

GEH Response to NRC Question 03.09.06-1

Although detailed design of the IC condensate return valves has not yet been completed, the design functions and features of the IC condensate return valves are anticipated to be like what is described in Section 5.4.6 of the Economically Simplified Boiling Water Reactor (ESBWR) Design Control Document (DCD). Compliance with the requirements of 10 CFR 50, Appendix A, General Design Criteria (GDC) 1, GDC 2, GDC 4, and GDC 37 for the IC condensate return valves is anticipated to be the same as described in Section 5.4.6 of the ESBWR DCD. However, NEDC-33910P is not requesting NRC approval for the IC condensate return valves to meet these GDC. Instead, it is requested that the limited design requirements specified for the ICS including the IC condensate return valves be found acceptable for ensuring that the ICS can perform the limited functions that are a subject of NEDC-33910P in demonstrating compliance with 10 CFR 50, Appendix A, GDC 35. These include the following design functions:

- ICS is initiated automatically on high reactor pressure vessel (RPV) pressure indicating an overpressure event or on signals indicating a loss-of-coolant accident (LOCA).

- [[ ]]
- [[ ]]
- [[ ]]
- [[ ]]
- [[ ]]
- [[ ]]
- [[ ]]
- [[ ]]
- [[ ]]

NEDC-33910P did not describe compliance with 10 CFR 50 Appendix A, GDC 2, and will be revised to include this information. The conclusion of this additional information to be provided is that the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 2. Subsection 5.1.6 of NEDC-33911P, BWRX-300 Containment Performance, also describes that the RPV isolation valves will comply with 10 CFR 50 Appendix A, GDC 2.

As described in NEDC-33910P, the combined design features of the [[ ]] meet the definition of an ECCS as described in 10 CFR 50.46(a)(1)(i) that has a calculated cooling performance following postulated LOCAs in compliance with the BWRX-300 acceptance criteria in response to a LOCA which bound the acceptance criteria set forth in 10 CFR 50.46(b). In addition, the [[ ]] are effective as an ECCS for breaks in pipes in the RCPB up to and including a break equivalent in size to the double ended rupture of the largest pipe in the RCS in compliance with the definition of a LOCA in 10 CFR 50.46(c)(1). The [[ ]] has the capability to provide more than sufficient emergency core cooling. [[ ]] The analyses to demonstrate compliance will be provided during future licensing activities. Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 35.

NEDC-33910P did not describe compliance with 10 CFR 50 Appendix A, GDC 37, and will be revised to include this information. The conclusion of this additional information to be provided is that the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 37.

The details of the design functions and features beyond those requirements described above and already described in NEDC-33910P are to be addressed in future licensing activities, either by GEH in support of a 10 CFR 52 Design Certification Application (DCA) or by a license applicant for requesting a Construction Permit (CP) and Operating License (OL) under 10 CFR 50 or a Combined Operating License (COL) under 10 CFR 52. The following discussions address the specific questions provided:

(a) No FOAK features will be specified for the IC condensate return valves.

(b) Valve and actuator types will be addressed in the detailed design of the valves.

(c) Valve size will be addressed in the detailed design of the valves and will be specified during future licensing activities.

(d) Qualification, such as compliance with ASME Standard QME-1-2007 (or later edition) as accepted in NRC Regulatory Guide 1.100, will be addressed in the detailed design of the valves and will be specified during future licensing activities.

(e) As described in NEDC-33910P, the [[

]] These requirements provide for sufficient description of valve and actuator diversity in support of the NEDC-33910P conclusions that [[
]].

(f) Incorporation of lessons learned from international operating experience where ICS valves failed to open as designed will be addressed in the detailed design of the valves and will be specified during future licensing activities. However, NEDC-33910P will be revised to include discussion for Generic Letter 95-07, Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves, as this operating experience may be applicable to the detailed design of the valves.

(g) Accessibility for IST activities in accordance with 10 CFR 50.55a will be addressed in the detailed design of the valves and will consider IST requirements like those described in ESBWR DCD, Tier 2, 26A6642AK, Rev. 10, April 2014, Table 3.9-8. The IC condensate return valves design features are to be designed using the standards approved in 10 CFR 50.55a(a) in effect within six months of any license application, either by GEH in support of a 10 CFR 52 DCA or by a license applicant for requesting a CP and OL under 10 CFR 50 or a COL under 10 CFR 52. The specific IST requirements for the BWRX-300 design will be specified during future licensing activities.

