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February 2, 2012 BW-JAH-2012-277

U.S. Nuclear Regulatory Commission (NRC)
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Babcock & Wilcox Nuclear Energy, Inc.
Docket Number-PROJ0776
Project Number-776

Subject: Babcock & Wilcox Nuclear Energy, Inc. (B&W NE) Response to NRC Request for Additional Information

Reference: 1. B&W NE Instrument Setpoint Methodology Topical Report 08-002089-001
2. Request for Additional Information Letter No.4 for the Review of Babcock & Wilcox (B&W) mPower Reactor Project Instrument Setpoint Methodology Topical Report 08-002-2089 [sic] Revision 1

On October 28, 2010, B&W NE submitted to the NRC Revision 0 of the above referenced topical report for technical staff review as part of our pre-application effort. Subsequently, on June 30, 2011, as a result of preliminary feedback from the NRC staff, B&W submitted Revision 1 to the Report (Ref 1).

On December 22, 2011, the NRC issued a Request for Additional Information (RAI) (Ref 2) containing thirteen (13) questions and a request that the responses to the questions and a revision to the Instrument Setpoint Methodology Topical Report, if needed, be submitted by February 2, 2012.

Enclosed is the set of B&W's responses to the RAI's questions which include proposed clarification to information provided in the topical report, and where appropriate, revised text, tables or figures to be incorporated into Revision 2 to B&W's Instrument Setpoint Methodology Topical Report 08-002089, pending satisfactory resolution of this RAI.

Questions concerning this submittal may be directed to Jeff Halfinger at 434-326-7507 (email: jahalfiner@babcock.com) or T.J. Kim at 434-382-9791 (email: tjkim@babcock.com).

Jeffrey A. Halfinger

VP, Technology Development
B&W NE

D104
NRO

JAH/jlr

Attachment: Setpoint Methodology Topical Report RAI Responses

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

Attachment: Setpoint Methodology Topical Report RAI Responses

Babcock & Wilcox Nuclear Energy, Inc. Response to
Requests for Additional Information No. 6236
RAI Letter No. 4

B&W mPower Pre-Application Activities
Docket No. PROJ 0776
Topical Report 08-002089-001

Question 07.01-C Appendix-1
Section 3.1 *- On page 3, paragraph 6 states, "Recognizing that RG 1.105, Revision 3, was published in 1999, the B&W mPower instrument setpoint methodology follows the guidance provided by ANSI/ISAS67.04.01-2000 (Ref. 6.3.1), which is equivalent to ANSI/ISA S67.04-1994, Part I (now ANSI/ISAS67.04.01-2006)."*

What is meant by "(now ANSI/ISAS67.04.01-2006)?" It is listed as reference 6.3.3, however, other than this statement, it is not mentioned anywhere else. Clarify whether the mPower setpoint methodology conforms to RG 1.105 Rev. 3 which endorses ANSI/ISA S67.04-1994. If the setpoint methodology does not meet RG 1.105 Rev. 3 then demonstrate how the methodology meets the Regulations.

B&W NE Response

The intent of the cited reference was to demonstrate that the B&W Instrument Setpoint Methodology follows the guidance provided by ANSI/ISA S67.04.01-2000, which is equivalent to ISA-67.04-1994, Part I. The current version of this standard was issued as ANSI/ISA 67.04.01-2006.

The statement was intended to make note of the fact that since the issuance of ISA S67.04-1994 Part I, which is endorsed by RG 1.105, Revision 3, updated versions of the applicable standards have been issued. By incorporating the latest industry guidance contained in ANSI/ISA 67.04.01-2000 and ANSI/ISA 67.04.01-2006, the B&W Instrument Setpoint methodology also ensures that RG 1.105, Revision 3, and the issues identified in RIS 2006-17 are also addressed.

The reference to ANSI/ISAS67.04.01-2006 will be deleted (Ref. 6.3.3), and Section 3.1, paragraph 6 (page 3) will be revised as follows:

> The calculation of safety-related instrument setpoints for the B&W mPower reactor is based on RG 1.105, which describes a method acceptable to the NRC for complying with the applicable regulations. RG 1.105 endorses the use of ISA-67.04-1994, Part I. Recognizing that RG 1.105, Revision 3, was published in 1999, and to ensure the issues identified in RIS 2006-17 (Ref. 6.2.4) are addressed, the B&W mPower instrument setpoint methodology follows the guidance provided by ANSI/ISA-S67.04.01-2000 (Ref. 6.3.1), which is equivalent to ISA 67.04-1994, Part I and ANSI/ISA-RP67.04.02-2000.

