Guidelines for Instrument Loop Performance Evaluation and Setpoint Verification

Ginna Station

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EWR 5126

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1.0 INTRODUCTION

This document, Methodology for Instrument Loop Performance Evaluation and Setpoint Verification, provides detailed instructions for performing Project activies.

Reg. Guide 1.105, Rev. 2 describes a methodology acceptable to the NRC for ensuring that instrument setpoints are initially within and remain within Technical Specification limits. This Regulatory Guide endorses ISA Standard S67.04-1982, "Setpoints for Nuclear Safety - Related Instrumentation Used in Nuclear Power Plants". A revision was issued to the document in 1987 and major draft supplements have been issued by ISA Committee S67.15 since that time. RG&E is not specifically committed to Reg. Guide 1.105 or ISA-S67.04. However this document is intended to establish similar requirements and utilizes the methods of ISA S67.04 where applicable.

This document is not intended to supersede any calculations performed previously by RG&E or its vendors. Such calculations and analyses were performed in accordance with the guidelines and assumptions in effect at the time of their development.

2.0 PURPOSE

This document is intended to provide RG&E engineering personnel with a step-by-step approach in performing an instrument loop performance and setpoint verification. It includes a verification that, after all uncertainties in the measured parameter are accounted for, the existing loop setpoints assure that all documented performance requirements are met.

3.0 APPLICABILITY

This document may be applied to any process instrument loop at Ginna Nuclear Power Plant. It is not applicable to:

- o Electrical Metering
- o Torque/Limit Switches
- o Snubber/Spring Cans
- o Time Delay Relays
- o Protective Relaying
- o Breaker Trip Settings
- o Relief/Safety Valves

4.0 PROCEDURAL REQUIREMENTS

Work performed in accordance with this document shall be performed to the requirements of the RG&E QA Manual and its appendices or another QA program meeting the requirements of 10 CFR 50, Appendix B.

DEFINITIONS

5.1 Accident Bias - The non-random uncertainty created by the accident conditions in a known direction. An example of this would be reference leg heatup during specific pipe break events, which could change the density of the fluid in the reference leg, impacting the accuracy of the sensor.

5.2 Accident Environmental Uncertainties (AEU) - The combined effect of errors on an instrument loop caused by exposure to nuclear radiation, elevated temperature, and steam/chemical spray, or an earthquake.

5.3 Accuracy - A measure of the degree by which the actual output of a device approximates the output of an ideal device nominally performing the same function. Error, inaccuracy, or uncertainty represent the difference between the measured value and the ideal value.

5.4 Allowable Value (AV) - The limiting value that the trip setpoint can have when tested periodically, beyond which the instrument channel must be evaluated for operability. **(THE GINNA TECHNICAL SPECIFICATIONS (TABLE 3.5-4) DEFINE THE TERM "ALLOWABLE VALUE" IN THE SAME SENSE AS THE ANALYTICAL LIMIT.)**

5.5 Analytical Limit (AL) - The limit of a measured or calculated variable "established by" the safety analysis to ensure that a safety limit is not exceeded. In some cases there may be no analysis associated with a particular setpoint function. In such cases, the Design Limit established for the function shall be used as the Analytical Limit.

5.6 As Found - The condition a device is found in after a period of operation.

5.7 As Left - The condition a device is left in after calibration.

5.8 Bias - For this document bias will have two separate definitions, one for calculating the setpoint and the other for performing scaling. The definition for calculating a setpoint is:

> The fixed or systematic error within a measurement.
>
> The bias error is a known, fixed, difference between the true value and the actual measurement.

The definition related to scaling is:

> A voltage that is utilized to produce a signal offset. Bias is often used to compensate for signals that do not begin at zero.

5.9 Bias Distribution - When performing scaling, the division of the total bias required by an instrument loop among the devices which comprise the loop.

5.10 Cable Leakage (Cl) - The error associated with leakage current exhibited by the instrument cable during environmental testing, or an accident, as correlated to the specified cable under analysis.

5.11 Calibration - Comparison of items of measuring and test equipment with reference standards or with items of measuring and test equipment of equal or closer tolerance to detect and quantify inaccuracies and to report or eliminate those inaccuracies.

5.12 Calibration Uncertainty, (CU) - The combined error associated with the test equipment and method used to determine that the instrument loop calibration is in compliance with the reference standards

5.13 Circuit Leakage Uncertainty, (CLU) - Summation of the errors associated with the electrical current leakage from the cable, cable splices, cable seal devices, penetrations, and terminal blocks.

5.14 Dependent - The condition in which two or more uncertainties, variables, or parameters rely upon one another, such that, under the conditions of interest, a change in one will produce a corresponding change in the other.

5.15 Design Limit - The limit of a measured or calculated variable established to prevent undesired conditions (e.g., equipment or structural damage, spurious trip or initiation signals, challenges to plant safety signals, etc.). Used in place of the Analytical Limit when there are no analytical bases. Bases may be industry standards or vendor recomendations. See also Estimated Design Limit.

5.16 Drift, Sensor (Sd) - An undesired change in output over a period of time, which is unrelated to the input, environment, or load.

Note: The uncertainty associated with drift is dependent on the calibration period of the device.

5.17 Drift Uncertainty (DU) - The combined error associated with the stability of the sensor and rack equipment. The errors included in this term are the sensor and rack equipment drift.

5.18 Independent - A condition in which two or more uncertainties, variables, or parameters are autonomous and do not rely on one another, such that, under the conditions of interest, a change in one does not lead to a corresponding change in the other, and they may be separated one from the other.

5.19 Limiting Safety System Setting, (LSSS) - Settings specified for automatic protective devices related to those variables having significant safety functions. A LSSS is chosen to begin protective action before the analytical limit is reached to ensure that the consequences of a design basis event are not more severe than the safety analysis predicted.

5.20 Loop Uncertainty - The range of values that the process parameter may assume corresponding to a particular indication or output. Depending on the loop output, this uncertainty could be related to indication or actuation.

5.21 Lower Setpoint Limit - The lowest value for a setpoint which when used in conjunction with the upper setpoint limit, describes the setpoint tolerance band (no adjustment required) which allows for safe function operation but minimizes the frequency of readjustment.

5.22 Margin - An additional allowance that may be added to the loop uncertainty for the purpose of increasing conservatism. Applying margin has the effect of moving a setpoint further away from the analytical limit.

Note: An additional expression, operating margin, should not be confused with margin. Adding or increasing operating margin has the effect of moving a setpoint closer to the analytical limit to increase the region of operation prior to reaching a setpoint.

5.23 Measuring and Test Equipment, (M&TE) - Devices or systems used to calibrate, measure, gage, test, inspect, or control in order to acquire research, development, test or operational data or to determine compliance with design, specifications, or other technical requirements. Measuring and test equipment does not include permanently installed operating equipment, nor test equipment used for preliminary checks where data obtained will not be used to determine acceptability or be the basis for design or engineering evaluation.

5.24 Mild Environment - An environment that would at no time be more severe that the environment that would occur during normal plant operation, including anticipated operational occurrences. It may also be referred to as the normal environment.

5.25 Normalization - The process of converting process parameters into quantities having a range from 0 to 1.0 percentage units.

5.26 Operational Limit - The operational value of a process variable established to allow trip avoidance margin for the limiting normal operating transient.

5.27 Penetration Leakage, (Pl) - The error associated with the leakage current exhibited by the penetration during environmental testing, as correlated to the specific penetration under analysis.

5.28 Primary Element (See also; Sensor) - An independently calibrated system component which converts the measured process variable to a form which is appropriate for the sensor input. This is usually a differential producer in a fluid system, (i.e. orifice, venturi nozzle), which converts flow rate to differential pressure. The differential pressure is then sensed by transmitters (sensors).

5.29 Primary Element Accuracy, (Pea) - The accuracy associated with the primary element that quantitatively converts the measured variable energy into a form suitable for measurement by the associated instrumentation, (i.e. Elbow Taps, orifice plates, venturies, etc.).

5.30 Process Measurement Accuracy, (Pma) - The accuracy specification that includes plant measurement errors up to, but not including, the sensor. Examples are the effect of fluid stratification on temperature measurements and the effect of changing fluid density on level measurements.

5.31 Process Uncertainty, (PU) - The combined error associated with the physical process and its measurement. The errors included in this term are the primary element accuracy and the process measurement accuracy.

5.32 Process Algorithm (or Process Equation) - The process calculation expressed in terms of engineering units.

5.33 Rack Equipment Uncertainty, (REU) - The combined errors of the rack-mounted devices that make up the instrument loop. These typically are accuracy, temperature effects, and power supply effects.

5.34 Rack Equipment Calibration Accuracy, (Rca) - The error associated with performance of rack equipment calibrations. This error is typically a result of test equipment accuracy and technician error.

5.35 Rack Equipment Drift, (Red) - An undesired change (error) in the rack equipment output over a period of time, which is unrelated to the input.

5.36 Rack Equipment Miscellaneous Effects, (Rme) - The error associated with any effect on the rack equipment not accounted for in the documented rack effects of this procedure.