(h) Design features to avoid thermal binding or pressure locking of the valves are not necessary for the IC condensate return valves. During normal operation with the ICS in standby, there are [[
]].

(i) IST requirements will be like those described in ESBWR DCD, Tier 2, 26A6642AK, Rev. 10, April 2014, Table 3.9-8, which consists of position indication verification (ASME OM Code Paragraph ISTC-3700), stroke open testing (ASME OM Code Paragraph ISTC-3521), and fail open testing (ASME OM Code Paragraph ISTC-3560). Like the ESBWR, the IC condensate return valves are classified as ASME OM Code Category B valves, and do not require leakage testing. However, the specific IST requirements for the BWRX-300 design will be specified during future licensing activities.

Proposed Changes to NEDC-33910P, Revision 0

NEDC-33910P, Revision 0, will be revised to reflect [[

]] and to add the following as new Subsections 4.1.5 and 4.1.13 to address compliance with 10 CFR 50, Appendix A, GDC 2 and GDC 37, and to address addition of Generic Letter 95-07 as new Subsection 4.5.2:

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1.1 Purpose

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The design of the RPV isolation valves and ICS meet the requirements of 10 CFR 50.46(b) and 10 CFR 50 Appendix A, General Design Criteria, GDC 1, GDC 2, GDC 4, GDC 14, GDC 30, GDC 31, GDC 33, ~~and~~ GDC 35, and GDC 37.

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4.1.5 10 CFR 50 Appendix A, GDC 2

- Regulatory Requirement: 10 CFR 50 Appendix A, GDC 2, Design bases for protection against natural phenomena, requires that SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. The design bases for these structures, systems, and components shall reflect: (1) Appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena and (3) the importance of the safety functions to be performed.

  Statement of Compliance: The BWRX-300 RPV isolation and overpressure protection design features, [[ ]] are to be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. Specific design requirements for the [[ ]] used to verify the capability to perform their safety functions, and the natural phenomena and effects evaluated, will be provided during future licensing activities.

Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 2.

. . .

4.1.13 10 CFR 50 Appendix A, GDC 37

- Regulatory Requirement: 10 CFR 50 Appendix A, GDC 37, Testing of emergency core cooling system, requires that the emergency core cooling system shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of its components, (2) the operability and performance of the active components of the system, and (3) the operability of the system as a whole and, under conditions as close to design as practical, the performance of the full operational sequence that brings the system into operation, including operation of applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of the associated cooling water system.

  Statement of Compliance: As previously described, the combined design features of the [[ ]] meet the definition of an ECCS as described in 10 CFR 50.46(a)(1)(i) that has a calculated cooling performance following postulated LOCAs in compliance with the BWRX-300 acceptance criteria in response to a LOCA which bound the acceptance criteria set forth in 10 CFR 50.46(b). In addition, the [[ ]] are effective as an ECCS for breaks in pipes in the RCPB up to and including a break equivalent in size to the double-ended rupture of the largest pipe in the RCS in compliance with the definition of a LOCA in 10 CFR 50.46(c)(1). The [[ ]] has the capability to provide more than sufficient emergency core cooling, which is assured for breaks in pipes in the RCPB up to and including a break equivalent in size to the double ended rupture of the largest pipe in the RCS through the use of [[ ]].

  Specific requirements for periodic pressure and functional testing of the [[ ]] to assure (1) the structural and leaktight integrity of these components, (2) the operability and performance of these active components, and (3) the operability of the systems as a whole containing the [[ ]] will be provided during future licensing activities.

  Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 37.

. . .

4.5.2 Generic Letter 95-07

Generic Letter 95-07, Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves, dated August 17, 1995, contains a request to ensure that safety-related power-operated gate valves that are susceptible to pressure locking or thermal binding are evaluated to ensure they are capable of performing the safety functions described in the licensing basis. This guidance will be evaluated for applicability during future licensing activities.

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NRC Question 03.09.06-2

Section 2.2 in NEDC-33910 provides a general overview of reactor pressure vessel (RPV) isolation concept, and Section 2.5 in NEDC-33910 specifies the RPV isolation valve design requirements for the BWRX-300 nuclear power plant. These sections indicate that there will be [[

]] To support the NRC staff review of NEC-33910 and its conformance to 10 CFR Part 50, Appendix A, GDC 1, 2, 4, 54, 55, and 56 for the RPV isolation valves, the NRC staff requests that GEH describe the following:

(j) Any FOAK features,

(k) Valve types and sizes,

(l) Qualification, such as compliance with ASME Standard QME-1-2007 (or later edition) as accepted in NRC Regulatory Guide 1.100,

(m) Plans for valve diversity,

(n) Accessibility for IST activities in accordance with 10 CFR 50.55a,

(o) Design to avoid thermal binding or pressure locking of the valves, and

(p) ASME OM Code leakage classification.