Question 07.01-C Appendix-2

Section 3.3.2 *- Regarding the last sentence of 3.3.2, the staff requests the applicant to clarify whether after the uncertainties are algebraically summed, the SRSS would then be applied as discussed in the second paragraph of 4.1.4.*

B&W NE Response

Section 3.3.2 contains information for the treatment of random uncertainties that are not independent (i.e., dependent uncertainties). In treating dependent uncertainties, the methodology conservatively combines these random, dependent uncertainties algebraically into a larger, more conservative independent uncertainty term which can then be combined using the SRSS method. This is consistent with the guidance presented in ISA-RP67.04.02-2000.Section 3.3.2 and 4.1.4 will be revised to clarify the treatment of dependent uncertainties.

A sentence will be added to the end of section 3.3.2 (pages 4-5) as shown with changes as highlighted in shaded text:

3.3.2 Dependent Uncertainties

Complicated relationships may exist between instrument channels and various instrument uncertainties. As such, a dependency might exist between some random uncertainty terms and parameters of an overall uncertainty analysis. A common root cause may exist which influences other uncertainty terms in the analysis with a known relationship. When these uncertainties are included, they are added algebraically, which results in a statistically larger value for that parameter when evaluated in the overall channel uncertainty. These combined dependent uncertainties are then treated as an additional independent random uncertainty, which can then be combined with other independent terms using the SRSS method in the overall uncertainty calculation.

A sentence will be added to section 4.1.4, paragraph 2 (page 14) as shown below in shaded text:

4.1.4 Channel Uncertainty

Individual module uncertainties and other uncertainty terms are combined to determine the overall channel uncertainty (CU) using the equations shown in Sections 4.2.1 and 4.2.2 ,respectively.

As described earlier, the methodology used in this report to combine instrument loop uncertainties is an appropriate combination of those groups that are statistically and functionally independent. Those uncertainties that are not independent are conservatively summed algebraically creating a new, larger independent uncertainty that are eligible for combination with other independent terms using the SRSS method described in this report.

<u>Question 07.01-C Appendix-3</u>
Section 3.5 *- The first bullet in this section appears to conflict with Section 3.4.1 (both stated below). The staff requests the applicant explain this inconsistency.*

> *3.4.1 Any bias effects that cannot be calibrated out are directly accounted for in the uncertainty calculation.*
>
> *3.5 Where bias terms have opposite effects on instrument accuracy (positive versus negative), and are both of known magnitude, the two uncertainties may be used to offset each other.*

<u>B&W NE Response</u>

B&W agrees with NRC's comment above.

For cases where the bias terms are known with respect to sign and magnitude, the bias effect can be accounted for directly in the instrument calibration procedure. The intent of the methodology was that in these cases, the bias term does not need to be included in the uncertainty calculation.

Therefore, the topical report will be revised to delete the first sentence of the first bullet of section 3.5 (page 5) and reads as follows:

- If both magnitude and direction of a bias are known (e.g., transmitter static pressure span effects), this effect can be accounted for in the instrument channel calibration procedure and calibrated out of an instrument and thus eliminated from the uncertainty calculation.

Question 07.01-C Appendix-4

Section 3.5 - *In the paragraph titled, Assumptions, clarify the assumption for instrument calibration (last bullet) is valid for sensor locations that may be exposed to the environment during calibration.*

B&W NE Response

To clarify how the temperatures of the instrumentation equipment are accounted for during calibration, the last bullet of section 3.5 (page 6) will be revised as shown below in shaded text:

- For the purposes of the setpoint analyses, the instrumentation is assumed to be calibrated based on the ambient conditions in which the instrumentation components are expected to operate and specified in the plant calibration procedures. The temperature effect (TE) for the instrumentation accounts for possible differences between the temperatures associated with the instrument calibration and the ambient conditions of the installed equipment and is based on the temperature deviation between this assumed calibration temperature and the maximum and minimum ambient temperature of the specific location of the actual instrumentation. The normal temperature effects are accounted for as shown in the equations in Section 4.2.1. By using the actual vendor data (typically stated in terms of ± X % span per Y °F), actual calibration temperatures and plant operating temperatures, the overall temperature effect is determined and accounted for in the TE term for the specific instrument channel of interest, consistent with the guidance contained in ANSI/ISA-RP67.04.02-2000 (Ref. 6.3.2).

Question 07.01-C Appendix-5

Figure 4.1 *- The setpoint steps at the bottom of the figure (below the step "Determine the Setpoint and Allowable Value"), deviate from ANSI/ISA 67.04.02 Figure 2. Explain how this meets the guidance in RG 1.105 Rev 3.*

B&W NE Response

Figure 4.1 of the B&W Instrument Setpoint Methodology is similar to Figure 2 in ANSI/ISA 67.04.02-2000, slightly amplified to provide more prescriptive guidance for obtaining the trip setpoint (NTSP) from the analytical limit (AL) based upon either an increasing or decreasing direction of the process variable. The amplified portion of Figure 4.1 refers to section 4.2.3 for the mathematical equation to use for calculating of the trip setpoint and provides guidance on the use of the equations based upon the direction of the process variable.

