ENCLOSURE 2

MFN 13-048

Comment Summary Table and Draft SE Markup

Non-Proprietary Information – Class I (Public)

INFORMATION NOTICE

This is a non-proprietary version of Enclosure 1, which has the proprietary information removed. Portions of the document that have been removed are indicated by white space with an open and closed bracket as shown here [[ ]].

Comment Summary for Draft Safety Evaluation for NEDE-33075P, Revision 7, "GE Hitachi Boiling Water Reactor Detect and Suppress Solution-Confirmation Density"

Location MFN 13-048 Markup	Comment
Section 1.0 Introduction	Page 1 (lines 40-41), Page 2 (line 1) GEH suggests the following changes: **A Final Safety Evaluation has been issued for NEDE-33147P, Revision 3 (Reference 6), while NEDO-32465 Supplement 1 (Reference 7),** ~~These additional~~ TR~~s are simultaneously~~ **is** currently under review by the NRC staff.
Table 2	Page 14 (parameter name GSF & MSF) Delete first two rows. Move these first two rows from Table 2 to Table 3.
Table 2	Page 14 (parameter name m) GEH suggests the following change: Slope of the automatic Backup Stability Protection (BSP) APRM flow biased trip and rod block setpoint linear segments. [[ ]]
Table 2	Page 14 (parameter name P_{BSP-RB}^{2}) GEH suggests the following change: Automatic BSP APRM flow biased rod block setpoint power intercept (% Rated power). The STP from the APRM channel is used to provide the power level. [[ ]]
Table 2	Page 14 (parameter name W_{BSP-RB}^{2}) GEH suggests the following change: Automatic BSP APRM flow biased rod block setpoint drive flow intercept (% Rated drive flow). The total recirculation flow (average of both loops) from the APRM channel is used to provide the recirculation drive flow. [[ ]]
Table 2	Page 14 (lines 3 & 5) Please change "GE" to "GEH" in two locations.
Table 3	Page 15 (Table 3) Add first two rows from Table 2 (parameters GSF and MSF).
Table 3	Page 15 (parameter name Manual BSP Region II) GEH suggests the following change: Inadvertent entry in Region II requires immediate exit. Intentional entry is permitted with stability control measured (See Section 7.2.3.2 ~~of the Approved LTR~~)

Location MFN 13-048 Markup	Comment
Section 3.6 Revision 7 Updates	Page 17 (line 19) GEH suggests the following changes: "… from decay ratio (DR)≤~~<~~0.6 to DR≤~~<~~0.8, and an Operator Awareness Region has been …."
Section 3.6 Revision 7 Updates	Page 17 (line 25) GEH suggests the following addition: "…which has been ~~submitted~~ **reviewed and approved** separately to the …"
Section 3.6 Revision 7 Updates	Page 17 (line 33) GEH suggests the following change: [[ ]]
Section 3.6 Revision 7 Updates	Page 19 (line 8) GEH suggests the following change: "…flow and power continue to be reduced following the pump trip and this **may** increase~~s~~ the available…"
Section 6.0 Conclusion	Page 24 (line 1) GEH suggests the following change: "…reduction events; (b) **for some plants** these instabilities **may** develop in a time frame of…"
Section 6.0 Conclusion	Page 24 (line 8) GEH suggests the following change: "…(Reference 1), and it provides three different ~~options~~ **elements**: Manual BSP…"
Section 6.0 Conclusion	Page 24 (lines 12-14) GEH suggests the following clarification to Item 5.a: The ABSP option and the BSP Boundary option are acceptable backup solutions for short periods of time ~~(up to 120 days for BSP Boundary)~~ when the licensed solution (e.g., DSS-CD) is declared inoperable. **For the BSP Boundary, this time is limited to 120 days.** This time frame is consistent with Action 3.3.1.1-J.3 of the proposed TSs.
Section 6.0 Conclusion	Page 24 (lines 37-39) GEH suggests the following change to Item 9: Table 6.5 of NEDC-33075P, Revision 7 (Reference 1), describes the **approved** fuel transition scenarios, **so** ~~which are subject to~~ a plant-specific ~~review for each application~~ **submittal is not required**.
Section 6.0 Conclusion	Page 25 (line 2) GEH suggests the following change: "…for all other events ~~is~~ **may be** increased."

Location MFN 13-048 Markup	Comment
Section 6.0 Conclusion	Page 25 (lines 20-21) GEH suggests the following addition: **For any other fuel design, the fuel transition process described in Table 6-5 is approved.**
Section 7.0 References	Page 26 (lines 22-23) GEH suggests the change to Reference 6: TR NEDE-33147P**-A**, Revision **4**~~3~~, "DSS-CD TRACG Application," dated **August 2013.**~~January 2011. (ADAMS Package Accession No. ML110270071)~~
Appendix A Introduction	Page A-1 (lines 32-33) "The NRC staff ~~is currently also reviewing~~ **has reviewed and approved** the TRACG04 code for DSS-CD application,
Appendix A References	Page A-3 (lines 39-40) GEH suggests the change to Reference 2: TR NEDE-33147P**-A**, Revision **4**~~3~~, "DSS-CD TRACG Application," dated **August 2013.**~~January 2011. (ADAMS Package Accession No. ML110270071)~~
Appendix A	Note, consistent with the Technical Evaluation which was included in the SE for Revision 5 of NEDC-33075P, Appendix A is proprietary in its entirety.
Entire document	Some of the information provided is considered to be GEH proprietary information. See the attached markup with dotted underline within double square brackets. [[ ]]

REVISED DRAFT SAFETY EVALUATION BY

THE OFFICE OF NUCLEAR REACTOR REGULATION

TOPICAL REPORT NEDC-33075P, REVISION 7

"GENERAL ELECTRIC BOILING WATER REACTOR DETECT AND SUPPRESS SOLUTION-CONFIRMATION DENSITY"

GE-HITACHI NUCLEAR ENERGY AMERICAS, LLC

PROJECT NO. 710

1.0 INTRODUCTION

By letter dated June 10, 2011, GE-Hitachi Nuclear Energy Americas, LLC (GEH) submitted Topical Report (TR) NEDC-33075P, Revision 7, "GE Hitachi Boiling Water Reactor Detect and Suppress Solution - Confirmation Density" (Reference 1) to the U.S. Nuclear Regulatory Commission (NRC) staff for review. NEDC-33075P, Revision 7, defines the licensing basis and reload applications for the "Detect and Suppress Solution - Confirmation Density" (DSS-CD) methodology. DSS-CD is a type of long-term stability solution previously approved by the NRC staff (References 2-3) that has features similar to the previously approved Solution III (References 3-5). Revision 7 of NEDC-33075P includes a transition from TRACG02/PANAC10 to TRACG04/PANAC11 GEH methodologies and clarification of several items that were discovered during implementation. This TR replaces the currently approved version, NEDC-33075P-A, Revision 6. (Reference 2)

With NEDC-33075P, Revision 7 (Reference 1), GEH requested an incremental review and approval of the improvements to the licensing basis for DSS-CD applications and other changes implemented since Revision 6. GEH requested review and approval of DSS-CD applications for GE BWR/3-6 product lines, GE14 and earlier GE fuel designs, and operating envelopes up to and including Extended Power Uprate (EPU) and Maximum Extended Load Line Limit Analysis Plus (MELLLA+).

