SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL℠ Company

Dwight E. Nunn
Vice President

September 6, 2000

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Subject: **Docket Nos. 50-361 and 50-362**
Proposed Technical Specification Change Number NPF-10/15-274, Supplement 1
Post Accident Monitoring Instrumentation Calibration Surveillance Frequency Extension
San Onofre Nuclear Generating Station Units 2 and 3

Reference: Letter dated November 24, 1999 from D. E. Nunn (SCE) to Document Control Desk (USNRC). Subject: Docket Nos. 50-361 and 50-362, Proposed Technical Specification Change Number NPF-10/15-274, Post Accident Monitoring Instrumentation Calibration Surveillance Frequency Extension.

Gentlemen:

Enclosed is Supplement 1 to Amendment Application Number 194 to Facility Operating License NPF-10, and Amendment Application Number 179 to Facility Operating License NPF-15, for the San Onofre Nuclear Generating Station, Units 2 and 3, respectively. Supplement 1 to these amendment applications supersedes entirely the applications forwarded by the Reference letter, which are hereby withdrawn. The Amendment Applications, which were submitted November 24, 1999, consist of Proposed Technical Specification Change Number (PCN)-274.

PCN-274 is a request to revise Technical Specification (TS) 3.3.11, “Post Accident Monitoring Instrumentation (PAMI)”. Specifically, the Proposed Change would extend the Post Accident Monitoring Instrumentation channel calibration surveillance frequency from 18 months to 24 months to accommodate a 24-month fuel cycle. To expedite the review of this PCN it was agreed that Reactor Coolant System (RCS) temperature instrumentation would be removed from PCN-274 until additional supporting information is available.

A001

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Amendment applications concerning the extension of RCS temperature instrumentation channel calibration surveillance frequency from 18 to 24 months will be submitted later. Surveillance Requirement (SR) 3.3.11.4 and SR 3.3.11.5 will be modified to incorporate this change.

Southern California Edison requests these amendments be issued effective as of the date of issuance, to be implemented within 30 days from the date of issuance.

If you have any questions regarding these amendment applications, please contact me or Mr. Jack L. Rainsberry (949) 368-7420.

Sincerely,

Enclosure

cc:

- E. W. Merschoff, Regional Administrator, NRC Region IV
- J. A. Sloan, NRC Senior Resident Inspector, San Onofre Units 2 and 3
- L. Raghavan, NRC Project Manager, San Onofre Units 2 and 3
- S. Y. Hsu, Department of Health Services, Radiologic Health Branch

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Application of SOUTHERN, CALIFORNIA EDISON COMPANY, ET AL. for a class 103 License to Acquire, Possess, and Use a Utilization Facility as Part of Unit No. 2 of the San Onofre Nuclear Generating Station	Docket No. 50-361 Supplement 1 to Amendment Application No. 194

SOUTHERN CALIFORNIA EDISON COMPANY, ET AL. pursuant to 10CFR50.90, hereby submit Supplement 1 to Amendment Application No. 194. Supplement 1 to the Amendment Application consists of a request to revise the Post Accident Monitoring Instrumentation channel calibration surveillance frequency, except for RCS temperature instrumentation, from 18 months to 24 months.

Subscribed on this 6th day of September, 2000.

Respectfully Submitted,

SOUTHERN CALIFORNIA EDISON COMPANY

By: [signature]
Dwight E. Nunn
Vice President
Engineering and Technical Services

State of California
County of San Diego

On 9/6/00 before me, Mariane Sanchez,

personally appeared Dwight E. Nunn, personally known to me ~~(or proved to me on the basis of satisfactory evidence)~~ to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/~~she/they~~ executed the same in his/~~her/their~~ authorized capacity(~~ies~~), and that by his/~~her/their~~ signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

Signature [signature]

MARIANE SANCHEZ
Commission # 1196482
Notary Public - California
San Diego County
My Comm. Expires Oct 14, 2002

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Application of SOUTHERN, CALIFORNIA EDISON COMPANY, ET AL. for a class 103 License to Acquire, Possess, and Use a Utilization Facility as Part of Unit No. 3 of the San Onofre Nuclear Generating Station	Docket No. 50-362 Supplement 1 to Amendment Application No. 179

SOUTHERN CALIFORNIA EDISON COMPANY, ET AL. pursuant to 10CFR50.90, hereby submit Supplement 1 to Amendment Application No. 179. Supplement 1 to the Amendment Application consists of a request to revise the Post Accident Monitoring Instrumentation channel calibration surveillance frequency, except for RCS temperature instrumentation, from 18 months to 24 months.

Subscribed on this 6th day of September, 2000.

Respectfully Submitted,

SOUTHERN CALIFORNIA EDISON COMPANY

By: [signature]

Dwight E. Nunn
Vice President
Engineering and Technical Services

State of California
County of San Diego

On 9/6/00 before me, Mariane Sanchez,

personally appeared Dwight E. Nunn, personally known to me ~~(or proved to me on the basis of satisfactory evidence)~~ to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/~~she/they~~ executed the same in his/~~her/their~~ authorized capacity~~(ies)~~, and that by his/~~her/their~~ signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

Signature [signature]

MARIANE SANCHEZ
Commission # 1196482
Notary Public - California
San Diego County
My Comm. Expires Oct 14, 2002

ENCLOSURE

AMENDMENT APPLICATIONS
194 and 179
(PCN-274)

Supplement 1

DESCRIPTION, NO SIGNIFICANT HAZARDS CONSIDERATIONS, AND ENVIRONMENTAL CONSIDERATION FOR PROPOSED CHANGE NPF-10/15-274, SUPPLEMENT 1

This is a request to revise Section 3.3.11, " Post Accident Monitoring Instrumentation (PAMI)" of the Technical Specifications (TS) for San Onofre Nuclear Generating Station (SONGS) Units 2 and 3. Supplement 1 to PCN-274 rescinds the previous request regarding certain PAMI instrumentation. Changes to the original PCN-274 description for Supplement 1 are indentified by vertical change bars in the right margin.

EXISTING TECHNICAL SPECIFICATIONS

Unit 2: See Attachment A
Unit 3: See Attachment B

PROPOSED TECHNICAL SPECIFICATIONS (with changes - strike out for deletions and highlight for additions)

Unit 2: See Attachment C
Unit 3: See Attachment D

PROPOSED TECHNICAL SPECIFICATIONS (changes incorporated)

Unit 2: See Attachment E
Unit 3: See Attachment F

PROPOSED BASES CHANGES (for information only - strike out for deletions and highlight for additions)

Unit 2: See Attachment G
Unit 3: See Attachment H

DESCRIPTION OF DRIFT STUDIES USED TO SUPPORT PCN-274 FOR EXTENDED SURVEILLANCE PERIODS FOR POST ACCIDENT MONITORING INSTRUMENTATION:

See Attachment I

CE DOCUMENT NPSD-1009, REV. 1, "I&C ENGINEERING LIMITS AND BASES IN EOPs, INCLUDING EVALUATION OF INSTRUMENT UNCERTAINTIES."

See Attachment J

SONGS DOCUMENT 931008S6277, "INSTRUMENT SUITABILITY STUDIES FOR THE EOPs, PHASE II REPORT."

See Attachment K

Description of Change:

This is a request to revise Section 3.3.11, " Post Accident Monitoring Instrumentation (PAMI)" of the Technical Specifications (TS) for San Onofre Nuclear Generating Station Units 2 and 3. The request would change the Post Accident Monitoring Instrumentation Channel Calibration Surveillance frequency (excluding Reactor Coolant System (RCS) temperature instrumentation) from 18 months to 24 months to accommodate a 24-month fuel cycle.

DESCRIPTION

SONGS Units 2 and 3 has increased the duration of the fuel cycle from 18 months to 24 months. In order to accommodate the 24 month fuel cycle, this request would change the current channel calibration frequency for PAMI (excluding RCS temperature instrumentation) from 18 months to 24 months. The frequency of the Channel Checks and Channel Functional Tests will remain unchanged. This request will not affect the calibration surveillance frequency of the Containment Area Radiation (PAMI) Monitors since they are already on a 24 month calibration frequency. This request will not affect the calibration surveillance frequency for instrumentation associated with RCS temperature. A separate submital concerning calibration surveillance frequency for instrumentation associated with RCS temperature will be prepared later. Therefore, SR 3.3.11.4 will continue to require channel calibration for all the instrumentation associated with RCS temperature every 18 months, and SR 3.3.11.5 will require a channel calibration for all other PAMI instrumentation every 24 months. The new calibration surveillance interval would still be subject to the 25% surveillance interval extension allowed by SR 3.0.2 for a maximum calibration interval of 30 months (24 months plus 25%).

The primary purpose of the PAMI is to display plant variables that provide information required by the control room operators during accident situations. This information provides the necessary support for the operator to take the manual actions for which no automatic control is provided and that are required for safety systems to accomplish their safety functions for Design Basis Events.

The OPERABILITY of PAMI ensures that there is sufficient information available on selected plant parameters to monitor and assess plant status and behavior following an accident. The availability of PAMI is important so that responses to corrective actions can be observed and the need for, and magnitude of, further actions can be determined.

DISCUSSION

The primary purpose of the PAMI is to display plant variables that provide information required by the control room operators during accident situations. The information provided may be qualitative, such as trending, or quantitative for specific Emergency Operating Instruction (EOI) decision points.

A review of the PAMI was performed to determine the usage of each instrument. This review was based on the classification philosophy given in CE document CE NPSD-925, Rev. 0, "Guideline for Addressing Instrument Uncertainties in Emergency Operating Procedures and Technical Specifications", and included reviews of the following documents:

- CE document NPSD-1009, Rev. 1, "I&C Engineering Limits and Bases in EOPs, Including Evaluation of Instrument Uncertainties",

- SONGS document 931008S6277, "Instrument Suitability Studies for the EOPs, Phase II Report," CE May 7, 1993,

- Technical Specification Table 3.3.11-1, "Post Accident Monitoring Instrumentation," and

- UFSAR Tables 7.5-1, "Safety-Related Display Instrumentation," and 7.5-2,"Post-Accident Monitoring Parameters Monitored."

According to these documents, explicit instrument uncertainties are not required for instrumentation used for trending or corroboration of other indications. Specifically, CE NPSD-1009, Rev. 1, "I&C Engineering Limits and Bases in EOPs, Including Evaluation of Instrument Uncertainties" states:

> "Corroborative instrumentation - For the purpose of this guideline, corroborative instrumentation is any set of Instrumentation Applications(s) that confirm the status of a different set of Instrument Applications. The corroborative argument may be invoked to justify classifying an Instrument Application into a lower Category than otherwise might be warranted were it not for the corroboration of other instruments to determine the same operational information."

Drift studies are unnecessary for extending the calibration interval for corroborative or trending instrumentation.

The total loop uncertainties for PAMI (not associated with RCS temperature) that provide quantitative information for EOI decision points were evaluated for a 900 day (i.e., 30 months) calibration interval. The existing drift studies were updated and extended, as necessary, to 900 days (i.e., 30 months) (see Attachment I for methodology). Instrument drift study status is presented in Table 1, "Drift Study Status." Some previous total loop uncertainty calculations had used manufacturer drift data, as allowed by the Edison Setpoint Program. These calculations were updated with As-Found/As-Left drift studies.

Drift Study Status
(RCS temperature instrumentation is excluded)
Table 1

No	Description	Category	Drift Study Status
1.	Excore Neutron Flux	*Qualitative*	N/A-Trending/corroboration
2.	Reactor Coolant System Hot Leg Temperature	N/A	The current 18 month calibration interval will remain unchanged.
3.	Reactor Coolant System Cold Leg Temperature	N/A	The current 18 month calibration interval will remain unchanged.
4.	Reactor Coolant System Pressure (wide range)	**Quantitative**	Updated drift study performed.
5.	Reactor Vessel Water Level	*Qualitative*	N/A-Trending/corroboration
6.	Containment Water Level (wide range)	*Qualitative*	N/A-Trending/corroboration
7.	Containment Pressure (wide range)	**Quantitative**	Updated drift study performed.
8.	Containment Isolation Valve Position	*Qualitative*	N/A - Valve position indication is categorized as qualitative since it provides open/closed indication rather than percent open (i.e., quantitative information).
9.	Containment Area Radiation (high range)	N/A	The current 24 month calibration interval will remain unchanged.
10.	Containment Hydrogen Monitors	**Quantitative**	N/A - No drift study update since channel calibrations are performed prior to use in the Emergency Operating Instructions thus eliminating instrument errors associated by drift. (PCN 496, Amendment No.159 for Unit 2 and Amendment 150 for Unit 3, approved by the NRC 10/7/99)
11.	Pressurizer Level	**Quantitative**	Updated drift study performed.
12.	Steam Generator Water Level (wide range)	**Quantitative**	Updated drift study performed.
13.	Condensate Storage Tank Level	**Quantitative**	Updated drift study performed.
14.	Core Exit Temperature - Quadrant 1	N/A	The current 18 month calibration interval will remain unchanged.
15.	Core Exit Temperature - Quadrant 2	N/A	The current 18 month calibration interval will remain unchanged.
16.	Core Exit Temperature - Quadrant 3	N/A	The current 18 month calibration interval will remain unchanged.
17.	Core Exit Temperature - Quadrant 4	N/A	The current 18 month calibration interval will remain unchanged.
18.	Auxiliary Feedwater Flow	**Quantitative**	Updated drift study performed.
19.	Containment Pressure (narrow range)	*Qualitative*	N/A-Trending/corroboration
20.	Reactor Coolant System Subcooling Margin Monitor	N/A	The current 18 month calibration interval will remain unchanged.
21.	Pressurizer Safety Valve Position	*Qualitative*	N/A - Valve position indication is categorized as qualitative since it provides open/closed indication rather than percent open (i.e., quantitative information).
22.	Containment Temperature	*Qualitative*	N/A-Trending/corroboration
23.	Containment Water Level (narrow range)	*Qualitative*	N/A-Trending/corroboration
24.	HPSI Flow Cold Leg	*Qualitative*	N/A-Trending/corroboration
25.	HPSI Flow Hot Leg	*Qualitative*	N/A-Trending/corroboration
26.	Steam Line Pressure	**Quantitative**	Updated drift study performed.
27.	Refueling Water Storage Tank	*Qualitative*	N/A-Trending/corroboration

Updated drift studies were performed for all sensors providing quantitative data except for the hydrogen monitor (the hydrogen monitors are calibrated before use in the Emergency Operating Instructions).

<u>Generic Letter 91-04 Considerations</u>

In order to justify an increase in surveillance intervals to accommodate a 24-month fuel cycle, the drift components of the TLUs for PAMI instrumentation used for EOI decision points were reviewed. The SONGS 2/3 Setpoint Program is consistent with the methodology of ISA-S67-04-1988, "Setpoints for Nuclear Safety-Related Instrumentation Used in Nuclear Power Plants" with uncertainty values established as having a 95% probability at a 95% confidence level. These drift studies used an as-found/as-left analysis which conservatively includes errors due to drift as well as repeatability (reference accuracy) and errors due to changes in the ambient temperature if the temperature was not the same for the two calibrations. Drift values were projected to 900 days (i.e., 30 months) using the methodology described in NUREG 1475, "Applying Statistics." A description of the methodology used to calculate instrument drift is included in Attachment I. Microsoft EXCEL® based Instrument History Performance Analysis© computer program (CRS Engineering, Inc.) was used to perform the actual drift calculations.

Justification for Increased Calibration Intervals.

Generic Letter 91-04 lists seven issues that should be addressed to provide an acceptable basis for increasing the calibration interval for instruments that are used to perform safety functions. These issues and the associated justification for each issue follows.

1. *Confirm that instrument drift as determined by as-found and as-left calibration data from surveillance and maintenance records has not, except on rare occasions, exceeded acceptable limits for a calibration interval.*

   All drift studies, except as noted in Table 1, for PAMI that provide quantitative information for EOI decision points were updated using the best available data.

   The new studies showed that three instruments had inappropriate allowable values. New allowable values for pressurizer wide range pressure, pressurizer narrow range pressure, and pressurizer level were calculated as a result of the new as-found/as-left drift studies. As a result of these updates, as-found and as-left calibration data from surveillance records has not, except on rare occasions, exceeded acceptable limits for a calibration interval.

2. *Confirm that the values of drift for each instrument type (make, model, and range) and application have been determined with a high probability and a high degree of confidence. Provide a summary of the methodology and assumptions used to determine the rate of instrument drift with time based upon historical plant calibration data.*

   The values of drift for the subject instruments have been determined with a 95% probability and at a 95% confidence level. Drift calculations were performed by specific application for instruments of like make, model, and range.

   The drift analysis was conducted consistent with the guidance provided by ISA-S67-.04-1988, "Setpoints for Nuclear Safety-Related Instrumentation Used in Nuclear Power Plants" by doing an As-found/As-left analysis of the calibration data. Instrument drift was then projected to 900 days (i.e., 30 months) by using linear regression with a prediction interval as described in NUREG 1475, "Applying Statistics." A description of the drift (As-found/As-left) study methods is given in Attachment I.

The data from these As Found/As Left studies typically show no time dependence based on correlation tests. However for conservatism, a set of prediction interval values for 900 days (i.e., 30 months) is used that includes trend line values. The maximum absolute value from the prediction values is used.

3. *Confirm that the magnitude of instrument drift has been determined with a high probability and a high degree of confidence for a bounding calibration interval of 30 months for each instrument type (make, model number, and range) and application that performs a safety function. Provide a list of the channels by TS section that identifies these instrument applications.*

The magnitude of instrument drift has been determined with a 95% probability and a 95% degree of confidence for a bounding calibration interval of 900 days (i.e., 30 months) for each specific instrument application that performs a quantitative safety function as described in the Table 1. Instruments used to make decisions in the Emergency Operating Instructions based on quantitative values have updated drift studies. Drift studies for instruments that provide trending information were not required to be updated. A list of non-RCS temperature instrument channels in TS section 3.3.11, Table 3.3.11-1 that are used for quantitative decision making in the Emergency Operating Instructions are as follows:

4. Reactor Coolant System Pressure (wide range)
7. Containment Pressure (wide range)
10. Containment Hydrogen Monitors
11. Pressurizer Level
12. Steam Generator Water Level (wide range)
13. Condensate Storage Tank Level
18. Auxiliary Feedwater Flow
26. Steam Line Pressure

4. *Confirm that a comparison of the projected instrument drift errors has been made with the values of drift used in the setpoint analysis. If this results in revised setpoints to accommodate larger drift errors, provide proposed TS changes to update trip setpoints. If the drift errors result in a revised safety analysis to support existing setpoints, provide a summary of the updated analysis conclusions to confirm that safety limits and safety analysis assumptions are not exceeded.*

The projected instrument drift errors were compared with the values of drift used in the setpoint analysis. The results did not result in any revised setpoints or revised safety analysis to support existing setpoints. The updated drift studies did not increase the total loop uncertainty (TLU) of the PAMI instruments evaluated (see Table 1).

5. *Confirm that the projected instrument errors caused by drift are acceptable for control of plant parameters to effect a safe shutdown with the associated instrumentation.*

The projected instrument errors caused by drift have been determined for instrumentation used to make quantitative decisions in the Emergency Operating Instructions. The projected instrument errors caused by drift are acceptable for control of plant parameters to effect a safe shutdown with the associated instrumentation.

6. *Confirm that all conditions and assumptions of the setpoint and safety analyses have been checked and are appropriately reflected in the acceptance criteria of plant surveillance procedures for channel checks, channel functional tests, and channel calibrations.*

   The conditions and assumptions of the safety analyses have been appropriately reflected in the Emergency Operating Instruction decision points and no changes are required to the decision points. Channel checks, channel functional tests, and safety setpoints are unaffected since this Amendment Application only requests a change in calibration surveillance interval from 18 months to 24 months for PAMI (excluding RCS temperature instrumentation). |

7. *Provide a summary description of the program for monitoring and assessing the effects of increased calibration surveillance intervals on instrument drift and its effect on safety.*

   PAMI is subject to the SCE Instrument Out-of-Tolerance Program. Calculations establish an as-found allowable value tolerance for PAMI. This allowable value tolerance is incorporated into the instrument calibration procedures or the Instrument Calibration Data Cards. An Action Request is initiated to Engineering to evaluate any as-found calibration data that exceeds the allowable value tolerance established by the setpoint calculation. This program monitors any effects of an increased calibration surveillance interval by requiring an engineering evaluation for PAMI that exceed the predicted error (including drift) during a channel calibration. |

NO SIGNIFICANT HAZARDS CONSIDERATION

Supplement 1 to PCN 274 proposes to change the CHANNEL CALIBRATION surveillance frequency requirements for TS 3.3.11, Post Accident Monitoring Instrumentation (PAMI) to accommodate a 24-month operating cycle (excluding RCS temperature instrumentation). The CHANNEL CHECK and CHANNEL FUNCTIONAL TEST interval will remain unchanged. |

The Commission has provided standards for determining whether a significant hazards consideration exists as stated in 10CFR50.92. A proposed amendment to an operating license for a facility involves no significant hazards consideration if operation of the facility in accordance with a proposed amendment would not: (1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or (2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) Involve a significant reduction in a margin of safety. A discussion of these standards as they relate to this amendment request follows:

1. Involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No

   The proposed license amendment to extend the calibration surveillance frequency of Post Accident Monitoring Instrumentation (PAMI) (excluding RCS temperature instrumentation) is being made to support plant operation with a 24-month fuel cycle. |

Increasing the calibration intervals for PAMI instrumentation to 30 months (excluding RCS temperature instrumentation) does not affect the initiation or probability of any previously analyzed accident. Increasing the calibration interval will not affect the integrity of any of the principal barriers against radiation release (fuel cladding, reactor vessel, and containment building). The ability of the plant to mitigate the consequences of any previously analyzed accidents is not adversely affected.

PAMI instrumentation provides to the operators both qualitative and quantitative information used in accident mitigation and for the safe shutdown of the plant. Instrumentation which provides qualitative information is unaffected by a change in instrument accuracy induced by drift due to the increased surveillance interval because no explicit value is required by the Emergency Operating Instructions (EOIs). Instrumentation that provides quantitative information (i.e., decision points) in the EOIs have been evaluated. This evaluation resulted in no changes to any operating instructions. This evaluation of the proposed change to the surveillance interval demonstrates that licensing basis safety analyses acceptance criteria and San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 EOI criteria will continue to be met.

The proposed new surveillance frequency for these instrument channels was evaluated using the guidance of Generic Letter 91-04. The basis for the change includes a quantitative evaluation of instrument drift for PAMI instrumentation (excluding RCS temperature instrumentation) providing quantitative information to the EOIs. Also, loop accuracy/setpoint calculations for these instruments were updated to accommodate the extended surveillance period. Analyses and evaluations completed to assess the proposed increase in the surveillance interval demonstrate that the effectiveness of these instruments in fulfilling their respective functions is maintained. Technical Specifications Channel Checks and Channel Functional Checks for the subject channels, will continue to be performed to provide assurance of instrument channel OPERABILITY.

Therefore, the proposed amendment does not involve a significant increase in the probability or consequences of any previously analyzed accident.

2. Create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No

   The increased calibration surveillance interval for PAMI instrumentation (excluding RCS temperature instrumentation) is justified based on evaluation of past equipment performance and does not require any plant hardware changes or changes in normal system operation. Changing the calibration interval for this instrumentation has no means of creating the possibility of a new or different kind of accident. There are no new decision points or operator responses required to support existing accident mitigation strategies.

   Therefore, there are no new failure modes introduced as a result of extending these surveillance intervals, and the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Involve a significant reduction in a margin of safety?

Response: No

The proposed change to the calibration surveillance interval (excluding RCS temperature instrumentation) was evaluated using the criteria of 95% probability/95% confidence level for process sensor drift.

PAMI instrumentation are used to provide indication following certain hypothetical accident conditions and are used in EOIs for trending and to initiate operator action at certain decision points. Instrument uncertainty calculations have been updated for PAMI instrumentation used for EOI decision points as appropriate. Updated calculations show that the total loop uncertainty for PAMI evaluated either decreased or remained the same. These updated calculations demonstrate that applicable accuracy requirements for SONGS 2 and 3 are satisfied with the proposed new surveillance intervals.

Changing the calibration interval for these channels does not affect the margin of safety for previously analyzed accidents. Therefore, the proposed amendment does not involve a significant reduction in a margin of safety.

Based on the responses to these three criteria, Southern California Edison (SCE) has concluded that the proposed amendment involves no significant hazards consideration.

ENVIRONMENTAL CONSIDERATION

SCE has determined that the proposed amendment involves no changes in the amount or type of effluent that may be released offsite, and results in no increase in individual or cumulative occupational radiation exposure. As described above, the proposed Technical Specification (TS) amendment involves no significant hazards consideration and, as such, meets the eligibility criteria for categorical exclusion set forth in 10CFR51.22(c)(9).

ATTACHMENT A

SURVEILLANCE REQUIREMENTS

-----------------------------------NOTE-----------------------------------
These SRs apply to each PAMI Function in Table 3.3.11-1, with exceptions noted.

SURVEILLANCE		FREQUENCY
SR 3.3.11.1	Perform CHANNEL CHECK for Function 9.	12 hours
SR 3.3.11.2	Perform CHANNEL CHECK for each required instrumentation channel, except Function 9, that is normally energized.	31 days
SR 3.3.11.3	Perform CHANNEL FUNCTIONAL TEST for function 9.	31 days
SR 3.3.11.4	Perform CHANNEL CALIBRATION, except Function 9.	18 months
SR 3.3.11.5	Perform CHANNEL CALIBRATION for Function 9.	24 months

ATTACHMENT B

SURVEILLANCE REQUIREMENTS

-----------------------------------NOTE-----------------------------------
These SRs apply to each PAMI Function in Table 3.3.11-1, with exceptions noted.

SURVEILLANCE		FREQUENCY
SR 3.3.11.1	Perform CHANNEL CHECK for Function 9.	12 hours
SR 3.3.11.2	Perform CHANNEL CHECK for each required instrumentation channel, except Function 9, that is normally energized.	31 days
SR 3.3.11.3	Perform CHANNEL FUNCTIONAL TEST for function 9.	31 days
SR 3.3.11.4	Perform CHANNEL CALIBRATION, except Function 9.	18 months
SR 3.3.11.5	Perform CHANNEL CALIBRATION for Function 9.	24 months

ATTACHMENT C

SURVEILLANCE REQUIREMENTS

------------------------------------NOTE------------------------------------
These SRs apply to each PAMI Function in Table 3.3.11-1, with exceptions noted.

SURVEILLANCE		FREQUENCY
SR 3.3.11.1	Perform CHANNEL CHECK for Function 9.	12 hours
SR 3.3.11.2	Perform CHANNEL CHECK for each required instrumentation channel, except Function 9, that is normally energized.	31 days
SR 3.3.11.3	Perform CHANNEL FUNCTIONAL TEST for function 9.	31 days
SR 3.3.11.4	Perform CHANNEL CALIBRATION, ~~except Function 9~~ for functions 2,3,14,15,16,17, and 20.	18 months
SR 3.3.11.5	Perform CHANNEL CALIBRATION ~~for Function 9~~ for functions 1,4,5,6,7,8,9,10,11,12,13,18, 19,21,22,23,24,25,26, and 27.	24 months

ATTACHMENT D

SURVEILLANCE REQUIREMENTS

-----------------------------------NOTE-----------------------------------
These SRs apply to each PAMI Function in Table 3.3.11-1, with exceptions noted.

SURVEILLANCE		FREQUENCY
SR 3.3.11.1	Perform CHANNEL CHECK for Function 9.	12 hours
SR 3.3.11.2	Perform CHANNEL CHECK for each required instrumentation channel, except Function 9, that is normally energized.	31 days
SR 3.3.11.3	Perform CHANNEL FUNCTIONAL TEST for function 9.	31 days
SR 3.3.11.4	Perform CHANNEL CALIBRATION, ~~except Function 9~~ for functions 2,3,14,15,16,17, and 20.	18 months
SR 3.3.11.5	Perform CHANNEL CALIBRATION ~~for Function 9~~ for functions 1,4,5,6,7,8,9,10,11,12,13,18, 19,21,22,23,24,25,26, and 27.	24 months

ATTACHMENT E

SURVEILLANCE REQUIREMENTS

------------------------------------NOTE------------------------------------
These SRs apply to each PAMI Function in Table 3.3.11-1, with exceptions noted.