The equation in section 4.2.3 for calculating the trip setpoint (NTSP) and limiting trip setpoint (LTSP) is shown below in its current form:

LTSP = AL ± CU

NTSP = AL ± (CU + Margin)

Therefore, when following the guidance illustrated in Figure 4.1, and applying the mathematical expressions from equation 4.2.3, for cases where the process signal increases towards the analytical limit, NTSP and LTSP calculated as follows:

LTSP = AL - CU	(increasing process)
NTSP = AL - (CU + Margin)	(increasing process)

For cases where the process signal increases towards the analytical limit, NTSP and LTSP calculated as follows:

LTSP = AL + CU	(decreasing process)
NTSP = AL + (CU + Margin)	(decreasing process)

To summarize these steps, <u>for an increasing process</u> the channel uncertainty (CU) is subtracted from the AL to obtain the LTSP, and the CU plus margin (if any) is subtracted from the AL to obtain the NTSP. <u>For a decreasing process</u>, the CU is added to the AL to obtain the LTSP, and the CU plus margin (if any) is added to the AL to obtain the NTSP. This is consistent with and identical to the methods described in section 7.2 of ISA/ANSI-67.04.02-2000.

These methods are consistent with the guidance in RG 1.105 for establishment of the LTSP as the LSSS. The LTSP is determined by subtracting the CU from the AL for an increasing process, and adding the CU to the AL for a decreasing process. To determine the NTSP, a value for safety margin may be added to the CU to add conservatism when establishing the trip setpoint. The CU is determined using accepted statistical methods. The AV is determined as the limiting value that the NTSP may have when tested periodically and ensure that both the AL and the SL are protected.

No changes to Figure 4.1 will be made; however, equation 4.2.3 (page 18) of the topical report will be slightly modified to more clearly show this mathematical relationship with changes as highlighted in shaded text:

4.2.3 Trip Setpoint

LTSP = AL - CU (increasing process)
LTSP = AL + CU (decreasing process)

NTSP = AL - (CU + Margin) (increasing process)
NTSP = AL + (CU + Margin) (decreasing process)

<u>Question 07.01-C Appendix-6</u>

Section 4.1.3.1 - *The last paragraph in this section lists the "elements of uncertainty for any module" and further specifies the definitions are provided in Appendix B. Two of the elements the "as-left tolerance specification" and "as-found specification" are not defined in Appendix B. The staff requests the applicant clarify the definitions of these elements.*

<u>B&W NE Response</u>

The list in section 4.1.3.1 lists the various elements of uncertainty for a module. The terms "as-left tolerance specification" and "as-found specification" should have matched the terms defined in Appendix B. B&W recognizes that the identified names for the terms in our report did not exactly match information included in Appendix B. Therefore, the list in paragraph 5 of section 4.1.3.1 (pages 13-14) will be revised to exactly match the defined terms provided in Appendix B as shown with changes highlighted in shaded text below.

Elements of uncertainty for any module that are considered are listed below (not all of the uncertainties listed apply to every measurement channel). Definitions, as appropriate, are provided in Appendix B.

- process measurements effect
- primary element accuracy
- drift
- temperature effects
- radiation effects
- static and ambient pressure effects
- overpressure effect
- measuring and test equipment uncertainty
- power supply effects
- indicator reading uncertainty
- conversion accuracy
- seismic effects
- environmental effects – accident
- as-left tolerance
- as-found tolerance
- propagation of uncertainty through modules

Question 07.01-C Appendix-7
Section 4.1.5 *- The staff requests the applicant specify which equation applies to "Trip SetPoint."*

B&W NE Response

B&W will revise the Instrument Setpoint Methodology topical report to explicitly identify the equations for the terms described in section 4.1.5. The following sentence will be added to the beginning of section 4.1.5 (page 14) as listed below:

4.1.5 Trip Setpoint

The nominal trip setpoint (NTSP) and limiting trip setpoint (LTSP) are calculated using equation 4.2.3.

Question 07.01-C Appendix-8

Section 4.1.6 *- The last half of the second paragraph states "A setpoint found within the allowable value region, but outside the as-found tolerance, is considered operable, but degraded. It is acceptable with respect to the analytical limit; however, the instrument must be reset to return it within the allowed as-left tolerance region (see definitions)..."*

This appears to conflict with Section 4.2.5 which states "The AFT is included to determine if the instrument needs to be reset after calibration or, if outside of the tolerance, requires further investigation as to its operability. The as-found readings also provide data for establishing actual instrument drift." The staff requests that the applicant explain this apparent contradiction and/or to revise Section 4.1.6 or Section 4.2.5 to eliminate the conflict.

In addition, providing an explanation for the following four scenarios listed in the mPower Setpoint Methodology Topical Report in terms of calibration requirements, instrument operability, and channel operability is optional but would aid in additional clarification for the section.

