Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

Mike D. Skaggs
Vice President, Browns Ferry Nuclear Plant

March 11, 2005

TVA-TS-447

10 CFR 50.90

U.S. Nuclear Regulatory Commission
Mail Stop: OFWN P1-35
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of	)	Docket Nos. 50-259
Tennessee Valley Authority	)	50-260
		50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - UNITS 1, 2, AND 3 - TECHNICAL SPECIFICATIONS (TS) CHANGE TS-447, REQUEST FOR ADDITIONAL INFORMATION (RAI) - EXTENSION OF CHANNEL CALIBRATION SURVEILLANCE REQUIREMENT PERFORMANCE FREQUENCY AND ALLOWABLE VALUE REVISION

On August 16, 2004, TVA submitted a license amendment request (TS-447, ADAMS accession number ML04237061) to extend the calibration surveillance frequency for the high pressure coolant injection (HPCI) system, reactor core isolation cooling (RCIC) system, and reactor water clean-up (RWCU) system high area temperature isolation instrument channels on BFN Units 1, 2, and 3. On January 10, 2005, NRC informed TVA via memo (ADAMS accession number ML043640556) that additional information was required in support of the requested amendments.

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The enclosures to this letter provide the requested additional information. This letter provides additional information only, and no information in the previous submittal is being revised. The proposed finding of no significant hazards considerations and environmental impact consideration as submitted in TVA's August 16, 2004, letter remain valid.

Approval of this TS change will result in ALARA and industrial safety enhancements benefiting the BFN plant staff; therefore, in the August 16, 2004, letter, TVA requested NRC approval by June 2005 to minimize the number of additional times plant personnel must perform these calibration surveillances at the current frequency. The ALARA and industrial safety implications for plant personnel remain; however, TVA recognizes that the originally requested approval date is now impractical to achieve. Therefore, TVA requests NRC approval of TS-447 by October 2005. TVA also requests that the implementation of the revised TS be within 60 days of NRC approval.

There are no regulatory commitments associated with this submittal. If you have any questions about this change, please contact Tim Abney at (256)729-2636 or Paul Heck at (256)729-3624.

Sincerely,

Mike Skaggs

Mike D. Skaggs

Enclosures:

1. TS-447 RAI response
2. BFN Instrument Setpoint Calculation Excerpts
3. TVA Setpoint Calculation Methodology

cc: See page 3

Enclosures
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ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

1.0 BACKGROUND INFORMATION AND RAI SUMMARY

TVA's August 16, 2004 letter (Reference 1) requested amendments to Operating Licenses DPR-33, DPR-52, and DPR-68 for Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3, respectively. The proposed changes would revise the operating licenses to extend the performance frequency of required calibration surveillance testing on instrumentation channels associated with high area temperature system isolation of the high pressure coolant injection (HPCI), reactor core isolation cooling (RCIC), and reactor water clean-up (RWCU) systems. Allowable values for the trip setpoints for some of these channels would also be revised. The Technical Specifications (TS) currently require performance of these calibration activities on a more frequent interval than is technically necessary, and the performance of these calibrations on the current frequency is contrary to both ALARA principles and good industrial safety practices.

NRC's January 10, 2005 letter to TVA (Reference 2) stated that additional information was necessary to allow proper review of this request. NRC's letter, along with related telephone discussions between TVA and NRC, identified the need for additional information in five specific areas:

- Methodology used in determining the allowable values requested
- Details of the available test (surveillance) data and how they were evaluated
- Methods used in extrapolation of the available 3-month interval testing results to support 24-month testing intervals
- Reliability of the temperature loops
- Use of Instrument Society of America (ISA) 067.04 Part 2 Method 3 which is currently under discussion by NRC and the industry

These areas are addressed below. Additional details are also provided on the ALARA and industrial safety benefits which result from extending the calibration intervals on the HPCI/RCIC temperature switches.

2.0 DETERMINATION OF ALLOWABLE VALUES

As stated in TVA's August 16, 2004 submittal of TS-447, TVA's methods for performing scaling and setpoint calculations meet the guidance documented in NRC Generic Letter (GL) 91-04. This methodology has been reviewed by the NRC and is consistent with NRC Regulatory Guide 1.105. These calculations consider the following types of factors [(1)] in determining the TS allowable values utilized at BFN:

- Temperature effects
- Radiation effects
- Seismic effects
- Test equipment input and output accuracies
- Read-out accuracies
- Process instrument drift
- Repeatability

(1) These factors are defined in the TVA setpoint methodology document provided as Enclosure 3.

While several factors potentially impact an instrument TS setpoint allowable value, time dependent variables are the major factor in determining the appropriate calibration intervals. Uncertainties which are time dependent will dictate how often an instrument loop must be calibrated to ensure that the loop continues to function within the analyzed limits. TVA's setpoint calculations consider any time dependent variables in the instrument measurable uncertainties. No time dependent uncertainties were identified for the HPCI or RCIC area temperature switches. Time dependent variables do exist for the RWCU area temperature instrument loops, however, analysis of the historical Unit 2 and Unit 3 operating data, taken together with the other instrument attributes that must be considered, showed that an extension of the calibration surveillance interval from the current 122 days to an interval of 24 months is acceptable.

The TVA calculations which determined the TS allowable values for the instruments impacted by TS-447 address redundant instrument channels, therefore the calculations contain much repetitive information and are quite lengthy. Representative portions of these calculations sufficient to illustrate the calculation methodology are included with this letter as Enclosure 2. Enclosure 3 provides TVA's setpoint calculation methodology document.

See Section 3.0 below for additional details on the operating data reviewed and how conclusions were drawn.

3.0 DATA EVALUATION DETAILS

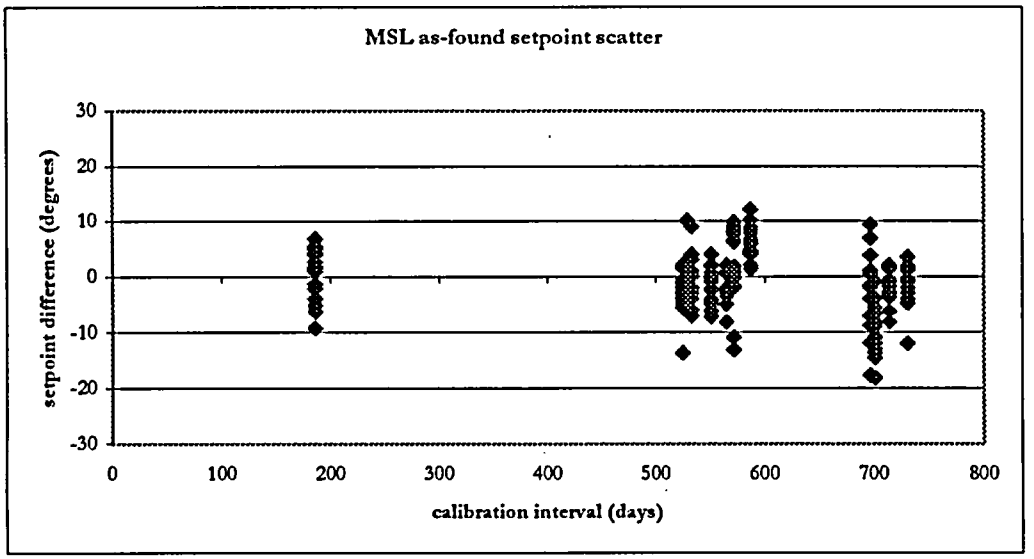
HPCI and RCIC area temperature switches

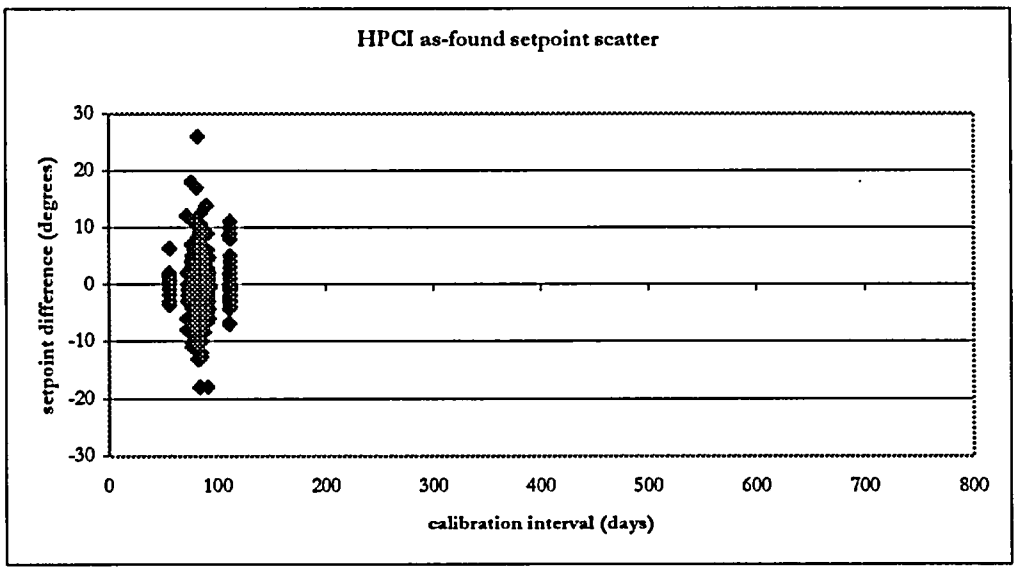
Extensive Unit 2 and Unit 3 historical operating data for the affected instrument channels are available. Additionally, and significantly, the main steam line (MSL) temperature switches at Browns Ferry are of the same instrument type as the switches used in the HPCI and RCIC operating areas. Because their locations are inaccessible with the reactor at power, the MSL switches have always been calibrated on an 18-month or 24-month calibration interval to allow the calibrations to be performed during refueling outages. The HPCI, RCIC, and MSL temperature switch calibration data were evaluated along with vendor information and consideration of the physical attributes of the affected instrumentation. The MSL, HPCI, and RCIC data, arranged in descending length of calibration interval, are included as attachments A, B, and C, respectively, to this enclosure.

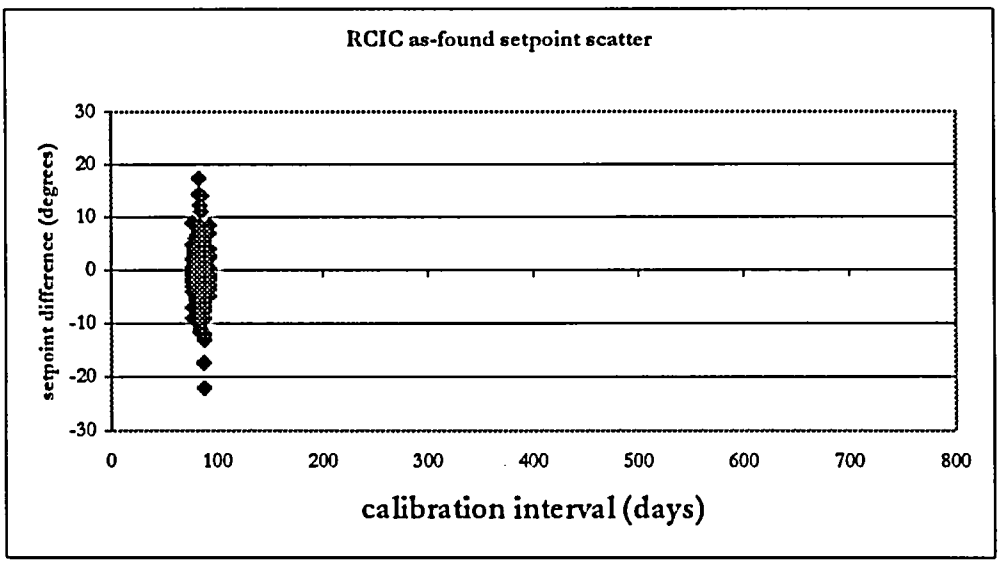
The plots on the following page show the setpoint difference scatter versus the calibration interval for the MSL, HPCI, and RCIC area temperature instruments. It is visually apparent that the calibration interval has no significant impact on the observed setpoint difference.

ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION





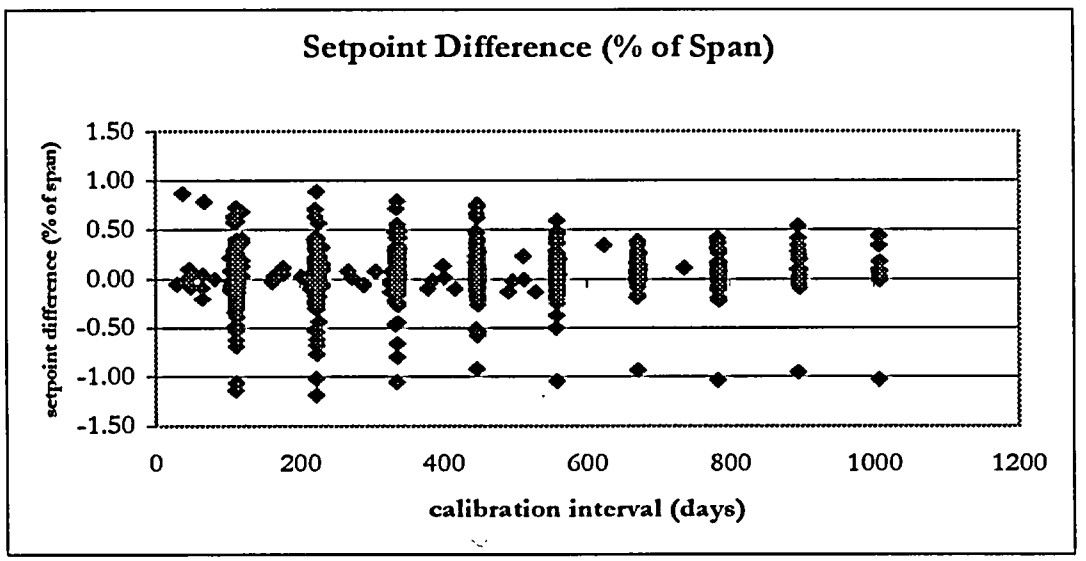


All of the MSL, HPCI, and RCIC area temperature switch historical operating data included in Attachments A, B, and C were evaluated. Statistical analysis of the historical data showed there were no time dependent variables in the instrument measurable uncertainties. The three plots included above visually depict the fact that the setpoint deviation exhibited by these temperature switches has no significant correlation with the time interval between calibrations. Extension of the calibration interval will have no discernible effect on the switch operating accuracy.

RWCU area temperature switches

The RWCU area temperature monitoring is accomplished by resistance temperature detector (RTD) instrument loops. The RWCU data which were evaluated are tabulated in Attachment D of this enclosure. Each point provides the length of time between calibrations and the as-found setpoint difference (in percent of calibrated span) of the temperature loop trip unit.

The plot below shows the RWCU temperature loop trip unit calibration scatter versus the calibration interval from the Attachment D data. The trip setpoint drift for these RTD-based loops is not significantly affected by the length of the calibration interval.



4.0 BASIS FOR 24-MONTH CALIBRATION INTERVAL

As stated above, TVA, using the calculation methods as exhibited in Enclosure 2, evaluated historical operating data for the affected instruments to quantify any time dependent variables in the instrument measurable uncertainties. In the case of the HPCI and RCIC area temperature instruments addressed in TVA's previous TS-447 submittal, no time dependent variables existed, therefore no actual extrapolation was necessary in determining the acceptability of the 24-month TS calibration interval. All applicable uncertainties were evaluated in

the determination of the TS allowable values. None of these attributes changed as a result of the TS-447 submittal, though some minor TS allowable value modifications were requested in TS-447 as refinements.

The MSL area temperature switches are already calibrated on a 24-month interval at BFN, and no negative performance trends have been observed. These switches are essentially identical to those used in the HPCI and RCIC areas, and the operating environments are quite similar in most respects, though the MSL switches are installed in a generally more harsh physical environment.

As previously stated, the RWCU area temperature monitoring on Unit 2 and Unit 3 (1) is not accomplished by the use of bimetallic temperature switches, but rather through the use of RTDs which provide an input to rack-mounted analog trip system master trip units. Similar trip units are used widely in safety-related applications at BFN, and essentially all such loops are already calibrated on 24-month intervals. The calibration time-drift component is therefore well established, and BFN has observed no negative performance trends on any analog trip system loops. In summary, for the RWCU area temperature instruments, minor time dependent variables do exist, they are contained within the vendor's supplied repeatability accuracy value, and they are addressed in the setpoint calculations.

Refer to Enclosure 2 for additional information on how the time dependent variables are addressed within the setpoint calculations for the RWCU area temperature instrumentation. Refer to Enclosure 3 for the document which controls TVA's setpoint calculation methodology.

(1) – Unit 1 will have similar RTD-based loops installed prior to its restart

5.0 TEMPERATURE INSTRUMENT LOOP RELIABILITY

As discussed above, BFN has identified no negative performance trend with either the bimetallic temperature switches in use in the MSL, HPCI, and RCIC areas, nor on the RTD-based, rack mounted temperature loops primarily used in the RWCU areas. Additionally, instruments of both types are utilized for TS functions currently calibrated on 24-month intervals. No failure trend has been observed, and likewise no calibration-drift problems have been identified.

6.0 ISA 067.04 PART 2 METHOD 3 APPLICATION

In a discussion with the NRC staff on February 1, 2005, TVA and NRC agreed to defer any responses concerning the use of Method 3 pending resolution of this issue with the industry. It is TVA's understanding that the NRC plans to resolve this issue with the industry by the end of March, 2005. The resolution as reached on the issue as a whole will then be applied to TS-447 as appropriate.

7.0 ADDITIONAL INFORMATION RELATED TO ALARA AND INDUSTRIAL SAFETY CONSIDERATIONS

In order to accomplish the required TS calibration function for the HPCI and RCIC area temperature instrumentation, personnel must access plant locations which involve fall hazards, high ambient temperatures, and radiation dose rates which are elevated relative to the general plant areas. Performing such work more frequently than is technically necessary is contrary to both ALARA principles and good industrial safety practices. Further information on these subjects is provided below.

ALARA

The purpose of the HPCI and RCIC area temperature switches is to provide a diverse means of identifying a leak in the high-energy steam lines which provide motive power to the HPCI and RCIC turbines. These switches are necessarily located in plant overhead areas distributed along the routes of the monitored system steam supply lines and near the system turbines. In order to comply with the TS requirement for switch calibration, on a nominal 92-day frequency, plant personnel must access these switches and physically replace them with identical switches which have been calibrated using measuring and test equipment available in the plant instrument maintenance shop. The removed switches are then returned to the shop for determination of their as-found actuation setpoint.

Given that the switches are located near the systems' steam supply lines, the general area radiation fields in the vicinity of the switches are higher relative to other plant operating areas. The work involved in accessing the switches, removing the old ones, installing the newly calibrated ones, and then leaving the area unavoidably involves the accrual of occupational radiation dose to the plant workers involved which would otherwise be avoided. Over the past 26 months, BFN personnel working on Unit 2 and Unit 3 have accrued approximately 4.4 man-REM of exposure performing these activities. Approval of the requested calibration frequency extension (from 3-months to 24-months) could therefore be reasonably expected to reduce the exposure by a corresponding factor, for a savings of approximately 3.85 man-REM over about two years of two-unit operation. This is approximately 1 man-REM/unit/calendar year. With the planned restart of Unit 1 in the spring of 2007, it is expected that similar exposure for the same work on Unit 1 could also be avoided. It should be noted that an accepted industry standard for occupational dose at boiling water reactor units is 120 man-REM/year/unit. Therefore, the anticipated occupational dose savings from reducing the performance frequency of this one set of plant maintenance activities as requested by TS-447 approaches 1% of each unit's entire yearly occupational dose goal.

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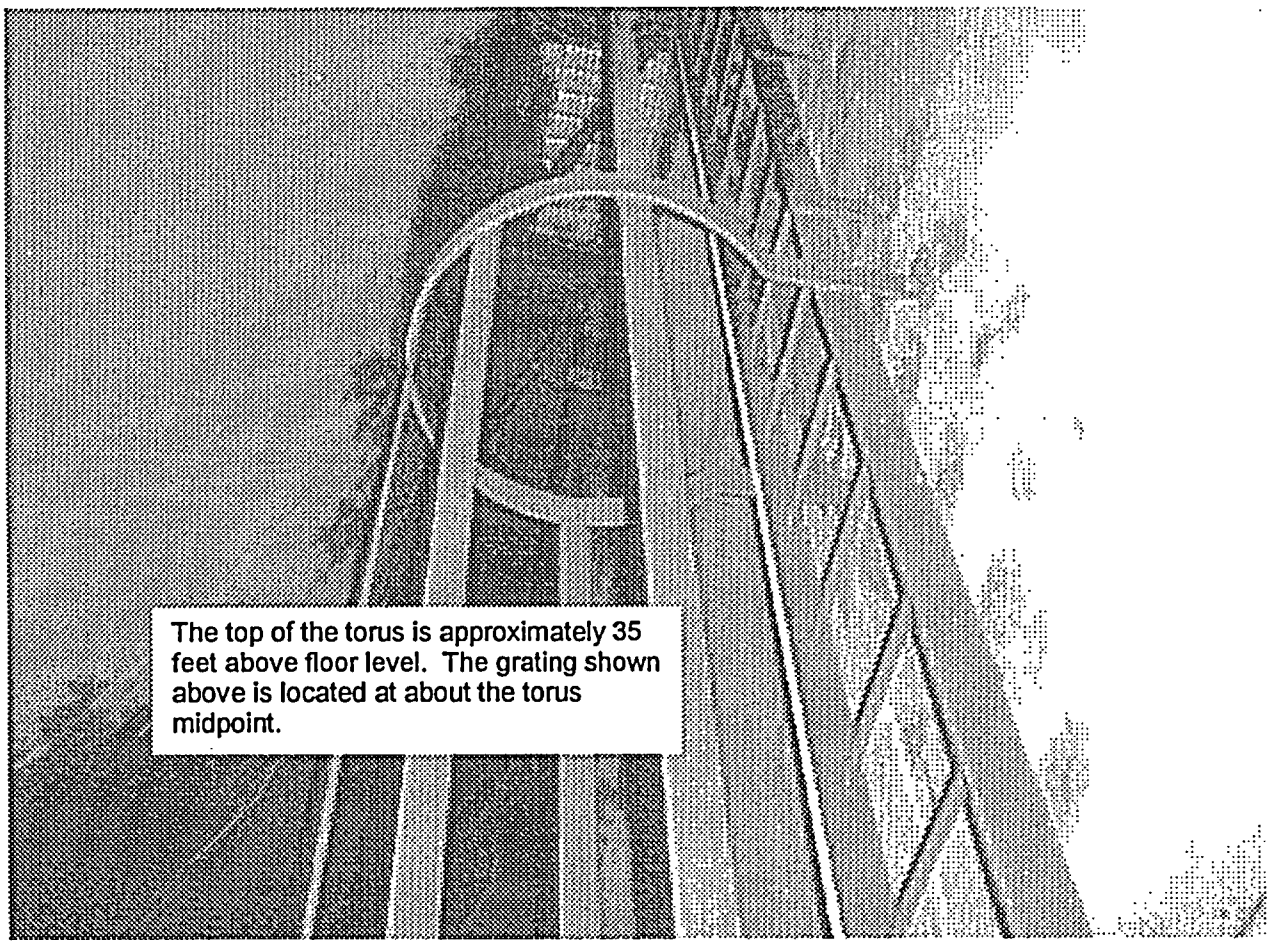
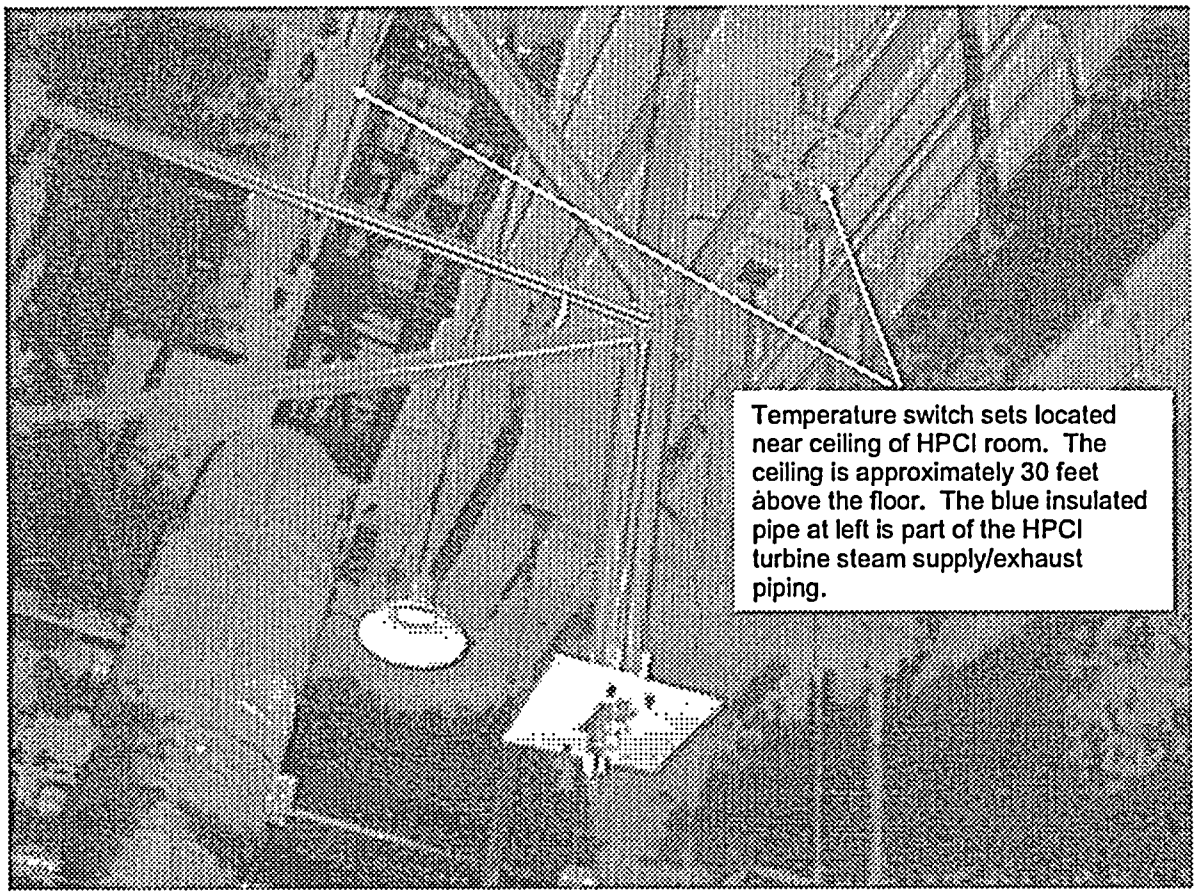
INDUSTRIAL SAFETY

As stated above, the HPCI and RCIC area temperature switches are installed in plant overhead locations. These locations are most often accessed by plant ladders, and the work must then be performed from platforms in many cases located 30 feet or higher above the floor elevations. In addition to the relatively higher radiation fields in these locations, these locations also have relatively high ambient temperatures. Accessing the switches at these heights is physically demanding, and working in the higher ambient temperature is also physically stressful. Thorough planning and preparation can reduce employee risk due to this work, but such efforts cannot eliminate all such risk. By extending the calibration frequency required by the TS, the number of times plant employees must place themselves in this increased-risk situation is correspondingly reduced. The two pictures below help illustrate the heights which must be negotiated in accomplishing these calibration activities.

Access Ladder to Top of Torus



HPCI Area Temperature Switches Seen from HPCI Room Floor



8.0 REFERENCES

1. August 16, 2004, Letter from TVA to NRC transmitting Browns Ferry Nuclear Plant (BFN) - Units 1, 2, and 3 – Technical Specifications (TS) Change TS-447 - Extension of Channel Calibration Surveillance Requirement Performance Frequency And Allowable Value Revision (ADAMS accession number ML04237061)
2. January 10, 2005, Letter from NRC to TVA transmitting Results Of Acceptance Review Regarding Request To Extend Technical Specification Channel Calibration Frequencies (MC4070, MC4071, and MC4072) (TS-447) (ADAMS accession number ML043640556)

ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

Attachment A

MSL area temperature switch calibration information

Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)
731	-4.8	701	-1.0	572	8.1	551	4.0	529	-0.1
731	-0.6	701	-8.4	572	7.6	551	-1.0	529	-0.6
731	1.9	701	-18.2	572	8.6	551	-1.0	525	-2.0
731	-3.0	701	-8.1	572	1.7	551	-6.2	525	-1.0
731	-3.0	701	-4.0	572	9.1	551	0.0	525	-0.5
731	3.5	701	-11.9	572	-0.3	551	-4.8	525	-2.5
731	-4.0	701	-9.0	572	6.5	551	-5.0	525	-3.0
731	1.3	701	-5.5	572	9.8	551	-0.3	525	-3.9
731	1.4	697	-7.1	572	-1.9	551	-4.1	525	-3.0
731	-12.0	697	3.8	572	6.3	533	1.0	525	-1.5
731	-0.5	697	9.3	572	-13.1	533	1.0	525	2.0
731	1.1	697	-8.8	572	1.2	533	-2.0	525	1.5
731	-2.1	697	-11.9	572	-1.8	533	-2.0	525	-1.4
731	-1.0	697	1.0	572	8.0	533	-7.0	525	-4.8
731	-2.0	697	-2.0	572	-10.9	533	-6.0	525	-13.7
731	-2.0	697	-4.0	572	0.7	533	-2.0	525	-5.6
714	-1.0	697	6.9	565	0.5	533	3.0	525	1.8
714	2.0	697	-1.6	565	-2.0	533	4.0	186	1.9
714	1.5	697	-17.7	565	0.8	533	-3.0	186	-1.3
714	-3.7	697	-1.9	565	-2.2	533	-4.0	186	-2.2
714	-0.9	697	-11.9	565	1.1	533	-2.0	186	3.9
714	-0.6	697	-1.7	565	2.0	533	0.0	186	2.7
714	1.6	697	0.4	565	-3.0	533	3.0	186	5.0
714	-1.5	587	2.0	565	-3.5	533	0.0	186	0.9
714	1.3	587	8.9	565	1.0	533	9.0	186	5.5
714	-3.3	587	5.8	565	1.0	529	0.9	186	5.0
714	-3.3	587	10.2	565	1.0	529	0.2	186	4.4
714	-8.1	587	7.8	565	-8.2	529	-1.2	186	-9.2
714	-2.8	587	4.6	565	-5.0	529	-2.6	186	6.8
714	-6.3	587	2.0	565	-3.0	529	-0.4	186	1.5
714	-1.9	587	4.3	565	-3.0	529	1.0	186	-4.0
714	-0.6	587	4.0	565	-2.0	529	2.9	186	-5.2
701	-10.9	587	6.3	551	-2.2	529	1.5	186	-6.3
701	-13.7	587	1.4	551	-7.2	529	-2.1		
701	-12.0	587	8.4	551	1.8	529	-5.9		
701	-6.8	587	12.1	551	2.1	529	-1.4		
701	-14.6	587	4.8	551	0.7	529	-3.0		
701	-12.9	587	5.9	551	-2.5	529	10.1		
701	-3.9	587	6.8	551	-4.4	529	-3.6		

Attachment A Data Set - MSL:

Average Deviation =	-1.06	degrees
Standard Deviation =	5.50	degrees
Maximum Positive Deviation =	12.1	degrees
Maximum Negative Deviation =	-18.2	degrees
Average Interval =	573.19	days

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Attachment B

HPCI Area Temperature Switch Operating Data

Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)
112.00	1.0	92.00	0.0	91.00	1.0	88.00	-0.1	85.00	5.8
112.00	-4.0	92.00	0.7	91.00	2.9	88.00	8.3	85.00	10.5
112.00	2.0	92.00	4.7	91.00	-2.0	88.00	-1.3	85.00	-0.2
112.00	9.0	92.00	1.7	91.00	0.0	88.00	-4.0	85.00	-0.8
112.00	-1.0	92.00	2.1	91.00	0.9	88.00	-0.1	85.00	1.3
112.00	8.0	92.00	-4.3	91.00	-2.0	88.00	-1.4	85.00	12.5
112.00	-0.5	92.00	-5.9	91.00	2.0	88.00	-4.0	85.00	2.2
112.00	-3.0	92.00	-0.6	91.00	5.0	88.00	0.7	85.00	1.8
112.00	5.0	92.00	0.7	91.00	-1.9	88.00	-5.1	85.00	4.0
112.00	1.0	92.00	-6.0	91.00	2.0	88.00	0.1	85.00	0.7
112.00	2.0	92.00	0.9	91.00	2.7	88.00	-8.4	85.00	0.2
112.00	-1.0	92.00	2.0	91.00	-6.5	88.00	0.6	85.00	-2.9
112.00	-1.0	92.00	1.0	91.00	2.0	88.00	-5.7	85.00	2.0
112.00	1.0	92.00	-0.8	91.00	2.4	87.00	2.9	85.00	-3.1
112.00	1.0	92.00	0.9	90.00	0.0	87.00	-3.5	85.00	0.5
112.00	5.0	91.00	-6.6	90.00	0.0	87.00	2.4	85.00	0.1
112.00	2.0	91.00	-0.6	90.00	-2.0	87.00	1.6	85.00	-1.6
112.00	-1.0	91.00	6.0	90.00	13.8	87.00	0.0	85.00	-4.3
112.00	4.0	91.00	-18.0	90.00	6.0	87.00	3.5	85.00	-2.3
112.00	9.0	91.00	-1.4	90.00	-1.0	87.00	1.5	85.00	0.1
112.00	0.0	91.00	0.0	90.00	-3.0	87.00	1.4	85.00	-6.0
112.00	-1.0	91.00	-0.5	90.00	3.0	87.00	2.9	85.00	-1.5
112.00	-1.0	91.00	-2.9	90.00	-4.0	87.00	5.0	85.00	-1.7
112.00	-1.0	91.00	1.0	90.00	1.0	87.00	0.8	85.00	-1.5
112.00	4.0	91.00	-2.3	90.00	-2.0	87.00	0.5	85.00	-5.0
112.00	5.0	91.00	0.4	90.00	1.0	87.00	1.8	85.00	0.6
112.00	11.0	91.00	9.0	90.00	-3.0	87.00	0.6	85.00	-1.0
112.00	4.0	91.00	-1.7	90.00	-4.0	87.00	3.5	85.00	0.1
112.00	3.0	91.00	-0.8	90.00	-4.0	87.00	0.9	85.00	-2.7
112.00	1.0	91.00	-2.3	90.00	4.0	86.00	-10.0	85.00	-1.7
112.00	-2.0	91.00	-1.2	88.00	0.9	86.00	1.0	85.00	2.9
112.00	10.0	91.00	2.3	88.00	-3.9	86.00	-2.0	85.00	-2.0
111.00	-2.9	91.00	0.0	88.00	4.9	86.00	-5.0	85.00	2.0
111.00	-0.1	91.00	-2.7	88.00	5.0	86.00	8.0	85.00	-1.4
111.00	-1.0	91.00	0.0	88.00	-1.5	86.00	-7.0	85.00	1.0
111.00	-4.3	91.00	0.9	88.00	-5.1	86.00	8.4	85.00	-0.9
111.00	8.6	91.00	0.9	88.00	1.5	86.00	-2.1	85.00	0.0
111.00	-3.2	91.00	0.3	88.00	-1.9	86.00	-3.0	85.00	-1.1
111.00	-3.1	91.00	1.0	88.00	1.5	86.00	-8.0	85.00	6.0
111.00	-2.7	91.00	-1.0	88.00	-0.5	86.00	7.0	85.00	-2.7
111.00	-0.3	91.00	6.0	88.00	1.1	86.00	-5.0	85.00	-0.6
111.00	-7.0	91.00	-4.9	88.00	0.2	86.00	0.1	85.00	3.4
111.00	-3.0	91.00	0.1	88.00	-0.2	86.00	0.6	85.00	0.8
111.00	-4.3	91.00	-3.0	88.00	1.1	86.00	2.0	85.00	6.7
111.00	-6.8	91.00	2.8	88.00	1.1	86.00	2.9	85.00	3.0
111.00	-2.2	91.00	-4.7	88.00	-6.9	85.00	0.0	85.00	-1.2
111.00	0.1	91.00	1.0	88.00	-4.4	85.00	2.6	85.00	3.2
111.00	1.9	91.00	2.3	88.00	-2.0	85.00	0.8	85.00	-2.9
92.00	-3.0	91.00	-2.5	88.00	1.6	85.00	3.2	85.00	-7.6

- continued –

ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

Attachment B

HPCI Area Temperature Switch Operating Data (continued)

Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)
85.00	2.5	84.00	0.0	84.00	-4.0	84.00	3.3	83.00	-1.5
85.00	8.6	84.00	7.0	84.00	3.3	84.00	6.1	83.00	0.7
85.00	-2.0	84.00	-1.6	84.00	-0.8	84.00	-1.0	83.00	3.8
85.00	-3.1	84.00	1.3	84.00	3.0	84.00	9.0	83.00	5.2
85.00	-4.4	84.00	-6.0	84.00	-2.0	84.00	1.5	83.00	1.9
85.00	-4.0	84.00	-2.0	84.00	-1.0	84.00	-4.0	83.00	-6.0
85.00	6.6	84.00	3.4	84.00	-2.0	84.00	2.0	83.00	-0.1
85.00	0.3	84.00	0.0	84.00	-2.3	84.00	4.0	82.00	0.0
85.00	-3.2	84.00	0.7	84.00	-5.0	84.00	4.0	82.00	7.7
85.00	3.0	84.00	-2.0	84.00	-0.4	84.00	4.0	82.00	5.0
85.00	1.9	84.00	0.4	84.00	0.7	84.00	6.0	82.00	-10.0
85.00	-8.6	84.00	-1.1	84.00	4.0	84.00	3.0	82.00	2.3
85.00	6.4	84.00	2.0	84.00	1.0	84.00	0.0	82.00	1.0
85.00	1.0	84.00	2.0	84.00	0.8	84.00	0.0	82.00	0.0
85.00	0.5	84.00	2.1	84.00	2.0	84.00	-6.0	82.00	-2.9
85.00	0.5	84.00	4.0	84.00	-1.0	84.00	-4.0	82.00	-13.1
85.00	-1.2	84.00	4.0	84.00	0.0	84.00	8.1	82.00	0.0
85.00	-3.0	84.00	-3.0	84.00	5.7	84.00	-0.2	82.00	5.6
85.00	3.8	84.00	-0.3	84.00	-1.6	84.00	-2.3	82.00	0.5
85.00	1.0	84.00	-5.9	84.00	-3.0	84.00	0.0	82.00	-1.0
85.00	-2.0	84.00	-1.0	84.00	0.0	84.00	-1.0	82.00	-5.6
85.00	-12.7	84.00	2.0	84.00	5.0	84.00	-1.0	82.00	-4.0
85.00	2.4	84.00	0.2	84.00	-3.0	84.00	-6.0	82.00	1.0
85.00	-0.4	84.00	1.0	84.00	1.0	84.00	-1.0	82.00	5.2
85.00	6.8	84.00	1.5	84.00	-8.0	83.00	2.2	82.00	-5.9
85.00	-2.0	84.00	-5.0	84.00	8.0	83.00	-0.1	82.00	-2.0
85.00	-0.1	84.00	-1.6	84.00	-4.0	83.00	1.3	82.00	-0.2
85.00	-3.4	84.00	7.5	84.00	-1.0	83.00	-0.6	82.00	-3.2
85.00	1.1	84.00	-1.0	84.00	1.0	83.00	2.6	82.00	0.0
85.00	0.7	84.00	2.0	84.00	0.7	83.00	0.9	82.00	7.0
85.00	1.5	84.00	-6.9	84.00	3.0	83.00	-2.4	82.00	-8.5
85.00	-5.0	84.00	1.0	84.00	2.0	83.00	-0.3	82.00	-4.0
85.00	-0.8	84.00	0.0	84.00	0.0	83.00	2.7	82.00	8.3
85.00	-12.0	84.00	1.0	84.00	3.1	83.00	-3.1	82.00	2.0
85.00	-1.6	84.00	0.2	84.00	-3.0	83.00	-4.8	82.00	3.0
85.00	0.4	84.00	2.8	84.00	-4.0	83.00	-0.6	82.00	4.8
85.00	4.9	84.00	-18.0	84.00	6.0	83.00	-2.9	82.00	-7.0
85.00	1.3	84.00	0.0	84.00	4.8	83.00	-1.1	82.00	1.0
85.00	-2.4	84.00	0.1	84.00	-2.0	83.00	-2.9	82.00	3.2
85.00	-1.9	84.00	-1.0	84.00	-5.0	83.00	2.5	82.00	0.0
85.00	-0.9	84.00	-0.9	84.00	-7.0	83.00	-8.0	82.00	0.0
85.00	0.1	84.00	0.8	84.00	-0.7	83.00	-1.8	82.00	1.3
85.00	0.7	84.00	2.7	84.00	-7.3	83.00	-1.2	82.00	2.5
84.00	9.4	84.00	-0.1	84.00	1.0	83.00	-3.2	82.00	26.0
84.00	-3.6	84.00	-3.0	84.00	-3.0	83.00	-0.9	82.00	2.9
84.00	-13.0	84.00	2.0	84.00	0.2	83.00	-0.3	82.00	1.1
84.00	1.0	84.00	1.5	84.00	-4.0	83.00	1.0	82.00	0.0
84.00	5.7	84.00	1.0	84.00	-4.0	83.00	-1.5	82.00	3.4
84.00	-5.0	84.00	2.0	84.00	-3.0	83.00	0.8	82.00	3.0

- continued -

ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

Attachment B

HPCI Area Temperature Switch Operating Data (continued)

Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)
82.00	-5.0	80.00	3.9	78.00	1.0	77.00	2.0	72.00	-2.0
82.00	7.5	80.00	-0.7	78.00	-4.0	77.00	-2.8	72.00	-1.0
82.00	-3.9	80.00	-0.6	78.00	2.0	77.00	0.0	72.00	12.0
82.00	-9.0	80.00	2.9	78.00	6.0	77.00	-1.4	72.00	-3.0
82.00	-2.1	80.00	4.6	78.00	7.0	77.00	-1.0	72.00	0.0
82.00	-0.2	80.00	4.5	78.00	0.0	77.00	2.1	72.00	0.0
81.00	4.0	80.00	-5.2	78.00	0.0	77.00	-2.0	72.00	0.0
81.00	17.0	80.00	-1.0	78.00	-1.0	77.00	1.8	72.00	-6.0
81.00	0.0	79.00	0.0	78.00	5.0	77.00	-3.0	72.00	-1.0
81.00	-3.0	79.00	0.9	78.00	-5.0	77.00	-11.0	72.00	-8.0
81.00	3.0	79.00	0.0	77.00	-2.0	77.00	-2.0	72.00	-8.0
81.00	3.0	79.00	-0.1	77.00	-10.2	77.00	0.7	72.00	-2.0
81.00	3.0	79.00	1.6	77.00	0.0	76.00	2.0	72.00	-3.0
81.00	-5.0	79.00	1.8	77.00	-0.3	76.00	-2.0	72.00	2.0
81.00	2.0	79.00	1.9	77.00	-2.0	76.00	0.0	56.00	0.0
81.00	0.0	79.00	-2.0	77.00	1.2	76.00	18.0	56.00	-3.0
81.00	0.0	79.00	3.7	77.00	0.0	76.00	4.0	56.00	-1.0
81.00	-2.0	79.00	0.7	77.00	0.9	76.00	0.0	56.00	-3.0
81.00	5.0	79.00	10.9	77.00	5.0	76.00	2.0	56.00	30.3
81.00	5.0	79.00	-1.0	77.00	-3.0	76.00	0.0	56.00	2.0
81.00	4.0	79.00	-0.2	77.00	2.0	76.00	0.0	56.00	-1.9
81.00	-5.0	79.00	1.9	77.00	-2.3	76.00	0.0	56.00	6.3
80.00	5.7	79.00	0.8	77.00	2.0	76.00	-4.0	56.00	-3.6
80.00	2.5	79.00	-1.0	77.00	-1.0	76.00	1.0	56.00	0.5
80.00	-0.1	78.00	2.0	77.00	0.0	76.00	1.0	56.00	0.2
80.00	-0.8	78.00	-2.0	77.00	-4.3	76.00	-2.0	56.00	-0.8
80.00	1.4	78.00	-3.0	77.00	-1.0	76.00	3.0	56.00	-1.9
80.00	2.9	78.00	1.0	77.00	-3.3	76.00	7.0	56.00	-0.9
80.00	1.5	78.00	1.0	77.00	4.0	72.00	-6.0	56.00	0.7
80.00	0.0	78.00	0.0	77.00	1.8	72.00	0.0	56.00	1.3

Attachment B Data Set - HPCI:

Average Deviation =	0.1	degrees
Standard Deviation =	4.3	degrees
Maximum Positive Deviation =	30.3	degrees
Maximum Negative Deviation =	-18.0	degrees
Average Interval =	85.2	days

ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

Attachment C

RCIC Area Temperature Switch Operating Data

Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)
93	-1.8	88	-5.8	87	-5.5	85	-1.2	84	1.5
93	-1.2	88	-3.8	87	1.0	85	3.5	84	3.3
93	2.5	88	-7.5	87	-2.2	85	1.7	84	-3.2
93	2.7	88	-3.6	87	-3.7	85	-3.5	84	0.8
93	2.3	88	-13.0	87	-1.9	85	-0.1	84	1.1
93	-0.8	88	-3.4	87	-0.1	85	0.3	84	-0.6
93	0.4	88	-6.0	87	-3.8	85	-0.9	84	2.0
93	8.4	88	2.1	87	-1.1	85	1.9	84	0.2
93	-4.8	88	-9.0	87	7.8	85	-1.9	84	-1.8
93	-3.6	88	1.8	87	-2.9	85	-7.4	84	1.0
93	2.3	88	-22.0	87	-1.5	85	2.7	84	0.0
93	2.5	88	5.7	87	-0.7	85	-1.2	84	0.0
93	4.0	88	-6.0	87	-17.3	85	1.9	84	2.0
93	-2.8	88	-3.3	87	-0.3	85	0.2	84	0.0
93	7.0	88	-12.0	86	7.2	85	-1.9	84	-5.9
93	-4.8	87	-1.9	86	-3.7	85	-0.9	84	-4.9
90	0.0	87	-6.7	86	5.4	85	8.2	84	4.1
90	2.0	87	4.6	86	-0.9	85	0.3	84	1.0
90	-1.0	87	-2.6	86	0.9	85	-1.0	84	0.9
90	2.0	87	-4.8	86	-2.7	85	3.6	84	-3.7
90	-1.0	87	2.8	86	2.7	85	11.0	84	3.0
90	1.0	87	1.1	86	2.3	85	-0.4	84	5.0
90	-5.0	87	0.6	86	0.9	85	0.0	84	-1.9
90	-4.0	87	0.9	86	-3.8	85	-0.9	84	0.8
90	0.0	87	3.7	86	4.9	85	4.0	84	-1.9
90	0.0	87	-2.9	86	2.9	85	-1.0	84	0.1
90	1.0	87	3.9	86	-5.0	85	3.0	84	-2.8
90	3.0	87	1.0	86	1.8	85	-6.5	84	-3.0
90	0.0	87	-0.7	86	-3.9	85	0.9	84	-4.0
90	-4.0	87	-0.3	86	-3.2	84	3.2	84	2.0
90	-4.0	87	6.6	86	-1.1	84	-1.1	84	6.0
90	-1.0	87	-1.9	86	-2.8	84	-2.1	84	-4.1
88	-4.2	87	-0.1	86	14.0	84	-0.2	84	-2.4
88	-0.2	87	-1.3	86	4.5	84	7.0	84	2.5
88	-2.0	87	-1.9	86	0.4	84	-3.6	84	1.4
88	1.2	87	-0.4	86	-0.8	84	-2.9	84	-3.7
88	0.5	87	-2.1	86	2.7	84	3.6	84	-4.5
88	-1.4	87	1.2	86	-11.9	84	1.4	84	-0.3
88	1.4	87	-2.6	86	-0.2	84	-4.7	84	-2.3
88	5.2	87	-0.5	86	1.2	84	-3.9	84	-0.8
88	-0.8	87	-1.0	86	-1.7	84	-1.7	84	-2.9
88	0.4	87	0.7	86	0.1	84	-1.3	84	0.2
88	4.2	87	0.1	86	7.3	84	0.7	84	4.2
88	-9.0	87	-7.8	86	2.2	84	-3.0	84	1.1
88	5.2	87	2.2	86	5.0	84	-3.0	84	-0.7
88	-6.8	87	-3.1	86	2.3	84	6.0	84	-1.0
88	-2.0	87	0.2	85	-0.3	84	12.2	84	-3.0
88	-1.4	87	1.8	85	-0.3	84	1.9	84	3.0
88	5.2	87	-0.6	85	-2.1	84	-2.3	84	0.6

- continued –

ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

Attachment C

RCIC Area Temperature Switch Operating Data (continued)

Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)
84	-2.8	84	6.0	84	-4.0	84	0.8	84	-4.0
84	-0.3	84	1.0	84	0.0	84	-3.0	84	-1.0
84	4.9	84	-0.1	84	-1.0	84	3.0	84	2.2
84	0.7	84	0.0	84	8.5	84	-3.0	84	0.4
84	-5.5	84	2.3	84	-5.7	84	3.0	84	0.0
84	3.2	84	0.3	84	-0.1	84	-10.9	84	-4.0
84	-3.3	84	-2.5	84	-0.2	84	-7.3	84	1.0
84	-2.1	84	-1.9	84	1.7	84	-2.0	83	7.4
84	-1.8	84	-2.1	84	1.0	84	2.6	83	-0.7
84	-0.8	84	0.1	84	1.0	84	-2.1	83	3.0
84	-0.7	84	1.3	84	0.7	84	-3.2	83	7.0
84	2.8	84	0.2	84	1.8	84	-9.1	83	-0.7
84	-1.4	84	-1.5	84	1.1	84	-2.1	83	3.0
84	-1.0	84	0.7	84	2.1	84	0.1	83	1.1
84	7.0	84	-1.3	84	1.0	84	1.1	83	-0.9
84	4.0	84	3.0	84	-2.1	84	0.0	83	2.0
84	2.0	84	0.0	84	0.5	84	0.8	83	2.3
84	1.7	84	2.0	84	2.0	84	-0.1	83	1.0
84	3.8	84	3.5	84	3.0	84	-1.3	83	1.0
84	-0.3	84	5.5	84	0.0	84	-4.0	83	6.0
84	-0.9	84	3.5	84	-8.8	84	-1.0	83	14.3
84	-1.7	84	-0.3	84	-2.0	84	-10.0	83	1.0
84	-1.3	84	2.9	84	-0.5	84	2.2	83	0.9
84	4.5	84	-0.7	84	2.9	84	-3.6	83	-4.8
84	0.3	84	-1.6	84	-0.6	84	0.6	83	-2.0
84	-0.7	84	-2.6	84	-3.6	84	0.9	83	-0.5
84	-2.9	84	0.5	84	-5.0	84	0.6	83	17.3
84	0.1	84	-0.8	84	2.0	84	-3.4	83	-1.0
84	4.8	84	4.2	84	-2.2	84	-0.1	83	-0.9
84	-3.3	84	-0.8	84	-7.8	84	4.0	83	-1.0
84	-2.0	84	-0.2	84	-3.6	84	4.8	83	2.0
84	8.0	84	-4.7	84	-2.1	84	-1.8	83	3.6
84	0.0	84	1.0	84	-0.4	84	-6.0	83	-3.6
84	1.5	84	3.0	84	-1.5	84	3.3	83	2.0
84	2.6	84	1.0	84	2.0	84	1.8	83	-1.1
84	4.5	84	-7.6	84	6.0	84	-1.2	83	-4.8
84	2.8	84	0.1	84	1.0	84	-1.0	83	1.0
84	-2.9	84	-1.4	84	6.8	84	-3.0	83	2.9
84	-3.5	84	0.4	84	-3.9	84	5.0	83	0.2
84	-11.6	84	-2.3	84	-4.3	84	5.3	83	2.0
84	1.9	84	-4.7	84	-1.7	84	-2.7	83	1.5
84	0.3	84	3.8	84	-1.6	84	-2.8	83	-6.0
84	1.0	84	-0.5	84	-0.7	84	2.1	83	0.0
84	2.5	84	0.3	84	-0.6	84	-4.2	83	2.2
84	0.3	84	-2.8	84	2.3	84	0.3	83	1.3
84	4.0	84	2.2	84	0.7	84	1.2	83	0.0
84	5.6	84	-1.3	84	2.2	84	1.5	83	-1.3
84	0.0	84	2.8	84	4.0	84	4.0	83	0.5
84	-1.0	84	1.9	84	2.6	84	2.8	83	-1.0

- continued –

ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

Attachment C

RCIC Area Temperature Switch Operating Data (continued)

Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)	Interval (days)	Setpoint Δ (°F)
83	3.6	82	-5.7	81	1.3	80	-1.0	78	1.0
83	0.1	82	-3.0	81	0.6	80	-5.0	78	0.0
83	1.0	82	0.0	81	2.4	80	4.8	78	1.0
83	-0.1	82	6.2	81	0.2	80	-2.3	78	-1.0
83	0.1	82	-1.0	81	2.2	80	1.3	78	1.0
83	0.0	82	-1.0	81	-1.8	80	-2.2	78	0.0
82	6.8	82	2.0	81	0.3	80	5.4	78	-1.0
82	3.4	82	2.0	81	-1.8	80	-1.2	78	-1.0
82	-1.0	82	0.0	81	-0.6	80	3.6	78	-1.0
82	-3.7	82	-1.7	81	-1.5	80	-1.2	78	-1.0
82	-2.6	82	0.0	80	-8.8	80	-1.4	78	1.0
82	2.0	82	0.0	80	-1.0	80	-1.5	78	0.0
82	0.2	82	-1.9	80	-4.8	79	1.4	78	4.0
82	-0.9	82	0.0	80	-4.3	79	0.2	78	3.0
82	-2.0	82	1.0	80	3.5	79	1.9	77	2.0
82	-1.2	82	2.8	80	-4.1	79	1.8	77	-1.7
82	0.1	82	0.0	80	4.2	79	2.5	77	-9.0
82	4.0	82	-1.0	80	-1.7	79	3.0	77	8.9
82	0.7	82	-0.5	80	-2.0	79	1.0	77	4.8
82	-7.0	82	-1.8	80	-4.9	79	-2.7	77	0.6
82	-4.0	82	-8.0	80	-1.2	79	1.4	77	-7.0
82	-8.0	82	2.4	80	-0.3	79	2.4	77	-3.0
82	3.7	82	-3.5	80	-7.1	79	2.7	77	-0.7
82	2.0	82	2.0	80	4.0	79	3.9	77	-0.3
82	6.7	81	0.2	80	-5.5	79	2.6	77	-2.1
82	-1.0	81	0.0	80	0.1	79	0.3	77	4.8
82	0.0	81	0.1	80	-0.8	79	2.6	77	-0.9
82	-2.9	81	-3.6	80	-1.9	79	-0.1	77	-4.0
82	-4.0	81	0.3	80	6.0	78	0.0	77	-0.3
82	-4.0	81	0.4	80	-5.6	78	2.0	77	0.5

Attachment C Data Set - RCIC:

Average Deviation =	-0.1	Degrees
Standard Deviation =	3.7	Degrees
Maximum Positive Deviation =	17.3	degrees
Maximum Negative Deviation =	-22.0	degrees
Average Interval =	84.0	Days

ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

Attachment D

RWCU area temperature loop calibration information

Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)
1008	0.08	785	0.00	672	0.18	671	0.06	560	0.01
1008	-0.01	784	0.10	672	0.20	671	0.03	560	-0.10
1008	0.02	784	0.36	672	-0.05	671	0.12	560	0.03
1008	0.09	784	0.02	672	0.11	625	0.34	560	0.59
1008	0.18	784	-0.09	672	0.07	562	0.21	560	0.06
1007	0.44	784	0.04	672	-0.16	562	0.04	560	0.13
1007	-1.03	784	0.10	672	-0.05	562	0.21	560	0.03
1007	0.34	784	-0.10	672	0.05	562	0.06	560	0.37
1007	0.10	784	-0.11	672	0.03	562	0.20	560	0.19
1007	0.07	784	0.03	672	0.16	560	0.48	560	0.19
897	0.10	784	0.12	672	0.09	560	0.11	560	-0.03
897	0.09	784	0.16	672	0.19	560	-0.12	560	0.17
897	0.20	784	0.00	672	0.09	560	0.10	560	0.00
897	0.04	784	0.08	672	0.35	560	0.03	560	0.14
897	-0.08	784	0.30	672	0.07	560	-0.02	560	-0.25
896	0.24	784	0.08	672	-0.05	560	0.00	560	0.46
896	0.20	784	0.15	672	0.11	560	-0.02	560	0.25
896	0.00	784	-0.02	672	0.02	560	0.10	560	-0.01
896	0.03	784	0.03	672	-0.05	560	0.00	560	-0.15
896	-0.06	784	-0.19	672	0.36	560	-0.16	560	-0.07
896	-0.03	784	0.09	672	0.29	560	0.11	560	-0.09
896	0.25	783	0.32	672	0.25	560	0.22	560	0.25
896	0.00	783	0.38	672	0.27	560	0.19	560	-0.07
896	0.19	783	-1.04	672	-0.94	560	0.04	560	0.26
896	0.28	783	0.17	672	0.05	560	0.36	560	0.11
895	0.54	783	0.06	672	0.09	560	0.05	559	-0.21
895	0.28	783	0.41	672	0.14	560	-0.07	559	0.05
895	-0.95	783	0.13	672	0.10	560	0.02	559	0.37
895	0.09	783	0.01	672	0.38	560	0.08	559	0.09
895	0.41	783	-0.09	672	0.09	560	0.03	559	-0.09
895	0.34	783	0.31	672	-0.18	560	0.04	559	0.11
895	0.10	737	0.11	672	-0.08	560	-0.09	559	-0.08
895	0.00	674	0.08	672	0.04	560	-0.03	559	0.05
895	0.10	674	0.00	672	0.12	560	-0.02	559	0.16
895	0.28	674	0.27	672	0.24	560	0.20	559	-0.04
785	-0.07	674	0.14	671	-0.04	560	0.03	559	0.11
785	-0.22	674	0.09	671	-0.02	560	0.25	559	0.23
785	0.10	673	0.00	671	-0.19	560	0.00	559	0.10
785	0.17	673	0.12	671	0.01	560	0.11	559	0.07
785	-0.06	673	0.05	671	0.16	560	-0.02	559	0.18
785	0.08	673	0.11	671	0.08	560	0.36	559	0.24
785	0.06	673	0.09	671	0.11	560	0.22	559	0.06
785	0.18	673	0.03	671	0.09	560	0.04	559	0.01
785	-0.02	673	0.07	671	0.09	560	0.02	559	-0.37
785	0.26	673	0.08	671	0.18	560	0.09	559	-1.04
785	0.02	673	0.02	671	0.06	560	-0.15	559	0.36
785	0.03	673	-0.02	671	0.02	560	0.11	559	0.03
785	0.02	672	0.08	671	0.17	560	-0.07	559	0.03
785	-0.10	672	0.22	671	0.09	560	-0.01	558	-0.05

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ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

Attachment D

RWCU area temperature loop calibration information (continued)

Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)
558	0.41	448	0.06	448	0.73	446	0.48	337	0.15
558	-0.17	448	-0.14	448	-0.07	446	0.02	337	-0.09
558	0.29	448	0.19	448	0.01	446	0.17	337	0.21
558	0.20	448	0.41	448	-0.02	446	0.01	337	0.06
558	-0.11	448	0.25	448	-0.08	446	0.24	337	0.13
558	-0.12	448	0.09	448	-0.02	446	0.00	337	-0.27
558	-0.02	448	0.38	448	0.25	446	0.14	337	0.07
558	0.09	448	0.02	448	0.29	446	-0.02	337	-0.24
558	0.05	448	-0.05	448	0.19	446	0.04	337	0.08
558	-0.01	448	-0.09	448	0.15	446	0.09	337	-0.45
558	-0.51	448	0.21	448	0.29	446	-0.12	337	0.02
529	-0.12	448	0.10	448	0.15	446	0.06	337	-0.16
513	0.00	448	0.10	448	0.08	446	-0.04	337	0.13
512	0.23	448	-0.08	448	0.07	446	-0.04	337	0.05
497	-0.02	448	-0.09	448	0.07	446	0.18	337	0.07
491	-0.12	448	-0.02	448	0.10	446	0.08	337	-0.02
450	0.03	448	-0.04	448	0.32	446	0.11	337	0.03
450	0.10	448	-0.17	448	0.02	446	0.05	337	0.27
450	0.27	448	0.25	448	-0.05	446	-0.01	337	0.12
450	0.05	448	0.76	448	-0.08	446	0.06	337	0.18
450	-0.01	448	0.12	448	0.07	446	-0.52	337	0.18
449	0.15	448	0.31	448	0.07	417	-0.09	337	-0.09
449	0.00	448	0.22	448	0.13	402	0.02	337	0.21
449	-0.19	448	0.21	448	0.08	400	0.14	336	0.09
449	-0.19	448	-0.01	447	-0.12	385	-0.01	336	-0.80
449	0.00	448	0.00	447	-0.17	379	-0.09	336	-0.03
449	-0.03	448	-0.03	447	0.08	339	0.01	336	0.03
449	-0.08	448	-0.01	447	0.09	339	0.31	336	-0.02
449	-0.27	448	0.04	447	0.46	339	0.42	336	0.08
449	-0.22	448	0.12	447	0.34	339	0.04	336	0.00
449	-0.54	448	0.03	447	0.15	339	0.48	336	0.11
449	-0.22	448	-0.01	447	0.15	338	0.21	336	0.12
449	0.06	448	-0.07	447	0.66	338	0.08	336	0.10
449	-0.01	448	-0.10	447	-0.03	338	0.29	336	0.04
449	0.00	448	0.00	447	0.33	338	0.14	336	0.03
449	0.07	448	0.17	447	0.12	338	0.26	336	0.16
449	-0.17	448	0.11	447	0.48	337	0.35	336	0.07
449	-0.19	448	0.12	447	-0.53	337	0.03	336	0.14
449	0.07	448	0.16	447	-0.92	337	-0.14	336	-0.07
448	-0.58	448	-0.03	447	0.08	337	0.10	336	0.05
448	0.02	448	0.02	447	0.17	337	0.08	336	-0.12
448	0.00	448	0.22	447	0.36	337	0.01	336	0.51
448	0.09	448	0.25	447	0.34	337	0.09	336	-0.14
448	0.22	448	0.23	447	-0.06	337	0.09	336	0.31
448	0.09	448	0.07	447	0.01	337	-0.04	336	-0.25
448	0.26	448	0.33	447	0.24	337	-0.12	336	0.41
448	0.39	448	-0.01	446	-0.09	337	0.01	336	-0.06
448	0.17	448	0.63	446	0.02	337	0.16	336	0.17
448	0.08	448	-0.01	446	0.05	337	-0.05	336	0.16

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ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

Attachment D

RWCU area temperature loop calibration information (continued)

Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)
336	0.10	336	-0.04	334	0.08	226	0.05	224	0.07
336	0.08	336	-0.01	334	0.01	226	-0.01	224	0.03
336	0.00	336	0.15	334	0.00	226	-0.09	224	-0.02
336	-0.02	336	0.05	333	0.01	225	0.12	224	0.15
336	0.24	336	-0.03	333	0.48	225	0.09	224	0.10
336	0.11	336	0.09	333	0.03	225	0.05	224	0.01
336	0.14	336	-0.25	333	0.29	225	0.19	224	0.13
336	0.07	336	-0.06	333	0.03	225	0.30	224	-0.01
336	0.15	336	0.08	333	-0.21	225	0.41	224	0.05
336	0.06	336	0.05	333	-0.13	225	0.17	224	0.40
336	0.10	336	-0.05	333	-0.05	225	0.05	224	-0.06
336	0.23	336	0.11	333	-0.05	225	0.10	224	0.03
336	0.03	335	-0.09	333	-0.05	225	0.00	224	0.05
336	0.79	335	0.13	333	-0.02	225	0.05	224	-0.08
336	-0.08	335	0.42	333	-0.47	225	0.08	224	-0.03
336	0.24	335	0.22	327	-0.12	225	0.03	224	0.20
336	0.13	335	0.72	327	-0.05	225	0.34	224	0.22
336	0.07	335	0.33	327	0.08	225	-0.17	224	-0.08
336	0.15	335	0.12	327	-0.03	225	0.10	224	0.18
336	-0.05	335	0.17	327	-0.01	225	0.03	224	-0.22
336	0.04	335	0.32	327	-0.04	225	0.16	224	0.23
336	0.03	335	0.19	306	0.08	225	0.17	224	-0.09
336	-0.05	335	-1.05	289	-0.06	225	0.28	224	0.04
336	0.13	335	0.21	289	-0.05	225	0.11	224	0.16
336	-0.09	335	0.01	273	0.02	225	0.06	224	-0.24
336	-0.02	335	0.02	268	0.08	225	0.03	224	0.19
336	0.05	335	0.17	232	-0.05	225	0.06	224	0.05
336	-0.14	335	0.26	232	0.09	225	0.06	224	0.08
336	-0.08	335	0.21	232	0.33	225	0.11	224	0.03
336	0.05	335	0.24	232	0.12	225	0.04	224	-0.03
336	0.09	335	0.02	232	-0.07	225	0.19	224	0.09
336	0.11	335	-0.13	232	0.16	225	0.12	224	0.02
336	0.03	335	0.22	227	-0.44	225	0.07	224	0.32
336	0.12	335	0.07	227	-0.04	225	0.05	224	0.17
336	-0.16	334	-0.24	227	-0.18	225	0.02	224	0.89
336	0.12	334	-0.03	227	-0.02	225	-0.01	224	0.29
336	0.01	334	-0.06	227	0.02	225	-0.03	224	0.06
336	0.12	334	-0.11	227	-0.04	225	0.04	224	-0.12
336	0.08	334	-0.05	227	0.21	225	0.09	224	0.02
336	0.28	334	-0.03	227	0.24	225	0.05	224	0.00
336	0.52	334	-0.05	227	0.03	225	-0.10	224	-0.20
336	0.55	334	0.02	227	0.56	225	0.08	224	-0.19
336	0.00	334	0.00	226	0.05	224	0.22	224	0.03
336	0.00	334	-0.22	226	0.04	224	-0.77	224	-0.62
336	-0.05	334	-0.04	226	0.22	224	-0.12	224	0.06
336	0.42	334	0.09	226	0.06	224	0.00	224	0.09
336	-0.66	334	0.06	226	0.13	224	0.04	224	0.04
336	0.07	334	0.02	226	0.03	224	-0.01	224	0.06
336	0.25	334	0.10	226	0.02	224	0.05	224	0.31

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ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

Attachment D

RWCU area temperature loop calibration information (continued)

Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)
224	0.01	224	-0.14	222	0.63	113	-0.01	112	0.06
224	0.01	224	0.11	222	0.71	113	-0.08	112	0.02
224	-0.04	224	-0.03	222	0.03	113	-0.12	112	-0.03
224	-0.01	224	0.03	222	0.02	113	-0.09	112	0.09
224	0.10	224	0.19	221	-0.25	113	-0.22	112	0.12
224	0.01	224	-0.08	221	0.40	113	0.14	112	-0.01
224	0.03	224	0.19	221	-0.04	113	0.04	112	0.06
224	0.10	223	0.17	221	0.17	113	0.09	112	0.10
224	-0.05	223	0.07	221	-0.02	113	-0.04	112	0.03
224	-0.15	223	0.02	221	-0.22	113	-0.39	112	0.00
224	0.04	223	0.01	221	-0.17	113	0.10	112	0.08
224	0.07	223	-0.04	221	-0.08	113	0.00	112	0.06
224	-0.12	223	-0.01	221	0.09	113	0.17	112	0.22
224	0.12	223	-0.21	221	-0.05	113	-0.26	112	0.17
224	0.17	223	-1.18	221	-0.05	113	-0.02	112	0.12
224	-0.04	223	0.14	221	-0.52	113	-0.02	112	-0.09
224	0.08	223	-0.02	215	-0.09	113	0.11	112	0.11
224	0.20	223	-0.23	215	0.00	113	0.17	112	-0.06
224	0.00	223	0.04	215	0.04	113	0.26	112	-0.18
224	0.03	223	0.36	215	0.03	113	0.23	112	0.16
224	0.11	223	0.43	215	0.05	113	0.03	112	0.03
224	-0.06	223	0.01	215	-0.04	113	0.00	112	-0.02
224	-0.08	223	0.29	202	0.03	113	0.03	112	0.32
224	0.28	223	-1.02	177	0.12	113	0.32	112	0.00
224	-0.02	223	0.07	177	0.06	113	0.13	112	-0.23
224	0.12	223	0.08	164	0.03	113	0.40	112	0.40
224	-0.28	223	0.32	162	-0.02	113	0.18	112	-0.03
224	-0.25	223	0.02	120	0.03	113	0.07	112	-0.15
224	-0.68	223	0.33	120	0.13	113	0.04	112	0.63
224	-0.31	223	0.30	120	0.41	113	0.59	112	-0.03
224	0.04	223	0.12	120	0.19	113	-0.02	112	0.02
224	0.03	223	0.03	120	0.68	113	0.11	112	0.02
224	0.23	223	0.04	120	0.37	113	0.10	112	-0.24
224	0.19	223	0.08	114	-0.05	113	0.00	112	0.01
224	0.08	223	0.09	114	0.09	113	0.17	112	0.06
224	0.16	222	0.08	114	0.11	113	-0.19	112	0.00
224	0.19	222	0.20	114	0.01	113	0.07	112	0.03
224	-0.54	222	0.09	114	-0.13	113	0.06	112	0.03
224	0.03	222	0.01	114	0.00	112	0.11	112	0.02
224	0.10	222	0.22	114	0.12	112	-0.09	112	0.06
224	0.09	222	0.17	114	0.24	112	0.01	112	-0.03
224	0.07	222	-0.02	114	0.02	112	0.21	112	-0.08
224	0.07	222	0.18	114	-0.02	112	0.05	112	-0.03
224	0.05	222	0.01	114	-0.02	112	-0.01	112	-0.02
224	-0.14	222	-0.30	114	-0.08	112	0.02	112	-0.52
224	0.41	222	0.12	114	-0.13	112	0.00	112	0.05
224	-0.27	222	0.11	114	-0.02	112	-0.07	112	0.12
224	0.33	222	0.37	114	-0.01	112	0.03	112	-0.04
224	0.05	222	0.31	113	-0.11	112	0.03	112	-0.69

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ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

Attachment D

RWCU area temperature loop calibration information (continued)

Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)	Interval (days)	Setpoint Δ (% span)
112	-0.06	112	0.05	112	-0.06	112	0.16	110	-0.01
112	-0.09	112	0.08	112	0.24	112	-0.02	110	0.00
112	-0.04	112	-0.03	112	-0.31	112	0.01	109	0.07
112	-0.20	112	0.11	112	0.03	112	-0.15	109	0.63
112	0.15	112	0.01	112	-0.02	112	-0.18	109	0.11
112	0.00	112	0.02	112	0.03	112	-0.11	109	0.29
112	-0.20	112	-0.10	112	0.01	112	0.17	109	0.26
112	0.07	112	-0.08	112	0.06	112	0.07	109	-0.02
112	-0.05	112	0.06	112	0.02	112	0.22	109	0.15
112	-0.06	112	0.00	112	-0.05	112	0.01	109	0.21
112	0.21	112	0.04	112	-0.02	111	0.08	109	0.63
112	-0.30	112	0.08	112	0.07	111	0.03	109	0.58
112	-0.12	112	0.15	112	0.01	111	0.01	109	-0.03
112	0.15	112	0.08	112	0.36	111	0.32	109	-0.50
112	0.07	112	-0.04	112	-0.11	111	0.02	104	0.08
112	-0.24	112	0.17	112	0.39	111	0.02	104	-0.11
112	0.05	112	0.11	112	-0.25	111	-0.17	104	-0.06
112	0.07	112	0.19	112	0.19	111	-1.14	104	-0.02
112	-0.20	112	-0.12	112	-0.12	111	0.10	104	0.22
112	0.03	112	-0.10	112	0.31	111	0.05	104	-0.09
112	-0.13	112	0.21	112	-0.62	111	-0.17	82	0.00
112	-0.03	112	-0.26	112	0.20	111	0.05	68	0.79
112	0.09	112	0.19	112	-0.08	111	0.16	65	-0.08
112	0.72	112	0.15	112	-1.06	111	0.01	65	-0.20
112	-0.47	112	0.14	112	-0.04	111	0.27	65	0.05
112	0.09	112	0.00	112	0.20	111	0.07	49	-0.08
112	0.00	112	0.08	112	-0.02	111	0.10	47	0.02
112	-0.14	112	-0.31	112	0.12	111	0.00	47	0.10
112	-0.03	112	0.05	112	0.00	111	0.32	44	0.00
112	0.21	112	0.03	112	0.06	111	-0.02	38	0.87
112	-0.14	112	0.07	112	-0.30	111	0.20	30	-0.05
112	0.24	112	-0.28	112	0.21	111	0.06		
112	0.16	112	0.05	112	0.27	111	0.25		
112	0.17	112	0.07	112	0.40	111	-0.10		
112	-0.16	112	0.11	112	-0.03	110	0.04		
112	-0.01	112	-0.53	112	0.19	110	-0.08		
112	0.00	112	-0.12	112	-0.07	110	-0.34		

Attachment D Data Set - RWCU:

Average Deviation =	0.21	% of span
Standard Deviation =	0.05	% of span
Maximum Positive Deviation =	0.89	% of span
Maximum Negative Deviation =	-1.18	% of span
Average Interval =	345	Days

ENCLOSURE 2

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION

BFN Instrument Setpoint Calculation Excerpts

part of BFN TS-447 RAI Enclosure 2

QA Record

ORIGINAL

TVAN CALCULATION COVERSHEET/CCRIS UPDATE

Page 1a

REV 0 EDMS/RIMS NO.	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
B22 900417 122	calculations(nuclear)	R14 040701 102

Calc Title: 1/2/3-TS-71/73-2A/S HPCI and RCIC Setpoint and Scaling Calculation

CALC ID	TYPE	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV
CURRENT	CN	NUC	BFN	EEB	EDQ0999880554	008	009
NEW	CN	NUC					

REVISION APPLICABILITY: Entire calc ☒ Selected pages ☐

ACTION	NEW ☐ REVISION ☒	DELETE ☐ RENAME ☐	SUPERSEDE ☐ DUPLICATE ☐	CCRIS UPDATE ONLY ☐ (Verifier Approval Signatures Not Required)	No CCRIS Changes ☐ (For calc revision, CCRIS been reviewed and no CCRIS changes required)

UNITS	SYSTEMS	UNIDS
1/2/3	071/073	1/2/3-TS-71-2A/S and 1/2/3-TS-73-2A/S

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
DCN 60183		EM

QUALITY RELATED?	SAFETY RELATED? (If yes, QR = yes)	UNVERIFIED ASSUMPTION	SPECIAL REQUIREMENTS AND/OR LIMITING CONDITIONS?	DESIGN OUTPUT ATTACHMENT?	SAR/TS AFFECTED
Yes ☒ No ☐	Yes ☒ No ☐	Yes ☐ No ☒	Yes ☒ No ☐	Yes ☐ No ☒	Yes ☒ No ☐

PREPARER ID	PREPARER PHONE NO	PREPARING ORG (BRANCH)	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
RGBRIGGS	614-8638	EEB	Design Review	☐ Yes ☒ No

PREPARER SIGNATURE	DATE	CHECKER SIGNATURE	DATE
Rodney Briggs	6/7/04	David W Armstrong DW Armstrong	06/07/04
VERIFIER SIGNATURE	**DATE**	**APPROVAL SIGNATURE**	**DATE**
Sam A Dias SAD	6/10/04	[illegible]	6/26/2004

STATEMENT OF PROBLEM/ABSTRACT

Calculations were performed to determine the accuracy of the subject instrument. The determined accuracies are compared to the required accuracies, setpoints, safety limits and/or operational limits and the accuracy of the loops listed below are demonstrated to be acceptable for the intended function of the instrument loops.