5.37 Rack Equipment Tolerance, (Ret) - Is equal to the No Adjust Limits of the rack equipment and is defined as the allowance to account for the difficulty of measuring the rack equipment calibration. It is a function of the repeatability of the rack equipment.

5.38 Rack Power Supply Effects, (Rps) - The error associated with the power supply variation for which the specific rack instruments are utilized.

5.39 Rack Temperature Effects, (Rte) - The error associated with the ambient temperature variations of the specific rack instruments. This error is not included in the calculation if already considered in the "Temperature Effect" term.

5.40 Radiation Effect, (Re) - The error associated with the normal radiation dose plus accident radiation exposure for the specific instrument.

5.41 Random - The condition in which the deviation of an observation (measurement) from an accepted (true) value is equally expected to be positive or negative. The algebraic sign of a random uncertainty is equally likely to be positive or negative with respect to some median value. Unless specifically stated otherwise, for the purposes of this document random also means approximately normally distributed.

5.42 Random Error - Errors which cannot be predicted except on a statistical basis. They occur wholly due to chance and can be expressed by probabilistic distribution. In most instrument applications, random errors occur with a frequency that approximates a normal distribution. For such distribution, 95% of all errors fall within 2 standard deviations of the mean.

5.43 Reference Accuracy - A number or quantity that defines a maximum for expected uncertainty when a device is used under referenced operating conditions.

5.44 Safety Limit - The limit on a safety process variable that is established by licensing requirements to provide conservative protection for the integrity of physical barriers that guard against uncontrolled release of radioactivity. The acceptability of safety limits is based on plant accident and transient analyses.

5.45 Scaling Equation - The equation that converts process variables from process/engineering units to the equivalent voltage values.

5.46 Sealing Device Leakage, (Dl) - The error associated with the leakage current exhibited by the cable sealing device during environmental testing, as correlated to the specific sealing device under analysis.

5.47 Seismic Effect, (Se) - The error associated with the specific instrument when subjected to seismic activity.

5.48 Sensor (See also; Primary Element) - The channel element which responds directly to the measured process variable to produce an electric or pneumatic signal which is transmitted to control and indication systems.

5.49 Sensor Uncertainty, (SU) - The combined error associated with the sensor itself. These typically are accuracy,

temperature effects, power supply effects and static pressure effects.

5.50 Sensor Calibration Accuracy, (Sca) - The error associated with the performance of sensor calibrations. This error is typically a result of test equipment accuracy and Technician error.

5.51 Sensor Miscellaneous Effect, (Sme) - The error associated with any effect on the sensor not accounted for in the other documented sensor effects.

5.52 Sensor Power Supply Effect, (Spse) - The error associated with the power supply variation for which the specific sensor is utilized.

5.53 Sensor Static Pressure Span Shift, (Ssps) - The change in the calibration of a differential pressure device which occurs when the process pressure is applied equally to both the high and low pressure connections.

5.54 Sensor Temperature Effects, (Ste) - The error associated with the ambient temperature variations of the specific sensor. This error is not included in the calculation if already considered in the "Temperature Effect" Term.

5.55 Sensor Tolerance, (St) - Is equal to the No Adjust Limit of the sensor and is identified as the allowance to account for the difficulty of measuring the sensor calibration. It is a function of the repeatability of the sensor.

5.56 Setpoint - A predetermined value at which a device changes state to indicate that the quantity under surveillance has reached the selected value.

5.57 Setpoint Verification -Information which identifies the specific functions to be performed by an instrument loop of a facility, and the specific values or ranges of values chosen for controlling parameters as reference bounds for design. These values may be (1) restraints derived from generally accepted "state of the art" practices for achieving functional goals, or (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which an instrument loop must meet its functional goals.

5.58 Splice Leakage, (Sl) - The error associated with leakage current exhibited by the cable splice during environmental testing, as correlated to the specific splice under analysis.

5.59 Steam/Chemical Spray Effect, (S/Ce) - The error associated with the steam/chemical spray environment for the specific instrument.

5.60 Temperature Effect, (Te) - The error of the specific instrument during a HELB or LOCA that is associated with the temperature as specified in the RG&E UFSAR.

5.61 Terminal Block Leakage, (Tl) - The error associated with leakage current exhibited by the terminal blocks during environmental testing, as correlated to the specific terminal block under analysis.

5.62 Tolerance - A band established around a desired value within which an instrument's performance is considered acceptable. Tolerances are established about specific instrument or loop output points to define the acceptable level of performance for the instrument or loop for given input points.

5.63 Tolerance Uncertainty, (TU) - The combined error associated with the difficulty of measuring the sensor and rack equipment during calibration. The errors included in this term are the sensor and rack equipment tolerance.

5.64 Trip Setpoint, (Tsp) - A predetermined level at which a bistable device changes state to indicate that the quantity under surveillance has reached the selected value.

5.65 Uncertainty - The quantifiable range of values within which the true value of a parameter is known to exist. For the purposes of this procedure, uncertainties shall include the broad spectrum of terms such as error, accuracy, bias, effect, etc.

5.66 Upper Setpoint Limit - The highest value for a setpoint which when used in conjunction with the lower setpoint limit, describes the setpoint tolerance band (no adjustment required) which allows for safe function operation but minimizes the frequency of readjustment.

5.67 Estimated Design Limit, (EDL) - Used in place of Analytical Limit or Design Limit when no formally documented bases are currently available for the limiting value of the process parameter.

6.0 ACRONYMS[1]

AE - Accident Effect

AL - Analytical Limit

APE - Accident Pressure Effect

ARE - Accident Radiation Effect

ATE - Accident Temperature Effect

AV - Allowable Value

BOP - Balance of Plant

CCD - Controlled Configuration Drawing

CP - Calibration Procedure

CSE - Conduit Seal Effect

DBD - Design Basis Document

DBE - Design Basis Event

DL - Design Limit

DR - Drift

DVM - Digital Voltmeter

EEQ - Equipment Environmental Qualification

EOP - Emergency Operating Procedure

GDC - General Design Criteria

HELB - High Energy Line Break

IEEE - Institute of Electrical and Electronics Engineers

ILWD - Instrument Loop Wiring Diagram

INPO - Institute of Nuclear Power Operations

IR - Insulation Resistance

ISA - Instrument Society of America

LOCA - Loss of Coolant Accident

LSSS - Limiting Safety System Setting

MCB - Main Control Board

M&TE - Measurement & Test Equipment

NRC - Nuclear Regulatory Commission

NSSS - Nuclear Steam Supply System

OBE - Operational Basis Earthquake

OL - Operational Limit

OP - Overpressure Effect

PEA - Primary Element Accuracy

PLS - Precautions, Limits and Setpoints (Document)

PME - Process Measurement Effect

PPCS - Process Plant Computer System

PS - Power Supply Effect

RA - Reference Accuracy

RE - Readability

RG - Regulatory Guide

RG&E - Rochester Gas & Electric

RTD - Resistance Temperature Detector

SE - Seismic Effect

SL - Safety Limit

SPE - Static Pressure Effect

SRSS - Square Root Sum of the Squares

SSE - Safe Shutdown Earthquake

T/C - Thermocouple

TE - Temperature Effect

TID - Total Integrated Dose

TLU - Total Loop Uncertainty

UFSAR - Updated Final Safety Analysis Report

URL - Upper Range Limit

1 Selected acronyms may also have another definition per the standard abbreviation list in the Ginna Quality Assurance Manual. However, the acronyms shown are common nuclear industry terms and for the purposes of this document will represent the meaning shown here.

7.0 REFERENCES

7.1 Reg. Guide 1.105, Rev 2, "Instrument Setpoints for Safety - Related Systems".

7.2 ISA - S67.04 - 1987, " Setpoints for Nuclear Safety - Related Instrumentation".

7.3 INPO 84-026, Rev. 1, "Setpoint Change Control Program".

7.4 ISA-S67.04 Part II, Draft 9, "Methodologies for the Determination of Setpoints for Nuclear Safety - Related Instrumentation."

7.5 RG&E EWR 5126, "Instrument Setpoint Verification", dated 8/31/89.

7.6 Title 10, Part 50 of the Code of Federal Regulations (10CFR50), as of January 1, 1990.

7.7 R.E. Ginna Nuclear Power Plant Updated Final Safety Analysis Report Volumes I thru VIII, Rev. 4.

7.8 Procedure P-1, Rev. 45, Reactor Control and Protection System.

7.9 Procedure P-2, Rev. 28, Reactor Coolant System Precautions and Limitations.

7.10 Procedure P-3, Rev. 15, Chemical and Volume Control System.

7.11 Procedure P-4, Rev. 10, Precautions, Limitations and Setpoints Auxiliary Coolant System.

7.12 Procedure P-6, Rev. 12, Precautions, Limitations and Setpoints Nuclear Instrumentation System.

7.13 Procedure P-7, Rev. 11, Safety Injection System.

7.14 Procedure P-8, Rev. 16, Waste Disposal System.

7.15 Procedure P-9, Rev. 55, Radiation Monitoring System.

7.16 R.E. Ginna Nuclear Power Plant Technical Specifications, Appendix A to Operating License No. DPR-18 (Amendment No. 40), Dated September 23, 1990.