TRACG04 applicability to DSS-CD calculations is documented in a separate TR, NEDE-33147P, Revision 3 (Reference 6). The "Delta CPR [critical power ratio] over Initial MCPR [minimum critical power ratio] Versus Oscillation Magnitude (DIVOM)" methodology using TRACG04 is documented in another TR, NEDO-32465 Supplement 1 (Reference 7). **A Final Safety Evaluation has been issued for NEDE-33147P, Revision 3 (Reference 6),**

while NEDO 32465 Supplement 1 (Reference 7)~~These additional~~ TR~~s are~~ **is** ~~simultaneously~~ **currently** under review by the NRC staff.
The NRC staff was assisted in this review by staff from Oak Ridge National Laboratory (ORNL). The NRC staff's review is based on the subject TR and its previous revisions, requests for additional information (RAIs), and information obtained during meetings with GEH to clarify and supplement these RAIs. The main conclusion from this review is that the proposed DSS-CD methodology provides protection against specified acceptable fuel design limits (SAFDLs) in the case of instabilities, even when operating the reactor in the EPU or MELLLA+ domains.

The NRC staff is currently evaluating the TRACG04 models for post-critical heat flux (CHF) heat transfer, dryout, and rewet, including the correlations for stable film boiling temperature (Tmin) and the quench front model (Reference 8). This SE documents the NRC staff's review regarding the application of TRACG04 for DSS-CD, where calculations are not analyzed past the point of CHF; therefore the approval of TRACG04 for DSS-CD does not imply the approval of the TRACG04 post-CHF models.

1.1. Background

Following the March 1988 instability event at a LaSalle County Station boiling water reactor (BWR), the BWR Owners Group (BWROG) initiated a task to investigate actions that industry should take to resolve the stability issue as an operational concern. Through analysis, the BWROG found that the existing plant protection system, which was based on a scram on high average power range monitor (APRM) signal, may not provide enough protection against out-of-phase modes of instability; thus, the BWROG decided that a new automatic instability suppression function was required as a long-term solution and that this function should have a rapid and automatic response which does not rely on operator action.

The BWROG submitted and the NRC staff approved three different long-term stability options (Reference 3). It is up to the individual licensees to choose which solution will be implemented in their reactor. These options can be summarized as follows:

I. Exclusion Region. A region outside which instabilities are very unlikely is calculated for each representative plant type using well-defined procedures. If the reactor is operated inside this exclusion region, an automatic protective action is initiated to exit the region. This action is based exclusively on power and flow measurements, and the presence of oscillations is not required for its initiation. Two concepts of Solution I were submitted by the BWROG and approved by the NRC staff:

- **I-A** Immediate protection action (either scram or select rod insert) upon entrance to the exclusion region.

- **I-D** Some small-core plants with tight inlet orifices have a reduced likelihood of out-of-phase instabilities. For these plants, the existing flow-biased high APRM scram provides a detect and suppress function to avoid safety limits violation for the expected instability mode. In addition, administrative controls are proposed to maintain the reactor outside the exclusion region.

II. Quadrant-Based APRM Scram. In a BWR/2, the quadrant-based APRM is capable of detecting both in-phase and out-of-phase oscillations with sufficient sensitivity to initiate automatic protective action to suppress the oscillations before safety margins are compromised.

III. LPRM-Based Detect and Suppress. Local power range monitor (LPRM) signals or combinations of a small number of LPRMs are analyzed on-line by using three diverse algorithms. If any of the algorithms detects an instability, automatic protective action is taken to suppress the oscillations before safety margins are compromised.

All of the above solutions have been implemented in commercial nuclear power plants in the United States (U.S.). Nevertheless there are three significant areas of consideration, which merit a revisit of these long-term solutions. These areas are: (a) deficiencies identified in the CPR versus oscillation amplitude correlation used for detect and suppress solutions (i.e., the DIVOM correlation,) which resulted in a Title 10 of the *Code of Federal Regulations* (10 CFR) Part 21 notification, (b) proposed increases in power density, and (c) lessons learned from instability events that occurred at Nine Mile Point Nuclear Station, Unit 2 (hereafter, “Nine Mile Point 2”) in July 2003 and Perry Nuclear Power Plant, Unit 1 (hereafter, “Perry”) in December 2004.

The DIVOM correlation is used to estimate the delta CPR as a function of oscillation amplitude, and it is required to select the scram set point for detect and suppress solutions. The DIVOM correlation was approved on the basis that it would be bounding for all reasonable circumstances; however, later analysis demonstrated that some plant-specific calculations result in larger loss of CPR margin than the DIVOM prediction. Therefore, the generic DIVOM curve may be non-conservative for some plant applications. A non-conservative DIVOM curve, would then result in stability-related setpoints that would not guarantee that SAFDLs would be maintained if a limiting instability event were to occur. This potential for a non-conservative DIVOM curve made Solution III invalid as a viable long-term solution, unless cycle-specific DIVOM correlations were used, which is the approach used by most plants today.

In recent years, the industry has been moving to reactor operation at higher and higher power densities and power-to-flow ratios. This operation is, in principle, detrimental to the stability characteristics of the reactor and results in two consequences: (a) it increases the probability of instability events, and (b) it increases the severity of the event should it occur (e.g., larger amplitude oscillations). Indeed, simulations of two recirculation pump trip (2RPT) transients initiated at MELLLA+ conditions (80 percent flow and 120 percent original licensed thermal power) indicate that instabilities of sufficiently large amplitude to compromise the safety limit MCPR (SLMCPR) in short time are not only possible, but very likely.

Since implementation of the long-term solutions, instability events have occurred at two U.S. plants: Nine Mile Point 2 in July 2003 and Perry in December 2004. Both events occurred in Solution III plants. Some deficiencies were identified in the performance of Solution III for the Nine Mile Point 2 event, resulting in a 10 CFR Part 21 notification. The deficiencies were related to the adjustable parameters for period-based detection, which are now recommended to be placed at their most sensitive settings. Most parameter settings for the long-term solutions are evaluated on a plant-specific basis by collecting noise data over a relatively long period of time. The parameters are adjusted during this trial period until normal plant transients do not trigger the stability detection algorithms. In Nine Mile Point 2, these parameters had been set to be fairly insensitive to avoid spurious actuations; however, this resulted in continuous resetting of the confirmation count because the Nine Mile Point 2 oscillation was very small in magnitude. In spite of stability solution deficiencies that were identified after careful analysis of the event data, Solution III automatically initiated a scram of the reactor and the SLMCPR was never compromised in the Nine Mile Point 2 event. The Perry event resulted from a malfunctioning valve, which triggered scram actuation by Solution III without compromising the SLMCPR.

2.0 <u>REGULATORY EVALUATION</u>

The DSS-CD design provides automatic detection and suppression of reactor instability and minimizes reliance on the operator to suppress instability events. The "Confirmation Density Algorithm" (CDA) is designed to recognize an instability and initiate control rod insertion before the power oscillations increase much above the noise level. The DSS-CD solution and its related licensing basis were developed to comply with the requirements of General Design Criteria (GDC) 10 and 12 in Part 50 of 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

Criterion 10, "Reactor design," requires that:

> The reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

Criterion 12, "Suppression of reactor power oscillations," requires that:

> The reactor core and associated coolant, control, and protection systems shall be designed to assure that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are not possible or can be reliably and readily detected and suppressed.

