babcock & wilcox mPower
109 ramsey place · lynchburg, va 24501 · phone 434.316.7592
fax 434.316.7534 · www.babcock.com

August 23, 2012 MPWR-LTR-12-00074

U.S. Nuclear Regulatory Commission (NRC)
ATTN: Document Control Desk
11555 Rockville Pike
Rockville, MD 20852-2738

Babcock & Wilcox mPower, Inc.
Docket Number-PROJ0776
Project Number-776

Subject: Letter, Mr. Stewart L. Magruder to Mr. Jeffrey A. Halfinger, Draft Safety Evaluation for Babcock & Wilcox mPower Topical Report R0003-08-002089, Revision 3, "Instrument Setpoint Methodology Topical Report" (TAC No. RN6113), dated August 15, 2012

This letter forwards B&W mPower comments on the NRC staff's draft safety evaluation of the B&W Instrument Setpoint Methodology Topical Report R0003-08-002089, Revision 3. The draft safety evaluation was forwarded for B&W mPower review and comment by the NRC in the subject letter.

As requested, B&W mPower is providing comments on a marked-up copy of the draft safety evaluation (Enclosure 1) and a summary table of the proposed changes (Enclosure 2). In addition, B&W mPower's comment (Comment No. 4 in Enclosure 2) requested that the safety evaluation utilize cleaner versions of Table 4.2 and Figure 5.1. Enclosure 3 provides the requested replacement.

Questions concerning this letter may be directed to Jeff Halfinger at 434-316-7507 (email: jahalfinger@babcock.com) or Peter Hastings at 434-382-9791 (email: pshastings@generationmpower.com).

Jeffrey A. Halfinger
VP, NSSS Technology
B&W mPower

JAH/jlr

Enclosures:
1. Mark-up of Draft Safety Evaluation
2. Summary Table of Proposed Changes
3. Clean Versions of Table 4.2 and Figure 5.1

cc: Joelle L. Starefos, NRC, TWFN 9-F-27
Stewart L. Magruder, Jr., NRC, TWFN 9-F-27

D104
NRO

Enclosure 1
Mark-up of Draft Safety Evaluation

Enclosure 1

DRAFT SAFETY EVALUATION REPORT FOR BABCOCK & WILCOX COMPANY TOPICAL REPORT R0003-08-002089, REVISION 3, "INSTRUMENT SETPOINT METHODOLOGY TOPICAL REPORT" (TAC NO. RN6113)

PROJECT NO. 0776

1.0 INTRODUCTION AND BACKGROUND

On October 28, 2010, Babcock & Wilcox Company (B&W) NE submitted to the Nuclear Regulatory Commission (NRC) Topical Report (TR) 08-002089, Revision 0, "Instrument Setpoint Methodology," for technical staff review as part of the pre-application effort (Reference 1). The NRC staff identified areas for further discussion and transmitted them to B&W (Reference 2). B&W resubmitted TR 08-002089, Revision 1 (Reference 3) for acceptance review and was accepted by the NRC (Reference 4). Revision 2 of TR 08-002089 was not submitted to the NRC.

The

The staff submitted "Request for Additional Information No. 6236 RAI Letter No. 4" dated December 22, 2011 (Reference 5). B&W response to RAIs 07.01-C Appendix-1 through 13 was submitted and incorporated into TR R0003-08-002089 ~~by~~ letters dated February 2 (Reference 6) and May 21, 2012 (Reference 7).

, Revision 3,

B&W states that the B&W TR details the instrument setpoint methodology applied to the reactor protection system (RPS) setpoints and other important instrument setpoints associated with the B&W mPower reactor. The RPS is a digital, integrated reactor protection and engineered safety features actuation system implemented for the B&W mPower reactor. The methodology described in this topical report is used to establish technical specification setpoints for the B&W mPower RPS in accordance with 10 CFR 50.36.