7.17 Deleted

7.18 R.E. Ginna Nuclear Power Plant System Descriptions (Training Department Handouts).

7.19 Deleted

7.20 Deleted

7.21 RG&E Quality Assurance Manual, Appendix A, Quality and Safety Related Listings, Rev. 9.

7.22 RG&E Quality Assurance Manual, Appendix E, Quality Assurance Program for EQ Equipment Replacements, Maintenance and Additions.

7.23 DELETED

7.24 RG&E Design Analysis (DRAFT), "Flow Measuring Element Technical Evaluation".

8.0 ASSUMPTIONS/CLARIFICATIONS

8.1 The intent of these guidelines is to establish a standard basis for instrument loop performance evaluation and setpoint verification analyses for existing process instrument systems at Ginna Station.

8.2 Information used to evaluate each instrument loop is preferrably obtained from controlled documents. However, this may not always be possible. Information from uncontrolled sources should be documented sufficiently to establish validity.

8.3 When data conflicts occur, an assumption may be made as to which of the sources is correct. All such conflicts and the bases for any related assumptions should be documented as open items.

8.4 The Instrument Performance Evaluation and Setpoint Verification Checklist, included as Attachment A, provides the format for indivual loop analyses. Supplemental calculations or analyses may be needed to fully document certain features of loop performance.

8.5 When information needed to complete Attachment A is abstracted from another document, that document shall referencedin the analysis.

8.6 When information is obtained from references that are not easily retrievable (e.g. vendor data, correspondence, purchase orders or specifications, etc.), copies should be made of the applicable portions of the reference. Copies should be attached to the Attachment A analysis.

8.7 When information requested in Attachment A is determined to be not applicable to a specific loop, the step should be marked "N/A".

8.8 Instrument loop performance evaluation and output uncertainty calculations shall assume that no degradation has occurred to the sensor, associated equipment, or output devices due to lack of maintenance or unanticipated operating phenomena. Any concerns related to problems of this kind should be addressed in accordance with the Ginna Station QA Manual and existing Quality Engineering (QE) Procedures.

9.0 Instrument Loop Performance Requirements

The intent of this section is to document the performance requirements for the instrument loop, established in the design bases for the Ginna Nuclear Plant. Performance requirements include the nature of the process parameter being detected, quantified, and transmitted, (what is being measured), the range and accuracy of the process parameter information that is required (appropriate) for the loop outputs, and the physical environment(s) in which the loop is installed, calibrated, and required to operate. To the extent possible, these requirements should be described without reference to the installed system design.

9.1 Performance Related Design Bases Associated with the Instrument Loop.

In Section 5.1.1 of Attachment A document the following design basis information which places constraints on instrument performance.

9.1.1 Safety Classification

The safety classifications established in Appendix A of the Ginna Station QA Manual, Safety Related (SR), Safety Significant (SS), and Non Safety (NS), are based on functional considerations only. However, they do indicate whether the loop is critical to some aspect of plant safety.

9.1.2 NUREG 0737/R.G. 1.97

The Ginna Station R.G. 1.97 design bases are documented in Table 7.5-1 of the UFSAR. A more detailed description of these loops is contained in the RG&E submittal to the NRC, dated March 13, 1992, "NUREG 0737 Supplemental 1/ R.G. 1.97: Comparison of Ginna Post Accident Instrumentation", Attachment 3, Table 1. A R.G. 1.97 instrument loop should conform with performance requirements stated in the Regulatory Guide, as qualified by status information or notes in Table 7.5-1 and the 3-13-92 NRC submittal. Design requirements related to physical separation, human factors, and reliability of power supply are not within the scope of this analysis.

9.1.3 Environmental Qualification (EQ)

If the instrument loop is required to function in harsh (accident) environments it is listed in the Ginna Station QA Manual, Appendix E, Attachment 1, (the 10CFR50.49 list). Environmental data for the instrument component location(s) is documented in Section 3.11 of the Ginna UFSAR. This information is also in the appropriate component EQ (File) Package. The EQ designation is only used for instruments

required to operate in "harsh" environments (50.49 list). This indicates that performance capability must be demonstrated by test, in accordance with IEEE 323-1974. Other ("mild environment") loops must demonstrate capability to perform throughout their range of "normal" ambient operating environments, but there is no regulatory requirement for testing.

9.1.4 Seismic Category

The safety classification of the instrument loop does not directly imply a particular category, so that other design basis information must be used to establish its seismic classification and performance requirements. For loops that are designated R.G. 1.97, the references in Section 9.1.3 provide the seismic classification (this covers most of the loops within the present project scope). In addition, loops which are identified in the Ginna Technical Specifications,

Table 3.5-1 Protection System Instrumentation,
Table 3.5-2 Engineered Safety Feature Actuation Instrumentation

should be designated Seismic Category 1 on the basis of IEEE 279-1971, and GDC 2 of Appendix A to 10CFR50. All other loops may be designated either non seismic (NS), or "structural integrity only" if a known R.G. 1.29, C.2 concern exists.

The performance requirements associated with instruments classified as Seismic Category 1 are not completely defined in the Ginna design basis. Per Attachment 2 of the RG&E 3-13-92 submittal to the NRC (referenced in 9.1.3), seismic qualification "is in accordance with the Ginna Seismic Qualification Program" and "Seismic qualification at Ginna is currently being resolved under USI-A46". Since 1978 RG&E practice has been to qualify new floor (or wall) mounted equipment to IEEE 344-1975. However most instrument racks and panels were installed during plant construction and therefore (because of the accepted practice at that time) were not seismically tested. Racks and panels for Protection System and ESFAS equipment have subsequently been inspected and modified to assure seismic integrity of anchorage and structure. Historical data (recognized by IEEE 344-1987) has been used by SQUG to establish reasonable assurance that A46 plants, in which equipment adequately anchored and constructed, can safely be shut down following a SSE.

The seismic performance requirement for Seismic Category 1 equipment within the scope of this analysis shall be that both the components of the loop and their supports or enclosures have documented seismic capability. Evaluation

of seismic capacity versus demand is not within the scope of this analysis. Instrument accuracy has not been identified as an issue in the A46 program and therefore seismic loop uncertainty will at this time be calculated for information only.

9.1.5 Technical Specifications

Ginna Station Technical Specifications, Section 3.5, Instrumentation Systems, identifies certain instrument loops which perform safety related functions. The following tables identify critical loop functions, the plant conditions when the loop must be operable, and the minimum number of channels that must be available for continued operation (LCOs).

Table 3.5-1 Protection System Instrumentation

Table 3.5-2 Engineered Safety Feature Actuation Instrumentation

Table 3.5-3 Accident Monitoring Instrumentation

Table 3.5-5 Radioactive Effluent Monitoring Instrumentation

Table 3.5-6 Radiation Accident Monitoring Instrumentation

Periodic test intervals, which are related to loop performance, are given in,

Table 4.1-1 Minimum Frequencies for Checks, Calibrations, and Test of Instruments.

Performance requirements for Reactor Protection System (Trip) instrument loops are described in detail in Section 2.0, SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS.

Performance requirements for Engineered Safety Features instruments is located in Table 3.5-4, ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION SETPOINTS. It should be noted that both setpoints and "allowable values" are given in this table. The term "allowable value" in this context is the same as "analytical limit".

Performance requirements for Radioactive Effluent Monitoring Instrumentation are stated in Table 3.5-5 and also in Section 3.9.1 Liquid Effluents, (3.9.1.1.a) and Section 3.9.2.3, Gaseous Waste Treatment (3.9.2.7.6).

Performance requirements for Control Rod Position Indication Systems are stated in Section 3.10.5, Control Rod Position Indication Systems.

9.1.6 Ginna Station UFSAR

Section 7 of the Ginna UFSAR describes design bases for Reactor Protection System and Engineered Safety Feature instruments. Instrument loops which initiate Reactor Protection and Engineered Safety Feature Actuation actions can be identified functionally from Table 7.2-1, LIST FOR REACTOR TRIP, ENGINEERED SAFETY FEATURES ACTUATION, AND CONTAINMENT ISOLATION. Interlocks associated with these loops are listed in Table 7.2-2, PERMISSIVE CIRCUITS.

Performance requirements for Reactor Protection systems are described in Section 7.2 of the UFSAR.

Performance requirements for Engineered Safety Feature Actuation instruments are described in Section 7.3 of the UFSAR. Table 7.3-1, ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS, is (or should be) identical with Tech Spec Table 3.5-4 discussed in 9.1.5.

Instrumentation for Safe Shutdown, and related performance requirements is discussed in Section 7.4 of the UFSAR. Safe Shutdown instruments and locations are shown by transmitter number on Table 7.4-2, SAFE SHUTDOWN INSTRUMENTS.

Performance requirements for Safety Related Display Instrumentation are described in Section 7.5. This section discusses the RG&E position on R.G. 1.97 Rev. 3 (See 9.1.2).