To ensure compliance with GDC 10 and 12, the NRC staff confirms that the thermal and hydraulic design of the core and the reactor coolant system has been accomplished using acceptable analytical methods, provides acceptable safety margins from conditions that could lead to fuel damage during normal reactor operation and anticipated operational occurrences, and is not susceptible to thermal-hydraulic instability or can be reliably and readily detected and suppressed. Regulatory guidance for the review of the thermal and hydraulic design and the suppression of reactor power oscillations is provided in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (SRP) Section 4.4, "Thermal and Hydraulic Design," and SRP Section 15.9, "BWR Core Stability." As prescribed in NUREG-0800, Chapter 4, the NRC staff will confirm that the licensee performs the plant-specific trip setpoint calculations using NRC-approved methodologies. SRP Section 15.9 describes review procedures to evaluate the possibility of thermal-hydraulic instability in BWRs, analytical methods and codes to predict the stability characteristics of BWRs, and the use of approved long-term stability solutions.

3.0 TECHNICAL EVALUATION

3.1. Solution Description

Section 3 of NEDC-33075P, Revision 7 (Reference 1) describes in detail the DSS-CD methodology. In summary, DSS-CD is based on the approved Solution III, and it shares most of its features. There are only two major differences between Solution III and DSS-CD:

1. DSS-CD does not require the calculation of an amplitude setpoint to trigger scram actuation if the period-based algorithm (PBA) identifies an instability event. Instead, DSS-CD implements an amplitude discriminator that is [[ ]] With DSS-CD implemented, the reactor will trip automatically if [[ ]] Therefore, DSS-CD does not rely on generic correlations like DIVOM or cycle-specific calculations.

2. To prevent spurious scrams, DSS-CD requires [[ ]] The CDA is relatively complex to cover all possibilities of combinations of failed and unresponsive OPRM cells, but under most conditions, [[ ]]

Other features of the DSS-CD methodology include:

1. DSS-CD maintains the defense-in-depth algorithms that were approved for Solution III: the PBDA, the amplitude based algorithm (ABA), and the growth rate algorithm (GRA). The ABA and GRA remain unchanged from the previously approved solution and provide defense-in-depth in the unlikely event that the CDA fails to detect the instability due to unforeseen situations. The range of setpoint values is now provided in Table 3-4 of NEDC-33075P, Revision 7 (Reference 1).

2. PBDA was the primary algorithm in Solution III, and it is retained in DSS-CD with the defined parameter settings documented in Table 3-4 of Reference 1. PBDA will provide a scram if [[ ]] as documented in Table 3-4 of Reference 1. PBDA thus provides defense-in-depth in case the confirmation density algorithm fails in an unexpected mode.

3. DSS-CD can be implemented as a software change using the existing GEH Nuclear Measurement Analysis and Control (NUMAC) hardware (Reference 9) currently used for Solution III. This review does not address implementation with non-GEH hardware.
4. In addition to the DSS-CD algorithm, NEDC-33075P (Reference 1) describes a backup stability protection (BSP) methodology. The BSP is intended to provide SLMCPR protection if the regular DSS-CD is declared inoperable. With BSP, the DSS-CD methodology attempts to incorporate the lessons learned from recent 10 CFR 50 Part 21 notifications, when the primary stability protection system is declared inoperable.

Figure 1 illustrates the operation of the main DSS-CD algorithm (CDA) and the defense-in-depth algorithms (PBDA, GRA, and ABA). The defense-in-depth algorithms would only be required in case the CDA failed for an unforeseen reason. They are armed when [[ ]]

BSP is described in Section 7 of NEDC-33075P (Reference 1) and it consists of three different options: (a) “Manual BSP,” (b) “Automated BSP” (ABSP), and (c) “BSP Boundary.” All three BSP options define cycle-specific exclusion regions, which are defined in the core operating limits report (COLR). In the ABSP option, the scram is performed automatically by the DSS-CD hardware. In the manual BSP option, the scram is enforced administratively. The BSP Boundary option limits high power operation [[ ]] when DSS-CD is not operable to ensure [[ ]]

The BSP methodology is an integral part of DSS-CD, which requires a non-manual backup option for operation in the MELLLA+ domain if the DSS-CD solution is declared inoperable. However the applicability of BSP is not limited only to DSS-CD. It may also be used in plants [[

]]

Figure 1. Illustration of Licensing Basis (CDA) and Defense-in-Depth Algorithms

with other long term solutions (Reference 10) to replace the current interim corrective actions (ICAs). The main advantage of BSP over ICAs is that BSP requires plant- and cycle-specific stability exclusion regions; therefore, more stable plants have smaller exclusion regions and less stable plants have larger regions. ICAs are generic in nature and treat all plants by the same norm. They are based mostly on historical plant operating experience, which may or may not be applicable to new fuels and operating strategies that include high power densities with flat power distributions. By requiring plant- and cycle-specific exclusion region calculations, the BSP methodology guarantees that the stability regions are up to date for each particular core loading and operating strategy.

The DSS-CD hardware design is unchanged from the Option III solution described in Reference 3, and it has not changed in Revision 7.

The basic input unit of the DSS-CD system is the OPRM cell. The OPRM cell consists of one to eight closely spaced LPRM detectors. The signals from the individual LPRM detectors in a cell are averaged to produce the OPRM cell signal. [[ ]] The cell signal is filtered to remove noise components with frequencies above the range of stability related power oscillations. This is accomplished by a second order Butterworth filter with cutoff frequency of 1.0 Hertz (Hz). This conditioned signal is filtered again using a second order Butterworth filter with a shorter cutoff frequency of 1/6 Hz (or an equivalent time constant of 0.95 seconds) to produce a time-averaged value. The conditioned and time-averaged signals are used by the four algorithms to detect reactor instabilities. Each of the four independent OPRM channels consists of many OPRM cells distributed throughout the core so that each channel provides monitoring of the entire core.

The DSS-CD solution includes four separate algorithms for detecting stability related oscillations: CDA, Period Based Detection Algorithm (PBDA), Amplitude Based Algorithm (ABA), and Growth Rate Algorithm (GRA). The PBDA, ABA, and GRA detection algorithms provide the protection basis for long term solution Option III (References 3 - 5). For long term solution Option III, only the PBDA is credited in the analysis, while ABA and GRA are defense-in-depth algorithms. PBDA, ABA, and GRA are retained in DSS-CD as defense-in-depth algorithms and are not part of the licensing basis for the DSS-CD solution, which is accomplished solely by the CDA. The CDA is designed to recognize an instability and [[ ]] The CDA capability of early detection and suppression of instability events is achieved by relying [[ ]] The CDA employs [[ ]] The CDA identifies a confirmation density (CD), [[ ]] A reactor trip is initiated when multiple channel trip signals are generated, consistent with the reactor protection system (RPS) logic design. [[

]] DSS-CD eliminates the reliance on the PBDA amplitude setpoint, which is included in the licensing basis of Option III. The instability suppression by the DSS-CD for high growth instability events [[ ]] Because the solution does [[ ]] Section 3.4.1 of NEDC-33075P, Revision 7 [[ ]] The NRC staff agrees that this process is significantly more conservative for detecting power oscillations.