The methodology described in this report is for the uncertainty analysis, setpoint determination, and determination of allowable values that protect analytical limits as applied to safety-related equipment that perform specific safety functions. Typical instrument setpoints in this category are established for equipment that supports reliable power generation or equipment protection. The results of the uncertainty evaluations can be applied to the following types of calculations:

- Determination of safety-related setpoints
- Extension of surveillance intervals
- Determination of instrument indication uncertainties
- Evaluation or justification of previously established setpoints

Determination of instrument setpoints using this methodology for non-safety related equipment that does not perform a specific safety function as discussed above, is controlled administratively by plant procedures.

2.0 REGULATORY BASIS

The following regulatory requirements and guidance documents are applicable to the staff's review of the TR R0003-08-002089:

~~Pursuant to~~ Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, General Design Criterion (GDC) 13, "Instrumentation and Control," requires, in part, that instrumentation be provided to monitor variables and systems and that controls be provided to maintain these variables and systems within prescribed operating ranges.

~~In~~ 10 CFR Part 50, Appendix A, GDC 20, "Protection System Functions," requires, in part, that the protection system be designed to initiate operation of appropriated systems to ensure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences.

10 CFR Part 50, Appendix B, Criterion XI, "Test Control," and Criterion XII, "Control of Measuring and Test Equipment," provide requirements for tests and test equipment used in maintaining instrument setpoints.

Paragraph (c)(1)(ii)(A) of 10 CFR 50.36, "Technical Specifications," requires, in part, that, where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded. It also requires, among other things, that the licensee notify the NRC if the licensee determines that an automatic safety system does not function as required. The licensee is required to then review the matter and record the results of the review.

10 CFR 50.36(c)(3), "Technical Specifications," states that surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met.

10 CFR 50.55a(h), "Protection and Safety Systems," requires compliance with IEEE Std. 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," and the correction sheet dated January 30, 1995. Clause 6.8.1 of IEEE Std. 603-1991, requires that allowances for uncertainties between the analytical limit and device setpoint be determined using a documented methodology.

3.0 RELEVENT GUIDANCE

Regulatory Guide (RG) 1.105, Revision 3, "Setpoints for Safety-Related Instrumentation," provides guidance for ensuring that instrument setpoints are initially - and remain - within the technical specification limits. This RG endorses ISA-S67.04-1994, Part I, "Setpoints for Nuclear Safety-Related Instrumentation Used in Nuclear Power Plants," with clarifications.

ISA-S67.04-1994, Part II, "Methodology for the Determination of Setpoints for Nuclear Safety-Related Instrumentation," provides additional guidance, but RG 1.105, Revision 3, does not endorse or address Part II of ISA-S67.04-1994.

NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Report for Nuclear Power Plants,” (SRP), Revision 5, March 2007, Branch Technical Position (BTP) 7-12, “Guidance on Establishing and Maintaining Instrument Setpoints,” provides guidelines for reviewing the process an applicant/licensee follows to establish and maintain instrument setpoints.

NRC Regulatory Issue Summary (RIS) 2006-17, “NRC Staff Position on the Requirements of 10 CFR 50.36, ‘Technical Specifications,' Regarding Limiting Safety System Settings during Periodic Testing and Calibration of Instrument Channels,” discusses issues that could occur during testing of LSSSs and which therefore, may have an adverse effect on equipment operability.

Generic Letter (GL) 91-04, "Guidance on Preparation of a Licensee Amendment Request for Changes in Surveillance Intervals to accommodate a 24-Month Fuel Cycle," provides guidance on issues that should be addressed by the setpoint analysis when calibration intervals are extended from 12 or 18 to 24 months.