Loop No.: 1-TS-71-2A/S and 1-TS-73-2A/S
2-TS-71-2A/S and 2-TS-73-2A/S
3-TS-71-2A/S and 3-TS-73-2A/S

MICROFICHE/EFICHE Yes ☒ No ☐ FICHE NUMBER(S)

☐ LOAD INTO EDMS AND DESTROY
☒ LOAD INTO EDMS AND RETURN CALCULATION TO CALCULATION LBRARY. ADDRESS:
☐ LOAD INTO EDMS AND RETURN CALCULATION TO:

BFN Setpoint and Scaling Calculation
ED-Q0999-880554

5. 0 Design Input Data (Continued):

5.6 Component Accuracy:

Fenwal Temperature Switches		
TYPE	**VALUE** in percentage of SP	**NOTE**
Re	± 5.1 %	1
De	N/A	2
TNe	Included in Re	3
SPEe	N/A	4
SECu	N/A	4
RNDe	Included in Re	5
ICTe	1.4%	7
ICRe	N/A	7
OCTe	N/A	8
OCRe	N/A	8
Ab	1.4%	6
Se	N/A	11
RADe	Negligible	12
TAe	N/A	13
INDRe	N/A	9
WLe	N/A	10
PRCSe	N/A	10
IRe	N/A	10

R9

BFN Setpoint and Scaling Calculation
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5.0 Design Input Data (Continued):

5.6 Component Accuracy (Continued):

1 A study was done to evaluate the periodicity for calibration for the Fenwal (bi-metallic) Temperature Switches currently used for isolation of the HPCI and RCIC Steam Isolation Valves, and justify extending the calculation frequency for the HPCI/RCIC switches (Attachments 01). Tech Specs require the HPCI and RCIC temperature switches be calibrated every quarter, but the MSL ones are calibrated every 24 months. Both the HPCI/RCIC and MSL are Fenwal bimetallic temperature switches, the HPCI/RCIC switches are normally open and the MSL switches are normally closed.

Data was gathered for HPCI, RCIC, and MS system "as-found" and "as-left" settings as shown in attachment 01. A sample of 1280 data points was taken for HPCI / RCIC system and 195 data points were taken for MS system. After eliminating all data outliers (95% confidence band), the variance test concluded that the variance in drift for the HPCI/RCIC temperature switches are with a 95% confidence band.

As per Analysis in attachment 01 conclusion, the HPCI-RCIC data deviation is normally distributed with a mean of -0.05 and a standard deviation of 3.84. This population has a high number of samples and from reference 32, 1.96 is taken as the multiplier. Therefore the inaccuracy will be

Re (Bias) = - 0.05 degree F = -0.03 % of SP = Negligible

Re (Random) = ± 3.84 x 1.96 = ± 7.5 degree F = ± 5.1 % of SP

2 As per the analysis given in attachment 01, there is no relationship between drift and the time between calibrations. Main steam line switches were calibrated every 24 months, and do not show any drift during this period. HPCI/RCIC switches are calibrated every 3 months and do not show any drift for that period. Therefore this analysis in attachment 01, justifies extending the calibration frequency of the HPCI/ RCIC switches from 3 months to 24 months and the drift over the period of 24 months for the Fenwal / EGS temperature switches are not applicable.

De = N/A

BFN Setpoint and Scaling Calculation
ED-Q0999-880554

5.0 Design Input Data (Continued):

5.6 Component Accuracy (Continued):

3 Per analysis in attachment 01, the repeatability calculated includes the temperature effect, if there is any. Normally for a temperature measuring instrument, the temperature effect is not applicable. Therefore

TNe = N/A

4 The Span Error Correction uncertainty (SECu) and Static Pressure effect (SPEe) is not applicable for this switch.

SECu = SPEe = N/A

5 Per analysis in attachment 01, the repeatability calculated includes the normal radiation effect. Therefore

RNDe = Included in Re

6 Per reference 3, the acceptance band should be equal to or greater than the reference accuracy. The repeatability calculated above includes drift, temperature effect, normal radiation effect and all calibration instrument errors. Field data and past calibration history shows that this switch can be calibrated to an acceptable as found value of +/- 2 degree F. Therefore

Ab = ± 2 degree F = ± 1.4% SP

7 Per Reference 36, the M&TE accuracies should be at least equal to the instrument acceptance band (Ab). A digital test instrument is used and thus,

ICTe = ± 2 degree F = ± 1.4% SP

ICRe = N/A

BFN Setpoint and Scaling Calculation
ED-Q0999-880554

5.0 Design Input Data (Continued):

5.6 Component Accuracy Data (Continued):

8 There is no output calibrating instrument required and hence OCTe and OCRe is not applicable.

OCTe = OCRe = N/A

9 This device does not have an indicator. Therefore,

INDRe = N/A

10 The pressure switch does not have any process error, water leg error or insulation resistance error. Therefore :

WLe = PRCSe = IRe = N/A

11 The basis of the accuracy calculation program is that no two transients, accidents of special events are considered to occur simultaneously. This was well documented in revisions 0, 1, and 2 of design criteria BFN-50-735. This criteria has now been voided. The calculation that has replaced it does not explicitly state this basis but only implies it. Fortunately, work for the A-46 program on seismic qualifications which have been approved by the NRC (References 42 and 43) states in section 3.2.5 "No concurrent or sequential potential events are postulated to occur other that a design basis safe shutdown earthquake (SSE) and loss of offsite power. For example, no loss of coolant accidents (LOCAs), high energy line breaks (HELBs), fires, flooding, extreme winds and tornados, lightning, sabotage, etc., are postulated to occur" Therefore, no other event other than the HELB will be considered. These temperature switches will be required to be calibrated after a seismic event. Therefore, R9

Se = N/A

BFN Setpoint and Scaling Calculation
ED-Q0999-880554

5.0 Design Input Data (Continued):

5.6 Component Accuracy Data (Continued):

12 The Wyle test report number 17509-1 on Fenwal temperature switch models 17002-40, 17023-6, 17323-0, 18002-27 and 18023-7 are analyzed to calculate the radiation effect on these switches. R9

Table 01
Wyle Technical Report 17509-1 for Radiation R9

Sample #	Setpoint °F Page D-28	Baseline Functional test Page D-59, D-61	Post Radiation effect Page D-111	Change in SP Baseline minus Post Radiation	
				°F	% of SP
1	152.5	153.8	155	-1.2	-0.8 %
2	152.5	153.4	147.2	6.2	4.1 %
3	152.5	154	153.2	0.8	0.5 %
4	149.5	149.5	155.1	-5.6	-3.7 %
5	149.5	151.1	154.2	-3.0	-2.0 %
6	149.5	151.8	158.6	-6.8	-4.6 %
10	137.5	134.6	142.5	-7.9	-5.7 %

The Patel Engineers Technical Report number PEI-TR-831200-1 on Fenwal temperature switch models 01-170020-090, and 01-170230-090 are analyzed to calculate the radiation effect on these switches which are tabulated in the table 02: R9

Table 02
Patel Engineers Technical Report PEI-TR-831200-1 for Radiation and Seismic effect.

Sample #	Setpoint °F page D2-11	Pre Seismic D2-124	Post Seismic D2-127	Post Radiation D2-129	Seismic effect		Radiation effect	
					° F	% SP	° F	% SP
1	135	133.9	--	133.9	--	--	--	--
2	135	137.3	137	137.5	0.3	0.2	-0.5	-0.4
3	180	182.9	--	182	--	--	--	--
4	180	176.4	176.9	--	-0.5	0.3	--	--
5	212	216.3	216.2	217.2	0.1	0.05	-0.9	-0.4

BFN Setpoint and Scaling Calculation
ED-Q0999-880554

5.0 Design Input Data (Continued):

5.6 Component Accuracy Data (Continued):

12 (Cont)

Although values vary in the tables, based on the following conclusions, RADe will be considered negligible.

- All inaccuracies between the pre and post radiation exposure with the exception of sample # 10 (5.7% of SP) in the Wyle Report are within the repeatability of the switch (note 1, 5.1% of SP).

R9

- The operation of these temperature switches is a function of the expansion and contraction of the metallic spring portions of these switches (Attachment 2). Metals are not affected by radiation except at very high levels.

Therefore accident radiation effects are considered negligible.

RADe = Negligible

13 These temperature switches are designed to be used in temperature ranges from -100 Deg. F. to 600 Deg F. The accident temperature peak only goes to 315 Deg F. Therefore:

TAe = 0%

BFN Setpoint and Scaling Calculation
ED-Q0999-880554

6.0 Computations and Analyses:

6.1 Instrument Accuracy:

Listed below are the accuracy parameters from section 5.0 used in these calculations. Unless otherwise specified, the accuracy parameters listed below and the values calculated in these sections are bidirectional (+/-).

Temperature switch accuracy Parameters (Values in % of SP)

Re	=	5.1 %	
De	=	N/A	
TNe	=	Included in Re	
ICTe	=	1.4 %	
OCTe	=	N/A	
Ab	=	1.4%	
WLe	=	N/A	
PRCSe	=	N/A	
SECu	=	N/A	
Se	=	N/A	R9
RNDe	=	Included in Re	
RADe	=	Negligible	R9
TAe	=	0	
IRe	=	N/A	

BFN Setpoint and Scaling Calculation
ED-Q0999-880554

6.0 Computations and Analyses: (Continued)

6.2 Temperature Switch Accuracy (Loop)

Normal Measurable Accuracy

$Anf = \pm [Re^2 + De^2 + TNe^2 + ICTe^2 + OCTe^2 + Ab^2]^{1/2}$

Anf = +/- 5.5 % of SP

Normal Accuracy

$An = [Anf^2 + SPEe^2 + SECu^2]^{1/2}$

An = +/- 5.5 % of SP

Accident Accuracy

Since there are no unmeasurable errors R9

Aa = An

Aa = +/- 5.5% of SP

Post Seismic Accuracy

As = N/A (switches require calibration after a seismic event.) R9

Design basis Accident Accuracy

The highest of the seismic or accident accuracy is taken for design basis accuracy.

Adbe = Aa R9

BFN Setpoint and Scaling Calculation
ED-Q0999-880554

6.0 Computations and Analyses: (Continued)

6.2 Temperature Switch Accuracy (Loop) (Continued)

Design basis Accident and Seismic Accuracy

The seismic and accident is not considered to happen at the same time and hence the accuracy is not used in the calculation. Furthermore since the switches are required to be calibrated after a seismic event seismic accuracy is not addressed. R9

Aas = N/A

Acceptance Band

Ab = ± 1.4 %

BFN Setpoint and Scaling Calculation
ED-Q0999-880554

6.0 Computations and Analyses: (Continued)

6.2 Temperature Switch Accuracy: (Continued)

6.2.1 The existing and revised Setpoints, Allowable values and Analytical Limits:

6.2.1.1 RCIC Temperature Switches:

BFN-1/2/3-TS-071-0002A thru D

		Existing	Revised
SP	=	160 °F	165 °F
AV	=	180 °F	180 °F
AL	=	180 °F	180 °F

R9

BFN-1/2/3-TS-071-0002E thru S

		Existing	Revised
SP	=	147 °F	165 °F
AV	=	155 °F	180 °F
AL	=	155 °F	180 °F

R9

6.2.1.2 HPCI Temperature Switches:

BFN-1/2/3-TS-073-0002A thru D

		Existing	Revised
SP	=	190 °F	185 °F
AV	=	200 °F	200 °F
AL	=	200 °F	200 °F

R9

BFN-1/2/3-TS-073-0002E thru S

		Existing	Revised
SP	=	170 °F	165 °F
AV	=	180 °F	180 °F
AL	=	180 °F	180 °F

R9

BFN Setpoint and Scaling Calculation
ED-Q0999-880554

6.0 Computations and Analyses: (Continued)

6.2 Temperature Switch Accuracy: (Continued)

6.2.1 The Allowable values:

6.2.1.1 Plant Operations Parameters

Allowable Value (AV) Calculation Method 3 (Ref. 41)
Trip Setpoint: SP = UAL – Adbe

For RCIC and torus area HPCI:	SP = 180 – 9.1 = <170.9 °F, taken as = **165 °F**
Per ref. 3, the allowable value is:	AV = SP ± Anf = > 165 + 9.1 = 174.1 °F
	Allowable value taken as **180 °F**
For Corner room HPCI:	SP = 200 – 10.2 = <189.8 °F, taken as = **185 °F**
Per ref. 3, the allowable value is:	AV = SP ± Anf = > 185 + 10.2 = 195.2 °F
	Allowable value taken as **200 °F**

R9

Check Calculation:

The required un-measurable error for RCIC and Torus area HPCI:

Accident accuracy	= 0 %	= 0 °F	
Available un-measurable	**AL-AV**	=180- 180	= 0 °F

R9

The required un-measurable error for Corner room area HPCI:

Accident accuracy	= 0 %	= 0 °F	
Available un-measurable	**AL-AV**	=200-200	= 0 °F

R9

The check calculation provides enough allowance for all the unmeasurable errors. This accounts fully for accident conditions. Hence the calculated Setpoint and allowable values are acceptable. This is concurred by Mechanical Engineering department. Seismic inaccuracy is not evaluated; therefore the switches will require calibration after a seismic event. R9

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

RCIC U2 3 data

DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV
83	17.3	83	2	82	0	82	-1.9	85	3.5	84	0.8	90	-1	82	-3.7
83	14.3	82	2	83	0	87	-1.9	84	3.5	84	0.8	84	-1	84	-3.7
86	14	82	2	82	0	88	-2	84	3.5	84	0.8	90	-1	84	-3.7
84	12.2	83	2	82	0	82	-2	82	3.4	84	0.8	84	-1	87	-3.7
85	11	84	2	85	0	80	-2	84	3.3	84	0.7	78	-1	88	-3.8
77	8.9	84	2	83	0	83	-2	84	3.3	82	0.7	82	-1	86	-3.8
84	8.5	84	2	90	0	84	-2	84	3.2	84	0.7	83	-1	87	-3.8
93	8.4	82	2	82	0	88	-2	84	3.2	84	0.7	84	-1	84	-3.9
85	8.2	84	1.9	84	0	84	-2	83	3	87	0.7	83	-1	86	-3.9
84	8	79	1.9	78	0	84	-2	83	3	84	0.7	87	-1	84	-3.9
87	7.8	85	1.9	83	0	85	-2.1	84	3	84	0.7	78	-1	84	-4
83	7.4	84	1.9	84	0	87	-2.1	84	3	87	0.6	82	-1	82	-4
86	7.3	85	1.9	85	-0.1	84	-2.1	79	3	84	0.6	78	-1	82	-4
86	7.2	84	1.9	87	-0.1	84	-2.1	84	3	77	0.6	84	-1	90	-4
84	7	79	1.8	84	-0.1	84	-2.1	84	3	81	0.6	82	-1	82	-4
83	7	86	1.8	84	-0.1	84	-2.1	84	3	84	0.6	80	-1	84	-4
84	7	84	1.8	87	-0.1	84	-2.1	90	3	84	0.6	85	-1	90	-4
93	7	87	1.8	84	-0.1	84	-2.1	84	3	88	0.5	78	-1	84	-4
82	6.8	84	1.8	84	-0.1	84	-2.1	84	3	84	0.5	78	-1	77	-4
84	6.8	88	1.76	83	-0.1	77	-2.1	85	3	84	0.5	83	-1	90	-4
82	6.7	84	1.7	79	-0.1	87	-2.2	78	3	83	0.5	84	-1	84	-4
87	6.6	85	1.7	88	-0.2	84	-2.2	86	2.9	77	0.5	82	-1	84	-4
82	6.2	84	1.7	84	-0.2	80	-2.2	84	2.9	88	0.4	85	-1	84	-4.1
84	6	84	1.5	84	-0.2	84	-2.3	83	2.9	81	0.4	84	-1	80	-4.1
84	6	84	1.5	86	-0.2	80	-2.3	84	2.9	93	0.4	84	-1	88	-4.2
83	6	83	1.5	84	-0.2	84	-2.3	87	2.8	84	0.4	90	-1	84	-4.2
84	6	84	1.5	80	-0.3	84	-2.3	84	2.8	86	0.4	86	-1.1	84	-4.3
80	6	79	1.4	85	-0.3	84	-2.4	84	2.8	84	0.4	83	-1.1	80	-4.3
84	6	84	1.4	85	-0.3	84	-2.5	84	2.8	85	0.3	87	-1.1	84	-4.5

Attachment No. 01
Calc. No. ED-R0099-880554 REV. 8
Sheet No. 01 of 21

Prepared E H Bradley 8/22/03 Checked Sam Dias 8/27/03

part of BFN TS-447 RAI Enclosure 2

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV
88	5.7	79	1.4	84	-0.3	82	-2.6	84	2.8	81	0.3	84	-1.1	84	-4.7
84	5.6	84	1.4	84	-0.3	87	-2.6	82	2.75	84	0.3	85	-1.2	84	-4.7
84	5.5	88	1.4	87	-0.3	87	-2.6	86	2.7	84	0.3	93	-1.2	84	-4.7
86	5.4	81	1.3	84	-0.3	84	-2.6	93	2.7	84	0.3	82	-1.2	80	-4.8
80	5.4	84	1.3	84	-0.3	86	-2.7	85	2.7	84	0.3	80	-1.2	87	-4.8
84	5.3	83	1.3	77	-0.3	79	-2.7	79	2.7	85	0.3	85	-1.2	83	-4.8
88	5.2	80	1.3	77	-0.3	84	-2.7	86	2.7	81	0.3	80	-1.2	93	-4.8
88	5.2	88	1.2	87	-0.3	84	-2.8	84	2.6	79	0.3	84	-1.2	83	-4.8
88	5.2	87	1.2	87	-0.4	84	-2.8	79	2.6	84	0.3	80	-1.2	93	-4.8
84	5	86	1.2	84	-0.4	84	-2.8	84	2.6	84	0.3	84	-1.3	84	-4.9
84	5	84	1.2	85	-0.4	86	-2.8	84	2.6	81	0.2	84	-1.3	80	-4.9
86	5	84	1.1	83	-0.5	84	-2.8	79	2.6	79	0.2	84	-1.3	86	-5
84	4.9	83	1.1	87	-0.5	93	-2.8	93	2.5	84	0.2	87	-1.3	90	-5
86	4.9	87	1.1	84	-0.5	84	-2.9	84	2.5	82	0.2	84	-1.3	80	-5
84	4.8	84	1.1	84	-0.5	87	-2.9	79	2.5	84	0.2	83	-1.3	84	-5
80	4.8	84	1.1	82	-0.5	84	-2.9	84	2.5	84	0.2	84	-1.3	84	-5.5
77	4.8	84	1.1	84	-0.6	84	-2.9	93	2.5	85	0.2	88	-1.4	80	-5.5
84	4.8	84	1	87	-0.6	84	-2.9	82	2.45	81	0.2	84	-1.4	87	-5.5
77	4.8	84	1	84	-0.6	82	-2.9	81	2.4	83	0.2	88	-1.4	80	-5.6
87	4.6	78	1	81	-0.6	87	-2.9	79	2.4	87	0.2	84	-1.4	82	-5.7
84	4.5	83	1	84	-0.6	84	-3	83	2.3	84	0.1	80	-1.4	84	-5.7
84	4.5	83	1	83	-0.7	84	-3	86	2.3	84	0.1	84	-1.5	88	-5.8
86	4.5	87	1	83	-0.7	84	-3	93	2.3	81	0.1	84	-1.5	84	-5.9
80	4.2	83	1	84	-0.7	84	-3	84	2.3	82	0.1	87	-1.5	88	-6
84	4.2	78	1	87	-0.7	77	-3	93	2.3	84	0.1	80	-1.5	83	-6
88	4.2	90	1	84	-0.7	82	-3	84	2.3	80	0.1	81	-1.5	88	-6
84	4.2	79	1	84	-0.7	84	-3	86	2.3	87	0.1	84	-1.6	84	-6
84	4.1	84	1	84	-0.7	84	-3	84	2.2	84	0.1	84	-1.6	85	-6.5
82	4	78	1	77	-0.7	84	-3	87	2.2	84	0.1	82	-1.69	87	-6.7
84	4	84	1	84	-0.7	87	-3.1	81	2.2	86	0.1	84	-1.7	88	-6.75
80	4	84	1	87	-0.7	84	-3.2	83	2.2	83	0.1	80	-1.7	82	-7

Attachment No. 01
Calc. No. ED-80997-880232 REV. 8
Sheet No. 02 of 21

Prepared E Bradley 8/22/03 Checked Sam Dias 8/27/03

part of BFN TS-447 RAI Enclosure 2

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV
84	4	84	1	88	-0.8	86	-3.2	84	2.2	83	0.1	84	-1.7	77	-7
84	4	83	1	80	-0.8	84	-3.2	84	2.2	90	0	84	-1.7	80	-7.1
93	4	84	1	84	-0.8	84	-3.3	86	2.2	78	0	86	-1.7	84	-7.3
85	4	84	1	84	-0.8	84	-3.3	84	2.2	84	0	77	-1.7	85	-7.4
84	4	84	1	84	-0.8	88	-3.3	84	2.1	81	0	93	-1.8	88	-7.5
78	4	90	1	93	-0.8	88	-3.4	88	2.1	84	0	84	-1.8	84	-7.6
84	4	87	1	84	-0.8	84	-3.4	84	2.1	84	0	84	-1.8	87	-7.8
87	3.9	84	1	86	-0.8	85	-3.5	77	2	78	0	81	-1.8	84	-7.8
79	3.9	78	1	86	-0.9	84	-3.5	84	2	84	0	81	-1.8	82	-8
84	3.8	82	1	82	-0.9	82	-3.5	90	2	84	0	82	-1.8	82	-8
84	3.8	83	1	83	-0.9	84	-3.6	78	2	82	0	84	-1.8	80	-8.8
87	3.7	84	1	85	-0.9	81	-3.6	84	2	84	0	80	-1.9	84	-8.8
82	3.7	86	0.9	84	-0.9	83	-3.6	82	2	78	0	87	-1.9	77	-9
84	3.6	84	0.9	83	-0.9	93	-3.6	83	2	84	0	84	-1.9	88	-9
83	3.6	87	0.9	85	-0.9	88	-3.6	84	2	90	0	84	-1.9	88	-9
85	3.6	86	0.9	77	-0.9	84	-3.6	90	2	82	0	87	-1.9	84	-9.1
83	3.6	83	0.9	85	-0.9	84	-3.6	84	2	90	0	85	-1.9	84	-10
80	3.6	84	0.9	80	-1	84	-3.6	82	2	84	0	87	-1.9	84	-10.9
80	3.5	85	0.9	82	-1	86	-3.7	83	2	84	0	84	-1.9	84	-11.6
88	-13	87	-17.3	88	-22	88	-12	84	2	82	0	85	-1.9	86	-11.9

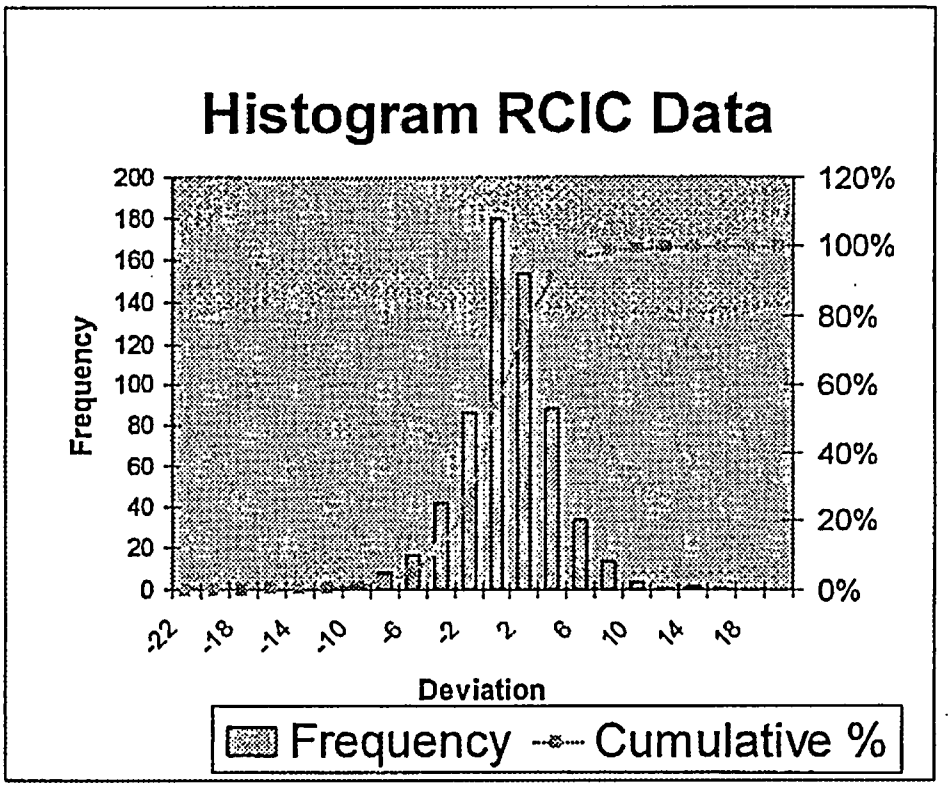
Attachment No. 01
Calc. No. ED-00992-880552 REV. 8
Sheet No. 03 of 21

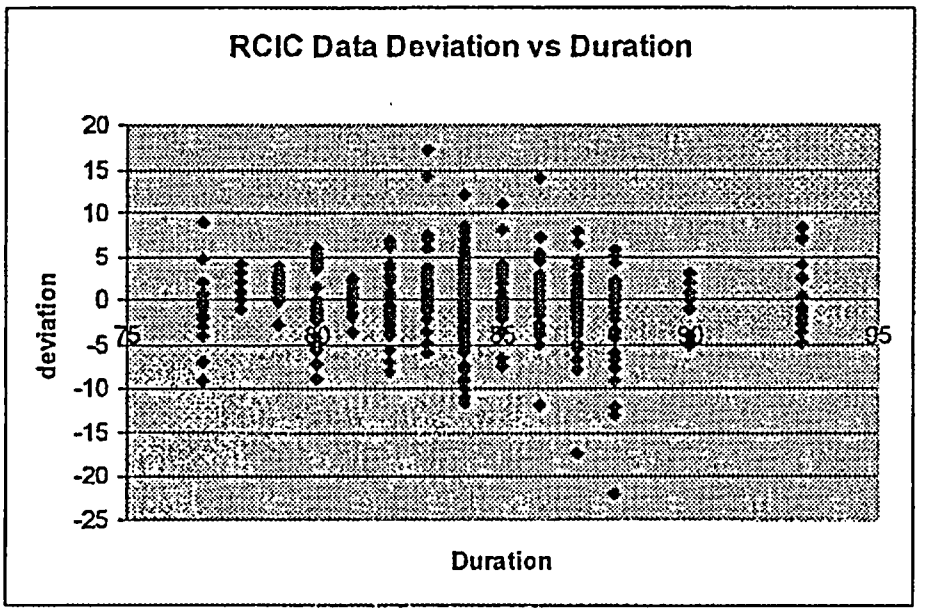
part of BFN TS-447 RAI Enclosure 2

Prepared EH Brodly 8/22/03 Checked Sam Dias 8/27/03

part of BFN TS-447 RAI Enclosure 2

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history





Attachment No. 01
Calc. No. ED-00999-880554 REV. 8
Sheet No. 04 of 21

Prepared E. Brady 8/22/03 Checked Sam Dias 8/27/03

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

HPCI U2 3 data

DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV
76	18	82	0	81	2	90	-2	84	4	85	-0.9	84	1	90	-4
81	17	77	0	82	2	81	-2	112	4	112	-1	85	1	85	-4
90	13.8	87	0	84	2	84	-2	84	4	56	-1	76	1	84	-4
85	12.5	84	0	78	2	91	-2	81	4	111	-1	92	1	76	-4
72	12	76	0	112	2	85	-2	84	4	72	-1	112	1	88	-4
112	11	84	0	84	2	72	-2	90	4	84	-1	88	0.9	84	-4
79	10.9	78	0	77	2	91	-2	80	3.9	84	-1	79	0.9	88	-4
85	10.5	91	0	92	2	85	-2	83	3.8	82	-1	83	0.9	84	-4
112	10	72	0	84	2	76	-2	85	3.8	85	-1	77	0.9	84	-4
84	9.4	85	0	91	2	77	-2	79	3.7	90	-1	91	0.9	90	-4
112	9	91	0	86	2	112	-2	87	3.5	84	-1	91	0.9	84	-4
91	9	80	0	91	2	77	-2	87	3.5	112	-1	92	0.9	90	-4
112	9	72	0	72	2	86	-2.1	84	3.4	112	-1	91	0.9	84	-4
84	9	76	0	91	2	82	-2.1	82	3.4	77	-1	92	0.9	85	-4.3
111	8.6	82	0	79	1.9	111	-2.2	85	3.4	84	-1	87	0.9	111	-4.3
85	8.6	77	0	85	1.9	91	-2.3	84	3.3	91	-1	85	0.8	92	-4.3
86	8.4	72	0	79	1.9	85	-2.3	84	3.3	84	-1	84	0.8	77	-4.3
82	8.3	76	0	83	1.9	91	-2.3	85	3.2	77	-1	85	0.8	111	-4.3
88	8.3	84	0	111	1.9	77	-2.3	85	3.2	112	-1	84	0.8	85	-4.4
84	8.1	81	0	85	1.8	84	-2.3	82	3.2	72	-1	87	0.8	88	-4.4
112	8	76	0	79	1.8	84	-2.3	84	3.1	84	-1	83	0.8	91	-4.7
86	8	84	0	77	1.8	83	-2.4	81	3	112	-1	79	0.8	83	-4.8
84	8	81	0	87	1.8	85	-2.4	81	3	79	-1	85	0.7	91	-4.9
82	7.7	82	0	77	1.8	91	-2.5	81	3	112	-1	83	0.7	84	-5
84	7.5	84	0	92	1.7	85	-2.7	84	3	112	-1	84	0.7	86	-5
82	7.5	112	0	87	1.6	91	-2.7	90	3	77	-1	92	0.7	84	-5
84	7	82	0	79	1.6	85	-2.7	85	3	84	-1	84	0.7	85	-5
82	7	78	0	88	1.6	111	-2.7	82	3	78	-1	92	0.7	81	-5
86	7	77	0	88	1.5	77	-2.8	85	3	80	-1	79	0.7	84	-5

Attachment No. 01
Calc. No. EP-00992-880554 REV. 8
Sheet No. 05 of 21

Prepared E. Brooks 8/22/03 Checked Sam Dias 8/27/03

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV
78	7	78	0	84	1.5	111	-2.9	84	3	79	-1	84	0.7	86	-5
76	7	91	0	88	1.5	82	-2.9	82	3	84	-1	88	0.7	84	-5
85	6.8	82	0	80	1.5	85	-2.9	76	3	84	-1	85	0.7	85	-5
85	6.7	84	0	87	1.5	91	-2.9	84	3	84	-1	56	0.7	82	-5
85	6.6	84	0	84	1.5	83	-2.9	112	3	84	-1.1	85	0.7	81	-5
85	6.4	84	0	84	1.5	83	-2.9	87	2.9	85	-1.1	77	0.7	78	-5
56	6.3	83	-0.1	85	1.5	85	-2.9	80	2.9	83	-1.1	85	0.6	88	-5.1
84	6.1	111	-0.1	80	1.4	92	-3	85	2.9	91	-1.2	87	0.6	88	-5.1
91	6	80	-0.1	87	1.4	56	-3	87	2.9	85	-1.2	86	0.6	80	-5.2
90	6	79	-0.1	84	1.3	78	-3	80	2.9	83	-1.2	88	0.6	82	-5.6
85	6	84	-0.1	85	1.3	84	-3	91	2.9	85	-1.2	85	0.5	88	-5.7
91	6	88	-0.1	83	1.3	81	-3	82	2.9	88	-1.3	82	0.5	84	-5.9
78	6	88	-0.1	82	1.3	56	-3	86	2.9	91	-1.4	56	0.5	82	-5.9
84	6	85	-0.1	85	1.3	112	-3	84	2.8	85	-1.4	87	0.5	92	-5.9
84	6	83	-0.1	56	1.3	77	-3	91	2.8	77	-1.4	85	0.5	72	-6
85	5.8	85	-0.2	77	1.2	72	-3	91	2.7	88	-1.4	85	0.45	84	-6
80	5.7	88	-0.2	88	1.1	84	-3	83	2.7	88	-1.5	84	0.4	85	-6
84	5.7	82	-0.2	88	1.1	90	-3	84	2.7	85	-1.5	91	0.4	72	-6
84	5.7	79	-0.2	88	1.1	86	-3	85	2.6	85	-1.5	85	0.4	92	-6
82	5.6	84	-0.2	82	1.1	84	-3	83	2.6	83	-1.5	91	0.3	84	-6
82	5.2	82	-0.2	85	1.1	84	-3	80	2.5	83	-1.5	85	0.3	83	-6
83	5.2	77	-0.3	84	1	91	-3	83	2.5	84	-1.6	85	0.2	84	-6
82	5	84	-0.3	112	1	111	-3	85	2.5	85	-1.6	84	0.2	91	-6.5
88	5	83	-0.3	86	1	84	-3	82	2.5	84	-1.6	84	0.2	91	-6.6
112	5	111	-0.3	82	1	85	-3	87	2.4	84	-1.6	88	0.2	111	-6.8
77	5	83	-0.3	91	1	84	-3	91	2.4	85	-1.6	56	0.2	84	-6.9
112	5	84	-0.4	84	1	90	-3	85	2.4	91	-1.7	84	0.2	88	-6.9
87	5	85	-0.4	78	1	84	-3	82	2.3	85	-1.7	85	0.1	86	-7
84	5	91	-0.5	84	1	72	-3	91	2.3	85	-1.7	85	0.1	82	-7
81	5	112	-0.5	78	1	77	-3	91	2.3	83	-1.8	85	0.1	111	-7
112	5	88	-0.5	84	1	85	-3.1	83	2.2	88	-1.9	84	0.1	84	-7

Attachment No. 01
Calc. No. 52-81999-88857 REV. 8
Sheet No. 06 of 21

Prepared E.L. Bradley 8/12/03 Checked Sam Dias 8/27/03

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV
81	5	91	-0.6	112	1	83	-3.1	85	2.2	56	-1.9	91	0.1	84	-7.3
91	5	83	-0.6	82	1	111	-3.1	84	2.1	56	-1.9	86	0.1	85	-7.6
78	5	83	-0.6	85	1	85	-3.1	92	2.1	91	-1.9	88	0.1	83	-8
88	4.9	85	-0.6	84	1	111	-3.2	77	2.1	85	-1.9	111	0.1	86	-8
85	4.9	92	-0.6	78	1	82	-3.2	76	2	77	-2	85	0.1	84	-8
82	4.8	80	-0.6	112	1	83	-3.2	78	2	76	-2	85	0	72	-8
84	4.8	80	-0.7	112	1	85	-3.2	112	2	84	-2	82	0	72	-8
92	4.7	84	-0.7	91	1	77	-3.3	84	2	78	-2	79	0	88	-8.4
80	4.6	85	-0.8	84	1	85	-3.4	84	2	84	-2	90	0	82	-8.5
80	4.5	80	-0.8	90	1	87	-3.5	85	2	72	-2	84	0	85	-8.6
81	4	91	-0.8	84	1	84	-3.6	84	2	86	-2	56	0	82	-9
85	4	84	-0.8	82	1	56	-3.6	84	2	90	-2	92	0	86	-10
84	4	56	-0.8	84	1	88	-3.9	112	2	77	-2	72	0	82	-10
84	4	92	-0.8	91	1	82	-3.9	56	2	85	-2	90	0	77	-10.2
76	4	85	-0.82	85	1	112	-4	77	2	82	-2	84	0	77	-11
84	4	84	-0.9	76	1	82	-4	85	2	79	-2	77	0	85	-12
112	4	85	-0.9	83	1	84	-4	76	2	84	-2	91	0	85	-12.7
77	4	83	-0.9	90	1	78	-4	84	2	84	-2	81	0	84	-13
112	4	56	-0.9	91	1	82	-4	84	2	88	-2	76	0	82	-13.1
								77	2	85	-2	82	0	91	-18