3.2. Key Review Features

The primary focus of the NRC staff's review was to determine whether the DSS-CD modifications proposed in NEDC-33075P, Revision 7 (Reference 1) satisfy the minimum requirements for a long-term solution by providing compliance with GDC 10 and 12. DSS-CD provides compliance by detecting and suppressing oscillations.

3.2.1. Licensing Basis

The licensing basis for the DSS-CD approach is to [[ ]] Thus, the DSS-CD [[ ]] This solution guarantees compliance with the SAFDLs.

Because DSS-CD does [[ ]] GEH demonstrates compliance with the SAFDLs [[ ]] NEDC-33075P, Revision 7 (Reference 1) documents [[ ]] (see Table 4-2 of Reference 1). In addition, DSS-CD has been demonstrated to work successfully for real-plant data, including the Nine Mile Point 2 event. For all the analyzed transients, the final MCPR margin is significant due to [[ ]]

The NRC staff finds, based on engineering judgment, that it is reasonable to expect that the [[ ]] real plant data application in NEDC-33075P, Revision 7 (Reference 1) will bracket most future situations. The analyses [[ ]] The analyses cover a wide range [[

]] which is as large as should be expected. For all cases, the [[ ]] (see Figures 4-17 and 4-18 of Reference 1 for an example).

3.2.2. Modifications to the Period Based Algorithm

[[ ]]

3.2.3. Reload Analysis and Methodology Applicability Extension

The DSS-CD reload licensing methodologies are described in Section 6 of the subject TR (Reference 1). Table 6.1 documents [[ ]]

For a new cycle in an already approved DSS-CD plant, [[ ]]

Section 6 of NEDC-33075P (Reference 1) describes the procedure for [[ ]]

The NRC staff finds this [[ ]] because it involves a plant- and cycle-specific calculation of [[ ]]

3.2.4. Backup Stability Protection

The example simulations in Section 4 of NEDC-33075P, Revision 7 (Reference 1) indicate that [[ ]] In these simulations, [[ ]] GEH has concluded and the NRC staff concurs that [[ ]] Thus, a BSP is required in case DSS-CD is declared inoperable. The BSP concept, documented in Section 7 of NEDC-33075P, Revision 7 (Reference 1) is a technically acceptable solution to the backup issue.

As described in Section 7 of the subject TR (Reference 1), the BSP methodology defines cycle-specific exclusion regions, which are documented in the COLR. These regions are calculated with a licensed stability code (e.g., ODYSY (Reference 11)) with well-defined procedures (see Table 7-1 of NEDC-33075P, Revision 7 (Reference 1)). The exclusion region is similar to the Solution I-A regions, but uses different criteria. In general, the BSP regions should be smaller (i.e., less conservative) than the Solution I-A regions for the same reactor.

In essence, BSP regions are cycle-specific, best-estimate exclusion regions, while the Solution I-A regions are expected to be bounding (i.e., conservatively large) for most postulated situations. Using cycle-specific, best-estimate regions for BSP is justified because BSP is only a backup solution that should never be in effect, and if needed, will be used only for short periods of time (e.g., less than 120 days, per Technical Specifications (TSs)). The probability of an instability event in a particular plant under those circumstances is small. The probability of a non-best-estimate instability event during this short period is sufficiently small to justify the use of these regions.

The BSP methodology is composed of three elements: (a) manual, (b) automated (ABSP), and (c) BSP Boundary. The manual BSP methodology is intended only as a transition between DSS-CD and ABSP or BSP Boundary. Manual BSP will be used only for at most the first 12 hours after DSS-CD is declared inoperable. This is a standard TS requirement that accounts for the time needed to switch from DSS-CD to the ABSP protection, and it is technically acceptable.

With the ABSP option, a scram is automatically initiated if the reactor enters the exclusion region. With the BSP Boundary option, [[ ]] It is noted that [[ ]] Any instability that develops due to a slow rise in power level can be easily detected and suppressed by operator action.

Both the ABSP and the BSP Boundary rely [[ ]] As discussed above, these calculations are of a "best-estimate" nature [[ ]]. It is unlikely, but not impossible, that an instability could be developed outside the calculated regions if, for example, unusual power distributions were present in the core (e.g., significant number of fuel failures leading to an unusual control rod pattern). However, the probability is very small that an unusual condition that leads to instability would be present in the core while the primary DSS-CD algorithm is inoperable. Therefore, the NRC staff concludes that the proposed BSP methodology is acceptable, and provides sufficient protection against SLMCPR violations commensurate with the probability of an instability event occurring in the short period of time that BSP would be active.

3.2.5. Technical Specification Requirements

The impact on TSs is documented in Section 8 of NEDC-33075P, Revision 7 (Reference 1). The TR appendix shows an example TS for a BWR/4. The proposed modifications are acceptable. In summary, they require DSS-CD to be operable, and they set operability and surveillance requirements consistent with other reactor protection systems. In case DSS-CD is declared inoperable, an immediate switch to manual BSP is required, and a switch to either ABSP or BSP Boundary is required within 12 hours. In case the ABSP is also declared inoperable, DSS-CD must be restored to full operation within 120 days. When a report is required by Condition I of Limiting Condition for Operation 3.3.1.1, "RPS Instrumentation," a report shall be submitted within 90 days of entering Condition I. The report shall outline the preplanned means to provide backup stability protection, the cause of the inoperability, and the plans and schedule for restoring the required instrumentation channels to operable status. The NRC staff agrees with the technical intent of the example TSs; however, the example TSs are not written consistent with the improved Standard TSs (STS) format. When referencing the subject TR in a licensing application, licensees should submit TSs that are consistent with their current approved TSs and the improved STS use and application section.

3.2.6. First Cycle Implementation

To prevent spurious scrams, the first cycle implementation of DSS-CD on a particular plant will allow the plant to disable DSS-CD during the first startup and shutdown maneuver. [[

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During the first startup and shutdown, the alarm features of DSS-CD will be enabled; therefore sufficient protection will be provided during this short period of time. This is an acceptable approach.

Note that DSS-CD will be disabled only during startup and shutdown, but it will be enabled for the remainder of the cycle. Thus for an 18-month cycle, DSS-CD will be disabled only the first and last days of the cycle. DSS-CD will be enabled and ready to be armed and scram, if necessary, if a flow reduction occurs during the 18-month cycle.

3.3. DSS-CD Algorithm Setpoints and Adjustable Parameters

DSS-CD relies on the CDA. The CDA [[ ]] which are described in Table 1, shown below. The setpoint [[ ]] defined in Section 3.3.1.4 and Table 3.1 of the subject TR (Reference 1). [[ ]]

CDA is a relatively complex algorithm, and [[ ]] which are shown in Table 1 below. Based on the lessons learned from the Nine Mile Point 2 instability event and several years of in-plant operation experience, GEH has decided [[ ]] In Long Term Solution III, [[ ]] This is a good technical approach that [[ ]]

Both, [[ ]] are defined in the subject TR (Reference 1). Deviation from the stated values or calculation formulas is not allowed without NRC review. To this end, the subject TR, when approved and implemented by a licensed nuclear power plant, must be referenced in the plant TSs, so that these values become controlled and part of the licensing bases.