The objectives of the review of TR R0003-08-002089 are to (1) verify that setpoint calculation methods are adequate to assure that protective actions are initiated before the associated plant process parameters exceed their analytical limits, (2) verify that setpoint calculation methods are adequate to assure that control and monitoring setpoints are consistent with their requirements, and (3) confirm that the established calibration intervals and methods are consistent with safety analysis assumptions. The staff evaluated the setpoint methodology using SRP BTP 7-12 to verify conformance with the previously cited regulatory bases and standards for instrument setpoints with emphasis on the following:

1. Relationships between the safety limit, analytical limit, limiting trip setpoint, the allowable value, the setpoint, the acceptable as-found band, the acceptable as-left band, and the setting tolerance.

2. The setpoint technical specifications meet the requirements of 10 CFR 50.36. Additional information related to setpoint technical specifications is provided in RIS 2006-17.

3. Basis for selection of the trip setpoint.

4. Uncertainty terms that are addressed.

5. Method used to combine uncertainty terms.

6. Justification of statistical combination.

7. Relationship between instrument and process measurement units.

8. Data used to select the trip setpoint, including the source of the data.

9. Assumptions used to select the trip setpoint (e.g., ambient temperature limits for equipment calibration and operation, potential for harsh accident environment).

10. Instrument installation details and bias values that could affect the setpoint.

11. Correction factors used to determine the setpoint (e.g., pressure compensation to account for elevation difference between the trip measurement point and the sensor physical location).

12. Instrument test, calibration or vendor data, as-found and as-left; each instrument should be demonstrated to have random drift by empirical and field data. Evaluation results should be reflected appropriately in the uncertainty terms, including the setpoint methodology.

4.0 TECHNICAL EVALUATION

The establishment of setpoints and the relationships between nominal trip setpoints (NTSPs), limiting trip setpoints (LTSPs), allowable value (AV), as-left values, as-found values, as-left tolerance (ALT), as-found tolerance (AFT), analytical limit (AL), and safety limit (SL) are discussed in this report. A thorough understanding of these terms is important in order to properly utilize the total instrument channel uncertainty in the establishment of setpoints.

The SLs are chosen to protect the integrity of physical barriers that guard against the uncontrolled release of radioactivity. The SLs are typically provided in the plant safety analyses. The AL is established to ensure that the SL is not exceeded. The ALs are developed from event analyses models that consider parameters such as process delays, rod insertion times, reactivity changes, analysis margin, transient response, modeling error, instrument response times, etc. and are provided in Chapter 15, "Transient and Accident Analysis," of the design control document (DCD) of the application. A properly established setpoint initiates a plant protective action before the process parameter exceeds its AL. This, in turn, assures that the transient will be avoided and/or terminated before the process parameters exceed the established SLs.

(Reference 8)

The applicant has committed to follow the requirements of RG 1.105, Revision 3 which describes a method acceptable to the NRC for complying with the applicable regulations. The applicant proposes following ANSI/ISA-67.04.01-2000 rather than ISA-S67.04-1994, Part I as endorsed by RG 1.105, Revision 3. Use of ANSI/ISA-67.04.01-2000 proposed by the applicant is acceptable in lieu of ISA-S67.04-1994, Part I because the staff has reviewed both revisions and has determined that the proposed alternative provides an acceptable level of quality and safety. The applicant also asserts conformance to the guidance listed in recommended practice ANSI/ISA-67.04.02-2000.

In the B&W methodology, the AL is established to ensure that a trip occurs before the SL is reached. The purpose of an LSSS is to assure that a protective action is initiated before the process conditions reach the AL. Trip setpoints are chosen based on the LSSS and to minimize spurious trips close to the normal operating point of the process. Figure 5.1 of the TR shown below provides a pictorial of the B&W setpoint methodology relationships.