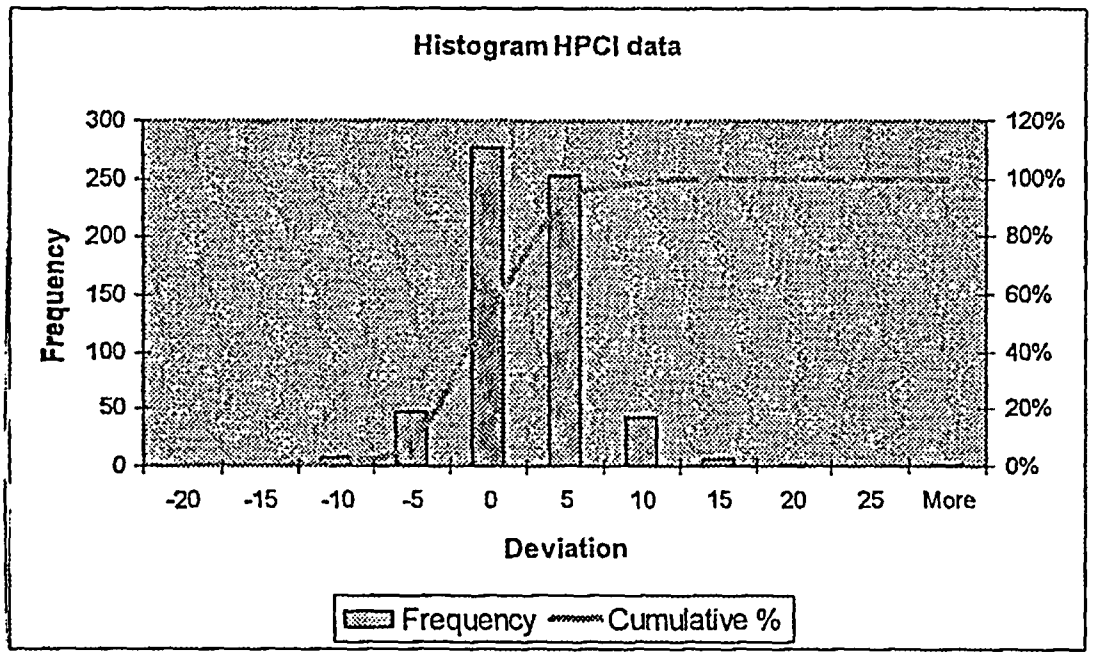
Attachment No. 01
Calc. No. ED-A10229-880052 REV. 8
Sheet No. 07 of 21

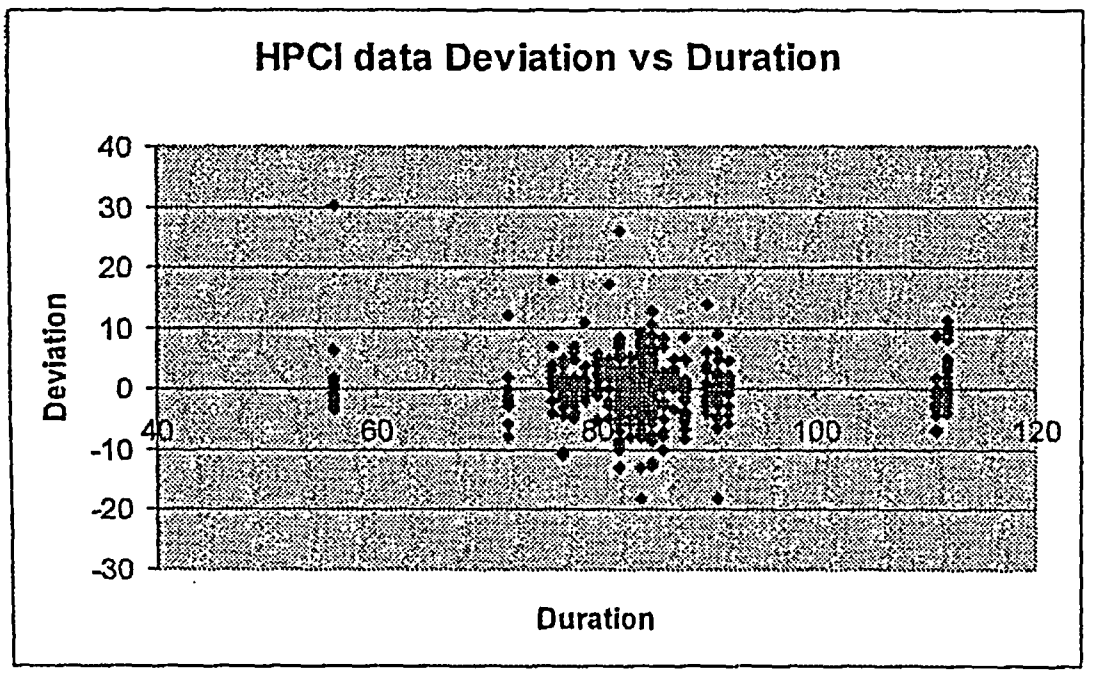
part of BFN TS-447 RAI Enclosure 2

Prepared E.L. Bradley 8/22/03 Checked Sam Dias 8/27/03

part of BFN TS-447 RAI Enclosure 2

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history





Attachment No. 01
Calc. No. ED-00994-880557 REV. 8
Sheet No. 08 of 21

Prepared E.L. Brody 8/22/03 Checked Sam Dias 8/27/03

Statistical comparison on HPCI, RCIC, and MSL temperatu e switch operational performance history

MSL Data

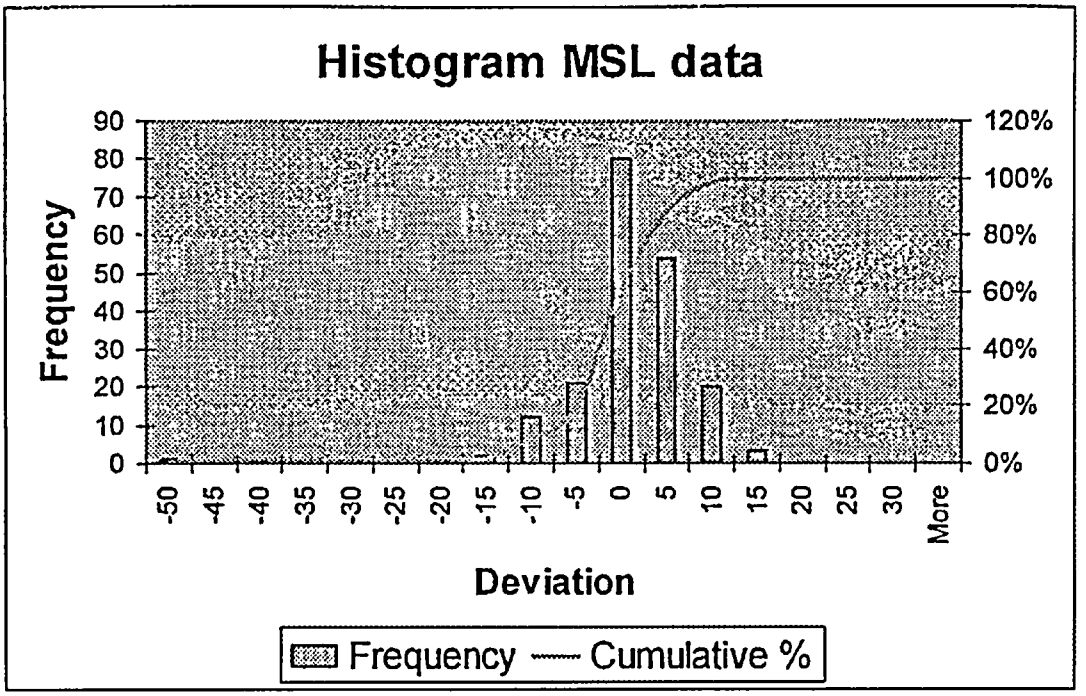
DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV	DUR	DEV
587	12.1	551	-1	525	1.8	714	-3.7	186	5	731	-2	565	0.8	701	-6.8
587	10.2	701	-1	572	1.7	525	-3.9	186	5	731	-2	551	0.7	533	-7
529	10.1	551	-1	714	1.6	701	-3.9	587	4.8	565	-2	572	0.7	697	-7.1
572	9.8	731	-1	714	1.5	731	-4	587	4.6	529	-2.1	565	0.5	551	-7.2
697	9.3	529	-1.2	529	1.5	697	-4	186	4.4	731	-2.1	697	0.4	714	-8.1
572	9.1	186	-1.3	525	1.5	533	-4	587	4.3	551	-2.2	529	0.2	701	-8.1
533	9	529	-1.4	186	1.5	701	-4	551	4	186	-2.2	0	0	565	-8.2
587	8.9	525	-1.4	731	1.4	186	-4	0	4	565	-2.2	0	0	701	-8.4
572	8.6	525	-1.5	587	1.4	551	-4.1	587	4	525	-2.5	0	0	697	-8.8
587	8.4	714	-1.5	731	1.3	551	-4.4	186	3.9	551	-2.5	551	0	701	-9
572	8.1	697	-1.6	714	1.3	731	-4.8	697	3.8	529	-2.6	533	0	186	-9.2
572	8	697	-1.7	572	1.2	551	-4.8	731	3.5	714	-2.8	533	0	701	-10.9
587	7.8	572	-1.8	565	1.1	525	-4.8	533	3	731	-3	529	-0.1	572	-10.9
572	7.6	572	-1.9	731	1.1	565	-5	533	3	731	-3	572	-0.3	697	-11.9
697	6.9	697	-1.9	533	1	551	-5	529	2.9	525	-3	551	-0.3	701	-11.9
186	6.8	714	-1.9	533	1	186	-5.2	186	2.7	525	-3	529	-0.4	697	-11.9
587	6.8	525	-2	529	1	701	-5.5	551	2.1	565	-3	525	-0.5	701	-12
572	6.5	565	-2	697	1	525	-5.6	587	2	533	-3	731	-0.5	731	-12
572	6.3	533	-2	565	1	529	-5.9	714	2	529	-3	731	-0.6	701	-12.9
587	6.3	533	-2	565	1	533	-6	565	2	565	-3	714	-0.6	572	-13.1
587	5.9	533	-2	565	1	551	-6.2	587	2	565	-3	529	-0.6	701	-13.7
587	5.8	697	-2	529	0.9	186	-6.3	525	2	714	-3.3	714	-0.6	525	-13.7
186	5.5	533	-2	186	0.9	714	-6.3	186	1.9	714	-3.3	714	-0.9	701	-14.6
551	1.8	529	-3.6	525	-1	701	-18.2	731	1.9	565	-3.5	714	-1	697	-17.7

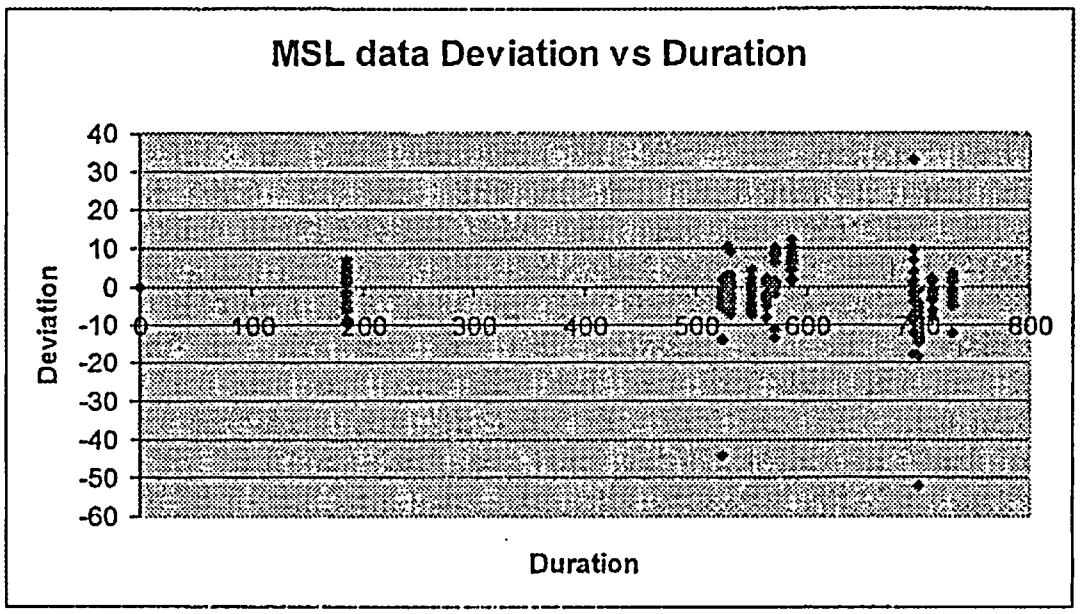
Attachment No. 01
Calc. No. ED-00999-88455-01 REV. 8
Sheet No. 09 of 21

Prepared EP Brolly 8/22/03 Checked Sam Lewis 8/27/03

part of BFN TS-447 RAI Enclosure 2

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history





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ED-80999-880554 8
10 21

Prepared E. Brady 8/22/03 Checked Sam Lias 8/27/03

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

Analysis of the raw data to determine if the three data sets (HPCI, RCIC, MSL) can be combined into a single dataset is accomplished by first calculating the Mean, Standard Deviation, and count of each dataset and then performing a NULL-Hypothesis test of the variances with the NULL-Hypothesis assumption that the variances are equal.

	Mean	Stdev	count
RCIC data	-0.14012	3.690413	640
HPCI data	0.047069	3.988284	638
MSL data	-1.04531	5.461831	192
HPCI+MSL	-0.20563	4.394087	830
RCIC+MSL	-0.34901	4.180276	832
RCIC+HPCI	-0.04667	3.841639	1278
ALL data	-0.17711	4.10138	1470

The first attempt of combining the data was to test each dataset against ALL the other datasets combined. When this was found not to be practical (the MSL data has statistically significant larger variance), the HPCI and RCIC data was checked against each other. The method of the test is described in the attached excerpt from "Probability and Statistics for Engineers, 2nd edition" by Irwin Miller. A test value F is calculated as the ratio of the larger variance over the smaller variance (recall that variance is the square of the standard deviation). This test value F is compared to a F-distribution value for 95% significance for n-1 and m-1 degrees of freedom where n and m are the dataset counts for the two datasets. If the calculated test variable F is larger than the F-distribution value then the NULL-Hypothesis must be rejected (in our case we assume that the two data sets are from the same population; thus, rejecting the Null-Hypothesis means the data can not be combined).

Variance Test Ftesting	Mean	Stdev	m count-1	mean of all others	stdev	n count-1	Calculated F Value	Critical Value at 95%	
RCIC vs all others	-0.14012	3.690413	639	-0.20563	4.394087	829	1.4177	1.1904	reject
HPCI vs all others	0.047069	3.988284	637	-0.34901	4.180276	831	1.0986	1.1581	accept
hpci vs rcic	0.047069	3.988284	638	-0.14012	3.690413	640	1.1679	1.1679	accept
MSL vs all others	-1.04531	5.461831	191	-0.04667	3.841639	1277	2.0214	1.2298	reject

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Prepared [illegible] 8/22/03 Checked Sam Dias 8/27/03

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

As can be seen from the preceding table the MSL data calculates an F test value of 2.02 which exceeds the F-distribution threshold value; therefore, the Null-Hypothesis is rejected and it is concluded that the variance of the MSL data is statistically different from the HPCI Data. The comparison of the HPCI vs RCIC data shows that the test F value is not greater than the F distribution threshold data; therefore, it is concluded that the HPCI and RCIC data is from the same population and can be combined.

Since the caveat that the variances of two datasets be the same prior to comparing means has been established for the HPCI and RCIC data sets then a T-test of the two means can be performed. The T test statistic is called z and is calculated as follows (x is mean, n is count, and sigma is standard deviation, delta is assumed 0):

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - \delta}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Mean Test T testing	Mean	Stdev	count-1	mean of all others	stdev of all others	count of all others minus 1	Calculated z Value	Critical Value at 95%	
hpci vs rcic	0.047069	3.988284	638	0.14012	3.690413	640	0.8709016	2.2440508	accept

Since the test value is less than the critical T distribution then the Null-Hypothesis is not rejected and the conclusion is drawn that the two data sets are from the same general population and that the difference is the means of the two different data sets is due to chance.

In summary the mean and standard deviation of the two reduced data sets (MSL and the combined HPCI/RCIC dataset) is as follows:

	mean	stdev	Count
hpci&rcic	-0.05	3.84	1278
msl	-1.05	5.46	191

Examination of the graphs for the MSL data shows no apparent relationship of deviation versus time. Since the construction of all the devices is the same it is concluded that they will all exhibit the same lack of drift over the longer times.

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Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

Excerpt from Probability and Statistics for Engineers by Irwin Miller, 2nd edition.

8.3 HYPOTHESES CONCERNING TWO VARIANCES

s^2 = variance

The two-sample t test for the difference between two means, described in Section 7.5, requires the assumption that the population variances are equal. Before proceeding with this test, therefore, it would be desirable to put this assumption to a test. In this section we shall describe a test of the null hypothesis $H_0: \sigma_1^2 = \sigma_2^2$ against an appropriate alternative, which applies to independent random samples from two normal populations. As we shall discover in Chapter 12, the test has many other important applications.

If independent random samples of size n_1 and n_2 are taken from normal populations having the same variance, it follows from Theorem 6.5 that the statistic

$$F = \frac{s_1^2}{s_2^2} = \frac{\text{Variance of sample 1}}{\text{Variance of sample 2}}$$

← Bigger

← Smaller.

is a value of a random variable having the F distribution with $n_1 - 1$ and $n_2 - 1$ degrees of freedom. Thus, if the null hypothesis $\sigma_1^2 = \sigma_2^2$ is true, the ratio of the sample variances s_1^2 and s_2^2 provides a statistic on which tests of the null hypothesis can be based.

The critical region for testing H_0 against the alternative hypothesis $\sigma_1^2 > \sigma_2^2$ is $F > F_\alpha$, where F_α is as defined on page 177, namely, it cuts off a right-hand tail of area α under the F distribution with $n_1 - 1$ and $n_2 - 1$

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Prepared [illegible] 8/22/03 Checked [illegible] 8/27/03

degrees of freedom. Similarly, the critical region for testing H_0 against the alternative hypothesis $\sigma_1^2 < \sigma_2^2$ is $F < F_{1-\alpha}$, and this causes some difficulties since Table 6 only contains values corresponding to right-hand tails of $\alpha = 0.05$ and $\alpha = 0.01$. As a result, we use the reciprocal of the original test statistic and make use of the relation

$$F_{1-\alpha}(\nu_1, \nu_2) = \frac{1}{F_\alpha(\nu_2, \nu_1)}$$

first given on page 178. Thus, we base the test on the statistic $F = s_2^2/s_1^2$ and the critical region for testing $H_0: \sigma_1^2 = \sigma_2^2$ against $H_1: \sigma_1^2 < \sigma_2^2$ becomes $F > F_\alpha$, where F_α is the appropriate critical value of F with $n_2 - 1$ and $n_1 - 1$ degrees of freedom.

For the two-sided alternative $\sigma_1^2 \neq \sigma_2^2$ the critical region is $F < F_{1-\alpha/2}$ or $F > F_{\alpha/2}$, where $F = s_1^2/s_2^2$ and the degrees of freedom are $n_1 - 1$ and $n_2 - 1$. In practice, we modify this test as in the preceding paragraph, so that we can again use the table of F values corresponding to right-hand tails of $\alpha = 0.05$ and $\alpha = 0.01$. To this end we let s_M^2 represent the larger of the two sample variances, s_m^2 the smaller, and we write the corresponding sample sizes as n_M and n_m. Thus, the test statistic becomes $F = s_M^2/s_m^2$ and the critical region is as shown in the following table:

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Prepared E.H. Bradley 8/22/03 Checked Sam Lias 8/27/03

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

CRITICAL REGIONS FOR TESTING $H_0: \sigma_1^2 = \sigma_2^2$
(Normal Populations)

Alternative hypothesis	*Test statistic*	*Reject H_0 if*
$\sigma_1^2 < \sigma_2^2$	$F = \frac{s_2^2}{s_1^2}$	$F > F_\alpha(n_2 - 1, n_1 - 1)$
$\sigma_1^2 > \sigma_2^2$	$F = \frac{s_1^2}{s_2^2}$	$F > F_\alpha(n_1 - 1, n_2 - 1)$
$\sigma_1^2 \neq \sigma_2^2$	$F = \frac{s_M^2}{s_m^2}$	$F > F_{\alpha/2}(n_M - 1, n_m - 1)$

The level of significance of these tests is α and the figures indicated in parentheses are the respective degrees of freedom. Note that, as in the chi-square test, "equal tails" are used in the two-tail test as a matter of mathematical convenience, even though the F distribution is not symmetrical.

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Prepared E Berg 8/22/03 Checked Sam Dias 8/27/03

Example. To give an example of a one-tail test for the equality of two variances, suppose that it is desired to determine whether Company 1 is better at plating silverware than Company 2. Assuming that there is essentially no difficulty in controlling the average thickness of the plating, we shall base our decision on the *variability* of its thickness. To set up the test so that rejection of the null hypothesis will enable us to conclude that the plating done by Company 1 is better (less variable) than that done by Company 2, we shall have to test the null hypothesis $\sigma_1^2 = \sigma_2^2$ against the alternative hypothesis $\sigma_1^2 < \sigma_2^2$, say, at the level of signficance $\alpha = 0.05$. Supposing now that random samples of size 12 of the work done by each company yields $s_1 = 0.035$ mil and $s_2 = 0.062$ mil for the thickness of the plating, we find that the appropriate test statistic has the value

$$F = \frac{(0.062)^2}{(0.035)^2} = 3.14$$

Comparing this value with 2.82, the value of $F_{0.05}(11,11)$ obtained from Table 6(a) by linear interpolation,* we conclude that the null hypothesis will have to be rejected; in other words, the data support the contention that the plating done by Company 1 is less variable than that done by Company 2.

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Prepared [illegible] 8/22/03 Checked Sam Dias 8/27/03

Example. To give an example of a two-tail test for the equality of two variances, let us return to the example on page 219, where we compared the average heat-producing capacity of the coal from two mines. In that example we went ahead and performed the two-sample t test even though there was a difference between the variances of the two samples. To justify this procedure, let us now test whether $\sigma_1^2 = \sigma_2^2$, and let us use the alternative hypothesis $\sigma_1^2 \neq \sigma_2^2$, since we are concerned only with the question whether or not these two variances are equal. Since we had $n_1 = 5$, $n_2 = 6$, $s_1^2 = \frac{63{,}000}{4} = 15{,}750$, and $s_2^2 = \frac{54{,}600}{5} = 10{,}920$ on page 219, we get

$$F = \frac{s_1^2}{s_2^2} = \frac{15{,}750}{10{,}920} = 1.44$$

Using $\alpha = 0.02$, we find from Table 6(b) that $F_{0.01}(4, 5) = 11.4$, and it follows that the null hypothesis cannot be rejected. In other words, it was justifiable to use the two-sample t test in the given example.

Had we wanted to use the level of significance $\alpha = 0.05$ or $\alpha = 0.01$ in this example, we would have required tables of the values of $F_{0.025}(\nu_1, \nu_2)$ or $F_{0.005}(\nu_1, \nu_2)$; such tables may be found in the *Biometrika Tables for Statisticians* listed in the Bibliography at the end of the book. Also, *OC* curves for the various F tests discussed in this section may be found in the book by A. H. Bowker and G. J. Lieberman listed in the Bibliography, while those for the one-tail tests only may be found in the *National Bureau of Standards Handbook 91*.

7.8 HYPOTHESES CONCERNING TWO MEANS

When dealing with population means, we are frequently faced with the problem of making decisions about the relative values of two or more means. Leaving the general problem until Chapter 12, we shall

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Prepared E H Brodly 8/22/03 Checked Sam Quis 8/27/03

devote this section to tests concerning the difference between *two* means. For example, if two methods of welding are being considered for use with railroad rails, we may take samples and decide which is better by comparing their mean strengths; also, if a licensing examination is given to engineers who graduated from two different colleges, we may want to decide whether any observed difference between the means of the scores of the students from the two colleges is significant or whether it may be attributed to chance.

Formulating the problem more generally, we shall consider two populations having the means μ_1 and μ_2 and the variances σ_1^2 and σ_2^2, and we shall want to test the null hypothesis $\mu_1 - \mu_2 = \delta$, where δ is a specified constant, on the basis of independent random samples of size n_1 and n_2. Analogous to the tests concerning one mean, we shall consider tests of this null hypothesis against each of the alternatives $\mu_1 - \mu_2 < \delta$, $\mu_1 - \mu_2 > \delta$, and $\mu_1 - \mu_2 \neq \delta$. The test, itself, will depend on the difference between the sample means, $\bar{x}_1 - \bar{x}_2$, and if both samples come from normal populations with known variances (or both samples are large), it can be based on the statistic

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - \delta}{\sigma_{x_1 - x_2}} \quad (\mu_1 - \mu_2)$$

X = mean of sample

μ = mean of population

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Prepared EBrad 8/22/03 Checked Sam Dias 8/27/03

whose sampling distribution is (or is approximately) the standard normal distribution. Here $\sigma_{\bar{x}_1-\bar{x}_2}$ is the standard deviation of the sampling distribution of the difference between the sample means, and its value for random samples from infinite populations may be obtained with the use of the following theorem, which we shall state without proof:

> THEOREM 7.1. *If the distributions of two independent random variables have the means μ_1 and μ_2 and the variances σ_1^2 and σ_2^2, then the distribution of their* sum (*or* difference) *has the mean $\mu_1 + \mu_2$* (or $\mu_1 - \mu_2$) *and the variance $\sigma_1^2 + \sigma_2^2$.*

To find the variance of the difference between the means of two independent random samples of size n_1 and n_2 from infinite populations, note first that the variances of the two means, themselves, are

$$\sigma_{\bar{x}_1}^2 = \frac{\sigma_1^2}{n_1} \quad \text{and} \quad \sigma_{\bar{x}_2}^2 = \frac{\sigma_2^2}{n_2}$$

where σ_1^2 and σ_2^2 are the variances of the respective populations. Thus, by Theorem 7.1

$$\sigma_{\bar{x}_1-\bar{x}_2}^2 = \frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}$$

and the test statistic can be written as

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - \delta}{\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}}}$$

Analogous to the table on page 212, the critical regions for testing the null hypothesis $\mu_1 - \mu_2 = \delta$ are as follows:

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Prepared E.H. Brady 8/22/03 Checked Sam Dias 8/27/03

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

CRITICAL REGIONS FOR TESTING $H_0: \mu_1 - \mu_2 = \delta$
(Normal Populations with σ_1 and σ_2 Known, or Large Samples)

Alternative hypothesis	*Reject H_0 if*
$\mu_1 - \mu_2 < \delta$	$z < -z_\alpha$
$\mu_1 - \mu_2 > \delta$	$z > z_\alpha$
$\mu_1 - \mu_2 \neq \delta$	$z < -z_{\alpha/2}$ or $z > z_{\alpha/2}$

Example. To illustrate this procedure, suppose that a company claims that its light bulbs are superior to those of its main competitor on the basis of a study which showed that a sample of $n_1 = 40$ of its bulbs had an average "lifetime" of 647 hours of continuous use with a standard deviation of 27 hours, while a sample of $n_2 = 40$ bulbs made by its main competitor had an average "lifetime" of 638 hours of continuous use with a standard deviation of 31 hours. If we wish to test at the 0.05 level of significance whether the observed difference of 9 hours between the two sample means is significant or whether it can be attributed to chance, placing the burden of proof on the claim, the appropriate null and alternative hypotheses are, respectively, $\mu_1 - \mu_2 = 0$ and $\mu_1 - \mu_2 > 0$. Accordingly, we put $\delta = 0$ in the formula for z and the test statistic becomes

$$z = \frac{647 - 638}{\sqrt{\frac{27^2}{40} + \frac{31^2}{40}}} = 1.38$$

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Prepared EJ Bailey 8/28/03 per telecon gms
Checked Sam Elias 8/28/03

Statistical comparison on HPCI, RCIC, and MSL temperature switch operational performance history

(Note that we have approximated the population variances with the variances of the respective samples, which is justifiable since both samples are fairly large.) Since the value which we obtained does *not* exceed the critical value $z_{0.05} = 1.645$, we find that the null hypothesis *cannot be rejected*; thus, we conclude that the observed difference between the two sample means is *not significant* at the level of significance $\alpha = 0.05$ or, in other words, that it can well be attributed to chance.

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Prepared E H Bradley 8/22/03 Checked Sam A. Dias 8/27/03

part of BFN TS-447 RAI Enclosure 2

QA Record

TVAN CALCULATION COVERSHEET/CCRIS UPDATE

Page i ORIGINAL

REV 0 EDMS/RIMS NO.	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
B22 900424 110	calculations(nuclear)	178 040726 001

Calc Title: 1/2/3-T-69-834A-D, 835A-D, 836A-D, 837A-D and 838A-D Setpoint and Scaling Calculation

CALC ID	TYPE	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV	REVISION APPLICABILITY
CURRENT	CN	NUC	BFN	EEB	EDQ0069890080	006	007	Entire calc ☒
NEW	CN	NUC						Selected pages ☐

ACTION	NEW ☐ REVISION ☒	DELETE ☐ RENAME ☒ A 7/22/04	SUPERSEDE ☐ DUPLICATE ☐	CCRIS UPDATE ONLY ☐ (Verifier Approval Signatures Not Required)	No CCRIS Changes ☐ (For calc revision, CCRIS been reviewed and no CCRIS changes required)

UNITS	SYSTEMS	UNIDS
001, 002, 003	069 001	1/2/3-TE-69-834A-D, 835A-D, 836A-D, 837A-D and 838A-D

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
51243, 51235	EEB-TI-28	E

QUALITY RELATED?	SAFETY RELATED? (If yes, QR = yes)	UNVERIFIED ASSUMPTION	SPECIAL REQUIREMENTS AND/OR LIMITING CONDITIONS?	DESIGN OUTPUT ATTACHMENT?	SAR/TS AFFECTED
Yes ☒ No ☐	Yes ☒ No ☐	Yes ☐ No ☒	Yes ☒ No ☐	Yes ☐ No ☒	Yes ☒ No ☐

PREPARER ID	PREPARER PHONE NO	PREPARING ORG (BRANCH)	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
BFDAVIDS	614-8666	EEB	Design Review	☐ Yes ☒ No

PREPARER SIGNATURE	DATE	CHECKER SIGNATURE	DATE
Brian F. Davidson	7/22/04	Joseph M. Ashcraft	7/22/04
VERIFIER SIGNATURE	**DATE**	**APPROVAL SIGNATURE**	**DATE**
Joseph M. Ashcraft	7/22/04		7/22/04

STATEMENT OF PROBLEM/ABSTRACT

Calculations were performed to determine the accuracy of the subject instrument loop(s). The determined accuracies are compared to the required accuracies, setpoints, safety limits and/or operational limits and the accuracy of the loops listed below are demonstrated to be acceptable for the intended function of the instrument loops.

Loop No. 1/2/3-T-69-834A-D, 835A-D, 836A-D, 837A-D and 838A-D

MICROFICHE/EFICHE Yes ☐ No ☐ FICHE NUMBER(S)

☐ LOAD INTO EDMS AND DESTROY
☐ LOAD INTO EDMS AND RETURN CALCULATION TO CALCULATION LIBRARY. ADDRESS:
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Appendix B

CALCULATION NUMBER	REV. NO.	SHEET NO.
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PREPARER	DATE	CHECKER	DATE

B4.0 DESIGN INPUT DATA (Continued)

B4.4 COMPONENT DATA (CONTINUED)

VALID FOR: 2/3-TIS -69-0834 A/ B/ C/ D IDENTIFIED IN SECTION B4.1

Instrument No.: 2/3-TIS -69-0834 A/ B/ C/ D		
TYPE	**VALUE** all values in mA	**NOTE**
Re	± 0.12 A	1
De	included in Re	2
TNe	± 0.11 mA	3
SPEe	N/A	4
SECu	N/A	4
PSEe	encompassed by Re	14
RNDe	included in Re	7
ICTe	± 0.12 mA	5
ICRe	N/A	5
OCTe	N/A	10
OCRe	N/A	10
Ab	± 0.12 mA	8
Se	0	11
RADe	N/A	6
TAe	N/A	6
INDRe	N/A	9
WLe	N/A	12
PRCSe	N/A	13
IRe	N/A	6

Appendix B

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B4.0 DESIGN INPUT DATA

B4.4 COMPONENT DATA (CONTINUED)

COMPONENT: 2/3-TIS -69-0834 A/B/C/D

NOTES

1. Per Reference 19, the Master Trip Unit will exhibit a trip accuracy repeatability of ± 0.75% of Span for a calibration interval of 6 months or less. The calibrated range of the subject trip unit is 4 - 20 mA which provides a span of 16 mA. The calibration data from units 2 and 3 were collected and analyzed as shown in section 5.0. It was found that there was no drift over time as seen on the graph on page 45. The regression analysis sheet on page 46 shows an R squared value of 0.00256, which means there is little or no drift in relation to time. Therefore the repeatability published by the vendor is taken as acceptable for a period of 30 months. Hence

Re	= ± 0.0075 x (20-4) MA	= ± 0.12 mA
	= ± 0.0075 x (5-1) Volt	= ± 0.03 V
	= ± 0.0075 x (32.065Ω)	= ± 0.24 Ω
	= ± 0.0075 x (200-50)° F	= ± 1.2 °F

2. Per Ref. 123, the drift is included in Re, Therefore:

   De = included in Re

3. Per Reference 19, the uncertainty introduced by temperature effects on the subject switches is given by TNe = ± (1.5 % Span/100°F) for a 6 month calibration cycle. Per reference 9, the subject switches will experience a maximum temperature deviation of 104°F - 60°F = 44°F. The calibration data from units 2 and 3 were collected and analyzed as shown in section 5.0. It was found that there was no drift over time as seen on the graph on page 45. The regression analysis sheet on page 46 shows an R squared value of 0.00256, which means there is little or no drift in relation to time. The span is 4 Volt or 16 mA. Therefore the temperature effect is

TNe	= ± 0.015 x (16 MA) x (44°F/100°F)	= ± 0.11 mA
	= ± 0.028 V	= ± 0.22 Ω
	= ± 1.03 °F	

B4.0 DESIGN INPUT DATA

B4.4 COMPONENT DATA(CONTINUED)

COMPONENT : **2/3-TIS -69-0834 A/B/C/D**

NOTES

4. The subject switches are not subject to static pressure, therefore:

   SPEe = N/A and SECu = N/A

5. M&TE accuracy shall be at least equal to the subject equipment's reference accuracy. The test equipment that will be used will have a digital readout; therefore, reading error does not exist. Thus,

   ICRe = N/A
   ICTe = ± 0.03 V = ±0.24 Ω = ± 1.2 °F
   = ± 0.12 mA

   These errors could be reduced by requiring the use of the trip calibrator which is more accurate. For conservatism, however, the equipment accuracy is used.

6. Per Reference 9, the trip units are installed in a mild environment; therefore inaccuracies due to accident temperature, accident radiation and accident induced cable leakage are not applicable.

   RADe = N/A
   TAe = N/A
   IRe = N/A

7. Per Reference 47, normal radiation effects are included in Re. Therefore,

   RNDe = included in Re

Appendix B

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B4.0 DESIGN INPUT DATA

B4.4 COMPONENT DATA (CONTINUED)

COMPONENT: 2/3-TIS -69-0834 A/B/C/D

NOTES

8. Per Reference 1, the acceptance band should never be less than the reference accuracy therefore for this instrument Ab is made equal to Re.

   Ab = Re
   Ab = ± 0.03 V = ±0.24 Ω = ± 1.2 °F
   = ± 0.12 mA

9. There is no indicator on the slave trip unit. Therefore,

   INDRe = N/A

10. The output action of the subject switches is a bistable change of state. Therefore,

    OCTe = N/A and OCRe = N/A

11 Per Reference 47, there is no additional uncertainty associated with seismic effects. Therefore,

   Se = 0

12 Water leg error does not apply to electronic switches, therefore,

   WLe = N/A

13 Process error does not apply to an electronic switch, therefore,

   PRSCe = N/A

14. Per Reference 47, the repeatability of the trip point is valid for power supply voltages of 22 to 28 vdc. The power supply delivers a regulated output of 23.2 to 24.2 VDC. Hence

    PSEe = encompassed by Re

Appendix B

CALCULATION NUMBER		REV. NO.	SHEET NO.
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PREPARER	DATE	CHECKER	DATE

B4.0 DESIGN INPUT DATA

B4.5 COMPONENT DATA FOR 2/3-TS-01-17A, B, C, D

VALID FOR: 2/3-TS-01-0017A / B / C / D IDENTIFIED IN SECTION B4.1

CONTRACT #: PR # 00015410-BFN REF #: 54 NOTE(S): N/A

MANUFACTURER/MODEL: ROSEMOUNT INC / 710 DU REF #: 54 NOTE(S): N/A

INSTRUMENT RANGE: 1 TO 5 Volt REF #: 54 NOTE(S): N/A

==========

INPUT RANGE & UNITS: 1 to 5 Volt OUTPUT RANGE & UNITS: CONTACT
4 to 20 mA

OVER RANGE LIMIT: N/A REF #: 54 NOTE(S): N/A

==========

MIN/MAX ABNORMAL TEMP: 60°F / 104°F ACCIDENT TEMP: N/A

RADIATION TID (RAD): <560 RADIATION ABNORMAL IAD (RAD): <210

40 YEAR NID (RAD): <350 REF #: 09 NOTE(S): N/A

==========

FUNCTIONAL REQUIREMENTS PER MCEL: REF #: 46 & 59 NOTE(S): N/A

ACCIDENT	EVENT / CAT.	OPER. TIME
LOCA	X	N/R
HELB-IPC	X	N/R
HPCI-OPC	X	N/R
RCIC-OPC	X	N/R
RWCU-OPC	1	1 Hr
MS-OPC	1	1 Hr

X MILD ENVIRONMENT, THEREFORE, NOT APPLICABLE.