Even though CDA is the primary algorithm for the licensing basis, the BSP becomes the licensing basis for up to 120 days in the event of CDA failure. Plants may choose to implement one of two options: ABSP or BSP Boundary. Table 2 shown below documents the allowable setpoints for the ABSP option. Note that the BSP regions are plant- and cycle-specific and, as such, are defined in the COLR when this option is applicable. In addition, the ABSP option provides a rod block function that is not part of the licensing basis. Therefore, the rod block regions may be defined simply by plant procedures.

Both BSP Boundary and Manual BSP rely on operator actions that are defined by specific setpoint regions in the power-to-flow map. These regions are plant- and cycle-specific and must be specified in the COLR when this option is applicable.

Table 1. CDA Algorithm Setpoints and Parameters

Parameter Name	Definition	Parameter Type	Defined in
T_{min} (sec)	The Period Based Algorithm (PBA) oscillation period lower time limit for anticipated reactor instability. If the time between successive peaks or valleys is less than T_{min}, then it is not indicative of an anticipated reactor instability.	FIXED	Section 3.4.1.1. Same value as PBDA T_{min} in Table 3.4.
[[		]]	Section 3.4.1.1. Same value as PBDA [[ ]] in Table 3.4.
f_c (Hz)	Two-pole Butterworth filter cutoff frequency (Hz) for the conditioning filter to remove high frequency noise from the LPRM signals.	FIXED	Table 3.5.
ε (ms)	The PBA period tolerance. This parameter defines the limits within which successive oscillation periods may vary from the first (base) oscillation period in order to increment the number of confirmation counts. If the difference between an oscillation period and the base period is not within this tolerance, the number of confirmation counts is reset to zero.	FIXED	Table 3.5.
N_{Th}	The Confirmation Density Algorithm (CDA) successive confirmation count setpoint.	FIXED	Section 3.3.1.5 and Table 3.1.
P_b	OPRM Armed Region Lower Power Boundary (% Rated Power). The Simulated Thermal Power (STP) from the APRM channel is used to provide the power level.	FIXED	Section 4.5.
W_b	OPRM Armed Region Upper Flow Boundary (% Rated drive flow). The total recirculation flow (average of both loops) from the APRM channel is used to provide the recirculation drive flow.	FIXED	Section 4.5.
$LPRM_{min}$	Minimum number of operable LPRM input signals to an OPRM cell for the OPRM cell to be considered operable. Cell sensitivity generally increases with fewer operable LPRMs.	PLANT SPECIFIC	Section 3.3.1.3. Value is plant specific and will be defined in the plant specific application.
M_{AX}	An OPRM configuration constant representing maximum number of OPRM cells along an instability symmetry axis. It is used to calculate the number of unresponsive OPRM cells	PLANT SPECIFIC	Section 3.3.1.3. Value is plant specific and will be defined in the plant specific application.
[[			Section 3.3.1.4 and Table 3.1.
		]]	Section 3.3.1.6 and Table 3.1.

Table 2. Automated Backup Stability Protection Setpoints

Parameter Name	Definition	Parameter Type	Defined in
~~GSF~~	~~The Generic Shape Function (GSF) defines the BSP exclusion regions based on the power and flow intercepts~~	~~FIXED~~	~~Section 7.2.1.1~~
~~MSF~~	~~The Modified Shape Function (MSF) defines a more accurate exclusion region based on cycle specific DR calculations~~	~~PLANT AND CYCLE SPECIFIC~~	~~Section 7.2.1.2~~
m	Slope of the automatic Backup Stability Protection (BSP) APRM flow biased trip and rod block setpoint linear segments. [[ ]]	PLANT AND CYCLE SPECIFIC	Section 7.5
$P_{BSP-Trip}$[1]	Automatic BSP APRM flow biased trip setpoint power intercept (% Rated power). The Simulated Thermal Power from the APRM channel is used to provide the power level. [[ ]]	PLANT AND CYCLE SPECIFIC	COLR
P_{BSP-RB}[2]	Automatic BSP APRM flow biased rod block setpoint power intercept (% Rated power). The STP from the APRM channel is used to provide the power level. [[ ]]	PLANT AND CYCLE SPECIFIC	Plant procedures (rod block functions are not licensing basis)
$W_{BSP-Trip}$[1]	Automatic BSP APRM flow biased trip setpoint drive flow intercept (% Rated drive flow). The total recirculation flow (average of both loops) from the APRM channel is used to provide the recirculation drive flow [[ ]]	PLANT AND CYCLE SPECIFIC	COLR
W_{BSP-RB}[2]	Automatic BSP APRM flow biased rod block setpoint drive flow intercept (% Rated drive flow). The total recirculation flow (average of both loops) from the APRM channel is used to provide the recirculation drive flow. [[ ]]	PLANT AND CYCLE SPECIFIC	Plant procedures (rod block functions are not licensing basis)

Notes: 1. Although this value is characterized by GEH as an ADJUSTABLE value, if the BSP trip function is credited as a licensing basis system, this value must be controlled consistent with the guidance provided by GEH.
2. Rod block limits are not licensing basis limits.

Table 3. Manual and Boundary Backup Stability Protection Setpoints

Parameter Name	Definition	Parameter Type	Defined in
GSF	**The Generic Shape Function (GSF) defines the BSP exclusion regions based on the power and flow intercepts**	**FIXED**	**Section 7.2.1.1**
MSF	**The Modified Shape Function (MSF) defines a more accurate exclusion region based on cycle-specific DR calculations**	**PLANT AND CYCLE SPECIFIC**	**Section 7.2.1.2**
Manual BSP Region I	Entry into Region I requires an immediate scram	PLANT AND CYCLE SPECIFIC	COLR
Manual BSP Region II	Inadvertent entry in Region II requires immediate exit. Intentional entry is permitted with stability control measured (See Section 7.2.3.2 ~~of the Approved TR~~)	PLANT AND CYCLE SPECIFIC	COLR
BSP Boundary	Operation with higher power or lower flow than the BSP Boundary Line is not permitted in the MELLLA+ region	PLANT AND CYCLE SPECIFIC	COLR

3.4. Instrumentation and Control

The NRC staff's SE for NEDC-33075P, Revision 5 (Reference 2) included an evaluation of the implementation of DSS-CD with respect to instrumentation and control. The changes implemented in NEDC-33075P, Revision 7 do not relate to that evaluation and as such, do not impact the NRC staff's findings stated in section 3.6 of the SE in Reference 2. Those findings were not a part of the current review and remain in effect. The NRC staff's SE for NEDC-33075P, Revision 5 also contained two conditions and limitations for approval related to the instrumentation and control evaluation that remain in effect (conditions 8 and 9 of the NRC staff's SE for NEDC-33075P, Revision 5). For completeness, these conditions will be restated in section 5.0 of this SE as conditions 3 and 4.

3.5. NRC Calculations

The NRC staff has performed a number of TRACG calculations for the reviews of earlier versions of this TR. For these calculations, a 2RPT was simulated with the TRACG code resulting in unstable oscillations. These oscillations were then analyzed with the PERIOD code to simulate the behavior of the DSS-CD algorithm and to determine the time at which a scram would occur if the DSS-CD solution were implemented. The hot channel critical power ratio calculated by TRACG provides an indication of the effectiveness of the DSS-CD solution.