SURVEILLANCE		FREQUENCY
SR 3.3.11.1	Perform CHANNEL CHECK for Function 9.	12 hours
SR 3.3.11.2	Perform CHANNEL CHECK for each required instrumentation channel, except Function 9, that is normally energized.	31 days
SR 3.3.11.3	Perform CHANNEL FUNCTIONAL TEST for function 9.	31 days
SR 3.3.11.4	Perform CHANNEL CALIBRATION, for functions 2,3,14,15,16,17, and 20.	18 months
SR 3.3.11.5	Perform CHANNEL CALIBRATION for functions 1,4,5,6,7,8,9,10,11,12,13,18, 19,21,22,23,24,25,26, and 27.	24 months

ATTACHMENT F

SURVEILLANCE REQUIREMENTS

-------------------------------------NOTE-------------------------------------
These SRs apply to each PAMI Function in Table 3.3.11-1, with exceptions noted.

SURVEILLANCE		FREQUENCY
SR 3.3.11.1	Perform CHANNEL CHECK for Function 9.	12 hours
SR 3.3.11.2	Perform CHANNEL CHECK for each required instrumentation channel, except Function 9, that is normally energized.	31 days
SR 3.3.11.3	Perform CHANNEL FUNCTIONAL TEST for function 9.	31 days
SR 3.3.11.4	Perform CHANNEL CALIBRATION, for functions 2,3,14,15,16,17, and 20.	18 months
SR 3.3.11.5	Perform CHANNEL CALIBRATION for functions 1,4,5,6,7,8,9,10,11,12,13,18, 19,21,22,23,24,25,26, and 27.	24 months

ATTACHMENT G

SURVEILLANCE
REQUIREMENTS

SR 3.3.11.4

A CHANNEL CALIBRATION is performed every 18 months. CHANNEL CALIBRATION is a complete check of the instrument channel including the sensor. The Surveillance verifies the channel responds to the measured parameter within the necessary range and accuracy.

The Frequency is based upon operating experience and consistency with the typical industry refueling cycle and is justified by the assumption of an 18 month calibration interval for the determination of the magnitude of equipment drift.

SR 3.3.11.5

A CHANNEL CALIBRATION is performed every 24 months. The Frequency is based upon operating experience and consistency with the typical industry refueling cycle and is justified by the assumption of an 24 month calibration interval for the determination of the magnitude of equipment drift.

REFERENCES

1. SONGS Units 2 and 3 Regulatory Guide 1.97 Instrumentation Report #90065, Rev. 0, dated October 1, 1992.

2. Regulatory Guide 1.97, Revision 2.

3. NUREG-0737, Attachment 1.

4. UFSAR, Section 7.5.1.7.

ATTACHMENT H

SURVEILLANCE
REQUIREMENTS

SR 3.3.11.4

A CHANNEL CALIBRATION is performed every 18 months. CHANNEL CALIBRATION is a complete check of the instrument channel including the sensor. The Surveillance verifies the channel responds to the measured parameter within the necessary range and accuracy.

The Frequency is based upon operating experience and consistency with the typical industry refueling cycle and is justified by the assumption of an 18 month calibration interval for the determination of the magnitude of equipment drift.

SR 3.3.11.5

A CHANNEL CALIBRATION is performed every 24 months. The Frequency is based upon operating experience and consistency with the typical industry refueling cycle and is justified by the assumption of an 24 month calibration interval for the determination of the magnitude of equipment drift.

REFERENCES

1. SONGS Units 2 and 3 Regulatory Guide 1.97 Instrumentation Report #90065, Rev. 0, dated October 1, 1992.

2. Regulatory Guide 1.97, Revision 2.

3. NUREG-0737, Attachment 1.

4. UFSAR, Section 7.5.1.7.

ATTACHMENT I

Description of Drift Studies

Used To Support PCN-274 for

Extended Surveillance Periods

for

Post Accident Monitoring Instrumentation

Oct 4, 1999

1. General

Current Post Accident Monitoring Instrumentation (PAMI) is calibrated or surveilled during the refueling process every 18 months. The allowed extension for these calibrations is 25% or a maximum of 22.5 months per calibration. Starting with cycle 10, fuel requires replacement at a less frequent period of 24 months. The object is to show that PAMI can be calibrated or surveilled at the same, less frequent, interval as the refueling cycle without suffering any increased risk to their Operability. The NRC Generic Letter, GL-91-04 outlines the need for addressing instrument drift issues when proposing extended fuel cycles.

In order to justify the extension of the calibration period of the PAMI equipment, it is necessary to show that by increasing the calibration interval :

1.) Equipment failure identification for ensuring Operability is not significantly reduced.

2.) That the equipment will not drift beyond its allowable tolerance limits.

This summary addresses the issue of drift over an increased calibration interval.

2 Drift Methodology

The methods used to determine drift values are consistent with standard industry practices. A program (Instrument History Performance Analysis © CRS Engineering Inc. was used to determine drift values. The overall drift method can be separated into major components. These being:

2.1 Organization of As Left/As Found data inputs into percent of instrument full scale variations for 5 data points across the instrument range. Each calibration point across the range of the instrument is treated separately.

2.2 Search for and reject data points that are outside of expected statistical range (Outliers).

2.3 Perform Linear Regression analyses for each data test point.

Included in these analyses are intercepts and slope values of a Trend Line for time dependent data, estimates of the Confidence Intervals about the Trend Line and estimates of the Prediction Intervals about the Trend Line. Values of the correlation factor, r^2 are generated. Perform Normality Tests on the remaining data.

2.4 Determine the Prediction Intervals about the Trend Line.

2.5 Apply Normalcy tests (W or D' tests) to modified input data

2.6 Produce one or two sided Ks results

2.7 Generate Histograms of the data for each of the data test points.

2.8 Generate Scatter Plots for each data test point.

Brief descriptions of each of these aspects of the drift analysis program are given in the following sections with examples of how the data is used to achieve each analysis.

3 As Found/As Left

Drift studies generally use data taken at the time of a calibration, in order to determine changes in the output of the transducer for the same, highly accurate, inputs. The transducer response values for a range of inputs across the range of the instrument (5 equally spaced points) prior to any calibration or adjustment to the instrument are referred as the "As Found" data. After completion of the calibration process, the output values are recorded for the same standard inputs are referred to "As Left" data.

Dated, calibration records are reviewed to determine the differences over time between the As Left values and the As Found values. These difference values form the basis of the drift study. An example of the As Found/As Left data is given in figure 4.1

4 Outliers

A test is made on the % of full span values determined by the As Found/As Left listings. This test determines the number of standard deviations, for all values. This number is compared with the number of standard deviations in a T-distribution that represents a 1% probability (or some other selectable significance value) of occurring under normal statistical variations.

If a value falls outside the selected significance range, this data point can be rejected. Another new mean value and a new standard deviation are calculated for the new reduced, data set. An example of an outlier rejection is:

Function: Demo-5
Outlier(s) = 1 Significance Level = 1.0%

Cal No. =	Value =	avg =	s =	T =	Critical Value =
21	0.25164	-0.00825	0.07851	3.31029	3.191

In this example, the value of the point in calibration 21 is 0.25164. The mean or average value of the data set is -0.00825 with a standard deviation of 0.07851. The deviation from the mean for this value is 0.25164 - (-0.00825) = 0.259890. The number of standard deviations from the mean (T-distribution) is 0.259890/0.07851 = 3.31028.

From a T-distribution table for the upper 1% significance with 36 data points, the value for the number of standard deviations to reach that significance is 3.191. Since the calculated range from the mean for this data point exceeds the 1% significance value, this data point is rejected.

No. Calib. Sets= 25

Test Calibration Points: 5 **Function: Cond.Storage Tank**

Calib. Set No.	TAG	MODEL	FUNCTION	A/L Date	A/F Date	Days	A/L Value	A/F Value	DELTA mAdc	DELTA %Span
1	2LT3204-1	NE13DM	Cond. Storage Tank L	3/6/90	9/5/90	183	4.050	4.060	0.010	0.0625
				3/6/90	9/5/90	183	8.060	8.070	0.010	0.0625
				3/6/90	9/5/90	183	12.050	12.060	0.010	0.0625
				3/6/90	9/5/90	183	16.050	16.040	-0.010	-0.0625
				3/6/90	9/5/90	183	19.990	19.980	-0.010	-0.0625
2	2LT3204-1	NE13DM	Cond. Storage Tank L	9/5/90	6/18/92	652	4.060	4.040	-0.020	-0.1250
				9/5/90	6/18/92	652	8.070	8.030	-0.040	-0.2500
				9/5/90	6/18/92	652	12.060	12.020	-0.040	-0.2500
				9/5/90	6/18/92	652	16.040	16.020	-0.020	-0.1250
				9/5/90	6/18/92	652	19.980	19.990	0.010	0.0625
3	2LT3204-1	NE13DM	Cond. Storage Tank L	6/18/92	11/22/93	522	4.040	4.030	-0.010	-0.0625
				6/18/92	11/22/93	522	8.030	8.010	-0.020	-0.1250
				6/18/92	11/22/93	522	12.020	12.010	-0.010	-0.0625
				6/18/92	11/22/93	522	16.020	15.990	-0.030	-0.1875
				6/18/92	11/22/93	522	19.990	19.940	-0.050	-0.3125
4	2LT3204-1	NE13DM	Cond. Storage Tank L	11/22/93	6/7/95	562	4.030	4.030	0.000	0.0000
				11/22/93	6/7/95	562	8.010	7.990	-0.020	-0.1250
				11/22/93	6/7/95	562	12.010	12.010	0.000	0.0000
				11/22/93	6/7/95	562	15.990	16.010	0.020	0.1250
				11/22/93	6/7/95	562	19.940	19.950	0.010	0.0625
5	2LT3204-1	NE13DM	Cond. Storage Tank L	6/7/95	11/12/96	524	4.030	4.000	-0.030	-0.1875
				6/7/95	11/12/96	524	7.990	7.990	0.000	0.0000
				6/7/95	11/12/96	524	12.010	12.020	0.010	0.0625
				6/7/95	11/12/96	524	16.010	16.030	0.020	0.1250
				6/7/95	11/12/96	524	19.950	20.000	0.050	0.3125
6	2LT3204-1	NE13DM	Cond. Storage Tank L	11/12/96	4/28/98	532	4.000	3.970	-0.030	-0.1875
				11/12/96	4/28/98	532	7.990	7.960	-0.030	-0.1875
				11/12/96	4/28/98	532	12.020	11.970	-0.050	-0.3125
				11/12/96	4/28/98	532	16.030	15.970	-0.060	-0.3750
				11/12/96	4/28/98	532	20.000	19.900	-0.100	-0.6250
7	2LT3204-2	NE13DM	Cond. Storage Tk Lev	7/28/92	2/22/94	574	3.985	3.870	-0.115	-0.7188
				7/28/92	2/22/94	574	7.962	7.910	-0.052	-0.3250
				7/28/92	2/22/94	574	11.982	11.940	-0.042	-0.2625
				7/28/92	2/22/94	574	16.012	15.950	-0.062	-0.3875
				7/28/92	2/22/94	574	19.998	19.960	-0.038	-0.2375
8	2LT3204-2	NE13DM	Cond. Storage Tk Lev	2/22/94	7/30/94	158	3.970	4.020	0.050	0.3125
				2/22/94	7/30/94	158	8.000	8.042	0.042	0.2625
				2/22/94	7/30/94	158	12.000	12.050	0.050	0.3125
				2/22/94	7/30/94	158	15.990	16.030	0.040	0.2500

Figure 4.1 An Example of Organized As Found/As Left data

5 Linear Regression Analysis

5.1 Calculating a Trend Line

The technique of applying linear regression analysis to data is an attempt to see if the As Found/As Left data is time dependent and if it is, to predict future values. The method of linear regression is well described in numerous statistics texts, handbooks and standards. This method attempts to model the data with a straight line that passes through the point of the averages of the As/Found difference (Drift) data and the average of the time data. It is also assumed that the intercept of the Drift is 0 at time 0. That is, that the drift at the time of calibration is 0. The slope of the Trend Line is determined by choosing a line that minimizes the sum of the squares of the difference between any drift data point and the Trend Line of the data set. This Sum of the differences can be expressed as:

$$\sum_{i=1} e_i^2 = \sum_{i=1}^{n} (y_i - A - Bx_i)^2$$

Where e_i is the error between the data point and the Trend Line

y_i is the drift data value

A is the Trend Line intercept which = 0 at Time = 0

B is the slope of the Trend Line

x_i is the time value that corresponds to y_i

n is the number of data points in the data set

To minimize the value of e_i, the right side of equation 1 is differentiated with respect to B. The resulting expression is equated to zero. This equation is solved for B. The Trend Line that uses the newly calculated value for B will be the line of least error.

The slope can be expressed as:

$$B = \frac{\sum_{i=1}^{n} x_i y_i}{\sum_{i=1}^{n} x_i^2}$$

Where x and y are the values of each data set

5.2 Dependence of Drift with Time

The computed value of B represents the drift (% of full span) per day. The projected drift out to 900 days (approximately 30 months) can be calculated. The value of B represents the change in drift with time. However if this value is small it may not have any significance. That is, the drift values that fall on the Trend line for different values of time may all be well within the normal random variations associated with taking the measurement.

In order to measure the significance of the estimated slope value, a factor called the correlation factor, r, is used. The factor, r, can be expressed as:

$$r = B\sqrt{\frac{\sum (x_i - \bar{x})^2}{\sum (y_i - \bar{y})^2}}$$

The correlation factor can be thought as the Trend Line slope times the ratio of the standard deviations of x and y where x is the time variable and y is the variable of drift. R has a range between 0 and 1.

A test can be applied to decide whether the Drift variable is a function of time. Using the correlation factor, r the test expression is:

$$|t| = \left|\frac{r}{\sqrt{1-r^2}}\right|\sqrt{n-2}$$

Where t is the t distribution value for n-2 degrees of freedom for (1 - α) where α = 99%) confidence or 1% uncertainty, and n is the number of data points used.

If the hypothesis is, that there is no significant relationship between time and drift, then the right-hand side term will be greater than the t value of the number of standard deviations from the mean that is required to be assured that the uncertainty is only 1%

This test is only good when sufficient data points across the time interval exists. If data is taken consistently at a given time interval, then all the drift data will be clustered in that given time interval. The outcome of the r test under these conditions is considered to be of limited value.

5.3 Prediction Intervals

The Trend Line is used to extrapolate expected values of drift beyond the time intervals where previously calibrations have occurred. This expectation is predicated on the belief that the process will be linear. Since very few, if any, of the previous drift data points coincided with the Trend Line, it is necessary to develop a band either side of the Trend Line that will, with a given confidence, envelop the range of drift values that can be expected at the extended time.

Many texts, handbooks and standards give the development and proof of the prediction interval that is used about extended time intervals. The prediction interval can be expressed (Ref. NUREG 1475) as:

$$Y = A + Bx \pm t_{1-\alpha/2,n-2} \times s \times \sqrt{1 + \frac{1}{n} + \frac{(x_i - \bar{x})^2}{S_{xx}}}$$

Where A + Bx is the Trend Line equation

$t_{(1-\alpha/2);\,n-2}$ is the t distribution value for n-2 degrees of freedom and for a given confidence

s is the square root of the Residual Mean Square Error or an estimate of the standard deviation

n is the number of data points used

S_{xx} is short hand for

$$\sum_{i=1}^{n} x_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)^2$$

s is calculated using expression:

$$s = \sqrt{\frac{(S_{xx} \times S_{yy} - S_{xy}^{\ 2})}{n \times (n-2) \times S_{xx}}}$$

Where

$$S_{yy} = n \times \sum_{i=1}^{n} y_i^2 - (\sum_{i=1}^{n} y_i)^2$$

And

$$S_{xy} = n \times \sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \times \sum_{i=1}^{n} y_i$$

An example of a typical linear regression analysis spread sheet is given in figure 5.3. This example provides the basic formulae used, the intermediate results and the final results. The final results include the calculation of the Trend Line for extrapolated time periods and the Prediction Interval values about the Trend Line. In this example, the data is clustered in the time region of 468 to 630 days with only one data point at 108 days. The r-test is not appropriate in this case. The Prediction Interval values at 900 days are +2.934 and -1.5807% full span. These uncertainty values include the Trend Line estimate at 900 days. The worst case drift value of ±2.934% span is chosen. This value will ensure that the ±2.2573% span Prediction Interval is covered if the drift is not a function of time.

Figure 5.3a is an example of a plot of the prediction interval about the Trend Line.

Calib. Point 0

Input Values

alpha= 0.05
n= 21
1 or 2 sided= 2
t= 2.093025

s Value Formulas

s^2= (Sxx*Syy-Sxy^2)/(n*(n-2)*Sxx)
s= Sqrt(s^2)

Sxx= n*sum(x^2)-sum(x)^2
Syy= n*sum(y^2)-sum(y)^2
Sxy= n*sum(xy)-sum(x)*sum(y)

s Value

s^2= 0.748486
s= 0.865151

Intermediate Values

sum(x)= 11337
avg(x)= 539.85714
sum(x)^2= 128527569

sum(y)= 8.8625
sum(y)^2= 75.038906

n*sum(x^2)= 133906017
n*sum(y^2)= 374.81719
n*sum(xy)= 100674.79

Sxx= 5378448
Syy= 299.77828
Sxy= 2468.025

TL= b+m*x

CI= b+m*x+(+/-)t*s*sqrt(1/n+(n*(x-avg(x))^2)/Sxx)

PI= b+m*x+(+/-)t*s*sqrt(1+1/n+(n*(x-avg(x))^2)/Sxx)

Point No.	Cal. No.	x(Days)	y(%Error)		x(n)^2=		y(n)^2=		x(n)*y(n)=
					0		0		0
1	1	637	0.66875	x1^2=	405769	y1^2=	0.447227	x1*y1=	425.99375
2	2	504	-0.375	x2^2=	254016	y2^2=	0.140625	x2*y2=	-189
3	3	569	0	x3^2=	323761	y3^2=	0	x3*y3=	0
4	4	630	2.875	x4^2=	396900	y4^2=	8.265625	x4*y4=	1811.25
5	5	490	-0.36875	.	240100	.	0.135977	.	-180.6875
6	6	604	0.30625	.	364816	.	0.093789	.	184.975
7	7	630	1.75	.	396900	.	3.0625	.	1102.5
8	8	503	-0.1	.	253009	.	0.01	.	-50.3
9	9	603	0.1875	.	363609	.	0.035156	.	113.0625
10	10	625	1.0625	.	390625	.	1.128906	.	664.0625
11	11	522	0.375	.	272484	.	0.140625	.	195.75
12	12	597	0.8125		356409		0.660156		485.0625
13	13	468	0.375		219024		0.140625		175.5
14	14	588	-0.875		345744		0.765625		-514.5
15	15	108	1.0625		11664		1.128906		114.75
16	17	588	0.625		345744		0.390625		367.5
17	18	497	0.625		247009		0.390625		310.625
18	19	520	-0.2375		270400		0.056406		-123.5
19	20	602	0.0625		362404		0.003906		37.625
20	21	489	0.5625		239121		0.316406		275.0625
21	22	563	-0.73125		316969		0.534727		-411.60375

Calib. Point 0
Results

X Max= 900

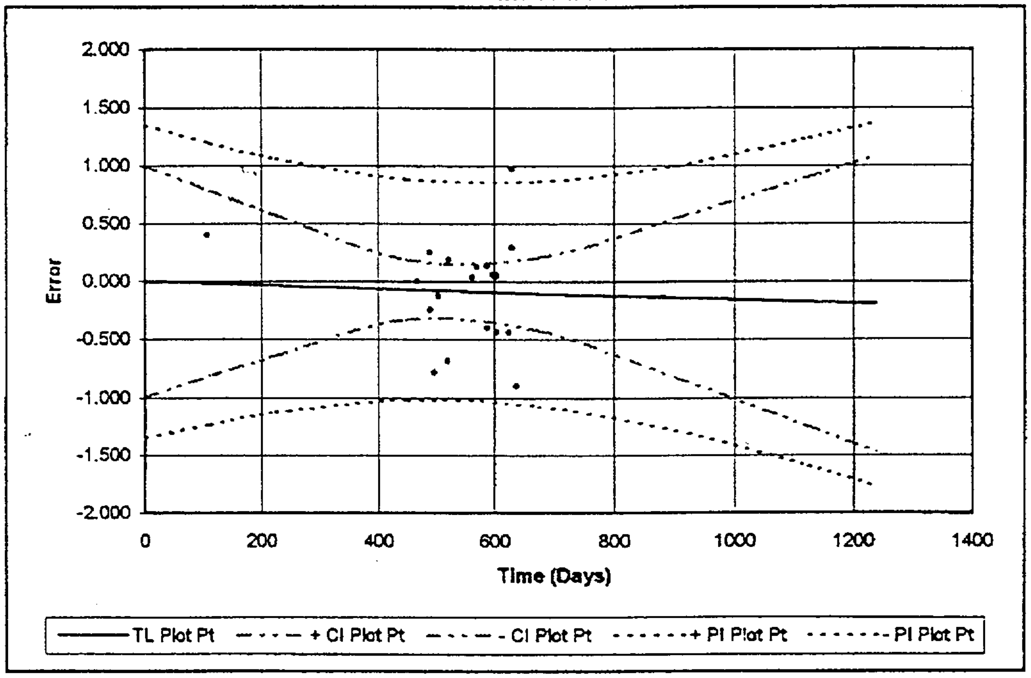
Days	TL Plot Pt	+/- Value	+ CI Plot Pt	- CI Plot Pt	+/- Value	+ PI Plot Pt	- PI Plot F
0	0.0000	1.9716	1.9716	-1.9716	2.6770	2.6770	-2.6770
112.5	0.0846	1.5793	1.6639	-1.4948	2.4028	2.4873	-2.3182
225	0.1692	1.1939	1.3630	-1.0247	2.1689	2.3381	-1.9996
450	0.3383	0.5094	0.8477	-0.1711	1.8811	2.2194	-1.5428
675	0.5075	0.6245	1.1320	-0.1170	1.9154	2.4229	-1.4079
900	0.6766	1.3478	2.0245	-0.6712	2.2573	2.9340	-1.5807
1125	0.8458	2.1306	2.9764	-1.2848	2.7962	3.6420	-1.9504
1237.5	0.9304	2.5273	3.4577	-1.5969	3.1090	4.0394	-2.1786

Calib. Point 0
Data Summary

Number of Points = 21
t Value= 2.0930247
Trendline Slope= 0.0007518
Trendline Intercept= 0
s= 0.8651506
alpha= 0.05

Figure 5.3 An Example of Linear Regression Results

Two Sided Interval Plot Pt-1



	Trend Line	Confidence Interval			Prediction Interval		
Days	TL Plot Pt	+/- Value	+ CI Plot Pt	- CI Plot Pt	+/- Value	+ PI Plot Pt	- PI Plot Pt
0	0.0000	0.9963	0.9963	-0.9963	1.3527	1.3527	-1.3527
112.5	-0.0177	0.7980	0.7803	-0.8158	1.2141	1.1964	-1.2318
225	-0.0355	0.6033	0.5678	-0.6387	1.0960	1.0605	-1.1314
450	-0.0709	0.2574	0.1865	-0.3283	0.9505	0.8796	-1.0214
675	-0.1064	0.3155	0.2092	-0.4219	0.9679	0.8615	-1.0742
900	-0.1418	0.6811	0.5393	-0.8229	1.1406	0.9988	-1.2824
1125	-0.1773	1.0766	0.8994	-1.2539	1.4129	1.2357	-1.5902
1237.5	-0.1950	1.2770	1.0821	-1.4720	1.5710	1.3760	-1.7660

Number of Points =	21	
t Value=	2.093025	
Trendline Slope=	-0.000158	%Span / Day
Trendline Intercept=	0	%Span
s=	0.437164	%Span
alpha=	0.05	

Figure 5.3a Plot of Linear Regression Prediction Interval

6 Normality Tests

The purpose of applying Normality tests is to verify that the distribution of the data follows a Normal distribution. If the distribution can be shown to be Normal, then assessments of the data can use Normal distribution tables to make estimates of the 95% probability drift number with a 95% confidence. It the Normality tests fail to show Normality, the Binomial estimation methods are used.

The input data may be biased such that a dependency with time exists. In order to test for normalcy, it is necessary to modify the input data by subtracting any Trend Line contribution that may exist.

If the number of data points is equal to or less than 50, then a W test is applied. The W test is described in ANSI Standard ANSI N15.15-1974. If the data set is equal to or larger than 50 data points, then a D' test is performed. Again this method is described in ANSI Standard ANSI N15.15-1974. A step by step example of applying the W test is described in document NUREG 1475, section 7-12.

If the data set fails its normality test, then further examination of the data is required to decide whether the nature of the data is truly normal where restrictions in M&TE accuracies produce peaked data, or there is insufficient data to develop normality or whether using a binomial fit of the data is appropriate.

7 Ks Results

Ks represents the distributions about the mean required to be assured that the random variations of the data are within the 95% probability with 95% confidence interval. K is the number of standard deviations, determined by the % probability and the number of data points used in the analysis. Standard Normalized distributions have look up tables to determine this value. S is the standard deviation of the data set. The standard deviation is independent of time and therefore the fluctuations in the data are used as if drift is independent of time. A typical example of summarized Ks results is given below.

Ks Results Summary

Function= **Cond.Storage Tank**

Two-Sided

Calib. Point:	Pt-1	Pt-2	Pt-3	Pt-4	Pt-5
Conf. Level =	0.95	0.95	0.95	0.95	0.95
Probability =	0.95	0.95	0.95	0.95	0.95
s=	0.3075	0.2661	0.2976	0.3799	0.4869
K=	2.673	2.673	2.673	2.673	2.673
Ks(max) =	0.8220	0.7113	0.7955	1.0155	1.3015
Ks(min) =	-0.8220	-0.7113	-0.7955	-1.0155	-1.3015
xbar =	0.0197	0.0101	0.0172	0.0036	0.0247
Ks(max)+xbar=	0.8417	0.7213	0.8127	1.0191	1.3262
Ks(min)+xbar=	-0.8024	-0.7012	-0.7782	-1.0119	-1.2768

Looking at Point #1, the mean or average value for this data set is xbar = 0.0197. The standard deviation is 0.3075. This data set had 23 data points. Therefore from a normalized look up table the K value for a 95% probability with a 95% confidence is 2.673. The Ks value is 2.673 x ±0.3075 = ±0.8220. Since the mean value (xbar) was not zero, applying the Ks value to the mean produces +0.8417 & -0.8024 for drift. The worst case of the 5 points would be used. In this case, the maximum and minimum xbar + Ks is +1.3262 & -1.2768 (see point 5).

8 Scatter Plots

The scatter plots give a pictorial representation of the data as a function of time. They can aid in deciding whether an r-test for significance of the time dependence has any meaning. Figure 8 is an example of a typical scatter plot.