- *As-found is within as-left tolerance*
- *As-found is outside as-left tolerance but within as-found tolerance*
- *As-found is outside as-found tolerance but within AV*
- *As-found is above/below AV*

B&W NE Response

To more clearly demonstrate the conditions during periodic surveillance testing that could occur, and the status of channel operability during periodic surveillance testing, the following revisions to the topical report will be made.

- Section 4.1.6 and 4.2.5 will be revised to clearly delineate the disposition of the as-found conditions during periodic surveillance testing.

- Revisions to Figure 5.1 (see response to Question 07.01-C Appendix-9) will be made to more clearly demonstrate the process of verifying channel function and operability during testing.

The following text will be revised in paragraph 2 in section 4.1.6 (pages 15-16) with changes highlighted in shaded text below:

> The AV is a value that the trip setpoint might have when tested periodically and accounts for instrument drift and other uncertainties applicable to normal plant operation associated with the test during normal plant operation including: instrument drift, reference accuracy, as-left tolerance from the previous calibration and measurement and test equipment uncertainty. A setpoint found within the allowable value region, but outside the as-found tolerance, is considered operable, but degraded. It is acceptable with respect to the analytical limit; however, the instrument must be reset to return it within the allowed as-left tolerance region (see definitions). A channel setpoint found outside the allowable value region is declared inoperable and an evaluation of acceptable channel functionality is performed. The channel is required to be calibrated to return the setpoint within the acceptable tolerance range. Plant-specific procedures will maintain and track the results of the periodic surveillance test procedures and the historical as-found and as-left data obtained during surveillance testing. These data will be evaluated to confirm the assumptions for instrument channel drift and uncertainty data remains valid.

The changes to section 4.2.5 include revisions to the first paragraph and additional information provided are shown below (pages 19-21) with changes highlighted in shaded text below:

The as-found tolerance (AFT) is the module uncertainty as discovered during module calibration. Therefore, it does not include uncertainties due to harsh environment or process measurement, and does not include primary element uncertainty. AFT includes consideration at a minimum of reference accuracy (RA), drift (DR), and as-left tolerance (ALT) uncertainties. The as-left tolerance (ALT) is also referred to as "calibration tolerance" in ANSI/ISA-S67.04.01-2000 (Ref. 6.3.1) or "setting tolerance" in RIS 2006-17.

The ALT is specified as a double-sided band around the NTSP. Depending on the condition of the as-found values for the NTSP, plant specific procedures will direct the operability determination and requirements for channel calibration or maintenance. The ALT typically is based on the reference accuracy of the module being calibrated; however, depending on the particular instrument loop in question, the limitations of the calibration procedure or need to minimize maintenance time, the magnitude of the ALT may be specified as a smaller or larger value in the specific calibration procedure. In this case, if the ALT used in the procedure differs from the reference accuracy specified by the vendor, the ALT would be included as a separate, explicit term in the setpoint calculation. Thus, in the equation to determine AFT_n, the as-left term is included as a bounding method to account for cases where not all attributes of the reference accuracy may verified in the particular calibration procedure.

Determination of the AFT may also include measurement and test equipment uncertainty if the equipment contributes errors greater than one tenth of the measurement uncertainty (refer to Section 3.5). For some modules, it may be necessary to include additional uncertainties (e.g., TE may be included in the determination of AFT if a change in the calibration environment occurred).

Therefore:

$$AFT_n = \pm (RA_n^2 + DR_n^2 + ALT_n^2 + MTE_n^2)^{1/2}$$

Where:

AFT	=	As-found tolerance (any typical module).
n	=	Module "n".
RA	=	Device reference accuracy.
DR	=	Device allowance for drift.
ALT	=	As-left tolerance.
MTE	=	Measurement and test equipment effect.

The AFT is evaluated to determine if the instrument needs to be reset after calibration or, if outside of the tolerance, requires further investigation as to its operability. The as-found readings also provide data for establishing actual instrument drift. In accordance with RG 1.105 (Ref. 6.2.1) and BTP 7-12, plant specific procedures are required to track, trend and maintain the results of periodic surveillance testing (i.e., the as-found and as-left values for sensors (as applicable) and modules associated with the instrument loop) for proper management of instrument uncertainties including drift.

Table 4.2 below, that will be added to the report, shows the various conditions to consider during surveillance testing of the instrumentation channel and are consistent with RIS 2006-17 (Ref. 6.2.4).

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.	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)	Recalibration is necessary to restore NTSP within the ALT, and evaluation of channel functionality is required to return channel to an operable status.