If any of this information is not available at this time, the staff requests that GEH indicate its plans to provide this information during future licensing activities for the BWRX-300 nuclear power plant.

GEH Response to NRC Question 03.09.06-2

The detailed design of the RPV isolation valve assemblies has not yet been completed. Compliance with the requirements of 10 CFR 50, Appendix A, General Design Criteria (GDC) 1, GDC 2 and GDC 4 for the RPV isolation valve assemblies is anticipated to be the same as for other ASME Class 1 valves described in the ESBWR DCD. Therefore, the BWRX-300 will comply with the requirements of GDC 1, GDC 2 and GDC 4 for the RPV isolation valve assemblies. NEDC-33910P is requesting that the limited design requirements specified for the RPV isolation valve assemblies be found acceptable for ensuring that the limited functions that are a subject of NEDC-33910P are met in demonstrating compliance with 10 CFR 50, Appendix A, GDC 33 and GDC 35.

Compliance with the requirements of 10 CFR 50, Appendix A, GDC 54, GDC 55, and GDC 56 as related to the design of the [[ ]] are described in Subsections 5.1.21, 5.1.22 and 5.1.26 of NEDC-33911P, Revision 0, BWRX-300 Containment Performance.

The details of the design functions and features beyond those requirements described above and already described in NEDC-33910P are to be addressed in future licensing activities, either by GEH in support of a 10 CFR 52 DCA or by a license applicant for requesting a CP and OL under 10 CFR 50 or a COL under 10 CFR 52. The following discussions address the specific questions provided:

(q) Any FOAK features will be addressed in the detailed design of the valves and will be specified during future licensing activities.

(r) Valve types and sizes will be addressed in the detailed design of the valves and will be specified during future licensing activities.

(s) Qualification, such as compliance with ASME Standard QME-1-2007 (or later edition) as accepted in NRC Regulatory Guide 1.100, will be addressed in the detailed design of the valves and will be specified during future licensing activities.

(t) As described in NEDC-33910P, the [[ ]] These requirements provide for sufficient description of diverse actuation in support of the NEDC-33910P conclusions that the [[ ]] to meet the BWRX-300 acceptance criteria in response to a LOCA which bound the acceptance criteria in 10 CFR 50.46(b)(1) through 10 CFR 50.46(b)(5). The [[ ]] for any breaks that would result in a loss of reactor coolant at a rate in excess of the capability of the nonsafety-related normal reactor coolant makeup systems, which for the BWRX-300 includes LOCA break sizes [[ ]]. The worst-case single failure affecting the [[ ]] does not prevent fulfillment of the required ECCS design functions. Therefore, there is no need for the [[ ]].

(u) Accessibility for IST activities in accordance with 10 CFR 50.55a will be addressed in the detailed design of the valves and will consider IST requirements like those described in ESBWR DCD, Tier 2, 26A6642AK, Rev. 10, April 2014, Table 3.9-8, for other active ASME Class 1 valves. The specific IST requirements for the BWRX-300 design will be specified during future licensing activities.

(v) Design features to avoid thermal binding or pressure locking of the valves are not necessary for the RPV isolation valves. The safety function of the RPV isolation valves is to close as opposed to having an opening safety function. Automatic actuation of [[ ]] performs the function to mitigate the effects of a LOCA. [[ ]] is a one-time action to open or close appropriate valves during accident response which may also be initiated manually as a one-time action if necessary.

As described in NEDC-33910P all BWRX-300 RPV isolation valves shall have a proven low leakage potential. Design and administrative leakage limits are applied to valve selection during the BWRX-300 preliminary design and are based on plant design and event evaluations using offsite dose consequences compared to regulatory limits as well as containment design limits. The leakage criteria are analyzed as part of the plant safety analysis. Therefore, the RPV isolation valves are classified as ASME OM Code Category A valves requiring a seat leakage rate test (ASME OM Code Paragraph ISTC-3600). IST requirements will be like what is described in ESBWR DCD, Tier 2, 26A6642AK, Rev. 10, April 2014, Table 3.9-8, for ASME Class 1 valves. The specific IST requirements for the BWRX-300 design will be specified during future licensing activities.