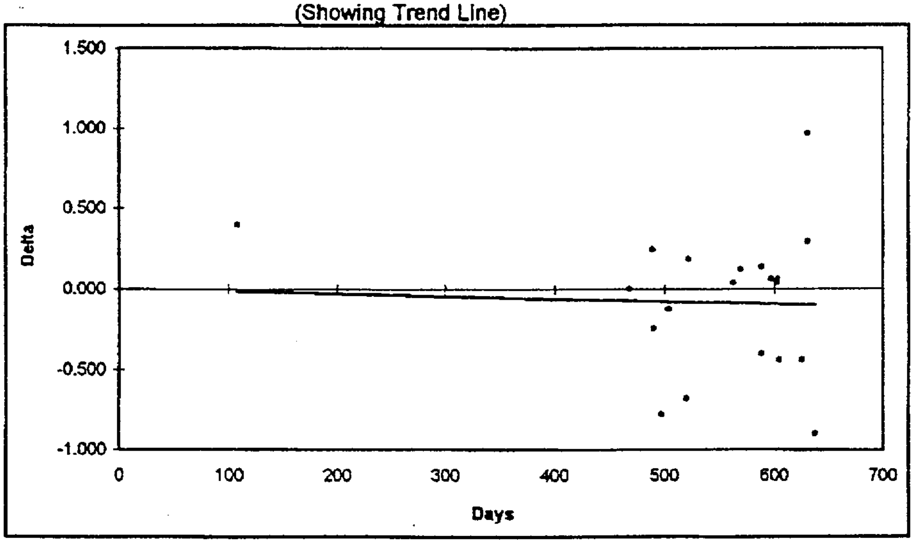
This applicati

Pt-1

Function:RWST Level

Scatter Plot: Raw Data

(Showing Trend Line)



y= -0.00016 x + 0

r^2= 0.011025

Drift Rate= -0.05751 % Per Year

Scatter Plot: Analysis Data

(Showing Average Value Line)

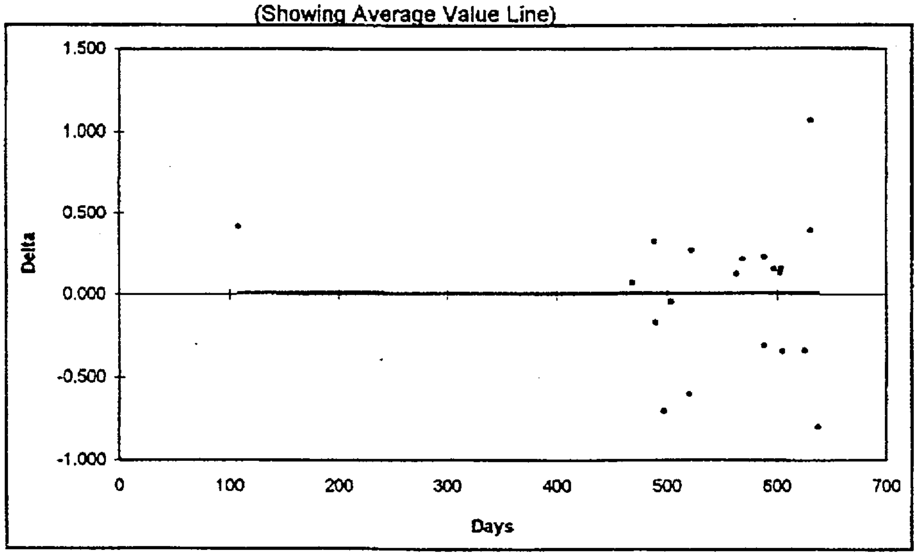


Figure 8 An Example of a Scatter Plot

The first scatter plot is based on the raw data. The second plot has had the projected Trend Line value subtracted from each data point based on the time interval for each point. This plot removes any bias to the variation to the data. It can be seen from this example how the data is clustered in the interval from 460 to 630 days with only one data point near 100 days.

9 Histograms

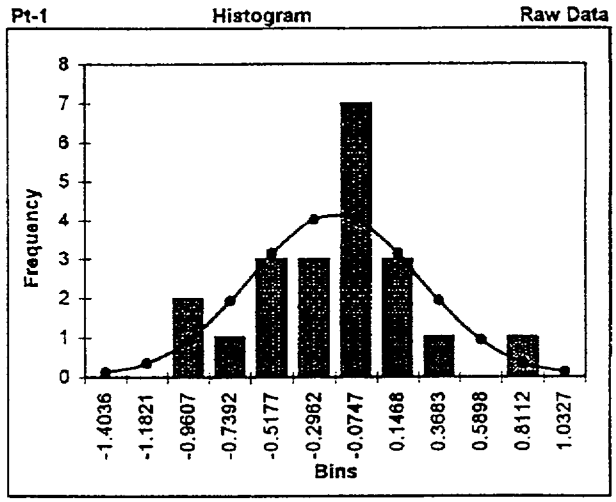
Histograms or Frequency Distributions about the mean are generated for each calibration point. These diagrams give a pictorial representation of the closeness of the As Found/As Left data differences to a normal distribution. Each frequency bin is chosen as ½ of the standard deviation, with 5 or 6 bins either side of the mean value. See figure 9 as an example of a calculated histogram set for a single calibration point.

The second histogram for analysis data points is developed from the difference between the raw data and the estimated Trend Line values. The difference produces an unbiased random variation.

Function: RWST Level

Bin	Freq	Exp Freq
-1.4036	0	0.1302
-1.1821	0	0.3486
-0.9607	2	0.9261
-0.7392	1	1.9299
-0.5177	3	3.1479
-0.2962	3	4.0215
-0.0747	7	4.0215
0.1468	3	3.1479
0.3683	1	1.9299
0.5898	0	0.9261
0.8112	1	0.3486
1.0327	0	0.1302
1.2542		
> ±3 s	0	

Mean= -0.0747
Bin Size= 0.2215
s= 0.4430



Bin	Freq	Exp Freq
-1.3108	0	0.1302
-1.0906	0	0.3486
-0.8704	2	0.9261
-0.6502	1	1.9299
-0.4300	3	3.1479
-0.2098	3	4.0215
0.0104	7	4.0215
0.2306	4	3.1479
0.4507	0	1.9299
0.6709	0	0.9261
0.8911	1	0.3486
1.1113	0	0.1302
1.3315		
> ±3 s	0	

Mean= 0.0104
Bin Size= 0.2202
s= 0.4404

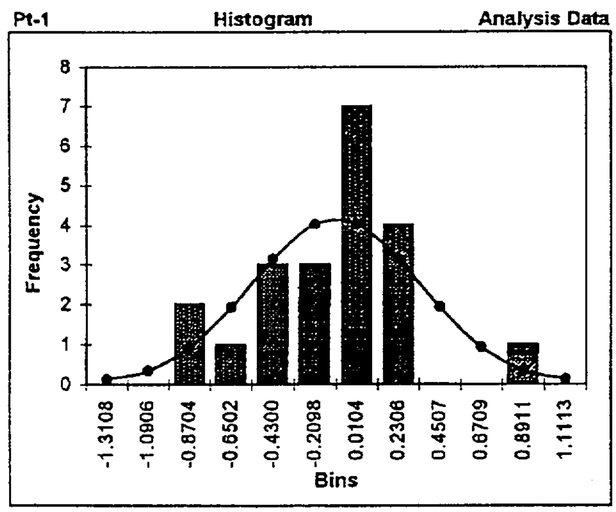


Figure 9 An Example of a Histogram

10 Summary

In the majority of drift cases analyzed so far, the projected Trend Line slope values are very small. This raises the question whether the data is time dependent or not. Applying the r-test to check for significant correlation can be misleading in that the independent variable, time, tends to be clustered at the scheduled calibration time with little data outside a band of about 150 days centered about a mean of about 500 days. Without data values at the shorter and longer time intervals, there is very little support for an estimated slope value other than in the active time band. The r value relies on the estimated value of slope, B, and therefore should only be used when there is adequate time distributed data.

Since the estimated slope value in most cases is very small, the difference between using the Ks value and the predicted Interval value is also very small. The overall drift value is chosen from the larger of the 5 calibration points across the range of the instrument. Typically, the prediction interval method yields a slightly higher value when the Trend Line value is added to the uncertainty band. This is the value that has been chosen for use in SCE calculations. If the data is well distributed over time and shown to be independent of time, then computing drift using the Ks method would be valid.

ATTACHMENT J

ABB

COMBUSTION ENGINEERING OWNERS GROUP

November 14, 1996
CEOG-96-463

C-E Owners Group
Instrument and Control Working Group
Participants in CEOG Tasks 868 and 884

Subject: Transmittal of Final Report CE NPSD-1009 Revision 01, "I&C Engineering Limits and Bases in EOPs, Including Evaluation of Instrument Uncertainties"

Gentlemen:

This letter forwards Revision 01 of CE NPSD-1009 (all modules), the final report of CEOG Tasks 868/884.

This document reflects comments received on the draft versions of the individual modules and participant input from the January 1996 workshop. It also incorporates changes needed as a result of completing Revision 4 of the CE Emergency Procedure Guidelines (CEN 152). This is the final deliverable of Tasks 868/884.

If there are any questions concerning CE NPSD-1009 Rev 01, please contact Joe Congdon at 860/285-2876. Also included is a Project Review Form. Each I&C Working Group participant is requested to complete and return this form in order to assist us in improving the work and products of ABB CE Nuclear Operations.

Sincerely,

Philip W. Richardson Jr. (for)

Philip W. Richardson Jr.
Assistant Project Manager
C-E Owners Group

PWR/m
Enclosure:
CE NPSD-1009, Revision 01

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CEOG COMBUSTION ENGINEERING OWNERS GROUP

CE NPSD-1009
Revision 01
Final Report

I&C ENGINEERING LIMITS AND BASES IN EOPs INCLUDING EVALUATIONS OF INSTRUMENT UNCERTAINTIES

CEOG TASKS 868 & 884

Prepared for the
C-E OWNERS GROUP
November 1996

ABB Combustion Engineering Nuclear Operations

EMERGENCY OPERATING PROCEDURE

ENGINEERING LIMITS

AND

INSTRUMENT UNCERTAINTY ASSESSMENT

CE-NPSD-1009

Prepared for the Combustion Engineering Owners Group

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ABB Combustion Engineering Nuclear Operations Inc.

Record of Revisions

Revision Number	Date
Draft	October 95
00	March 96
01	November 96

TABLE OF CONTENTS

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REFERENCES:

1. CEOG Program Plan "To Address Instrument Uncertainties Within The EOPs And Technical Specifications," January 12, 1993

2. "Emergency Procedure Guidelines," CEN-152, Revision 3, May 1987

3. "Guidelines for Addressing Instrument Uncertainties in Emergency Operating Procedures and Technical Specifications," CE-NPSD-925, Revision 00, January 1994.

4. "Emergency Procedure Guidelines," CEN-152, Revision 4, October 1996

EXECUTIVE SUMMARY

1.0 Executive Summary

All analog instrument loops possess some amount of channel uncertainty that varies with time and environmental conditions. At the time CE-NPSD-925, revision 0 was issued, there was no industry standard that gave guidance on how instrument uncertainties should be accounted for in Emergency Operating Procedures.

CE-NPSD-925 provides a suggested process for determining where to account for instrument uncertainties in the Technical Specifications and Emergency Operating Procedures, and makes general recommendations on methods that can be used to determine the instrument uncertainties. In this context, *account for instrument uncertainty* means: to make a deliberate effort to determine the impact of instrument uncertainty on safe plant operation, and to take action to ensure that instrument uncertainties do not compromise safe plant operation. The guideline covers the treatment of instrument uncertainties for installed instruments that perform monitoring and control functions associated with technical specifications and emergency operating procedures.

Due to the large number of Instrument Applications covered by CE-NPSD-925, a rule-based system of classification was developed to divide the decision problem into a logical sequence of smaller more manageable tasks. The result is a hierarchal model designed specifically to deal with a large variety of Instrument Applications and parameters. The classification process presented in CE-NPSD-925 provided an efficient means of sorting Instrument Applications and their associated plant parameters into groups with common instrument uncertainty requirements.

The purpose of this project was to review all EOP category 01 and 02 instrument applications, and: 1) define the associated engineering limit and the basis for each limit; and 2) determine how instrument uncertainties should be accounted for and provide a justification for this determination.

The conclusions and recommendations found in this report are the result of a collaborative effort between the participants, and shall not be construed as a requirement. Questions and comments that arose during the development of the Engineering Limit Bases Documents were resolved using a consensus approach.

In revision 01, each Engineering Limit Bases Document was up-dated to agree with information found in CEN-152, revision 04. The "nominal values" in revision 00 were replaced with the CEN-152 revision 04 "value descriptors". If new applications were added by CEN-152, revision 04, the associated Engineering Limit bases Documents were developed and incorporated into this report. To protect the integrity of Task 766 work, CE-NPSD-925 was not revised following CEN-152, revision 04. Revision of this report provides adequate linkage to ensure agreement and easy cross-reference between the work of the I&C Working Group and the CEN-152, revision 04 Working Group.

Three new appendices have been added to this report. The new appendices are: 1) revised Task 776 Use Report, 2) CE-NPSD-1009 to CEN-152, revision 04 Cross Reference. 3) CEN-152, revision 03 to revision 04 Value Descriptor Cross Reference. The Task 776 Use Report was revised to show the changes in EOP Use categories that have been made since CD-NPSD-925, revision 00 was issued. CE-NPSD-1009 to CEN-152, revision 04 Cross reference was added to correlate CEN-152, revision 04 instrument applications to CE-NPSD-1009 Engineering Limit Bases Documents.

2.0 Introduction

2.1 Purpose

The purpose of Task 868 was to determine the engineering limits and develop a complete basis statement for all Task 776 Category 1 and 2 numbers and value descriptors contained in the Combustion Engineering (CE) Emergency Procedure Guidelines (EPGs), CEN-152 revision 03. Ultimately, the goal was to provide an up to date document that will help participants ensure a consistent translation of Task 776 instrument uncertainty recommendations into their equivalent plant specific EOP parameter values and value descriptors.

2.2 Background

There are many occurrences throughout the EPGs where operators must observe a parameter indicator and compare the reading to a value or description of the appropriate number (called a value descriptor) within the guidelines to determine whether or not the parameter is within acceptable limits.

The EPGs contain a "Bases" section which describes the reason for each instruction within the EPGs. At the time these bases statements were developed, certain boundaries were drawn around their development to keep them as short and concise as possible while still addressing the purpose and background of each step. The main objective was to provide plant specific Emergency Operating Procedure (EOP) writers a concise statement regarding the purpose of each step contained in the EPGs, determine if the EPG steps were applicable to their plant, and to determine how to translate appropriate EPG steps for use in the EOPs.

Because of this basic EPG development philosophy, many of the numbers found in the EPGs are not explained at the level that would be most beneficial to plant Nuclear Safety Groups or Instrument and Controls (I&C) departments when attempting to determine the impact of instrument uncertainties on their plant specific EOPs. Consequently, some numbers and value descriptors translated from the EPGs to plant specific EOP values may not be as precise as they could be with current technology and guidelines.

2.3 Scope

2.3.1 Task 868

In this project, engineering limits and bases for each Category 1 and 2 instrument application in the Emergency Procedure Guidelines were determined. In addition, category 03 applications for all category 1 and 2 parameters were included in the project, to provide a complete bases for all category 1 and 2 parameters. Instrument Uncertainties Guideline, (CE-NPSD-925) "EOP Condensed Use and Category" database for Task 776 was used as a starting point for this project. Note that the original task #776 database and its reports were not altered.

For each Category 1 and 2 instrument application, a narrative statement of what the number or value descriptor is intended to represent was developed. In addition, EPG engineering limits were identified (except for curves, graphs, RCS P/T limits, shutdown margin, and radiation alarm values). In those cases, the narrative description of what the item represents was determine to explain how to develop the graph or value for the plant specific application. A concise bases for each engineering was then prepared. The bases includes all applicable reference information that could be located, to clearly describe the bases, to help ensure accuracy and consistency in developing plant specific engineering limits.

2.3.2 Task 884

During the I & C Working Group meeting held in December 1994, it was suggested that the scope of Task 868 be expanded to include possible solutions that the utilities could use in the event that margin loss was not acceptable, when attempting to accommodate EOP instrument uncertainties. ABB CENO had provided some examples of this type of information for the project pilot, but indicated that a complete analysis was outside the scope of Task 868 as it was originally proposed (determine the engineering limits and bases for EPG values and value descriptors).

Per the original Program Plan, the engineering limits and bases for all EPG values and value descriptors would first be determined. After the utilities applied their plant specific instrument uncertainties to their engineering limits, they would determine where margin loss was unacceptable. After a list of instrument applications with unacceptable margin was developed, a follow-on CEOG task would determine possible solutions to margin loss.

At the December 1994 CEOG I&C Working group meeting, some members felt that this process could take too long and may be inefficient. It was suggested that the scope of the project be modified to include an assessment of the application of instrument uncertainties and possible solutions to margin loss.

TASK DESCRIPTION

3.0 Description

3.1 Task 868

3.1.1 Parameters

The parameters included in the project are those pertaining to all category 01, category 02 and category 03 EOP instrument applications as stated in CE-NPSD-925, (reference 3). The parameter is identified in the Engineering Limit Basis Document (ELBD) the same way that is it found in CE-NPSD-925, to preserve a link between the two documents and for use in the databases, (e.g. RCS HOT LEG TEMP).

3.1.2 Value

The value descriptors used in the project are those found in CEN-152, revision 04, (reference 4). Where more than one value or variation of a value applies to a single ELBD, they are presented in a bullated list.

3.1.3 Use

The USE CODE, (e.g.U22) designates a specific Use listed in CE-NPSD-925. The Use statement is also included, as it is expressed in CE-NPSD-925. Use statements were developed to aid in the classification process of Task 776. They are by design general in nature. Specificity has been added by the "intent statements" found in the Engineering Limit Basis Section of this report. In some cases the Use assignment was changed in the course of this project. The changes have been incorporated into the revised Use Report located in the appendices.

3.1.4 Category

The CATEGORY CODE, (e.g. C01), is the current category assignment, as determined by this project. In some cases the category code listed in this report will be different than the category assignment found in CE-NPSD-925. This report contains the most up-to-date assignments. The purpose of the instrument uncertainties assessment performed in this project was to perform a more in depth evaluation of the application and determine if and how instrument uncertainties should be applied. In some cases, the evaluation resulted in changing the category assignment. An application may have been C01 based on an initial evaluation the its safety significance in Task 776. However, as a result of further evaluation in this project, the safety significance, and hence category of the application may have been down-graded, based on the reasoning and justification provided. The latest category assignments are shown in the revised Use Report and in the Engineering Limit Bases Documents.

3.1.5 Engineering Limit(s)

The absolute upper and/or lower acceptable value(s) for a parameter specified in the EPGs. When determining the Engineering Limit(s), every effort was made to locate source documentation (preferably a controlled document) to support all assumptions and conclusions. If no such documentation could be found, the best explanation available was provided, noting that it is the informed opinion of the author and/or participants, and it can not be supported with qualified documentation.

The Engineering Limit does not include any uncertainties or operational margin, unless specifically stated. They are intentionally expressed in descriptive phrases to facilitate determination of a plant specific Engineering Limit. When appropriate, the limit is presented as either the "Upper" or the "Lower" limit, to indicate on which side of the limit to apply the uncertainties.

3.1.6 Engineering Limit(s) Basis Section

This section contains a detailed explanation of the bases for each Engineering Limit. All available information with appropriate references, if available, is incorporated into the basis section.

The Engineering Limit Basis Document (ELBD) is intended to be a stand alone document as much as possible, supported by legitimate reference material. If no documentation can be found, the best explanation available was provided, noting that this is the opinion of the author/participants and it can not be supported with qualified documentation. All assumptions, made or implied, in the Engineering Limits Bases section are stated.

When the basis for the EPG application and Engineering Limit is found to be incomplete, non-existent, or otherwise inadequate, an appropriate engineering limit was developed and a basis prepared.

3.1.7 References Section

All references cited in the ELBD are listed in this section.

3.2 Task 884

3.2.1 Instrument uncertainties assessment Section

This section provides guidance that may be useful in translating the EPG engineering limit to a plant specific engineering limit. The primary objective is to reach a conclusion and specify where instrument uncertainties should be explicitly applied, where engineering judgement may be used, or where instrument uncertainties need no be applied. The report provides the rationale/justification used in making the determination. The following are examples of what was considered in making the determination; 1) the specificity of the engineering limit, 2) the safety significance, 3) the relationship to plant design, 4) operational and equipment considerations, 5) the expected accident and instrument response, 6) other corroborative indications available to the operator, and 7) possible operator response to finding the parameter in or out of spec.

In accordance with CE-NPSD-925, each utility should determine a numerical uncertainty value for all Category 1 and 2 instrumentation. The methodology to be used by the utility to arrive at the explicit value is defined generically in the "Category Report" CE-NPSD-925, and specifically by each plant's procedures for calculating uncertainties. Also included in this section is guidance for deriving an operational limit from the engineering limit. The discussion addresses how to apply the plant specific instrument uncertainties, processes uncertainties and other operational margin to the plant specific engineering limit to arrive at the operational limit.

3.2.2 Margin Loss Options Section

Potential margin loss options are offered for consideration and use in cases where the margin loss is determined to be unacceptable. This section applies to applications where it has been determined that explicit instrument uncertainties must be applied and where engineering judgement may be used to account for instrument uncertainties. It is not applicable to applications where it has been determined that instrument uncertainties need not be applied.

In developing margin loss options, a review was conducted to address the following questions: 1) What other plant instrumentation could be used to satisfy the intent of the particular Use and application? 2) What alternative technical guidance could be incorporated into the EPGs instead of relying solely on a particular instrument to accomplish the intended Use and application? These options are provided for plant specific consideration. If a plant decides to investigate adopting a particular option, it is the utilities responsibility to verify the applicability and appropriateness of the option for their facility.

Engineering judgement was used to conduct a preliminary evaluation of the technical adequacy of each potential margin loss option. When appropriate, the authors provided recommendations for additional analyses, verifications or simulator validations to confirm the assumptions and conclusions of each potential margin loss option. [Note: Specific analysis, verification workshops, or simulator validations were not part of this project.]

3.2.3 Summary Section

The summary contains a concise statement of the bases for the Engineering Limit, the intent, and whether or not instrument uncertainties should be applied.

4.0 Glossary

4.1 Definition of Terms

Account for instrument uncertainties - Accounting for instrument uncertainties relates to the following:

1) To make a deliberate effort to determine the impact of instrument uncertainty on safe plant operation;
2) To take action, as necessary, to ensure that the impact of instrument uncertainty is consistent with safe plant operation;
3) To document this effort including a complete justification for the actions taken.

In some situations this evaluation may conclude that explicit application (actually adjusting the operational target value to include instrument uncertainty) of instrument uncertainty is not in the best interest of overall plant safety. In these cases, even though no instrument uncertainty value is included in the operational target value, it can still be said that instrument uncertainties are accounted for as a result of the evaluation.

Category - The highest level in the instrument uncertainty classification hierarchy. An Instrument Application's Category determines how instrument uncertainties should be accounted for.

Category 01 These Instrument Applications possess a high degree of nuclear safety significance. Explicit instrument uncertainty calculation(s) should be performed.

Category 02 These Instrument Applications possess a moderate to low degree of nuclear safety significance. Engineering judgement alone is acceptable in determining instrument uncertainties.

Category 03 These Instrument Applications are not nuclear safety significant or are located outside of design bases space. Instrument uncertainties need not be considered.

Corroborative instrumentation - For the purpose of this guideline, corroborative instrumentation is any set of Instrument Application(s) that confirm the status of a different set of Instrument Applications. The corroborative argument may be invoked to justify classifying an Instrument Application into a lower Category than otherwise might be warranted were it not for the corroboration of other instruments to determine the same operational information.

Engineering Limit - The absolute upper and/or lower acceptable value(s) for a parameter specified in the EPGs. Engineering limits do not include any uncertainties or operational margin, unless specifically stated.

Engineering Judgement - A decision making process that relies on the use of informed engineering opinion as the primary basis for resolution of an instrument uncertainty concern. When engineering judgement is used, it is best to use a consensus approach where the decision process team consists of members that are both, 1) knowledgeable in the particular issue being decided, and 2) have the background and experience to evaluate the full impact of their decision on integrated plant operations and plant safety.

Instrument Application - the lowest level in the classification hierarchy. An Instrument Application is a unique instance of an instruction (either direct or implied) to measure the value of a plant parameter.

Nominal - A nominal value is a theoretical value considered to be a reasonable estimate of the actual value. Nominal values are non-limiting, and of such an imprecise nature that it serves no useful purpose to calculate and apply instrument uncertainties.

Operational Limit - The target operational value that is used in the EOPs. It is the value the operator evaluates plant performance against while executing the EOPs.

Safety Significance - Relates to the degree of importance to safety (measured by the consequence of failure to indicate properly) attached to Instrument Application parameters which monitor Nuclear Safety Related Systems, Structures, or Components (SSCs). The concept of degrees (high, moderate, low) of nuclear safety significance is the bases for many Category and Use definitions.

Use - The name of the intermediate level in the classification hierarchy, e.g.:

Category - top level
Use - intermediate level
Instrument Application (either EOP or Tech Spec) - lowest level

A Use links all its member Instrument Applications to a single instrument uncertainty Category. The purpose of a Use is to provide a single group for Instrument Applications with common nuclear safety significance and operational functions, so that they may be assigned to one Category as a group.

APPENDICES

5.0 Appendices

Tabs 1 through 4 of the report contain discussions pertaining to the task scope and description in relationship to other CEOG docuMents that address Emergency Operating Procedure instrument uncertainties. Tabs 5 through 25 contain Engineering Limit Bases Documents (ELBDs) for EOP instrument applications within the scope of this project. Tab 26 contains the revised Task 776 Use Report. Tabs 27 and 28 contain cross-references to CEN-152, revision 04.

Appendix	EBLD	Parameter
A	111	Condensate Storage Tank Level
B	121 - 122	Feedwater Flow
C	131 - 138	Steam Generator Level
D	141 - 144	Steam Generator Pressure
E	211 - 214	Radiation Monitoring
F	221 - 222	Containment Hydrogen Concentration
G	231 - 236	Containment Pressure
H	241 - 244	Containment Temperature
I	251 - 253	Reactor Power
J	261	CEA Position
K	271	Containment Spray Flow
L	311 - 312	CVCS Charging and Letdown Flow
M	321 - 327	Pressurizer Level

N	**331 - 333**	**Reactor Vessel Level Monitoring**
O	**341 - 343**	**HPSI Pump Flow**
P	**351**	**Refueling Water Tank Level**
Q	**411 - 415**	**RCS Average Temperature**
R	**421 - 423**	**Core Exit Temperature**
S	**431 - 437**	**RCS Cold Leg Temperature**
T	**441 - 445**	**RCS Hot Leg Temperature**
U	**451 - 452**	**RCS Delta Temperature**
V	**511 - 514**	**RCS Subcooling**
W	**521 - 5214**	**Pressurizer Pressure**
X	**531**	**Reactor Vessel Head Temperature**
Y	**EOP Use Report**	
Z	**CEN-152 Revision 3 to Revision 4 Value Cross Reference**	
AA	**CEN-152 Revision 4 to Engineering Limit Bases Document Cross Reference**	

CONDENSATE
STORAGE TANK
LEVEL

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 1

COND CST VOLUME {11}

RECORD OF REVISIONS

Rev	Date	Pages	Preparer	Ind.Reviewer	Approver
Draft	04/21/95	ALL	Congdon	Kramarchyk	Greene
00	03/29/96	ALL	Congdon	Smith	Greene
01	11/15/96	ALL	Congdon	Kramarchyk	Greene

PREPARED BY: Joseph R. Congdon
Cognizant Engineer (Print Name)

[signature]
Cognizant Engineer (Signature) Date: 11/8/96

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Attachment 2, (QA Checklist) found in the Project Quality Plan.

Paul Kramarchyk [signature] 11/8/96
Name Signature Date
Independent Reviewer

APPROVED BY: Mark Greene
Cognizant Engineering Supervisor (Print Name)

[signature] 11/13/96
Cognizant Engineering Supervisor (Signature) Date

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 1 - APPLICATION 1

{111}
System Subject Parameter: CST Volume

Value: [minimum required inventory]

Use: U09
To monitor operability or operation of safety related Systems, Structures, and Components (SSCs), that could impact the accomplishment of a safety function, if impaired.

Cat: C02

Engineering Limit(s):

The minimum quantity of available feedwater needed to remove sensible and decay heat to cool down to Shutdown Cooling entry conditions within an assumed period of time.

Summary:

The engineering limit is the minimum quantity of available feedwater needed to remove sensible and decay heat to cool down to Shutdown Cooling entry conditions within an assumed period of time.

Category C02 instrument uncertainty treatment is acceptable when constructing the condensate inventory graphs referenced in this application. In these applications, the operator is making a comparison of one set of conditions to another set of conditions. Instrument uncertainties will not impact the determination of a step change in tank level. However, an allowance for instrument uncertainty is typically applied to the lower end of the indication to ensure that the operator switches tanks before loosing suction to the in-service tank.

Basis for Engineering Limit(s):

The following statement is found in those guidelines in which an assessment of condensate inventory determines a course of action:

> The available condensate inventory should be monitored, and replenished from available sources as necessary to continually provide a source for a secondary heat sink. Examples of alternate sources of condensate are nonseismic tanks, fire mains, lake water supplies, potable tanks, etc. Plant-specific alternate sources of feedwater should be identified and cited in the procedure. The condensate required to either maintain the plant at hot standby or cooldown may be determined from CEN-152, Figures 13-14 and 13-15 (refs.1 and 2).

Figures 13-14 and 13-15 are examples of the types of figures that could be used in determining how much condensate is required while a plant is being cooled by auxiliary feedwater.

Figure 13-14 represents the amount of condensate required to remove decay heat for a specific duration of time before the shutdown cooling system must be used. Each curve reflects a different time after shutdown (in hours). Curves representing intermediate time segments may be added.

Figure 13-15 provides the operator with an indication of how much condensate is required to remove system sensible heat while cooling down the plant to a desired cold leg temperature from an initial cold leg temperature. Figure 13-14 and Figure 13-15 must be used together to calculate the condensate inventory required for decay heat and sensible heat removal for a given cooldown.