Question 07.01-C Appendix-9
Figure 5.1 *- This figure shows Margin (Note 2) added to the setpoint calculation. The staff requests that the applicant clarify the use of margin in the figure and revise the figure to reflect both the +/- of AFT, ALT, and the location of Margin (Note 2) in relationship to NTSP, AFT and AV (see below).*

Sections 4.2.4, 4.2.5 and Figure 5.1:

- *Section 4.2.4 - How is AFT^{TOT} calculated as a +/- value and shown on both sides of NTSP on Figure 5.1?*
- *Section 4.2.5 - How is AFTn calculated as a +/- value?*
- *Section 4.2.4 - Explain why the definition of Margin is different from Note 2 on Figure 5.1.*
- *Is Margin (Note 2) correctly shown on Figure 5.1? see bullet 1 above.*
- *What value of ALT would be used in Figure 5.1? (Refer to RG 1.105 Rev. 3 Figure 1, "E. Region of Calibration Tolerance")*

B&W NE Response

To clarify the relationship between Margin and NTSP, AFT and AV a number of changes will be made to Figure 5.1 and the text contained in Sections 4.2.4 and 4.2.5 of the topical report.

The as-found tolerance is used, when applied to the NTSP, to determine the allowable value for the instrument channel. The AV is the limiting value of an instrument's as-found trip setting during surveillance testing while still ensuring the AL and SL are protected. If the as-found value for the NTSP is non-conservative with respect to the AV, actions are required to restore the NTSP. Additionally, RIS 2006-17 raised concerns about conditions where the as-found NTSP may be more conservative than the AV, indicating that abnormally large changes in the trip setpoint have occurred which could be signs of the channel malfunctioning. Thus a concept of a double-sided acceptance criteria band for the measured trip setpoint during surveillance testing was introduced.

The determination of the AFT_{TOT} in section 4.2.4 (page 19) has been revised by removing the margin term in the determination of the AV, and includes the proper mathematical operator (±) to ensure the double-sided band is correctly applied as shown below with changes highlighted in shaded text:

4.2.4 Allowable Value

$$AV = NTSP \pm AFT_{TOT}$$

Where:

AV	=	Allowable value.
NTSP	=	Trip setpoint.
AFT_{TOT}	=	Total as-found tolerance for the entire instrument channel.

To protect against identification of potential masking of equipment degradation during periodic surveillance testing, no margin is included as part of the AV determination and the AFT_{TOT} is applied as a double-sided band around the NTSP.

AFT_{TOT} determination includes consideration of all channel AFT uncertainties pertaining to the calibration being performed. Therefore, when considering AV, AFT_{TOT} is based on;

$$AFT_{TOT} = \pm (AFT_1^2 + AFT_2^2 + \ldots. + \ldots. + \ldots + AFT_n^2)^{1/2}$$

Where:

AFT_n = as-found tolerance for module "n" (see 4.2.5).

Figure 5.1 will be updated to properly illustrate the application of a double-sided band for the AFT_{TOT} as applied to the NTSP to ensure consistency with revisions to equation 4.2.4 described above. Additional revisions and enhancements to Figure 5.1 (page 24) include the following and the revised figure is shown below:

- Addition of a double-sided band for the ALT to aid in determination of channel operability and be consistent with Figure 1 in RG. 1.105.
- Illustration of regions of different conditions that may exist during periodic surveillance testing to clarify status of channel operability and required actions (if any).
- Removal of the margin applied to the AFT_{TOT} and its associated note (Note 2). (To protect against the potential for masking of equipment degradation during periodic surveillance testing.)