Performance requirements for certain Control Systems Not Required for Safety are described in Section 7.7.

9.1.7 Emergency Operating Procedures (EOPs)

The "EOP Data Base" can be used to identify instrument loops with output (indication) required by an EOP. Since EOPs were often written without reference to the accuracy of the available indicator, critical supplemental studies have been performed on certain loops to establish the performance requirements and relate these to the accuracy of the installed equipment. These studies are documented as, Design Analysis, "Calculation of EOP Footnotes", NSL-4173-014, EWR 4173, Rev. 1. This information should be referenced for applicable loops. For loops that have not been analyzed in this reference, some judgement regarding required accuracy may be necessary.

9.1.8 Other Documents

For instrument loops installed after 1978, design criteria documentation was prepared which defined performance requirements.

Loop specific regulatory performance requirements may exist. Where known these should be addressed.

9.2 Process Parameter Description and Instrument Loop Function

In Section 5.1.2 of Attachment A, describe the process parameter being measured and its anticipated range of values under normal, test (calibration), and accident conditions. Typical value(s) for the parameter during normal operation as well as the extremes of the "normal" operating range should be documented. Document the functions of the instrument loop in Sections 4.0 and 4.1 of Attachment A. Both control and protection modes of operation should be described even if evaluation of the control application is not currently under review. "Worst Case" bounding values should clearly be documented. Note that the intent of this section is to describe the values that the parameter can "take on", not the parameter values (limits) which represent "safe operation". System "safe operating" limits are documented in the next section.

9.2.1 Description of System Limits

In Section 5.1.3 of Attachment A, describe the limits which confine the process parameter (described in 9.2) to values which assure that no system design constraints (e.g. Departure from Nucleate Boiling) are violated. These limits will be used in Section 10 of Appendix A to evaluate the instrument loop performance margin after uncertainties are accounted for; therefore the bases for the limit(s) must be clearly understood and documented. Any uncertainty or "fuzziness" in these limits should be noted here, so that it can be considered in the final loop performance evaluation. Limits should be documented as "analytical", "design", or "estimated design". These terms are defined in Section 5.0 but require some elaboration.

9.2.1.1 Analytical Limit

Safety analyses supporting "analytical limits" are performed using a variety of methods. Ideally the Safety Analysis demonstrates that when the process parameter reaches the limit, under specified conditions, a system design constraint violation occurs. Often however the analysis, such as an accident simulation, has been performed assuming a value for the limit; and the validity of the limit is based on the fact that no design constraints were violated during the simulation. The limit established using the latter approach can conservatively be treated as if it would result in constraint violation, however, there is and obvious margin uncertainty introduced.

9.2.1.2 Design Limit

"Design limit" should be applied to those limits without a documented analytical basis, but which use an established value taken from an industry standard or from well established vendor literature.

9.2.1.3 Estimated Design Limit

"Estimated design limit" should be applied when bases for 9.2.1.1 or 9.2.1.2 are not available. That is, some limit must be provided to evaluate instrument performance and if no existing basis is available, an "Estimated Design Limit" will be provided using the best available system data.

9.3 Environmental Service Conditions

In Section 5.2 of Appendix A the physical environment in which the instrument loop is installed, calibrated, and required to function is documented.

9.3.1 The Sensor Environment

In Sections 5.2.1 and 5.2.2, identify the sensor location and the environmental service conditions for calibration, normal operation, and if necessary, accident operation. Section 3.11 of the Ginna UFSAR provides environmental data based on plant location. For EQ (50.49) sensors, the applicable EEQ-1 Form in the Ginna EQ File defines the bounding accident environmental conditions, and the EQ Block Diagram shows the location and associated equipment. If any known localized environmental conditions, more severe than the general area ambient (hot spots) exist near the Sensor location, they are identified on the EQ Block Diagram.

9.3.2 Associated Equipment Environments

9.3.2.1 Associated Equipment in Harsh Environment

If equipment other than the sensor is EQ (50.49) (e.g. cable, splices, connectors and penetrations) it is identified on the EQ Block Diagram for the loop. The diagram identifies the boundary between harsh and mild environments. Document harsh environment conditions, temperature, pressure, humidity and chemical spray, in Section 5.2.4.2 of Appendix A.

9.3.2.2 Associated Equipment in Mild Environments

If equipment is not designated EQ (50.49), it is considered subject to mild environment only. Temperature, radiation if above background (otherwise indicate "background"), and humidity ranges should be documented in Section 5.2.4.1 of Appendix A.

10.0 DESCRIPTION OF THE EXISTING INSTRUMENT LOOP CONFIGURATION

The intent of this section is to provide direction for documenting the configuration, operation, and calibration of the installed instrument loop, including applicable dimensional information, equipment capability and range data, environmental performance data and test reports, and calibration and maintenance procedures. This data will be used in Section 7.0 of Appendix A to compare the capability of the installed loop with the performance requirements documented in Section 6.0 of Appendix A. Uncertainty data will be documented in Section 8.0 of Attachment A.

10.1 Organization of Data and Documentation to support this activity is listed in Attachment B.

10.2 Process Measurement Data

10.2.1 Primary Element Information

If the instrument loop has a primary element such as an orifice or plate differential producer for flow measurement, identify the manufacturer, model number, size and specifications for the element. The draft design analysis, "Flow Measuring Element Technical Evaluation", Generic Reference 30, Attachment B, contains the design information for several differential producers. The upstream and downstream piping configurations should be reviewed for conformance with good design practice.

Document this information in Section 6.1.1 of Attachment A.

10.2.2 Sensor Data

Document the sensor's manufacturer and model number in Section 6.1.2.1 of Attachment A. Also list the vendor's published range and span limits of the sensor, including engineering units. The range should be obtained from vendor data sheets or manuals. The span should be obtained from the calibration procedure. Span and range are documented in 6.1.2.2 of Appendix A.

10.2.3 Sensor Environmental Limits

For EQ (50.40) Sensors, using appropriate EEQ-1s, review the environmental limits within which the instrument is qualified to function. This information, should include pressures, temperatures, radiation, chemical sprays,

humidity, and any associated time periods. Any assumptions or conditions specified by the vendor for operating within a harsh environment should also be documented. This information is already available in the EQ file, and is summarized on the EEQ-1 form for the sensor. It is reviewed and documented here to assure a complete description of instrument loop performance in the Attachment A checklist.

All other sensors (located in a mild environment) shall be reviewed for temperature effects only, unless the available vendor information identifies additional environmental constraints. This information should be entered in Section 6.1.3 of Attachment A.

10.2.4 Environmental Limits on Associated Equipment.

Review the EQ Block Diagram for the instrument loop to assure that cable, splices, connectors, penetrations, and any other equipment associated with the sensor and subject to harsh environment are shown and referenced to appropriated EQ package. Document the EQ Block Diagram number in Section 6.1.4 of Attachment A.

For instrument loops subject only to mild environment no review of associated equipment is required unless special environmental constraints exist.

10.3 Documentation of Signal Conditioning and Output Equipment

10.3.1 Signal Conditioning/Output Device Information.

For each device within the scope of the analysis provide the manufacturer and model number. Document the range of the component from vendor data. From the calibration procedure, provide the span, setpoint and/or reset point. The above information should be entered in Section 6.2.1 of Attachment A.

10.4 Scaling

Scaling is the process of modifying a primary measurement signal to achieve a desired input-output response, appropriate to a specific application, from the instrument loop. This includes compensation for systematic biasing effects (e.g. static head corrections in fluid systems), functional conversion to provide a linear output from a nonlinear input (e.g. taking the square root of differential pressure to provide a linear output proportional to flow rate), compensation for other types of nonlinear detector response, temperature, correction, compensation for density and pressure

effects, and engineering unit conversions. It also includes the algebraic methods used to combine inputs from more than one sensor to provide a single output.

Reference 25 "NRC Information Notice 91-75", notes that a number of cases of incorrect static head compensation have been found in calibration procedures recently. Special attention should be placed on this correction when applicable.

10.4.1 In Section 6.3 of Attachment A, provide a description of the way the process parameter, documented in Sections 5.1.1 and 5.1.2 of Attachment A is measured and processed to produce an output appropriate to the application and performance requirements. This description should include a discussion of those features of the instrument design which provide compensation for, or eliminate, effects of physical processes, other than the process parameter being measured, that would otherwise bias or influence the instrument loop output. An overall scaling equation should be provided as part of the description. This equation is the basis for the Total Loop Uncertainty (TLU) function, documented in Section 9.9 of Attachment A.

Provide information in Section 6.1.1 of Attachment A, Primary Element Information and 6.1.2 of Attachment A, Sensor Information, as appropriate.

Describe any compensation required due to sensor or associated equipment location with respect to the process parameter or to environmental effects.

Reference should be made to existing studies of certain systems such as the Reactor Vessel Level Monitor, where scaling processes have been documented in detail, when available.

10.5 Documentation of Uncertainty Data

This section provides direction for documenting instrument error data to be entered in Sections 8.1 through 8.8 of Attachment A. These data will be utilized in Section 10.0 of Attachment A to calculate total loop uncertainty.