Proposed Changes to NEDC-33910P, Revision 0

None

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NRC Question 03.09.06-6

Section 4.1.3 in NEDC-33910 indicates that the requirements of 10 CFR 50.55a will be satisfied. This section specifically references the RPV isolation valves. This section also states that no alternative approach, exception, or exemption from these requirements is required. The NRC staff requests that GEH describe the compliance with the requirements in 10 CFR 50.55a for the [[ ]]. The staff also requests that GEH clarify the intent of the statement in this section and elsewhere in NEDC-33910 that no alternative approach, exception, or exemption from these requirements is required.

GEH Response to NRC Question 03.09.06-6

GEH understands that the use of statements like "Full compliance with these requirements is to be demonstrated in the preliminary and final design of the BWRX-300 to be completed during future licensing activities. Therefore, no alternative approach, exception, or exemption from these requirements is required" are not appropriate where used. Therefore, the discussion containing those statements, including in Section 4.1.3, are proposed to be revised in NEDC-33910P as described below for clarification of the intent, which is to provide a commitment to meeting the applicable regulatory requirements during detailed design.

Proposed Changes to NEDC-33910P, Revision 0

NEDC-33910P, Revision 0, will be revised to reflect [[ ]] and to include compliance with the requirements of the BWRX-300 acceptance criteria in response to a LOCA which bound the acceptance criteria in 10 CFR 50.46(b)(5) using a long-term cooling timeframe of [[ ]], and to replace the use of these statements with appropriate statements of compliance to provide a commitment to meeting the applicable regulatory requirements during detailed design:

. . .

2.7 Categories of Pipe Breaks

. . .

The emergency core cooling system (ECCS) evaluation model for the BWRX-300 is to be developed using previously approved methodologies used in the ECCS performance analyses for the ESBWR as modified using BWRX-300 specific design requirements and parameters. ~~Full compliance with these requirements is to be demonstrated in the final~~Final ECCS performance analyses are to be completed during future licensing activities using an NRC-approved BWRX-300 ECCS evaluation model. Methodology for containment response is described in ~~a separate~~ LTR NEDC-33911P, BWRX-300 Containment Performance [Reference 5.6].

. . .

4.1.2 10 CFR 50.46

. . .

Based on the above evaluation, the combined design features of the [[ ]] meet the definition of an ECCS as described in 10 CFR 50.46(a)(1)(i) that has a calculated cooling performance following postulated LOCAs in ~~full~~ compliance with the BWRX-300 acceptance criteria in response to a LOCA which bound the acceptance criteria set forth in 10 CFR 50.46(b). In addition, the [[ ]] are effective as an ECCS for breaks in pipes in the RCPB up to and including a break equivalent in size to the double-ended rupture of the largest pipe in the RCS ~~in full compliance~~consistent with the definition of a LOCA in 10 CFR 50.46(c)(1).

Although this is a~~n alternative and~~ non-traditional approach for the design of the ECCS for past LWRs, no [[ ]] is ~~required~~needed following the worst case LOCA to meet the BWRX-300 acceptance criteria in response to a LOCA which bound the acceptance criteria in 10 CFR 50.46(b). ~~Final ECCS performance analyses are to~~ The analyses to demonstrate compliance with the BWRX-300 acceptance criteria in response to a LOCA will be completed during future licensing activities. Therefore, ~~no exception or exemption is required for these regulatory requirements. Full compliance with these requirements is to be demonstrated in the final ECCS performance analyses to be completed during future licensing activities.~~the BWRX-300 design will meet the requirements of 10 CFR 50.46.

. . .

Statement of Compliance: The ECCS evaluation model for the BWRX-300 is to be developed using previously approved methodologies used in the ECCS performance analyses for the ESBWR as modified using BWRX-300 specific design requirements and parameters. ~~Full compliance with these requirements is to be demonstrated in the final ECCS performance analyses to~~The analyses to demonstrate compliance with the BWRX-300 acceptance criteria in response to a LOCA will be completed during future licensing activities using an NRC-approved BWRX-300 ECCS evaluation model which includes reasonably conservative methods. Because of the BWRX-300 acceptance criteria being applied to bound the 10 CFR 50.46(b) acceptance criteria, uncertainties will be addressed in the BWRX-300 ECCS evaluation model to verify that there is a high level of probability that the BWRX-300 acceptance criteria would not be exceeded rather than the 10 CFR 50.46(b) acceptance criteria. The BWRX-300 evaluation model will not use the alternatives provided in 10 CFR 50 Appendix K.