B4.0 DESIGN INPUT DATA

B4.5 COMPONENT DATA (CONTINUED)

VALID FOR: 2/3-TS -01-0017 A/ B/ C/ D IDENTIFIED IN SECTION B4.1

Instrument No.: 2/3-TS -01-0017A/ B/ C/ D		
TYPE	**VALUE** all values in mA	**NOTE**
Re	± 0.032 mA	1
De	included in Re	2
TNe	included in Re	3
SPEe	N/A	4
SECu	N/A	4
PSEe	encompassed by Re	14
RNDe	included in Re	7
ICTe	± 0.032 mA	5
ICRe	N/A	5
OCTe	N/A	10
OCRe	N/A	10
Ab	± 0.107 mA	8
Se	0	11
RADe	N/A	6
TAe	N/A	6
INDRe	N/A	9
WLe	N/A	12
PRCSe	N/A	13
IRe	N/A	6

Appendix B

CALCULATION NUMBER ED-Q2069-890080		REV. NO. 4	SHEET NO. 15 of 66
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B4.0 DESIGN INPUT DATA

B4.5 COMPONENT DATA

COMPONENT: 2/3-TS -01-0017A/B/C/D

#	NOTES
1.	Per Reference 56, the Slave Trip Unit will exhibit a trip accuracy repeatability of ± 0.20 % of Span for a calibration interval of 30 months. The calibrated range of the subject switch is 1-5 V or 4 - 20 mA which provides a span of 4V or 16 mA. Therefore the drift for 30 months is

Re = ± 0.002 x (20-4) MA = ± 0.032 mA
= ± 0.002 x (5-1) Volt = ± 0.008 V
= ± 0.002 x (32.065Ω) = ± 0.064 Ω
= ± 0.002 x (200-50)° F = ± 0.3 °F

2. Per Ref. 56, the drift is included in Re, Therefore:

De = included in Re

3. Per Ref. 56, the temperature effect is included in Re, Therefore:

TNe = included in Re

4. The subject switches are not subject to static pressure, therefore:

SPEe = N/A and SECu = N/A

Appendix B

CALCULATION NUMBER		REV. NO.	SHEET NO.
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B4.0 DESIGN INPUT DATA

B4.5 COMPONENT DATA (CONTINUED)

COMPONENT : 2/3-TS -01-0017A/B/C/D

NOTES

5. M&TE accuracy shall be at least equal to the subject equipment's reference accuracy. From note 1 above, the reference accuracy of the subject instruments is ± 0.008 V. The test equipment that is used, will have a digital readout; therefore, reading error does not exist. Thus,

ICRe = N/A
ICTe = ± 0.032 mA
= ± 0.008 V = ± 0.064 Ω
= ± 0.3 °F

These errors could be reduced by requiring the use of the trip calibrator which is more accurate. For conservatism, however, the equipment accuracy is used.

6. Per Reference 9, the trip units are installed in a mild environment; therefore inaccuracies due to accident temperature, accident radiation and accident induced cable leakage are not applicable.

RADe = N/A
TAe = N/A
IRe = N/A

7. Per Reference 47, normal radiation effects are included in Re. Therefore,

RNDe = included in Re

8. Per Reference 1, the acceptance band should never be less than the reference accuracy therefore for this instrument Ab is made equal to Re.

Ab >/= Re >/= ± 0.3 °F

Ab is rounded off to a good readable value of 1 °F, Therefore

Ab = ± 0.107 mA = ± 0.027 V
= ± 0.214 Ω = ± 1.0 °F

Appendix B

CALCULATION NUMBER ED-Q2069-890080		REV. NO. 4	SHEET NO. 17 of 66
PREPARER	DATE	CHECKER	DATE

B4.0 DESIGN INPUT DATA

B4.5 COMPONENT DATA (CONTINUED)

COMPONENT: 2/3-TS -01-0017A/B/C/D

NOTES

9. There is no indicator on the slave trip unit. Therefore,
   INDRe = N/A

10. The output action of the subject switches is a bistable change of state. Therefore,
    OCTe = N/A and OCRe = N/A

11 Per Reference 47, there is no additional uncertainty associated with seismic effects. Therefore,
   Se = 0

12 Water leg error does not apply to electronic switches, therefore,
   WLe = N/A

13 Process error does not apply to an electronic switch, therefore,
   PRSCe = N/A

14. Per Reference 47, the repeatability of the trip point is valid for power supply voltages of 22 to 28 VDC. The power supply delivers regulated output of 23.2 to 24.2 VDC. Hence

    PSEe = encompassed by Re

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
3-T-69-834A	135.466	11/02/1998	135.5	02/22/1999	112	0.106034617
	135.25	02/22/1999	135.22	06/14/1999	112	-0.093559956
	135.209	06/14/1999	135.211	10/04/1999	112	0.00623733
	135.214	10/04/1999	135.28	01/24/2000	112	0.205831904
	135.466	11/02/1998	135.28	01/24/2000	448	-0.580071729
	135.25	02/22/1999	135.28	01/24/2000	336	0.093559956
	135.209	06/14/1999	135.28	01/24/2000	224	0.22142523
	135.466	11/02/1998	135.22	06/14/1999	224	-0.767191642
	135.466	11/02/1998	135.211	10/04/1999	336	-0.795259629
	135.25	02/22/1999	135.211	10/04/1999	224	-0.121627943
3-T-69-835A	121.235	11/02/1998	121.25	02/22/1999	112	0.046779978
	121.25	02/22/1999	121.248	06/14/1999	112	-0.00623733
	121.241	06/14/1999	121.246	10/04/1999	112	0.015593326
	121.24	10/04/1999	121.24	01/24/2000	112	0
	121.235	11/02/1998	121.24	01/24/2000	448	0.015593326
	121.25	02/22/1999	121.24	01/24/2000	336	-0.031186652
	121.241	06/14/1999	121.24	01/24/2000	224	-0.003118665
	121.235	11/02/1998	121.248	06/14/1999	224	0.040542648
	121.235	11/02/1998	121.246	10/04/1999	336	0.034305317
	121.25	02/22/1999	121.246	10/04/1999	224	-0.012474661
3-T-69-836A	124.871	11/02/1998	124.85	02/22/1999	112	-0.065491969
	124.854	06/14/1999	124.864	10/04/1999	112	0.031186652
	124.86	10/04/1999	124.87	01/24/2000	112	0.031186652
	124.871	11/02/1998	124.87	01/24/2000	448	-0.003118665
	124.854	06/14/1999	124.87	01/24/2000	224	0.049898643
	124.871	11/02/1998	124.864	10/04/1999	336	-0.021830656
3-T-69-837A	124.851	11/02/1998	124.87	02/22/1999	112	0.059254639
	124.855	02/22/1999	124.861	06/14/1999	112	0.018711991
	124.859	06/14/1999	124.85	10/04/1999	112	-0.028067987
	124.85	10/04/1999	124.88	01/24/2000	112	0.093559956
	124.851	11/02/1998	124.88	01/24/2000	448	0.090441291
	124.855	02/22/1999	124.88	01/24/2000	336	0.07796663
	124.859	06/14/1999	124.88	01/24/2000	224	0.065491969
	124.851	11/02/1998	124.861	06/14/1999	224	0.031186652
	124.851	11/02/1998	124.85	10/04/1999	336	-0.003118665
	124.855	02/22/1999	124.85	10/04/1999	224	-0.015593326
3-T-69-838A	123.05	11/02/1998	123.09	02/22/1999	112	0.124746608
	123.086	02/22/1999	123.082	06/14/1999	112	-0.012474661
	123.072	06/14/1999	123.09	10/04/1999	112	0.056135974
	123.087	10/04/1999	123.12	01/24/2000	112	0.102915952
	123.05	11/02/1998	123.12	01/24/2000	448	0.218306565
	123.086	02/22/1999	123.12	01/24/2000	336	0.106034617
	123.072	06/14/1999	123.12	01/24/2000	224	0.14969593
	123.05	11/02/1998	123.082	06/14/1999	224	0.099797287

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	123.05	11/02/1998	123.09	10/04/1999	336	0.124746608
	123.086	02/22/1999	123.09	10/04/1999	224	0.012474661
3-T-69-839A	128.66	11/02/1998	128.67	02/22/1999	112	0.031186652
	128.657	02/22/1999	128.657	06/14/1999	112	0
	128.647	06/14/1999	128.672	10/04/1999	112	0.07796663
	128.671	10/04/1999	128.69	01/24/2000	112	0.059254639
	128.66	11/02/1998	128.69	01/24/2000	448	0.093559956
	128.657	02/22/1999	128.69	01/24/2000	336	0.102915952
	128.647	06/14/1999	128.69	01/24/2000	224	0.134102604
	128.66	11/02/1998	128.657	06/14/1999	224	-0.009355996
	128.66	11/02/1998	128.672	10/04/1999	336	0.037423983
	128.657	02/22/1999	128.672	10/04/1999	224	0.046779978
3-T-69-834B	135.255	08/03/1998	135.324	11/23/1998	112	0.2151879
	135.328	11/23/1998	135.384	03/15/1999	112	0.174645252
	135.4	03/15/1999	135.366	07/06/1999	113	-0.106034617
	135.355	07/06/1999	135.38	10/25/1999	111	0.07796663
	135.372	10/25/1999	135.41	02/14/2000	112	0.118509278
	135.255	08/03/1998	135.41	02/14/2000	560	0.483393108
	135.328	11/23/1998	135.41	02/14/2000	448	0.255730547
	135.4	03/15/1999	135.41	02/14/2000	336	0.031186652
	135.355	07/06/1999	135.41	02/14/2000	223	0.171526587
	135.255	08/03/1998	135.384	03/15/1999	224	0.402307812
	135.255	08/03/1998	135.38	10/25/1999	448	0.389833151
	135.328	11/23/1998	135.38	10/25/1999	336	0.162170591
	135.4	03/15/1999	135.38	10/25/1999	224	-0.062373304
	135.255	08/03/1998	135.366	07/06/1999	337	0.346171838
	135.328	11/23/1998	135.366	07/06/1999	225	0.118509278
3-T-69-835B	121.364	08/03/1998	121.334	11/23/1998	112	-0.093559956
	121.345	11/23/1998	121.38	03/15/1999	112	0.109153282
	121.379	03/15/1999	121.375	07/06/1999	113	-0.012474661
	121.378	07/06/1999	121.389	10/25/1999	111	0.034305317
	121.42	10/25/1999	121.4	02/14/2000	112	-0.062373304
	121.364	08/03/1998	121.4	02/14/2000	560	0.112271948
	121.345	11/23/1998	121.4	02/14/2000	448	0.171526587
	121.379	03/15/1999	121.4	02/14/2000	336	0.065491969
	121.378	07/06/1999	121.4	02/14/2000	223	0.068610635
	121.364	08/03/1998	121.389	10/25/1999	448	0.07796663
	121.345	11/23/1998	121.389	10/25/1999	336	0.137221269
	121.379	03/15/1999	121.389	10/25/1999	224	0.031186652
	121.364	08/03/1998	121.375	07/06/1999	337	0.034305317
	121.345	11/23/1998	121.375	07/06/1999	225	0.093559956
	121.364	08/03/1998	121.38	03/15/1999	224	0.049898643
3-T-69-836B	124.969	08/03/1998	124.91	11/23/1998	112	-0.184001247
	124.91	11/23/1998	124.96	03/15/1999	112	0.155933261

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	124.952	03/15/1999	124.925	07/06/1999	113	-0.084203961
	124.922	07/06/1999	124.925	10/25/1999	111	0.009355996
	124.92	10/25/1999	124.93	02/14/2000	112	0.031186652
	124.969	08/03/1998	124.93	02/14/2000	560	-0.121627943
	124.91	11/23/1998	124.93	02/14/2000	448	0.062373304
	124.952	03/15/1999	124.93	02/14/2000	336	-0.068610635
	124.922	07/06/1999	124.93	02/14/2000	223	0.024949322
	124.969	08/03/1998	124.925	10/25/1999	448	-0.137221269
	124.91	11/23/1998	124.925	10/25/1999	336	0.046779978
	124.952	03/15/1999	124.925	10/25/1999	224	-0.084203961
	124.969	08/03/1998	124.925	07/06/1999	337	-0.137221269
	124.91	11/23/1998	124.925	07/06/1999	225	0.046779978
	124.969	08/03/1998	124.96	03/15/1999	224	-0.028067987
3-T-69-837B	124.968	08/03/1998	124.96	11/23/1998	112	-0.024949322
	124.938	11/23/1998	125.04	03/15/1999	112	0.318103852
	125.037	03/15/1999	125	07/06/1999	113	-0.115390613
	124.998	07/06/1999	125.1	10/25/1999	111	0.318103852
	125	10/25/1999	125	02/14/2000	112	0
	124.968	08/03/1998	125	02/14/2000	560	0.099797287
	124.938	11/23/1998	125	02/14/2000	448	0.193357243
	125.037	03/15/1999	125	02/14/2000	336	-0.115390613
	124.998	07/06/1999	125	02/14/2000	223	0.00623733
	124.968	08/03/1998	125.1	10/25/1999	448	0.411663808
	124.938	11/23/1998	125.1	10/25/1999	336	0.505223764
	125.037	03/15/1999	125.1	10/25/1999	224	0.196475908
	124.968	08/03/1998	125	07/06/1999	337	0.099797287
	124.938	11/23/1998	125	07/06/1999	225	0.193357243
	124.968	08/03/1998	125.04	03/15/1999	224	0.224543895
3-T-69-838B	123.02	08/03/1998	122.946	11/23/1998	112	-0.230781226
	122.95	11/23/1998	123.077	03/15/1999	112	0.396070482
	123.075	03/15/1999	123.047	07/06/1999	113	-0.087322626
	123.043	07/06/1999	123.05	10/25/1999	111	0.021830656
	123.04	10/25/1999	123.03	02/14/2000	112	-0.031186652
	123.02	08/03/1998	123.03	02/14/2000	560	0.031186652
	122.95	11/23/1998	123.03	02/14/2000	448	0.249493217
	123.075	03/15/1999	123.03	02/14/2000	336	-0.140339935
	123.043	07/06/1999	123.03	02/14/2000	223	-0.040542648
	123.02	08/03/1998	123.05	10/25/1999	448	0.093559956
	122.95	11/23/1998	123.05	10/25/1999	336	0.311866521
	123.075	03/15/1999	123.05	10/25/1999	224	-0.07796663
	123.02	08/03/1998	123.047	07/06/1999	337	0.084203961
	122.95	11/23/1998	123.047	07/06/1999	225	0.302510525
	123.02	08/03/1998	123.077	03/15/1999	224	0.177763917
3-T-69-839B	128.725	08/03/1998	128.676	11/23/1998	112	-0.152814595

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	128.597	11/23/1998	128.8	03/15/1999	112	0.633089038
	128.799	03/15/1999	128.728	07/06/1999	113	-0.22142523
	128.724	07/06/1999	128.73	10/25/1999	111	0.018711991
	128.73	10/25/1999	128.72	02/14/2000	112	-0.031186652
	128.725	08/03/1998	128.72	02/14/2000	560	-0.015593326
	128.597	11/23/1998	128.72	02/14/2000	448	0.383595821
	128.799	03/15/1999	128.72	02/14/2000	336	-0.246374552
	128.724	07/06/1999	128.72	02/14/2000	223	-0.012474661
	128.725	08/03/1998	128.73	10/25/1999	448	0.015593326
	128.597	11/23/1998	128.73	10/25/1999	336	0.414782473
	128.799	03/15/1999	128.73	10/25/1999	224	-0.2151879
	128.725	08/03/1998	128.728	07/06/1999	337	0.009355996
	128.597	11/23/1998	128.728	07/06/1999	225	0.408545143
	128.725	08/03/1998	128.8	03/15/1999	224	0.233899891
3-T-69-834C	135.335	11/02/1998	135.342	02/22/1999	112	0.021830656
	135.34	02/22/1999	135.348	06/14/1999	112	0.024949322
	135.348	06/14/1999	135.32	01/24/2000	224	-0.087322626
	135.335	11/02/1998	135.32	01/24/2000	448	-0.046779978
	135.34	02/22/1999	135.32	01/24/2000	336	-0.062373304
	135.335	11/02/1998	135.348	06/14/1999	224	0.040542648
3-T-69-835C	121.328	11/02/1998	121.25	02/22/1999	112	-0.243255886
	121.246	02/22/1999	121.25	06/14/1999	112	0.012474661
	121.248	06/14/1999	121.3	01/24/2000	224	0.162170591
	121.328	11/02/1998	121.3	01/24/2000	448	-0.087322626
	121.246	02/22/1999	121.3	01/24/2000	336	0.168407921
	121.328	11/02/1998	121.25	06/14/1999	224	-0.243255886
3-T-69-836C	124.902	11/02/1998	124.92	02/22/1999	112	0.056135974
	124.919	02/22/1999	124.918	06/14/1999	112	-0.003118665
	124.909	06/14/1999	124.97	01/24/2000	224	0.190238578
	124.902	11/02/1998	124.97	01/24/2000	448	0.212069234
	124.919	02/22/1999	124.97	01/24/2000	336	0.159051926
	124.902	11/02/1998	124.918	06/14/1999	224	0.049898643
3-T-69-837C	124.907	11/02/1998	124.916	02/22/1999	112	0.028067987
	124.907	02/22/1999	124.916	06/14/1999	112	0.028067987
	124.913	06/14/1999	124.94	01/24/2000	224	0.084203961
	124.907	11/02/1998	124.94	01/24/2000	448	0.102915952
	124.907	02/22/1999	124.94	01/24/2000	336	0.102915952
	124.907	11/02/1998	124.916	06/14/1999	224	0.028067987
3-T-69-838C	123.007	11/02/1998	123.015	02/22/1999	112	0.024949322
	123.015	02/22/1999	123.06	06/15/1999	113	0.140339935
	123.05	06/14/1999	123.04	01/24/2000	224	-0.031186652
	123.007	11/02/1998	123.04	01/24/2000	448	0.102915952
	123.015	02/22/1999	123.04	01/24/2000	336	0.07796663
	123.007	11/02/1998	123.06	06/15/1999	225	0.165289256

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
3-T-69-839C	128.719	11/02/1998	128.737	02/22/1999	112	0.056135974
	128.738	02/22/1999	128.75	06/15/1999	113	0.037423983
	128.75	06/14/1999	128.767	01/25/2000	225	0.053017309
	128.719	11/02/1998	128.767	01/25/2000	449	0.14969593
	128.738	02/22/1999	128.767	01/25/2000	337	0.090441291
	128.719	11/02/1998	128.75	06/15/1999	225	0.096678622
3-T-69-834D	135.316	08/04/1998	135.3	09/03/1998	30	-0.049898643
	135.29	09/03/1998	135.568	10/11/1998	38	0.866988929
	135.29	10/11/1998	135.29	11/24/1998	44	0
	135.288	11/24/1998	135.299	03/24/1999	120	0.034305317
	135.29	03/24/1999	135.316	07/06/1999	104	0.081085295
	135.316	07/06/1999	135.26	10/25/1999	111	-0.174645252
	135.26	10/25/1999	135.25	02/14/2000	112	-0.031186652
	135.316	08/04/1998	135.25	02/14/2000	559	-0.205831904
	135.29	09/03/1998	135.25	02/14/2000	529	-0.124746608
	135.29	10/11/1998	135.25	02/14/2000	491	-0.124746608
	135.288	11/24/1998	135.25	02/14/2000	447	-0.118509278
	135.29	03/24/1999	135.25	02/14/2000	327	-0.124746608
	135.316	07/06/1999	135.25	02/14/2000	223	-0.205831904
	135.316	08/04/1998	135.26	10/25/1999	447	-0.174645252
	135.29	09/03/1998	135.26	10/25/1999	417	-0.093559956
	135.29	10/11/1998	135.26	10/25/1999	379	-0.093559956
	135.288	11/24/1998	135.26	10/25/1999	335	-0.087322626
	135.29	03/24/1999	135.26	10/25/1999	215	-0.093559956
	135.316	08/04/1998	135.316	07/06/1999	336	0
	135.29	09/03/1998	135.316	07/06/1999	306	0.081085295
	135.29	10/11/1998	135.316	07/06/1999	268	0.081085295
	135.288	11/24/1998	135.316	07/06/1999	224	0.087322626
	135.316	08/04/1998	135.299	03/24/1999	232	-0.053017309
	135.29	09/03/1998	135.299	03/24/1999	202	0.028067987
	135.29	10/11/1998	135.299	03/24/1999	164	0.028067987
	135.316	08/04/1998	135.29	11/24/1998	112	-0.081085295
	135.29	09/03/1998	135.29	11/24/1998	82	0
	135.316	08/04/1998	135.568	10/11/1998	68	0.785903633
3-T-69-835D	121.31	08/04/1998	121.299	11/24/1998	112	-0.034305317
	121.299	11/24/1998	121.34	03/24/1999	120	0.127865274
	121.34	03/24/1999	121.304	07/06/1999	104	-0.112271948
	121.704	07/06/1999	121.34	10/25/1999	111	-1.135194137
	121.333	10/25/1999	121.325	02/14/2000	112	-0.024949322
	121.31	08/04/1998	121.325	02/14/2000	559	0.046779978
	121.299	11/24/1998	121.325	02/14/2000	447	0.081085295
	121.34	03/24/1999	121.325	02/14/2000	327	-0.046779978
	121.704	07/06/1999	121.325	02/14/2000	223	-1.181974115
	121.31	08/04/1998	121.34	10/25/1999	447	0.093559956

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	121.299	11/24/1998	121.34	10/25/1999	335	0.127865274
	121.34	03/24/1999	121.34	10/25/1999	215	0
	121.31	08/04/1998	121.304	07/06/1999	336	-0.018711991
	121.299	11/24/1998	121.304	07/06/1999	224	0.015593326
	121.31	08/04/1998	121.34	03/24/1999	232	0.093559956
3-T-69-836D	124.865	08/04/1998	124.699	11/24/1998	112	-0.517698425
	124.838	11/24/1998	124.97	03/24/1999	120	0.411663808
	124.96	03/24/1999	124.941	07/06/1999	104	-0.059254639
	124.941	07/06/1999	124.973	10/25/1999	111	0.099797287
	124.97	10/25/1999	124.985	02/14/2000	112	0.046779978
	124.865	08/04/1998	124.985	02/14/2000	559	0.374239825
	124.838	11/24/1998	124.985	02/14/2000	447	0.458443786
	124.96	03/24/1999	124.985	02/14/2000	327	0.07796663
	124.941	07/06/1999	124.985	02/14/2000	223	0.137221269
	124.865	08/04/1998	124.973	10/25/1999	447	0.336815843
	124.838	11/24/1998	124.973	10/25/1999	335	0.421019804
	124.96	03/24/1999	124.973	10/25/1999	215	0.040542648
	124.865	08/04/1998	124.941	07/06/1999	336	0.237018556
	124.838	11/24/1998	124.941	07/06/1999	224	0.321222517
	124.865	08/04/1998	124.97	03/24/1999	232	0.327459847
3-T-69-837D	124.941	08/04/1998	124.98	11/24/1998	112	0.121627943
	124.92	11/24/1998	124.98	03/24/1999	120	0.187119913
	124.98	03/24/1999	124.975	07/06/1999	104	-0.015593326
	124.975	07/06/1999	124.99	10/25/1999	111	0.046779978
	124.983	10/25/1999	124.969	02/14/2000	112	-0.043661313
	124.941	08/04/1998	124.969	02/14/2000	559	0.087322626
	124.92	11/24/1998	124.969	02/14/2000	447	0.152814595
	124.98	03/24/1999	124.969	02/14/2000	327	-0.034305317
	124.975	07/06/1999	124.969	02/14/2000	223	-0.018711991
	124.941	08/04/1998	124.99	10/25/1999	447	0.152814595
	124.92	11/24/1998	124.99	10/25/1999	335	0.218306565
	124.98	03/24/1999	124.99	10/25/1999	215	0.031186652
	124.941	08/04/1998	124.975	07/06/1999	336	0.106034617
	124.92	11/24/1998	124.975	07/06/1999	224	0.171526587
	124.941	08/04/1998	124.98	03/24/1999	232	0.121627943
3-T-69-838D	123.221	08/04/1998	123	11/24/1998	112	-0.689225012
	122.98	11/24/1998	123.199	03/24/1999	120	0.682987681
	123.195	03/24/1999	123.265	07/06/1999	104	0.218306565
	123.265	07/06/1999	123.21	10/25/1999	111	-0.171526587
	123.21	10/25/1999	123.192	02/14/2000	112	-0.056135974
	123.221	08/04/1998	123.192	02/14/2000	559	-0.090441291
	122.98	11/24/1998	123.192	02/14/2000	447	0.661157025
	123.195	03/24/1999	123.192	02/14/2000	327	-0.009355996
	123.265	07/06/1999	123.192	02/14/2000	223	-0.22766256

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	123.221	08/04/1998	123.21	10/25/1999	447	-0.034305317
	122.98	11/24/1998	123.21	10/25/1999	335	0.717292999
	123.195	03/24/1999	123.21	10/25/1999	215	0.046779978
	123.221	08/04/1998	123.265	07/06/1999	336	0.137221269
	122.98	11/24/1998	123.265	07/06/1999	224	0.888819585
	123.221	08/04/1998	123.199	03/24/1999	232	-0.068610635
3-T-69-839D	128.65	08/04/1998	128.62	11/24/1998	112	-0.093559956
	128.58	11/24/1998	128.7	03/24/1999	120	0.374239825
	128.7	03/24/1999	128.672	07/06/1999	104	-0.087322626
	128.672	07/06/1999	128.687	10/25/1999	111	0.046779978
	128.7	10/25/1999	128.686	02/14/2000	112	-0.043661313
	128.65	08/04/1998	128.686	02/14/2000	559	0.112271948
	128.58	11/24/1998	128.686	02/14/2000	447	0.330578512
	128.7	03/24/1999	128.686	02/14/2000	327	-0.043661313
	128.672	07/06/1999	128.686	02/14/2000	223	0.043661313
	128.65	08/04/1998	128.687	10/25/1999	447	0.115390613
	128.58	11/24/1998	128.687	10/25/1999	335	0.333697178
	128.7	03/24/1999	128.687	10/25/1999	215	-0.040542648
	128.65	08/04/1998	128.672	07/06/1999	336	0.068610635
	128.58	11/24/1998	128.672	07/06/1999	224	0.286917199
	128.65	08/04/1998	128.7	03/24/1999	232	0.155933261
2-T-69-834A	132.843	06/23/1999	132.872	10/14/1999	113	0.090441291
	132.846	10/14/1999	132.87	01/31/2000	109	0.074847965
	132.83	01/31/2000	132.765	05/22/2000	112	-0.202713239
	132.802	05/22/2000	132.85	09/11/2000	112	0.14969593
	132.83	09/11/2000	132.817	01/02/2001	113	-0.040542648
	132.831	01/02/2001	132.83	04/24/2001	112	-0.003118665
	132.843	06/23/1999	132.83	04/24/2001	671	-0.040542648
	132.846	10/14/1999	132.83	04/24/2001	558	-0.049898643
	132.83	01/31/2000	132.83	04/24/2001	449	0
	132.802	05/22/2000	132.83	04/24/2001	337	0.087322626
	132.83	09/11/2000	132.83	04/24/2001	225	0
	132.843	06/23/1999	132.817	01/02/2001	559	-0.081085295
	132.846	10/14/1999	132.817	01/02/2001	446	-0.090441291
	132.83	01/31/2000	132.817	01/02/2001	337	-0.040542648
	132.802	05/22/2000	132.817	01/02/2001	225	0.046779978
	132.843	06/23/1999	132.85	09/11/2000	446	0.021830656
	132.846	10/14/1999	132.85	09/11/2000	333	0.012474661
	132.83	01/31/2000	132.85	09/11/2000	224	0.062373304
	132.843	06/23/1999	132.765	05/22/2000	334	-0.243255886
	132.846	10/14/1999	132.765	05/22/2000	221	-0.252611882
	132.843	06/23/1999	132.87	01/31/2000	222	0.084203961
2-T-69-835A	121.391	03/01/1999	121.376	06/23/1999	114	-0.046779978
	121.375	06/23/1999	121.25	10/14/1999	113	-0.389833151

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	121.237	10/14/1999	121.44	01/31/2000	109	0.633089038
	121.43	01/31/2000	121.366	05/22/2000	112	-0.199594574
	121.366	05/22/2000	121.39	09/11/2000	112	0.074847965
	121.36	09/11/2000	121.392	01/02/2001	113	0.099797287
	121.386	01/02/2001	121.37	04/24/2001	112	-0.049898643
	121.391	03/01/1999	121.25	10/14/1999	227	-0.439731795
	121.391	03/01/1999	121.44	01/31/2000	336	0.152814595
	121.375	06/23/1999	121.44	01/31/2000	222	0.202713239
	121.391	03/01/1999	121.366	05/22/2000	448	-0.07796663
	121.375	06/23/1999	121.366	05/22/2000	334	-0.028067987
	121.237	10/14/1999	121.366	05/22/2000	221	0.402307812
	121.391	03/01/1999	121.39	09/11/2000	560	-0.003118665
	121.375	06/23/1999	121.39	09/11/2000	446	0.046779978
	121.237	10/14/1999	121.39	09/11/2000	333	0.477155777
	121.43	01/31/2000	121.39	09/11/2000	224	-0.124746608
	121.391	03/01/1999	121.392	01/02/2001	673	0.003118665
	121.375	06/23/1999	121.392	01/02/2001	559	0.053017309
	121.237	10/14/1999	121.392	01/02/2001	446	0.483393108
	121.43	01/31/2000	121.392	01/02/2001	337	-0.118509278
	121.366	05/22/2000	121.392	01/02/2001	225	0.081085295
	121.391	03/01/1999	121.37	04/24/2001	785	-0.065491969
	121.375	06/23/1999	121.37	04/24/2001	671	-0.015593326
	121.237	10/14/1999	121.37	04/24/2001	558	0.414782473
	121.43	01/31/2000	121.37	04/24/2001	449	-0.187119913
	121.366	05/22/2000	121.37	04/24/2001	337	0.012474661
	121.36	09/11/2000	121.37	04/24/2001	225	0.031186652
2-T-69-836A	125.072	03/01/1999	125.101	06/23/1999	114	0.090441291
	125.06	06/23/1999	125.059	10/14/1999	113	-0.003118665
	125.056	10/14/1999	125.09	01/31/2000	109	0.106034617
	125.06	01/31/2000	125.042	05/22/2000	112	-0.056135974
	125	05/22/2000	125.067	09/11/2000	112	0.208950569
	125.056	09/11/2000	125.11	01/02/2001	113	0.168407921
	125.095	01/02/2001	125	04/24/2001	112	-0.296273195
	125.072	03/01/1999	125.059	10/14/1999	227	-0.040542648
	125.072	03/01/1999	125.09	01/31/2000	336	0.056135974
	125.06	06/23/1999	125.09	01/31/2000	222	0.093559956
	125.072	03/01/1999	125.042	05/22/2000	448	-0.093559956
	125.06	06/23/1999	125.042	05/22/2000	334	-0.056135974
	125.056	10/14/1999	125.042	05/22/2000	221	-0.043661313
	125.072	03/01/1999	125.067	09/11/2000	560	-0.015593326
	125.06	06/23/1999	125.067	09/11/2000	446	0.021830656
	125.056	10/14/1999	125.067	09/11/2000	333	0.034305317
	125.06	01/31/2000	125.067	09/11/2000	224	0.021830656
	125.072	03/01/1999	125.11	01/02/2001	673	0.118509278

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	125.06	06/23/1999	125.11	01/02/2001	559	0.155933261
	125.056	10/14/1999	125.11	01/02/2001	446	0.168407921
	125.06	01/31/2000	125.11	01/02/2001	337	0.155933261
	125	05/22/2000	125.11	01/02/2001	225	0.343053173
	125.072	03/01/1999	125	04/24/2001	785	-0.224543895
	125.06	06/23/1999	125	04/24/2001	671	-0.187119913
	125.056	10/14/1999	125	04/24/2001	558	-0.174645252
	125.06	01/31/2000	125	04/24/2001	449	-0.187119913
	125	05/22/2000	125	04/24/2001	337	0
	125.056	09/11/2000	125	04/24/2001	225	-0.174645252
2-T-69-837A	125.049	03/01/1999	125.083	06/23/1999	114	0.106034617
	125.076	06/23/1999	124.992	10/14/1999	113	-0.261967878
	124.988	10/14/1999	125.08	01/31/2000	109	0.286917199
	125.08	01/31/2000	125.042	05/22/2000	112	-0.118509278
	125.032	05/22/2000	125.08	09/11/2000	112	0.14969593
	125.07	09/11/2000	125.064	01/02/2001	113	-0.018711991
	125.059	01/02/2001	125.08	04/24/2001	112	0.065491969
	125.049	03/01/1999	124.992	10/14/1999	227	-0.177763917
	125.049	03/01/1999	125.08	01/31/2000	336	0.096678622
	125.076	06/23/1999	125.08	01/31/2000	222	0.012474661
	125.049	03/01/1999	125.042	05/22/2000	448	-0.021830656
	125.076	06/23/1999	125.042	05/22/2000	334	-0.106034617
	124.988	10/14/1999	125.042	05/22/2000	221	0.168407921
	125.049	03/01/1999	125.08	09/11/2000	560	0.096678622
	125.076	06/23/1999	125.08	09/11/2000	446	0.012474661
	124.988	10/14/1999	125.08	09/11/2000	333	0.286917199
	125.08	01/31/2000	125.08	09/11/2000	224	0
	125.049	03/01/1999	125.064	01/02/2001	673	0.046779978
	125.076	06/23/1999	125.064	01/02/2001	559	-0.037423983
	124.988	10/14/1999	125.064	01/02/2001	446	0.237018556
	125.08	01/31/2000	125.064	01/02/2001	337	-0.049898643
	125.032	05/22/2000	125.064	01/02/2001	225	0.099797287
	125.049	03/01/1999	125.08	04/24/2001	785	0.096678622
	125.076	06/23/1999	125.08	04/24/2001	671	0.012474661
	124.988	10/14/1999	125.08	04/24/2001	558	0.286917199
	125.08	01/31/2000	125.08	04/24/2001	449	0
	125.032	05/22/2000	125.08	04/24/2001	337	0.14969593
	125.07	09/11/2000	125.08	04/24/2001	225	0.031186652
2-T-69-838A	123.086	03/01/1999	123.09	06/23/1999	114	0.012474661
	123.088	06/23/1999	123.08	10/14/1999	113	-0.024949322
	123.077	10/14/1999	123.16	01/31/2000	109	0.258849213
	123.15	01/31/2000	123.072	05/22/2000	112	-0.243255886
	123.072	05/22/2000	123.087	09/11/2000	112	0.046779978
	123.087	09/11/2000	123.122	01/02/2001	113	0.109153282

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	123.118	01/02/2001	123.14	04/24/2001	112	0.068610635
	123.086	03/01/1999	123.08	10/14/1999	227	-0.018711991
	123.086	03/01/1999	123.16	01/31/2000	336	0.230781226
	123.088	06/23/1999	123.16	01/31/2000	222	0.224543895
	123.086	03/01/1999	123.072	05/22/2000	448	-0.043661313
	123.088	06/23/1999	123.072	05/22/2000	334	-0.049898643
	123.077	10/14/1999	123.072	05/22/2000	221	-0.015593326
	123.086	03/01/1999	123.087	09/11/2000	560	0.003118665
	123.088	06/23/1999	123.087	09/11/2000	446	-0.003118665
	123.077	10/14/1999	123.087	09/11/2000	333	0.031186652
	123.15	01/31/2000	123.087	09/11/2000	224	-0.196475908
	123.086	03/01/1999	123.122	01/02/2001	673	0.112271948
	123.088	06/23/1999	123.122	01/02/2001	559	0.106034617
	123.077	10/14/1999	123.122	01/02/2001	446	0.140339935
	123.15	01/31/2000	123.122	01/02/2001	337	-0.087322626
	123.072	05/22/2000	123.122	01/02/2001	225	0.155933261
	123.086	03/01/1999	123.14	04/24/2001	785	0.168407921
	123.088	06/23/1999	123.14	04/24/2001	671	0.162170591
	123.077	10/14/1999	123.14	04/24/2001	558	0.196475908
	123.15	01/31/2000	123.14	04/24/2001	449	-0.031186652
	123.072	05/22/2000	123.14	04/24/2001	337	0.212069234
	123.087	09/11/2000	123.14	04/24/2001	225	0.165289256
2-T-69-839A	128.691	03/01/1999	128.65	06/23/1999	114	-0.127865274
	128.646	06/23/1999	128.699	10/14/1999	113	0.165289256
	128.707	10/14/1999	128.7	01/31/2000	109	-0.021830656
	128.7	01/31/2000	128.635	05/22/2000	112	-0.202713239
	128.63	05/22/2000	128.639	09/11/2000	112	0.028067987
	128.637	09/11/2000	128.719	01/02/2001	113	0.255730547
	128.715	01/02/2001	128.673	04/24/2001	112	-0.130983939
	128.691	03/01/1999	128.699	10/14/1999	227	0.024949322
	128.691	03/01/1999	128.7	01/31/2000	336	0.028067987
	128.646	06/23/1999	128.7	01/31/2000	222	0.168407921
	128.691	03/01/1999	128.635	05/22/2000	448	-0.174645252
	128.646	06/23/1999	128.635	05/22/2000	334	-0.034305317
	128.707	10/14/1999	128.635	05/22/2000	221	-0.224543895
	128.691	03/01/1999	128.639	09/11/2000	560	-0.162170591
	128.646	06/23/1999	128.639	09/11/2000	446	-0.021830656
	128.707	10/14/1999	128.639	09/11/2000	333	-0.212069234
	128.7	01/31/2000	128.639	09/11/2000	224	-0.190238578
	128.691	03/01/1999	128.719	01/02/2001	673	0.087322626
	128.646	06/23/1999	128.719	01/02/2001	559	0.22766256
	128.707	10/14/1999	128.719	01/02/2001	446	0.037423983
	128.7	01/31/2000	128.719	01/02/2001	337	0.059254639
	128.63	05/22/2000	128.719	01/02/2001	225	0.277561204

