Southern California Edison Company
23 PARKER STREET
IRVINE, CALIFORNIA 92718

September 28, 1992

WALTER C. MARSH
ASSISTANT MANAGER
NUCLEAR REGULATORY AFFAIRS

TELEPHONE
(714) 454-4403

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

Gentlemen:

Subject: **Docket Nos. 50-361 and 50-362**
Revised Calculational Method for Determining Changes in Transmitter Calibration
San Onofre Nuclear Generating Station
Units 2 and 3

The purpose of this letter is to identify a revised method utilized by the Southern California Edison (SCE) Company in calculating transmitter drift. This revised method was used in determining the setpoints for certain instruments replaced during the Unit 2 Cycle 6 Refueling Outage. In addition, SCE plans to use this revised method in future setpoint calculations.

In 1989, as part of SCE's request to extend the 18 month surveillance interval for certain PPS functions to a refueling interval, nominally 24 months, SCE performed a historical evaluation of transmitter calibration data. This evaluation, the Instrument Drift Study (IDS), was provided in summary to the NRC as part of Proposed Technical Specification Change Number NPF-10/15-275 (PCN-275), NPF-10/15-276 (PCN-276), and NPF-10/15-280 (PCN-280).

The IDS was the first known attempt to calculate allowances for transmitter drift and other effects based on experienced calibration data. Since the report was issued, however, improvements in the methods used in the IDS have been developed. In the current draft of Recommended Practice RP67.04, the Instrument Society of America (ISA) has acknowledged the basic methods developed in the IDS with some improvements. In addition, an alternate method has been acknowledged by ISA. This alternate method was utilized as part of Proposed Technical Specification Change NPF-10/15-344 (PCN-344) to extend the surveillance interval from monthly to quarterly for Plant Protection System (PPS) bistables.

DISCUSSION

During the Cycle 6 Refueling Outage (Fall 1991) for the San Onofre Nuclear Generating Station (SONGS) Unit 2, certain pressure and level transmitters which provide input signals to the PPS, were replaced. In the course of preparing the design change, it was determined it would be necessary to update certain PPS setpoint calculations to reflect the transmitter qualification test results.

9210010156 920928
PDR ADOCK 05000361
P PDR

A001

SCE evaluated the qualification test results obtained for the replaced pressure and level transmitters in comparison to the previously used devices. Based on this, the historical transmitter calibration data was reevaluated to develop more appropriate allowances for transmitter drift.

The following PPS functions are affected:

- High Pressurizer Pressure;
- Low Steam Generator Pressure
- Low Steam Generator Level;
- High Steam Generator Delta Pressure;
- High Steam Generator Level; and
- Low Pressurizer Pressure

A method similar to that used in PCN-344 was utilized in the revised calculational method for determining the changes in transmitter setpoints for these PPS functions. The most recent setpoint calculations were performed by ABB Combustion Engineering using the more recent transmitter qualification data and the revised allowances for transmitter drift provided by SCE. No changes were made in the safety analysis.

The revised method for calculating changes in transmitter calibration provides a more precise method of determining the expected changes in transmitter calibration. The primary differences between the new method, and the method described in the IDS Summary, are summarized below:

- All five calibration data points were utilized. The IDS utilized the maximum of the five points;
- The change in calibration was not annualized. The IDS annualized the drift data;
- No test for outliers was applied. The IDS used the T-Test to identify and remove outliers for the sample population;
- No test for normality was applied since the technique does not depend on a normal distribution of drift data. The IDS applied a Chi-Square test for normality; and
- The 95% confidence interval was determined using the F Distribution. The IDS selected an appropriate standard deviation multiplier based on the sample size.

Enclosure A to this letter provides a summary of the revised method. Also provided for reference is Enclosure B, the IDS Summary, which was originally provided as an enclosure to PCN-275, PCN-276, and PCN-280. Enclosure B describes the previous method for calculating the transmitter drift for the above PPS functions.

SUMMARY

During the SONGS Unit 2 Cycle 6 Refueling Outage, certain pressure and level transmitters were replaced. This necessitated updating PPS setpcint calculations to reflect the transmitter qualification test results. An alternate method to that used previously was used to develop more appropriate allowances for transmitter drift. In addition, this revised method will be used in future setpoint calculations.

If you have any questions or comments regarding this letter, please do not hesitate to call me.