Therefore, ~~no alternative approach, exception, or exemption from these requirements is required~~the BWRX-300 design will meet the requirements of 10 CFR 50.46(a)(1).

. . .

Statement of Compliance: The ~~design goal~~BWRX-300 acceptance criteria in response to a LOCA is that ~~the core does not uncover during LOCAs~~reactor water level is maintained at or above TAF or fuel cladding temperature is maintained within normal operating temperature range, and that no significant fuel cladding heatup occurs, such that the calculated maximum fuel element cladding temperature does not exceed the acceptance criterion of 2200°F.

~~Therefore, no alternative approach, exception, or exemption from these requirements is required. Full compliance with this requirement is to be demonstrated in the finalFinal ECCS performance~~

~~analyses are to~~The analyses to demonstrate compliance with the BWRX-300 acceptance criteria in response to a LOCA will be completed during future licensing activities. Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50.46(b)(1).

. . .

Statement of Compliance: The ~~design goal~~BWRX-300 acceptance criteria in response to a LOCA is that ~~the core does not uncover during LOCAs~~reactor water level is maintained at or above TAF or fuel cladding temperature is maintained within normal operating temperature range, and that no significant fuel cladding oxidization occurs, such that the calculated total oxidation of the cladding does not nowhere exceed the acceptance criterion of 0.17 times the total cladding thickness before oxidation.

~~Therefore, no alternative approach, exception, or exemption from these requirements is required. Full compliance with this requirement is to be demonstrated in the final~~Final ~~ECCS performance analyses are to~~The analyses to demonstrate compliance with the BWRX-300 acceptance criteria in response to a LOCA will be completed during future licensing activities. Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50.46(b)(2).

. . .

Statement of Compliance: The ~~design goal~~BWRX-300 acceptance criteria in response to a LOCA is that ~~the core does not uncover during LOCAs~~reactor water level is maintained at or above TAF or fuel cladding temperature is maintained within normal operating temperature range, and that no significant fuel cladding hydrogen generation occurs, such that the calculated total amount of hydrogen generated from the chemical reaction of the cladding with water or steam does not exceed the acceptance criterion of 0.01 times the hypothetical amount that would be generated if all of the metal in the cladding cylinders surrounding the fuel, excluding the cladding surrounding the plenum volume, were to react.

~~Therefore, no alternative approach, exception, or exemption from these requirements is required. Full compliance with this requirement is to be demonstrated in the final~~Final ~~ECCS performance analyses are to~~The analyses to demonstrate compliance with the BWRX-300 acceptance criteria in response to a LOCA will be completed during future licensing activities. Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50.46(b)(3).

. . .

Statement of Compliance: The ~~design goal~~BWRX-300 acceptance criteria in response to a LOCA is that ~~the core does not uncover during LOCAs~~reactor water level is maintained at or above TAF or fuel cladding temperature is maintained within normal operating temperature range, and that no significant changes in core geometry occur, such that the acceptance criterion of the core remaining amenable to cooling is met.

~~Therefore, no alternative approach, exception, or exemption from these requirements is required. Full compliance with this requirement is to be demonstrated in the final~~~~Final ECCS performance analyses are to~~The analyses to demonstrate compliance with the BWRX-300 acceptance criteria in response to a LOCA will~~Final ECCS performance analyses are to~~ be completed during future licensing activities. Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50.46(b)(4).

. . .

Statement of Compliance: The ~~design goal~~BWRX-300 acceptance criteria in response to a LOCA is that ~~the core does not uncover during LOCAs~~reactor water level is maintained at or above TAF or fuel cladding temperature is maintained within normal operating temperature range, and that ~~no significant fuel cladding heatup~~long-term cooling removes decay heat and maintains the core temperature to acceptably low values ~~occurs~~, such that after any calculated successful initial operation of the ECCS, the acceptance criteria of the calculated core temperature being maintained at an acceptably low value and decay heat being removed for the extended period of time required by the long lived radioactivity remaining in the core are met.