The intent of condensate inventory information, whether it is presented in graphical, nomograph, or other forms, is to enable the operating staff to determine whether sufficient inventory exists for the planned actions. It should give the operator information in a timely manner such that, if a cooldown is required, enough condensate will be available to accomplish the task. In the event that enough condensate does not exist for a cooldown to shutdown cooling entry conditions, the operator(s) can plan accordingly to maximize the time to establish alternate sources of condensate.

The inventory from those plant-specific alternate sources of condensate must be designated in the procedure (i.e., nonseismic tanks, fire mains, lake water supplies, potable tanks, etc.). Through use of Figures 13-14 and 13-15, the operations staff can evaluate condensate availability and select an appropriate course of action for the plant conditions which exist.

Instrument uncertainties were not taken into consideration in generating these curves. The curves were arrived at analytically.

The engineering limit is the minimum quantity of available feedwater needed to remove sensible and decay heat to cool down to Shutdown Cooling entry conditions. The actual engineering limit at any given time will depend on decay heat load (time after shut down), power history, initial RCS temperature, and desired terminal RCS temperature.

During the development of CEN-152, it was recognized that the scenarios that had to be addressed included: 1) situations where the main condenser would not be available to conserve feedwater inventory, and 2) situations where secondary plant water inventory losses were placing a significant demand on condensate makeup reserves. It was also recognized that the potential inability to replenish condensate makeup reserves must be considered in the development of strategies to respond to these scenarios.

These considerations were used in the development of the following two types of steps in CEN-152:

(A) "Ensure the available condensate inventory is adequate per Figures [X]."

(B) "Evaluate the need for a plant cooldown based on:

a. plant status,
b. auxiliary systems availability,
c. condensate inventory (refer to Figures [X])."

The authors of CEN-152 were considering an underlying strategy in both of these two types of procedure steps. In this underlying strategy, plant operators take actions to remain informed on what are the existing or potential limitations concerning the continued use of any steam generator heat sink if the ability to replenish condensate makeup reserves is interrupted for an indefinite duration.

These actions include: 1) obtaining information concerning the condensate makeup requirement for specific control strategies for heat removal safety functions, 2) the existing inventory of condensate makeup reserves, 3) comparison of the information obtained from the first two actions, 4) interpretation of the information obtained from the third action, 5) follow-up responses to the interpretation from the fourth action.

Uncertainties Application Assessment:

Category C02 instrument uncertainty treatment is acceptable when constructing the condensate inventory graphs referenced in this application. In these applications, the operator is making a comparison of one set of conditions to another set of conditions. Instrument uncertainties will not impact the determination of a step change in tank level. However, an allowance for instrument uncertainty is typically applied to the lower end of the indication to ensure that the operator switches tanks before loosing suction to the in-service tank.

There exist several sources of condensate makeup that could legitimately be included as available inventory for EOP purposes. Each source having a finite capacity, i.e. tanks, will have level\volume indication. The inaccuracies associated with the tank level\volume indicator should be accounted for when determining the available\usable inventory in each tank.

Potential Margin Loss Options:

Margin loss is not an issue for this particular application.

References:

1. CEN-152, Revision 04, Figures 13-14 and 13-15

2. CEN-152, Revision 04, Section 13.5.4, Derivation of Condensate Inventory Curves

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 1 of 2)	OK	N/A
1.	Are the deliverables consistent with the Project Plan and the Project Authorization?	✓	
2.	Has the intent of the Engineering Limit been clearly expressed?	✓	
3.	Has the Engineering Limit been clearly identified?	✓	
4.	Has the bases for the Engineering Limit been clearly expressed?	✓	
5.	Has what the Engineering Limit ensures been clearly expressed?	✓	
6.	Have all assumptions been clearly stated?	✓	
7.	Has the relationship of the EPG value or descriptor to nuclear Safety been addressed?	✓	
8.	Does the document explicitly state that instrument uncertainties need or need not be applied for each application?	✓	
9.	Has the rational/justification used in making the applicability determination been clearly expressed?	✓	
10.	Is there evidence that a deliberate effort has been made to consider other options to be used in the event that the instrument uncertainties can not be accommodated when it is desirable for them to be explicitly applied?	✓	

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 2 of 2)	OK	N/A
11.	When necessary, have recommendations for additional analyses, verifications or simulator validations, to confirm assumptions or conclusions, been provided?	✓	
12.	Is there evidence that industry operating experience has been considered and incorporated as appropriate?	✓	
13.	Is there evidence that a deliberate effort has been made to consider the impact of the work product on the health and safety of the public?	✓	
14.	Does the title page contain the following: - Document Title - Document Number - Date of Issue - Correct Revision - Pagination (page 1 of X) - All Required Signatures	✓	
15.	Does the header of each page contain the following: - Sequentially numbered pages (page 1 of X) - Document Number - Correct Revision - Date of Issue	✓	
16.	Is the document legible and reproducible?	✓	
17.	Are all cross-outs and overstrikes initialed and dated by the author?	✓	

Comments/remarks:

PAUL KRAMARCHYK / Paul B. Kramarchyk / 11/12/96
Independent Reviewer: Name/Signature/Date

FEEDWATER FLOW

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 2

MFW OR AFW FLOW {12}

RECORD OF REVISIONS

Rev	Date	Pages	Preparer	Ind.Reviewer	Approver
Draft	04/21/95	ALL	Congdon	Kramarchyk	Greene
Draft	10/31/95	ALL	Congdon	N/A	N/A
00	03/29/96	ALL	Congdon	Smith	Greene
01	11/15/96	ALL	Congdon	Kramarchyk	Greene

PREPARED BY: Joseph R. Congdon
Cognizant Engineer (Print Name)

[signature]
Cognizant Engineer (Signature) Date: 11/8/96

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Attachment 2, (QA Checklist) found in the Project Quality Plan.

Paul Kramarchyk [signature] 11/8/96
Name Signature Date
Independent Reviewer

APPROVED BY: Mark Greene
Cognizant Engineering Supervisor (Print Name)

[signature] 11/13/96
Cognizant Engineering Supervisor (Signature) Date

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 2 - APPLICATION 1

{121}
System Subject Parameter: MFW or AFW Flow

Value: [minimum feedflow for heat removal], nominally 150 gpm

Use: U22
To provide corroborative information related to the accomplishment of a safety function.

Cat: C03

Engineering Limit(s):

Lower = Sufficient feedwater flow to support post-trip RCS heat removal, which includes core decay heat and RCP pump heat (if RCPs are operating), and allows the steam generator level to recover over time.

Summary:

The engineering limit is based on the required feedwater flow to support post-trip RCS heat removal, which includes core decay heat and RCP pump heat (if RCPs are operating), and allows the SG level to recover over time. The intent of this limit is to provide backup or secondary criteria in the heat removal acceptance criteria that will ensure RCS temperature and subcooling are controlled and SG level is being restored.

Instrument uncertainties need not be applied to the plant specific engineering limit when determining the operational limit for this application, if wide range SG level indication is available.

Basis for Engineering Limit(s):

The engineering limit is based on the required feedwater flow to support post-trip RCS heat removal, which includes core decay heat and RCP pump heat (if RCPs are operating), and allows the SG level to recover over time. The engineering limit for this instrument application is variable depending on plant conditions.

This application is not used in the generic EPGs (CEN-152), however it may be applicable to plant specific applications associated with RCS heat removal acceptance criteria in standard post trip actions (SPTA) and the safety function status checks (SFSCs) of other EPGs.

The intent of each of these sets of safety function acceptance criteria is to ensure the presence of an operable steam generator for heat removal. Each set is intended to prevent core damage by ensuring adequate decay heat removal following reactor shutdown. For plants with only narrow range SG level instrumentation, it is not uncommon for SG level to drop below the indicated range after a reactor trip. Therefore, the requirement to check for a minimum amount of feedwater flow was included as a backup or secondary parameter in the heat removal acceptance criteria to provide indication of an adequate heat sink when SG level indication was unavailable and to ensure that a "below normal range" SG level is corrected over time.

CEN-152, revision 04, specifies: "level being restored by main or auxiliary feedwater" as part of the heat removal criteria because sometimes level can rise due to a heatup of the steam generator or due to steam generator swell. Therefore, this criteria requires the operator to verify that main or auxiliary feedwater is flowing to the steam generator(s) to restore level and that the level rise is not from another heatup or swell. The operational limit [150 gpm per SG] that was used in CEN-152, revision 3 was a reference plant "nominal" value based on a rough calculation of "minimum Feed Rate", obtained by dividing "decay Heat Rate" by the "change in Enthalpy". The results provide an approximation of the required flow to each steam generator that is needed to remove the maximum assumed decay heat following reactor trip and to restore SG level over time. Originally, CEN-152 did not include removal of RCP heat or sensible heat from the RCS in this limit. However, the engineering limit should include all of the above. Instrument inaccuracies have not been accounted for in this value.

Uncertainties Application Assessment:

The engineering limit value for post-trip feedwater flow rate need not be adjusted for instrument uncertainties when determining the appropriate plant specific operational limit, if wide range SG level indication is available. If only narrow range SG level indication is available, accurate feedwater flow indication is needed when SG level is off-scale low, and in instrument uncertainties should be accounted for.

EPG safety function control strategies rely on process variable indications and trends other than feedflow rate to provide an indication of the status of RCS Heat Removal. The safety function success criteria in CEN-152 are deliberately designed to only include consideration of specific feedwater flow rates when the indicated steam generator downcomer levels of in-use steam generator(s) are less than the indicating range.

When steam generator level is not in the indicated range, the combination of feedwater flow to the in-use SG and RCS temperature and their associated trends, provide adequate indication of successful plant and operator responses to monitor the RCS Heat Removal safety function. If these process variables are in the acceptable range, while steam generator level is less than the indicating range, the RCS heat removal safety function is satisfied.

The above mentioned process variables are primary indicators, and feedwater flow indication is secondary. Therefore, the need for precise measurement of feedwater flow at the expected rates following a reactor trip is determined to be not necessary if wide range SG level indication is available and in use in the EOPs.

Trending of wide range SG level should be used to evaluate the degree to which existing feedflow rates are supporting recovery of steam generator level.

Potential Margin Loss Options:

Not applicable

References:
None

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 2 - APPLICATION 2

{122}
System Subject Parameter: MFW or AFW Flow

Value: [maximum feedflow that will not cause water-hammer], nominally 150 gpm

Use: U36
To verify the operability of non-safety related equipment such as RCPs, whose failure to operate is not likely to impact a safety function.

Cat: C03

Engineering Limit(s):

Upper = The maximum MFW/AFW flowrate to a drained steam generator feed ring that can be demonstrated will not cause water-hammer damage to the feed ring of piping leading to the feed ring.

Summary:

This limit is only applicable to plants that are equipped with feed rings which are susceptible to damage due to water-hammer. The engineering limit is based on preventing feed ring damage due to re-establishing feedwater to a voided feed ring too quickly.

Instrument uncertainties need not be applied for this application. [150 gpm] is a nominal value used for equipment protection only. Because this application does not directly impact a safety function, a best estimate degree of accuracy is acceptable to obtain the desired result.

Basis for Engineering Limit(s):

The engineering limit is based on preventing feed ring damage due to re-establishing feedwater to a voided feed ring too quickly.

This operational limit is only applicable to plants that are equipped with feed rings which are susceptible to damage due to water-hammer. The application appears in the loss of all feed (LOAF) optimal recovery guideline (ORG) and the functional recovery guideline (FRG). The purpose of the engineering limit is to prevent feed ring damage due to excessive refill flow to a drained feed ring.

During the early 1980s, steam generator feed rings at several CE NSSS units were damaged as the result of "water-hammer" pressure transients during recovery of feedwater flow to a drained feed ring. The physical evidence of this damage included displaced, unattached "J-tubes", bending of the feedring from its installed geometry, and collapsing of portions of the feed ring.

As the various revisions of CEN-152 were developed, the authors of CEN-152 were generally aware that feed ring damage had occurred as the result of water-hammer in feedwater piping during feedwater restoration. However, at the same time, no studies were available to demonstrate to what degree feed ring damage could occur during response to a plant transient without unacceptably degrading the heat removal capabilities of the affected steam generator during the remainder of the response of the transient.

There is no analytical correlation between feedwater flow rate and the conditions to preclude feed ring failure. A nominal feedflow of 150 gpm was recommended as a procedural limit in CEN-152, revision 03, based on the fact that no significant water-hammer had been observed during testing or operation with flow rates of this magnitude. Additionally, 150 gpm has been traditionally accepted as a flow limit by industry and the NRC for water hammer protection. The five minute duration of this limited flow is conservatively based on twice the refill time for the 350 gallon feed ring. In the event that refilling of portions of the main feedwater piping must be considered, this time should be adjusted accordingly. Instrument uncertainties were not included.

An intention of the authors of CEN-152 was to help ensure that feedwater recovery strategies of plant-specific Emergency Operating Procedures were designed to minimize opportunities for "water-hammer" shock waves in feedwater piping during recovery of feedwater flow to a drained feedring. The resulting steps that were placed in the EPGs focus on deliberate manual control of feedflow to a steam generator that has had a complete interruption of feedflow to a steam generator during an event.

Operator training should stress slow restoration of feedflow to the steam generator. If the ability to accurately monitor feedflow rate to a voided SG feedring is compromised, then, the only other corroborative methods that address the intent of the bases is to rely on operator skill and judgment to very slowly re-establish feed to the voided SG feedring.

Uncertainties Application Assessment:

The engineering limit need not be adjusted for instrument uncertainties. [maximum feedflow that will not cause water-hammer] is assumed to be a nominal value used for equipment protection only. This application does not directly impact a safety function, because it is not related to the piping leading to the feedring.

In addition, the application of instrument uncertainties does not make sense in this case. Applying instrument uncertainties to such a low engineering limit may result in the operational limit approaching zero, which renders the limit useless. Using a low nominal number, such as [150] gpm, even if appreciable instrument uncertainty does exists, should not result in sever water hammer, as long as the flow is restored gradually. This opinion was reached by a consensus of task 884/868 participants, and can not be supported with qualified documentation. Therefore, a best estimate degree of accuracy is acceptable to obtain the desired result.

The consequences to the steam generator internals of restoring feed water flow too rapidly to a drained feed may be severe. It depends on the operator's ability to accurately determine if the feedring is drained or less than completely full, and subsequently the operators ability to restore flow slowly.

When assessing the impact of instrument uncertainties on this application, the following questions should apply:

1. Is the steam generator design susceptible to feedring damage due to water hammer?
2. Prior to restoring feed flow, is the actual level in the downcommerless than the bottom of the feedring, and is the feedring less than completely full?
3. Is the temperature of the feed water assumed to be that of the coldest possible feedwater source?

Potential Margin Loss Options:

Not applicable

References:

None

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 1 of 2)	OK	N/A
1.	Are the deliverables consistent with the Project Plan and the Project Authorization?	✓	
2.	Has the intent of the Engineering Limit been clearly expressed?	✓	
3.	Has the Engineering Limit been clearly identified?	✓	
4.	Has the bases for the Engineering Limit been clearly expressed?	✓	
5.	Has what the Engineering Limit ensures been clearly expressed?	✓	
6.	Have all assumptions been clearly stated?	✓	
7.	Has the relationship of the EPG value or descriptor to nuclear Safety been addressed?	✓	
8.	Does the document explicitly state that instrument uncertainties need or need not be applied for each application?	✓	
9.	Has the rational/justification used in making the applicability determination been clearly expressed?	✓	
10.	Is there evidence that a deliberate effort has been made to consider other options to be used in the event that the instrument uncertainties can not be accommodated when it is desirable for them to be explicitly applied?	✓	

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 2 of 2)	OK	N/A
11.	When necessary, have recommendations for additional analyses, verifications or simulator validations, to confirm assumptions or conclusions, been provided?	✓	
12.	Is there evidence that industry operating experience has been considered and incorporated as appropriate?	✓	
13.	Is there evidence that a deliberate effort has been made to consider the impact of the work product on the health and safety of the public?	✓	
14.	Does the title page contain the following: - Document Title - Document Number - Date of Issue - Correct Revision - Pagination (page 1 of X) - All Required Signatures	✓	
15.	Does the header of each page contain the following: - Sequentially numbered pages (page 1 of X) - Document Number - Correct Revision - Date of Issue	✓	
16.	Is the document legible and reproducible?	✓	
17.	Are all cross-outs and overstrikes initialed and dated by the author?	✓	

Comments/remarks:

PAUL KRAMARCHYK / Paul B. Kramarchyk / 11/12/96

Independent Reviewer: Name/Signature/Date

STEAM GENERATOR LEVEL

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 3

MS STEAM GENERATOR LEVEL {13}

RECORD OF REVISIONS

Rev	Date	Pages	Preparer	Ind.Reviewer	Approver
Draft	04/21/95	ALL	Congdon	Kramarchyk	Greene
Draft	10/31/95	ALL	Congdon	N/A	N/A
00	03/29/96	ALL	Congdon	Smith	Greene
01	11/15/96	ALL	Congdon	Kramarchyk	Greene

PREPARED BY: Joseph R. Congdon
Cognizant Engineer (Print Name)

[signature]
Cognizant Engineer (Signature) Date: 11/8/96

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Attachment 2, (QA Checklist) found in the Project Quality Plan.

Paul Kramarchyk [signature] 11/12/96
Name Signature Date
Independent Reviewer

APPROVED BY: Mark Greene
Cognizant Engineering Supervisor (Print Name)

[signature] 11/13/96
Cognizant Engineering Supervisor (Signature) Date

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 3 - APPLICATION 1

{131}
System Subject Parameter: MS Steam Generator Level

Value: [[above the feedring] or [below the feedring]

Use: U09
To monitor operability or operation of safety related systems, structures, and components (SSCs), that could impact the accomplishment of a safety function, if impaired.

Cat: C02

Engineering Limit(s):

Lower = SG level equivalent to the bottom of the feed ring.

Summary:

The engineering limit is based on traditionally accepted industry and NRC guidance for the prevention of water hammer damage to feed rings. With steam generator level at the bottom of the feedring, following an interruption of feedwater flow, water hammer and the resultant structural damage to the feed ring will be avoided when feedflow is restored.

Category C02 instrument uncertainties should be applied to the engineering limit based on the need for the operator to take compensatory actions to avoid feedring damage.

Basis for Engineering Limit(s):

The bases for the lower engineering limit is to keep the feed ring from drying out. With SG level at the bottom of the feedring following an interruption of feed water flow, water hammer and the resultant structural damage to the feed ring will be avoided when feedflow is restored.

This operational limit is only applicable to plants that are equipped with feed rings which are susceptible to damage due to water-hammer. The application appears in the loss of all feed (LOAF) optimal recovery guideline (ORG) and the functional recovery guideline (FRG). The purpose of the engineering limit is to prevent feed ring damage due to excessive refill flow to a drained feed ring.

During the early 1980s, steam generator feed rings at several CE NSSS units were damaged as the result of "water-hammer" pressure transients during recovery of feedwater flow to a drained feed ring. The physical evidence of this damage included displaced, unattached "J-tubes", bending of the feedring from its installed geometry, and collapsing of portions of the feed ring.

As the various revisions of CEN-152 were developed, the authors of CEN-152 were aware that feed ring damage had occurred as the result of water-hammer in feedwater piping during feedwater restoration. However, at the same time, no studies were available to demonstrate to what degree feed ring damage could occur during response to a plant transient without unacceptably degrading the heat removal capabilities of the affected steam generator during the remainder of the response of the transient.

There is no analytical correlation between feedwater flow rate and the conditions to preclude feed ring failure. A nominal feedflow rate of 150 gpm has been recommended as a procedural limit based on the fact that no significant water-hammer has been observed during testing or operation with flow rates of this magnitude. Additionally, 150 gpm has been traditionally accepted as a flow limit by industry and the NRC for water hammer protection. The five minute duration of this limited flow is conservatively based on twice the refill time for the 350 gallon feed ring. In the event that refilling of portions of the main feedwater piping must be considered, this time should be adjusted accordingly. Instrument uncertainties were not included.

The intention of the authors of CEN-152 was to help ensure that feedwater recovery strategies of plant-specific Emergency Operating Procedures were designed to minimize opportunities for "water-hammer" shock waves in feedwater piping during recovery of feedwater flow to a drained feed ring. The resulting steps that were placed in the EPGs concern deliberate manual control of feedflow to a steam generator that has had a complete interruption of feedflow to a steam generator during an event.

Operator training should stress slow restoration of feedflow to the steam generator. If the ability to accurately monitor feedflow rate to a voided SG feedring is compromised, then, the only other corroborative methods that address the intent of the bases is to rely on operator skill and judgment to very slowly re-establish feed to the voided SG feedring.

Uncertainties Application Assessment:

Category C02 instrument uncertainties should be applied to the engineering limit based on the need for the operator to take compensatory actions to avoid feedring damage. Category C02 treatment is justified because this application does not directly impact a safety function. There is no evidence to show that water-hammer in the feed ring will damage feed piping external to the SG. This opinion was reached by a consensus of task 884/868 participants, and can not be supported with qualified documentation.

If feed ring damage were to occur as a result of water-hammer, the damage would not interfere with adding water to the generator and consequently cooling the core. This opinion was reached by a consensus of task 884/868 participants, and can not be supported with qualified documentation.

Potential Margin Loss Options:

Not applicable

References:

None

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 3 - APPLICATION 2

{132}
System Subject Parameter: MS Steam Generator Level

Value: [SG level for initiating OTC], nominally 15 %

Use: U05
To verify or ensure RCS and Core Heat Removal Safety Function Acceptance Criteria are satisfied.

Cat: C01

Use: U19
To provide indirect support for the accomplishment of a safety function.

Cat: C02

Engineering Limit(s):

Lower = The point at which the steam generator starts to become ineffective as a heat sink.

Summary:

The intent of this limit is to ensure that action is taken to line up Once-Through-Cooling (OTC), after a loss of all feedwater event, while some margin still exists to the point where the steam generator starts to become ineffective as a heat sink. This margin is necessary to ensure that OTC will be initiated prior to a complete loss of SG heat removal, and ultimately prevent core uncovery.

This application possesses a moderate degree of nuclear safety significance, because of the use of T cold instrumentation as a backup to SG level instrumentation. Therefore, category two (C02) instrument uncertainties and engineering judgment may be applied to the plant specific engineering limit to arrive at an appropriate plant specific operational limit. If T cold is not used as a backup to SG level, this application should be C01.

Basis for Engineering Limit(s):

The basis for the engineering limit is to initiate Once-Through-Cooling (O-T-C) during a loss of all feedwater (LOAF) event before the steam generator (SG) becomes ineffective as a heatsink.

The conditions under which primary feed and bleed would be successful in preventing core uncovery can be qualitatively described by starting with a comparison of the mass flow rates of the PORVs, HPSI pumps and charging pumps as a function of pressure. During O-T-C, there will always be a net mass loss from the RCS as long as the RCS pressure is above the shutoff head of the HPSI pump. Thus, in order for primary feed and bleed to be successful in preventing core uncovery, it must be initiated in a manner that results in RCS depressurization to below the HPSI pump shutoff head in time to prevent core uncovery. Parametric studies, for a given plant design, show that the two factors which primarily determine if core uncovery will occur are the size of the PORVs and when they are opened. The larger the PORVs, the later they can be opened and still prevent core uncovery. (refs.1, 2 and 3).

Wide range SG level decreasing to [SG level for initiating OTC], nominally [15%] in both SGs is used as indication of a total loss of all feedwater event in the EPGs. This value was selected to ensure that at least one SG is a viable heat sink at the time O-T-C is established. This strategy is intended to ensure that there is no interruption in core and RCS heat removal during the transition from heat removal via O-T-C. The CEN-152, revision 03 operational limit is based on an assumed SG wide range level instrument inaccuracy of [±10%] plus a [5%] margin to where the SG starts to become an ineffective heat sink. An effective SG heatsink is defined as a SG having enough secondary inventory with steaming capability such that core decay heat can be removed without uncontrolled reduction in RCS subcooling.

In the event of a total loss of all feed water, if O-T-C is not initiated until after both SGs are lost as a heatsink, core uncovery and possible core damage may occur. The loss of a SG as a heatsink will result in reactor coolant system (RCS) temperature and pressure increasing rapidly. RCS expansion into the pressurizer will result in RCS pressure opening the PORVs. Following a period of subcooled depressurization, two phase repressurization occurs resulting in the primary safety valves (PSVs) lifting and RCS pressure remaining above high pressure safety injection (HPSI) pump shutoff head. The duration of the subsequent two phase depressurization phase of the event depends on the decay heat generation rate at the time feedwater was lost. However, RCS inventory will continue to be lost through the PSVs or the PORVs, with no means to replenish it, and core uncovery will occur before HPSI injection is reestablished (ref. 1).

The authors of CEN-152 used engineering judgment in selecting the engineering limit used in the EPGs. They did not actually calculate the time required to steam the SG dry. They did not actually calculate the time required to transition from SG heat removal to O-T-C. In both cases, the results would be plant specific.

They validated the operational limit and margin through the various simulator validation sessions to ensure the adequacy of the selected EPG strategy. The EPG specified times and margins were found to be acceptable through those validation sessions, and in fact, are more accurate for operator action times, than calculations would most likely be. Each utility should use their plant specific design and system response to determine their engineering limit and EOP operational limit.

Uncertainties Application Assessment:

This application possesses a moderate degree of nuclear safety significance, because of the use of T cold instrumentation as a backup to SG level instrumentation. Therefore, category two (C02) instrument uncertainties and engineering judgment may be applied to the plant specific engineering limit to arrive at an appropriate plant specific operational limit. If T cold is not used as a backup to SG level, this application should be C01.

Task 776 defines the SPTA, SFSC, and success path acceptance criteria applications as category one applications. Category C02 is acceptable in this case because of the use of T cold as a backup indication. Also by definition in task 776, applications in the instructions and contingency actions were assigned to category two. To avoid a situation where similar applications located in different sections of the EPGs have different operational limits, all of these applications should be treated as C02. By doing so, the same value will be used throughout the EPGs. This practice is conservative by nature, and preferred from a human factors perspective.

At least one SG, having at least [SG level for initiating OTC], nominally 15 % wide range level is intended to ensure that sufficient SG inventory is available to support RCS heat removal during the transition to O-T-C. This operational limit is based on an assumed SG wide range level instrument inaccuracy of [±10%] plus a [5%] margin to where the SG starts to become an ineffective heat sink (0% for the EPG reference plant).

The actual inventory in the SG where it begins to be an ineffective heat sink is difficult to accurately establish for all plant conditions and power histories. The operational limit should not be less than the engineering limit, plus instrument inaccuracies, plus some operational margin, based on how long it takes to initiate O-T-C. It is important to stress that these are the criteria for initiating O-T-C. When the criteria are reached, the primary effort of the crew then becomes initiating O-T-C, not continuing efforts to restore feedwater. It is important to establish O-T-C before RCS temperature and pressure start increasing.

Efforts to restore feedwater may continue, as long as it does not delay establishing O-T-C. For plants that do not have PORVs, or a depressurization system, restoration of a viable SG heat sink is the only option.

Potential Margin Loss Options:

Margin loss is not an issue with this application. Applying a larger amount of instrument uncertainty will move the operational limit in the conservative direction. The consequences of this may possibly result in prematurely initiating O-T-C. From a safety point of view, this is acceptable.

References:

1. CE-NPSD-167, "Alternatives for Decay Heat Removal in C-E Supplied Nuclear Steam Supply Systems", Task 434 Final Report, September 1982, section 5.5, "Analysis of Primary Feed and Bleed".

2. CEN-239, "Depressurization and Decay heat Removal Response to NRC Questions", June 1983, section 2.8, "Question 8: Extended Loss of Feedwater".

3. CEN-152, revision 03, page 8-50.

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 3 - APPLICATION 3

{133}
System Subject Parameter: MS Steam Generator Level

Value: [SG level for terminating O-T-C], nominally 30 %

Use: U69
to verify a parameter is in agreement with "nominal values" provided in SSC design criteria or safety analyses.

Cat: C03

Engineering Limit(s):

Lower = Steam generator level corresponding to approximately 1/3 of the tube height.

Summary:

The engineering limit is a "nominal value" that represents a conservative steam generator level that will provide adequate primary to secondary heat transfer area to ensure single phase natural circulation flow will be established. The operational limit is intended to increase the likelihood that single phase natural circulation can be maintained following termination of OTC, even if a temporary interruption of feedwater should occur.