Very truly yours,

Walter C Marsh

Enclosures
cc: J. B. Martin, Regional Administrator, NRC Region V
C. W. Caldwell, NRC Senior Resident Inspector, San Onofre Units 1, 2&3
M. B. Fields, NRC Project Manager, San Onofre Units 2 and 3

ENCLOSURE A

SUMMARY OF
REVISED CALCULATIONAL METHOD FOR DETERMINING
CHANGES IN TRANSMITTER CALIBRATION

Summary of

Revised Calculational Method for Determining Changes in Transmitter Calibration

1.0 Scope

The scope of this calculation is limited to Foxboro NE13DM and E13DM transmitters used at SONGS Units 2 and 3 for various monitoring, control, and protective functions. The scope was primarily limited to transmitters which are used in technical specification applications.

2.0 Determination of Drift Values

To conduct this analysis, a Lotus 1-2-3 spreadsheet template was constructed. The calibration data for the transmitters of interest were recovered, entered into this spreadsheet template, and a unique spreadsheet was constructed for each transmitter. A "best effort" was made to recover calibration data. Data associated with transmitters used in technical specification applications where the interval between calibration was greater than 683 days (22.5 months) was excluded from the population. The results of the analysis of the total population can be applied to the subsets if there are no significant differences between the subsets. These differences will be quantified by comparison of the average, median, and standard deviation of each subset.

Each spreadsheet contains a group of 5 cells (corresponding to each of the 5 calibration points) that calculate the difference between the as-found readings and the as-left readings of the previous calibration period. This difference is calculated for each set of successive calibration records that were recovered for increasing data only. Using this technique results in five data points, one each for 0, 25, 50, 75, and 100% of span, for two successive calibrations. A unique spreadsheet was constructed for each transmitter. Each of these spreadsheets may contain multiple, one, or no calibration drift data.

The values for drift were determined for each transmitter by first subtracting the related required value from both the as-left and as-found values for each transmitter to determine the deviations associated with each calibration. The as-left deviation was then subtracted from the as-found deviation to determine the change in calibration for the respective calibration point. In equation form,

$$Delta_{i,j} = [\ (AF_{i,j} - AFR_{i,j}) - (AL_{i-1,j} - ALR_{i-1,j})\ ]$$

where,

$Delta_{i,j}$	=	The change in calibration of the jth calibration point determined at the ith calibration interval;
$AF_{i,j}$	=	The as-found value of the jth calibration point determined at the ith calibration interval;
$AL_{i,j}$	=	The as-left value of the jth calibration point determined at the ith calibration interval;
$AFR_{i,j}$	=	The required as-found value of the jth calibration point determined at the ith calibration interval;
$ALR_{i,j}$	=	The required as-left value of the jth calibration point determined at the [illegible] calibration interval;
i	=	Calibration interval; and
j	=	Calibration point

[illegible]ce the drift data was determined for individual transmitters, the data was extracted from the transmitter spreadsheets and entered into another spreadsheet. Macros were written to automatically access each transmitter spreadsheet and transfer the data to a "raw data" spreadsheet. The changes in calibration were converted to a percentage of calibrated span to facilitate comparison of the subsets. This percentage was calculated as follows.

$$\% SPAN_{i,j} = Delta_{i,j} / 16 * 100$$

wh[illegible]

[illegible] $SPAN_{i,j}$	=	per cent of calibrated span; and
[illegible]6	=	calibrated span, in milliamps

3.0 Analysis of Drift Data

The methods used to [illegible]luate the transmitter drift are from Reference 4.3. LOTUS 1-2-3 was utilized to perform the calculations. Histograms and Difference versus Time plots were prepared for the total population as well as for each of the five process applications.

There are two primary objectives of this analysis. First, the time dep[illegible]dence of the differences in calibration data is investigated by taking the absolute value of the differences and then performing a linear regression analysis of this data. If the changes in calibration of these transmitters is an increasing function of time then a line with a positive slope would be obtained from this analysis. A very small slope would indicate no time dependence for intervals approximating the time intervals included in the analyzed data.

The second objective is to quantify the changes in calibration data betwe[illegible] calibrations. To analyze the transmitter drift data, a "drift" specification for each process application was arbitrarily selected as a pass/fail criteria. The probability of the drift value falling within this criteria can then be estimated by:

$$P = x/n$$

where,

P = probability of drift within the pass/fail criteria;
x = number of values inside the pass/fail criteria; and
n = number of drift values

Since P is an estimate of the nominal probability that a value will fall inside the pass/fail criteria, the confidence interval on this estimate must be determined. From Reference 4.3. Page 467, an exact confidence interval for P can be calculated as follows:

$$P_u = [(x+1)*F_{a/2;2*(x+1),2*(n-x)}] / [(n-x)+(x+1)*F_{a/2;2*(x+1),2*(n-x)}]$$

$$P_l = x / [x+(n-x+1)*F_{a/2;2*(n-x+1),2*x}]$$

Confidence interval, % = 100*(1-a)

where,

$P_{u,l}$	=	the minimum (l) and maximum (u) values of the probability that a value will fall inside the pass/fail criteria;
a	=	probability that the estimated probability will fall outside of the estimated confidence interval bounds; and
$F_{a/2;v1,v2}$	=	Value from F distribution with v1 and v2 degrees of freedom.