10.5.1 Accident Uncertainty

These errors, random and biasing, are addressed only for EQ (50.49) equipment. Harsh environment (accident) effects on most EQ instrument loops are analyzed in Generic Reference 17, "Integrated System Performance

Analysis", Attachment B performed by EPM. This study is based on detailed review of test report data in the Ginna EQ File. Random and biasing errors are calculated for sensors and associated equipment. These studies should be utilized for accident error data on instrument loops to which they apply.

Estimates of non-accident related error where made in these studies to provide a reasonable basis for evaluating instrument loop performance during the Design Basis Event. The non-accident error estimates should <u>not</u> be used in this analysis.

In some cases EOP studies, Generic Reference 9, Attachment B, also calculated or obtained accident errors. These values should be reviewed for consistency.

When error data is obtained from EQ tests performed in accordance with IEEE 323-1974, it is not normally possible to resolve the uncertainty into separate temperature, pressure, radiation, and steam/spray effects. A combined accident error is used in this case. The random component of this error is called "combined random accident effect" (Crae) and the systematic or biasing error is called "accident bias" (AB). When the Crae is used there will be no "separate effects" uncertainty. These data are entered in Section 8.1.1 of Attachment A.

Accident related uncertainties produced in equipment associated with the sensor (cable, splices, penetrations) are assumed to be due to current leakage only. The associated equipment is identified on the EQ Block Diagram, as discussed in Section 9.3.2. Leakage effects are modeled and calculated in Generic Reference 17, Attachment B. Current leakage biases the instrument loop output in one direction, but the magnitude depends on unpredictable accident conditions and must therefore be assumed to vary from zero to the calculated maximum. Both extremes should be considered. The maximum accident leakage bias error is entered in Section 8.2 of Attachment A.

The seismic performance requirements for Ginna instruments are discussed in Section 9.1.4. Seismic uncertainty data and calculations will be documented for potential use during A-46 resolution. The main use of seismic uncertainty data at this time is to provide reasonable assurance of instrument loop seismic integrity. Seismic error may be principally due to the sensor or may in some cases involve rack and output device effects. These data are entered in Section 8.2 of

10.5.2 Non Accident Uncertainty

10.5.2.1 Process Measurement Uncertainty

Based on the data from 5.1.2 of Attachment A, provide an uncertainty estimate for the state of the measured parameter. Possible ranges of temperature, pressure, chemical composition, and flow rate should be considered. If more than one effect is present, use subscripts.

If a primary element is present, the uncertainty should be listed in the data sheet. Record these data in Section 8.3 of Attachment A.

10.5.2.2 Measurement and Test Equipment Uncertainty

The accuracy of sensor and rack equipment calibration is limited by the accuracy of the equipment used to perform the calibration procedure. The measurement and test equipment used to calibrate the instrument loop is listed in the calibration procedure(s). Obtain the test equipment accuracy from Generic Reference 23, Test Instrument Calibration Procedures (TICP's). The appropriate TICP's should be referenced in the Calibration Procedure. Test instrument manufacturer data should be reviewed to assure that the equipment is capable of the accuracy required by the TICP. If several test equipment items are involved appropriate subscripts should be used. Use the same rules for combining test equipment error as are used for the instrument loop itself. Record these data in Section 8.4 of Attachment A.

10.5.2.3 Rack Equipment Uncertainty

The accuracy of rack mounted equipment in the instrument loop should be obtained from manufacturer's information or individual component calibration procedures.

If the output device is an indicator or recorder, the readability should be documented as a Rack Miscellaneous Effect. The readability of an analog indicator/recorder is based on the interval between scale demarcations. The indicator/recorder scale demarcations and calibrated span define the readability of the device.

It is important to differentiate between the readability of the indicator/recorder for calibration purposes and its readability during operation. When calibrating an

indicator/recorder, an input test signal will be provided by M&TE and the "output" will be directly read from the indicator/recorder. No additional M&TE is required. This output is aligned on the scale demarcations during the calibration process. Thus, the readability of the indicator/recorder during calibration are the same as for a separate piece of M&TE if one were used. This readability is a part of the calibration, just like any other calibration, and is typically a part of the M&TE uncertainty or calibration tolerance.

For an indicator/recorder, however, there is a separate readability that must be included for its use by an operator.

For Ginna, the readability is defined as one half of the smallest scale increment or 1% full scale, whichever is greater.

RE = 1/2 smallest scale demarcation

10.5.2.4 Sensor Uncertainty

The sensor uncertainty should be obtained from manufacturer's literature. If separate effects such as linearity, hysteresis, or repeatability are listed, they may be appropriately combined, with the separate effect uncertainties documented in a note, or documented separately using subscripts, in Section 8.6 of Attachment A.

Non accident temperature effects on the sensor that are not compensated for in the instrument design or scaling should be documented in Section 8.6 of Attachment A. Any design features which compensate for temperature uncertainty (e.g. 4 wire RTD circuits) should be briefly described in a footnote.

Most sensor designs are stabilized against small variations in power supply voltage. This feature also provides flexibility in adding or removing loads in the instrument loops (e.g. bistables). When such features eliminate sensor power supply effects, provide a short description of the design feature and the associated load limits. An appropriate reference can be used also. Power supply effects are documented in Section 8.6 of Attachment A.

Account for other uncertainties (such as construction tolerances) which produce errors in Section 8.6 of Attachment A.

10.5.2.5 Drift Tolerance

The expected or allowable time dependent change in instrument calibration during the calibration interval for sensors and rack mounted equipment should be obtained from the calibration procedure and documented in Section 8.7 of Attachment A. When no allowable drift is specified in the calibration procedure vendor information or plant maintenance history may be used.

10.5.2.6 Tolerance Uncertainty

The calibration procedures for sensors and rack mounted equipment provide tolerance bands to reduce calibration time as much as possible within the loop accuracy requirements. This tolerance band represents a random error and should be documented in Section 8.8 of Attachment A.

11.0 EVALUATION OF THE EXISTING INSTRUMENT LOOP CONFIGURATION AGAINST DOCUMENTED PERFORMANCE REQUIREMENTS

Section 9.0 addresses documenting the performance requirements for the instrument loop and Section 10.0 addresses documenting the existing instrument loop design. This section addresses comparing the information from these two sections. Portions of the existing calibration procedure will be reviewed. The remaining portions of the calibration procedure, related to the setpoints, are addressed in Sections 12.0 and 13.0 of this document.

11.1 Evaluating the Loop's Configuration

11.1.1 Conformance with Performance Requirments

Review the performance requirements documented per Section 9.1 for the instrument loop. Compare these to the existing design, documented per Section 10, to ensure that all of the criteria are addressed and met.

After all performance requirments are evaluated, provide a conclusive statement as to whether the existing design meets the requirments. Identify any requirements that are not met. Document the evaluation in Section 7.1.1 of Attachment A.

11.1.2 Performance of Safety Related and Safety Significant Functions

Review the required Safety Related and Safety Significant functions (protection, control, indication) of the loop documented in Sections 4.0 and 4.1 of Attachment A. Compare these functions to the existing loop design to ensure that all functions are achieved. Document the evaluation in Section 7.1.2 of Attachment A.

11.1.3 Consistency of Instrument Loop Documentation

In Section 7.1.3 of Attachment A, describe documentation consistency.

11.2 Evaluating the Loop Measurement Capability

11.2.1 Evaluating the Range/Span

Sections 10.2.2 and 10.3.1 of this document the range and span of the sensor and other loop components.

Section 9.2.1 of this document addresses the limits that apply to this loop. Ensure that the calibrated spans of the sensor and the appropriate output devices (indicators, recorders, computer inputs, etc.) envelope all of the specified limits. Document this evaluation in Section 7.2.1 of Attachment A.

11.2.2 Evaluating Setpoints and Indicated Values

In Section 7.2.2 of Attachment A, document the setpoint and indicated value with respect to span. In Section 7.2.3 document the units of measure.

11.3 Evaluating the Calibration

11.3.1 Reviewing the Calibrated Components

Review the calibration procedure(s) for the loop and ensure that each applicable component is properly calibrated. This calibration should include the sensor, all safety related output devices, and other applicable intermediate components (power supplies, comparators, etc.).

The calibration data specified in the Calibration Procedure shall be verified by calculation to be consistent with the existing system design. This includes range, span, gain and bias (scaling), and time constants for dynamic compensation.

Document this review in Section 7.3.1 of Attachment A.

11.3.2 Reviewing the Primary Element

Section 10.2.1 of this document addresses the primary element. Ensure that the primary element is adequately sized for its application. Ensure the sensor's calibration properly reflects the output of the primary element.

Document this review in Section 7.3.2 of Attachment A.

11.3.3 Reviewing the Direction of Interest

The calibration procedure should exercise the instrument loop, as a minimum, in the direction of interest. The calibration may be conducted in both directions. For instrument loops with both a setpoint and a reset point, the calibration should be conducted in both directions.

Document this review in Section 7.3.3 of Attachment A.