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	128.691	03/01/1999	128.673	04/24/2001	785	-0.056135974
	128.646	06/23/1999	128.673	04/24/2001	671	0.084203961
	128.707	10/14/1999	128.673	04/24/2001	558	-0.106034617
	128.7	01/31/2000	128.673	04/24/2001	449	-0.084203961
	128.63	05/22/2000	128.673	04/24/2001	337	0.134102604
	128.637	09/11/2000	128.673	04/24/2001	225	0.112271948
2-T-69-834B	135.39	07/27/1998	135.38	11/16/1998	112	-0.031186652
	135.37	11/16/1998	135.4	03/08/1999	112	0.093559956
	135.393	03/08/1999	135.4	04/24/1999	47	0.021830656
	132.8	04/24/1999	132.773	06/28/1999	65	-0.084203961
	132.768	06/28/1999	133	10/18/1999	112	0.723530329
	132.722	10/18/1999	132.57	02/07/2000	112	-0.474037112
	132.55	02/07/2000	132.768	06/28/1999	-224	0.679869016
	132.81	05/31/2000	132.722	10/18/1999	-226	-0.274442539
	132.774	09/18/2000	132.803	01/08/2001	112	0.090441291
	132.794	01/08/2001	132.793	04/30/2001	112	-0.003118665
	135.39	07/27/1998	135.4	03/08/1999	224	0.031186652
	132.768	06/28/1999	132.57	02/07/2000	224	-0.617495712
	132.768	06/28/1999	132.768	06/28/1999	0	0
	132.722	10/18/1999	132.768	06/28/1999	-112	0.1434586
	132.768	06/28/1999	132.722	10/18/1999	112	-0.1434586
	132.722	10/18/1999	132.722	10/18/1999	0	0
	132.55	02/07/2000	132.722	10/18/1999	-112	0.536410416
	132.768	06/28/1999	132.803	01/08/2001	560	0.109153282
	132.722	10/18/1999	132.803	01/08/2001	448	0.252611882
	132.55	02/07/2000	132.803	01/08/2001	336	0.789022298
	132.81	05/31/2000	132.803	01/08/2001	222	-0.021830656
	132.768	06/28/1999	132.793	04/30/2001	672	0.07796663
	132.722	10/18/1999	132.793	04/30/2001	560	0.22142523
	132.55	02/07/2000	132.793	04/30/2001	448	0.757835646
	132.81	05/31/2000	132.793	04/30/2001	334	-0.053017309
	132.774	09/18/2000	132.793	04/30/2001	224	0.059254639
2-T-69-835B	121.3	07/27/1998	121.29	11/16/1998	112	-0.031186652
	121.26	11/16/1998	121.328	03/08/1999	112	0.212069234
	121.318	03/08/1999	121.274	06/28/1999	112	-0.137221269
	121.261	06/28/1999	121.338	10/18/1999	112	0.240137221
	121.31	10/18/1999	121.36	02/07/2000	112	0.155933261
	121.328	02/07/2000	121.327	05/31/2000	114	-0.003118665
	121.319	05/31/2000	121.332	09/18/2000	110	0.040542648
	121.322	09/18/2000	121.377	01/08/2001	112	0.171526587
	121.377	01/08/2001	121.325	04/30/2001	112	-0.162170591
	121.3	07/27/1998	121.328	03/08/1999	224	0.087322626
	121.3	07/27/1998	121.274	06/28/1999	336	-0.081085295
	121.26	11/16/1998	121.274	06/28/1999	224	0.043661313

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	121.3	07/27/1998	121.338	10/18/1999	448	0.118509278
	121.26	11/16/1998	121.338	10/18/1999	336	0.243255886
	121.318	03/08/1999	121.338	10/18/1999	224	0.062373304
	121.3	07/27/1998	121.36	02/07/2000	560	0.187119913
	121.26	11/16/1998	121.36	02/07/2000	448	0.311866521
	121.318	03/08/1999	121.36	02/07/2000	336	0.130983939
	121.261	06/28/1999	121.36	02/07/2000	224	0.308747856
	121.3	07/27/1998	121.327	05/31/2000	674	0.084203961
	121.26	11/16/1998	121.327	05/31/2000	562	0.208950569
	121.318	03/08/1999	121.327	05/31/2000	450	0.028067987
	121.261	06/28/1999	121.327	05/31/2000	338	0.205831904
	121.31	10/18/1999	121.327	05/31/2000	226	0.053017309
	121.3	07/27/1998	121.332	09/18/2000	784	0.099797287
	121.26	11/16/1998	121.332	09/18/2000	672	0.224543895
	121.318	03/08/1999	121.332	09/18/2000	560	0.043661313
	121.261	06/28/1999	121.332	09/18/2000	448	0.22142523
	121.31	10/18/1999	121.332	09/18/2000	336	0.068610635
	121.328	02/07/2000	121.332	09/18/2000	224	0.012474661
	121.3	07/27/1998	121.377	01/08/2001	896	0.240137221
	121.26	11/16/1998	121.377	01/08/2001	784	0.36488383
	121.318	03/08/1999	121.377	01/08/2001	672	0.184001247
	121.261	06/28/1999	121.377	01/08/2001	560	0.361765165
	121.31	10/18/1999	121.377	01/08/2001	448	0.208950569
	121.328	02/07/2000	121.377	01/08/2001	336	0.152814595
	121.319	05/31/2000	121.377	01/08/2001	222	0.180882582
	121.3	07/27/1998	121.325	04/30/2001	1008	0.07796663
	121.26	11/16/1998	121.325	04/30/2001	896	0.202713239
	121.318	03/08/1999	121.325	04/30/2001	784	0.021830656
	121.261	06/28/1999	121.325	04/30/2001	672	0.199594574
	121.31	10/18/1999	121.325	04/30/2001	560	0.046779978
	121.328	02/07/2000	121.325	04/30/2001	448	-0.009355996
	121.319	05/31/2000	121.325	04/30/2001	334	0.018711991
	121.322	09/18/2000	121.325	04/30/2001	224	0.009355996
2-T-69-836B	124.963	07/27/1998	124.96	11/16/1998	112	-0.009355996
	124.95	11/16/1998	124.949	03/08/1999	112	-0.003118665
	124.929	03/08/1999	124.946	06/28/1999	112	0.053017309
	124.937	06/28/1999	124.962	10/18/1999	112	0.07796663
	124.95	10/18/1999	124.939	02/07/2000	112	-0.034305317
	124.923	02/07/2000	124.962	05/31/2000	114	0.121627943
	124.96	05/31/2000	124.934	09/18/2000	110	-0.081085295
	124.929	09/18/2000	124.964	01/08/2001	112	0.109153282
	124.957	01/08/2001	124.96	04/30/2001	112	0.009355996
	124.963	07/27/1998	124.949	03/08/1999	224	-0.043661313
	124.963	07/27/1998	124.946	06/28/1999	336	-0.053017309

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	124.95	11/16/1998	124.946	06/28/1999	224	-0.012474661
	124.963	07/27/1998	124.962	10/18/1999	448	-0.003118665
	124.95	11/16/1998	124.962	10/18/1999	336	0.037423983
	124.929	03/08/1999	124.962	10/18/1999	224	0.102915952
	124.963	07/27/1998	124.939	02/07/2000	560	-0.074847965
	124.95	11/16/1998	124.939	02/07/2000	448	-0.034305317
	124.929	03/08/1999	124.939	02/07/2000	336	0.031186652
	124.937	06/28/1999	124.939	02/07/2000	224	0.00623733
	124.963	07/27/1998	124.962	05/31/2000	674	-0.003118665
	124.95	11/16/1998	124.962	05/31/2000	562	0.037423983
	124.929	03/08/1999	124.962	05/31/2000	450	0.102915952
	124.937	06/28/1999	124.962	05/31/2000	338	0.07796663
	124.95	10/18/1999	124.962	05/31/2000	226	0.037423983
	124.963	07/27/1998	124.934	09/18/2000	784	-0.090441291
	124.95	11/16/1998	124.934	09/18/2000	672	-0.049898643
	124.929	03/08/1999	124.934	09/18/2000	560	0.015593326
	124.937	06/28/1999	124.934	09/18/2000	448	-0.009355996
	124.95	10/18/1999	124.934	09/18/2000	336	-0.049898643
	124.923	02/07/2000	124.934	09/18/2000	224	0.034305317
	124.963	07/27/1998	124.964	01/08/2001	896	0.003118665
	124.95	11/16/1998	124.964	01/08/2001	784	0.043661313
	124.929	03/08/1999	124.964	01/08/2001	672	0.109153282
	124.937	06/28/1999	124.964	01/08/2001	560	0.084203961
	124.95	10/18/1999	124.964	01/08/2001	448	0.043661313
	124.923	02/07/2000	124.964	01/08/2001	336	0.127865274
	124.96	05/31/2000	124.964	01/08/2001	222	0.012474661
	124.963	07/27/1998	124.96	04/30/2001	1008	-0.009355996
	124.95	11/16/1998	124.96	04/30/2001	896	0.031186652
	124.929	03/08/1999	124.96	04/30/2001	784	0.096678622
	124.937	06/28/1999	124.96	04/30/2001	672	0.0717293
	124.95	10/18/1999	124.96	04/30/2001	560	0.031186652
	124.923	02/07/2000	124.96	04/30/2001	448	0.115390613
	124.96	05/31/2000	124.96	04/30/2001	334	0
	124.929	09/18/2000	124.96	04/30/2001	224	0.096678622
2-T-69-837B	125.122	07/27/1998	125.13	11/16/1998	112	0.024949322
	125.14	11/16/1998	125.107	03/08/1999	112	-0.102915952
	125.119	03/08/1999	125.093	06/28/1999	112	-0.081085295
	125.113	06/28/1999	125.132	10/18/1999	112	0.059254639
	125.135	10/18/1999	125.136	02/07/2000	112	0.003118665
	125.13	02/07/2000	125.207	05/31/2000	114	0.240137221
	125.2	05/31/2000	125.09	09/18/2000	110	-0.343053173
	125.09	09/18/2000	125.104	01/08/2001	112	0.043661313
	125.104	01/08/2001	125.13	04/30/2001	112	0.081085295
	125.122	07/27/1998	125.107	03/08/1999	224	-0.046779978

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Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	125.122	07/27/1998	125.093	06/28/1999	336	-0.090441291
	125.14	11/16/1998	125.093	06/28/1999	224	-0.146577265
	125.122	07/27/1998	125.132	10/18/1999	448	0.031186652
	125.14	11/16/1998	125.132	10/18/1999	336	-0.024949322
	125.119	03/08/1999	125.132	10/18/1999	224	0.040542648
	125.122	07/27/1998	125.136	02/07/2000	560	0.043661313
	125.14	11/16/1998	125.136	02/07/2000	448	-0.012474661
	125.119	03/08/1999	125.136	02/07/2000	336	0.053017309
	125.113	06/28/1999	125.136	02/07/2000	224	0.0717293
	125.122	07/27/1998	125.207	05/31/2000	674	0.265086543
	125.14	11/16/1998	125.207	05/31/2000	562	0.208950569
	125.119	03/08/1999	125.207	05/31/2000	450	0.274442539
	125.113	06/28/1999	125.207	05/31/2000	338	0.29315453
	125.135	10/18/1999	125.207	05/31/2000	226	0.224543895
	125.122	07/27/1998	125.09	09/18/2000	784	-0.099797287
	125.14	11/16/1998	125.09	09/18/2000	672	-0.155933261
	125.119	03/08/1999	125.09	09/18/2000	560	-0.090441291
	125.113	06/28/1999	125.09	09/18/2000	448	-0.0717293
	125.135	10/18/1999	125.09	09/18/2000	336	-0.140339935
	125.13	02/07/2000	125.09	09/18/2000	224	-0.124746608
	125.122	07/27/1998	125.104	01/08/2001	896	-0.056135974
	125.14	11/16/1998	125.104	01/08/2001	784	-0.112271948
	125.119	03/08/1999	125.104	01/08/2001	672	-0.046779978
	125.113	06/28/1999	125.104	01/08/2001	560	-0.028067987
	125.135	10/18/1999	125.104	01/08/2001	448	-0.096678622
	125.13	02/07/2000	125.104	01/08/2001	336	-0.081085295
	125.2	05/31/2000	125.104	01/08/2001	222	-0.29939186
	125.122	07/27/1998	125.13	04/30/2001	1008	0.024949322
	125.14	11/16/1998	125.13	04/30/2001	896	-0.031186652
	125.119	03/08/1999	125.13	04/30/2001	784	0.034305317
	125.113	06/28/1999	125.13	04/30/2001	672	0.053017309
	125.135	10/18/1999	125.13	04/30/2001	560	-0.015593326
	125.13	02/07/2000	125.13	04/30/2001	448	0
	125.2	05/31/2000	125.13	04/30/2001	334	-0.218306565
	125.09	09/18/2000	125.13	04/30/2001	224	0.124746608
2-T-69-838B	123.082	07/27/1998	123.13	11/16/1998	112	0.14969593
	123.11	11/16/1998	123.136	03/08/1999	112	0.081085295
	123.111	03/08/1999	123.097	06/28/1999	112	-0.043661313
	123.082	06/28/1999	123.138	10/18/1999	112	0.174645252
	123.11	10/18/1999	123.146	02/07/2000	112	0.112271948
	123.121	02/07/2000	123.128	05/31/2000	114	0.021830656
	123.122	05/31/2000	123.12	09/18/2000	110	-0.00623733
	123.1	09/18/2000	123.161	01/08/2001	112	0.190238578
	123.148	01/08/2001	123.11	04/30/2001	112	-0.118509278

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	123.082	07/27/1998	123.136	03/08/1999	224	0.168407921
	123.082	07/27/1998	123.097	06/28/1999	336	0.046779978
	123.11	11/16/1998	123.097	06/28/1999	224	-0.040542648
	123.082	07/27/1998	123.138	10/18/1999	448	0.174645252
	123.11	11/16/1998	123.138	10/18/1999	336	0.087322626
	123.111	03/08/1999	123.138	10/18/1999	224	0.084203961
	123.082	07/27/1998	123.146	02/07/2000	560	0.199594574
	123.11	11/16/1998	123.146	02/07/2000	448	0.112271948
	123.111	03/08/1999	123.146	02/07/2000	336	0.109153282
	123.082	06/28/1999	123.146	02/07/2000	224	0.199594574
	123.082	07/27/1998	123.128	05/31/2000	674	0.1434586
	123.11	11/16/1998	123.128	05/31/2000	562	0.056135974
	123.111	03/08/1999	123.128	05/31/2000	450	0.053017309
	123.082	06/28/1999	123.128	05/31/2000	338	0.1434586
	123.11	10/18/1999	123.128	05/31/2000	226	0.056135974
	123.082	07/27/1998	123.12	09/18/2000	784	0.118509278
	123.11	11/16/1998	123.12	09/18/2000	672	0.031186652
	123.111	03/08/1999	123.12	09/18/2000	560	0.028067987
	123.082	06/28/1999	123.12	09/18/2000	448	0.118509278
	123.11	10/18/1999	123.12	09/18/2000	336	0.031186652
	123.121	02/07/2000	123.12	09/18/2000	224	-0.003118665
	123.082	07/27/1998	123.161	01/08/2001	896	0.246374552
	123.11	11/16/1998	123.161	01/08/2001	784	0.159051926
	123.111	03/08/1999	123.161	01/08/2001	672	0.155933261
	123.082	06/28/1999	123.161	01/08/2001	560	0.246374552
	123.11	10/18/1999	123.161	01/08/2001	448	0.159051926
	123.121	02/07/2000	123.161	01/08/2001	336	0.124746608
	123.122	05/31/2000	123.161	01/08/2001	222	0.121627943
	123.082	07/27/1998	123.11	04/30/2001	1008	0.087322626
	123.11	11/16/1998	123.11	04/30/2001	896	0
	123.111	03/08/1999	123.11	04/30/2001	784	-0.003118665
	123.082	06/28/1999	123.11	04/30/2001	672	0.087322626
	123.11	10/18/1999	123.11	04/30/2001	560	0
	123.121	02/07/2000	123.11	04/30/2001	448	-0.034305317
	123.122	05/31/2000	123.11	04/30/2001	334	-0.037423983
	123.1	09/18/2000	123.11	04/30/2001	224	0.031186652
2-T-69-839B	128.793	07/27/1998	128.76	11/16/1998	112	-0.102915952
	128.76	11/16/1998	128.828	03/08/1999	112	0.212069234
	128.825	03/08/1999	128.742	06/28/1999	112	-0.258849213
	128.739	06/28/1999	128.8	10/18/1999	112	0.190238578
	128.78	10/18/1999	128.829	02/07/2000	112	0.152814595
	128.828	02/07/2000	128.823	05/31/2000	114	-0.015593326
	128.82	05/31/2000	128.82	09/18/2000	110	0
	128.81	09/18/2000	128.855	01/08/2001	112	0.140339935

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	128.849	01/08/2001	128.85	04/30/2001	112	0.003118665
	128.793	07/27/1998	128.828	03/08/1999	224	0.109153282
	128.793	07/27/1998	128.742	06/28/1999	336	-0.159051926
	128.76	11/16/1998	128.742	06/28/1999	224	-0.056135974
	128.793	07/27/1998	128.8	10/18/1999	448	0.021830656
	128.76	11/16/1998	128.8	10/18/1999	336	0.124746608
	128.825	03/08/1999	128.8	10/18/1999	224	-0.07796663
	128.793	07/27/1998	128.829	02/07/2000	560	0.112271948
	128.76	11/16/1998	128.829	02/07/2000	448	0.2151879
	128.825	03/08/1999	128.829	02/07/2000	336	0.012474661
	128.739	06/28/1999	128.829	02/07/2000	224	0.280679869
	128.793	07/27/1998	128.823	05/31/2000	674	0.093559956
	128.76	11/16/1998	128.823	05/31/2000	562	0.196475908
	128.825	03/08/1999	128.823	05/31/2000	450	-0.00623733
	128.739	06/28/1999	128.823	05/31/2000	338	0.261967878
	128.78	10/18/1999	128.823	05/31/2000	226	0.134102604
	128.793	07/27/1998	128.82	09/18/2000	784	0.084203961
	128.76	11/16/1998	128.82	09/18/2000	672	0.187119913
	128.825	03/08/1999	128.82	09/18/2000	560	-0.015593326
	128.739	06/28/1999	128.82	09/18/2000	448	0.252611882
	128.78	10/18/1999	128.82	09/18/2000	336	0.124746608
	128.828	02/07/2000	128.82	09/18/2000	224	-0.024949322
	128.793	07/27/1998	128.855	01/08/2001	896	0.193357243
	128.76	11/16/1998	128.855	01/08/2001	784	0.296273195
	128.825	03/08/1999	128.855	01/08/2001	672	0.093559956
	128.739	06/28/1999	128.855	01/08/2001	560	0.361765165
	128.78	10/18/1999	128.855	01/08/2001	448	0.233899891
	128.828	02/07/2000	128.855	01/08/2001	336	0.084203961
	128.82	05/31/2000	128.855	01/08/2001	222	0.109153282
	128.793	07/27/1998	128.85	04/30/2001	1008	0.177763917
	128.76	11/16/1998	128.85	04/30/2001	896	0.280679869
	128.825	03/08/1999	128.85	04/30/2001	784	0.07796663
	128.739	06/28/1999	128.85	04/30/2001	672	0.346171838
	128.78	10/18/1999	128.85	04/30/2001	560	0.218306565
	128.828	02/07/2000	128.85	04/30/2001	448	0.068610635
	128.82	05/31/2000	128.85	04/30/2001	334	0.093559956
	128.81	09/18/2000	128.85	04/30/2001	224	0.124746608
2-T-69-834C	135.325	11/09/1998	135.351	03/01/1999	112	0.081085295
	132.781	06/23/1999	132.855	10/14/1999	113	0.230781226
	132.852	10/14/1999	132.9	01/31/2000	109	0.14969593
	132.9	01/31/2000	132.799	05/22/2000	112	-0.314985186
	132.794	05/22/2000	132.81	09/11/2000	112	0.049898643
	132.804	09/11/2000	132.813	01/02/2001	113	0.028067987
	132.804	01/02/2001	132.815	04/24/2001	112	0.034305317

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	132.781	06/23/1999	132.9	01/31/2000	222	0.37112116
	132.781	06/23/1999	132.799	05/22/2000	334	0.056135974
	132.852	10/14/1999	132.799	05/22/2000	221	-0.165289256
	132.781	06/23/1999	132.81	09/11/2000	446	0.090441291
	132.852	10/14/1999	132.81	09/11/2000	333	-0.130983939
	132.9	01/31/2000	132.81	09/11/2000	224	-0.280679869
	132.781	06/23/1999	132.813	01/02/2001	559	0.099797287
	132.852	10/14/1999	132.813	01/02/2001	446	-0.121627943
	132.9	01/31/2000	132.813	01/02/2001	337	-0.271323873
	132.794	05/22/2000	132.813	01/02/2001	225	0.059254639
	132.781	06/23/1999	132.815	04/24/2001	671	0.106034617
	132.852	10/14/1999	132.815	04/24/2001	558	-0.115390613
	132.9	01/31/2000	132.815	04/24/2001	449	-0.265086543
	132.794	05/22/2000	132.815	04/24/2001	337	0.065491969
	132.804	09/11/2000	132.815	04/24/2001	225	0.034305317
2-T-69-835C	121.417	11/09/1998	121.441	03/01/1999	112	0.074847965
	121.432	03/01/1999	121.427	06/23/1999	114	-0.015593326
	121.421	06/23/1999	121.42	10/14/1999	113	-0.003118665
	121.455	10/14/1999	121.522	01/31/2000	109	0.208950569
	121.52	01/31/2000	121.429	05/22/2000	112	-0.283798534
	121.423	05/22/2000	121.439	09/11/2000	112	0.049898643
	121.431	09/11/2000	121.442	01/02/2001	113	0.034305317
	121.428	01/02/2001	121.45	04/24/2001	112	0.068610635
	121.417	11/09/1998	121.427	06/23/1999	226	0.031186652
	121.417	11/09/1998	121.42	10/14/1999	339	0.009355996
	121.432	03/01/1999	121.42	10/14/1999	227	-0.037423983
	121.417	11/09/1998	121.522	01/31/2000	448	0.327459847
	121.432	03/01/1999	121.522	01/31/2000	336	0.280679869
	121.421	06/23/1999	121.522	01/31/2000	222	0.314985186
	121.417	11/09/1998	121.429	05/22/2000	560	0.037423983
	121.432	03/01/1999	121.429	05/22/2000	448	-0.009355996
	121.421	06/23/1999	121.429	05/22/2000	334	0.024949322
	121.455	10/14/1999	121.429	05/22/2000	221	-0.081085295
	121.417	11/09/1998	121.439	09/11/2000	672	0.068610635
	121.432	03/01/1999	121.439	09/11/2000	560	0.021830656
	121.421	06/23/1999	121.439	09/11/2000	446	0.056135974
	121.455	10/14/1999	121.439	09/11/2000	333	-0.049898643
	121.52	01/31/2000	121.439	09/11/2000	224	-0.252611882
	121.417	11/09/1998	121.442	01/02/2001	785	0.07796663
	121.432	03/01/1999	121.442	01/02/2001	673	0.031186652
	121.421	06/23/1999	121.442	01/02/2001	559	0.065491969
	121.455	10/14/1999	121.442	01/02/2001	446	-0.040542648
	121.52	01/31/2000	121.442	01/02/2001	337	-0.243255886
	121.423	05/22/2000	121.442	01/02/2001	225	0.059254639

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	121.417	11/09/1998	121.45	04/24/2001	897	0.102915952
	121.432	03/01/1999	121.45	04/24/2001	785	0.056135974
	121.421	06/23/1999	121.45	04/24/2001	671	0.090441291
	121.455	10/14/1999	121.45	04/24/2001	558	-0.015593326
	121.52	01/31/2000	121.45	04/24/2001	449	-0.218306565
	121.423	05/22/2000	121.45	04/24/2001	337	0.084203961
	121.431	09/11/2000	121.45	04/24/2001	225	0.059254639
2-T-69-836C	124.999	11/09/1998	125.034	03/01/1999	112	0.109153282
	125.032	03/01/1999	125.006	06/23/1999	114	-0.081085295
	124.997	06/23/1999	125.1	10/14/1999	113	0.321222517
	124.999	10/14/1999	125.2	01/31/2000	109	0.626851707
	125.2	01/31/2000	125.029	05/22/2000	112	-0.533291751
	125.022	05/22/2000	124.983	09/11/2000	112	-0.121627943
	125.014	09/11/2000	125.056	01/02/2001	113	0.130983939
	125.046	01/02/2001	125.027	04/24/2001	112	-0.059254639
	124.999	11/09/1998	125.006	06/23/1999	226	0.021830656
	124.999	11/09/1998	125.1	10/14/1999	339	0.314985186
	125.032	03/01/1999	125.1	10/14/1999	227	0.212069234
	124.999	11/09/1998	125.2	01/31/2000	448	0.626851707
	125.032	03/01/1999	125.2	01/31/2000	336	0.523935755
	124.997	06/23/1999	125.2	01/31/2000	222	0.633089038
	124.999	11/09/1998	125.029	05/22/2000	560	0.093559956
	125.032	03/01/1999	125.029	05/22/2000	448	-0.009355996
	124.997	06/23/1999	125.029	05/22/2000	334	0.099797287
	124.999	10/14/1999	125.029	05/22/2000	221	0.093559956
	124.999	11/09/1998	124.983	09/11/2000	672	-0.049898643
	125.032	03/01/1999	124.983	09/11/2000	560	-0.152814595
	124.997	06/23/1999	124.983	09/11/2000	446	-0.043661313
	124.999	10/14/1999	124.983	09/11/2000	333	-0.049898643
	125.2	01/31/2000	124.983	09/11/2000	224	-0.676750351
	124.999	11/09/1998	125.056	01/02/2001	785	0.177763917
	125.032	03/01/1999	125.056	01/02/2001	673	0.074847965
	124.997	06/23/1999	125.056	01/02/2001	559	0.184001247
	124.999	10/14/1999	125.056	01/02/2001	446	0.177763917
	125.2	01/31/2000	125.056	01/02/2001	337	-0.44908779
	125.022	05/22/2000	125.056	01/02/2001	225	0.106034617
	124.999	11/09/1998	125.027	04/24/2001	897	0.087322626
	125.032	03/01/1999	125.027	04/24/2001	785	-0.015593326
	124.997	06/23/1999	125.027	04/24/2001	671	0.093559956
	124.999	10/14/1999	125.027	04/24/2001	558	0.087322626
	125.2	01/31/2000	125.027	04/24/2001	449	-0.539529082
	125.022	05/22/2000	125.027	04/24/2001	337	0.015593326
	125.014	09/11/2000	125.027	04/24/2001	225	0.040542648
2-T-69-837C	124.965	11/09/1998	125.041	03/01/1999	112	0.237018556

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	125.023	03/01/1999	124.98	06/23/1999	114	-0.134102604
	124.973	06/23/1999	125.1	10/14/1999	113	0.396070482
	125.015	10/14/1999	125.2	01/31/2000	109	0.576953064
	125.1	01/31/2000	125	05/22/2000	112	-0.311866521
	124.989	05/22/2000	125	09/11/2000	112	0.034305317
	124.99	09/11/2000	125.049	01/02/2001	113	0.184001247
	125.037	01/02/2001	125.03	04/24/2001	112	-0.021830656
	124.965	11/09/1998	124.98	06/23/1999	226	0.046779978
	124.965	11/09/1998	125.1	10/14/1999	339	0.421019804
	125.023	03/01/1999	125.1	10/14/1999	227	0.240137221
	124.965	11/09/1998	125.2	01/31/2000	448	0.732886325
	125.023	03/01/1999	125.2	01/31/2000	336	0.552003742
	124.973	06/23/1999	125.2	01/31/2000	222	0.707937003
	124.965	11/09/1998	125	05/22/2000	560	0.109153282
	125.023	03/01/1999	125	05/22/2000	448	-0.0717293
	124.973	06/23/1999	125	05/22/2000	334	0.084203961
	125.015	10/14/1999	125	05/22/2000	221	-0.046779978
	124.965	11/09/1998	125	09/11/2000	672	0.109153282
	125.023	03/01/1999	125	09/11/2000	560	-0.0717293
	124.973	06/23/1999	125	09/11/2000	446	0.084203961
	125.015	10/14/1999	125	09/11/2000	333	-0.046779978
	125.1	01/31/2000	125	09/11/2000	224	-0.311866521
	124.965	11/09/1998	125.049	01/02/2001	785	0.261967878
	125.023	03/01/1999	125.049	01/02/2001	673	0.081085295
	124.973	06/23/1999	125.049	01/02/2001	559	0.237018556
	125.015	10/14/1999	125.049	01/02/2001	446	0.106034617
	125.1	01/31/2000	125.049	01/02/2001	337	-0.159051926
	124.989	05/22/2000	125.049	01/02/2001	225	0.187119913
	124.965	11/09/1998	125.03	04/24/2001	897	0.202713239
	125.023	03/01/1999	125.03	04/24/2001	785	0.021830656
	124.973	06/23/1999	125.03	04/24/2001	671	0.177763917
	125.015	10/14/1999	125.03	04/24/2001	558	0.046779978
	125.1	01/31/2000	125.03	04/24/2001	449	-0.218306565
	124.989	05/22/2000	125.03	04/24/2001	337	0.127865274
	124.99	09/11/2000	125.03	04/24/2001	225	0.124746608
2-T-69-838C	122.986	11/09/1998	122.997	03/01/1999	112	0.034305317
	122.99	03/01/1999	122.984	06/23/1999	114	-0.018711991
	122.979	06/23/1999	123	10/14/1999	113	0.065491969
	123	10/14/1999	122.99	01/31/2000	109	-0.031186652
	122.98	01/31/2000	122.983	05/22/2000	112	0.009355996
	122.976	05/22/2000	122.994	09/11/2000	112	0.056135974
	122.983	09/11/2000	122.997	01/02/2001	113	0.043661313
	122.993	01/02/2001	122.998	04/24/2001	112	0.015593326
	122.986	11/09/1998	122.984	06/23/1999	226	-0.00623733

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	122.986	11/09/1998	123	10/14/1999	339	0.043661313
	122.99	03/01/1999	123	10/14/1999	227	0.031186652
	122.986	11/09/1998	122.99	01/31/2000	448	0.012474661
	122.99	03/01/1999	122.99	01/31/2000	336	0
	122.979	06/23/1999	122.99	01/31/2000	222	0.034305317
	122.986	11/09/1998	122.983	05/22/2000	560	-0.009355996
	122.99	03/01/1999	122.983	05/22/2000	448	-0.021830656
	122.979	06/23/1999	122.983	05/22/2000	334	0.012474661
	123	10/14/1999	122.983	05/22/2000	221	-0.053017309
	122.986	11/09/1998	122.994	09/11/2000	672	0.024949322
	122.99	03/01/1999	122.994	09/11/2000	560	0.012474661
	122.979	06/23/1999	122.994	09/11/2000	446	0.046779978
	123	10/14/1999	122.994	09/11/2000	333	-0.018711991
	122.98	01/31/2000	122.994	09/11/2000	224	0.043661313
	122.986	11/09/1998	122.997	01/02/2001	785	0.034305317
	122.99	03/01/1999	122.997	01/02/2001	673	0.021830656
	122.979	06/23/1999	122.997	01/02/2001	559	0.056135974
	123	10/14/1999	122.997	01/02/2001	446	-0.009355996
	122.98	01/31/2000	122.997	01/02/2001	337	0.053017309
	122.976	05/22/2000	122.997	01/02/2001	225	0.065491969
	122.986	11/09/1998	122.998	04/24/2001	897	0.037423983
	122.99	03/01/1999	122.998	04/24/2001	785	0.024949322
	122.979	06/23/1999	122.998	04/24/2001	671	0.059254639
	123	10/14/1999	122.998	04/24/2001	558	-0.00623733
	122.98	01/31/2000	122.998	04/24/2001	449	0.056135974
	122.976	05/22/2000	122.998	04/24/2001	337	0.068610635
	122.983	09/11/2000	122.998	04/24/2001	225	0.046779978
2-T-69-839C	128.665	11/09/1998	128.65	03/01/1999	112	-0.046779978
	128.639	03/01/1999	128.635	06/23/1999	114	-0.012474661
	128.632	06/23/1999	128.82	10/14/1999	113	0.58630906
	128.8	10/14/1999	128.64	01/31/2000	109	-0.498986434
	128.64	01/31/2000	128.632	05/22/2000	112	-0.024949322
	128.628	05/22/2000	128.65	09/11/2000	112	0.068610635
	128.64	09/11/2000	128.634	01/02/2001	113	-0.018711991
	128.636	01/02/2001	128.638	04/24/2001	112	0.00623733
	128.665	11/09/1998	128.635	06/23/1999	226	-0.093559956
	128.665	11/09/1998	128.82	10/14/1999	339	0.483393108
	128.639	03/01/1999	128.82	10/14/1999	227	0.564478403
	128.665	11/09/1998	128.64	01/31/2000	448	-0.07796663
	128.639	03/01/1999	128.64	01/31/2000	336	0.003118665
	128.632	06/23/1999	128.64	01/31/2000	222	0.024949322
	128.665	11/09/1998	128.632	05/22/2000	560	-0.102915952
	128.639	03/01/1999	128.632	05/22/2000	448	-0.021830656
	128.632	06/23/1999	128.632	05/22/2000	334	0

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	128.8	10/14/1999	128.632	05/22/2000	221	-0.523935755
	128.665	11/09/1998	128.65	09/11/2000	672	-0.046779978
	128.639	03/01/1999	128.65	09/11/2000	560	0.034305317
	128.632	06/23/1999	128.65	09/11/2000	446	0.056135974
	128.8	10/14/1999	128.65	09/11/2000	333	-0.467799782
	128.64	01/31/2000	128.65	09/11/2000	224	0.031186652
	128.665	11/09/1998	128.634	01/02/2001	785	-0.096678622
	128.639	03/01/1999	128.634	01/02/2001	673	-0.015593326
	128.632	06/23/1999	128.634	01/02/2001	559	0.00623733
	128.8	10/14/1999	128.634	01/02/2001	446	-0.517698425
	128.64	01/31/2000	128.634	01/02/2001	337	-0.018711991
	128.628	05/22/2000	128.634	01/02/2001	225	0.018711991
	128.665	11/09/1998	128.638	04/24/2001	897	-0.084203961
	128.639	03/01/1999	128.638	04/24/2001	785	-0.003118665
	128.632	06/23/1999	128.638	04/24/2001	671	0.018711991
	128.8	10/14/1999	128.638	04/24/2001	558	-0.505223764
	128.64	01/31/2000	128.638	04/24/2001	449	-0.00623733
	128.628	05/22/2000	128.638	04/24/2001	337	0.031186652
	128.64	09/11/2000	128.638	04/24/2001	225	-0.00623733
2-T-69-834D	135.295	07/27/1998	135.33	11/17/1998	113	0.109153282
	135.32	11/17/1998	135.37	03/08/1999	111	0.155933261
	135.367	03/08/1999	135.399	04/24/1999	47	0.099797287
	132.824	04/24/1999	132.76	06/28/1999	65	-0.199594574
	132.744	06/28/1999	132.861	10/18/1999	112	0.36488383
	132.84	10/18/1999	132.805	02/07/2000	112	-0.109153282
	132.798	02/07/2000	132.83	05/30/2000	113	0.099797287
	132.82	05/30/2000	132.823	09/18/2000	111	0.009355996
	132.81	09/18/2000	132.934	01/08/2001	112	0.386714486
	132.939	01/08/2001	132.86	04/30/2001	112	-0.246374552
	135.295	07/27/1998	135.37	03/08/1999	224	0.233899891
	132.824	04/24/1999	132.861	10/18/1999	177	0.115390613
	132.824	04/24/1999	132.805	02/07/2000	289	-0.059254639
	132.744	06/28/1999	132.805	02/07/2000	224	0.190238578
	132.824	04/24/1999	132.83	05/30/2000	402	0.018711991
	132.744	06/28/1999	132.83	05/30/2000	337	0.268205208
	132.84	10/18/1999	132.83	05/30/2000	225	-0.031186652
	132.824	04/24/1999	132.823	09/18/2000	513	-0.003118665
	132.744	06/28/1999	132.823	09/18/2000	448	0.246374552
	132.84	10/18/1999	132.823	09/18/2000	336	-0.053017309
	132.798	02/07/2000	132.823	09/18/2000	224	0.07796663
	132.824	04/24/1999	132.934	01/08/2001	625	0.343053173
	132.744	06/28/1999	132.934	01/08/2001	560	0.59254639
	132.84	10/18/1999	132.934	01/08/2001	448	0.29315453
	132.798	02/07/2000	132.934	01/08/2001	336	0.424138469