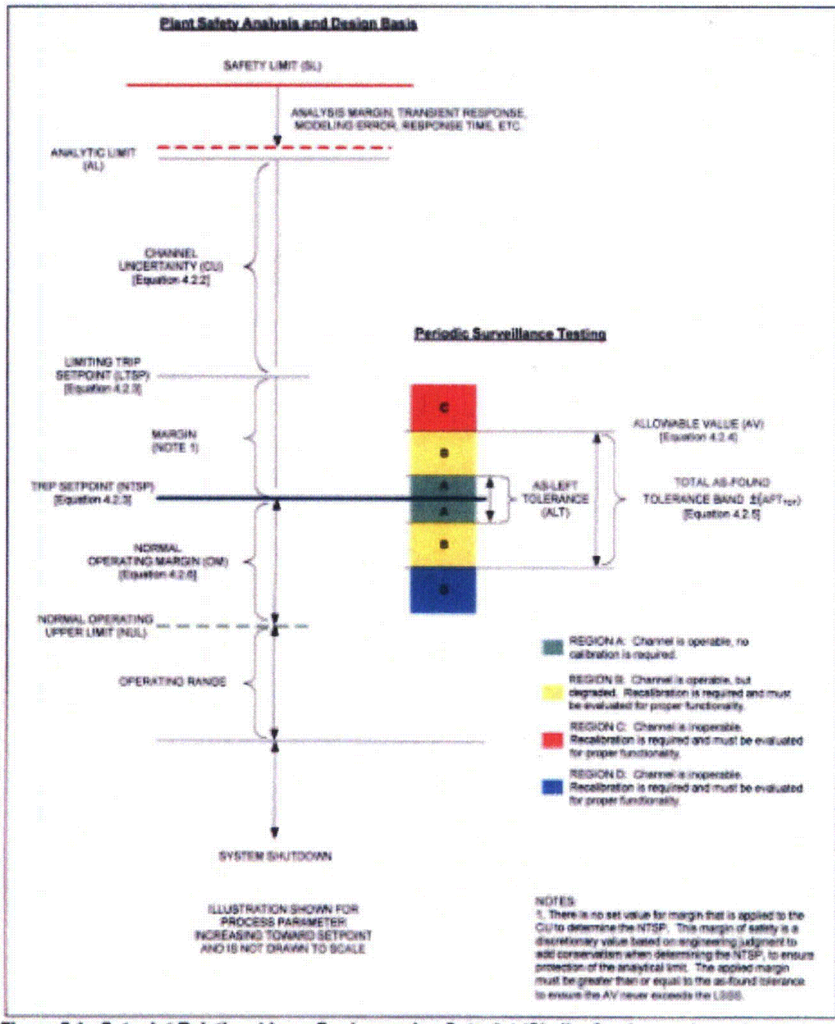

Figure 5.1: Setpoint Relationships – For Increasing Setpoint (Similar for decreasing setpoint, but process is decreasing towards the setpoint).

Replace with Figure 5.1 in Enclosure 3

As presented in the B&W setpoint methodology Sections 4.1.5 and 4.2.3, the applicant defines LTSP as an LSSS and also defines NTSP as the desired value of the measured variable at which an actuation occurs. The calculation of the LTSP value is set forth in Section 4.2.3 as LTSP = AL+/- CU, where CU is the total channel uncertainty. In Note 1 on Figure 5.1, the applicant defines AV such that it will never exceed the LTSP (LSSS) and in most cases should be more conservative than the LTSP. The calculation of the AV is set forth in Section 4.2.4 as AV = NTSP +/- AFT_{TOT} where AFT_{TOT} is the total AFT for the entire instrument ~~chain~~. The NTSP includes additional margin such that it is more conservative than the LTSP. In Section 4.2.5 the applicant defines the AFT and ALT as double sided bands around the NTSP. The applicant states that at a minimum the AFT includes reference accuracy, drift, and ALT

channel

uncertainties. The ALT is based on accuracy of the channel calibration. The staff finds that this approach is consistent with RG 1.105, Revision 3 and ANSI/ISA-67.04.01-2000.

Based on the discussion, sample calculations, and figures presented in the TR, the staff finds that the B&W setpoint methodology demonstrates that the correct relationships between the SL, AL, AV, NTSP, LTSP, AFT, and ALT will be ensured, that the basis for the trip setpoint is correct, and that the requirements of GDC 13 and 20 are met.