11.3.4 Evaluating Scaling

Assure that any scaling equations and constants addressed in Section 10.4.1 are included in the calibration procedure and are consistent with the existing system performance requirements. Document general scaling information in 7.3.4 of Attachment A.

11.3.5 Evaluating Scaling (Correction Factors)

Static head correction is identified as a frequently overlooked factor in NRC Information Notice 91-75. Document this and similar "correction" factors, separate from other scaling equations in Section 7.3.5 of Attavhment A.

12.0 EVALUATION OF LOOP UNCERTAINTY

This section provides direction for combining and evaluating the uncertainty data obtained in accordance with Section 10.5, and documented in Sections 8.0 to 8.8 of Attachment A. Unless a bias is demonstrated in the uncertainty data, the documented error is assumed to be random, and approximately normally distributed with zero mean and standard deviation equal to one half the documented error. This corresponds to assuming that error data (from vendors, test reports, etc.) is at least two standard deviations. These assumptions provide the basis for combining error data using the square root of the sum of the squares (SRSS) method. This method is based on the fact that the sum of normally distributed random variables (errors in our case) is itself normally distributed random variable (error), with variance (standard deviation squared) equal to the sum of the individual term variances. When loop outputs are functions other than sums (typically square roots in flow measurement) of terms, the resulting output is no longer normally distributed. The error combining methods of Reference 7.4 should be used for these measurements with the knowledge that they are based on expansions which assume that the error is "small" compared with the magnitude of the parameter. Some judgement is therefore required using this methodology.

12.1 Process Measurement Uncertainty (PMU)

As documented in Section 8.3 of Attachment A, the PMU is composed of one or more process measurement accuracies (Pma) combined using SRSS, and if a primary element is present, a primary element is present, a primary element accuracy (Pea). These are combined using SRSS, and documented in Section 9.1 of Attachment A.

12.2 Measurement and Test Equipment Uncertainty

As documented in Section 8.4 of Attachment A, the individual M&TEU data are combined using SRSS. Document this in Section 9.2 of Attachment A using separate sensor (Sce) and Rack Equipment (Rce) terms combined using SRSS.

12.3 Accident Sensor Environmental Uncertainty

12.3.1 Pipe Breaks (AEUp)

Combine the random accident error terms using SRSS if necessary and add or subtract the accident bias (AB) as appropriate. Document in Section 9.3 of Attachment A.

12.3.2 Seismic Events (AEUs)

Combine seismic errors if necessary using SRSS. Document in Section 9.3 of Attachment A.

12.4 Accident Current Leakage Uncertainty (CLU)

All current leakage terms are biasing errors and are combined algebraically. Document in Section 9.4 of Attachment A.

12.5 Rack Equipment Uncertainty (REU)

Combine terms using SRSS and document in Section 9.5 of Attachment A.

12.6 Sensor Uncertainty (SU)

Combine terms using SRSS and document in Section 9.6 of Attachment A.

12.7 Drift Uncertainty (DU)

Combine terms using SRSS and document in Section 9.7 of Attachment A.

12.8 Tolerance Uncertainty (TU)

Combine terms using SRSS and document in Section 9.8 of Attachment A.

12.9 Total Loop Uncertainty

Using the methods in Reference 7.4, Section 6.3, calculate the total loop uncertainty and document in Section 9.9 of Attachment A. Note the LU and AB are biasing terms which may produce opposing effects. The bias terms should be combined in a way that produces the "worst case" error(s).

The form of the total loop uncertainty function is dependent on the scaling processes addressed in Section 10.4 and documented in Section 6.3 of Attachment A.

12.10 Comparison of Reference Accuracy with Calibration Tolerance

In Section 9.10 of Attachment A document the data showing that the calibration tolerances for components in the instrument loop are larger than the corresponding reference accuracies.

13.0 SETPOINT EVALUATION

13.1 Assigning Limits to Output Devices

Section 9.2.1 of this procedure addresses the limits associated with the instrument loop. The limits are documented in Section 5.1.3 of Attachment A. Pair these limits with the corresponding output devices which prevent the limit from being exceeded. Document the output device/limit pairs in Section 10.1 of Attachment A.

13.2 Evaluating the Setpoint(s)

13.2.1 Total Loop Uncertainty

Obtain the total loop uncertainty (TLU), addressed in the previous section, from Section 9.9 of Attachment A.

13.2.2 Evaluation of Existing Setpoint Using Total Loop Uncertainty

13.2.2.1 To determine the maximum or minimum acceptable instrument setpoint, the total loop uncertainty (TLU) is subtracted from or added to the limit (analytical, design, or estimated design) depending on whether the setpoint actuation occurs on an increasing or decreasing process parameter.

For an increasing process parameter setpoint actuation:

maximum acceptable setpoint = limit - TLU

For a decreasing process parameter setpoint actuation:

minimum acceptable setpoint = limit + TLU

13.2.2.2 Using the Total Loop Uncertainty, determine whether the existing setpoint is adequate to prevent system parameters from exceeding (high or low) documented analytical or design limits. In some cases there may not be a documented analytical or design limit. When this occurs, reasonable assumptions may be made. For example the instrument loop uncertaintyassumed in original accident analyses, might be used to establish an "Estimated Design Limit" (EDL). The setpoint adequacy can then be determined from the equations:

increasing process parameter setpoint:

setpoint $\leq$ maximum acceptable setpoint

decreasing process parameter setpoint:

setpoint $\geq$ minimum acceptable setpoint

13.3 Comparison of Existing Setpoint With Technical Specification Allowable Values

If the calculation results are not consistent with the Technical Specification values, or other performance requirements documented in Section 5.0 of Attachment A, take appropriate corrective action based on the Ginna Station QA Manual.

14.0 CONCLUSION

Within the Conclusion Section, Section 12 of Attachment A, summarize the overall results of the instrument's evaluation. Discuss whether or not the instrument's present design and use meets the documented performance requirements. Also, state whether or not the existing calibration procedure(s) support the instrument loop functions. Identify any necessary changes to the calibration procedure and/or to the instrument's design. The discussion shall only address necessary changes. Suggestions for improvement should be documented in a separate report.

Within the discussion of any proposed change, include a well defined basis for why the change is needed. This basis shall include the potential consequences of not performing the change and any alternative measures that could be performed instead. Mark-ups of the calibration procedures, ILWDS, or other documents should be used as necessary to support the discussion. These shall be included as attachments to this checklist and referenced within the discussion.

ATTACHMENT A

INSTRUMENT PERFORMANCE EVALUATION AND SETPOINT VERIFICATION

Design Analysis

Ginna Station

Instrument Loop Performance Evaluation
and Setpoint Verification

Instrument Loop Number (   )

Rochester Gas and Electric Corporation
89 East Avenue
Rochester, New York 14649

DA EE-92-_ _ _-21

Revision __

(Date)

EWR 5126

Prepared by:	Instrument Performance Verification Engineer	Date
Reviewed by:	Instrument Performance Verification Project Manager	Date
Reviewed by:	Nuclear Safety & Licensing	Date
Approved by:	Manager, Electrical Engineering	Date

NUCLEAR SAFETY & LICENSING
INQUIRY DATA BLOCK

Changed or new equipment/system information requires copy to Ginna if any box is checked below.	Safety Class From GMEDB	Review By NS&L
Requires Copy to Ginna.(Check applicable box)	See #1	(Y/N)
☐ Setpoints (Instrument, Relief Valve, Time Delay, Other)	______	See(#2)
☐ Operating Parameter (Flow, Pressure, Temperature, Volume, Other)	______	See(#2)
☐ Operational Restrictions	______	See(#3)
☐ UFSAR changes are required	______	See(#4)

Section(s) ______ ______ ______

NOTES:
(#1) If any box is checked, consult the GMEDB records to determine the component safety class, then enter "SR" if Safety Related,or "SS" if Safety Significant or "NSR" if Non-Safety Related.
(#2) If Safety Class is "SR" or "SS" review by NS&L is required.
(#3) If box is checked, review by NS&L is required.
(#4) Responsible NES Engineer shall complete the UFSAR section. If UFSAR changes are required, review by NS&L is required.

DOCUMENT CONTROL DATA FORM

PLANT SYSTEMS AND STRUCTURES LIST
(Ref. 2.3; PSSL Numeric Identifiers)

KEY WORDS:

CROSS REFERENCED TO:

SUPERSEDED REFERENCE DATA:

EIN DESIGNATORS(S):

<u>REVISION STATUS SHEET</u>

Page	Latest Revision	Page	Latest Revision

INSTRUMENT PERFORMANCE EVALUATION AND
SETPOINT VERIFICATION

TABLE OF CONTENTS

INSTRUMENT PERFORMANCE EVALUATION AND SETPOINT VERIFICATION

Instrument Loop Identification

Calibration Procedure No: ____________________

Description: ____
____
____
____

The Instrument Performance Evaluation and Setpoint Verification of the following equipment will be performed by this document:

1. ____
____
2. ____
____
3. ____
____
4. ____
____

1.0 Purpose

Provide a brief description of the reason for preparing the calculation specific to the loop being evaluated.

2.0 References

List all of the references used in the Setpoint Verification Evaluation specific to the loop being evaluated.