A 95% confidence level is widely recommended and accepted for setpoint calculations by industry standards and the NRC.

This process is repeated until a pass/fail criteria is found which will result in a minimum probability, at the 95% confidence level, of at least 95% that the drift values will fall within the pass/fail criteria.

To summarize the methods, trial pass/fail limits are set, the nominal probability of meeting these trial limits is calculated, and the 95% confidence interval of the probability is calculated. If the minimum probability, at the 95% confidence level, of meeting the trial criteria is greater than 95%, then it is concluded that the trial criteria will bound the expected results on a 95/95 basis. The trial criteria is then considered to be the bounding variation in the calibration results.

This calculation uses methods from Reference 4.3 which are slightly different than those of References 4.1 and 4.2. The advantage of using the statistics from the F distribution is that they are exact and not based on an approximation of a normal distribution. This method was compared to the methods of Reference 4.1 and found to be slightly more conservative for the sample sizes contained in this calculation.

4.0 References

4.1 SCE Engineering Standard for Instrument Setpoint/Loop Accuracy Calculation Methodology, JS-123-103C, Revision 0, dated June, 1990

4.2 Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation, ISA-RP67.04, Part II-1991, Recommended Practice, Committee Draft 9, dated March, 1991

4.3 Engineering Statistics, 2nd Edition, Albert H. Bowker and Gerald J. Lieberman, Copyright 1972 by Prentice-Hall, Inc., Englewood Cliffs, New Jersey

ENCLOSURE B

IDS SUMMARY

INSTRUMENT DRIFT STUDY SUMMARY

1.0 Introduction

This is a summary of an analysis of instrument transmitter drift that has been performed by Southern California Edison, Reference 5.1. The purpose of the study was to quantify the magnitude of transmitter drift that is occurring at the San Onofre Nuclear Generating Station, Units 2 and 3. This is important when considering the extension of transmitter calibration intervals to 30 months.

In order to arrive at trip setpoints for automatic protection systems, many factors are considered. Uncertainties associated with installed equipment, calibration equipment, normal environmental effects, and, if applicable, accident environmental effects are examples of these factors. Drift, or change of calibration of instrumentation over time, of the installed instrumentation is also one of the factors and is the only one with a time dependence. The maximum expected drift is established based on the calibration interval of the installed equipment. Historically, this has been based on information provided by instrumentation suppliers.

This summary describes an analysis of the historical calibration data of certain instrumentation used at the San Onofre Nuclear Generating Station (SONGS) Units 2&3. The purpose of this summary is to provide a reference document of an investigation into extending the calibration interval of this instrumentation from the current technical specification requirement of 18 months to 30 months.

There are four technical specifications where, in addition to conducting specific procedures on logic and actuation devices, it is necessary to perform calibrations of transmitters. These technical specifications are

3/4.3.1	Reactor Protective System (RPS)
3/4.3.2	Engineering Safety Features Actuation System (ESFAS) Instrumentation
3/4.3.3.5	Remote Shutdown Monitoring (RSM) Instrumentation
3/4.3.3.6	Accident Monitoring System (AMS) Instrumentation

These technical specifications cover a large number of instrument channels, which in some cases share a common instrument transmitter. There are three types of transmitters which are addressed by these technical specifications; pressure transmitters (PTs), differential pressure transmitters (DPs), and temperature transmitters (TTs). PT and DP transmitters are electro-mechanical devices that are located remote from the control room while temperature transmitters are solid state, electronic modules located in the control room area. In each instrument loop, the transmitter is a common device that drives a number of output devices.

Estimates for drift are developed for each model of transmitter. These values are provided in terms of % of span. These estimates reflect a "best estimate" value and a "95/95" value. Best estimates are values which reflect an expected performance of 50% of the hardware and is determined by averaging the absolute value of drift data. The 95/95 values are values of drift which will bound all hardware performance with a 95% probability at a 95% confidence level. The probability value establishes the portion of the population that is included within the tolerance interval. The 95% probability was selected for this study. This means that 95% of all past, present, and future values of drift will be bounded by the 95/95 interval value.