NRC RIS 2006-17 detailed a concern with verification of operability using only AV or a one-sided approach during periodic testing (channel operational test, calibration test). To address this concern the B&W mPower setpoint methodology uses double-sided acceptance criteria bands. Figure 5.1 (above) and Table 4.2 (below) of the TR describe how the operability of the instrument loop is evaluated. Exceeding the AFT in either the high or low direction may indicate degraded performance and inability of the instrument channel to meet its intended function.

Another concern detailed in RIS 2006-17 is that 10 CFR 50.36(c)(1)(ii)(A) includes requirements for a general class of LSSSs related to variables having significant safety functions but which do not protect SLs. Operating plant licenses have TSs for LSSSs that are not related to SLs. For these LSSSs, 10 CFR 50.36(c)(1)(ii)(A) requires that a licensee take appropriate action if it is determined that the automatic safety system does not function as required. To address this concern the B&W mPower setpoint methodology uses double-sided acceptance criteria bands. For this reason, the staff finds that the B&W setpoint methodology addresses the concerns noted in RIS 2006-17 and is consistent with the requirements of 10 CFR 50.36.

Table 4.2: Instrument Operability During Periodic Surveillance Testing

As-found NTSP During Surveillance Testing	Status of Channel Operability and Required Actions
As-found NTSP within ALT (Region A of Figure 5.1)	Channel is operable, no action required. The results are tracked by plant procedures for historical trending.
As-found NTSP outside of ALT band, but within AFT band (Region B of Figure 5.1)	Channel is operable, recalibration is necessary to restore the NTSP within the ALT.
<u>Increasing process:</u> As-found NTSP is conservative with respect to the AV (NTSP < AV) but outside AFT band (Region D of Figure 5.1); or <u>Decreasing process:</u> As-found NTSP is conservative with respect to the AV (NTSP > AV) but outside AFT band.	Channel is inoperable. Recalibration is necessary to restore the NTSP within the ALT, and evaluation of channel functionality is required
As-found NTSP non-conservative to the AV (Region C of Figure 5.1)	Channel is inoperable. Recalibration is necessary to restore NTSP within the ALT, and evaluation of channel functionality is required to return channel to an operable status.

Replace with Figure 4.2 in Enclosure 3

The B&W setpoint methodology allows for a minimum set of assumptions to be used (refer to Section 3.5 of the TR), one of which requires that all uncertainty terms of devices are calculated typical

in percent calibrated span. Following the setpoint calculation flow depicted in Figure 4.1 the pertinent information required to be documented for each calculation is collected in ~~a~~ data sheet as shown in Table 4.1 of the TR. This table also provides traceability and documentation of the loop data and uncertainties used. The results of the calculation are documented in accordance with controlled plant procedures and programs (such as the Setpoint Control Program) with adequate detail so that all bases, equations, and conclusions are fully understood and documented. Table 4.1 includes a list of uncertainties that must be considered for inclusion in the total channel uncertainty (CU) calculation.

The surveillance and calibration intervals are determined as part of the development of the reference technical specifications. Determination of surveillance and calibration intervals takes into account the uncertainty due to instrument drift as described in this report such that there is reasonable assurance that the plant protection system instrumentation is functioning as expected between the surveillance intervals. Plant-specific procedures will include required methods to evaluate the historical performance of the drift for each instrument channel and confirm that the surveillance and calibration intervals do not exceed the assumptions in the plant safety analysis. The guidance contained in GL 91-04 is used to evaluate and determine the acceptable surveillance and calibration intervals for each instrument channel as needed. For these reasons the staff finds that the B&W setpoint methodology conforms to ANSI/ISA-67.04.01-2000 and RG 1.105, Revision 3 with respect to assumptions and data used to determine the uncertainties and select the trip setpoint.