For the BWRX-300, [[

]] In addition, the operation of the ICS does not require offsite electric power system operation, and only requires one-time automatic actuation using onsite Class 1E battery-backed power without any further need of onsite or offsite electric power system operation.~~For the BWRX-300,~~ [[

]]~~In addition, the operation of the ICS does not require offsite electric power system operation, and only requires one-time automatic actuation using onsite Class 1E battery-backed DC power and then remains in service for at least~~ [[ ]]~~ without any further need of onsite or offsite electric power system operation.~~

The selected long-term cooling timeframe of [[ ]] is sufficient to maintain reactor water level at or above TAF or fuel cladding temperature within normal operating temperature range for both [[

]] Following [[

]], the [[ ]] continues to provide long-term cooling to meet the BWRX-300 acceptance criteria in response to a LOCA and only requires operator action to [[ ]] after approximately seven days.

~~Therefore, no alternative approach, exception, or exemption from these requirements is required. Full compliance with this requirement is to be demonstrated in the final~~~~Final ECCS performance analyses are to~~The analyses to demonstrate compliance with the BWRX-300 acceptance criteria in response to a LOCA will~~Final ECCS performance analyses are to~~ be completed during future licensing activities. Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50.46(b)(5).

. . .

4.1.3 10 CFR 50.55a

. . .

These requirements are to be implemented during detailed design of the safety-related components of the [[ ]].~~Full compliance with these requirements is to be demonstrated in the preliminary and final design of the BWRX-300 to be completed during future licensing activities.~~

Therefore, ~~no alternative approach, exception, or exemption from these requirements is required~~the BWRX-300 design will meet the requirements of 10 CFR 50.55a.

. . .

4.1.4 10 CFR 50 Appendix A, GDC 1

. . .

~~Full compliance with these requirements is to be demonstrated in the preliminary and final design of the BWRX-300 to be completed during future licensing activities.~~

Therefore, ~~no alternative approach, exception, or exemption from these requirements is required~~the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 1.

. . .

~~4.1.5~~4.1.6 10 CFR 50 Appendix A, GDC 4

. . .

Therefore, ~~no alternative approach, exception, or exemption from these requirements is required~~the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 4.

. . .

~~4.1.6~~4.1.7 10 CFR 50 Appendix A, GDC 14

. . .

This results in an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture, in ~~full~~ compliance with this criterion. For piping that have [[

]]. Further design details are to be described during future licensing activities.

Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 14.

. . .

~~4.1.7~~4.1.8 10 CFR 50 Appendix A, GDC 15

. . .

The combination of RPS and [[ ]] design features ensure that the acceptance criteria for each component in the protected system are met including 1) the overpressure does not exceed 1.1 times design pressure for the expected system pressure transient condition, and 2) the calculated stress intensity and other design limitations for Service Level C are not exceeded for the unexpected system excess pressure transient condition, with further design details to be described during future licensing activities. ~~Full compliance with these requirements is to be demonstrated in the preliminary and final design of the BWRX-300 to be completed during future licensing activities.~~

Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 15.

. . .

~~4.1.8~~4.1.9 10 CFR 50 Appendix A, GDC 30

. . .

In addition, means are to be provided to detect and identify the location of the source of reactor coolant leakage, including the components of the ICS and RPV isolation valves, for components of the RCPB, with further design details to be described during future licensing activities.~~ Full compliance with these requirements is to be demonstrated in the preliminary and final design of the BWRX-300 to be completed during future licensing activities.~~

Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 30.

. . .

~~4.1.9~~4.1.10 10 CFR 50 Appendix A, GDC 31

. . .

The components of the RCPB, including the ICS and RPV isolation valves, are to be designed with sufficient margin to assure that these requirements are met, with further design details to be described during future licensing activities.~~ Full compliance with these requirements is to be demonstrated in the preliminary and final design of the BWRX-300 to be completed during future licensing activities.~~

Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 31.

. . .

~~4.1.11~~4.1.12 10 CFR 50 Appendix A, GDC 35

. . .

As previously described, the combined design features of the [[ ]] meet the as described in 10 CFR 50.46(a)(1)(i) that has a calculated cooling performance following postulated LOCAs in ~~full~~ compliance with the criteria set forth in 10 CFR 50.46(b). In addition, the [[ ]] are effective as an ECCS for breaks in pipes in the RCPB up to and including a break equivalent in size to the double-ended rupture of the largest pipe in the RCS in ~~full~~ compliance with the definition of a LOCA in 10 CFR 50.46(c)(1).

. . .