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	132.82	05/30/2000	132.934	01/08/2001	223	0.355527834
	132.824	04/24/1999	132.86	04/30/2001	737	0.112271948
	132.744	06/28/1999	132.86	04/30/2001	672	0.361765165
	132.84	10/18/1999	132.86	04/30/2001	560	0.062373304
	132.798	02/07/2000	132.86	04/30/2001	448	0.193357243
	132.82	05/30/2000	132.86	04/30/2001	335	0.124746608
	132.81	09/18/2000	132.86	04/30/2001	224	0.155933261
2-T-69-835D	121.23	07/28/1998	121.29	11/17/1998	112	0.187119913
	121.28	11/17/1998	121.367	03/08/1999	111	0.271323873
	121.323	03/08/1999	121.283	06/28/1999	112	-0.124746608
	121.284	06/28/1999	121.383	10/18/1999	112	0.308747856
	121.31	10/18/1999	121.11	02/07/2000	112	-0.623733042
	121.323	02/07/2000	121.322	05/30/2000	113	-0.003118665
	121.31	05/30/2000	121.333	09/18/2000	111	0.0717293
	121.338	09/18/2000	121.402	01/08/2001	112	0.199594574
	121.397	01/08/2001	121.37	04/30/2001	112	-0.084203961
	121.23	07/28/1998	121.367	03/08/1999	223	0.427257134
	121.23	07/28/1998	121.283	06/28/1999	335	0.165289256
	121.28	11/17/1998	121.283	06/28/1999	223	0.009355996
	121.23	07/28/1998	121.383	10/18/1999	447	0.477155777
	121.28	11/17/1998	121.383	10/18/1999	335	0.321222517
	121.323	03/08/1999	121.383	10/18/1999	224	0.187119913
	121.23	07/28/1998	121.11	02/07/2000	559	-0.374239825
	121.28	11/17/1998	121.11	02/07/2000	447	-0.530173086
	121.323	03/08/1999	121.11	02/07/2000	336	-0.66427569
	121.284	06/28/1999	121.11	02/07/2000	224	-0.542647747
	121.23	07/28/1998	121.322	05/30/2000	672	0.286917199
	121.28	11/17/1998	121.322	05/30/2000	560	0.130983939
	121.323	03/08/1999	121.322	05/30/2000	449	-0.003118665
	121.284	06/28/1999	121.322	05/30/2000	337	0.118509278
	121.31	10/18/1999	121.322	05/30/2000	225	0.037423983
	121.23	07/28/1998	121.333	09/18/2000	783	0.321222517
	121.28	11/17/1998	121.333	09/18/2000	671	0.165289256
	121.323	03/08/1999	121.333	09/18/2000	560	0.031186652
	121.284	06/28/1999	121.333	09/18/2000	448	0.152814595
	121.31	10/18/1999	121.333	09/18/2000	336	0.0717293
	121.323	02/07/2000	121.333	09/18/2000	224	0.031186652
	121.23	07/28/1998	121.402	01/08/2001	895	0.536410416
	121.28	11/17/1998	121.402	01/08/2001	783	0.380477156
	121.323	03/08/1999	121.402	01/08/2001	672	0.246374552
	121.284	06/28/1999	121.402	01/08/2001	560	0.368002495
	121.31	10/18/1999	121.402	01/08/2001	448	0.286917199
	121.323	02/07/2000	121.402	01/08/2001	336	0.246374552
	121.31	05/30/2000	121.402	01/08/2001	223	0.286917199

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	121.23	07/28/1998	121.37	04/30/2001	1007	0.43661313
	121.28	11/17/1998	121.37	04/30/2001	895	0.280679869
	121.323	03/08/1999	121.37	04/30/2001	784	0.146577265
	121.284	06/28/1999	121.37	04/30/2001	672	0.268205208
	121.31	10/18/1999	121.37	04/30/2001	560	0.187119913
	121.323	02/07/2000	121.37	04/30/2001	448	0.146577265
	121.31	05/30/2000	121.37	04/30/2001	335	0.187119913
	121.338	09/18/2000	121.37	04/30/2001	224	0.099797287
2-T-69-836D	125.33	07/28/1998	124.99	11/17/1998	112	-1.060346172
	124.97	11/17/1998	125.003	03/08/1999	111	0.102915952
	125.007	03/08/1999	124.993	06/28/1999	112	-0.043661313
	124.971	06/28/1999	125.036	10/18/1999	112	0.202713239
	125	10/18/1999	124.995	02/07/2000	112	-0.015593326
	124.977	02/07/2000	125.03	05/30/2000	113	0.165289256
	124.998	05/30/2000	124.998	09/18/2000	111	0
	124.984	09/18/2000	125.024	01/08/2001	112	0.124746608
	125	01/08/2001	125	04/30/2001	112	0
	125.33	07/28/1998	125.003	03/08/1999	223	-1.019803524
	125.33	07/28/1998	124.993	06/28/1999	335	-1.050990176
	124.97	11/17/1998	124.993	06/28/1999	223	0.0717293
	125.33	07/28/1998	125.036	10/18/1999	447	-0.916887572
	124.97	11/17/1998	125.036	10/18/1999	335	0.205831904
	125.007	03/08/1999	125.036	10/18/1999	224	0.090441291
	125.33	07/28/1998	124.995	02/07/2000	559	-1.044752846
	124.97	11/17/1998	124.995	02/07/2000	447	0.07796663
	125.007	03/08/1999	124.995	02/07/2000	336	-0.037423983
	124.971	06/28/1999	124.995	02/07/2000	224	0.074847965
	125.33	07/28/1998	125.03	05/30/2000	672	-0.935599563
	124.97	11/17/1998	125.03	05/30/2000	560	0.187119913
	125.007	03/08/1999	125.03	05/30/2000	449	0.0717293
	124.971	06/28/1999	125.03	05/30/2000	337	0.184001247
	125	10/18/1999	125.03	05/30/2000	225	0.093559956
	125.33	07/28/1998	124.998	09/18/2000	783	-1.03539685
	124.97	11/17/1998	124.998	09/18/2000	671	0.087322626
	125.007	03/08/1999	124.998	09/18/2000	560	-0.028067987
	124.971	06/28/1999	124.998	09/18/2000	448	0.084203961
	125	10/18/1999	124.998	09/18/2000	336	-0.00623733
	124.977	02/07/2000	124.998	09/18/2000	224	0.065491969
	125.33	07/28/1998	125.024	01/08/2001	895	-0.954311555
	124.97	11/17/1998	125.024	01/08/2001	783	0.168407921
	125.007	03/08/1999	125.024	01/08/2001	672	0.053017309
	124.971	06/28/1999	125.024	01/08/2001	560	0.165289256
	125	10/18/1999	125.024	01/08/2001	448	0.074847965
	124.977	02/07/2000	125.024	01/08/2001	336	0.146577265

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	124.998	05/30/2000	125.024	01/08/2001	223	0.081085295
	125.33	07/28/1998	125	04/30/2001	1007	-1.02915952
	124.97	11/17/1998	125	04/30/2001	895	0.093559956
	125.007	03/08/1999	125	04/30/2001	784	-0.021830656
	124.971	06/28/1999	125	04/30/2001	672	0.090441291
	125	10/18/1999	125	04/30/2001	560	0
	124.977	02/07/2000	125	04/30/2001	448	0.0717293
	124.998	05/30/2000	125	04/30/2001	335	0.00623733
	124.984	09/18/2000	125	04/30/2001	224	0.049898643
2-T-69-837D	124.89	07/28/1998	124.91	11/17/1998	112	0.062373304
	124.89	11/17/1998	124.994	03/08/1999	111	0.324341182
	124.99	03/08/1999	124.895	06/28/1999	112	-0.296273195
	124.877	06/28/1999	124.945	10/18/1999	112	0.212069234
	124.92	10/18/1999	125.007	02/07/2000	112	0.271323873
	124.995	02/07/2000	124.935	05/30/2000	113	-0.187119913
	124.917	05/30/2000	124.91	09/18/2000	111	-0.021830656
	124.895	09/18/2000	125.023	01/08/2001	112	0.399189147
	125.009	01/08/2001	125	04/30/2001	112	-0.028067987
	124.89	07/28/1998	124.994	03/08/1999	223	0.324341182
	124.89	07/28/1998	124.895	06/28/1999	335	0.015593326
	124.89	11/17/1998	124.895	06/28/1999	223	0.015593326
	124.89	07/28/1998	124.945	10/18/1999	447	0.171526587
	124.89	11/17/1998	124.945	10/18/1999	335	0.171526587
	124.99	03/08/1999	124.945	10/18/1999	224	-0.140339935
	124.89	07/28/1998	125.007	02/07/2000	559	0.36488383
	124.89	11/17/1998	125.007	02/07/2000	447	0.36488383
	124.99	03/08/1999	125.007	02/07/2000	336	0.053017309
	124.877	06/28/1999	125.007	02/07/2000	224	0.405426477
	124.89	07/28/1998	124.935	05/30/2000	672	0.140339935
	124.89	11/17/1998	124.935	05/30/2000	560	0.140339935
	124.99	03/08/1999	124.935	05/30/2000	449	-0.171526587
	124.877	06/28/1999	124.935	05/30/2000	337	0.180882582
	124.92	10/18/1999	124.935	05/30/2000	225	0.046779978
	124.89	07/28/1998	124.91	09/18/2000	783	0.062373304
	124.89	11/17/1998	124.91	09/18/2000	671	0.062373304
	124.99	03/08/1999	124.91	09/18/2000	560	-0.249493217
	124.877	06/28/1999	124.91	09/18/2000	448	0.102915952
	124.92	10/18/1999	124.91	09/18/2000	336	-0.031186652
	124.995	02/07/2000	124.91	09/18/2000	224	-0.265086543
	124.89	07/28/1998	125.023	01/08/2001	895	0.414782473
	124.89	11/17/1998	125.023	01/08/2001	783	0.414782473
	124.99	03/08/1999	125.023	01/08/2001	672	0.102915952
	124.877	06/28/1999	125.023	01/08/2001	560	0.455325121
	124.92	10/18/1999	125.023	01/08/2001	448	0.321222517

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	124.995	02/07/2000	125.023	01/08/2001	336	0.087322626
	124.917	05/30/2000	125.023	01/08/2001	223	0.330578512
	124.89	07/28/1998	125	04/30/2001	1007	0.343053173
	124.89	11/17/1998	125	04/30/2001	895	0.343053173
	124.99	03/08/1999	125	04/30/2001	784	0.031186652
	124.877	06/28/1999	125	04/30/2001	672	0.383595821
	124.92	10/18/1999	125	04/30/2001	560	0.249493217
	124.995	02/07/2000	125	04/30/2001	448	0.015593326
	124.917	05/30/2000	125	04/30/2001	335	0.258849213
	124.895	09/18/2000	125	04/30/2001	224	0.327459847
2-T-69-838D	123.019	07/28/1998	123.08	11/17/1998	112	0.190238578
	123.05	11/17/1998	123.114	03/08/1999	111	0.199594574
	123.11	03/08/1999	123.087	06/28/1999	112	-0.0717293
	123.076	06/28/1999	123.127	10/18/1999	112	0.159051926
	123.079	10/18/1999	123.094	12/22/1999	65	0.046779978
	123.056	12/20/1999	123.03	02/07/2000	49	-0.081085295
	123.027	02/07/2000	123.048	05/30/2000	113	0.065491969
	123.043	05/30/2000	123.061	09/18/2000	111	0.056135974
	123.059	09/18/2000	123.052	01/08/2001	112	-0.021830656
	123.047	01/08/2001	123.05	04/30/2001	112	0.009355996
	123.019	07/28/1998	123.114	03/08/1999	223	0.296273195
	123.019	07/28/1998	123.087	06/28/1999	335	0.212069234
	123.05	11/17/1998	123.087	06/28/1999	223	0.115390613
	123.019	07/28/1998	123.127	10/18/1999	447	0.336815843
	123.05	11/17/1998	123.127	10/18/1999	335	0.240137221
	123.11	03/08/1999	123.127	10/18/1999	224	0.053017309
	123.019	07/28/1998	123.094	12/22/1999	512	0.233899891
	123.05	11/17/1998	123.094	12/22/1999	400	0.137221269
	123.11	03/08/1999	123.094	12/22/1999	289	-0.049898643
	123.076	06/28/1999	123.094	12/22/1999	177	0.056135974
	123.019	07/28/1998	123.03	02/07/2000	559	0.034305317
	123.05	11/17/1998	123.03	02/07/2000	447	-0.062373304
	123.11	03/08/1999	123.03	02/07/2000	336	-0.249493217
	123.076	06/28/1999	123.03	02/07/2000	224	-0.1434586
	123.079	10/18/1999	123.03	02/07/2000	112	-0.152814595
	123.019	07/28/1998	123.048	05/30/2000	672	0.090441291
	123.05	11/17/1998	123.048	05/30/2000	560	-0.00623733
	123.11	03/08/1999	123.048	05/30/2000	449	-0.193357243
	123.076	06/28/1999	123.048	05/30/2000	337	-0.087322626
	123.079	10/18/1999	123.048	05/30/2000	225	-0.096678622
	123.056	12/20/1999	123.048	05/30/2000	162	-0.024949322
	123.019	07/28/1998	123.061	09/18/2000	783	0.130983939
	123.05	11/17/1998	123.061	09/18/2000	671	0.034305317
	123.11	03/08/1999	123.061	09/18/2000	560	-0.152814595

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5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	123.076	06/28/1999	123.061	09/18/2000	448	-0.046779978
	123.079	10/18/1999	123.061	09/18/2000	336	-0.056135974
	123.056	12/20/1999	123.061	09/18/2000	273	0.015593326
	123.027	02/07/2000	123.061	09/18/2000	224	0.106034617
	123.019	07/28/1998	123.052	01/08/2001	895	0.102915952
	123.05	11/17/1998	123.052	01/08/2001	783	0.00623733
	123.11	03/08/1999	123.052	01/08/2001	672	-0.180882582
	123.076	06/28/1999	123.052	01/08/2001	560	-0.074847965
	123.079	10/18/1999	123.052	01/08/2001	448	-0.084203961
	123.056	12/20/1999	123.052	01/08/2001	385	-0.012474661
	123.027	02/07/2000	123.052	01/08/2001	336	0.07796663
	123.043	05/30/2000	123.052	01/08/2001	223	0.028067987
	123.019	07/28/1998	123.05	04/30/2001	1007	0.096678622
	123.05	11/17/1998	123.05	04/30/2001	895	0
	123.11	03/08/1999	123.05	04/30/2001	784	-0.187119913
	123.076	06/28/1999	123.05	04/30/2001	672	-0.081085295
	123.079	10/18/1999	123.05	04/30/2001	560	-0.090441291
	123.056	12/20/1999	123.05	04/30/2001	497	-0.018711991
	123.027	02/07/2000	123.05	04/30/2001	448	0.0717293
	123.043	05/30/2000	123.05	04/30/2001	335	0.021830656
	123.059	09/18/2000	123.05	04/30/2001	224	-0.028067987
2-T-69-839D	128.817	07/28/1998	128.76	11/17/1998	112	-0.177763917
	128.75	11/17/1998	128.83	03/08/1999	111	0.249493217
	128.81	03/08/1999	128.775	06/28/1999	112	-0.109153282
	128.764	06/28/1999	128.82	10/18/1999	112	0.174645252
	128.805	10/18/1999	128.826	02/07/2000	112	0.065491969
	128.813	02/07/2000	128.831	05/30/2000	113	0.056135974
	128.819	05/30/2000	128.788	09/18/2000	111	-0.096678622
	128.778	09/18/2000	128.848	01/08/2001	112	0.218306565
	128.836	01/08/2001	128.84	04/30/2001	112	0.012474661
	128.817	07/28/1998	128.83	03/08/1999	223	0.040542648
	128.817	07/28/1998	128.775	06/28/1999	335	-0.130983939
	128.75	11/17/1998	128.775	06/28/1999	223	0.07796663
	128.817	07/28/1998	128.82	10/18/1999	447	0.009355996
	128.75	11/17/1998	128.82	10/18/1999	335	0.218306565
	128.81	03/08/1999	128.82	10/18/1999	224	0.031186652
	128.817	07/28/1998	128.826	02/07/2000	559	0.028067987
	128.75	11/17/1998	128.826	02/07/2000	447	0.237018556
	128.81	03/08/1999	128.826	02/07/2000	336	0.049898643
	128.764	06/28/1999	128.826	02/07/2000	224	0.193357243
	128.817	07/28/1998	128.831	05/30/2000	672	0.043661313
	128.75	11/17/1998	128.831	05/30/2000	560	0.252611882
	128.81	03/08/1999	128.831	05/30/2000	449	0.065491969
	128.764	06/28/1999	128.831	05/30/2000	337	0.208950569

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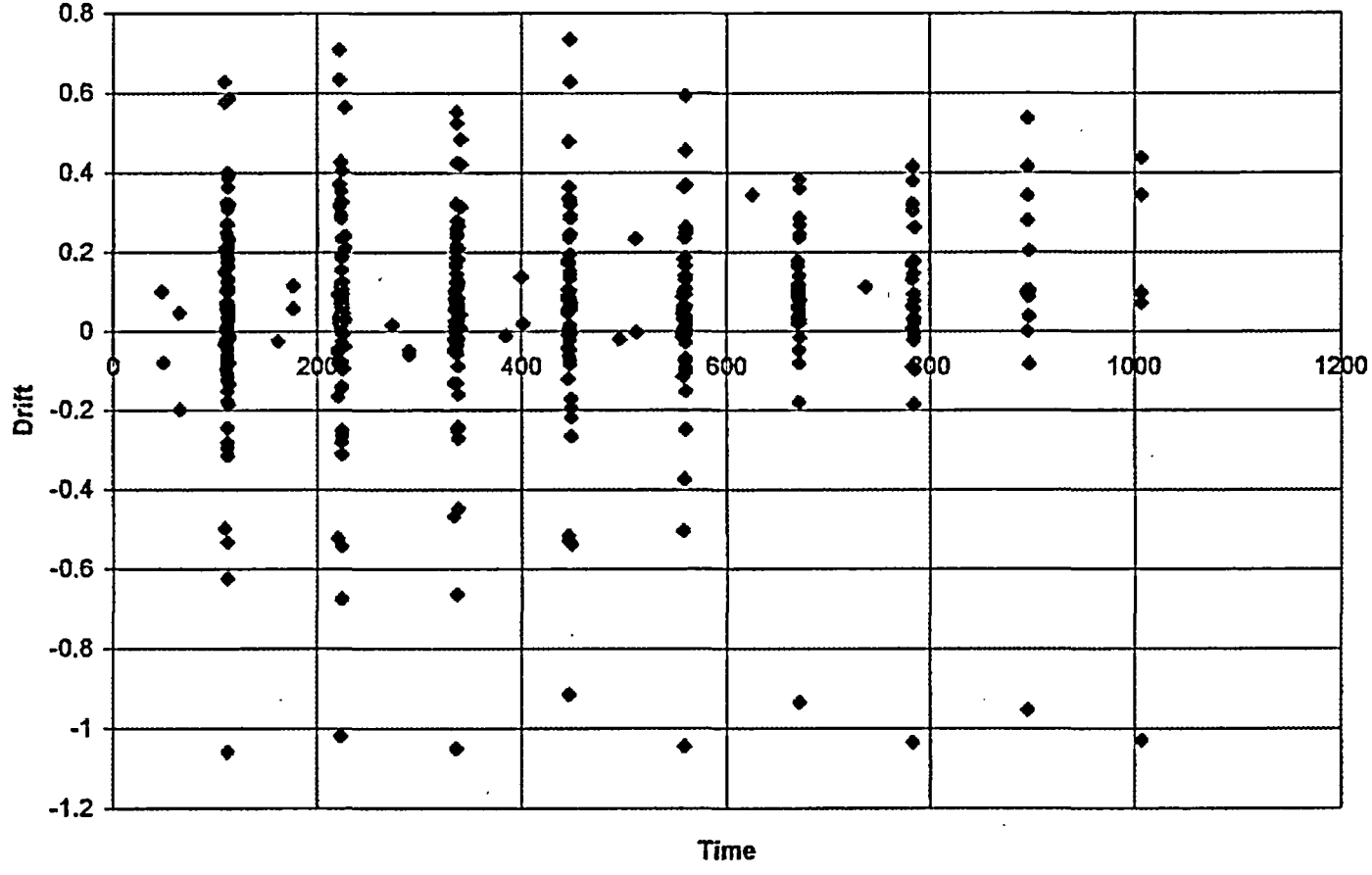
5.0 Drift Analysis

Instrument	As Left	Date	As Found	Date	Delta Days	Deviation % of Span
	128.805	10/18/1999	128.831	05/30/2000	225	0.081085295
	128.817	07/28/1998	128.788	09/18/2000	783	-0.090441291
	128.75	11/17/1998	128.788	09/18/2000	671	0.118509278
	128.81	03/08/1999	128.788	09/18/2000	560	-0.068610635
	128.764	06/28/1999	128.788	09/18/2000	448	0.074847965
	128.805	10/18/1999	128.788	09/18/2000	336	-0.053017309
	128.813	02/07/2000	128.788	09/18/2000	224	-0.07796663
	128.817	07/28/1998	128.848	01/08/2001	895	0.096678622
	128.75	11/17/1998	128.848	01/08/2001	783	0.305629191
	128.81	03/08/1999	128.848	01/08/2001	672	0.118509278
	128.764	06/28/1999	128.848	01/08/2001	560	0.261967878
	128.805	10/18/1999	128.848	01/08/2001	448	0.134102604
	128.813	02/07/2000	128.848	01/08/2001	336	0.109153282
	128.819	05/30/2000	128.848	01/08/2001	223	0.090441291
	128.817	07/28/1998	128.84	04/30/2001	1007	0.0717293
	128.75	11/17/1998	128.84	04/30/2001	895	0.280679869
	128.81	03/08/1999	128.84	04/30/2001	784	0.093559956
	128.764	06/28/1999	128.84	04/30/2001	672	0.237018556
	128.805	10/18/1999	128.84	04/30/2001	560	0.109153282
	128.813	02/07/2000	128.84	04/30/2001	448	0.084203961
	128.819	05/30/2000	128.84	04/30/2001	335	0.065491969
	128.778	09/18/2000	128.84	04/30/2001	224	0.193357243

Standard Deviation	0.2148861
Mean	0.0513617
Count	1166
Number of RTDs	48
K for 48 RTDs	2.408

Deviation in % of Span	0.5174458	% of span
	0.165919	ohms
	0.0827913	mA
	0.0206978	Volt
	0.7761688	°F

Drift vs Time



part of BFN TS-447 RAI Enclosure 2

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B5.0 Drift Analysis

The least square regression analysis is done using the Excel program and the summary is as follows:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.050656017
R Square	0.002566032
Adjusted R Square	0.00170913
Standard Error	0.214702436
Observations	1166

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.138039966	0.13804	2.9945454	0.083810393
Residual	1164	53.65706644	0.046097		
Total	1165	53.7951064			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.034407391	0.011641521	2.955575	0.0031837	0.011566693	0.0572481	0.011566693	0.057248089
X Variable 1	4.94575E-05	2.85803E-05	1.730475	0.0838104	-6.6171E-06	0.0001055	-6.6171E-06	0.000105532

Conclusion:

The R square value is very small and hence there is no relationship to time .

B6.0 COMPUTATIONS / ANALYSES

B6.1 ACCURACY CALCULATIONS (COMPONENTS TE, TIS, TS) :

The following accuracy information for the RTD is extracted from the body of this calculation, and the master and the Slave Trip Units are calculated.

B6.1.1 NORMAL MEASURABLE ACCURACY Anf

Anf = Normal Inst. Errors at the time of cal. (NE) + Test Equip Errors (CE)

$Anf_{TE} := \pm 0\ \Omega.$ $= \pm 0$ mA (From base Calc.)

$Anf_{TIS} := \pm\sqrt{0.12^2 + 0.11^2 + 0.12^2 + 0.12^2}$ $= \pm 0.24$ mA

The existing NESSD 2F-069-0834A, B, C, D has an acceptable as found value of ± 2.9°F.
The existing NESSD 3F-069-0834A, B, C, D has an acceptable as found value of ± 3.5°F.
Therefore it is conservative to use the existing values. Therefore,

For Unit 2: Anf_{TIS} $= \pm 2.9$ °F $= \pm 0.62\ \Omega$ $= \pm 0.077$ V $= \pm 0.309$ mA

For Unit 3: Anf_{TIS} $= \pm 3.5$ °F $= \pm 0.748\ \Omega$ $= \pm 0.093$ V $= \pm 0.373$ mA

$Anf_{TS} := \pm\sqrt{0.032^2 + 0.107^2 + 0.032^2}$

$= \pm 0.116$ mA ± 0.029 V $\pm 0.233\ \Omega$ $= \pm 1.1$ °F

B6.1.2 NORMAL ACCURACY An

An = Anf COMBINED WITH UNMEASURABLE ERRORS

For unit 2:

$An_{TE} := \pm 0.43\ \Omega$ $= \pm 0.215$ mA (From base Calc.)
$An_{TIS} := \pm 0.62\ \Omega$ $= \pm 0.309$ mA
$An_{TS} := \pm 0.233\ \Omega$ $= \pm 0.116$ mA

For unit 3:

$An_{TE} := \pm 0.43\ \Omega$ $= \pm 0.215$ mA (From base Calc.)
$An_{TIS} := \pm 0.748\ \Omega$ $= \pm 0.373$ mA
$An_{TS} := \pm 0.233\ \Omega$ $= \pm 0.116$ mA

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B6.0 COMPUTATIONS / ANALYSES

B6.1.3 SEISMIC ACCURACY (As)

As = Normal accuracy (An) + Seismic contributions

For unit 2:

$An_{TE} := \pm 0.43\ \Omega$ $= \pm 0.215$ mA (From base Calc.)
$An_{TIS} := \pm 0.62\ \Omega$ $= \pm 0.309$ mA
$An_{TS} := \pm 0.233\ \Omega$ $= \pm 0.116$ mA

For unit 3:

$An_{TE} := \pm 0.43\ \Omega$ $= \pm 0.215$ mA (From base Calc.)
$An_{TIS} := \pm 0.748\ \Omega$ $= \pm 0.373$ mA
$An_{TS} := \pm 0.233\ \Omega$ $= \pm 0.116$ mA

B6.1.4 ACCIDENT ACCURACY Aa

Aa is An PLUS ACCIDENT CONTRIBUTIONS

For unit 2:

$An_{TE} := \pm 0.43\ \Omega$ $= \pm 0.215$ mA (From base Calc.)
$An_{TIS} := \pm 0.62\ \Omega$ $= \pm 0.309$ mA
$An_{TS} := \pm 0.233\ \Omega$ $= \pm 0.116$ mA

For unit 3:

$An_{TE} := \pm 0.43\ \Omega$ $= \pm 0.215$ mA (From base Calc.)
$An_{TIS} := \pm 0.748\ \Omega$ $= \pm 0.373$ mA
$An_{TS} := \pm 0.233\ \Omega$ $= \pm 0.116$ mA

B6.1.5 DESIGN BASIS EVENT ACCURACY (Adbe)

Since Adbe is equal to the larger of Aa and As

For unit 2:

$An_{TE} := \pm 0.43\ \Omega$ $= \pm 0.215$ mA (From base Calc.)
$An_{TIS} := \pm 0.62\ \Omega$ $= \pm 0.309$ mA
$An_{TS} := \pm 0.233\ \Omega$ $= \pm 0.116$ mA

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B6.0 COMPUTATIONS / ANALYSES

B6.1.5 DESIGN BASIS EVENT ACCURACY (Adbe) Continued

For unit 3:

$An_{TE} := \pm 0.43\ \Omega$ $= \pm 0.215$ mA (From base Calc.)
$An_{TIS} := \pm 0.748\ \Omega$ $= \pm 0.373$ mA
$An_{TS} := \pm 0.233\ \Omega$ $= \pm 0.116$ mA

B6.1.6 COMBINED ACCIDENT AND SEISMIC ACCURACY (Aas)

Aas = Aa + Se

For unit 2:

$An_{TE} := \pm 0.43\ \Omega$ $= \pm 0.215$ mA (From base Calc.)
$An_{TIS} := \pm 0.62\ \Omega$ $= \pm 0.309$ mA
$An_{TS} := \pm 0.233\ \Omega$ $= \pm 0.116$ mA

For unit 3:

$An_{TE} := \pm 0.43\ \Omega$ $= \pm 0.215$ mA (From base Calc.)
$An_{TIS} := \pm 0.748\ \Omega$ $= \pm 0.373$ mA
$An_{TS} := \pm 0.233\ \Omega$ $= \pm 0.116$ mA

B6.1.7 COMPONENT ACCEPTANCE BAND (Ab)

Ab_{TE} := N/A	= N/A		
$Ab_{TIS} := \pm 0.24\ \Omega$	$= \pm 0.12$ mA	$= \pm 1.2$ °F	$= \pm 0.03$ V
$Ab_{TS} := \pm 0.214\ \Omega$	$= \pm 0.107$ mA	$= \pm 1.0$ °F	$= \pm 0.027$ V

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B6.0 COMPUTATIONS / ANALYSES

B6.2 TIS LOOP (TE AND TIS) ACCURACY CALCULATIONS:

B6.2.1 NORMAL MEASURABLE ACCURACY Anf

Anf = Normal Inst. Errors at the time of cal. (NE) + Test Equip Errors (CE)

LAnf $= \pm Anf_{TIS}$

For unit 2: LAnf	= ± 0.62 Ω.	± 0.309 mA	= ± 0.077 V	± 2.9 °F
For unit 3: LAnf	= ± 0.748 Ω.	± 0.373 mA	= ± 0.093 V	= ± 3.5 °F

B6.2.2 NORMAL ACCURACY An

An = Anf COMBINED WITH UNMEASURABLE ERRORS

LAn $= \pm \sqrt{Anf_{TE}^2 + Anf_{TIS}^2}$

For unit 2:LAn $= \pm \sqrt{0.43^2 + 0.62^2}$

= ± 0.755 Ω. = ±0.377 mA = ± 0.094 V = ± 3.6 °F

For unit 3:LAn $= \pm \sqrt{0.43^2 + 0.748^2}$

= ± 0.863 Ω. = ±0.43 mA = ± 0.105 V = ± 4.1 °F

B6.2.3 SEISMIC ACCURACY (As)

As = Normal accuracy (An) + Seismic contributions

For Unit 2:	LAs	= ± 0.755 Ω.	= ±0.377 mA	= ± 0.094 V	= ± 3.6 °F
For Unit 3:	LAs	= ± 0.863 Ω.	= ±0.43 mA	= ± 0.105 V	= ± 4.1 °F

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B6.0 COMPUTATIONS / ANALYSES

B6.2.4 ACCIDENT ACCURACY LAa

LAa is An plus accident contributions

For Unit 2:	LAa	= ± 0.755 Ω.	= ±0.377 mA	= ± 0.094 V	= ± 3.6 °F
For Unit 3:	LAa	= ± 0.863 Ω.	= ±0.43 mA	= ± 0.105 V	= ± 4.1 °F

B6.2.5 DESIGN BASIS EVENT ACCURACY (Adbe)

Since Adbe is equal to the larger of Aa and As

For Unit 2:	LAdbe	= ± 0.755 Ω.	= ±0.377 mA	= ± 0.094 V	= ± 3.6 °F
For Unit 3:	LAdbe	= ± 0.863 Ω.	= ±0.43 mA	= ± 0.105 V	= ± 4.1 °F

B6.2.6 COMBINED ACCIDENT AND SEISMIC ACCURACY (Aas)

LAas = Aa + Se

For Unit 2:	LAas	= ± 0.755 Ω.	= ±0.377 mA	= ± 0.094 V	= ± 3.6 °F
For Unit 3:	LAas	= ± 0.863 Ω.	= ±0.43 mA	= ± 0.105 V	= ± 4.1 °F

B6.2.7 L00P ACCEPTANCE BAND Ab

LAb	= ± 0.12 mA	= ± 0.24 Ω.	= ± 1.2 °F	= ± 0.03 V

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B6.0 COMPUTATIONS / ANALYSES

B6.3 TS LOOP (TE, TIS, TS) ACCURACY CALCULATIONS:

B6.3.1 NORMAL MEASURABLE ACCURACY Anf

Anf = Normal Inst. Errors at the time of cal. (NE) + Test Equip Errors (CE)

$$LAnf = \pm\sqrt{Anf_{TIS}^2 + Anf_{TS}^2}$$

For Unit 2: $LAnf = \pm\sqrt{0.309^2 + 0.116^2}$

$= \pm 0.33$ mA $= \pm 0.662\ \Omega$. $= \pm 0.083$ V $= \pm 3.1$ °F

For Unit 3: $LAnf = \pm\sqrt{0.373^2 + 0.116^2}$

$= \pm 0.391$ mA $= \pm 0.784\ \Omega$. $= \pm 0.098$ V $= \pm 3.7$ °F

B6.3.2 NORMAL ACCURACY An

An = Anf COMBINED WITH UNMEASURABLE ERRORS

$$LAn = \pm\sqrt{Anf_{TE}^2 + Anf_{TIS}^2 + Anf_{TS}^2}$$

For Unit 2: $LAn = \pm\sqrt{0.215^2 + 0.309^2 + 0.116^2}$

$= \pm 0.394$ mA $= \pm 0.790\ \Omega$ $= \pm 0.099$ V $= \pm 3.7$ °F

For Unit 3: $LAn = \pm\sqrt{0.215^2 + 0.373^2 + 0.116^2}$

$= \pm 0.446$ mA $= \pm 0.894\ \Omega$ $= \pm 0.112$ V $= \pm 4.2$ °F

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B6.0 COMPUTATIONS / ANALYSES

B6.3.3 SEISMIC ACCURACY (As)

As = Normal accuracy (An) + Seismic contributions

For unit 2:	LAs	= ± 0.394 mA	= ±0.790 Ω	= ± 0.099 V	= ± 3.7 °F
For unit 3:	LAs	= ± 0.446 mA	= ±0.894 Ω	= ± 0.112 V	= ± 4.2 °F

B6.3.4 ACCIDENT ACCURACY LAa

LAa is An plus accident contributions

For unit 2:	LAa	= ± 0.394 mA	= ±0.790 Ω	= ± 0.099 V	= ± 3.7 °F
For unit 3:	LAa	= ± 0.446 mA	= ±0.894 Ω	= ± 0.112 V	= ± 4.2 °F

B6.3.5 DESIGN BASIS EVENT ACCURACY (Adbe)

Since Adbe is equal to the larger of Aa and As

For unit 2:	LAdbe =	± 0.394 mA	= ±0.790 Ω	= ± 0.099 V	= ± 3.7 °F
For unit 3:	LAdbe =	± 0.446 mA	= ±0.894 Ω	= ± 0.112 V	= ± 4.2 °F

B6.3.6 COMBINED ACCIDENT AND SEISMIC ACCURACY (Aas)

LAas = Aa + Se

For unit 2:	LAas	= ± 0.394 mA	= ±0.790 Ω	= ± 0.099 V	= ± 3.7 °F
For unit 3:	LAas	= ± 0.446 mA	= ±0.894 Ω	= ± 0.112 V	= ± 4.2 °F

B6.3.7 LOOP ACCEPTANCE BAND $Ab_{TIS/TS}$

$$LAb = \pm\sqrt{Ab_{TIS}^2 + Ab_{TS}^2}$$

$$= \pm \sqrt{0.12^2 + 0.107^2}\ \text{mA}$$

$$= \pm 0.161\ \text{mA} = 0.323\ \Omega. \quad = \pm 1.5\ °F \quad = \pm 0.041\ V$$

B6.4 Setpoint (SP) of unit 2 and unit 3 TS

The setpoint must satisfy the following :
Therefore SP < AV + Anf

For unit 2: SP < 200 - 2.9 = 197.1 ° F
For unit 3: SP < 200 - 3.5 = 196.5 °F

Therefore, for both units, the Setpoint is kept the same as the existing of
SP = 189 °F

B6.5 Setpoint (SP) of TIS for Unit 2

The setpoint must satisfy the following :
Therefore SP < AV + Anf
SP < 188 - 2.9 = 185.1 ° F

Therefore the Setpoint is kept the same as the existing of
SP = 185 °F

B6.6 Setpoint (SP) of TIS for Unit 3

The setpoint must satisfy the following :
Therefore SP < AV + Anf
SP < 201 - 3.5 = 197.5 ° F

Therefore the Setpoint is kept the same as the existing of
SP = 197 °F

B6.0 COMPUTATIONS / ANALYSES

B6.7 Plant Operations Parameters

Allowable Value (AV)