The B&W setpoint methodology combines the uncertainty of the instrument loop components to determine the CU for the functions of the reactor protection system and other important instrument setpoints. All appropriate and applicable uncertainties are considered for each reactor protection system and other important instrument setpoint functions. Section 4.1.3.1 of the TR lists elements of uncertainty that are considered typical, but not inclusive, and the list is consistent with ANSI/ISA-67.04.01-2000. Other considerations that contribute to the uncertainty, such as environmental conditions and installation details of the components are also factored into the CU. For these reasons, the staff finds that the B&W setpoint methodology conforms to ANSI/ISA-67.04.01-2000 and RG 1.105, Revision 3 with respect to uncertainty terms, bias values, and correction factors used to select the trip setpoint.

The CU values are established at a 95 percent probability and a 95 percent confidence level, using a 2 sigma Gaussian distribution which is consistent with RG 1.105, Revision 3. The CU calculation is based on the following:

I. Random, independent uncertainties are eligible for the square-root-sum-of-squares method (SRSS) combination propagated from the process measurement module through the signal conditioning module of the instrument channel to the device that initiates the actuation. Refer to Sections 3.3 and 3.3.1 of the TR.

II. Dependent uncertainties are combined algebraically to create a larger independent uncertainty that is eligible for SRSS combination. Refer to Section 3.3.2 of the TR.

III. Non-Random, bias and abnormally distributed uncertainties are those that consistently have the same algebraic sign. If they are predictable for a given set of conditions because of a known positive or negative direction, they are classified as bias with a known sign. If they do not have a known sign, they are treated conservatively by algebraically adding the bias in the worst direction. These are classified as bias with an unknown sign. Refer to Sections 3.4.1 and 3.4.2 of the TR

The staff finds that the described method of statistical combination of uncertainties conforms to ANSI/ISA-67.04.01-2000 and to RG 1.105, Revision 3.

The equations for determining module and channel uncertainty, and trip setpoint shown in Sections 4.2.1, 4.2.2, and 4.2.3 conform to ANSI/ISA-67.04.01-2000 and to RG 1.105, Revision 3.

All NRC RAIs and acceptance review comments have been resolved (References 2 through 7) and incorporated into TR R0003-08-002089, Revision 3. There are no RAI open items.

Based on the discussion above, the staff finds that TR R0003-08-002089, Revision 3 follows the guidance of RG 1.105, Revision 3, RIS 2006-17, GL 94-01, and ANSI/ISA-67.04.01-2000 with respect to setpoint methodology, and therefore complies with the NRC regulations for ensuring that setpoints for safety-related instruments are initially within and remain within the technical specification limits.

5.0 CONCLUSION

The staff has reviewed the B&W mPower Instrument Setpoint Methodology Topical Report (Reference 7) and found that (1) the setpoint calculation methods are adequate to assure that protective actions are initiated before the associated plant process parameters exceed their analytical limits, (2) the setpoint calculation methods are adequate to assure that control and monitoring setpoints are consistent with their requirements, and (3) the established calibration intervals and methods are consistent with safety analysis assumptions. Therefore, the staff concludes that the proposed TR R0003-08-002089, Revision 3, is an acceptable setpoint methodology that satisfies the requirements of 10 CFR Part 50, Appendix A, GDC 13 and 20, 10 CFR Part 50, Appendix B, Criterion XI, Paragraphs (c)(1)(ii)(A) and (c)(3) of 10 CFR 50.36, and of 10 CFR 50.55a(h), which requires compliance with IEEE Std. 603-1991.

If this TR is referenced in a design certification application under 10 CFR Part 52, the application must include ITAAC for the plant-specific setpoint analysis, which details the procedures for establishing the setpoints including the margins and their location. Prior to initial fuel load, a reconciliation of the setpoint analysis and setpoint program against the final design for each plant must be performed, as required by the ITAAC. The staff will review the proposed ITAAC during the design certification review.

6.0 REFERENCES

1. B&W letter BW-JAH-2010-230, dated October 28, 2010, (ML103020473) B&W submitted, for U.S. Nuclear Regulatory Commission (NRC) staff review, TR 08-002089, Revision 0, "Instrument Setpoint Methodology."