The confidence level essentially establishes the repeatability of calculating a value which will fall within the estimated values. A 95% confidence level was selected. This means that if the drift values would be recalculated in the future, there is a 95% chance that the values would be bounded by the 95/95 interval values. Using 95/95 values means that we are 95% sure that 95% of all drift values will be less than the estimated values.

Best estimate values are used in evaluating the acceptability of Accident Monitoring and Remote Shutdown Instrumentation, while 95/95 values are used in evaluating instruments related to the Plant Protection Systems (PPS), i.e., the Reactor Protective and Engineered Safety Features Actuation Systems.

Regulatory Guide 1.105, Reference 5.3, provides the basis for the use of 95/95 values for establishing and maintaining instrument setpoints of individual instrument channels in safety-related systems. These values provide assurance that the PPS will initiate automatic operation of appropriate systems to ensure that specified acceptable design limits are not excluded. Setpoints are not provided for Accident Monitoring and Remote Shutdown instrumentation. AMS and RSM instrumentation results in operator actions and is therefore not required to be as accurate as the PPS. This warrants the use of best estimate values for AMS and RSM instrumentation.

2.0 <u>Method of Analysis</u>

The methods used to determine the experienced drift values are described in this section. A flow chart describing the process is attached. Lotus 1-2-3 was used extensively to perform the calculations. Statistical methods described in Reference 5.2 were used to determine the maximum values for experienced drift for those transmitters which are used in applications covered by the SONGS Units 2&3 technical specifications on the Reactor Protective System and Engineered Safety Features Actuation System. These calculations were verified by an independent check of a sample of the data.

2.1 <u>Individual Transmitter Data</u>

To conduct this analysis, a Lotus 1-2-3 spreadsheet template was constructed. The calibration data for the transmitters of interest were recovered and entered into this spreadsheet template and a unique spreadsheet was constructed for each transmitter. In some cases, transmitters not addressed

by these technical specifications were included in order to increase the amount of historical experience for a particular model of instrument.

Each spreadsheet contains a groups of 5 cells (corresponding to each of the 5 calibration points) that calculate the difference between the as-found readings and the as-left readings of the previous calibration period. This difference is calculated for each set of successive calibration records that were recovered. Once these differences are determined, the maximum value of drift for each set of 5 points is selected. This maximum value is then divided by the time interval between calibrations to determine an annual drift rate. A unique spreadsheet was constructed for each transmitter resulting in several hundred spreadsheets. Each of these spreadsheets may contain multiple, one or no calibration drift data.

2.2 Analysis of Data by Model and Process

Once the drift data was determined (as percent of span per year) for individual transmitters, the data was extracted from the transmitter spreadsheets and entered into another spreadsheet to perform a first cut at editing the data. Macros were written to automatically access each transmitter spreadsheet and transfer the data to a "raw data" spreadsheet. This method minimizes the chance for error in transferring data. One raw data spreadsheet was constructed for each of the different types of transmitters, i.e. one for pressure transmitters, one for differential pressure transmitters, and one for temperature transmitters.

The data in these three spreadsheets was then edited using two criteria related to the interval between successive calibration data that had been recovered. Any data that was related to a calibration interval less than 100 days was removed from the data base. This data represents a short term problem which was likely to have been discovered by operators during shiftly surveillances or through some other means. The purpose of this analysis was to determine the magnitude of drift to be expected over a fuel cycle and to exclude problems related to short term effects that are discovered during the fuel cycle.

The second screening criteria was that any interval greater than 22 1/2 months was removed from the data base. These data points were removed because the maximum interval allowed by the Technical Specifications is 22 1/2 months so an interval that is greater than this value is likely to indicate that a calibration occurred in the intervening period but the data was not recovered.

Unique, explicit values exist for transmitters associated with PPS setpoints and CPC uncertainties. Common values exist for each of the following, Foxboro pressure transmitters, Rosemount pressure transmitters, Foxboro differential pressure transmitters and CPC temperature inputs. The product of the drift study is to either validate that these numbers are valid or to define new acceptable values. To accomplish this objective, the data was then grouped and analyzed in a manner consistent with the existing groupings. To assure that these groupings are appropriate, the data was divided into models, then by processes, and then analyzed at each level.

Once the grouping was established, identical final editing and analyses on the data were conducted. Methods described in Reference 5.2 were used to identify and remove outliers from the data base and to determine the 95/95 drift values. They are briefly described here.