3.0 Assumptions

List all assumptions that were made to perform the calculation specific to the loop being evaluated.

4.0 Block Diagram and Scope of Analysis

Provide a Block Diagram of the specific loop being evaluated

4.1 Description of Functions

Making reference to the Block Diagram, describe the instrument loop functions that are within the scope of the analysis using the format below.

4.1.1 Protection

Describe any loop functions that input to the Reactor Protection and Engineered Safety Features Actuation Systems.

4.1.2 Control

Describe any loop control functions that are within the scope of the analysis. Describe loop control functions not within the scope to the extent necessary to justify exclusion.

4.1.3 Indication

Describe loop functions that produce indications that are within the scope of the analysis (e.g. RG 1.97 and EOPs). Reference existing EOP studies where available. List indication not within scope.

5.0 Instrument Loop Performance Requirements

5.1 Documenting the Design Requirements for Monitoring the Process Parameter

5.1.1 Identify Performance Related Design Bases Associated with the Instrument Loop:

_______ Safety Classification (SR/SS/NS) as documented in the Ginna Q-list.

_______ NUREG 0737/RG 1.97 as documented in Table 7.5-1, of the Ginna UFSAR.

_______ EQ (per the 10 CFR 50.49 list)

_______ Seismic Category (Seismic Category 1/ Structual Integrity Only / NS)

_______ Tech Spec

_______ UFSAR

_______ EOP

_______ other ______________________________

5.1.2 Description of Process Parameter:

Under normal conditions:

Under test conditions:

Under accident conditions (which accidents?):

5.1.3 Description of Limits

Limits	Type	Ref	Section
______	______	______	______
______	______	______	______
______	______	______	______

5.2 Documenting the Environmental Conditions Associated With the Process Parameter

5.2.1 Identification of the Sensor Location:

5.2.2 Description of Environmental Service Conditions for the Sensor:

5.2.2.1 Normal

5.2.2.1.1 Normal Operation

5.2.2.1.2 During Calibration

5.2.2.2 Accident

5.2.3 Identification of Other Components Locations:

5.2.4 Description of Environmental Service Conditions for Other Components:

5.2.4.1 Normal

5.2.4.1.1 Normal Operation

5.2.4.1.2 During Calibration

5.2.4.2 Accident

6.0 Description of the Existing Instrument Loop Configuration

6.1 Summary of Process Measurement

6.1.1 Primary Element Information

Manufacturer/Model No.

____

Size

____

Specifications

____

____

____

Ref. # ________________ Section ____________________

Piping Configuration/Element Description

____

____

Ref. # ________________ Section ____________________

6.1.2 Sensor Information

6.1.2.1 Manufacturer/Model No. ______________________________

Ref. # ______________ Section ______________

6.1.2.2 Sensor Range __________ Ref. __________ Sec. __________
Sensor Span __________ Ref. __________ Sec. __________

6.1.3 Sensor Environmental Limits:

Press ________________ **Ref.** __________ **Sec.** __________
Temp. ________________ **Ref.** __________ **Sec.** __________
Radiation ____________ **Ref.** __________ **Sec.** __________
Humidity _____________ **Ref.** __________ **Sec.** __________

6.1.4 Associated Equipment Environmental Limits:

Reference the appropriate EQ Block Diagram.

EQ Block Diagram ________________

6.2 Summary of Signal Conditioning and Output Devices:

6.2.1 Signal Conditioning/Output Device Information:

6.2.1.1

Tag #/Type	Manuf./Model#	Ref	Sec

6.2.1.2

Tag #	Span	Setpoint/Reset Pt	Ref	Sec

6.3 **Scaling**

6.3.1 Performing the Conversions:

Describe the conversion performed by the instrument loop from the sensor input to the appropriate loop outputs and quantify the calculated biases and gains for each applicable component.

7.0 Evaluation of Existing Instrument Loop Configuration Against Documented Performance Requirements

7.1 Evaluating the Loop Configuration

7.1.1 Compliance with Design Basis Performance Requirements:

Does the existing design conform to the design basis performance requirements identified in Section 5.1.1 of this checklist?

Explain:

7.1.2 Performance of Safety Related or Safety Significant Functions:

Can the existing loop adequately perform each of its Safety Related or Safety Significant functions (protection, control, and/or indication)?

Explain:

7.1.3 Evaluating the Consistency of Instrument Loop Documentation

Is the loop configuration shown in the calibration procedure(s) consistent with the applicable design drawing(s)? Are component manufacturers and model numbers documented in the calibration procedure consistent with those shown on applicable design drawings? If significant inconsistencies exist, has reasonable assurance of the actual configuration been established? Have appropriate notifications been made regarding drawing changes?

7.2 Evaluating the Loop's Measurement Capability

7.2.1 Evaluating the Range/Span:

Is the calibrated span of the sensor and indication devices (indicators, recorders, computer output points) broad enough to envelope all of the limits in Section 5.1.3 of this checklist?

Explain:

7.2.2 Evaluating the Setpoints and Indicated Values vs. the Span:

Are setpoints located within the instrument span in a way that assures reasonable accuracy for the critical instrument loop functions.

Explain:

7.2.3 Reviewing the Units of Measure:

Are the units for the indicated values shown within the calibration procedures consistent with the EOPs?

Explain:

7.3 Evaluating the Calibration

7.3.1 Reviewing the Calibrated Components:

Is every applicable component and output calibrated?

Explain:

7.3.2 Reviewing the Primary Element:

Does the calibration of the sensor properly reflect the sizing of the primary element?

Explain:

7.3.3 Reviewing the Direction of Interest:

Does the calibration procedure exercise the components in the direction of interest?

Explain:

7.3.4 Evaluating Scaling:

Are the scaling equations and constants described in Section 6.3 of this checklist consistent with the existing system performance requirements.

Explain:

7.3.5 Evaluating Scaling (Calibration Correction Factors):

Describe any calibration corrections used to account for process, environmental, installation effects or for any special design features employed by the instrument. These include corrections within the calibration process for elevation, static head, density, calibration temperatures, etc. Ensure any effect not accounted for by the calibration process is included within the determination of the total loop uncertainty.

8.0 Documentation of Loop Uncertainties

8.1 Documenting the Components of Sensor Accident Uncertainty (AEUp and AEUs)

8.1.1 Pipe Breaks

Accident Effect	Uncertainty	Ref/Section
Temperature Effect(Te)		
Pressure Effect(Pe)		
Radiation Effect(Re)		
Steam/Chem Spray(S/Ce)		
Combined Random Accident Effect(Crae) (per IEEE 323 tests)		
Accident Bias(AB)		

8.1.2 Seismic Event

Seismic Effect	Uncertainty	Ref/Section
Sensor		
Rack		
Output Device		

8.2 Documenting the Components of the Accident Current Leakage Effect (CLU)

Associated Equipment Accident Effects	Uncertainty	Ref/Section
Cable Leakage(Cl)		
Splice Leakage(Sl)		
Penetration Leakage(Pl)		

Term Block Leakage(TB1)		
Conduit Seal Leakage(CS1)		

8.3 Documenting the Components of Process Measurement Uncertainty (PMU)

	Uncertainty	Ref/Section
Process Measurement Accuracy(Pma)		
Primary Element Accuracy(Pea)		

8.4 Documenting Measurement and Test Equipment Uncertainty (M&TEU)

	Uncertainty	Ref/Section
Sensor Calibration Effect(Sce)		
Rack Equipment Calibration Effect(Rce)		

8.5 Documenting Rack Equipment Uncertainty (REU)

	Uncertainty	Ref/Section
Rack Equipment Accuracy(Rea)		
Rack Temperaure Effect(Rte)		
Rack Power Supply Effect(Rpse)		
Rack Miscellaneous Effect(Rme)		

8.6 Documenting Sensor Uncertainty (SU)

	Uncertainty	Ref/Section
Sensor Accuracy(Sa)		
Sensor Static Pressure Effect(Sspe)		
Sensor Temperature Effect(Ste)		
Sensor Power Supply Effect(Spse)		
Sensor Miscellaneous Effect(Sme)		

8.7 Documenting Drift Uncertainty (DU)

	Uncertainty	Ref/Section
Sensor Drift(Sd)		
Rack Equipment Drift(Red)		

8.8 Documenting Tolerance Uncertainty (TU)

	Uncertainty	Ref/Section
Sensor Tolerance(St)		
Rack Equipment Tolerance(Ret)		

9.0 Loop Uncertainty Evaluation

9.1 Process Measurement Uncertainty (PMU)

$$PMU = \sqrt{(Pma)^2 + (Pea)^2}$$

9.2 Measurement and Test Equipment Uncertainty (M&TEU)

$$MTEU = \sqrt{(Sce)^2 + (Rce)^2}$$

9.3 Determining the Accident Sensor Environmental Uncertainties (AEU)

For Pipe Breaks:

$$AEUp = \sqrt{(Te)^2 + (Re)^2 + (Pe)^2 + (S/Ce)^2} + AB$$

or

AEUp = Crae + AB

For Seismic Events:

AEUs = Se

9.4 Accident Current Leakage Effect (CLU)

CLU = Cl + Sl + Pl + TBl + CSl

9.5 Rack Equipment Uncertainty (REU)

$$REU = \sqrt{(Rea)^2 + (Rte)^2 + (Rpse)^2 + (Rme)^2}$$

The miscellaneous errors must be confirmed by the engineer to be random and independent.