Instrument uncertainties need not be applied when determining an appropriate plant specific operational limit. This application possesses a low degree of nuclear safety significance, relative to this EOP application. 1/3 of the tube height is a nominal value.

Basis for Engineering Limit(s):

The engineering limit is a "nominal value" that represents a conservative steam generator level that will provide adequate primary to secondary heat transfer area to ensure single phase natural circulation flow will be established. The steam generator heat transfer area is sized for full power operation. Therefore, only a portion of the tubes (approximately 1/3 of the tube height, corresponding to 30-40% WR level) must remain covered to ensure normal NC flow. This is a minimum level for ensuring that single phase NC is viable. It also provides some margin to the point where OTC initiation would be justified (ref.1).

The operational limit is intended to increase the likelihood that single phase natural circulation can be maintained following termination of OTC, even if a temporary interruption of feedwater should occur. The operational limit of 30% WR in CEN-152, revision 03 was obtained by adding 25% margin to the O-T-C initiation level of 5% WR to ensure that RCS heat removal can be maintained for some time after OTC has been terminated in case feed water is once again lost. The 25% margin was arbitrarily chosen to provide additional assurance that natural circulation will be established.

This application appears only once in the EPGs as part of the termination criteria for stopping Once-Through-Cooling (O-T-C). The particular criterion deals with verifying that at least one SG is available to provide a viable heat sink for RCS heat removal before securing O-T-C, by verifying wide range SG level greater than [SG level for terminating O-T-C], nominally 30 %, with feed and controlled steaming capability.

Uncertainties Application Assessment:

This application possesses a low degree of nuclear safety significance, relative to this EOP application. The engineering limit is a nominal value. Therefore category (C03) applies and instrument uncertainties need not be applied when determining an appropriate plant specific operational limit.

The actual amount of operational margin to be applied is arbitrary and up to the analyst. 25% margin was used by the authors of CEN-152. When determining the amount of additional operational margin, it is important to keep in mind that the basic intent of the operational limit. The purpose of the limit is to ensure that when trainsitioning back to SG heat removal, there is more than an adequate feedwater inventory in the SG to support natural circulation, plus some additional margin in case feedwater makeup is temporarily interrupted. Therefore, the minimum required level is proportional to decay heat load. The time required to establish a thermal driving head will vary with decay heat load and initial level. The operational value should include an allowance for a possible interruption of feedwater makeup capability.

Potential Margin Loss Options:

Margin loss is not an issue with this application. Applying a larger amount of instrument uncertainty will move the operational limit in the conservative direction. The consequences of this may possibly result in remaining in OTC longer than necessary. From a safety point of view, this is acceptable.

References:

1. CE-NPSD-154, Natural Circulation Cooldown, Task 430 final Report, section 5.3.5, "RCS Heat Removal", page 5-35.

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 3 - APPLICATION 4

{134}
System Subject Parameter: MS Steam Generator Level

Value: [expected post-trip band]

Use: U11
To verify plant parameters are in the "normal" or expected post-trip range.

Cat: C03

Engineering Limit(s):

Upper = Maximum observed normal post-trip steam generator level.

Lower = Minimum observed normal post-trip steam generator level.

Summary:

The bases for the upper and lower engineering limits is the normal post-trip steam generator level response.

Calculated instrument uncertainties need not be explicitly applied or accounted for in this application.

Basis for Engineering Limit(s):

The bases for the upper and lower engineering limits is the normal or "nominal" post-trip steam generator level response. A nominal value is one that is consistent with the planned or design plant response. Nominal is by definition, not limiting, and may have a wide range of acceptable values depending on plant conditions.

The intent of this application is to establish a post-trip reference band for SG level, where the operator can correctly conclude that the secondary systems are operating satisfactory. This is particularly true when SG level in the [expected post-trip band] is used in SPTA and in RTR.. In CEN-152, the purpose of SPTA and SFSCs is to try to identify safety functions that are being challenged by the event. The ability to maintain [expected post-trip band] implies the RCS heat removal via the steam generators is not being challenged by the event.

The authors of the CEN-152, decided to refer to the no-load SG control band as the "normal control band". For simplicity, the terminology, "normal control band" is used through out the EPGs. This convention is true for all of the referenced EPG applications, even though they may differ slightly on a plant specific level.

The acceptance criteria for RCS heat removal success paths involving a steam generator require that at least one steam generator must have level within the [normal control band] with feedwater available to maintain level, or level being restored to its [normal control band] by feedwater . Based on these requirements, the engineering limits for these uses will be equal to the upper and lower engineering limits for normal operation.

Uncertainties Application Assessment:

The relative degree of safety significance associated with this application in the EOPs is low. This application does not directly impact a safety function. It does not require a high degree of accuracy to conclude that the post-trip response is in the normal band. In this case, the same degree of accuracy that is required for normal operations is acceptable for EOP applications.

It is generally not practical, nor necessary to explicitly apply instrument uncertainties to nominal values. Further, instrument inaccuracy should only be applied to limiting values where the basis for the limit is known, and the limit can be numerically determined. Therefore, for this application, calculated instrument uncertainties need not be explicitly applied or accounted for.

Potential Margin Loss Options:

Not applicable

References:

None

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 3 - APPLICATION 6

{136}
System Subject Parameter: MS Steam Generator Level

Value: [normal control band]

Use: U11
To verify plant parameters are in the "normal" or expected post-trip range.

Cat: C03

Engineering Limit(s):

Upper = Maximum observed normal post-trip steam generator level.

Lower = Minimum observed normal post-trip steam generator level.

Summary:

The bases for the upper and lower engineering limits is the normal post-trip steam generator level response.

Calculated instrument uncertainties need not be explicitly applied or accounted for in this application.

Basis for Engineering Limit(s):

The bases for the upper and lower engineering limits is the normal or "nominal" post-trip steam generator level response. A nominal value is one that is consistent with the planned or design plant response. Nominal is by definition, not <u>limiting</u>, and may have a wide range of acceptable values depending on plant conditions.

The authors of the CEN-152, EPGs decided to refer to the no-load SG control band as the "normal control band". For simplicity, the terminology, "normal control band" is used through out the EPGs. This convention is true for all of the referenced EPG applications, even though they may differ slightly on a plant specific level.

The acceptance criteria for RCS heat removal success paths involving a steam generator require that at least one steam generator must have level within the [normal control band] with feedwater available to maintain level, or level being restored to its [normal control band] by main or auxiliary feedwater. Based on these requirements, the engineering limits for these uses will be equal to the upper and lower engineering limits for normal operation.

Uncertainties Application Assessment:

The relative degree of safety significance associated with this application in the EOPs is low. This application does not directly impact a safety function. It does not require a high degree of accuracy to conclude that SG level is within of being restored to the normal control band. In this case, the same degree of accuracy that is required for normal operations is acceptable for EOP applications.

It is generally not practical, nor necessary to explicitly apply instrument uncertainties to nominal values. Further, instrument inaccuracy should only be applied to limiting values where the basis for the limit is known, and the limit can be numerically determined. Therefore, for this application, calculated instrument uncertainties need not be explicitly applied or accounted for.

Potential Margin Loss Options:

Not applicable

References:

None

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 3 - APPLICATION 7

{137}
System Subject Parameter: MS Steam Generator Level

Value: [top of the indicated range], nominally 85%

Use: U22
To provide corroborative information related to the accomplishment of a safety function.

Cat: C03

Engineering Limit(s):

Upper = the highest reliable and measurable level which can be accepted before steam generator level is considered off-scale high

Summary:

The engineering limit is the highest reliable and measurable level which can be accepted before steam generator level is considered off-scale high. Calculated instrument uncertainties need not be explicitly applied or accounted for in this application because there is no defined upper limit within the range of indication that is being protected against.

Basis for Engineering Limit(s):

The engineering limit is the highest reliable and measurable level which can be accepted before steam generator level is considered off-scale high. A nominal operational limit is 85%. The upper limit maintains level in the indicated range to limit the possibility of filling the affected steam generator to the point that the main steam header is also filled.

This application is used in SGTR instructions. The intent is to maintain the isolated SG level to prevent over filling the SG and keep the tubes covered. If the isolated SG level is rising due to RCS in-leakage, the operator is instructed to let it continue to rise to greater than the [top of the tubes], then maintain it less than the [top of the indicated range].

Uncertainties Application Assessment:

Calculated instrument uncertainties need not be explicitly applied or accounted for in this application because there is no defined upper limit within the range of indication that is being protected against. Instrument uncertainties will not negatively affect accomplishing the intended function of the step because there are several feet of elevation above the upper tap of the SG level instruments to the elevation of the MS lines. Engineering judgement may be used when selecting the highest reliable and measurable level which can be accepted before steam generator level is considered off-scale high.

Potential Margin Loss Options:

Not applicable

References:

None

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 3 - APPLICATION 8

{138}
System Subject Parameter: MS Steam Generator Level

Value: [top of the tube bundle]

Use: U34
To determine if operator actions associated with safety related equipment are necessary to support a safety function.

Cat: C02

Engineering Limit(s):

Lower = the elevation of the top of the steam generator tube bundle.

Summary:

The engineering limit is the elevation of the top of the tube bundle. Accurate SG level indication is very important is this case to effectively execute the associated SG level control strategies. Therefore, instrument uncertainties must be accounted for. Engineering judgement may be used when applying the uncertainties.

Basis for Engineering Limit(s):

The engineering limit is the elevation of the top of the tube bundle. This instrument application is used in SGTR strategies to control level in the isolated SG and to cool\ depressurize the isolated SG to SDC entry conditions.

Uncertainties Application Assessment:

These applications possess of low degree of nuclear safety significance. However, accurate SG level indication is very important to effectively execute the associated SG level control strategies. Instrument uncertainties should be known and accounted for when selecting the associated operational limit. Due to the low safety significance of these applications, engineering judgement may be used when applying the uncertainties.

Potential Margin Loss Options:

Not applicable

References:
None

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 1 of 2)	OK	N/A
1.	Are the deliverables consistent with the Project Plan and the Project Authorization?	✓	
2.	Has the intent of the Engineering Limit been clearly expressed?	✓	
3.	Has the Engineering Limit been clearly identified?	✓	
4.	Has the bases for the Engineering Limit been clearly expressed?	✓	
5.	Has what the Engineering Limit ensures been clearly expressed?	✓	
6.	Have all assumptions been clearly stated?	✓	
7.	Has the relationship of the EPG value or descriptor to nuclear Safety been addressed?	✓	
8.	Does the document explicitly state that instrument uncertainties need or need not be applied for each application?	✓	
9.	Has the rational/justification used in making the applicability determination been clearly expressed?	✓	
10.	Is there evidence that a deliberate effort has been made to consider other options to be used in the event that the instrument uncertainties can not be accommodated when it is desirable for them to be explicitly applied?	✓	

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 2 of 2)	OK	N/A
11.	When necessary, have recommendations for additional analyses, verifications or simulator validations, to confirm assumptions or conclusions, been provided?	✓	
12.	Is there evidence that industry operating experience has been considered and incorporated as appropriate?	✓	
13.	Is there evidence that a deliberate effort has been made to consider the impact of the work product on the health and safety of the public?	✓	
14.	Does the title page contain the following: - Document Title - Document Number - Date of Issue - Correct Revision - Pagination (page 1 of X) - All Required Signatures	✓	
15.	Does the header of each page contain the following: - Sequentially numbered pages (page 1 of X) - Document Number - Correct Revision - Date of Issue	✓	
16.	Is the document legible and reproducible?	✓	
17.	Are all cross-outs and overstrikes initialed and dated by the author?	✓	

Comments/remarks:

PAUL KRAMARCHYK / Paul B. Kramarchyk / 11/12/96
Independent Reviewer: Name/Signature/Date

STEAM GENERATOR
PRESSURE

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 4

MS STEAM GENERATOR PRESSURE {14}

RECORD OF REVISIONS

Rev	Date	Pages	Preparer	Ind.Reviewer	Approver
Draft	04/21/95	ALL	Congdon	Kramarchyk	Greene
00	03/29/96	ALL	Congdon	Smith	Greene
01	11/15/96	ALL	Congdon	Kramarchyk	Greene

PREPARED BY: Joseph R. Congdon
Cognizant Engineer (Print Name)

[signature]
Cognizant Engineer (Signature) Date: 11/11/96

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Attachment 2, (QA Checklist) found in the Project Quality Plan.

Paul Kramarchyk — [signature] — 11/12/96
Name — Signature — Date
Independent Reviewer

APPROVED BY: Mark Greene
Cognizant Engineering Supervisor (Print Name)

[signature] 11/13/96
Cognizant Engineering Supervisor (Signature) Date

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 4 - APPLICATION 1

{141}
System Subject Parameter: MS Steam Generator Pressure

Value: [minimum expected post-trip value], nominally < 800 psia

Use: U11
To verify plant parameters are in the normal or expected post-trip range.

Cat: C03

Engineering Limit(s):

Upper = Minimum expected normal post-trip SG pressure.

Lower = Main Steam Isolation System (MSIS) setpoint.

Summary:

The upper engineering limit is based on the lowest expected post-trip steam generator pressure. The lower engineering limit is based on the low steam generator pressure setpoint for MSIS for in technical specifications. The operational limit and engineering limit are intended to mitigate or prevent excessive RCS heat removal resulting from a malfunction of the Turbine Bypass Valves (TBVs), Atmospheric Dump Valves (ADVs), or Main Steam Safety Valves (MSSVs).

Instrument uncertainties need not be applied in this application because it is backed up by MSIS which is designed to protect the core in severe overcooling events, independent of operator action.

Basis for Engineering Limit(s):

The bases for the upper engineering limit is the lowest expected post-trip steam generator pressure. The bases for the lower limit is the same as the bases for the TS low SG pressure setpoint for MSIS (refs.1 and 2).

This application is used in standard post trip actions (SPTAs), reactor coolant system (RCS) Heat Removal contingency actions to provide early recognition of an over-cooling event and to verify that the secondary systems are working properly.

In this application, the operator is directed to ensure that the turbine bypass valves (TBVs), atmospheric dump valves (ADVs), and main steam safety valves (MSSVs) are closed if SG pressure is less than the [minimum expected post-trip value], nominally < 850 psia . The operational limit should be set for approximately 50 psia below the upper engineering limit, (approximately 800 psia). The limit is intended to detect off-normal SG pressure response following a reactor trip. It is assumed that if SG pressure decreases to less than the [minimum expected post-trip value], nominally < 850 psia , approximately 100 psia below the normal control point, then some system abnormality exists that should be investigated and corrected. The operational limit should be far enough below the [expected post-trip band], nominally 850 - 920 psia] to minimize unnecessary operator action, but high enough to allow time for the operator to identify and correct a control system problem prior to reaching the MSIS setpoint.

The degree of safety significance of this application is low because MSIS will back up any omitted operator action. CEN-152 revision 03 did not include instrument uncertainties in the [800 psia] EPG operational limit.

Uncertainties Application Assessment:

Explicit SG pressure instrument uncertainties need not be applied or specifically accounted for in the equivalent plant specific operational limit.

This application was category two (C02) in CEOG task 776, CE-NPSD-925, revision 00. As a result of a more extensive review of this application in this task, this application has been changed to category three (C03). This change is justified for the following reasons:

1. The lack of absolute accuracy of the SG pressure instrumentation in this case will not prevent the operator from accomplishing the intended function of this instrument application.
2. There is significant redundant and corroborative instrumentation available to the operator to address the intent of this instrument application.
3. The instrument application is backed up by and MSIS which is designed to protect the core in sever overcooling events, independent of operator action.

The plant specific operational limit should be less than the no-load SBCS control program band and less than the typical SG pressure trend following an uncomplicated reactor trip. The selected value should be far enough below the SBCS control program to avoid unnecessary operator intervention, while still high enough to give the operator time to find and correct a problem prior to a MSIS actuation, if possible.

Potential Margin Loss Options:

Not applicable

References:

1. CEN-355, Restructured Standard Technical Specifications, Volume 3, Bases, May 1989, page B 3.2-46A

2. NUREG-1432, Revision 01 "Standard Technical Specifications Combustion Engineering Plants, page B 3.3-17 and B 3.3-20

**EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT**

MODULE 1 - DOCUMENT 4 - APPLICATION 2

{142}
System Subject Parameter: MS Steam Generator Pressure

Value: [lowest MSSV setpoint] or [maximum expected post trip value], nominally 950 psia.

Use: U27
To prevent or mitigate off-site exposure to the public.

Cat: C01

Engineering Limit(s):

Upper = less than the equivalent pressure to the lowest set Main Steam Safety Valve (MSSV), including lift tolerance.

Summary:

The engineering limit is the pressure setpoint for the lowest lifting main steam safety valve, plus lift tolerance. Maintaining this limit prevents an uncontrolled release of radioactivity from a ruptured steam generator through the MSSVs.

An explicit plant specific instrument uncertainty calculation should be performed for this application due to its relationship to off-site exposure to the public as described in the bases section. The derived uncertainties should be applied to the plant specific engineering limit when determining the appropriate plant specific operational limit.

Basis for Engineering Limit(s):

The bases for the engineering limit is the lift setpoint of the lowest MSSV, plus lift tolerance.

The intent of the application is prevent lifting an MSSV which then sticks open, resulting in an uncontrolled release to the environment, because the operator can do nothing to stop it.
The CEN-152 revision 03 operational limit [≤ 950 psia] was derived by taking the lowest MSSV setting [1000 psia.], subtracting the lift tolerance, typically ±1% (ref.1), [± 10 psi], and additional operational margin [40 psi].

This application appears in steam generator tube rupture (SGTR) and in heat removal (HR-and HR-2) of the functional recovery guideline (FRG). In these steps the operator is directed to maintain the affected steam generator (SG) pressure less than the [lowest MSSV lift setpoint], nominally 950 psia.] once the ruptured SG has been isolated. The operator is instructed to operate the atmospheric dump valves (ADVs) from the Control Room, or locally as necessary. Maintaining this operational limit prevents an uncontrolled release of radioactivity from the ruptured SG to the environment via the MSSVs, if the MSSV sticks open after actuating. The objective is to use the ADVs to control SG pressure prior to reaching the MSSV lift setpoint.

It is believed that this application was included in earlier revisions of CEN-152 during its development in response to NRC concerns about off-site exposure during a SGTR event. However, documented evidence in support this belief could not be located.

In SGTR, the steam generator with higher activity, higher radiation levels, or increasing water level should be isolated. Reducing RCS temperature to below the saturation temperature associated with the setpoint of the lowest MSSV is one of the actions required to prevent inadvertent opening the isolated SG MSSV, which is a direct path to the environment. However, should the pressure in the isolated SG approach the lift setpoint for the isolated SG MSSVs for steam generator protection, it is more desirable from the perspective of positive operator control that the ADVs open first. This is accomplished by raising the automatic ADV lift setpoint to the upper end of the [expected post-trip band], nominally 850 - 920 psia, or by manually\locally opening the ADV at the upper end of the [expected post-trip band], nominally 850 - 920 psia and increasing, if it fails to open in auto. To minimize release of radioactivity to the environment, opening the affected SG ADVs should be minimized.

This instrument application helps ensure that the assumptions in accident analysis associated with off-site exposure during design basis events (DBEs) are not exceeded. Instrumentation used to mitigate off-site exposure to the public have a high priority in 10 CFR 50 Appendix A criteria. Therefore, this instrument application is considered to have a high degree of nuclear safety significance.

Uncertainties Application Assessment:

An explicit plant specific instrument uncertainty calculation (C01) should be performed for the SG pressure instruments used by the operator in this application. The derived uncertainties should be applied to the plant specific engineering limit when determining the appropriate plant specific operational limit.

The application of instrument uncertainties is important to carrying out the intent of this particular instrument application due to its relationship to off-site exposure to the public as described in the bases section.

The plant specific engineering limit is derived as described in the bases section. The plant specific operational limit is arrived at by subtracting plant specific SG pressure instrument uncertainties from the plant specific engineering limit.

Additional operational margin is taken from the resultant value to arrive at a readable and controllable operational limit. The amount of additional operational margin is arrived at subjectively. When doing so, it is important to keep in mind the basic intent of the operational limit and what it is designed to protect against, i.e. inadvertent or unnecessary opening of the MSSVs on an isolated steam generator with a tube rupture. Deliberate operation of the ADVs is preferred, if necessary to control SG pressure. The operational limit should be high enough to avoid unnecessarily opening the ADVs, but low enough to ensure operator action prior to lifting an MSSV. Equipment location, operator training, and response time should be factored in to the value determination. The value should be easy to read on the designated SG pressure indicators.

This application occurs in SGTR and in the Functional Recovery Procedure. Consequently, harsh containment instrument uncertainties need to be included for the FRG instrument application.

Potential Margin Loss Options:

If when plant specific instrument uncertainties are applied to the plant specific engineering limit and the resultant margin between the engineering limit and the operational limit is not acceptable, the following options may be considered:

1. SG temperature indication (if available) could be used to determine the equivalent saturated SG pressure. The operator would have to place the controller in manual and operate the ADVs manually using this indication. Directing the operator to take action based on SG shell temperature instrumentation to address the intent of this application may have unacceptable limitations. For example, deriving the equivalent saturation pressure requires that the operator refer to the steam tables.

2. T hot in the affected loop will be approximately equal to the affected SG temperature. Therefore, SG pressure will be approximately equal to the saturation temperature associated with T hot. It should be noted that this will not be true under some circumstances, (e.g. forced flow in an isolated SG loop during a rapid RCS cooldown).

References:

1. ASME Boiler and Pressure Vessel Code, Section III, Article NC-7000, "Overpressure Protection" Class 2 Components.

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 4 - APPLICATION 3

{143}
System Subject Parameter: MS Steam Generator Pressure

Value: [expected post-trip band], nominally 850 - 920 psia

Use: U11
To verify plant parameters are in the normal or expected post-trip range.

Cat: C03

Engineering Limit(s):

Upper = 35 psi above a nominal [885 psia] setpoint for the TBVs/SBCS

Lower = 35 psi below a nominal [885 psia] setpoint for the TBVs/SBCS

Summary:

The engineering and operational limits are based on a 10°F post-trip RCS temperature control band of nominally [525 - 535°F] which was established based on engineering judgment (including, but not centered on the no-load temperature) to arrive at the SG pressure control band.

Instrument uncertainties need not be applied in this application. Instrument uncertainties were already included when establishing the normal TBVs/SBCS control band. In addition, it does not require a high degree of instrument accuracy to verify that a parameter is within the normal control band.

Basis for Engineering Limit(s):

The engineering and operational limits are based on a 10°F post-trip RCS temperature control band of nominally [525 - 535°F] which was established based on engineering judgment (including, but not centered on the no-load temperature) to arrive at the SG pressure control band. The resulting nominal SG pressure band is [850 - 920 psia], with a nominal TBV setpoint of 885 psia.. The intent of this application is to assist the operator in detecting a malfunction of the TBVs, MSSVs or steam bypass control system (SBCS) as soon as possible.

This application is used in Standard Post Trip Actions (SPTAs) as part of the criteria for acceptable Reactor Coolant System (RCS) heat removal, i.e. at least one steam generator (SG) has level in the [normal control band] or feedwater restoring level to the [normal control band], average RCS temperature within the [expected post-trip band], and SG pressure within the [expected post-trip band].
The high and low operational limits are intended to define the normal post-trip SG pressure band, and thereby assist the operator in detecting and responding to a malfunction with the TBVs, MSSVs or steam bypass control system (SBCS) as soon as possible. The TBVs/SBCS is designed to remove decay heat and sensible heat following a reactor trip without overcooling the RCS.

Uncertainties Application Assessment:

This instrument application does not directly impact a safety function. Therefore, it does not require a high degree of accuracy. Explicit SG pressure instrument uncertainties need not be applied or specifically accounted for in determining the appropriate plant specific operational limit.

This application is used to confirm that SG pressure is within the expected range (normal control band) following an uncomplicated reactor trip. It is used to help the operator verify that the TBVs/SBCS is functioning properly.

Potential Margin Loss Options:

Not applicable

References:
None

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 1 - DOCUMENT 4 - APPLICATION 4

{144}
System Subject Parameter: MS Steam Generator Pressure

Value: [MSIS setpoint], nominally 500 psia.

Use: U13
To verify automatic actuation of the ESFAS due to its setpoint being exceeded, or to indicate directly to the operator to manually actuate the safety systems associated with those setpoints since they failed to automatically actuate.

Cat: C03

Engineering Limit(s):

Lower = the technical specification engineered safety features actuation system (ESFAS) setpoint for main steam isolation system (MSIS) on low steam generator (SG) pressure.

Summary:

The bases for the engineering limit is the same as the bases for the technical specification low steam generator pressure setpoint for MSIS. This application is used in SPTA (RCS heat removal), to prompt the operator to ensure that MSIS has actuated at the low SG pressure setpoint.

Instrument uncertainties need not be applied for this application, because the ESFAS setpoint is included only for the purpose of ensuring actuation at setpoint.

Basis for Engineering Limit(s):

The bases for the engineering limit is the same as the bases for the TS low SG pressure setpoint for MSIS. The operational limit is the same as the engineering limit. The MSIS setpoint is set sufficiently below the full load operating value for steam pressure so as not to interfere with normal plant operation. However, the setting is high enough to provide the required protection for excessive steam demand. An excessive steam demand causes the RCS to cool down resulting in a positive reactivity addition to the core. A MSIS is required to prevent the excessive cooldown(refs.1 and 2).

This instrument application is used in standard post trip actions (SPTAs), RCS heat removal, to prompt the operator to ensure that main steam isolation system (MSIS) has actuated on low SG pressure. The intent of the application is to prompt the operator to verify automatic MSIS actuation or to manually initiate MSIS if it did not actuate when required.

The engineering limit establishes the decreasing SG pressure value at which automatic pressure controls activate to backup the SBCS to mitigate an excessive heat removal event independent of operator action.

Uncertainties Application Assessment:

This application is a nominal ESFAS actuation setpoint. Since the intent is to verify MSIS actuation at setpoint, it serves no useful purpose to add additional uncertainties to those already applied to establish the MSIS setpoint.

Instrument uncertainties are not applied in this case because we do not want the operator to initiate any safety signal too early. Such action may further complicate an event. Also, we expect the safety systems to automatically initiate when designed and the design setpoint already accounts for instrument uncertainties (ref. 2). Therefore, this should only be a manual backup in case the automatic setpoint does not initiate.

In addition, failure of the RPS and ESFAS systems to automatically actuate (as would be the case if manual actuation was required) is considered to be outside design bases space. Therefore, it is not possible to accurately calculate and apply instrument uncertainties in a meaningful manner in this operational space.

Finally, no additional instrument uncertainties need to be added to the ESFAS setpoint because doing so would unnecessarily complicate the EOPs by creating a second number to be used in the EOPs for MSIS actuation verification. This would place an unjustified burden on the operator.

Potential Margin Loss Options:

Not applicable

References:

1. CEN-355, Restructured Standard Technical Specifications, Volume 3, Bases, May 1989, page B 3.2-46A

2. NUREG-1432, Revision 01 "Standard Technical Specifications Combustion Engineering Plants, page B 3.3-17 and B 3.3-20

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 1 of 2)	OK	N/A
1.	Are the deliverables consistent with the Project Plan and the Project Authorization?	✓	
2.	Has the intent of the Engineering Limit been clearly expressed?	✓	
3.	Has the Engineering Limit been clearly identified?	✓	
4.	Has the bases for the Engineering Limit been clearly expressed?	✓	
5.	Has what the Engineering Limit ensures been clearly expressed?	✓	
6.	Have all assumptions been clearly stated?	✓	
7.	Has the relationship of the EPG value or descriptor to nuclear Safety been addressed?	✓	
8.	Does the document explicitly state that instrument uncertainties need or need not be applied for each application?	✓	
9.	Has the rational/justification used in making the applicability determination been clearly expressed?	✓	
10.	Is there evidence that a deliberate effort has been made to consider other options to be used in the event that the instrument uncertainties can not be accommodated when it is desirable for them to be explicitly applied?	✓	

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 2 of 2)	OK	N/A
11.	When necessary, have recommendations for additional analyses, verifications or simulator validations, to confirm assumptions or conclusions, been provided?	✓	
12.	Is there evidence that industry operating experience has been considered and incorporated as appropriate?	✓	
13.	Is there evidence that a deliberate effort has been made to consider the impact of the work product on the health and safety of the public?	✓	
14.	Does the title page contain the following: - Document Title - Document Number - Date of Issue - Correct Revision - Pagination (page 1 of X) - All Required Signatures	✓	
15.	Does the header of each page contain the following: - Sequentially numbered pages (page 1 of X) - Document Number - Correct Revision - Date of Issue	✓	
16.	Is the document legible and reproducible?	✓	
17.	Are all cross-outs and overstrikes initialed and dated by the author?	✓	

Comments/remarks:

PAUL KRAMARCHYK, Paul B. Kramarchyk, 4/12/96
Independent Reviewer: Name/Signature/Date

RADIATION
MONITORING

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 1

RADIATION MONITORS {21}

RECORD OF REVISIONS

Rev	Date	Pages	Preparer	Ind.Reviewer	Approver
Draft	05/19/95	ALL	Kramarchyk	Wild	Greene
Draft	10/31/95	ALL	Congdon	N/A	N/A
00	03/29/96	ALL	Congdon	Smith	Greene
01	11/15/96	ALL	Congdon	Kramarchyk	Greene

PREPARED BY: Joseph R. Congdon
Cognizant Engineer (Print Name)

[signature]
Cognizant Engineer (Signature) Date: 11/11/96

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Attachment 2, (QA Checklist) found in the Project Quality Plan.