~~Full compliance with these requirements is to be demonstrated in the final ECCS performance~~The analyses to ~~be completed~~demonstrate compliance will be provided during future licensing activities.

Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 35.

. . .

4.2.1 Regulatory Guide 1.26

. . .

Therefore, the BWRX-300 design conforms to the guidance for the RPV isolation valves and the ICS, including regulatory positions of RG 1.26~~, without requiring an alternative approach or exception~~.

. . .

4.2.2 Regulatory Guide 1.29

. . .

Therefore, the BWRX-300 design conforms to the guidance, including regulatory positions of RG 1.29~~, without requiring an alternative approach or exception~~.

. . .

4.2.3 Regulatory Guide 1.45

. . .

Additionally, the means for detecting and, to the extent practical, identifying the location of the source of reactor coolant leakage in compliance with the requirements of 10 CFR 50 Appendix A, GDC 30, and the requirements for in-service inspection and testing of the [[ ]] in compliance with the requirements of 10 CFR 50.55a, are to be demonstrated during future licensing activities~~, and no alternative approach, exception, or exemption from these requirements is required~~.

Therefore, the BWRX-300 design conforms to the guidance, including regulatory positions of RG 1.45~~, without requiring an alternative approach or exception~~.

. . .

4.2.4 Regulatory Guide 1.84

. . .

Compliance with the requirements of 10 CFR 50.55a, including the use of ASME B&PV Section III Code Cases endorsed in RG 1.84 where necessary, is to be demonstrated during future licensing activities~~, and no alternative approach, exception, or exemption from these requirements is required~~.

Therefore, the BWRX-300 design conforms to the guidance, including regulatory positions of RG 1.84~~, without requiring an alternative approach or exception~~.

eRAI No.: 9730
Date of eRAI Issue: 04/09/20

NRC Question 03.09.06-8

Section 4.1.10 in NEDC-33910 describes compliance with the intent of GDC 33 regarding reactor coolant makeup. The NRC staff requests that GEH clarify its statement that the intent of this criterion is met.

GEH Response to NRC Question 03.09.06-8

As stated in NEDC-33910P, 10 CFR 50, Appendix A, GDC 33, Reactor coolant makeup, requires that a system to supply reactor coolant makeup for protection against small breaks in the RCPB shall be provided. The system safety function shall be to assure that specified acceptable fuel design limits are not exceeded as a result of reactor coolant loss due to leakage from the RCPB and rupture of small piping or other small components which are part of the boundary. The system shall be designed to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished using the piping, pumps, and valves used to maintain coolant inventory during normal reactor operation.

~~For the BWRX-300,~~ [[

]] ~~In addition, the operation of the ICS does not require offsite electric power system operation, and only requires one-time automatic actuation using onsite Class 1E battery-backed power without any further need of onsite or offsite electric power system operation. Further discussion regarding the selected long-term cooling period for the BWRX-300 is included in the GEH response to NRC Question NONE-2 in Enclosures 3 (Proprietary) and 6 (Non-Proprietary).~~

~~Because specified acceptable fuel design limits are not exceeded as a result of reactor coolant loss due to leakage from the RCPB and rupture of small piping or other small components which are part of the boundary~~ [[ ]] ~~the special circumstance as specified in 10 CFR 50.12(a)(2)(ii) is present justifying an exemption to these specific requirements of 10 CFR 50 Appendix A, GDC 33. The application of the regulation in these particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule. Instead, a new Principal Design Criterion (PDC) 33 is proposed as described in the proposed changes to NEDC-33910P provided below.~~GDC 33 applies to small leaks in the RCPB that are [[

]] (e.g., leakage from flanges or cracks in piping or other components), and which do not exceed the capability of the nonsafety-related high-pressure CRD system used as normal reactor coolant makeup during power operations. The maximum allowed leakage rate for continuing power operation is stipulated in the plant Technical Specifications. For leakage greater than the maximum allowed leakage rate, automatic reactor scram and automatic actuation of the [[ ]] is not anticipated for most of these small leaks because the normal means of makeup from the high-pressure CRD system and feedwater maintains the level in the normal operating range. However, these small leaks which do not exceed the capability of the nonsafety-related high-pressure CRD system are evaluated using specified acceptable fuel design limits rather than the BWRX-300 acceptance criteria in response to a LOCA.

The high-pressure CRD system pumps can operate using either onsite electric power system operation (assuming offsite power is not available) backed up by nonsafety-related standby diesel generators and offsite electric power system operation (assuming onsite power is not available).