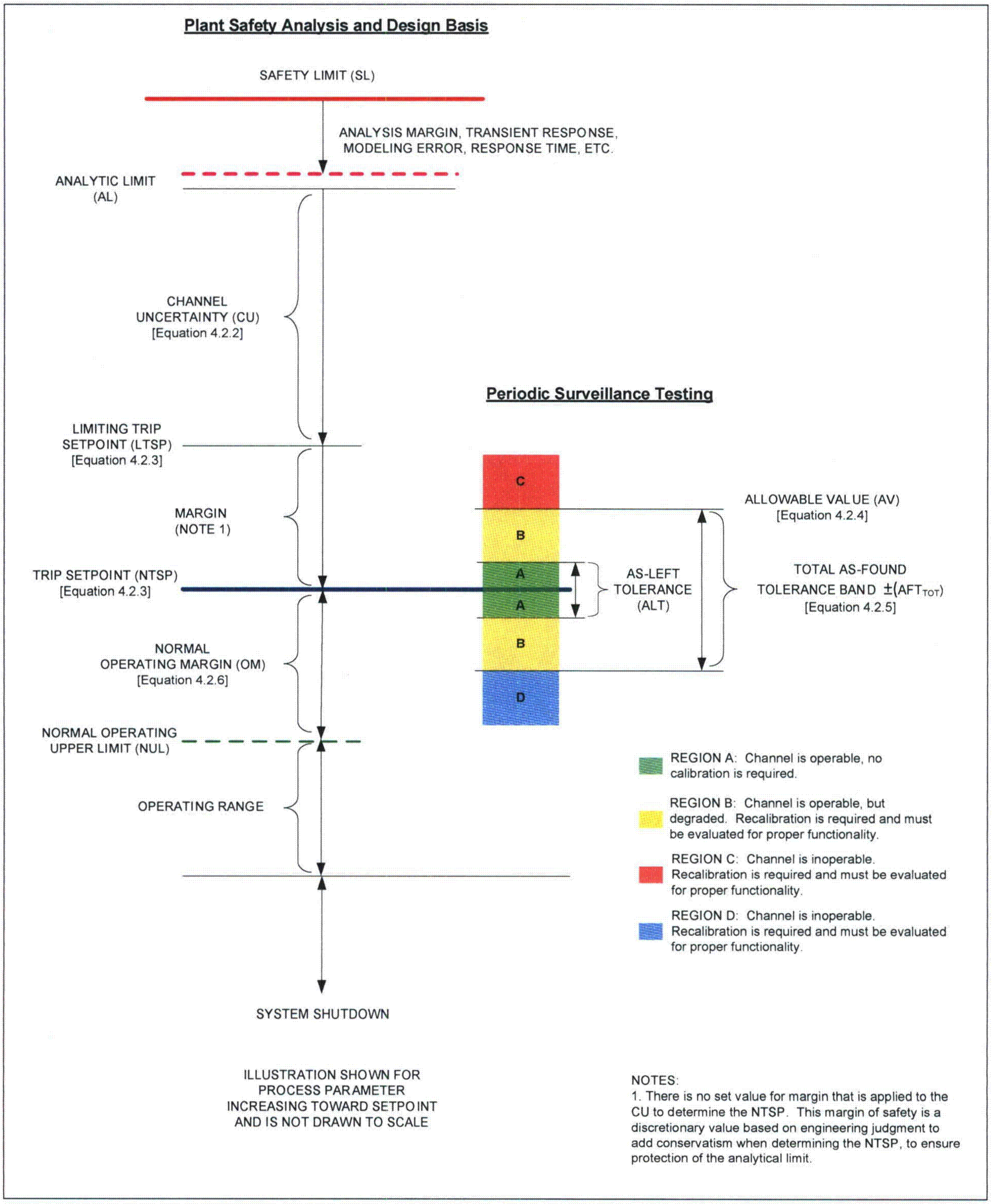

Figure 5.1: Setpoint Relationships – For Increasing Setpoint (Similar for decreasing setpoint, but process is decreasing towards the setpoint).

Question 07.01-C Appendix-10

Section 4.2.5 *- The staff requests the applicant to explain how the mPower Setpoint Methodology conforms to BTP 7-12 or the corresponding regulations with regards to:*

- *Use of as found and as left data (sensors, SPs)*
- *How are AV, as-found and as-left values verified for a SP that is within a digital platform?*

B&W NE Response

The review guidelines contained in BTP 7-12 contain numerous acceptance criteria and review procedures. Specifically, the review procedures contain guidance that the instrument setpoint methodology should include the basis for determination of the as-found and acceptable as-left bands and evaluation of the instrument operability based on acceptable as-found and acceptable as-left bands. Additionally, the methodology should contain measures for tracking and trending of historical as-found and as-left data to ensure each instrument channel exhibits random drift characteristics, and confirmation that the uncertainty data remains valid.

The basis for the acceptable as-found and as-left bands and operability determination method is presented in the B&W Instrument Setpoint Methodology. Please see the response to Questions 07.01-C Appendix-8 and 07.01-C Appendix-9 that addresses this question.

Plant-specific procedures will track the results of the periodic surveillance test procedures to trend and evaluate the as-found and as-left data to evaluate the instrument channel drift and uncertainty data. Section 4.2.5, paragraph 3 (page 20) and paragraph 5 (page 20) of the topical report will be revised to include requirements for these steps as shown below.

The following sentences will be added to section 4.2.5, paragraph 3 (page 20) with changes highlighted in shaded text below:

> In accordance with RG 1.105 (Ref. 6.2.1) and BTP 7-12, plant specific procedures are required to track, trend and maintain the results of periodic surveillance testing (i.e., the as-found and as-left values for sensors (as applicable) and modules associated with the instrument loop) for proper management of instrument uncertainties including drift.

The following sentences will be added to section 4.2.5, paragraph 5 (page 20) as shown in shaded text below:

> Plant-specific procedures will contain required methods to evaluate the historical performance of the drift for each instrument channel and confirm the surveillance and calibration intervals do not exceed the assumptions in the plant safety analysis. The guidance contained in Generic Letter 91-04 may be used to evaluate and determine the acceptable surveillance and calibration intervals for each instrument channel.