2.3 Treatment of Outliers

An outlier is an observation that is significantly different from the rest of the sample and most likely comes from a different distribution. They usually result from mistakes or measuring device problems. To identify outliers, the T-Test described in Reference 5.2 was utilized. The extreme studentized deviate is calculated as

$$T = \frac{| x_e - \bar{x} |}{s}$$

where

T Extreme studentized deviate
x_e Extreme observation
$\bar{x}$ Mean
s Standard deviation of the same sample

If T exceeds the critical value given in Table XVI of Reference 5.2 at the 5% significance level, the extreme observation is considered to be an outlier. Once the outlier is identified, it is removed from the data base.

2.4 Normality Tests

Once the edited data base was finalized and grouped, the Chi-Square Goodness of Fit Test (Reference 5.2) was utilized to assure that the underlying distribution could be represented by a normal distribution. This test assumes a normal distribution and based on the sample mean and deviation, predicts the expected number of observations in each interval. The expected values are compared to the observed values. Since this test requires a rather large number of points, it could only be applied to the groups with a large population.

2.5 Maximum Expected Drift

In order to establish a value for the total drift population that is conservative with a 95% probability at a 95% confidence level, a 95/95 tolerance interval is determined as described in Reference 5.2. A tolerance interval places bounds on the proportion of the sampled population contained within it. This tolerance interval about the mean bounds 95% of the past, present and future drift values. Determining the interval and adding it to the absolute value of the mean determines the maximum expected drift.

The maximum drift values were calculated as follows

$$x_{max} = |\bar{x}| + Ks$$

where

- x_{max} Maximum expected drift with a 95% probability at the 95% confidence level
- $\bar{x}$ Sample mean
- K A value from Reference 5.2, Table VII(a), with 95% probability and at the 95% confidence level that is selected based on the sample size
- s Standard deviation of the sample

2.6 Best Estimate of Drift

The best estimates of instrument drift were calculated in much the same manner as the 95/95 values. As before, the maximum value of drift for the five calibration points was determined for each interval. Again, this maximum value was divided by the time duration of the interval to arrive at an annual drift rate. At this point, the process differs from that used to calculate the 95/95 value. The best estimate of drift for the population is determined as follows.

$$x_{exp} = \frac{|x_i|}{n}$$

where

- x_{exp} The best estimate of drift
- x_i Annual drift rate of the ith data point
- n Number of data points

3.0 Results

The purpose of this section is to make comparisons of the results of the drift calculations to the existing drift allowances. Where those allowances are insufficient for 30 month calibration intervals, and where no explicit allowances exist, revised allowances are identified. The experienced values of drift are then compared to these revised allowances.

Selection of the 95/95 interval value or the best estimate value is dependent upon the technical specification that is being addressed. The 95/95 values are selected for those instruments related to PPS setpoints, while best estimate values are selected for instruments related to AMS and RSM instruments.

In general, the value selected for comparison to the existing and revised allowances are based on the drift rates for the particular model of transmitter that is used in support of the technical specification. For the Rosemount 1153GD9 transmitters, this would lead to unnecessarily large conservatisms. The drift rates for the 1153GD9's used in the low range pressurizer pressure application cause the 95/95 interval values to be substantially larger. It is clear that the drift rates for these transmitters are different when used in these distinctly different applications. This is

further discussed in Section 3.1 below.

On the other hand, selection of the best estimate for Foxboro E13DH differential pressure transmitters would underestimate the experienced drift associated with pressurizer level indication. In this case the value for the pressurizer level transmitters taken by themselves was used as the best estimate of their performance.

The revised allowances shown in the tables in this section were chosen based on the groupings originally made for PPS setpoints. Assumptions were made for drift rates for Foxboro pressure transmitters (1.5% for 18 months), Rosemount pressure transmitters (0.75% for 18 months), Foxboro differential pressure transmitters (0.18% for 18 months), and Foxboro temperature transmitters (0.40% for 18 months). These values were extrapolated to the maximum calibration interval allowed by the technical specifications, which is 22.5 months, and used in determining the PPS setpoints. The revised allowances for drift were determined by inspecting the 30 month drift values and selecting a value which would bound the experienced values. In order to keep the number of different allowances to a minimum, the value selected for PPS setpoint is utilized as the allowance for AMS and RSM instrumentation.

3.1 Reactor Protective System Instrumentation

Table 3.1 provides a summary comparison of the results of the analysis of long term drift, the existing allowances for drift in RPS setpoints and revised allowances for long term drift to accommodate 30 month intervals between transmitter calibrations.

All experienced drift values reflect the 95/95 interval value for the model of transmitter related to the functional unit, except for Functional Unit #5, Pressurizer Pressure - Low. In this case, a substantial difference exists between the Rosemount 1153GD9's (wide range, 0 to 3000 psia) used for this trip function and those 1153GD9's used for low range (100 to 765 psia) pressurizer pressure. The drift rates for the transmitters differ in the distinct applications. This can be attributed to two factors. Firstly, the low range transmitters are "ranged down" three times that of the wide range. This is expected to cause approximately three times the drift. Secondly, the low range transmitters are exposed to an over range condition during normal operation, i.e. pressure in excess of 765 psia. Therefore, the 95/95 interval for the wide range Rosemount 1153GD9's is used as representing their performance.