For all the cases analyzed by the NRC staff, the final MCPR margin at the moment of scram was larger than the initial MCPR. [[
]] (for example, see Figure 7-10). Therefore, the NRC staff calculations confirm the TR

conclusion that the DSS-CD solution is very effective in suppressing the unstable oscillations before fuel safety limits are compromised.

3.6. Revision 7 Updates

Page xiii of NEDC-33075P, Revision 7 (Reference 1) includes a comprehensive list of all 68 changes that were implemented in Revision 7 of the TR. Of these 68 changes, only 10 are non-trivial and they are summarized in Section 1.4 of the Reference 1. Of these 10 changes, the 2 most relevant updates are:

1. upgrade to TRACG04/PANAC11 methodology, and

2. a new methodology to allow for an increase in the amplitude setpoint discriminator from the already-approved [[ ]], if required due to large amplitude noise during normal operation.

Most other changes are editorial or clarifications. A list of the most significant changes follows:

1. Use of the TRACG04 version (References 12-14), including PRIME (Reference 15) fuel properties and gap conductance fuel input files.

2. Use of PANAC11 as three-dimensional neutron kinetics model (References 6 and 16-18).

3. Section 3.2 of the TR clarifies the reactor protection system trip logic. Figure 3-2 of the TR provides an example of the logic.

4. In Section 3.3.1 of the TR, a number of clarifications are provided for the methodology, including:

    a. the purpose of alarm settings,

    b. the logic if an OPRM channel is set to “INOP,”

    c. the single loop operation (SLO) amplitude discriminator setpoint determination,

    d. the description of the alarm settings, and

    e. the setpoint application process for higher-amplitude discriminator setpoints.

5. Section 3.3.1.6 of the TR contains an updated discussion of the two loop operation (TLO) amplitude discriminator setpoint determination based on recent plant data noise analyses.

6. Section 3.4.1 of the TR adds a description of the recommended selection of the defense-in-depth PBDA amplitude setpoints for higher CDA amplitude discriminator setpoints. Table 3.4 has been modified with the recommended defense-in-depth values.

7. Sections 4.4.1 and 4.4.2 of the TR update the TRACG cases and initial conditions to be run.

8. Section 4.7 was added to the TR, to cover CDA setpoints [[ ]] Table 4-17 provides a summary.

9. Section 5 has been shortened because the Code Scaling Applicability and Uncertainty (CSAU) section has been moved to the TR NEDE 33147P, Revision 3, "DSS-CD TRACG Application" (Reference 6).

10. Section 7.2 has been updated to allow the use of a modified shape function for BSP, consistent with other long term solution applications.

11. In Section 7.2.3.2, the BSP Control Entry Region definition criteria has been increased from decay ratio (DR)**≤**~~<~~0.6 to DR**≤**~~<~~0.8, and an Operator Awareness Region has been defined with 10 percent margin to the Control Entry Region.

As described in Section 2.3 of the TR, NEDC-33075P, Revision 7 (Reference 1) is supplemented by a separate TR on TRACG04 applicability, NEDE-33147, Revision 3 (Reference 6). The CSAU section has been moved from the DSS-CD TR (Reference 1) to the DSS-CD TRACG Application TR (Reference 6), which has been ~~submitted~~ **reviewed and approved** separately to the NRC for review. Since the information is provided, the new location of the CSAU is acceptable.

During implementation phases for DSS-CD, GEH [[ ]] For these plants, [[ ]] The approach taken in the subject TR revision is to allow [[ ]] This process is described in detail in Section 4.7 of the TR, along with an example application for [[ ]] The proposed approach is acceptable because: [[ ]]

[[ ]] in NEDC-33075P, Revision 7. These cases provide additional confidence that the DSS-CD solution provides sufficient margin to limits. These [[ ]] Although this is recognized to be still true, [[ ]] in Revision 7, which is acceptable.

The BSP solution has been updated to include a new modified shape function (MSF) that can replace the generic shape function (GSF). The MSF defines the exclusion region boundary for other long term solutions (specifically Solutions II, ID, and III) and operating plants are familiar with its use. MSF is smaller than the GSF, but it guarantees compliance by performing plant- and cycle-specific DR calculations. The process is described in Section 7 of the subject TR. Both approaches, GSF and MSF, are acceptable to define BSP exclusion regions because both approaches demonstrate very low likelihood of instabilities when operating outside the regions. The smaller MSF region is acceptable because it is confirmed by cycle-specific calculations.

Sections 3.3 and 3.4 of the subject TR describe the PBDA and CDA. No significant changes have been incorporated in this revision. The PBDA setpoint for the defense-in-depth function [[ ]] used for defense-in-depth. In this case, [[ ]] This modification is acceptable because [[ ]]

Tables 4-3 and 4-8 of the TR define the process that must be followed [[ ]] The methodology in Revision 7 of the TR includes [[ ]] that was approved in previous versions of the TR (Reference 2). Following [[ ]] This approach remains acceptable.

Table 4-17 of the TR documents the process to evaluate amplitude setpoint S_{AD} values [[ ]] This methodology is a change in Revision 7 of the TR. Tables 4-15 and 4-16 document the required [[ ]] selected for a particular application. The use of Tables 4-15, 4-16, and 4-17 of the TR is acceptable for setpoint S_{AD} values [[ ]]

In Section 7.2.3.2 of Revision 7, GEH proposes to modify the criteria for point A' of the BSP Control Entry Region from DR<0.6 to DR<0.8. This loss of margin is compensated by [[ ]] This approach is acceptable because the [[ ]] in previous revisions of the TR. In addition, the Manual BSP entry regions are only used for defense-in-depth since the main backup solution is the ABSP, which automatically scrams the reactor.

Section 7.4 of the subject TR describes the ABSP function. In particular, Figures 7-9, 7-10, and 7-16 of the TR show that the ABSP function implements a preventive scram, which [[ ]] Thus, a setpoint calculation for ABSP is not required. Figure 2 and Figure 3 illustrate this point (these are Figures 7-9 and 7-10 of the subject TR). Figure 2 shows that BSP performs [[ ]] It is noteworthy that the CPR margin at the time of scram is even larger (i.e., more conservative) if the oscillations are allowed to develop because the core flow and power continue to be reduced following the pump trip and this **may** increase~~s~~ the available margin by a larger amount than the reduction caused by the incipient oscillations.

Section 8 of the TR has been updated with minor editorial changes to the proposed TSs. The NRC staff finds these changes acceptable.

In summary, the NRC staff has reviewed the modifications to the design concept documented in NEDC-33075P, Revision 7 (Reference 1) and found them acceptable. The DSS-CD solution as described in Reference 1 complies with GDC 10 and 12 of 10 CFR Part 50, Appendix A, and enhances overall plant safety by providing a reliable, automatic oscillation detection and suppression function while avoiding unnecessary scrams.

[[

]]

Figure 2. Typical scram times for BSP and CDA functions

[[

]]

Figure 3. Typical CPR margins at scram time for BSP and CDA functions

4.0 RAI RESOLUTION

The NRC staff issued an RAI to GEH about a number of topics. Most of these requests were clarifications to the statements in the TR, or requests to define more specifically the methodology for future applications. GEH submitted detailed responses in Reference 19. The resolution of these responses is provided in this section. No open issues remain following this evaluation.