Per reference 1, the allowable value is :

$AV = SP \pm Anf$

$AV_u \geq 189 + 2.9 = 191.9$ °F for unit 2 MSIV Isolation

$AV_u = 200$ °F

$AV_u \geq 189 + 3.5 = 192.5$ °F for unit 3 MSIV Isolation

$AV_u = 200$ °F

$AV_u \geq 185 + 2.9 = 187.3$ °F for Unit 2 RWCU Isolation

$AV_u = 188$ °F

$AV_u \geq 197 + 3.5 = 200.5$ °F for Unit 3 RWCU Isolation

$AV_u = 201$ °F

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7.0 Computations and Analyses
7.1 Temperature Component Analyses

1-TE-69-834A/B/C/D, -835A/B/C/D, -836A/B/C/D, -837A/B/C/D, -838A/B/C/D (from body of calculation):

Re_{TE} = ±0.43 Ω = ± 2.0 °F

Normal Measurable Accuracy:
Anf_{TE} = N/A

Normal Accuracy:
$An_{TE} = Re_{TE}$ = ± 2.0 °F

Seismic Accuracy:
$As_{TE} = An_{TE}$ = ± 2.0 °F

Accident Accuracy:
$Aa_{TE} = An_{TE}$ = ± 2.0 °F

Combined Seismic and Accident Accuracy:
$Aas_{TE} = As_{TE}$ = ± 2.0 °F

1-TIS-69-834A/B/C/D, -835A/B/C/D, -836A/B/C/D, -837A/B/C/D, -838A/B/C/D (from Appendix B):
SPAN = 150°F

Re_{TIS} =	±0.75% SPAN	=	± 1.2 °F
TNe_{TIS} =	±0.015% SPAN / °F x (104-60)	=	± 1.0 °F
$ICTe_{TIS}$ =	Re_{TIS}	=	± 1.2 °F
$ICTe_{TIS_\Omega}$ =	Re_{TIS} x 2.116 Ω / 150 °F	=	± 0.24 Ω
Ab_{TIS} =	Re_{TIS}	=	± 1.2 °F

Normal Measurable Accuracy:
$Anf_{TIS} = \pm(Re_{TIS}^2 + TNe_{TIS}^2 + ICTe_{TIS}^2 + Ab_{TIS}^2)^{1/2}$
Anf_{TIS} = ± 2.3 °F

Normal Accuracy:
$An_{TIS} = Anf_{TIS}$ = ± 2.3 °F

Seismic Accuracy:
$As_{TIS} = An_{TIS}$ = ± 2.3 °F

Accident Accuracy:
$Aa_{TIS} = An_{TIS}$ = ± 2.3 °F

Combined Seismic and Accident Accuracy:
$Aas_{TIS} = As_{TIS}$ = ± 2.3 °F

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7.0 Computations and Analyses (continued)
7.1 Temperature Component Analyses (continued)

1-TS-1-17A/B/C/D (from Appendix B):
SPAN = 150°F

Re_{TS} =	±0.2% SPAN	=	± 0.3 °F
$ICTe_{TS}$ =	Re_{TS}	=	± 0.3 °F
$ICTe_{TS_V}$ =	Re_{TS} x 4 V / 150°F	=	± 0.008 V
Ab_{TS} =	Selected >= Re_{TS}	=	± 1.0 °F

Normal Measurable Accuracy:
$Anf_{TS} = \pm(Re_{TS}^2 + ICTe_{TS}^2 + Ab_{TS}^2)^{1/2}$
$Anf_{TS} = \pm 1.1$ °F

Normal Accuracy:
$An_{TS} = Anf_{TS} = \pm 1.1$ °F

Seismic Accuracy:
$As_{TS} = An_{TS} = \pm 1.1$ °F

Accident Accuracy:
$Aa_{TS} = An_{TS} = \pm 1.1$ °F

Combined Seismic and Accident Accuracy:
$Aas_{TS} = As_{TS} = \pm 1.1$ °F

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7.0 Computations and Analyses (continued)
7.2 Temperature Loop Accuracies

For RWCU Isolation (TE-TIS):

NORMAL MEASURABLE ACCURACY:
$LAnf_{TIS} = Anf_{TIS}$
$LAnf_{TIS} = \pm 2.3\ °F$

NORMAL ACCURACY:
$LAn_{TIS} = \pm (An_{TE}^2 + An_{TIS}^2)^{1/2}$
$LAn_{TIS} = \pm 3.1\ °F$

SEISMIC ACCURACY:
$LAs_{TIS} = LAn_{TIS}$
$LAs_{TIS} = \pm 3.1\ °F$

ACCIDENT ACCURACY:
$LAa_{TIS} = LAn_{TIS}$
$LAa_{TIS} = \pm 3.1\ °F$

DESIGN BASIS EVENT ACCURACY:
$LAdbe_{TIS}$ is the greater of LAs_{TIS} and LAa_{TIS}
$LAdbe_{TIS} = \pm 3.1\ °F$

SEISMIC & ACCIDENT ACCURACY:
$LAas_{TIS} = LAn_{TIS}$
$LAas_{TIS} = \pm 3.1\ °F$

ACCEPTANCE BAND:
$LAb_{TIS} = Ab_{TIS}$
$LAb_{TIS} = \pm 1.2\ °F$

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7.0 Computations and Analyses (continued)
7.2 Temperature Loop Accuracies

For MS Isolation (TE-TIS-TS):

NORMAL MEASURABLE ACCURACY:
$LAnf_{TS} = \pm (An_{TIS}^2 + An_{TS}^2)^{1/2}$
$LAnf_{TS} = \pm 2.6$ °F

NORMAL ACCURACY:
$LAn_{TS} = \pm (An_{TE}^2 + An_{TIS}^2 + An_{TS}^2)^{1/2}$
$LAn_{TS} = \pm 3.2$ °F

SEISMIC ACCURACY:
$LAs_{TS} = LAn_{TS}$
$LAs_{TS} = \pm 3.2$ °F

ACCIDENT ACCURACY:
$LAa_{TS} = LAn_{TS}$
$LAa_{TS} = \pm 3.2$ °F

DESIGN BASIS EVENT ACCURACY:
$LAdbe_{TS}$ is the greater of LAs_{TS} and LAa_{TS}
$LAdbe_{TIS} = \pm 3.2$ °F

SEISMIC & ACCIDENT ACCURACY:
$LAas_{TS} = LAn_{TS}$
$LAas_{TS} = \pm 3.2$ °F

ACCEPTANCE BAND:
$LAb_{TS} = \pm (Ab_{TIS}^2 + Ab_{TS}^2)^{1/2}$
$LAb_{TS} = \pm 1.6$ °F

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7.0 Computations and Analyses (continued)
7.3 Plant Operations Parameters
7.3.1 1-TIS-069-0834A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:
LOL + LAdbe ≤ SP ≤ UAL - LAdbe
180 + 3.1 ≤ SP ≤ 205 - 3.1
183.1 ≤ SP ≤ 201.9
Therefore, the selected setpoint of 197°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe)
M_{UAL} = 205 - (197 + 3.1)
M_{UAL} = 4.9°F

M_{LOL} = (SP + LAdbe) - LOL
M_{LOL} = (197 - 3.1) – 180
M_{LOL} = 13.9°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:
SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
197 + 2.3 ≤ AV ≤ 205 - (3.1 - 2.3)
199.3 ≤ AV ≤ 204.2
Therefore, the technical specification allowable value of 201°F is acceptable.

7.3.2 1-TS-001-0017A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:
LOL + LAdbe ≤ SP ≤ UAL - LAdbe
180 + 3.2 ≤ SP ≤ 205 - 3.2
183.2 ≤ SP ≤ 201.8
Therefore, the selected setpoint of 189°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe)
M_{UAL} = 205 - (189 + 3.2)
M_{UAL} = 12.8°F

M_{LOL} = (SP + LAdbe) - LOL
M_{LOL} = (189 - 3.2) – 180
M_{LOL} = 5.8°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:
SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
189 + 2.6 ≤ AV ≤ 205 - (3.2 - 2.6)
191.6 ≤ AV ≤ 204.4
Therefore, the technical specification allowable value of 200°F is acceptable.

7.0 Computations and Analyses (continued)
7.3 Plant Operations Parameters (continued)
7.3.3 1-TIS-069-0835A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:
LOL + LAdbe ≤ SP ≤ UAL - LAdbe
100 + 3.1 ≤ SP ≤ 140 - 3.1
103.1 ≤ SP ≤ 136.9
Therefore, the selected setpoint of 131°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe)	M_{LOL} = (SP + LAdbe) - LOL
M_{UAL} = 140 - (131 + 3.1)	M_{LOL} = (131 - 3.1) - 100
M_{UAL} = 5.9°F	M_{LOL} = 27.9°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:
SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
131 + 2.3 ≤ AV ≤ 140 - (3.1 - 2.3)
133.3 ≤ AV ≤ 139.2
Therefore, the technical specification allowable value of 135°F is acceptable.

7.3.4 1-TIS-069-0836A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:
LOL + LAdbe ≤ SP ≤ UAL - LAdbe
130 + 3.1 ≤ SP (no upper analytical limit)
133.1 ≤ SP
Therefore, the selected setpoint of 148°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe)	M_{LOL} = (SP + LAdbe) - LOL
M_{UAL} = N/A	M_{LOL} = (148 - 3.1) - 130
M_{UAL} = N/A	M_{LOL} = 14.9°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:
SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
148 + 2.3 ≤ AV (no upper analytical limit)
150.3 ≤ AV
Therefore, the technical specification allowable value of 152°F is acceptable.

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7.0 Computations and Analyses (continued)
7.3 Plant Operations Parameters (continued)
7.3.5 1-TIS-069-0837A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:
LOL + LAdbe ≤ SP ≤ UAL - LAdbe
130 + 3.1 ≤ SP (no upper analytical limit)
133.1 ≤ SP
Therefore, the selected setpoint of 148°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe)	M_{LOL} = (SP + LAdbe) - LOL
M_{UAL} = N/A	M_{LOL} = (148 - 3.1) - 130
M_{UAL} = N/A	M_{LOL} = 14.9°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:
SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
148 + 2.3 ≤ AV (no upper analytical limit)
150.3 ≤ AV
Therefore, the technical specification allowable value of 152°F is acceptable.

7.3.6 1-TIS-069-0838A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:
LOL + LAdbe ≤ SP ≤ UAL - LAdbe
135 + 3.1 ≤ SP ≤ 175 - 3.1
138.1 ≤ SP ≤ 171.9
Therefore, the selected setpoint of 139°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe)	M_{LOL} = (SP + LAdbe) - LOL
M_{UAL} = 175 - (139 + 3.1)	M_{LOL} = (139 - 3.1) - 135
M_{UAL} = 32.9°F	M_{LOL} = 0.9°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:
SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
139 + 2.3 ≤ AV ≤ 175 - (3.1 - 2.3)
141.3 ≤ AV ≤ 174.2
Therefore, the technical specification allowable value of 143°F is acceptable.

Appendix D

CALCULATION NUMBER		REV. NO.	SHEET NO.
ED-Q0069-890080		6	1 of 22
PREPARER	DATE	CHECKER	DATE

ANALYSIS OF INSTRUMENT LOOPS
2/3-T-69-835A, B, C,D; 2/3-T-69-836A,B,C,D; 2/3-T-69-837A,B,C,D; and 2/3-T-69-838A, B, C, D

1.0 Purpose

The purpose of this Appendix is to document the applicability of the following list of instruments to have a calibration cycle of 24 +25% months.

2/3-T-69-835 A, B, C, D 2/3-T-69-836 A, B, C, D
2/3-T-69-837 A, B, C, D and 2/3-T-69-838 A, B, C, D

2.0 Methodology

This Appendix contains a summary of instrument accuracies for the subject instruments and loops. The methodology utilized for the evaluation of instrument and loop uncertainties in this Appendix is identical to that used in the body of this calculation.

3.0 Assumptions / Requirements

There are no unverified assumptions in this Appendix.

4.0 References

The references used in this Appendix refer to the references from Section 3 and Appendix B of this calculation. Additional references needed to support the analysis of this Appendix are numbered starting from the next numerical number and are listed below:

Ref.#	DDI Y/N	Att#	Reference
72	Y		DCN 60183

5.0 Loop Component List:

All instruments for unit 2 and 3, which are called out in section 1.0 of this appendix.

6.0 Component Data:

All component data is given in the respective sections. Setpoints, allowable values, lower operational limit and upper analytical limits are given in the next page.

Appendix D

CALCULATION NUMBER	REV. NO.	SHEET NO.
ED-Q0069-890080	6	2 of 22
PREPARER DATE	CHECKER DATE	

6.0 Component Data:

Setpoints, Allowable value and Analytical Limits:

Unit 2						
Tag	Location/ EQ room	Setpoint in °F	AV in °F	LOL in °F	UAL in °F	Ref.
835 A,B,C,D	PPTR 8	131	135	120	140	43,44,5
836 A,B,C,D	PR-A 10	148	152	130	N/A	43,44,7
837 A,B,C,D	PR-B 10	148	152	130	N/A	43,44,7
838 A,B,C,D	HER 11	139	143	135	160	43,44,7
Unit 3						
Tag	Location / EQ Room	Setpoint in °F	AV in °F	LOL in °F	UAL in °F	Ref.
835 A,B,C,D	PPTR 8	131	135	120	140	42,45,5
836 A,B,C,D	PR-A 10	148	152	130	N/A	42,45,7
837 A,B,C,D	PR-B 10	148	152	130	N/A	42,45,7
838 A,B,C,D	HER 11	139	143	135	175	42,45,7

Appendix D

CALCULATION NUMBER		REV. NO.	SHEET NO.
ED-Q0069-890080		6	3 of 22
PREPARER	DATE	CHECKER	DATE

7.0 Computations and Analyses

7.1 Component Analyses

7.1.1 The Weed RTD accuracy from the body of calculation:

Repeatability: Re_{TE} = ± 0.43 Ω = ± 2.0 °F

Normal Measurable Accuracy:

Anf_{TE} = N/A

Normal Accuracy:

$An_{TE} = Re_{TE}$ = ± 2.0 °F

Seismic Accuracy:

$As_{TE} = An_{TE}$ = ± 2.0 °F

Accident Accuracy:

$Aa_{TE} = An_{TE}$ = ± 2.0 °F

Combined Seismic and Accident Accuracy:

$Aas_{TE} = As_{TE}$ = ± 2.0 °F

7.1.2 The Rosemount TIS accuracy from Appendix B (Master trip unit):

SPAN = 150°F

Re_{TIS}	= ±0.75% SPAN	= ± 1.2 °F
TNe_{TIS}	= ±0.015% SPAN / °F x (104-60)	= ± 1.0 °F
$ICTe_{TIS}$	= Re_{TIS}	= ± 1.2 °F
Ab_{TIS}	= Re_{TIS}	= ± 1.2 °F

Appendix D

CALCULATION NUMBER	REV. NO.	SHEET NO.
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7.0 Computations and Analyses (continued)

7.2 Temperature Switch Accuracies (Master trip unit)

Normal Measurable Accuracy:

$$Anf_{TIS} = \pm(Re_{TIS}^2 + TNe_{TIS}^2 + ICTe_{TIS}^2 + Ab_{TIS}^2)^{1/2}$$

$$Anf_{TIS} = \pm 2.3\ °F$$

Normal Accuracy:

$$An_{TIS} = Anf_{TIS} = \pm 2.3\ °F$$

Seismic Accuracy:

$$As_{TIS} = An_{TIS} = \pm 2.3\ °F$$

Accident Accuracy:

$$Aa_{TIS} = An_{TIS} = \pm 2.3\ °F$$

Combined Seismic and Accident Accuracy:

$$Aas_{TIS} = As_{TIS} = \pm 2.3\ °F$$

7.3 Temperature Loop Accuracies

For RWCU Isolation (TE-TIS):

NORMAL MEASURABLE ACCURACY:

$$LAnf_{TIS} = Anf_{TIS}$$

$$LAnf_{TIS} = \pm 2.3\ °F$$

NORMAL ACCURACY:

$$LAn_{TIS} = \pm (An_{TE}^2 + An_{TIS}^2)^{1/2}$$

$$LAn_{TIS} = \pm 3.1\ °F$$

Appendix D

CALCULATION NUMBER		REV. NO.	SHEET NO.
ED-Q0069-890080		6	5 of 22
PREPARER	DATE	CHECKER	DATE

7.0 Computations and Analyses (continued)

7.3 Temperature Loop Accuracies (Continued)

For RWCU Isolation (TE-TIS):

SEISMIC ACCURACY:

$LAs_{TIS} = LAn_{TIS}$

$LAs_{TIS} = \pm 3.1\ °F$

ACCIDENT ACCURACY:

$LAa_{TIS} = LAn_{TIS}$

$LAa_{TIS} = \pm 3.1\ °F$

DESIGN BASIS EVENT ACCURACY:

$LAdbe_{TIS}$ is the greater of LAs_{TIS} and LAa_{TIS}

$LAdbe_{TIS} = \pm 3.1\ °F$

SEISMIC & ACCIDENT ACCURACY:

$LAas_{TIS} = LAn_{TIS}$

$LAas_{TIS} = \pm 3.1\ °F$

ACCEPTANCE BAND:

$LAb_{TIS} = Ab_{TIS}$

$LAb_{TIS} = \pm 1.2\ °F$

Appendix D

CALCULATION NUMBER		REV. NO.	SHEET NO.
ED-Q0069-890080		6	6 of 22
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7.0 Computations and Analyses (continued)

7.4 Plant Operations Parameters (continued)

7.4.1 2-TIS-069-0835A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:

$LOL + LAdbe \leq SP \leq UAL - LAdbe$
$120 + 3.1 \leq SP \leq 140 - 3.1$
$123.1 \leq SP \leq 136.9$

Therefore, the selected setpoint of 131°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

$M_{UAL} = UAL - (SP + LAdbe)$ $\quad$ $M_{LOL} = (SP + LAdbe) - LOL$
$M_{UAL} = 140 - (131 + 3.1)$ $\quad$ $M_{LOL} = (131 - 3.1) - 120$
$M_{UAL} = 5.9°F$ $\quad$ $M_{LOL} = 7.9°F$

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:

$SP + LAnf \leq AV \leq UAL - (LAdbe - LAnf)$
$131 + 2.3 \leq AV \leq 140 - (3.1 - 2.3)$
$133.3 \leq AV \leq 139.2$

Therefore, the technical specification allowable value of 135°F is acceptable.

7.4.2 3-TIS-069-0835A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:

$LOL + LAdbe \leq SP \leq UAL - LAdbe$
$120 + 3.1 \leq SP \leq 140 - 3.1$
$123.1 \leq SP \leq 136.9$

Therefore, the selected setpoint of 131°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

$M_{UAL} = UAL - (SP + LAdbe)$ $\quad$ $M_{LOL} = (SP + LAdbe) - LOL$
$M_{UAL} = 140 - (131 + 3.1)$ $\quad$ $M_{LOL} = (131 - 3.1) - 120$
$M_{UAL} = 5.9°F$ $\quad$ $M_{LOL} = 7.9°F$

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:

$SP + LAnf \leq AV \leq UAL - (LAdbe - LAnf)$
$131 + 2.3 \leq AV \leq 140 - (3.1 - 2.3)$
$133.3 \leq AV \leq 139.2$

Therefore, the technical specification allowable value of 135°F is acceptable.

Appendix D

CALCULATION NUMBER		REV. NO.	SHEET NO.
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PREPARER	DATE	CHECKER	DATE

7.0 Computations and Analyses (continued)

7.4 Plant Operations Parameters (continued)

7.4.3 2-TIS-069-0836A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:

LOL + LAdbe ≤ SP ≤ UAL - LAdbe
130 + 3.1 ≤ SP (no upper analytical limit)
133.1 ≤ SP

Therefore, the selected setpoint of 148°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe) M_{LOL} = (SP + LAdbe) - LOL
M_{UAL} = N/A M_{LOL} = (148 - 3.1) - 130
M_{UAL} = N/A M_{LOL} = 14.9°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:

SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
148 + 2.3 ≤ AV (no upper analytical limit)
150.3 ≤ AV

Therefore, the technical specification allowable value of 152°F is acceptable.

7.4.4 3-TIS-069-0836A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:

LOL + LAdbe ≤ SP ≤ UAL - LAdbe
130 + 3.1 ≤ SP (no upper analytical limit)
133.1 ≤ SP

Therefore, the selected setpoint of 148°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe) M_{LOL} = (SP + LAdbe) - LOL
M_{UAL} = N/A M_{LOL} = (148 - 3.1) - 130
M_{UAL} = N/A M_{LOL} = 14.9°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:

SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
148 + 2.3 ≤ AV (no upper analytical limit)
150.3 ≤ AV

Therefore, the technical specification allowable value of 152°F is acceptable.

Appendix D

CALCULATION NUMBER		REV. NO.	SHEET NO.
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PREPARER	DATE	CHECKER	DATE

7.0 Computations and Analyses (continued)

7.4 Plant Operations Parameters (continued)

7.4.5 2-TIS-069-0837A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:

LOL + LAdbe ≤ SP ≤ UAL - LAdbe
130 + 3.1 ≤ SP (no upper analytical limit)
133.1 ≤ SP

Therefore, the selected setpoint of 148°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe) M_{LOL} = (SP + LAdbe) - LOL
M_{UAL} = N/A M_{LOL} = (148 - 3.1) - 130
M_{UAL} = N/A M_{LOL} = 14.9°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:

SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
148 + 2.3 ≤ AV (no upper analytical limit)
150.3 ≤ AV

Therefore, the technical specification allowable value of 152°F is acceptable.

7.4.6 3-TIS-069-0837A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:

LOL + LAdbe ≤ SP ≤ UAL - LAdbe
130 + 3.1 ≤ SP (no upper analytical limit)
133.1 ≤ SP

Therefore, the selected setpoint of 148°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe) M_{LOL} = (SP + LAdbe) - LOL
M_{UAL} = N/A M_{LOL} = (148 - 3.1) - 130
M_{UAL} = N/A M_{LOL} = 14.9°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:

SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
148 + 2.3 ≤ AV (no upper analytical limit)
150.3 ≤ AV

Therefore, the technical specification allowable value of 152°F is acceptable.

Appendix D

CALCULATION NUMBER		REV. NO.	SHEET NO.
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7.0 Computations and Analyses (continued)

7.4 Plant Operations Parameters (continued)

7.4.7 2-TIS-069-0838A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:

LOL + LAdbe ≤ SP ≤ UAL - LAdbe
135 + 3.1 ≤ SP ≤ 160 - 3.1
138.1 ≤ SP ≤ 156.9

Therefore, the selected setpoint of 139°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe)
M_{UAL} = 160 - (139 + 3.1)
M_{UAL} = 17.9°F

M_{LOL} = (SP + LAdbe) - LOL
M_{LOL} = (139 - 3.1) - 135
M_{LOL} = 0.9°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:

SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
139 + 2.3 ≤ AV ≤ 160 - (3.1 - 2.3)
141.3 ≤ AV ≤ 159.2

Therefore, the technical specification allowable value of 143°F is acceptable.

7.4.8 3-TIS-069-0838A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:

LOL + LAdbe ≤ SP ≤ UAL - LAdbe
135 + 3.1 ≤ SP ≤ 175 - 3.1
138.1 ≤ SP ≤ 171.9

Therefore, the selected setpoint of 139°F is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

M_{UAL} = UAL - (SP + LAdbe)
M_{UAL} = 175 - (139 + 3.1)
M_{UAL} = 32.9°F

M_{LOL} = (SP + LAdbe) - LOL
M_{LOL} = (139 - 3.1) - 135
M_{LOL} = 0.9°F

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:

SP + LAnf ≤ AV ≤ UAL - (LAdbe - LAnf)
139 + 2.3 ≤ AV ≤ 175 - (3.1 - 2.3)
141.3 ≤ AV ≤ 174.2

Therefore, the technical specification allowable value of 143°F is acceptable.

Appendix D

CALCULATION NUMBER		REV. NO.	SHEET NO.
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7.5 Setpoint and Allowable value in Ωs

From Vendor literature, reference 4, attachment 4,

120 °F =118.97 Ω	160 °F =127.50 Ω
140 °F =123.24 Ω	180 °F =131.74 Ω
	200 °F =135.97 Ω
20 °F $_{120 \text{ to } 140}$ = 4.27 Ω	20 °F $_{160 \text{ to } 180}$ = 4.24 Ω
20 °F $_{140 \text{ to } 160}$ = 4.26 Ω	20 °F $_{180 \text{ to } 200}$ = 4.23 Ω
1 °F $_{120 \text{ to } 140}$ = 0.2135 Ω	1 °F $_{160 \text{ to } 180}$ = 0.212 Ω
1 °F $_{140 \text{ to } 160}$ = 0.213 Ω	1 °F $_{180 \text{ to } 200}$ = 0.2115 Ω

Therefore

SP of 131°F	= 118.97+0.2135 x 11	=121.32 Ω
SP of 148 °F	= 123.24+0.213 x 8	=124.94 Ω
SP of 139 °F	= 123.24-0.2135 x 1	=123.03 Ω
AV of 135 °F	= 123.24-0.2135 x 5	= 122.17 Ω
AV of 152 °F	= 123.24 + 0.213 x12	= 125.80 Ω
AV of 143 °F	= 123.24 + 0.213 x3	= 123.87 Ω
2.3 °F	= 0.212 x 2.3	= 0.488 Ω
1.2 °F	= 0.212 x 1.2	= 0.254 Ω

part of BFN TS-447 RAI Enclosure 2

QA Record

ORIGINAL

TVAN CALCULATION COVERSHEET/CCRIS UPDATE

REV 0 EDMS/RIMS NO.	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
W81 920822 001	calculations(nuclear)	K14 040429 101

Calc Title: 1/2/3-T-69-839 A, B, C, & D Setpoint and Scaling Calculation

CALC ID	TYPE	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV	REVISION APPLICABILITY
CURREN	CN	NUC	BFN	EEB	EDQ2069920474	006	007	Entire calc ☐ Selected pages ☒

ACTION	NEW ☐ REVISION ☒	DELETE ☐ RENAME ☐	SUPERSEDE ☐ DUPLICATE ☐	CCRIS UPDATE ONLY ☐ (Verifier Approval Signatures Not Required)	No CCRIS Changes ☐ (For calc revision, CCRIS been reviewed and no CCRIS changes required)

UNITS	SYSTEMS	UNIDS
1/2/3	069	1/2/3-TE-69-839 A, B, C, D

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
60183	EEB-TI-28	E

QUALITY RELATED?	SAFETY RELATED? (If yes, QR = yes)	UNVERIFIED ASSUMPTION	SPECIAL REQUIREMENTS AND/OR LIMITING CONDITIONS?	DESIGN OUTPUT ATTACHMENT?	SAR/TS AFFECTED
Yes ☒ No ☐	Yes ☒ No ☐	Yes ☐ No ☒	Yes ☐ No ☒	Yes ☐ No ☒	Yes ☒ No ☐

PREPARER ID	PREPARER PHONE NO	PREPARING ORG (BRANCH)	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
Sam A. Dias	729-7958	EEB	Design Review	☐ Yes ☒ No

PREPARER SIGNATURE	DATE	CHECKER SIGNATURE	DATE
Sam A. Dias *Sam A Dias*	04/27/2004	*Rodney Briggs*	4/26/04
VERIFIER SIGNATURE	**DATE**	**APPROVAL SIGNATURE**	**DATE**
Rodney Briggs	4/26/04	*[illegible]*	4/29/2004

STATEMENT OF PROBLEM/ABSTRACT

Calculations were performed to determine the accuracy of the subject instrument loop(s). The determined accuracies are compared to the required accuracies, setpoints, safety limits and/or operational limits and the accuracy of the loops listed below are demonstrated to be acceptable for the intended function of the instrument loops.

Loop No. 1/2/3-T-69-839 A, B, C, D

MICROFICHE/EFICHE Yes ☐ No ☐ FICHE NUMBER(S)

☐ LOAD INTO EDMS AND DESTROY
☐ LOAD INTO EDMS AND RETURN CALCULATION TO CALCULATION LIBRARY. ADDRESS:
☐ LOAD INTO EDMS AND RETURN CALCULATION TO:

Appendix A

CALCULATION NUMBER		REV. NO.	SHEET NO.
ED-Q2069-920474		7	1 of 19
PREPARER	DATE	CHECKER	DATE

ALANALYSIS OF INSTRUMENT LOOPS
1/2/3-T-69-839A, B, C, D

1.0 Purpose

The purpose of this Appendix is to document the applicability of the above instruments to have a calibration cycle of 24 +25% months to all the components (Units 1, 2, and 3) of this calculation.

2.0 Assumptions / Requirements

There are no unverified assumptions in this Appendix.

3.0 Methodology

This Appendix contains a summary of instrument accuracies for the subject instruments and loops. The methodology utilized for the evaluation of instrument and loop uncertainties in this Appendix is identical to that used in the body of this calculation.

4.0 References

The references used in this Appendix refer to the references from Section 4 of this calculation. Additional references needed to support the analysis of this Appendix are numbered starting from the next numerical number and are listed below:

Ref.#	DDI Y/N	Att#	Reference
44	Y		DCN 60183

5.0 Design Input data:

All Instruments data for unit 1, 2, and 3 are listed in section 5 of this calculation.

6.0 Component Accuracies:

All component accuracies are given in the section 6.

Appendix A

CALCULATION NUMBER		REV. NO.	SHEET NO.
ED-Q2069-920474		7	2 of 19
PREPARER	DATE	CHECKER	DATE

7.0 Computations and Analyses

7.1 Component Analyses

The Weed RTD accuracy from the body of calculation:

Repeatability: Re_{TE} = ± 0.424 Ω = ± 2.0 °F

Self Heating error SHn = ± 0.19 °F

Normal Measurable Accuracy:

Anf_{TE} = N/A

Normal Accuracy:

$An_{TE} = Re_{TE}$ = ± 2.0 °F

Seismic Accuracy:

$As_{TE} = An_{TE}$ = ± 2.0 °F

Accident Accuracy:

$Aa_{TE} = An_{TE}$ = ± 2.0 °F

Combined Seismic and Accident Accuracy:

$Aas_{TE} = As_{TE}$ = ± 2.0 °F

Appendix A

CALCULATION NUMBER		REV. NO.	SHEET NO.
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7.0 Computations and Analyses (Continued)

7.2 Component Analyses (Continued)

The Rosemount TIS accuracy from Appendix B of Reference 06 (Master trip unit):

In Setpoint and Scaling calculation ED-Q2069-890080 Appendix B (reference 6), the field calibration data is collected and a statistical analysis is completed to derive the repeatability and drift for a period of 30 months. All the inaccuracy for the master trip unit is taken from the above calculation and they are as follows:

Instrument Range = 50 °F – 200 °F = 103.9 to 135.97 Ω

Therefore Span = 150°F

Re_{TIS} =	±0.75% SPAN	± 1.2 °F	± 0.254 Ω
TNe_{TIS} =	±0.015% SPAN / °F x (104-60)	± 1.0 °F	± 0.212 Ω
$ICTe_{TIS}$ =	Re_{TIS}	± 1.2 °F	± 0.254 Ω
Ab_{TIS} =	Re_{TIS}	± 1.2 °F	± 0.254 Ω

Normal Measurable Accuracy:

$$Anf_{TIS} = \pm(Re_{TIS}^2 + TNe_{TIS}^2 + ICTe_{TIS}^2 + Ab_{TIS}^2)^{1/2}$$

$$Anf_{TIS} = \pm 2.3\ °F$$

Normal Accuracy:

$$An_{TIS} = Anf_{TIS} = \pm 2.3\ °F$$

Seismic Accuracy:

$$As_{TIS} = An_{TIS} = \pm 2.3\ °F$$

Accident Accuracy:

$$Aa_{TIS} = An_{TIS} = \pm 2.3\ °F$$

Combined Seismic and Accident Accuracy:

$$Aas_{TIS} = As_{TIS} = \pm 2.3\ °F$$

Appendix A

CALCULATION NUMBER		REV. NO.	SHEET NO.
ED-Q2069-920474		7	4 of 19
PREPARER	DATE	CHECKER	DATE

7.0 Computations and Analyses (Continued)

7.3 Temperature Loop Accuracies for RWCU Isolation (TE-TIS):

NORMAL MEASURABLE ACCURACY:

$LAnf_{TIS} = Anf_{TIS}$

$LAnf_{TIS} = \pm 2.3\ °F$

NORMAL ACCURACY:

$LAn_{TIS} = \pm (An_{TE}^2 + An_{TIS}^2)^{1/2}$

$LAn_{TIS} = \pm 3.1\ °F$

SEISMIC ACCURACY:

$LAs_{TIS} = LAn_{TIS}$

$LAs_{TIS} = \pm 3.1\ °F$

ACCIDENT ACCURACY:

$LAa_{TIS} = LAn_{TIS}$

$LAa_{TIS} = \pm 3.1\ °F$

DESIGN BASIS EVENT ACCURACY:

$LAdbe_{TIS}$ is the greater of LAs_{TIS} and LAa_{TIS}

$LAdbe_{TIS} = \pm 3.1\ °F$

SEISMIC & ACCIDENT ACCURACY:

$LAas_{TIS} = LAn_{TIS}$

$LAas_{TIS} = \pm 3.1\ °F$

ACCEPTANCE BAND:

$LAb_{TIS} = Ab_{TIS}$

$LAb_{TIS} = \pm 1.2\ °F$

Appendix A

CALCULATION NUMBER		REV. NO.	SHEET NO.
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7.0 Computations and Analyses (continued)

7.4 Plant Operations Parameters

7.4.1 1-TIS-069-0839A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:

$LOL + LAdbe \leq SP \leq UAL - LAdbe$
$135 + 3.1 \leq SP \leq 173 - 3.1$
$138.1 \leq SP \leq 169.9$

Therefore, the selected setpoint of **166°F** is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

$M_{UAL} = UAL - (SP + LAdbe)$ $\quad$ $M_{LOL} = (SP - LAdbe) - LOL$
$M_{UAL} = 173 - (166 + 3.1)$ $\quad$ $M_{LOL} = (166 - 3.1) - 135$
$M_{UAL} = 3.9°F$ $\quad$ $M_{LOL} = 27.9°F$

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:

$SP + LAnf \leq AV \leq UAL - (LAdbe - LAnf)$
$166 + 2.3 \leq AV \leq 173 - (3.1 - 2.3)$
$168.3 \leq AV \leq 172.2$

Therefore, the technical specification allowable value of **170°F** is acceptable.

7.4.2 2-TIS-069-0839A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:

$LOL + LAdbe \leq SP \leq UAL - LAdbe$
$135 + 3.1 \leq SP \leq 172 - 3.1$
$138.1 \leq SP \leq 168.9$

Therefore, the selected setpoint of **166°F** is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

$M_{UAL} = UAL - (SP + LAdbe)$ $\quad$ $M_{LOL} = (SP + LAdbe) - LOL$
$M_{UAL} = 172 - (166 + 3.1)$ $\quad$ $M_{LOL} = (166 - 3.1) - 135$
$M_{UAL} = 2.9°F$ $\quad$ $M_{LOL} = 27.9\ °F$

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:

$SP + LAnf \leq AV \leq UAL - (LAdbe - LAnf)$
$166 + 2.3 \leq AV \leq 172 - (3.1 - 2.3)$
$168.3 \leq AV \leq 171.2$

Therefore, the technical specification allowable value of **170°F** is acceptable.

Appendix A

CALCULATION NUMBER		REV. NO.	SHEET NO.
ED-Q2069-920474		7	6 of 19
PREPARER	DATE	CHECKER	DATE

7.0 Computations and Analyses (continued)

7.4 Plant Operations Parameters (continued)

7.4.3 3-TIS-069-0839A/B/C/D

SETPOINT:
Per reference 1, the selected setpoint must satisfy the following criteria:

$LOL + LAdbe \leq SP \leq UAL - LAdbe$
$135 + 3.1 \leq SP \leq 173 - 3.1$
$138.1 \leq SP \leq 169.9$

Therefore, the selected setpoint of **166°F** is acceptable.

MARGIN:
Per reference 1, margin is defined by the following equation:

$M_{UAL} = UAL - (SP + LAdbe)$ $\quad$ $M_{LOL} = (SP + LAdbe) - LOL$
$M_{UAL} = 173 - (166 + 3.1)$ $\quad$ $M_{LOL} = (166 - 3.1) - 135$
$M_{UAL} = 3.9°F$ $\quad$ $M_{LOL} = 27.9°F$

ALLOWABLE VALUE:
Per reference 1, the allowable value must satisfy the following criteria:

$SP + LAnf \leq AV \leq UAL - (LAdbe - LAnf)$
$166 + 2.3 \leq AV \leq 173 - (3.1 - 2.3)$
$168.3 \leq AV \leq 172.2$

Therefore, the technical specification allowable value of **170 °F** is acceptable.

7.4.4 Setpoint and Allowable value in Ωs

160 °F	=	127.50 Ω	
180 °F	=	131.74 Ω	
Therefore	20 °F	= 4.24 Ω	
	1 °F	= 0.212 Ω	
Therefore SP of 166 °F		= 127.5+0.212 x 6	=128.772 Ω
AV 0f 170 °F		= 127.5 + 4.24/2	= 129.62 Ω
2.3 °F		= 0.212 x 2.3	= 0.488 Ω
1.2 °F		= 0.212 x 1.2	=0.254 Ω