Table 3.1

Reactor Protective System
Comparison of Results to Allowances

Functional Unit	Instrument Model	95/95 Interval Drift[1]	Existing Drift Allow[1,2]	New Drift Allow[1]
1. Manual Reactor Trip	N/A			
2. Lin Power Level - High	N/A			
3. Log Power Level - High	N/A			
4. Pzr Pressure - High	E11GM	3.13	1.88	3.75
5. Pzr Pressure - Low	1153GD9	1.09	0.94	1.25
6. Cont Pressure - High	NE11DM	2.86	1.88	3.75
7. S/G Pressure - Low	E11GM	3.13	1.88	3.75
8. S/G Level - Low	E13DM	6.04	0.22	6.25
9. Local Power Density	N/A			
10. DNBR - Low	See #14			
11. S/G Level - High	E13DM	[3]	0.22	[3]
12. RPS Logic	N/A			
13. Reactor Trip Breakers	N/A			
14. CPCs	2AI-P2V	0.82	0.50	0.94
	E11GM	3.13	1.88	3.75
15. CEA Calculators	N/A			
16. RCS Flow - Low	1153HD6	4.55	[4]	
17. Seismic - High	N/A			
18. Loss of Load	N/A			

NOTES:

1. Drift values are in terms of % of span.

2. The Existing Drift Allowances are derived from generic vendor data.

3. Steam Generator Level - High Trip uses a best estimate value of ±2.25%. This is acceptable because this trip is used for equipment protection only.

4. The Reactor Coolant Flow-low trip uses a Rate-Limited Variable Setpoint (RLVS) module. Transmitter drift errors will be included in the process signal and in the trip setpoint calculate by the RLVS module. These drift errors will therefore cancel each other out.

All of the experienced drift values exceed the existing allowance when extrapolated to 30 month calibration intervals. The revised values are conservatively larger than the experienced drift rates.

3.2 <u>Engineered Safety Features Actuation System</u>

Table 3.2 provides a summary comparison of the results of the analysis of long term drift, the existing allowances for drift in ESFAS setpoints and revised allowances for long term drift to accommodate 30 month intervals between transmitter calibrations.

All experienced drift values reflect the 95/95 interval value for the model of transmitter related to the functional unit, except for Functional Unit 1.c, Pressurizer Pressure - Low. The reason for using the lower value of drift associated with the wide range transmitters is discussed in Section 3.1 above.

Table 3.2
ESFAS Instrumentation
Comparison of Results to Allowances

Functional Unit	Instrument Model	95/95 Interval Drift[1]	Existing Drift Allow[1,2]	New Drift Allow[1]
1. Safety Injection				
a. Manual	N/A			
b. Cont Pressure - High	NE11DM	2.86	1.88	3.75
c. Pzr Pressure - Low	1153GD9	1.09	0.94	1.25
d. Auto Actuation Logic	N/A			
2. Containment Spray				
a. Manual	N/A			
b. Cont Pressure - Hi-Hi	NE11DM	2.86	1.88	3.75
c. Auto Actuation Logic	N/A			
3. Containment Isolation				
a. Manual CIAS	N/A			
b. Manual SIAS	N/A			
c. Cont Pressure - High	NE11DM	2.86	1.88	3.75
d. Auto Actuation Logic	N/A			
4. Main Steam Isolation				
a. Manual	N/A			
b. S/G Pressure - Low	E11GM	3.13	1.88	3.75
c. Auto Actuation Logic	N/A			
5. Recirculation				
a. RWT Level - Low	E13DM	6.04	0.22	6.25
b. Auto Actuation Logic	N/A			
6. Containment Cooling	N/A			
7. Loss of Power	N/A			
8. Emergency Feedwater				
a. Manual	N/A			
b. SG Level (A/B)-Low	E13DM	6.04	0.22	6.25
and DP(A/B) - High	E11GM	3.13	1.88	3.75
c. SG Level (A/B)-Low and No	E13DM	6.04	0.22	6.25
Pressure - Low Trip(A/B)	E11GM	3.13	1.88	3.75
d. Auto Actuation Logic	N/A			

Table 3.2
ESFAS Instrumentation
Comparison of Results to Allowances
(Continued)

Functional Unit	Instrument Model	95/95 Interval Drift[1]	Existing Drift Allow[1,2]	New Drift Allow[1]
9. Control Room Isolation	N/A			
10. Toxic Gas Isolation	N/A			
11. Fuel Handling Isolation	N/A			
12. Cont Purge Isolation	N/A			

Notes:

1. Drift values are in terms of % of span.

2. The Existing Drift Allowances are derived from generic vendor data.

All of the 95/95 experienced drift values exceed the existing allowances when extrapolated to 30 month calibration intervals. The revised allowances are conservatively larger than the experienced drift rates.