4.1. RAI 01 – Local Power Range Monitor Detector Modeling

The TRACG demonstration matrix relies on modeling the oscillation power range monitor (OPRM) response, which is obtained from the calculated local power range monitor (LPRM) time traces. Please provide a reference to how TRACG models the LPRM detectors and any available benchmarks.

The information was provided. LPRM signals in TRACG are calculated from the average nodal fission power of the eight surrounding kinetics nodes. The TRACG LPRM values have been qualified against data for the Peach Bottom turbine trip tests, LaSalle instability event, Leibstadt stability tests, and the Nine Mile Point 2 instability event in Reference 13.

4.2. RAI 02 – Requirement For Full Analysis Matrix

Section 4.7.2 of NEDC-33075P state that [[

]]. *The wording appears to be misleading because additional analyses are required if the applicability checklist is not satisfied. Please specify under which circumstances the full analysis matrix is required.*

In the RAI response, GEH clarifies that additional analyses are required each time the applicability checklists in Tables 4-1 and 4-6 of NEDC-33075P, Revision 7 (Reference 1) are not satisfied. The response is consistent with the review of previous versions of the TR, and it is acceptable.

4.3. RAI 03 – Definition of RS Term

Please define the term "RS" and its units in the figure on page 4-27 labeled "OPRM Cell 121."

In the RAI response, GEH clarifies that the RS signal is normalized and has no units. It represents the filtered OLPRM value divided by its running average. A short explanation about the meaning and units of RS will be added to the approved TR.

4.4. RAI 04 – Clarification of Data in Table 4-28

In the table on page 4-28, the fourth column is labeled [[

]] *However, only one margin value is presented in the table, which appears to be the TLO margin. Please explain. Please specify whether* [[ ]] *in the third column of this table.*

In the RAI response, GEH provides additional data to demonstrate that the values in Table 4-28 are calculated correctly. The values represent either [[ ]]. The values are [[ ]], which is applied at the next step of the process.

4.5. RAI 05 – Plant X Margins VS Matrix Evaluation

In the table on page 4-29, the fifth column is labeled [[ ]]. *Since NEDC-33075P is the DSS-CD LTR, this statement is somewhat confusing. Does this mean* [[ ]]*? Would a restriction on initial MCPR/operating limit MCPR*

(IMCPR/OLMCPR) be imposed if the "Plant X" margins were lower than the "Matrix" margins?

In the RAI response, GEH clarifies that the [[ ]] that the values in the table [[ ]]. GEH also clarifies that if Plant X margins were lower than the Matrix, [[ ]]. The [[ ]]. Plant X may or may not have [[ ]]. The NRC staff finds this approach [[ ]] acceptable.

4.6. RAI 06 – Step 7 Clarification

Step 7 on page 4-29 is confusing. It refers to an [[ ]] *It is not clear from the text in Step 7 how plant X satisfies this criterion. Do the criteria in Table 4-15* [[ ]]*? Please explain Step 7 in more detail.*

In the RAI response, GEH clarifies Step 7. The values provided as [[ ]]. Step 8 shows an example.

4.7. RAI 07 – Typographical Error

In Table 3-4, the period based detection algorithm setpoint (Sp) value in row 2, column 3 is marked as proprietary; however, on page 3-24, the same formula for Sp is not marked as proprietary. Please provide the correct proprietary marking. Additionally, for this Sp value in Table 3-4, the "max" function is missing the closing parenthesis.

In the RAI response, GEH clarifies that the Sp algorithm is indeed proprietary. The corrections will be included in the approved version of the TR.

5.0 LIMITATIONS AND CONDITIONS

The NRC staff's approval of NEDC-33075P, Revision 7 is subject to the following limitations and conditions:

1. The NRC staff previously reviewed and approved the implementation of DSS-CD using the approved GEH Option III hardware and software. The DSS-CD solution is not approved for use with non-GEH hardware. The hardware components required to implement DSS-CD are expected to be those currently used for the approved Option III. If the DSS-CD hardware implementation deviates from the approved Option III solution, a hardware review by the NRC staff will be required. Implementations on other Option III platforms will require plant-specific reviews.

2. The CDA setpoint calculation formula and the adjustable parameters values are defined in NEDC-33075P, Revision 7 (Reference 1). Deviation from the stated values or calculation formulas is not allowed without NRC review. To this end, the subject TR, when approved and implemented by a licensed nuclear power plant, must be referenced in the plant TSs, so that these values become controlled and part of the licensing bases.

3. The NRC staff previously concluded that the plant-specific settings for eight of the FIXED parameters and three of the ADJUSTABLE parameters, as stated in section 3.6.3 of the NRC staff's SE for NEDC-33075P, Revision 5 (Reference 2), are licensing basis values. The process by which these values will be controlled must be addressed by licensees.

4. If plants other than Brunswick Steam Electric Plant, Units 1 and 2, use the DSS-CD trip function, those plant licensees must ensure the DSS-CD trip function is applicable in their plant licensing bases, including the optional BSP trip function, if it is to be installed.

6.0 CONCLUSION

Based on its review of the subject TR, as stated above, the NRC staff has reached the following conclusions:

1. NEDC-33075P, Revision 7, describes the DSS-CD methodology with a number of updates. The NRC staff concludes that DSS-CD, as updated in NEDC-33075P, Revision 7, is a technically acceptable methodology to detect and suppress oscillations should they occur and, thus, satisfies GDC 10 and GDC 12.

2. The existing Solution III is already approved for plant operation up to 20 percent EPU. DSS-CD is an extension of Solution III, where the need to determine the PBDA scram setpoint with a DIVOM correlation is eliminated by [[ ]] Thus, DSS-CD is, in essence, [[ ]] Therefore, DSS-CD is a technically acceptable methodology for any reactor operating up to and including EPU conditions.

3. The confirmation analyses documented in Section 4 of NEDC-33075P, Revision 7 (Reference 1), indicate that the DSS-CD methodology provides significant protection against MCPR criteria violations during anticipated instability events even under high-power-density conditions, including EPU and MELLLA+. Under all analyzed conditions, the loss of MCPR margin induced by the instability event is compensated by the gain in MCPR margin induced by the reduction in flow, so that the net MCPR margin is positive. Based on this analysis, DSS-CD is a technically acceptable methodology for any reactor operating up to and including MELLLA+ conditions.

4. Analyses documented in NEDC-33075P, Revision 7 (Reference 1), indicate that for reactors operating in the MELLLA+ domain: (a) instabilities are very likely following flow

reduction events; (b) **for some plants** these instabilities **may** develop in a time frame of a few seconds, so that manual operations to suppress them are not acceptable; and (c) the consequences of these instabilities can be serious. Therefore, plants operating in the MELLLA+ domain require a backup methodology that does not rely on manual operator actions in the event that DSS-CD is declared inoperable.

5. An acceptable BSP methodology is described in Section 7 of NEDC-33075P, Revision 7 (Reference 1), and it provides three different ~~options~~**elements**: Manual BSP (Section 7.2), BSP Boundary (Section 7.3), and ABSP (Section 7.4).

   a. The ABSP option and the BSP Boundary option are acceptable backup solutions for short periods of time ~~(up to 120 days for BSP Boundary)~~ when the licensed solution (e.g., DSS-CD) is declared inoperable. **For the BSP Boundary, this time is limited to 120 days.** This time frame is consistent with Action 3.3.1.1-J.3 of the proposed TSs.

   b. The Manual BSP option without the BSP boundary is only acceptable for very short periods of time (up to 12 hours) while one of the other two BSP solutions is activated. This time frame is consistent with Action 3.3.1.1-I.2 of the proposed TSs.