Paul Kramarchyk [signature] 11/12/96
Name Signature Date
Independent Reviewer

APPROVED BY: Mark Greene
Cognizant Engineering Supervisor (Print Name)

[signature] 11/13/96
Cognizant Engineering Supervisor (Signature) Date

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 1 - APPLICATION 1

{211}
System Subject Parameter: Cond Air Eject Rad Monitor Activity

Value: Condenser offgas monitor[alarm]

Use: U28
To prevent significant releases of radioactive material to the environment by plant configuration control during accident conditions

Cat: C03

Engineering Limit(s):

Upper = condenser off-gas monitor alarm value.

Summary:

The engineering limit is the condenser off-gas monitor alarm setpoint, based on the minimum detectable activity. The intent of the application is to assist the operator in diagnosing a steam generator tube rupture event.

Instrument uncertainties, in addition to those all ready included in the alarm setpoint, need not be applied. Alarm setpoints are adjusted/calibrated under the direction of other controlled procedures. The EOPs simply use the existing alarm to assist in identifying steam generator tube rupture events.

Bases for Engineering Limit(s):

The engineering limit is based on the minimum detectable activity which is defined as the smallest concentration of radioactive material in a sample that will consistently yield a net count, above system and detector background, with a low [5%] probability of non-detection or false detection (e.g. nuisance alarm). Minimum detectable is further defined as the following:
1) the threshold level at which the detection system will consistently detect the signal,
2) the level that could be detected most of the time, and not detected only occasionally,
3) however defined, does not guarantee with certainty the presence or absence of a signal, it is a function of statistics, probabilities and background (ref 2).

The intent of this application is to assist the operator in diagnosing a SGTR event, and to help to discriminate between a SGTR and other events that result in indications of RCS inventory loss (i.e. LOCAs and ESDEs). The importance of basing the alarm setpoint on minimum detectable activity is further supported by a review of a recent SGTR event. This event provides more evidence that the condenser off-gas monitor alarm setpoint should not be based on projected site boundary dose, but on the activity levels in the primary and secondary coolant.

After reviewing the above event, an NRC Augmented Inspection Team (AIT) concluded that because of this inappropriate setting, the condenser off-gas monitor alarm could not have provided reliable and timely indication of a tube rupture (ref. 1). In fact, the condenser off-gas monitor did not alarm until about 1 hour after the SGTR occurred due to the high alarm setpoint based on off-site dose and because the monitor was not within calibration tolerances. This resulted in a substantial delay in diagnosing the SGTR, and therefore prevented the operators from taking prompt mitigative actions in accordance with plant emergency procedures. In addition they concluded that operators should not overly rely on high radiation alarms to provide early warning of abnormal rad levels. They stressed the importance of the operator trending radiation and radioactivity levels, and being alert to unexplained changes.

The condenser offgas high activity, including the high alarm is important to plant safety because it is used to alert the operator to the onset of a radioactive release to the environment.

The determination of the alarm setpoint is not addressed in this document.

Uncertainties Application Assessment:

This application is category 03. It is not necessary to apply additional instrument uncertainties for this EOP use because this monitor alarm setpoint is adjusted/calibrated under other controlled procedures. The EOPs simply use the existing setpoint to provide indication of a SGTR event.

Periodic adjustment of the alarm setpoint may be required to accommodate changes in SG activity, due to small changes in SG tube leakage that may be within the bounds of the technical specification limits, as well as variations in detector Background. Adjustments to the air ejector high activity alarm setpoint should be made to maintain the operational integrity of the alarm, such that further degradation of SG tube performance (i.e., increased activity) can be readily detected.

An alarm setpoint based on minimum detectable activity is justified for this application because of its importance in detecting SGTRs. This application is not related to off-site dose projections for DBAs.

Design basis steam generator tube rupture events would result in a large increase in condenser off-gas activity, much greater than the minimum level of detection and the alarm setpoint. Smaller tube ruptures (or leaks) would be detected and confirmed by monitoring changes in condenser off-gas activity and changes in steam generator secondary chemistry. In the EOPs, the primary use of the high radiation alarm is to aid in quick initial diagnoses of an event. Once the alarm has done its job, the operators focus then becomes trending the direction and magnitude of change to confirm diagnoses. Applying additional instrument uncertainties will have no impact on the operators ability to do this.

Potential Margin Loss Options:

Not applicable.

References:

1) NRC Information Notice 93-56, 7/22/93

2) NCRP Report No.58, A Handbook of Radioactivity Measurements Procedures, May 15, 1989

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 1 - APPLICATION 2

{212}
System Subject Parameter: Containment Area Radiation

Value: Containment area or atmospheric radiation monitor [alarm]

Use: U28
To prevent significant releases of radioactive material to the environment by plant configuration control during accident conditions

Cat: C03

Engineering Limit(s):

Upper = containment area radiation monitor alarm value.

Summary:

The engineering limit is the alarm setpoint, which is based on the minimum detectable radiation levels above background. The intent of this application is to determine if containment isolation is necessary, if containment integrity is being maintained, and to confirm that the radiation alarm is consistent with the diagnosed event.

Instrument uncertainties, in addition to those all ready included in the alarm setpoint, need not be applied. Alarm setpoints are adjusted/calibrated under the direction of other controlled procedures. The EOPs simply use the existing alarm to assist in identifying and categorizing emergency events.

Bases for Engineering Limit(s):

The engineering limit is based on the minimum detectable activity which is defined as the smallest concentration of radioactive material in a sample that will consistently yield a net count, above system and detector background, with a low [5%] probability of non-detection or false detection (e.g. nuisance alarm). Minimum detectable is further defined as the following:
1) the threshold level at which the detection system will consistently detect the signal,
2) the level that could be detected most of the time, and not detected only occasionally,
3) however defined, does not guarantee with certainty the presence or absence of a signal, it is a function of statistics, probabilities and background (ref 1).

The intent of the application is to determine if containment isolation is necessary and/or if containment integrity is being maintained, and to confirm that the radiation alarm is consistent with the diagnosed event. The operator is expected to routinely monitor and trend radiation and radioactivity levels, and be alert to unexplained changes. In the context of the EOPs, increases in containment area radiation may be indicative of a LOCA, core uncovery and core damage, or another containment radiation anomaly that must be investigated further to determine its full meaning and implications to plant safety.

The determination of the alarm setpoint is not addressed in this document.

Uncertainties Application Assessment:

This application is category 03. It is not necessary to apply additional instrument uncertainties for this EOP use because this monitor alarm setpoint is adjusted/calibrated under other controlled procedures. The EOPs simply use the existing setpoints to accomplish the stated intent.

Design basis events would result in a large increase in containment radiation levels, much greater than the minimum level of detection and the alarm setpoint. Less than design base events may be detected by high alarms and would be confirmed by trending the radiation levels. In the EOPs, the primary use of the high radiation alarm is to aid in quick initial diagnosis of an event. Once the alarm has done its job, the operators focus then becomes trending the direction and magnitude of change to confirm diagnosis. Instrument uncertainties will have no impact on the operators ability to do this.

Potential Margin Loss Options:

not applicable

References:

1) NCRP Report No.58, A Handbook of Radioactivity Measurements Procedures, May 15, 1989

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 1 - APPLICATION 3

{213}
System Subject Parameter: MS Activity Alarm

Value: Steam plant activity monitor[alarm]

Use: U28
To prevent significant releases of radioactive material to the environment by plant configuration control during accident conditions

Cat: C03

Engineering Limit(s):

Upper = steam plant activity monitor alarm values.

Summary:

The engineering limit is the alarm setpoint, which is based on the minimum detectable radiation levels above background. The intent of the application is to determine if containment isolation is necessary, if containment integrity is being maintained, and to confirm that the radiation alarm is consistent with the diagnosed event.

Instrument uncertainties, in addition to those all ready included in the alarm setpoint, need not be applied. Alarm setpoints are adjusted/calibrated under other controlled procedures. The EOPs simply use the existing setpoint to provide indication of a SGTR event.

Bases for Engineering Limit(s):

The engineering limit is based on the minimum detectable activity which is defined as the smallest concentration of radioactive material in a sample that will consistently yield a net count, above system and detector background, with a low [5%] probability of non-detection or false detection (e.g. nuisance alarm). Minimum detectable is further defined as the following:
1) the threshold level at which the detection system will consistently detect the signal,
2) the level that could be detected most of the time, and not detected only occasionally,
3) however defined, does not guarantee with certainty the presence or absence of a signal, it is a function of statistics, probabilities and background (ref 1).

The intent of the application is to help the operator determine if containment isolation is necessary and/or if containment integrity is being maintained and to aid in determining if the radiation alarm is consistent with the diagnosed event. This application is also used to assist the operator in diagnosing a SGTR event. The operator is expected to routinely monitor and trend radiation and radioactivity levels, and be alert to unexplained changes. In the context of the EOPs, steam plant activity monitor alarms may be indicative of a SGTR, or other steam plant radiation anomaly that must be investigated further to determine its full meaning and implications to plant safety.

The determination of the alarm setpoint is not addressed in this document.

Uncertainties Application Assessment:

This application is category 03. It is not necessary to apply additional instrument uncertainties because this monitor alarm setpoint is adjusted/calibrated under other controlled procedures. The EOPs simply use the existing setpoint to provide indication of a SGTR event.

In the EOPs, the primary use of the high radiation alarm is to aid in quick initial diagnoses of an event. Once the alarm has done its job, the operators focus then becomes trending the direction and magnitude of change to confirm diagnoses. Instrument uncertainties will have no impact on the operators ability to do this.

Potential Margin Loss Options:

not applicable

References:

1) NCRP Report No.58, A Handbook of Radioactivity Measurements Procedures, May 15, 1989

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 1 - APPLICATION 4

{214}
System Subject Parameter: Process Rad Mon Alarm

Value: Process radiation monitor [alarm]

Use: U28
To prevent significant releases of radioactive material to the environment by plant configuration control during accident conditions

Cat: C03

Engineering Limit(s):

Upper = process radiation monitor alarm values.

Summary:

The engineering limit is the alarm setpoint, which is based on the minimum detectable radiation levels above background. The intent of the application is to prompt the operator to investigate the cause of the high radiation and to confirm that the radiation alarm is consistent with the diagnosed event.

Instrument uncertainties, in addition to those all ready included in the alarm setpoint, need not be applied. Alarm setpoints are adjusted/calibrated under the direction of other controlled procedures. The EOPs simply use the existing alarm to assist in identifying and categorizing emergency events.

Bases for Engineering Limit(s):

The engineering limit is based on the minimum detectable activity which is defined as the smallest concentration of radioactive material in a sample that will consistently yield a net count, above system and detector background, with a low [5%] probability of non-detection or false detection (e.g. nuisance alarm). Minimum detectable is further defined as the following:
1) the threshold level at which the detection system will consistently detect the signal,
2) the level that could be detected most of the time, and not detected only occasionally,
3) however defined, does not guarantee with certainty the presence or absence of a signal, it is a function of statistics, probabilities and background (ref 1).

The intent of the application is to prompt the operator to investigate the cause of the high radiation and to confirm that the radiation alarm is consistent with the diagnosed event. The operator is expected to routinely monitor and trend radiation and radioactivity levels, and be alert to unexplained changes. In the context of the EOPs, steam plant activity monitor alarms may be indicative of a SGTR, or other steam plant radiation anomaly that must be investigated further to determine its full meaning and implications to plant safety.

The determination of the alarm setpoint is not addressed in this document.

Uncertainties Application Assessment:

This application is category 03. It is not necessary to apply additional instrument uncertainties for this EOP application because this monitor alarm setpoint is adjusted/calibrated under other controlled procedures. The EOPs simply use the existing setpoint to provide indication associated to the event in progress.

In the EOPs, the primary use of the high radiation alarm is to aid in quick initial diagnoses of an event. Once the alarm has done its job, the operators focus then becomes trending the direction and magnitude of change to confirm diagnoses. Instrument uncertainties will have no impact on the operators ability to do this.

Potential Margin Loss Options:

not applicable

References:

1) NCRP Report No.58, A Handbook of Radioactivity Measurements Procedures, May 15, 1989

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 1 of 2)	OK	N/A
1.	Are the deliverables consistent with the Project Plan and the Project Authorization?	✓	
2.	Has the intent of the Engineering Limit been clearly expressed?	✓	
3.	Has the Engineering Limit been clearly identified?	✓	
4.	Has the bases for the Engineering Limit been clearly expressed?	✓	
5.	Has what the Engineering Limit ensures been clearly expressed?	✓	
6.	Have all assumptions been clearly stated?	✓	
7.	Has the relationship of the EPG value or descriptor to nuclear Safety been addressed?	✓	
8.	Does the document explicitly state that instrument uncertainties need or need not be applied for each application?	✓	
9.	Has the rational/justification used in making the applicability determination been clearly expressed?	✓	
10.	Is there evidence that a deliberate effort has been made to consider other options to be used in the event that the instrument uncertainties can not be accommodated when it is desirable for them to be explicitly applied?	✓	

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 2 of 2)	OK	N/A
11.	When necessary, have recommendations for additional analyses, verifications or simulator validations, to confirm assumptions or conclusions, been provided?	✓	
12.	Is there evidence that industry operating experience has been considered and incorporated as appropriate?	✓	
13.	Is there evidence that a deliberate effort has been made to consider the impact of the work product on the health and safety of the public?	✓	
14.	Does the title page contain the following: - Document Title - Document Number - Date of Issue - Correct Revision - Pagination (page 1 of X) - All Required Signatures	✓	
15.	Does the header of each page contain the following: - Sequentially numbered pages (page 1 of X) - Document Number - Correct Revision - Date of Issue	✓	
16.	Is the document legible and reproducible?	✓	
17.	Are all cross-outs and overstrikes initialed and dated by the author?	✓	

Comments/remarks:

PAUL KRAMARCHYK / [signature] / 11/12/96
Independent Reviewer: Name/Signature/Date

CONTAINMENT HYDROGEN CONCENTRATION

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 2

CONTAINMENT HYDROGEN CONCENTRATION {22}

RECORD OF REVISIONS

Rev	Date	Pages	Preparer	Ind.Reviewer	Approver
Draft	05/19/95	ALL	Kramarchyk	Wild	Congdon/Greene
Draft	10/31/95	ALL	Congdon	N/A	N/A
00	03/29/96	ALL	Congdon	Smith	Greene
01	11/15/96	ALL	Congdon	Kramarchyk	Greene

PREPARED BY: Joseph R. Congdon
Cognizant Engineer (Print Name)

[signature]
Cognizant Engineer (Signature) Date: 11/8/96

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Attachment 2, (QA Checklist) found in the Project Quality Plan.

Paul Kramarchyk — [signature] — 11/11/96
Name — Signature — Date
Independent Reviewer

APPROVED BY: Mark Greene
Cognizant Engineering Supervisor (Print Name)

[signature] 11/13/96
Cognizant Engineering Supervisor (Signature) Date

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 2 - APPLICATION 1

{221}
System Subject Parameter: Containment Hydrogen Concentration

Value: [minimum detectable concentration], nominally 0.5 %

Use: U20
To determine when to activate a safety related SSC for which no automatic initiation is provided in support of a safety function, safe shutdown, cooldown or depressurization.

Cat: C01

Value: [minimum detectable concentration], nominally < 0.5 %

Use: U34
To determine if operator actions associated with safety related equipment are necessary to support a safety function.

Cat: C02

Value: [minimum detectable concentration], nominally 0.5 %

Use: U19
To provide indirect support for accomplishment of a safety function.

Cat: C02

Engineering Limit(s):

Upper = the lower flammability concentration of hydrogen in dry air <u>or</u> the most limiting value assumed in the SAR.

Summary:

The engineering limit establishes a nominal value for hydrogen that is high enough to be within the limits of detectability, yet low enough to permit the operator to take corrective action prior to the hydrogen concentration reaching hazardous levels (i.e. the flammability limit).

Category one (C01) instrument uncertainties should be conservatively applied to the upper engineering limit when arriving at all the associated EPG values, regardless of category application.

Bases for Engineering Limit(s):

The upper engineering limit is based on the design criteria for the Hydrogen Recombiners which is to control the bulk hydrogen concentration in containment to less than the [lower flammable concentration for hydrogen], , nominally 4.0% v/o, following a DBA. This control would prevent a containment wide hydrogen burn, thus ensuring the pressure and temperature assumed in the analysis are not exceeded and minimizing damage to safety related equipment located in containment. The limiting DBA relative to hydrogen generation is a LOCA (ref. 1).

Studies have shown that in dry air and abundant oxygen, the lower limit of flammability for H2 is 4%. Therefore, the engineering limit is usually <u>conservatively</u> set at 4% (since the Containment atmosphere will contain moisture) (refs. 1 and 2).

Although hydrogen is not flammable until it reaches the lower limit of flammability, it is prudent to maintain hydrogen concentration as low as possible. Therefore, H2 recombiners are placed in service at [minimum detectable concentration], nominally 0.5 % . Such action minimizes the possibility of reaching the lower limit of flammability. It also preserves the assumptions made in the Safety Analyses (ref 2).

The intent of the engineering limits is to establish a low nominal value for H2 concentration that is high enough to be within the limits of detectability, yet low enough to prompt taking corrective action prior to reaching hazardous levels. The EPG authors of earlier revisions to CEN-152 assumed [0.5%] H2 concentration to be the lower limit of detection (LLD) and therefore established [0.5%] as the generic operational target value.

These instrument applications are used in the following context in CEN-152: 1) less than [minimum detectable concentration], nominally 0.5 % hydrogen concentration is used in LOCA, ESDE, and CCCG-1 safety function status checks as an acceptance criterion for Containment Combustible Gas, 2) greater than [minimum detectable concentration], nominally 0.5 % hydrogen concentration is used as the setpoint to initiate hydrogen Recombiner operation.

Uncertainties Application Assessment:

Category one (C01) instrument uncertainties should be applied to the upper engineering limit. Additional operational margin should then be subtracted to arrive at an operational limit corresponding to LLD. This will ensure that the Containment Combustible Gas Control safety function criterion is maintained below the lower flammability limit and therefore meets the intent of the engineering limit.

Potential Margin Loss Options:

Not applicable

References:

1) NUREG-1432, Revision 01: (A) Section 3.3.11 (Analog), "Post Accident Monitoring (PAM) Instrumentation,", (B) Section 3.3.11 (Digital), "Post Accident Monitoring (PAM) Instrumentation (Digital), (C) Section B 3.3.11 (Analog), and (D) Section B 3.3.11 (Digital) Page 6 of 13

2) NUREG-1432, revision 01, Section B 3.6.8 (Pages B 3.6-71 through B 3.6-75.)

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 2 - APPLICATION 2

{222}
System Subject Parameter: Containment Hydrogen Concentration

Value: [lower flammability concentration for hydrogen], nominally 4 %

Use: U08
To verify or ensure Containment Combustible Gas Control Safety Function Acceptance Criteria are satisfied.

Cat: C01

Engineering Limit(s):

Upper = the lower flammability concentration for hydrogen in dry air <u>or</u> the most limiting value assumed in the SAR.

Summary:

The engineering limit is based on ensuring the containment hydrogen concentration remains less than the lower flammable concentration following a DBA, nominally [lower flammability concentration for hydrogen], nominally 4 % v/o. The intent of this instrument application is to establish Containment Combustible Gas Control H2 concentration safety function acceptance criteria that is less than the lower flammability concentration for hydrogen in the Containment.

Category one (C01) instrument uncertainties should be applied to the engineering limit to arrive at a conservative operational value.

Bases for Engineering Limit(s):

The engineering limit is based on ensuring the containment H2 concentration remains less than the lower flammable concentration following a DBA, nominally [4.0%] v/o. This control would prevent a containment wide hydrogen burn, thus ensuring the pressure and temperature assumed in the analysis are not exceeded as a result of the burn and minimizing damage to safety related equipment located in containment.

The limiting DBA relative to hydrogen generation is a LOCA (ref.1)

Studies have shown that in dry air and abundant oxygen, the lower limit of flammability for H2 is 4%. Therefore, the engineering limit is conservatively set at 4% (since the Containment atmosphere will contain moisture). The authors of CEN-152 incorporated NRC guidance that the Containment Combustible Gas Control Safety Function Acceptance Criteria should be less than the lower flammability concentration for hydrogen in the Containment, and within the design capacity of the hydrogen recombiners. It was the informed opinion of the working group that in making that determination. The CEN-152 authors used data that was generated for the NRC in post-TMI studies. No controlled documentation in support of this opinion was located.

The intent of this instrument application is to establish Containment Combustible Gas Control H2 concentration safety function acceptance criteria that is less than the lower flammability concentration for hydrogen in the Containment.

Uncertainties Application Assessment:

Category one (C01) instrument uncertainties should be applied to the engineering limit to arrive at a conservative H2 concentration operational value. This will ensure that the Containment Combustible Gas Control safety function criterion is below the lower flammability limit and therefore meets the intent of the engineering limit.

Potential Margin Loss Options:

1) More accurate H2 measuring devices may be required in order to meet the intent of the engineering limit.

References:

1) NUREG-1432, revision 01, Section B 3.6.8 (Pages B 3.6-71 through B 3.6-75.)

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 1 of 2)	OK	N/A
1.	Are the deliverables consistent with the Project Plan and the Project Authorization?	✓	
2.	Has the intent of the Engineering Limit been clearly expressed?	✓	
3.	Has the Engineering Limit been clearly identified?	✓	
4.	Has the bases for the Engineering Limit been clearly expressed?	✓	
5.	Has what the Engineering Limit ensures been clearly expressed?	✓	
6.	Have all assumptions been clearly stated?	✓	
7.	Has the relationship of the EPG value or descriptor to nuclear Safety been addressed?	✓	
8.	Does the document explicitly state that instrument uncertainties need or need not be applied for each application?	✓	
9.	Has the rational/justification used in making the applicability determination been clearly expressed?	✓	
10.	Is there evidence that a deliberate effort has been made to consider other options to be used in the event that the instrument uncertainties can not be accommodated when it is desirable for them to be explicitly applied?	✓	

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 2 of 2)	OK	N/A
11.	When necessary, have recommendations for additional analyses, verifications or simulator validations, to confirm assumptions or conclusions, been provided?	✓	
12.	Is there evidence that industry operating experience has been considered and incorporated as appropriate?	✓	
13.	Is there evidence that a deliberate effort has been made to consider the impact of the work product on the health and safety of the public?	✓	
14.	Does the title page contain the following: - Document Title - Document Number - Date of Issue - Correct Revision - Pagination (page 1 of X) - All Required Signatures — na. pK	✓	
15.	Does the header of each page contain the following: - Sequentially numbered pages (page 1 of X) - Document Number - Correct Revision - Date of Issue	✓	
16.	Is the document legible and reproducible?	✓	
17.	Are all cross-outs and overstrikes initialed and dated by the author?	✓	

Comments/remarks:

Paul B. Kramarchyk / Paul B. Kramarchyk / 11/11/96
Independent Reviewer: Name/Signature/Date

CONTAINMENT
PRESSURE

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 3

CONTAINMENT PRESSURE {23}

RECORD OF REVISIONS

Rev	Date	Pages	Preparer	Ind.Reviewer	Approver
Draft	05/19/95	ALL	Smith	Kramarchyk	Greene
Draft	10/31/95	ALL	Congdon	N/A	N/A
00	03/29/96	ALL	Congdon	Smith	Greene
01	11/15/96	ALL	Congdon	Kramarchyk	Greene

PREPARED BY: Joseph R. Congdon
Cognizant Engineer (Print Name)

[signature]
Cognizant Engineer (Signature) Date: 11/[illegible]/96

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Attachment 2, (QA Checklist) found in the Project Quality Plan.

Paul Kramarchyk [signature] 11/11/95
Name Signature Date
Independent Reviewer

APPROVED BY: Mark Greene
Cognizant Engineering Supervisor (Print Name)

[signature] 11/13/96
Cognizant Engineering Supervisor (Signature) Date

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 3 - APPLICATION 1

{231}
System Subject Parameter: Containment Pressure

Value: [maximum expected normal containment pressure], nominally 1.5 psia or [high containment pressure alarm setpoint], nominally 1.5 psia

Use:
U28
To prevent significant releases of radioactive material to the environment by plant configuration control during accident conditions.

Cat: C03

Engineering Limit:

Upper = the High Containment pressure alarm setpoint.

Summary:

The engineering limit is based on the high containment pressure alarm setpoint, which is typically near the high end of the normal containment pressure band. The CEN-152 authors selected [1.5 psig] as the engineering limit because it was the alarm setpoint for the reference plant.

Instrument uncertainties need not be applied to the plant-specific engineering limit when determining the plant-specific operational limit, because the limit is based on an alarm setpoint. Typically, instrument uncertainties are applied to the alarm setpoint with respect to the technical specification LCO for containment pressure. Therefore, they are inherent in the plant-specific operational limit.

Basis for Engineering Limit:

The engineering limit is based on the high containment pressure alarm setpoint which is typically the high end of the normal operating band for containment pressure. The CEN-152 authors selected an engineering limit and operational limit of 1.5 PSIG for these applications. The engineering limit is consistent with the High Containment Pressure alarm setpoint associated with monitoring Technical Specification LCO requirements for containment pressure during operating MODES 1, 2, and 3. (ref. 1).

This instrument application is used in instructions and safety function status checks to prompt the operator to further evaluate instantaneous containment pressure changes and to alert the operator to a possible high energy line break in the containment. It is not used to verify automatic actuation's or for manual actuation of safety systems.

In developing CEN-152 instructions and safety function status checks (SFSCs) to address containment pressure, the authors assumed the following:

1) Immediately prior to the initiation of any plant transient, indicated containment pressure is within the associated limits of Technical Specifications.

2) The control room has high Containment pressure alarm circuitry designed to alert the operator that containment pressure is approaching the LCO value stated in Technical Specifications.

3) During any plant transient that does <u>not</u> include a high energy line release into the containment environment, the available means of containment cooling will support continued maintenance of the limit on containment pressure that is provided in Technical Specifications (including scenarios that include interruption of off-site AC electrical power sources and scenarios that include interruption of all AC electrical power to vital electrical busses.)

4) Indications that containment pressure is increasing and approaching or exceeding Technical Specification limits should prompt the operator to monitor for the possible actuation of Engineered Safety Features Actuation Systems.

The authors of CEN-152 did not apply additional instrument uncertainties to the EPG engineering limit when arriving at an appropriate operational limit.

Uncertainties Application Assessment:

Instrument uncertainties need not be applied to the plant-specific engineering limit when determining the appropriate plant-specific operational limit, because it is based on the alarm setpoint. Typically, instrument uncertainties are applied to the alarm setpoint with respect to the technical specification limit. Therefore, they are inherent in the plant-specific operational limit.

In addition, if a high energy line break were to occur in containment and instrument uncertainties are present, containment pressure will continue to increase until the alarm is actuated, or until the ESFAS setpoint is reached. Therefore, the intent of the step would still be met.

When developing the plant specific operational limit, each plant must verify that the appropriate amount of uncertainties were included in the containment pressure high alarm setpoint. When possible, EOP limits should be consistent with limits for normal operations.

Potential Margin Loss Options:

Not applicable

References:

1. NUREG-1432, Revision 01, Section B 3.6.4.A "Bases for Containment Pressure (Atmospheric)", Pages B 3.6-34 and 3.6-35

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 3 - APPLICATION 2

{232}
System Subject Parameter: Containment Pressure

Value: [CIAS reset pressure], nominally 3.0 psig

Use: U15
To Determine if an ESFAS initiating parameter is less than the reset value, to facilitate resetting the actuation and taking manual control of affected equipment.