3.3 Remote Shutdown Monitoring System Instrumentation

Table 3.3 provides a summary comparison of the results of the analysis of long term drift and revised allowances for long term drift to accommodate 30 month intervals between transmitter calibrations. All experienced drift values reflect the best estimate value for the model of transmitter related to the instrument channel except for wide range pressurizer pressure and pressurizer level. The reason for using a different value for wide range pressurizer pressure is discussed in Section 3.1. Substantial differences exist between pressurizer level transmitters and the same model transmitter, Foxboro E13DH, used to monitor HPSI flow. This is probably due to the normally inactive HPSI system versus the constantly pressurized RCS. The higher best estimate value for the pressurizer level transmitters taken by themselves was selected to represent the best estimate of the performance of these transmitters.

The revised drift allowances were chosen to be consistent with the allowances used for similar equipment used in the PPS except for the transmitters used for condenser vacuum indication. The PPS includes Rosemount 1153GD9 pressure transmitters for monitoring pressurizer pressure. The condenser vacuum loops include Rosemount 1151AP4E transmitters which are calibrated over a range of

only 4 inches of mercury. The drift allowance used for Rosemount pressure transmitters (1.25% of span) is not sufficient to bound the best estimate of long term drift for the Rosemount 1151AP4E transmitters used for monitoring condenser vacuum, so a value of 8.75% of span was established. Although this is a relatively large value in terms of percent of span, it represents a very small change in terms of pressure (less than 0.5 inches Hg per 30 months).

Table 3.3

Remote Shutdown Monitoring Instrumentation
Comparison of Results to Allowances

Instrument	Instrument Model	Best Estimate Drift[1]	Drift Allowance[1,2]
1. Log Power Level	N/A		
2. RCS Cold Leg Temperature	444RL	0.31	0.94[3]
	2AI-P2V	0.28	0.94
3. Pressurizer Pressure	1153GD9	0.29	1.25
4. Pressurizer Level	E13DH	4.96	6.25[3]
5. Steam Generator Level	E13DM	1.98	6.25
6. Steam Generator Pressure	E11GM	0.99	3.75
7. Source Range NIs	N/A		
8. Condenser Vacuum	1151AP4E	7.24	8.75[3]
9. Volume Control Tank Level	E13DM	1.98	6.25
10. Letdown HX Pressure	E11GM	0.99	3.75
11. Letdown HX Temperature	2AI-P2V	0.28	0.94
12. BAMU Tank Level	NE13DM	4.31	6.25[3]
13. Cond Storage Tank Level	1153DD5	0.44	6.25
	1152DP5	1.08	6.25
14. RCS Hot Leg Temperature	444RL	0.31	0.94[3]
15. Pzr Pressure - Low Range	NE11GM	0.59	3.75
16. Pzr Pressure - High Range	E11GM	0.99	3.75
17. Pressurizer Level	E13DH	4.96	6.25[3]
18. Steam Generator Pressure	NE11GM	0.59	3.75
19. Steam Generator Level	E13DM	1.98	6.25

Note:

1. Drift values are in terms of % of span.

2. The Drift Allowances for all Remote Shutdown Monitoring (RSM) instruments except those noted (3) are based on the 95/95 values. The 95/95 values are derived from the Instrument Drift Study for the RSM System instruments.

3. The Drift Allowance h been selected to bound the Best Estimate Drift Value. The best estimate values are derived from the Instrument Drift Study.

As can be seen from the table, the revised allowances for drift over a 30 month period are generally several times the experienced best estimate values.

3.4 Acc dent Monitoring System Instrumentation

Table 3.4 provides a summary comparison of the results of the analysis of long term drift and revised allowances for long term drift to accommodate 30 month intervals between transmitter calibrations. All experienced drift values reflect the best estimate value for the model of transmitter related to the instrument channel except for pressurizer pressure and pressurizer level. The reasons for treating these instruments differently are discussed in Sections 3.1 and 3.3, respectively.

The revised drift allowances were chosen to be consistent with the allowances used for similar equipment in the PPS.