Proposed Changes to NEDC-33910P, Revision 0

NEDC-33910P, Revision 0, will be revised to address ~~proposal of a PDC 33 and provide justification for an exemption to these specific~~compliance with the regulatory requirements of 10 CFR 50 Appendix A, GDC 33~~, which may be used as the bases for the necessary exemption during future licensing activities either by GEH in support of a 10 CFR 52 DCA or by a license applicant for requesting a CP and OL under 10 CFR 50 or a COL under 10 CFR 52~~:

. . .

~~4.1.10~~4.1.11 10 CFR 50 Appendix A, GDC 33

. . .

Statement of Compliance: ~~The safety analysis assumes that the small pipe breaks~~ [[

]] ~~In addition, the operation of the ICS does not require offsite electric power system operation, and only requires one-time automatic actuation using onsite Class 1E battery-backed DC power without any further need of onsite or offsite electric power system operation.~~

~~Although the BWRX-300~~ [[ ]] ~~nonsafety-related injection systems may be used for manual addition of reactor coolant inventory~~

~~by the operator using high pressure CRD injection or by reestablishing feedwater injection. These nonsafety-related injection systems can be used at any time following a LOCA. The timing of such operator actions is to be determined during the final ECCS performance analyses to be completed during future licensing activities. Therefore, specified acceptable fuel design limits are not exceeded as a result of reactor coolant loss due to leakage from the RCPB and rupture of small piping or other small components which are part of the boundary~~ [[

]]~~. Based on the above discussions, the special circumstance as specified in 10 CFR 50.12(a)(2)(ii) is present justifying an exemption to these specific requirements of 10 CFR 50 Appendix A, GDC 33. The application of the regulation in these particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule. Instead, the following PDC 33 is proposed:~~

~~PDC 33, Reactor coolant makeup, a safety-related system to supply reactor coolant makeupfor protection against small breaks in the is not needed to assure that specified acceptable fuel design limits are not exceeded as a result of reactor coolant loss due to leakage from the RCPB and rupture of small piping or other small components which are part of the boundary. In addition, the operation of the systems to mitigate the consequences of small breaks in the RCPB do not require offsite electric power system operation, and only require one-time automatic actuation using onsite Class 1E battery-backed power without any further need of onsite or offsite electric power system operation.~~

~~These statements of compliance and proposed PDC 33 may be used as the bases for the necessary exemption during future licensing activities either by GEH in support of a 10 CFR 52 DCA or by a license applicant for requesting a CP and OL under 10 CFR 50 or a COL under 10 CFR 52.The safety analysis assumes that the small pipe breaks~~ [[

]]~~ In addition, the operation of the ICS does not require offsite electric power system operation, and only requires one-time actuation using onsite Class 1E battery-backed DC power.~~

~~Although the BWRX-300~~ [[ ]] ~~nonsafety-related injection systems may be used for manual addition of reactor coolant inventory by the operator using high pressure CRD injection or by reestablishing feedwater injection. These nonsafety-related injection systems can be used at any time following a LOCA. The timing of such operator actions is to be determined during the final ECCS performance analyses to be completed during future licensing activities. Therefore, specified acceptable fuel design limits are not exceeded as a result of reactor coolant loss due to leakage from the RCPB and rupture of small piping or other small components which are part of the boundary~~ [[

]] GDC 33 applies to small leaks in the RCPB that are [[
]] (e.g., leakage from flanges or cracks in piping or other components), and which do not exceed the capability of the nonsafety-related high-pressure CRD system used as normal reactor coolant makeup during power operations. The

maximum allowed leakage rate for continuing power operation is stipulated in the plant Technical Specifications. For leakage greater than the maximum allowed leakage rate, automatic reactor scram and automatic actuation of the [[ ]] is not anticipated for most of these small leaks because the normal means of makeup from the high-pressure CRD system and feedwater maintains the level in the normal operating range. However, these small leaks which do not exceed the capability of the nonsafety-related high-pressure CRD system are evaluated using specified acceptable fuel design limits rather than the BWRX-300 acceptance criteria in response to a LOCA.

The high-pressure CRD system pumps can operate using either onsite electric power system operation (assuming offsite power is not available) backed up by nonsafety-related standby diesel generators and offsite electric power system operation (assuming onsite power is not available).

Therefore, the BWRX-300 design will meet the requirements of 10 CFR 50 Appendix A, GDC 33.