In channels using digital processing equipment, uncertainties are introduced by analog-to-digital (A/D) and digital-to-analog (D/A) conversions within the specific platform hardware. These uncertainties are typically provided by the platform manufacturer or determined through testing. Uncertainty data sources within the software are typically determined by the software

designer and quantified. They can then be combined using the methods described in the topical report.

With most digital platforms, they are self-calibrating and errors due to drift or temperature are accounted in the reference accuracy determined by the platform manufacturer. Thus, the only applicable uncertainty is associated with the A/D conversion input into the microprocessor which also is typically combined into the reference accuracy. Generally, there is only one module associated with this conversion, thus combining uncertainties from multiple modules is not applicable. The NTSP is determined from the AL as described in section 4.2.3 of the topical report. Once the appropriate channel uncertainty has been determined based on the reference accuracy for the digital instrument channel, the AV, ALT, and AFT can be determined for use during surveillance testing following the methods described in the topical report.

Configuration control measures will be applied as part of the setpoint control program to maintain instrument setpoint databases for digital systems ensuring installed trip setpoints are installed and programmed as required. The online diagnostics of most digital platforms continually perform system checks and self-report errors or faults associated with digital channels.

During periodic surveillance testing, the test is a simple verification that the digital channel processes channel trips as determined by the digital signal processing within the AFT band. The results are evaluated and the operability determination steps are identical. However, typically, if the channel trip setpoint is found to be outside of the AFT band, this would indicate a failure with the digital channel and the faulty components will require replacement. There is typically no ability to re-calibrate the setpoint.

Question 07.01-C Appendix-11

Appendix A Figure A.2 *- The staff requests the applicant to respond to the following:*

- *Is margin correctly shown as 5.5 psig?*
- *Using example problem and Notes 1& 2 from Figure 5.1, what would AV, Margin 2 and AFT^{TOT} be if Margin 1 is 5.5 psig (allowed by note 1) versus 55 psig?*

B&W NE Response

Appendix A Figure A.2 contains a typographical error where the margin was incorrectly shown as 5.5 psig. The proper value for the margin as determined in this example is 5.0% of the span which is 55.0 psig.

Based on the revision to Figure 5.1 and section 4.2.4 discussed in response to Question 07.01-C Appendix-9, the relationship between the allowable value, as-found and as-left tolerances is more clearly understood. Figure A.2 has been revised to more clearly illustrate the relationships in the example between the AFT and ALT as shown below:

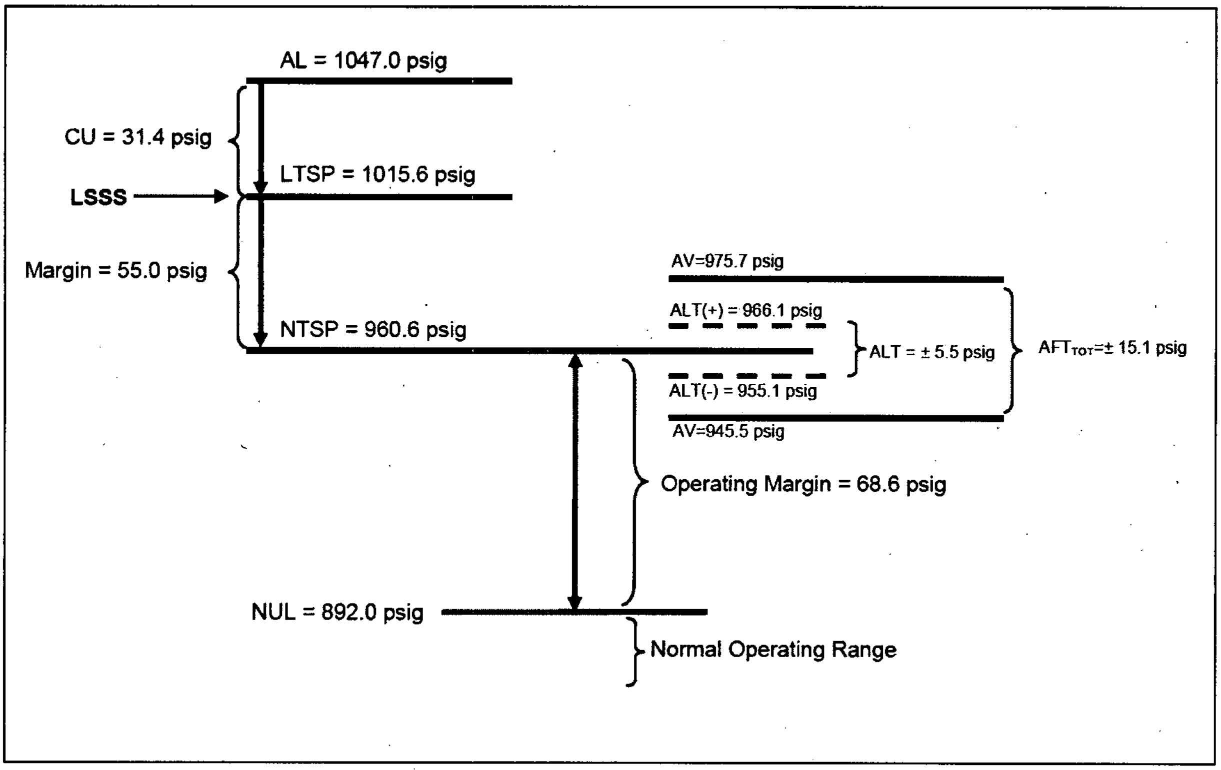

Figure A.2: Relationships between analytical limit and calculated setpoints

Question 07.01-C Appendix-12
Appendix A Figure A.2 - *The staff requests the applicant to respond to the following:*

- *Using AFT^{TOT} +/- 15.1 psig (-15.1 psig), what would be the operating margin (OM) as described in Section 4.2.6 in order to avoid potential spurious channel trips?*
- *Is the methodology described in 4.2.6 sufficient for all cases?*

B&W NE Response

Additional information was included in the example presented in Appendix A to specify the normal upper limit (NUL) is 892 psig. Therefore, when applying equation 4.2.6 for an increasing process the operating margin (OM) is calculated as follows:

OM = NTSP – NUL (increasing setpoint).

While this particular case is a simple example to demonstrate the application of the setpoint methodology, the methodology to determine the operating margin described in section 4.2.6 is sufficient and conforms with RG 1.105, revision 3 (Figure 1) that shows the operating margin is simply the difference between the normal operating range of the process variable and the NTSP. If, during worse cases the setpoint were to drift to the lower range of operability, the operating margin would be sufficient to minimize spurious channel trips.

This additional calculation will be added to the example in Appendix A, page A-4, with changes highlighted in shaded text below:

> The operating margin is calculated using equation 4.2.6 and ensures that sufficient operating margin exists to minimize and prevent spurious channel trips should the NTSP drift.
>
> OM = NTSP – NUL (increasing setpoint) = 960.6 psig – 892.0 psig = 68.6 psig.

Question 07.01-C Appendix-13

Figure 4.1 *- The portion of the figure that shows the setpoint calculation for a harsh environment does not specify seismic effects as described in section 4.3.1.1 paragraph 2 and equation 4.2.1. Is seismic considered in figure 4.1 and if so how would this be applied to the setpoint calculation for normal, seismic, and other postulated accident conditions, as applicable?*

B&W NE Response

The flow path presented in Figure 4.1(page 9) was provided for illustrative purposes to demonstrate how, for instrument channels in harsh environments, the additional evaluation of uncertainties is required. It was not intended to list all uncertainty contributions for instrument channels subject to harsh conditions during normal or postulated design basis accident conditions in this figure.

The method for treating channel uncertainties for portions of the instrument channel that are subject to harsh environments during normal, seismic and other postulated design basis accidents is included in the current text in section 4.1.3.1 (pages 13-14) in the topical report. The existing applicable portions of this section that explicitly include the uncertainties due to seismic effects are shown in the boxed sections below.

There are no changes to the topical report in response to this question.

4.1.3.1 Contributing Uncertainties

The environment is analyzed and classified as mild or harsh. The environment in any plant area is considered harsh if, because of postulated accidents, the temperature, pressure, relativity humidity, vibration (seismic displacement), or radiation significantly increases above the normal conditions. A mild environment is an environment that at no time is more severe than the expected environment during normal plant operation, including anticipated operational occurrences.

For portions of the instrument channel that are located in a harsh environment, the accident process measurement effects are determined (e.g., reference leg heat-up, density changes, radiation exposure, seismic experience, etc.) and the uncertainties are determined. For portions of the instrument channel that are located in a mild environment, the normal process measurement effects are identified and uncertainties are determined. All uncertainties are included as applicable.

After the environmental conditions are determined, the potential uncertainties affecting each portion of the channel are identified.

Uncertainties are classified as random or non-random (Section 3.2). This determination is an interactive process requiring the development of assumptions and, where possible, verification of assumptions based on actual data. The determination of type of uncertainty establishes whether the SRSS method can be used or if the uncertainty is to be added algebraically, or a combination of both.

Elements of uncertainty for any module that are considered are listed below (not all of the uncertainties listed apply to every measurement channel). Definitions, as appropriate, are provided in Appendix B.

- process measurements effect
- primary element accuracy
- drift
- temperature effects
- radiation effects
- static and ambient pressure effects
- overpressure effect
- measuring and test equipment uncertainty
- power supply effects
- indicator reading uncertainty
- conversion accuracy
- seismic effects
- environmental effects – accident
- as-left tolerance
- as-found tolerance
- propagation of uncertainty through modules