Table 3.4

Accident Monitoring System Instrumentation
Comparison of Results to Allowances

Instrument	Instrument Model	Best Estimate Drift[1]	Drift Allowance[1,2]
1. Cont Press-Narrow Range	NE11DM	0.66	3.75
2. Cont Press-Wide Range	NE11GM	0.59	3.75
	E11GM	0.99	3.75
3. RCS Outlet Temperature	2AI-P2V	0.28	0.94
4. RCS Inlet Temperature(WR)	2AI-P2V	0.28	0.94
5. Pressurizer Pressure (WR)	1153GD9	0.29	1.25
6. Pressurizer Water Level	E13DH	4.96	6.25[3]
7. Steam Line Pressure	E11GM	0.99	3.75
8. S/G Level (Wide Range)	1153HD5	1.09	6.25
9. RWT Water Level	E13DM	1.98	6.25
10. Auxiliary FW Flow Rate	E13DM	1.98	6.25
11. RCS Subcooling	2AI-P2V	0.28	0.94
Margin Monitor (QSPDS)	1153GD9	0.29	1.25
12. Safety Valve Position Ind	N/A		
13. Spray System Pressure	NE11DM	0.66	3.75
14. LPSI Header Temperature	2AI-P2V	0.28	0.94
15. Containment Temperature	2AI-T2V	0.50	0.94[3]
16. Containment Water Level (Narrow Range)	N/A		
17. Containment Water Level (Wide Range)	N/A		
18. Core Exit Thermocouples	N/A		
19. Cold Leg HPSI Flow	E13DH	1.49	6.25
20. Hot Leg HPSI Flow	E13DH	1.49	6.25
21. HJTC System - RVLMS	N/A		

Table 3.4

Accident Monitoring System Instrumentation
Comparison of Results to Allowances
(Continued)

Note:

1. Drift values are in terms of % of span.

2. The Drift Allowances for all Accident Monitoring System (AMS) instruments except those noted (3) are based on the 95/95 values. The 95/95 values are derived from the Instrument Drift Study for the AMS System instruments.

3. The Drift Allowance has been selected to bound the Best Estimate Drift Value. The best estimate values are derived from the Instrument Drift Study.

Comparisons of the best estimate drift values to the revised allowances show that those allowances conservatively reflect transmitter performance.

4.0 Conclusions

The preceding sections of this summary provide a description of the methods and results of an analysis of the long term drift characteristics of transmitters installed at San Onofre Nuclear Generating Station, Units 2&3. A comparison of the results of analysis of the long term drift data is made to existing allowances for long term drift. The results are also compared to revised allowances for long term drift assuming 30 month intervals between calibrations.

The scope of this summary is sufficient in that all of the models of transmitters used in applications covered by the relevant technical specifications are addressed. The methods used to develop 95/95 interval values and best estimates are accepted and documented. These methods assure results which are consistent with the design assumptions.

There are several inherent conservatisms with using the revised allowances.

- Drift allowances are larger than 95/95 and best estimate values.

  Since bounding values were selected to repre t several types of transmitters, the 95/95 and best estimate va..es are, in general, substantially less than the revised drift allowance.

- o Differences in as-found and as-left values were assumed to be entirely due to drift.

  The differences in as-found and as-left readings were assumed to be entirely due to drift, when factors such as transmitter accuracy, calibration uncertainties, and normal environmental effects are most certainly present. Setpoint calculations treat each of these factors independently resulting in accounting for these factors twice.

- o Only the maximum value of the five calibration points was used.

  A typical calibration is done at five points over the range of the transmitter. Only the maximum value of drift for the five calibration points was utilized as a data point in the drift assessment. Incorporating the data related to the other four points would increase the amount of data by a factor of five, with four of the points of each data set being less than the point in the current data base.

This analysis provides a conservative assessment of transmitter performance for those transmitters addressed within the scope of this summary. Utilization of the revised allowances for long term drift in setpoint and uncertainty calculations, and in evaluations of instrument performance with respect to the EOIs will provide a sound basis for extending the calibration interval of these transmitters to 30 months.

5.0 <u>References</u>

5.1 Instrument Drift Study, CDM Document Number M-89047, R. M. Bockhorst, Southern California Edison Company, May, 1989

5.2 Statistics for Nuclear Engineers and Scientists, Part 1: Basic Statistical Inference, WAPD-TM-1292, DOE Research and Development Report, William J. Beggs, February, 1981, Bettis Atomic Power Laboratory, West Mifflin, Pennsylvania

5.3 U.S. Nuclear Regulatory Commission, Regulatory Guide 1.105, "Instrument Setpoints for Safety-Related Systems," February, 1986.