6. Tables 6-1 and 6-2 of NEDC-33075P, Revision 7 (Reference 1) document a plant-specific applicability checklist, which contains specific criteria that must be reviewed and satisfied for each core reload. This methodology is a technically acceptable process for plant- and cycle-specific reviews of DSS-CD applicability.

7. For situations where the plant applicability checklist is not satisfied (e.g., introduction of a new fuel type) Tables 6-3 and 6-4 of NEDC-33075P, Revision 7 (Reference 1), describe an acceptable procedure to extend the future applicability of DSS-CD.

8. Section 8 of NEDC-33075P, Revision 7 (Reference 1), provides a description of required changes to TSs, and an example is provided in Appendix A. The proposed TSs are an acceptable implementation of DSS-CD, except as noted in Section 3.2.5 above with regard to the format of the proposed TSs. When referencing the subject TR in a licensing application, licensees should submit TSs that are consistent with their current approved TSs and the improved STS use and application section.

9. Table 6-5 of NEDC-33075P, Revision 7 (Reference 1), describes the **approved** fuel transition scenarios, **so**~~which are subject to~~ a plant-specific ~~review for each application~~**submittal is not required**.

10. Tables 4-15, 4-16, and 4-17, and Section 4.7 of NEDC-33075P, Revision 7 (Reference 1), provide an acceptable methodology to use plant-specific amplitude discriminator CDA setpoints (S_{AD}) for plants where [[ ]]. The proposed approach is acceptable because: (1)

[[ ]], and (2) [[ ]]

11. Application of an alternative to the generic CDA setpoints defined in NEDC-33075P, Revision 7 (Reference 1) ([[ ]]) with respect to the susceptibility of a plant's intrinsic noise will require plant-specific review.

12. The full statistical application of the CSAU methodology (Reference 6) demonstrates that the "[[ ]]" methodology approved for DSS-CD applications is conservative and its use is acceptable.

13. The modification of the criteria for point A' of the BSP Control Entry Region from DR<0.6 to DR<0.8 is acceptable because [[ ]]

Based on this review and the conclusions stated above, subject to the limitations and conditions stated in Section 5.0 of this SE, NEDC-33075P, Revision 7, is approved for DSS-CD applications in General Electric (GE) BWR/3-6 product lines, with GE14 and earlier GE fuel designs, and for operating envelopes up to and including EPU and MELLLA+. **For any other fuel design, the fuel transition process described in Table 6-5 is approved.**

7.0 REFERENCES

1. TR NEDC-33075P, Revision 7, "General Electric Boiling Water Reactor Detect and Suppress Solution-Confirmation Density," dated June 2011. (ADAMS Package Accession No. ML111610593)

2. TR NEDC-33075P-A, Revision 6, "General Electric Boiling Water Reactor Detect and Suppress Solution-Confirmation Density," dated January 2008. (ADAMS Package Accession No. ML080310384)

3. TR NEDO-31960-A, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," dated November 1995. (ADAMS Legacy Accession No. 9603130105)

4. TR NEDO-31960-A, Supplement 1, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," dated November 1995. (ADAMS Legacy Accession No. 9603130105)

5. TR NEDO-32465-A, "BWR Owners' Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications," dated August 1996. (ADAMS Package Accession No. ML072260045)

6. TR NEDE-33147P**-A**, Revision ~~3~~**4**, "DSS-CD TRACG Application," dated ~~January~~ **August** 201**3**~~1~~. ~~(ADAMS Package Accession No. ML110270071)~~

7. TR NEDO-32465 Supplement 1, "Migration to TRACG04/PANAC11 from TRACG02/PANAC10 for Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications," dated September 2011. (ADAMS Accession No. ML112550358)

8. Letter from Monticello Nuclear Generating Plant to NRC, L-MT-12-108, "Maximum Extended Load Line Limit Analysis Plus License Amendment Request – Request for Additional Information Responses for TRACE/TRACG Differences (TAC ME3145)," dated December 21, 2012. (ADAMS Accession No. ML13002A261)

9. TR NEDC-32410P-A, Supplement 1, "NUMAC-PRNM Retrofit Plus Option III Stability Trip Function," dated November 1997. (ADAMS Legacy Package Accession No. 9806120229A)

10. BWROG-94078, "BWR Owner's Group Guidelines for Stability Interim Corrective Action," dated June 1994. (ADAMS Legacy Accession No. 9406150226)

11. TR NEDC-32992P-A, "ODYSY Application for Stability Licensing Calculations," dated July 2001. (ADAMS Package Accession No. ML012610606)

12. TR NEDE-32176P, Revision 4, "TRACG Model Description," dated January 2008. (ADAMS Package Accession No. ML080370259)

13. TR NEDE-32177P, Revision 3, “TRACG Qualification,” dated August 2007. (ADAMS Package Accession No. ML072480007)

14. TR NEDE-32906P-A, Revision 3, “TRACG Application for Anticipated Operational Occurrences (AOO) Transient Analyses,” dated April 2003. (ADAMS Package Accession No. ML062720163)

15. TR NEDC-33256P-A, Revision 1, “The PRIME Model for Analysis of Fuel Rod Thermal – Mechanical Performance Part 1,” Technical Bases, NEDC-33257P-A, Revision 1, “Part 2 –Qualification,” and NEDC-33258P-A, Revision1, “Part 3 - Application Methodology,” dated September 2010. (ADAMS Package Accession No. ML102600259)

16. TR NEDE-30130-P-A, “Steady State Nuclear Methods,” dated April 1985. (ADAMS Legacy Package Accession No. 8505090321)

17. TR NEDE-32906P, Supplement 3-A, Revision1, “Migration to TRACG04/PANAC11 from TRACG02/PANAC10 for TRACG AOO and ATWS Overpressure Transients,” dated April 2010. (ADAMS Package Accession No. ML110970401)

18. Letter from NRC to General Electric Nuclear Energy, “Amendment 26 to GE Licensing Topical Report NEDE-24011-P-A, “GESTAR II” Implementing Improved GE Steady-State Methods (TAC No. MA6481)”, FLN-1999-011, dated November 10, 1999. (ADAMS Package Accession No. ML993230387)

19. Letter from GEH to NRC, MFN 12-078, “Response to Request for Additional Information Re: GE-Hitachi Nuclear Energy Americas Topical Report (TR) NEDC-33075P, Revision 7 and NEDO-33075, Revision 7, “GE Hitachi Boiling Water Reactor Detect and Suppress Solution – Confirmation Density” (TAC No. ME6577),” dated June 27, 2012. (ADAMS Package Accession No. ML121790572)

Attachment: Confirmatory Calculations

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Date: August 6, 2013

APPENDIX A - CONFIRMATORY CALCULATIONS

Consistent with the Technical Evaluation which was included in the SE for Revision 5 of NEDC-33075P, Appendix A is proprietary in its entirety.

ATTACHMENT