9.6 Sensor Uncertainty (SU)

$$SU = \sqrt{(Sa)^2 + (Sspe)^2 + (Ste)^2 + (Spse)^2 + (Sme)^2}$$

9.7 Drift Uncertainty (DU)

$$DU = \sqrt{(Sd)^2 + (Red)^2}$$

9.8 Tolerance Uncertainty (TU)

$$TU = \sqrt{(St)^2 + (Ret)^2}$$

9.9 Calculating the Total Loop Uncertainties

Provide the total loop uncertainty (TLU) for each end device for normal, seismic and accident conditions as applicable.

Output Device ___________________________

TLU = f(LU,AB,AEU,PMU,M&TEU,REU,SU,DU,TU)

Where:

TLUs = The Total Loop Uncertainty Seismic
TLUa = The Total Loop Uncertainty Accident
LU = Current Leakage Uncertainty
AEUs = Accident Environmental Uncertainty (Seismic)
AEUp = Accident Environmental Uncertainty (Pipe Break)
PMU = Process Measurement Uncertainty
REU = Rack Equipment Uncertainty
SU = Sensor Uncertainty
DU = Drift Uncertainty
TU = Tolerance Uncertainty
AB = Accident Bias
M&TEU= Measurement and Test Equipment Uncertainty

9.10 Comparing the Reference Accuracy vs. the Calibration Tolerance

From the calibration procedure(s), identify the calibration tolerance associated with each component. Next, obtain the reference accuracy associated with each component. Translate both effects into the equivalent units. Ensure that the calibration tolerance is greater than or equal to the reference accuracy for each component.

10.0 Setpoint Evaluations

10.1 Assigning the Limits:

For each instrument function, identify the associated limits from 5.1.3 of this checklist.

Output Device	Limit Value	Type of Limit

10.2 Evaluating the Setpoint(s):

Compare the existing setpoint, reset point or indicated value within the calibration procedure with the maximum or minimum acceptable setpoint.

Output Device	Setpt (INC/DEC)	Acceptbl Setpt

10.3 Verifying the Adequacy of the Allowable Tolerance Band:

For each component, calculate the maximum as-found and as-left value lmits. Compare these to the existing allowable tolerance band presently within the calibration procedure.

Component	Calc. Allow. Tol. Bd	Exist. Allow. Tol. Bd.

11.0 Conclusion

Attachment A
Open Items List

Attachment B
Selected References

ATTACHMENT B

Organization of Data and Documentation Support for Instrument Loop Performancœ and Setpoint Verification

Documentation and data to support project calculations being performed by the contractor will be furnished in either of two ways. "Generic" data and documentation, applicable to a number of the instrument loops or the associated plant systems, will be provided at near the start of project activity. This data and documentation is contained in existing reports, files, or packages that can be identified, segregated, and transmitted without reference to a specific instrument loop. Instrument loop "specific" data and documentation (not contained in the "generic" packages) will be identified by RG&E Engineering in a "pre-calculation" review of each instrument loop being analyzed. These reviews will be performed, and identified data and documentation transmitted to the contractor (Cygna, Boston), in advance of the contractors work start on the applicable instrument loop calculations.

The following tables list the data and documents in each of the groups. These tables may be revised as the project advances.

I. "Generic" documents to be supplied to Cygna for general reference.

Generic Reference Document	Date Sent	Initials	Comments
1. Ginna Technical Specifications			
2. Ginna UFSAR			
3. Foxboro BD Series Dwgs: RPS & Process Control Block Diag.			
4. Foxboro CD Series Dwgs: RPS & Process Control Connection Diag.			
5. Fox 1, Fox 2, Fox 3, RVLMS1, RVLMS2, SAFW Cab. Dwgs.			
6. Foxboro PSS 9-1B1A NE-10 Series Transmitters			
7. Foxboro PSS 9-1A1A 820 Series Transmitters			
8. Foxboro WAPD Manual (First Three Vols.) and System Inst. Man.			
9. Design Analysis, "Calculation of EOP Footnotes," NSL-4173-014, EWR 4173, Rev. 1			
10. Procedure Index (CPs only)			
11. P&IDs (complete set)			
12. CCD Index			
13. Instrument Index (4 Vols.)			DELETED
14. "P" Series Procedures (Precautions & Limitations)			
15. W PWR Training Manual			
16. RG&E Training Dept. System Descriptions			
17. Integrated System Performance Analyses for Harsh Environment Effects.			
18. Foxboro SPEC 200 Manual (4 volumes)			

Generic Reference Document	Date Sent	Initials	Comments
19. Foxboro (SPEC 200) Nuclear Qualification Doc. (7 volumes)			
20. EOP Setpoint Data Base			
21. Ginna Station QA Manual, Appendix E, Attachment 1			
22. Instrument Loop Wiring Diagrams (ILWDs) (Set)			
23. Test Instrument Calibration Procedures (TICPs) (Complete Set)			
24. RG&E Submittal to NRC, 3/13/92, NUREG 0737/RG 1.97:Comparison of Ginna Post Accident Instr.			
25. NRC Information Notice 91-75: Static Head Corrections in Pressure Transmitter Cal. Proc.			
26. NRC Information Notice 92-12: Effects of Cable Leakage on Instrument Settings and Indications			
27. NRC Information Notice 91-52: Non Cons. Errors in Overtemp Del. T Caused by Improp. Gain also IEN 91-52 S1 and RGE response			
28. RG&E Dwg 03201-0102 R1 Inst. Bus Single Line			Also R0 colored
29. RG&E Dwg 33013-652 R12 480V One Line Diag.			
30. RG&E Design Analysis (DRAFT),"Flow Measuring Element Tech. Eval."			Also EWR 5085ME-1 Rev 0

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II. Loop or System "unique" documents

1. Calibration Procedure(s)
2. Applicable Instrument Loop Wiring Diagram (ILWD) if it exists.
3. Component vendor manuals not included in "generic" documents
4. Isometric, piping and equipment drawings,and sketches showing component locations, and dimensions.
5. Other applicable Vendor/RG&E drawings.
6. EQ Package Data (e.g. EEQ-1s, EQ Block Diagrams)
7. Existing analyses not included in generic packages.
8. Other applicable documentation (e.g. data sheets, EOPs)

Precalculation Instrument Review Checklist

1. Instrument Loop ______________________________ (Rev   ) ______

2. Calibration Procedure(s)

Procedure Number	Date Sent	Initials

3. Instrument Loop Block Diagram (Figure 1), Simplified Schematic Diagram (Figure 2) (Optional).

4. Component Documentation (list all components shown in block diagram and indicate "generic" (gen) with "generic" doc pkg. number or date sent).

   a. Isometric, piping, or equipment drawings showing physical configuration.

Dwg. Number	Description	Date Sent	Initials

   b. Component vendor drawings and documentation.

   (i) Vendor Manuals/Data

Component (EIN)	MFG	Model #	VTD #/ Doc #	Date/ Initials

(ii) Vendor/RG&E Drawings

Vendor	Dwg. Number	Description	Date Sent	Initials

c. EQ data for 50.49 instrument loops (list all components subject to harsh environmental effects).

Component	EQ Ref. Doc.	Date Sent	Initials

d. Note any other information provided.

Prepared by: ______________________________
Date

Reviewed by: ______________________________
Date

Approved by: ______________________________
R. A. Baker Date
RG&E Lead I & C Engineer

xc: R. Baker
J. Bitter
G. Daniels
D. Kosack (Cygna)
P. Swift
EWR 5126 File
Elec. Eng. File

INSTRUMENT LOOP

BLOCK DIAGRAM

FIG 1

SIMPLIFIED SCHEMATIC DIAGRAM
(OPTIONAL)

FIG 2

INSTRUMENT CALIBRATION DATA SHEET 1

INSTRUMENT NO.: CURRENT-TO-VOLTAGE (I/V) CONVERTER LO-504

LOCATION: RELAY ROOM, RVLMS-1 RACK, NEST 5, SLOT 9

PURPOSE: STEAM GENERATOR A WIDE RANGE LEVEL

INPUT	OUTPUT			
UNITS mA	DESIRED VALUE VDC	AS FOUND VDC	ALLOWABLE TOLERANCE BAND VDC	AS LEFT VDC
4.0 *	0.00		-0.05 to 0.05	
8.0	2.50		2.45 to 2.55	
12.0	5.00		4.95 to 5.05	
16.0	7.50		7.45 to 7.55	
20.0 **	10.00		9.95 to 10.05	
All Tolerances are % of Span.			TOLERANCE ±0.5% (±0.05 VDC)	

* ZERO A Adjust Point.
** SPAN A Adjust Point.

M&TE	SERIAL NO.	CAL DUE DATE