Cat: C03

Engineering Limit:

Upper = less than the technical specification allowable setpoint for the Containment Isolation Actuation Signal (CIAS) or [Containment Cooling Actuation Signal (CCAS)].

Summary:

The engineering limit is based on the technical specification allowable setpoint for Containment Isolation Actuation Signal (CIAS) or [Containment Cooling Actuation Signal (CCAS)]. The intent of the reset value is to permit restoration of emergency systems to a standby status as soon as soon as possible, but not so early so as to unnecessarily challenge the actuation logic and actuate CCAS.

Instrument uncertainties need not be applied in this application because, there is no safety impact on containment integrity, or NSSS operations associated with resetting this system.

Basis for Engineering Limit(s):

The bases for the engineering limit is the same as the bases for the technical specification allowable setpoint for the Containment Isolation Actuation signal (CIAS) or [Containment Cooling Actuation Signal (CCAS)].

The allowable setpoint is high enough to allow for small pressure increases in Containment that are expected during normal operation (i.e. heatup), and which are not indicative of an off-normal condition. The setpoint is low enough to initiate the CIAS or [CCAS] when an off-normal condition is indicated. This allows the emergency containment cooling systems to perform as expected in the Accident Analyses to mitigate the consequences of the analyzed accidents (ref. 1).

The reset setpoint represents the containment pressure value at which the CIAS of [CCAS] may be reset and the emergency fan coolers may be shifted to their normal standby configuration. The intent of this operational limit is to restore emergency systems to a standby status as soon as soon as possible, but not so early so as to unnecessary challenge to the actuation logic and actuate CIAS or [CCAS].

This instrument application is used in LOCA, ESDE, and FRG Safety Function Success Path CTPC-2 to allow the emergency fan coolers to be shifted to their normal configuration when containment temperature and pressure are reduced to levels where there is no impact on containment integrity, or NSSS operations. The intent is to minimize unnecessary prolonged operation of emergency systems, to stabilize the plant and to support long term recovery of the plant.

There is no safety significance associated with this application because continued operation of containment cooling systems in emergency mode would provide no reduction in a plants' safety margin and premature resetting CIAS or [CCAS] would only result in immediate auto actuation.

Uncertainties Application Assessment:

This instrument application is a category 03, because there is no impact on containment integrity, or NSSS operations.

Potential Margin Loss Options:

The following design and administrative features ensure that any premature resetting of containment cooling systems from an emergency configuration is promptly corrected: 1) containment cooling actuation logic and 2) EOP steps based on CEN-152 guidance that prompt verification or manual actuation of containment cooling systems in emergency configurations.

References:

1. NUREG-1432, Revision 01 Section 3.3.5 (Digital), "ESFAS Instrumentation (Digital)," Page 3.3-26, NUREG-1432, Revision 01, Section 3.3.6 (Digital) "ESFAS Logic and Manual Trip (Digital)," Page 3.3-31 and NUREG-1432, Revision 01, Section B 3.3.6 (Digital), Page B 3.3-112

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 3 - APPLICATION 3

{233}
System Subject Parameter: Containment Pressure

Value: [CSAS reset pressure], nominally 7.0 psig

Use: U15
To Determine if an ESFAS initiating parameter is less than the reset value, to facilitate resetting the actuation and taking manual control of affected equipment.

Cat: C03

Engineering Limit(s):

Upper = less than the technical specification allowable trip setpoint for Containment Spray Actuation System (CSAS).

Summary:

The bases for the engineering limit is the same as the bases for the technical specification allowable value for resetting the Containment Spray Actuation System (CSAS).

The reset value represents the containment pressure at which the Containment Spray System may be secured, the CSAS logic may be reset, and the Containment Spray System may be returned to a normal standby configuration. The intent of this instrument application is to restore containment spray to a standby status as soon as possible to minimize the effects of the spray on equipment inside containment, but not so early so as to unnecessary challenge to the actuation logic and actuate CSAS.

Instrument uncertainties need not be applied in this application because, there is no safety impact on containment integrity, or NSSS operations associated with resetting this system.

Bases for Engineering Limit(s):

The bases for the engineering limit is the same as the bases for the technical specification ALLOWABLE VALUE for CSAS. CSAS initiates containment spray, preventing containment overpressurization during a LOCA or MSLB. The Allowable Values are based on the analytical limits stated in FSAR analysis. Setpoints in accordance with the Allowable Value will ensure that the consequences of Design Basis Accidents (DBAs) will be acceptable, providing the plant is operated from within the LCOs at the onset of the DBA and the equipment functions as designed (ref 1, 2, 3, and 4).

The reset value represents the containment pressure value at which the Containment Spray System may be secured, the CSAS logic may be reset, and the Containment Spray System may be returned to a normal standby configuration. The intent of this operational limit is to restore emergency systems to a standby status as soon as soon as possible to minimize the effects of the spray on equipment inside containment, but not so early so as to unnecessary challenge to the actuation logic and actuate CSAS.

This instrument application is used in LOCA, ESDE, and FRG Safety Function Success Path CTPC-2 to permit terminating Containment Spray when containment temperature and pressure are reduced to acceptable levels and when continued operation of the sprays will increase the possibility of wetting electrical connectors which may result in electrical grounds, shorts, and other malfunctions. The containment spray system should then be realigned for automatic operation in case containment pressure again increases to the actuation setpoint. This instrument application is intended to minimize unnecessary prolonged operation of emergency systems, to stabilize the plant and to support long term recovery of the plant.

This instrument application possesses a low degree of safety significance because continued operation of Containment Spray systems would provide no reduction in a plants safety margin and premature resetting CSAS would only result in immediate auto actuation.

Uncertainties Application Assessment:

This instrument application is a category 03, because there is no impact on containment integrity, or NSSS operations.

Potential Margin Loss Options:

The following design and administrative features ensure that any premature resetting of containment spray systems is promptly corrected: 1) containment spray actuation logic and 2) EOP steps based on CEN-152 guidance that prompt verification or manual actuation of containment spray systems.

References:

1. NUREG-1432, Revision 01, Section B 3.3.4 (Analog), "ESFAS Instrumentation (Analog)" Bases, Pages B 3.3-70 & B 3.3-71, Section B 3.3.5 (Digital), Page B 3.3-91

2. NUREG-1432, Revision 01, Section B 3.3.5 (Analog), "ESFAS Logic and Manual Trip (Analog)" Bases, Page B 3.3-93, Section 3.3.6 (Digital), Page 3.3-117

3. NUREG-1432, Revision 01, Section B 3.6.6A (Atmospheric and Dual), Pages B 3.6-44 through B 3.6-53 and Section B3.6.6B Pages B 3.6-55 through B3.6-64.

4. NUREG-1432, Revision 01, Section B 3.6.7, "Spray Additive System (Atmospheric and Dual), Pages B.6-65 through B.6-70.

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 3 - APPLICATION 4

{234}
System Subject Parameter: Containment Pressure

Value: [CSAS setpoint], nominally 10 psig.

Use: U13
To verify automatic actuation of the ESFAS due to its setpoint being exceeded, or to indicate directly to the operator to manually actuate the safety systems associated with those setpoints since they failed to automatically actuate.

Cat: C03

Engineering Limit(s):

Upper = the technical specification allowable trip setpoint for the Containment Spray Actuation System (CSAS).

Summary:

The basis for the engineering limit is the same as the basis for the technical specification allowable setpoint for CSAS. The operational limit is the same as the engineering limit.

The engineering limit establishes the increasing containment pressure at which automatic containment pressure/temperature controls activate to remove heat from the containment atmosphere, thereby ensuring that containment pressure remains below design pressure, independent of operator action.

This instrument application is a nominal ESFAS actuation setpoint. Since the intent of this instrument application is to verify actuation of Containment Spray at setpoint, it serves no useful purpose to add additional uncertainties to those already applied to establish the CSAS setpoint, which is a category 01 application.

Bases for Engineering Limit(s):

The bases for the engineering limit is the same as the bases for the TS allowable setpoint for CSAS. The operational limit is the same as the engineering limit.

CSAS initiates containment spray, preventing containment overpressurization during a LOCA or MSLB. The Allowable Values are based on the analytical limits stated in FSAR analysis. Setpoints in accordance with the TS ALLOWABLE VALVE will ensure that, to the extent possible, the consequences of Design Basis Accidents (DBAs) will be acceptable, providing the plant is operated from within the LCOs at the onset of the DBA, and the equipment functions as designed.

This instrument application appears in LOCA and ESDE Containment Temperature and Pressure SFSCs and SPTA. It is also used in LOCA, ESDE, and FRG Safety Function Success Path CTPC-2 instructions to prompt the operator to ensure that Containment Spray has actuated or other Containment Emergency Cooling systems are in operation, based on Containment pressure increasing to the CSAS setpoint. The intent of the application is to prompt the operator to verify automatic Containment Spray actuation or to manually initiate CSAS if it did not actuate when required.

The engineering limit establishes the increasing Containment pressure value at which automatic Containment atmosphere pressure/temperature controls activate to remove heat from the Containment atmosphere, thereby ensuring that Containment pressure remains below design pressure, independent of operator action.

The authors of CEN-152 assumed that the instrument inaccuracy considerations that have previously been discussed in this section were taken into consideration in the development of this setpoint.

Uncertainties Application Assessment:

This instrument application is the ESFAS actuation setpoint. Since the intent is to verify Containment Spray actuation at setpoint, it serves no useful purpose to add additional uncertainties to those already applied to establish the CSAS setpoint (C01) (ref.1 and 2).

Additional instrument uncertainties are not applied because, in order to work to the goal of preventing unnecessary challenges to Engineered Safeguard Features, the operator should not initiate any safety signal <u>too</u> early. Such action may further complicate an event. Also, we expect the safety systems to automatically initiate when designed and the design setpoint already accounts for instrument uncertainties. Therefore, this should only be a manual backup in case the automatic setpoint does not initiate.

Additionally, failure of automatic actuation of redundant ESF trains in the presence of a valid automatic actuation condition is beyond scope of required design base accident analysis for individual licenses and the requirements of 10CFR50.

Finally, no additional instrument uncertainties need to be added to the ESFAS setpoint because doing so would unnecessarily complicate the EOPs by creating a second number to be used in the EOPs for Containment Spray actuation verification. This would place an unjustified burden on the operator.

Potential Margin Loss Options:

Not applicable

References:

1. NUREG-1432, Rev. 01, Section B.3.3.4 (Analog), Page B 3.3-65

2. NUREG-1432, Rev. 01, Section B 3.3.5 (Digital), Page B 3.3-83

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 3 - APPLICATION 5

{235}
System Subject Parameter: Containment Pressure

Value: [CIAS setpoint], nominally 4 psig

Use: U13
To verify automatic actuation of the ESFAS due to its setpoint being exceeded, or to indicate directly to the operator to manually actuate the safety systems associated with those setpoints since they failed to automatically actuate.

Cat: C03

Engineering Limit(s):

Upper = the technical specification allowable trip setpoint for Containment Isolation Actuation Signal (CIAS) and Containment Cooling Actuation Signal (CCAS).

Summary:

The bases for the engineering limit is the same as the bases for the technical specification allowable values for CIAS/CCAS. The operational limit is the same as the engineering limit. The engineering limit establishes the increasing containment pressure value at which automatic controls activate to isolate and cool the containment, independent of operator action.

This instrument application verifies an ESFAS actuation. Since the intent is to verify Containment Isolation and Containment Cooling actuation at setpoint, it serves no useful purpose to add additional uncertainties to those already applied to establish the CIAS/CCAS setpoints, which is a category 01 application.

Bases for Engineering Limit(s):

The bases for the engineering limit is the same as the bases for the TS ALLOWABLE VALUES for CIAS and CCAS. The operational limit is the same as the engineering limit.

The Design Bases Accidents that will likely result in release of radioactive material to the Containment atmosphere are a loss of coolant accident (LOCA), a main steam line break (MSLB), and a control element assembly ejection accident (CEAEA). In the analysis for each of these accidents, it is assumed that containment isolation valves are either closed or function to close within the required time following event initiation.

The Containment Isolation Actuation Signal logic is designed to support these DBA analysis assumptions. The Allowable Value for the bistable setpoint is set high enough to allow for small pressure increases in containment expected during normal operation (i.e. plant heatup) and is not indicative of an off-normal condition. The setting is low enough to initiate the ESF functions when an off-normal condition is indicated (ref. 1, 2, and 3).

This instrument application is used in SPTA, LOCA, ESDE, and the FRG instructions to prompt the operator to ensure that Containment Isolation and Containment Emergency Cooling have actuated, based on Containment pressure increasing to the CIAS/CCAS setpoint.

The intent of the application is to prompt the operator to verify automatic Containment Isolation actuation and to manually initiate Containment Isolation and Emergency Cooling if they did not actuate when required to.

The engineering limit establishes the increasing Containment pressure value at which automatic controls activate to isolate and cool the containment, independent of operator action. The authors of CEN-152 assumed that the instrument inaccuracy considerations that have previously been discussed in this section were taken into consideration in the development of this setpoint. It was also assumed that the same value of indicated Containment pressure is used as the setpoint for the Containment Isolation Actuation Signal (CIAS) and the setpoint for the Containment Cooling Actuation Signal.

Uncertainties Application Assessment:

This instrument application is a ESFAS actuation setpoint. Since the intent is to verify Containment Isolation and Containment Cooling actuation at setpoint, it serves no useful purpose to add additional uncertainties to those already applied to establish the CIAS/CCAS setpoints (C01) (ref. 1).

Additional instrument uncertainties are not applied because, in order to work to the goal of preventing unnecessary challenges to Engineered Safeguard Features, the operator should not initiate any safety signal <u>too</u> early. Such action may further complicate an event. Also, we expect the safety systems to automatically initiate when designed and the design setpoint already accounts for instrument uncertainties. Therefore, this should only be a manual backup in case the automatic setpoint does not initiate.

Additionally, failure of automatic actuation of redundant ESF trains in the presence of a valid automatic actuation condition is beyond scope of required design base accident analysis for individual licenses and the requirements of 10CFR50.

Finally, no additional instrument uncertainties need to be added to the ESFAS setpoint because doing so would unnecessarily complicate the EOPs by creating a second number to be used in the EOPs for Containment Isolation and Cooling verification. This would place an unjustified burden on the operator.

Potential Margin Loss Options:

Not Applicable

References:

1. NUREG-1432, Revision 01, Section B 3.3.4 (Analog), "ESFAS Instrumentation (Analog)" Bases, Pages B 3.3-71 and Section B.3.3.5 (Digital) Page B 3.3-87

2. NUREG-1432, Revision 01, Section B 3.3.5 (Analog), "ESFAS Logic and Manual Trip (Analog)" Bases, Page B 3.3-90 and Section B 3.6.6 (Digital) Page 3.3-112

3. NUREG-1432, Revision 01, Section B 3.6.6A (Atmospheric and Dual), Pages B 3.6-44 through B 3.6-53 and Section B 3.3.6B Pages B 3.6-55 through B 3.6-64

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 3 - APPLICATION 6

{236}
System Subject Parameter: Containment pressure

Value: [Containment design pressure], nominally 60 psig

Use: U25
To verify operation within the design limits to prevent damage to safety related SSCs.

Cat: C01

Engineering Limit(s):

Upper = Containment design pressure.

Summary:

The engineering limit is based on the containment design pressure. This limit is consistent with the FSAR design criteria and the limiting pressure assumed in the accident analysis for high energy line releases inside containment.

An explicit plant specific instrument uncertainty calculation (C01) should be performed for containment pressure instrumentation for this application. The derived uncertainties should be applied to the plant specific engineering limit when determining the plant specific operational value.

Basis for Engineering Limit(s):

The engineering limit is based on the containment design pressure. This limit is consistent with the FSAR design criteria and the limiting pressure assumed in the accident analysis for high energy line releases inside containment (ref 1).

Uncertainties Application Assessment:

An explicit plant specific instrument uncertainty calculation (C01) should be performed for containment pressure instrumentation for this application. The derived uncertainties should be applied to the plant specific engineering limit when determining the plant specific operational limit.

Harsh containment instrument uncertainties need to be applied for the LOCA, ESDE, and FRG instrument applications.

Potential Margin Loss Options:

None

References:

1. NUREG-1432, CEOG ISTS, revision 1, 04/07/95, LCO 3.6.4 and associated Bases

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 1 of 2)	OK	N/A
1.	Are the deliverables consistent with the Project Plan and the Project Authorization?	✓	
2.	Has the intent of the Engineering Limit been clearly expressed?	✓	
3.	Has the Engineering Limit been clearly identified?	✓	
4.	Has the bases for the Engineering Limit been clearly expressed?	✓	
5.	Has what the Engineering Limit ensures been clearly expressed?	✓	
6.	Have all assumptions been clearly stated?	✓	
7.	Has the relationship of the EPG value or descriptor to nuclear Safety been addressed?	✓	
8.	Does the document explicitly state that instrument uncertainties need or need not be applied for each application?	✓	
9.	Has the rational/justification used in making the applicability determination been clearly expressed?	✓	
10.	Is there evidence that a deliberate effort has been made to consider other options to be used in the event that the instrument uncertainties can not be accommodated when it is desirable for them to be explicitly applied?	✓	

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 2 of 2)	OK	N/A
11.	When necessary, have recommendations for additional analyses, verifications or simulator validations, to confirm assumptions or conclusions, been provided?	✓	
12.	Is there evidence that industry operating experience has been considered and incorporated as appropriate?	✓	
13.	Is there evidence that a deliberate effort has been made to consider the impact of the work product on the health and safety of the public?	✓	
14.	Does the title page contain the following: - Document Title - Document Number - Date of Issue - Correct Revision - Pagination (page 1 of X) - All Required Signatures — n. a. pk	✓	
15.	Does the header of each page contain the following: - Sequentially numbered pages (page 1 of X) - Document Number - Correct Revision - Date of Issue	✓	
16.	Is the document legible and reproducible?	✓	
17.	Are all cross-outs and overstrikes initialed and dated by the author?	✓	

Comments/remarks: ______________________________

Paul B. Kramarchyk / Paul B. Kramarchyk / 11/11/96

Independent Reviewer: Name/Signature/Date

PAUL B. KRAMARCHYK

CONTAINMENT
TEMPERATURE

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 4

CONTAINMENT TEMPERATURE {34}

RECORD OF REVISIONS

Rev	Date	Pages	Preparer	Ind.Reviewer	Approver
Draft	05/19/95	ALL	Smith	Kramarchyk	Greene
Draft	10/31/95	ALL	Congdon	N/A	N/A
00	03/29/96	ALL	Congdon	Smith	Greene
01	11/15/96	ALL	Congdon	Kramarchyk	Greene

PREPARED BY: Joseph R. Congdon
Cognizant Engineer (Print Name)

[signature]
Cognizant Engineer (Signature) Date: 11/11/96

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Attachment 2, (QA Checklist) found in the Project Quality Plan.

Paul Kramarchyk [signature] 11/11/96
Name Signature Date
Independent Reviewer

APPROVED BY: Mark Greene
Cognizant Engineering Supervisor (Print Name)

[signature] 11/13/96
Cognizant Engineering Supervisor (Signature) Date

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 4 - APPLICATION 1

{241}
System Subject Parameter: Containment Atmospheric Temperature

Value: [maximum expected normal containment temperature], nominally 120°F.

Use: U22
To provide corroborative information related to the accomplishment of a safety function.

Cat: C03

Engineering Limit(s):

Upper = technical specification LCO for containment temperature.

Summary:

The CEN-152 authors selected the technical specification LCO for containment temperature [120°F] as the engineering and operational limit based on human factor considerations. [120°F] was a value familiar to operators. It was located at the upper end of the normal containment temperature band, and would therefore provide adequate indication of the on-set of an off-normal condition.

The primary purpose of this instrument application is to assist in determining if a high energy line break exists inside containment. This instrument application is category 03 because it is essentially a nominal value.

Bases for Engineering Limit(s):

The CEN-152 authors selected [120°F] as the engineering and operational limit for a variety of reasons based on human factor considerations. The chosen value was a familiar value located at the upper end of the normal containment temperature band. Therefore, the value would provide adequate indication of an off-normal condition. It was consistent with the technical specification LCO for containment temperature. It was also the design temperature of the containment, and assumed in the accident analysis for a loss of coolant accident (LOCA) and main steam line break (MSLB), (ref 1).

Even though the assumptions for the initial conditions of the accident analyses do not need to be preserved in the EOPs, if a condition such as this exceeds the accident analysis initial condition assumption, a high energy line break inside containment should be suspected.

The primary purpose of this instrument application is to assist in determining if a high energy line break exists inside containment. Hence, it is chiefly used as part of the diagnostic tools of Safety Function Status Checks. It is also used to prompt operators to evaluate if containment atmospheric conditions warrant further evaluation of the performance of containment cooling and spray systems.

It is used in throughout the EPGs to prompt the operator to further evaluate containment temperature and pressure trends. It is not used to prompt actions to verify the automatic actuation or to prompt manual actuation of a system or component. If containment temperature and pressure are greater than expected, the operator is instructed to verify that the Containment normal coolers are operating, or if necessary, operate the Containment emergency cooling system when the [Containment Cooling Actuation System (CCAS)] or equivalent setpoint is reached, or the Containment Spray System when the CSAS setpoint is reached.

In developing SPTA and the SFSCs that address Containment atmosphere temperature, the authors of CEN-152 made the following assumptions:

1) Immediately prior to the initiation of any plant transient, indicated Containment atmospheric temperature is within the associated limits of Technical Specifications.

2) During any plant transient that does not include a high energy line release into the Containment environment, the available means of Containment cooling will support continued maintenance of the Containment atmospheric temperature limit that is provided in Technical Specifications.

3) The presence of Containment atmospheric temperature and pressure conditions that are within the Technical Specification limits provide indirect indication that the conditions required for free hydrogen generation in Containment do not exist.

4) Indications that Containment atmospheric temperature is approaching or exceeding Technical Specification limits should prompt operator evaluation concerning the degree to which Containment cooling systems are controlling related safety functions.

5) Only Containment pressure indication signals are used to prompt automatic actuation of related reactor protection systems and emergency safeguard actuation systems

The authors of CEN-152 ensured that containment atmosphere temperature was never used in any part of EPG guidance as the sole process variable reviewed in evaluating equipment performance or in considering what manual response/recovery actions should be taken. In addition, they did not apply additional instrument uncertainties to the EPG engineering limit when arriving at an appropriate operational limit.

Uncertainties Application Assessment:

This instrument application is category 03 because this value is essentially a nominal value. If during normal operation, containment temperature exceeds the technical specification LCO value, the plant would be shut down. In addition, if a high energy line break occurs inside containment, containment temperature will not remain less than the technical specification limit. Therefore, instrument uncertainties are inherently included in this EOP value. When possible, EOP limits should be consistent with limits for normal operations.

Potential Margin Loss Options:

Not applicable

References:

1. NUREG 1432, revision 1, 04/07/95, Section B 3.6.5, Page 3.6-40 and B 3.6-41.

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 4 - APPLICATION 2

{242}
System Subject Parameter: Containment Atmosphere Temperature

Value: [saturated vapor temperature corresponding to the CIAS setpoint], nominally 180 °F

Use: U22
To provide corroborative information related to the accomplishment of a safety function.

Cat: C03

Engineering Limit(s):

Upper = the maximum containment atmosphere temperature value that:
(A) does not exceed the plant-specific temperature requiring application of harsh containment uncertainties for instrumentation located inside containment AND
(B) that is less than the saturated vapor temperature corresponding to the high containment pressure alarm setpoint [1.5 psig].

Summary:

This engineering limit is based on the plant-specific temperature at which pressure transmitters located in containment may start to be significantly affected by harsh containment conditions, and the saturated vapor temperature corresponding to the [CIAS setpoint], nominally 180 °F. This application is a corroborative indication used to back up the [maximum expected normal containment pressure], nominally 1.5 psia or [high containment pressure alarm setpoint], nominally 1.5 psia

Instrument uncertainties need not be applied to the plant-specific engineering limit when determining the appropriate plant-specific operational limit, because the limit is essentially based on the high containment pressure alarm setpoint.

Bases for Engineering Limit(s):

The engineering limit is based on the plant-specific temperature at which the pressure transmitters located in containment may start to be significantly affected by harsh containment conditions and the saturated vapor temperature corresponding to a containment pressure that is equivalent to the alarm setpoint.

This Containment Temperature application is being used as a corroborative to the [maximum expected normal containment pressure], nominally 1.5 psia or [high containment pressure alarm setpoint], nominally 1.5 psia. The authors of CEN-152 intended this operational limit to be a backup to the Containment Emergency Cooling actuation if they should fail to actuate due to non-conservative common-cause environmental factors on Containment pressure instrumentation. The degree to which the design of independent, redundant channels of Containment pressure instrumentation mitigates the potential for such common-cause factors was not evaluated by the authors of CEN-152.

Among the plant transient scenarios that are addressed in CEN-152 are scenarios where harsh Containment conditions may result in ambiguous or conflicting indications concerning the presence of high energy line breaks inside containment. Such scenarios could include cases where reactor coolant system parameters or secondary system parameters indicated the presence of a high energy release to the Containment, while indicated Containment pressure readings remained below the nominal ESFAS setpoint values.

The intent of the authors of CEN-152 was that this engineering limit would prompt operators to consider the possibility that all containment pressure indications had been non-conservatively affected by harsh containment environmental factors. This was made evident in the basis for this limit in the Functional Recovery Safety Function Status Checks of CEN-152, Revision 03, Submittal 1, dated July 1985 (Ref. 2). The reference to this original bases does not exist in the final submittal of CEN-152, Revision 03 (Ref. 1).

In developing the concepts that resulted in the development of this engineering limit application, the authors of CEN-152 used the following assumption:

1) During any plant transient that does <u>not</u> include a high energy line release into the Containment environment, the available means of Containment cooling will support continued maintenance of the limit on Containment atmospheric temperature that is provided in Technical Specifications.

   When the authors of CEN-152 applied this assumption in consideration of a combination of "high" indicated containment temperature and "low"/normal indicated containment pressure, their conservative conclusion was that such conditions would be caused by a common-cause and non-conservative effect on all containment pressure instrumentation.

The following considerations demonstrate that this assumption may not be applicable in all possible event scenarios that require the use of EOPs:

2) The authors of CEN-152 did not validate that containment atmosphere temperatures would remain below plant-specific Technical Specification limits during the following scenarios:
   i.) Partial or complete interruptions of cooling water to containment air coolers
   ii.) Partial or complete interruptions of electrical power to containment air coolers.

3) The degree to which the design of redundant, independent containment pressure instrumentation addresses the potential effects of harsh containment conditions was not evaluated by the authors of CEN-152.

Containment temperature instrument uncertainties were not applied to the engineering limit by the authors of CEN-152 in the development of this operational limit.

The inclusion of this operational limit in CEN-152, was an attempt by the authors of CEN-152 to address an issue concerning the possible effects of harsh containment environmental conditions on plant instrumentation in one specific scenario (indicated containment pressures did not correspond to the potential for a high energy line break that was represented by indications of other process variables).

While monitoring of containment atmosphere temperature is important in evaluation the degree of success obtained by in-use safety function success paths, the guidance of CEN-152 is intentionally designed to ensure that containment atmospheric temperature is never used as the sole process variable reviewed in evaluating equipment performance or in considering what manual response/recovery actions should be taken.

Uncertainties Application Assessment:

Instrument uncertainties need not be applied to the plant-specific engineering limit when determining the appropriate plant-specific operational limit, because the limit is based on the high containment pressure alarm setpoint.

In addition, if a high energy line break were to occur in containment and instrument uncertainties are present, containment pressure will continue to increase until the alarm is actuated, or until the ESFAS setpoint is reached. Therefore, the intent of the step would still be met.

Potential Margin Loss Options:

Not applicable

References:

1. CEN-152, Revision 03, Functional Recovery Guideline Safety Function Success Path CTPC-1 Criterion 1a, Page 11-369.

2. CEN-152, Revision 03, Submittal 1, dated July 1985, Bases for Safety Function Status Check Criteria, Page 10 - 39

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 4 - APPLICATION 3

{243}
System Subject Parameter: Containment Atmospheric Temperature

Value: [saturated vapor temperature corresponding to CSAS setpoint], nominally 240 °F

Use: U22
To provide corroborative information related to the accomplishment of a safety function.

Cat: C03

Engineering Limit(s):

Upper = the maximum containment atmosphere temperature value that:
A) corresponds to the saturated vapor temperature for the Containment pressure value that is equal to the nominal Containment Spray Actuation Setpoint (CSAS), OR
B) the containment atmosphere vapor temperature value as derived from plant-specific computer modeling of high energy line break scenarios inside Containment that corresponds to the nominal CSAS setpoint.