2. NRC Request for the Review of Babcock & Wilcox Company TR 08-002089-000, Revision 0, "Instrument Setpoint Methodology, October 2010," dated April 7, 2011 (ML110900508).

3. B&W letter BW-JAH-2011-253, dated June 30, 2011, (ML11182C034) B&W submitted, for U.S. Nuclear Regulatory Commission (NRC) staff review, TR 08-002089, Revision 1, "Instrument Setpoint Methodology" (ML11182C0353).

4. NRC Acceptance for Review of Babcock & Wilcox Company TR 08-002089-001, Revision 1, "Instrument Setpoint Methodology Topical Report," dated August 24, 2011 (ML112351116).

5. Request for Additional Information 6236 RAI Letter No. 4, dated December, 22, 2011, for the review of B&W mPower Reactor Project Instrument Setpoint Methodology Topical Report 08-002089 Revision 1 (ML11357A141).

6. B&W letter BW-JAH-2012-277, dated February 2, 2012, "Babcock & Wilcox Nuclear Energy, Inc. (B&W NE) Response to NRC Request for Additional Information" (ML12037A001).

7. B&W letter MPWR-LTR-12-00051, dated May 21, 2012, (ML12143A424) B&W submitted, for NRC staff review, TR R0003-08-002089, Revision 3, "Instrument Setpoint Methodology" (ML12153A304).

8. ANSI/ISA--67.04.01-2000, "Setpoints for Nuclear Safety-Related Instrumentation," February 2000 (Equivalent to ANSI/ISA-S67.04-1994, Part 1).

Enclosure 2
Summary Table of Proposed Changes

Enclosure 2

Comments on NRC draft Safety Evaluation for B&W's Instrument Setpoint Methodology Topical Report R0003-08-002089 Revision 3

No.	Type	Section / Page	Comment:
1.	E	Section 1.0, page 1	2nd paragraph, 2nd sentence: Reword to add "The" at the beginning of the sentence: "[The] B&W response to RAIs...." Add revision 3 to the report number, "TR R0003-08-002089, [Revision 3]..."
2.	E	Section 2.0, page 2	Delete "Pursuant to" from the 1st sentence of 2nd paragraph Delete "In" (preceding 10 CFR....) from the 1st sentence of 3rd paragraph
3.	E	Section 4.0, page 4	3rd paragraph, 2nd sentence: Identify ANSI/ISA-67.04.01-2000 as Reference 8, consistent with Section 6.0, REFERENCES
4.	E	Section 4.0, pages 5-6	Insert cleaner version of Figure 5.1 and Table 4.2. (A clean version included as Enclosure 3 and will be provided electronically)
5.	T	Section 4.0, page 5	1st paragraph, 4th sentence: Replace "chain" with "channel": "where AFT_{TOT} is the total AFT for the entire instrument [channel]."
6.	T	Section 4.0, page 7	2nd line, add "typical" to describe the data sheet: "...information required to be documented for each calculation is collected in a [typical] data sheet as shown in Table 4.1 of the TR."

Key (to Type of Comment):

E – Editorial

T – Technical

Enclosure 3
Clean Versions of Table 4.2 and Figure 5.1

Enclosure 3

Table 4.2: Instrument Operability During Periodic Surveillance Testing

As-found NTSP During Surveillance Testing	**Status of Channel Operability and Required Actions**
As-found NTSP within ALT (Region A of Figure 5.1)	Channel is operable, no action required. The results are tracked by plant procedures for historical trending.
As-found NTSP outside of ALT band, but within AFT band (Region B of Figure 5.1)	Channel is operable, recalibration is necessary to restore the NTSP within the ALT.
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Enclosure 3

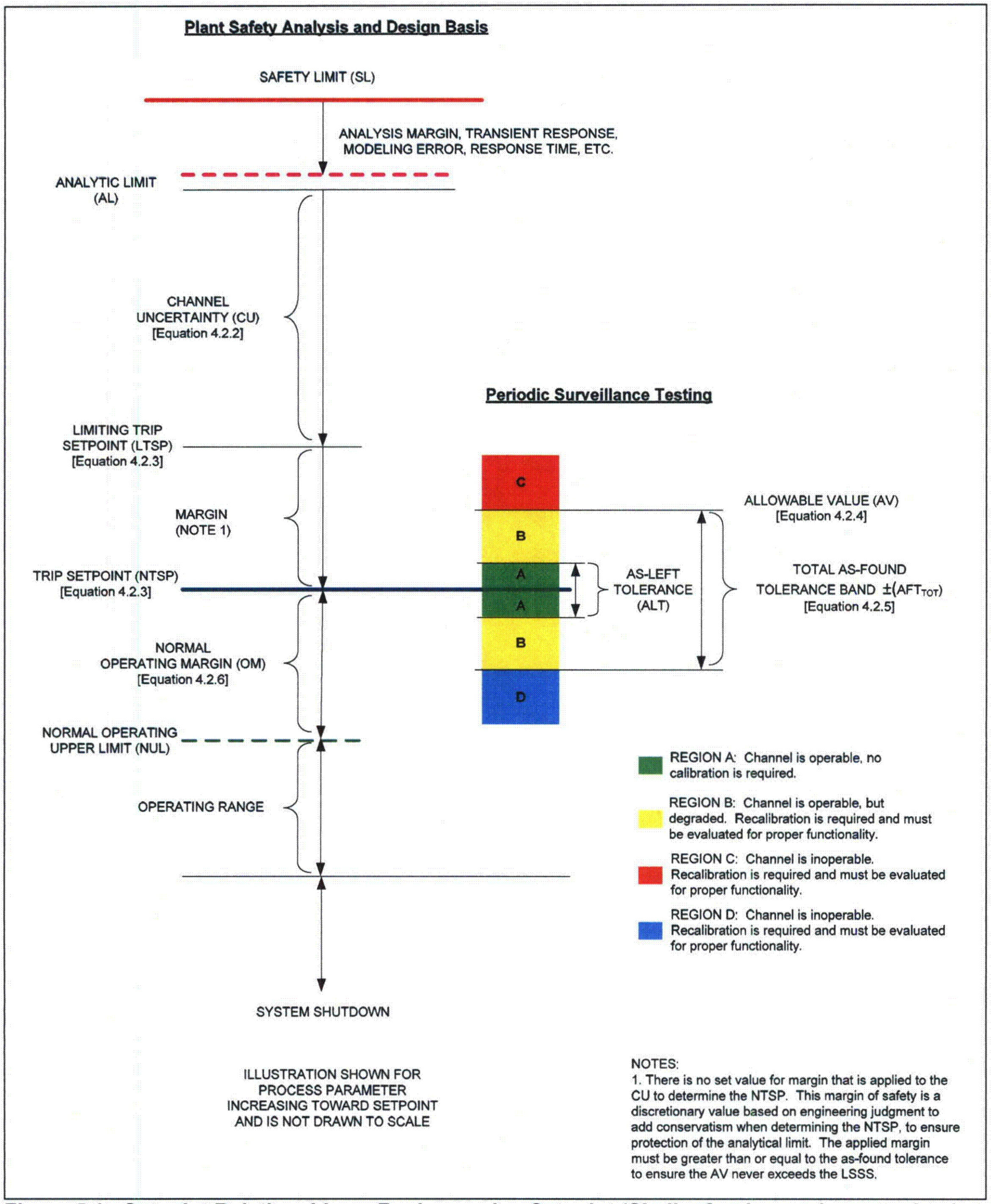

Figure 5.1: Setpoint Relationships – For Increasing Setpoint (Similar for decreasing setpoint, but process is decreasing towards the setpoint).