Summary:

The engineering limit may be based on the saturated vapor temperature corresponding to the Containment Spray Actuation (CSAS) Setpoint, or on the saturated vapor temperature derived from plant-specific computer modeling of high energy line break scenarios inside Containment corresponding to the CSAS setpoint.

The primary purpose of this instrument application is to provide an independent, approximate validation of indicated containment pressure when determining if containment spray and/or containment emergency cooling should have initiated.

Instrument uncertainties need not be applied to the plant-specific engineering limit when determining the appropriate plant-specific operational limit, because temperature is a back up approximation. Containment pressure is the primary process variable that is monitored and acted on by the operator.

Bases for Engineering Limit(s):

The engineering limit may be based on the saturated vapor temperature corresponding to the Containment pressure value that is equal to the Containment Spray Actuation Setpoint (CSAS), or the containment atmosphere vapor temperature value as derived from plant-specific computer modeling of high energy line break scenarios inside Containment that corresponds to the nominal CSAS setpoint.

The primary purpose of this EPG value is to provide an independent, approximate validation of indicated containment pressure when evaluating if containment spray should have already initiated. Indicated containment pressure remains the fundamental process variable that is monitored concerning containment spray and containment cooling. It is the process variable that provides input signals to generate automatic Engineered Safeguard Features Actuation Signals (ESFAS). Containment atmospheric temperature is not an input variable in the licensed design of ESFAS actuation logic circuitry.

During a high energy line break inside containment, steam mixes with the pre-existing containment atmosphere. As a result, it is anticipated that the actual containment atmospheric temperatures would be less than the saturated steam temperature when containment pressure reached the pressure setpoint for Containment Spray actuation. Any indication that containment atmosphere temperature has reached a value corresponding to a saturated vapor temperature for the pressure value equal to the CSAS setpoint provides indication that containment pressure has exceeded the CSAS setpoint.

During the development of CEN-152, the degree to which containment pressures would exceed the CSAS setpoint before containment atmospheric temperatures reached this value were not quantified. Since the development of CEN-152, some CE NSSS stations have used sophisticated containment performance modeling software to identify the anticipated maximum indicated containment temperature that would exist when containment pressure reached the nominal CSAS setpoint during high energy line break scenarios.

[Containment atmospheric temperature less than the saturated vapor temperature corresponding to CSAS setpoint], nominally 240 °F is included to provide an approximate correlation to pressure in containment, recognizing that the actual temperature would likely be different. The assumed nominal CSAS setpoint is [10 psig]. The actual temperature in containment at spray actuation will not be equal to the saturation temperature corresponding to the pressure increase required to actuate spray. The containment temperature value is included in the EPGs as a backup to containment pressure for spray actuation.

No specific instrument uncertainties were applied by the authors of CEN-152 in the development of this setpoint.

Uncertainties Application Assessment:

Instrument uncertainties need not be applied to the plant-specific engineering limit when determining the appropriate plant-specific operational limit. This is justified because this evaluation has concluded that the instrument application possess a low degree of nuclear safety significance. Containment pressure is the primary process variable that is monitored and acted on by the operator in conjunction with Containment Spray and Containment Emergency Cooling actuation.

Potential Margin Loss Options:

Consider not using this instrument application in the plant specific EOPs, if a plant-specific number can not be generated that will be a close approximation of what the operator will actually observe under similar Containment conditions. Including an invalid number is worst than not providing one at all. It was intended to be a corroborative indication only.

References:

None

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 4 - APPLICATION 4

{244}
System Subject Parameter: Containment Atmospheric Temperature

Value: [maximum expected containment temperature during station blackout]

Use: U22
To provide corroborative information related to the accomplishment of a safety function.

Cat: C03

Engineering Limit(s):

Upper = The maximum expected containment atmosphere temperature based on time after blackout, as determine by plant specific analysis.

Summary:

The engineering limit is based on the projected maximum containment temperature based on time after blackout. This value is calculated on a plant specific bases.

Instrument uncertainties need not be applied to the plant-specific engineering limit when determining the appropriate plant-specific operational limit, because containment temperature is used only as a back up for containment pressure indication.

Bases for Engineering Limit(s):

The engineering limit is based on the projected maximum containment temperature based on time after blackout. This value is calculated on a plant specific bases.

The application is used in the Station Blackout ORG safety function status checks for Containment Temperature and Pressure, and Combustible Gas Control. The associated acceptance criteria are: Containment temperature less than [maximum expected containment temperature for station blackout] and Containment Pressure less than [maximum expected normal containment pressure].

It is used to prompt the operator to further evaluate containment temperature and pressure trends, in addition to directing the operator to the Functional Recovery Procedure, due to a failed safety function. It is not used to prompt actions to verify the automatic actuation or to prompt manual actuation of a system or component. The containment temperature value is included in the EPGs as a corroborative backup to containment pressure. It a station blackout, it is assumed that the operators are doing everything possible to restore power to containment cooling and ventilation equipment.

Uncertainties Application Assessment:

Instrument uncertainties need not be applied to the plant-specific engineering limit when determining the appropriate plant-specific operational limit, because temperature is a back up approximation. Containment pressure is the primary process variable that is monitored and acted on by the operator.

Potential Margin Loss Options:

Not applicable

References:

None

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 1 of 2)	OK	N/A
1.	Are the deliverables consistent with the Project Plan and the Project Authorization?	✓	
2.	Has the intent of the Engineering Limit been clearly expressed?	✓	
3.	Has the Engineering Limit been clearly identified?	✓	
4.	Has the bases for the Engineering Limit been clearly expressed?	✓	
5.	Has what the Engineering Limit ensures been clearly expressed?	✓	
6.	Have all assumptions been clearly stated?	✓	
7.	Has the relationship of the EPG value or descriptor to nuclear Safety been addressed?	✓	
8.	Does the document explicitly state that instrument uncertainties need or need not be applied for each application?	✓	
9.	Has the rational/justification used in making the applicability determination been clearly expressed?	✓	
10.	Is there evidence that a deliberate effort has been made to consider other options to be used in the event that the instrument uncertainties can not be accommodated when it is desirable for them to be explicitly applied?	✓	

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

Review Criteria (page 2 of 2)	OK	N/A
11. When necessary, have recommendations for additional analyses, verifications or simulator validations, to confirm assumptions or conclusions, been provided?	✓	
12. Is there evidence that industry operating experience has been considered and incorporated as appropriate?	✓	
13. Is there evidence that a deliberate effort has been made to consider the impact of the work product on the health and safety of the public?	✓	
14. Does the title page contain the following: - Document Title - Document Number - Date of Issue - Correct Revision - Pagination (page 1 of X) - All Required Signatures — n.a. pk	✓	
15. Does the header of each page contain the following: - Sequentially numbered pages (page 1 of X) - Document Number - Correct Revision - Date of Issue	✓	
16. Is the document legible and reproducible?	✓	
17. Are all cross-outs and overstrikes initialed and dated by the author?	✓	

Comments/remarks:

Paul B. Kramarchyk, Paul B. Kramarchyk, 11/11/96
Independent Reviewer: Name/Signature/Date

REACTOR POWER

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 5

CORE POWER {25}

RECORD OF REVISIONS

Rev	Date	Pages	Preparer	Ind.Reviewer	Approver
Draft	05/19/95	ALL	Kramarchyk	Wild	Greene
Draft	10/31/95	ALL	Congdon	N/A	N/A
00	03/29/96	ALL	Congdon	Smith	Greene
01	11/15/96	ALL	Congdon	Kramarchyk	Greene

PREPARED BY: Joseph R. Congdon
Cognizant Engineer (Print Name)

[signature]
Cognizant Engineer (Signature) Date: 11/11/96

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Attachment 2, (QA Checklist) found in the Project Quality Plan.

Paul Kramarchyk [signature] 11/12/96
Name Signature Date
Independent Reviewer

APPROVED BY: Mark Greene
Cognizant Engineering Supervisor (Print Name)

[signature] 11/13/96
Cognizant Engineering Supervisor (Signature) Date

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 5 - APPLICATION 1

{251}
System Subject Parameter: Core Power

Value: [maximum expected reactor power 15 minutes after shutdown], nominally 1E(X)%

Use: U22
To provide corroborative information related to the accomplishment of a safety function.

Cat: C03

Use: U16
To evaluate whether or not automatic control of safety equipment should/may be overridden to regain manual control of affected equipment

Cat: C03

Engineering Limit(s):

Upper = The maximum expected reactor power level at approximately 15 minutes after shutdown following extended full power operation.

Summary:

The engineering limit is based on the post trip trend of reactor power following an uncomplicated trip from 100% power and extended full power operation. The intent is to provide the maximum post-trip value of reactor power that will verify successful reactivity control and confirm that the reactor is shutdown and is being maintained shutdown throughout the event.

Instrument uncertainties need not be applied because the engineering limit is a nominal value and there is no explicit design limit to protect against. Also, in the context of the EPGs, the engineering limit is supplemented with the additional criteria that, "reactor power is constant or lowering." This additional qualification decreases the reliance on a specific reactor power value to determine the status of the reactivity control safety function.

Bases for Engineering Limit(s):

The engineering limit is based on the post trip trend of reactor power following an uncomplicated trip from 100% power and extended full power operation.

After the reactor is tripped, neutron power should immediately drop to approximately 6%, due to prompt drop. It will then asymptotically approach an negative 80 second period (1/3 DPM), due to decay of the longest lived delayed neutron precursor. It will remain on the negative 80 second Period (1/3 DPM) for approximately 15 - 20 minutes, until it starts turning at about 10^{-6}% power. The rate of decrease in power level then slows significantly. Power level is then a function of the photoneutron reaction with the Deuterium in the water. The slowly decreasing trend will continue for approximately 3 - 4 hours until reaching equilibrium conditions due to subcritical multiplication (ref. 1).

The intent of this engineering limit is to provide the maximum post-trip value of reactor power that will verify successful reactivity control and confirm that the reactor is shutdown and is being maintained shutdown throughout the event. This application is used in the Functional Recovery Procedure, Reactivity Control, Safety Function Status Check and in Success Path RC-3.

Constant or decreasing reactor power is a positive indication of reactivity control. If no specific value is provided along with "constant or decreasing", the operator may not be certain that the reactor is shutdown, once power level becomes constant. Therefore, the authors of CEN-152 included a value to help the operator to verify that the reactor remained shutdown.

The power level at approximately 15 minutes after the trip is used as a benchmark value because it will typically take at least this amount of time for the operator to get into the FRG, where this instrument application is used in the EPGs.

Uncertainties Application Assessment:

The engineering limit need not be adjusted for instrument uncertainties when determining the plant specific operational value. Adjusting the engineering limit for instrument uncertainties is unnecessary to meet the intent of the limit, for the following reasons:

1) The engineering limit is a nominal value and there is no explicit design limit to protect against.
2) In the context of the EPGs, the engineering limit is supplemented with the additional criteria that, "reactor power is constant or decreasing." This additional qualification decreases the reliance on a specific reactor power value to determine the status of the reactivity control safety function.
3) The application of instrument uncertainties may create a safety function acceptance criterion that is misleading or impossible to meet: For example, once the theoretical subcritical core power is determined, if instrument uncertainties are subtracted from the calculated value (i.e., conservatively lowering the limit below what was calculated) the operator may believe there is a problem with reactivity control when in fact the reactor is shutdown as expected.

However, the selected operational limit should be above the "noise" level, but low enough to ensure the reactor is shutdown.

Potential Margin Loss Options:

not applicable

References:

1) Reactor Theory training information on post-trip trace, pages 8 and 9. (This training material is not a controlled document. The origin and author are not known. It is the opinion of the working group, that its use as a reference in this case is acceptable.)

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 5 - APPLICATION 2

{252}
System Subject Parameter: Core Power

Value: [reactor shutdown] or reactor [remains shutdown]

Use: U60 To monitor core design parameters to ensure reactivity control.

Cat: C04

Engineering Limit(s):

Lower Limit = keff < 0.99

Summary:

The engineering limit is based on the reactivity condition (Keff) used in the technical specification definition of Hot Standby, Hot Shutdown, and Cold Shutdown (Modes 3, 4 and 5). Additional instrument uncertainties need not be applied for this instrument application. Reactivity is a core physics parameter, possessing a high degree of nuclear safety significance, but it is not considered a process variable when used in EOP instrument applications.

Bases for Engineering Limit(s):

The engineering limit is based on the reactivity condition (Keff) used in the technical specification definition of Hot Standby, Hot Shutdown, and Cold Shutdown (Modes 3, 4 and 5). The intent of the engineering limit is to ensure that the reactor is maintained subcritical during accident conditions when there is no available means to borate the RCS, such as during a station blackout.

In mode 3 and 4 technical specification LCO 3.1.1 (Shutdown Margin (SDM) - >200°F) is applicable. If the condition of this LCO can not be maintained the operator is required to initiate boration to restore SDM to within the limit. If there is no means to borate, due to the nature of the event in progress, the operator must control moderator temperature to preclude inadvertent criticality. RCS temperature should be maintained as stable as possible to minimize RCS cooldown. It is always preferred to meet the LCO. If the plant is outside the condition limits of the LCO (i.e, using the lower engineering limit as stated above), the operator is required to continue efforts to comply with the technical specification action statement and restore the conditions of the LCO as conditions permit.

However, there may be competing factors that collectively warrant initiating cooling down the RCS to the greatest extent possible without exceeding the above engineering limit.

When choosing this reactivity control strategy, the utility must understand that the plant is now operating outside the Shutdown Margin LCO. This means that the plant may no longer be protected for a MSLB, CEA bank withdrawal, CEA ejection, inadvertent RCP start or inadvertent boron dilution. The decision to lessen the margin to criticality must be justified by the specifics of the event and the need to cooldown. For example, in a Station Blackout (SB) when there is no ability to borate to the RCS. The MSLB analysis assumes boron will be injected during the MSLB event. Maintaining the Shutdown Margin LCO during a SB no longer maintains the plant within the assumptions of the MSLB analysis. Cooling and depressurizing the plant will minimize loss of inventory while maintaining the RCS subcooled. Many multiple casualty events are beyond the design bases and attempting to maintain an LCO under these conditions may not provide the best strategy to mitigate multiple events. Under such conditions maintaining the reactor Keff .99 or less will maintain the reactor shutdown as defined in the Technical Specification of Operational Modes.

Each plant should determine the best indications to be used by the operator to impliment this reactivity control strategy. A plant specific table and curves, similar to the that located in the implimentation section of CEN-152 under "Reactivity Control Strategy" could be developed and placed in the EOPs. The curves would show the minimum temperature that the operator could cooldown to and not exceed the engineering limit and still maintain the [reactor shutdown], assuming all rods in, one rod stuck out, or one or two charging pumps operating.

Uncertainties Application Assessment:

Additional instrument uncertainties need not be applied for this instrument application. Reactivity is a core physics parameter, possessing a high degree of nuclear safety significance, but it is not considered a process variable when used in EOP instrument applications.

When calculations for the determination of the margin to criticality are performed, calculational uncertainties should be applied when necessary. In addition, anytime data from a process loop inputs to these calculation, category one level uncertainty calculations must be performed on those loops and the resulting instrument uncertainties accounted for in the core physics parameter calculation.

Potential Margin Loss Options:

Not applicable

References:

1. Standard Technical Specification for Combustion Engineering Plants, NUREG-1432, Vol 1, Revision 1, April 1995, Table 1.1-1.

2. CEN-152, Implimentation Section, "Reactivity Control Strategy"

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 5 - APPLICATION 3

{253}
System Subject Parameter: Core Power

Value: [adequate shutdown margin]

Use: U60 To monitor core design parameters to ensure reactivity control.

Cat: C04

Engineering Limit(s):

Lower Limit = In accordance with technical specification limits.

Summary:

The intent of the engineering limit is to be in compliance with plant specific technical specification shutdown margin requirements based on moderator temperature.

Additional instrument uncertainties need not be applied for this instrument application. Reactivity is a core physics parameter, possessing a high degree of nuclear safety significance, but it is not considered a process variable when used in EOP instrument applications.

Bases for Engineering Limit(s):

The engineering limit is based on the technical specification limits on shutdown margin (ref 1 and 2)

Uncertainties Application Assessment:

Additional instrument uncertainties need not be applied for this instrument application. Reactivity is a core physics parameter, possessing a high degree of nuclear safety significance, but it is not considered a process variable when used in EOP instrument applications. When calculations for the determination of the margin to criticality are performed, calculational uncertainties should be applied when necessary. In addition, anytime data from a process loop inputs to these calculation, category one level uncertainty calculations must be performed on those loops and the resulting instrument uncertainties accounted for in the core physics parameter calculation.

Potential Margin Loss Options:

Not applicable

References:

1. Standard Technical Specification for Combustion Engineering Plants, NUREG-1432, Vol 1, Revision 1, April 1995, Table 1.1-1.

2. CEN-152, Implimentation Section, "Reactivity Control Strategy"

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 1 of 2)	OK	N/A
1.	Are the deliverables consistent with the Project Plan and the Project Authorization?	✓	
2.	Has the intent of the Engineering Limit been clearly expressed?	✓	
3.	Has the Engineering Limit been clearly identified?	✓	
4.	Has the bases for the Engineering Limit been clearly expressed?	✓	
5.	Has what the Engineering Limit ensures been clearly expressed?	✓	
6.	Have all assumptions been clearly stated?	✓	
7.	Has the relationship of the EPG value or descriptor to nuclear Safety been addressed?	✓	
8.	Does the document explicitly state that instrument uncertainties need or need not be applied for each application?	✓	
9.	Has the rational/justification used in making the applicability determination been clearly expressed?	✓	
10.	Is there evidence that a deliberate effort has been made to consider other options to be used in the event that the instrument uncertainties can not be accommodated when it is desirable for them to be explicitly applied?	✓	

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 2 of 2)	OK	N/A
11.	When necessary, have recommendations for additional analyses, verifications or simulator validations, to confirm assumptions or conclusions, been provided?	✓	
12.	Is there evidence that industry operating experience has been considered and incorporated as appropriate?	✓	
13.	Is there evidence that a deliberate effort has been made to consider the impact of the work product on the health and safety of the public?	✓	
14.	Does the title page contain the following: - Document Title - Document Number - Date of Issue - Correct Revision - Pagination (page 1 of X) - All Required Signatures	✓	
15.	Does the header of each page contain the following: - Sequentially numbered pages (page 1 of X) - Document Number - Correct Revision - Date of Issue	✓	
16.	Is the document legible and reproducible?	✓	
17.	Are all cross-outs and overstrikes initialed and dated by the author?	✓	

Comments/remarks:

PAUL KRAMARCHYK, Paul B. Kramarchyk, 11/12/96

Independent Reviewer: Name/Signature/Date

CEA POSITION

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 6

CORE CEA POSITION {26}

RECORD OF REVISIONS

Rev	Date	Pages	Preparer	Ind.Reviewer	Approver
Draft	05/19/95	ALL	Kramarchyk	Wild	Congdon/Greene
Draft	10/31/95	ALL	Congdon	N/A	N/A
00	03/29/96	ALL	Congdon	Smith	Greene
01	11/15/96	ALL	Congdon	Kramarchyk	Greene

PREPARED BY: Joseph R. Congdon
Cognizant Engineer (Print Name)

[signature]
Cognizant Engineer (Signature) Date: 11/15/96

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Attachment 2, (QA Checklist) found in the Project Quality Plan.

Paul Kramarchyk [signature] 11/11/96
Name Signature Date
Independent Reviewer

APPROVED BY: Mark Greene
Cognizant Engineering Supervisor (Print Name)

[signature] 11/13/96
Cognizant Engineering Supervisor (Signature) Date

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 6 - APPLICATION 1

{261}
System Subject Parameter: Core CEA Position

Value: no more than [one full length CEA] not inserted

Use: U22
To provide corroborative information related to the accomplishment of a safety function.

Cat: C03

Engineering Limit(s):

Upper = maximum of 1 CEA not fully inserted

Summary:

The bases for the engineering limit is to ensure that the actual CEA positions are within the limits assumed in the technical specification definition of shutdown margin. The intent is to determine the status of the reactivity control safety function via CEA position.

The engineering limit need not be adjusted for instrument uncertainties because the engineering limit is a specific plant condition that is either true or false. There is no analog component in this application, it only represents a binary condition. Therefore, it is both unnecessary and impractical to apply instrument uncertainties to the engineering limit.

Bases for Engineering Limit(s):

The bases for the engineering limit is to ensure that the actual CEA positions are within the limits assumed in the Technical Specification definition of Shutdown Margin (references 1 and 2). Where, Shutdown Margin is defined as: the instantaneous amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming all full length control element assemblies (shutdown and regulating) are fully inserted except for the single assembly of highest reactivity worth which is assumed to be fully withdrawn.

The intent of the engineering limit is to determine the status of the reactivity control safety function via CEA position. In the context of the EPGs, the purpose for determining the status of the reactivity control safety function via CEA position is to ensure sufficient shutdown margin.

Uncertainties Application Assessment:

The engineering limit need not be adjusted for instrument uncertainties when determining the plant specific operational target value.

The engineering limit need not be adjusted for instrument uncertainties because the engineering limit is a specific plant condition that is either true or false. There is no analog component in this application, it only represents a binary condition. Therefore, it is both unnecessary and impractical to apply instrument uncertainties to the engineering limit.

In addition, the importance of instrument uncertainties is diminished because CEA position is only one of several possible indications to determine the status of the reactivity control safety function (reactor power constant or decreasing, and boron addition flow rate are other methods).

Potential Margin Loss Options:

Not applicable

References:

1). CEOG RSTS, rev 1, 04/07/95, page B 3.1-1

2) NUREG-1432, Revision 01, "Standard Technical Specifications Combustion Engineering Plants": Section B 3.1.1 (Analog) Pages B 3.1-1 through B 3.1-3 and Section B 3.1.1 (Digital) Pages B 3.1.1 through B 3.1.3

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 1 of 2)	OK	N/A
1.	Are the deliverables consistent with the Project Plan and the Project Authorization?	✓	
2.	Has the intent of the Engineering Limit been clearly expressed?	✓	
3.	Has the Engineering Limit been clearly identified?	✓	
4.	Has the bases for the Engineering Limit been clearly expressed?	✓	
5.	Has what the Engineering Limit ensures been clearly expressed?	✓	
6.	Have all assumptions been clearly stated?	✓	
7.	Has the relationship of the EPG value or descriptor to nuclear Safety been addressed?	✓	
8.	Does the document explicitly state that instrument uncertainties need or need not be applied for each application?	✓	
9.	Has the rational/justification used in making the applicability determination been clearly expressed?	✓	
10.	Is there evidence that a deliberate effort has been made to consider other options to be used in the event that the instrument uncertainties can not be accommodated when it is desirable for them to be explicitly applied?	✓	

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

Review Criteria (page 2 of 2)		OK	N/A
11.	When necessary, have recommendations for additional analyses, verifications or simulator validations, to confirm assumptions or conclusions, been provided?	✓	
12.	Is there evidence that industry operating experience has been considered and incorporated as appropriate?	✓	
13.	Is there evidence that a deliberate effort has been made to consider the impact of the work product on the health and safety of the public?	✓	
14.	Does the title page contain the following: - Document Title - Document Number - Date of Issue - Correct Revision - Pagination (page 1 of X) - All Required Signatures — n.a. PK	✓	
15.	Does the header of each page contain the following: - Sequentially numbered pages (page 1 of X) - Document Number - Correct Revision - Date of Issue	✓	
16.	Is the document legible and reproducible?	✓	
17.	Are all cross-outs and overstrikes initialed and dated by the author?	✓	

Comments/remarks: ______________________

PAUL B. KRAMARCHYK / Paul B. Kramarchyk / 11/11/96
Independent Reviewer: Name/Signature/Date

CONTAINMENT
SPRAY FLOW

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 7

CONTAINMENT SPRAY FLOW {27}

RECORD OF REVISIONS

Rev	Date	Pages	Preparer	Ind.Reviewer	Approver
Draft	05/19/95	ALL	Congdon	Kramarchyk	Greene
Draft	10/31/95	ALL	Congdon	N/A	N/A
00	03/29/96	ALL	Congdon	Smith	Greene
01	11/15/96	ALL	Congdon	Kramarchyk	Greene

PREPARED BY:

Joseph R. Congdon
Cognizant Engineer (Print Name)

[signature]
Cognizant Engineer (Signature) Date: 11/8/96

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Attachment 2, (QA Checklist) found in the Project Quality Plan.

Paul Kramarchyk — [signature] — 11/12/96
Name — Signature — Date
Independent Reviewer

APPROVED BY:

Mark Greene
Cognizant Engineering Supervisor (Print Name)

[signature] 11/13/96
Cognizant Engineering Supervisor (Signature) Date

EMERGENCY PROCEDURE GUIDELINE (CEN-152)
ENGINEERING LIMIT BASES DOCUMENT

MODULE 2 - DOCUMENT 7 - APPLICATION 1

{271}
System Subject Parameter: ESF-CS Flow

Value: CS pump [design flowrate], nominally 1500 gpm

Use:

U69
To verify a parameter is in agreement with "nominal values" provided in SSC design criteria or safety analyses.

Cat: C03

Engineering Limit(s):

Lower = TS LCO containment spray pump design flowrate, nominally [1500 GPM].

Basis for Engineering Limit(s):

The engineering limit is based on the minimum required containment spray flow needed to remove 50% of the design basis containment heat load assumed in the accident analyses for LOCA or MSLB DBA. Containment spray flow in each header equal to or greater than the engineering limit ensures that each spray header is providing 50% of design requirements for containment heat removal (Ref. 1).

The intent of the operational limit is to provide the operator with criteria for verification that adequate containment spray flow exists after CS system actuation and to prompt the operator to investigate possible causes of degraded system flow if it is below the expected value. The operational limit is used to aid the operator in evaluating CS system performance and to prompt the operator to investigate possible causes of degraded system flow if it is below the expected value.

The Containment Spray and Emergency Containment Cooling systems are designed to provide containment atmosphere cooling to limit post accident pressure and temperature in containment to within their design limits. The reduction of containment pressure, and the iodine removal capability of the spray, reduces the total release of fission product activity from containment to the environment, following a Design Basis Accident (DBA), to within the acceptable limits.

The authors of the EPGs did not include instrument uncertainties when selecting the EPG operational limit.

References:

1. NUREG-1432, Revision 01, dated April 1995: Section B 3.6.6A (Pages B 3.6-44 through B 3.6-54) and Section B 3.6.6B (Pages B 3.6-55 through B 3.6.6-64)

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

Review Criteria (page 1 of 2)		OK	N/A
1.	Are the deliverables consistent with the Project Plan and the Project Authorization?	✓	
2.	Has the intent of the Engineering Limit been clearly expressed?	✓	
3.	Has the Engineering Limit been clearly identified?	✓	
4.	Has the bases for the Engineering Limit been clearly expressed?	✓	
5.	Has what the Engineering Limit ensures been clearly expressed?	✓	
6.	Have all assumptions been clearly stated?	✓	
7.	Has the relationship of the EPG value or descriptor to nuclear Safety been addressed?	✓	
8.	Does the document explicitly state that instrument uncertainties need or need not be applied for each application?	✓	
9.	Has the rational/justification used in making the applicability determination been clearly expressed?	✓	
10.	Is there evidence that a deliberate effort has been made to consider other options to be used in the event that the instrument uncertainties can not be accommodated when it is desirable for them to be explicitly applied?	✓	

TASK 868 & 884 QUALITY ASSURANCE CHECKLIST

	Review Criteria (page 2 of 2)	OK	N/A
11.	When necessary, have recommendations for additional analyses, verifications or simulator validations, to confirm assumptions or conclusions, been provided?	✓	
12.	Is there evidence that industry operating experience has been considered and incorporated as appropriate?	✓	
13.	Is there evidence that a deliberate effort has been made to consider the impact of the work product on the health and safety of the public?	✓	
14.	Does the title page contain the following: - Document Title - Document Number - Date of Issue - Correct Revision - Pagination (page 1 of X) - All Required Signatures	✓	
15.	Does the header of each page contain the following: - Sequentially numbered pages (page 1 of X) - Document Number - Correct Revision - Date of Issue	✓	
16.	Is the document legible and reproducible?	✓	
17.	Are all cross-outs and overstrikes initialed and dated by the author?	✓	

Comments/remarks:

PAUL KRAMARCHIK Paul B. Kramarchyk 11/12/96
Independent Reviewer: Name/Signature/Date