Attachment V
R.E. Ginna Nuclear Power Plant

Proposed Revised R.E. Ginna Nuclear Power Plant
Improved Technical Specifications

Included pages:

2.0-1
3.3.1-1 to 3.3.1-16
3.3.2-1 to 3.3.2-10
3.3.4-1 to 3.3.4-2
3.3.5-1 to 3.3.5-3
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2.0 SAFETY LIMITS (SLs)

2.0 SLs and SL Violations

2.1 SLs

2.1.1 Reactor Core SLs

In MODES 1 and 2, the combination of THERMAL POWER, Reactor Coolant System (RCS) average temperature, and pressurizer pressure shall not exceed the limits specified in the COLR; and the following SLs shall not be exceeded:

2.1.1.1 The departure from nucleate boiling ratio (DNBR) shall be maintained ≥ 1.17 for the WRB-1 correlation.

2.1.1.2 The peak fuel centerline temperature shall be maintained < 5080°F, decreasing by 58°F per 10,000 MWD/MTU of burnup.

2.1.2 RCS Pressure SL

In MODES 1, 2, 3, 4, and 5, the RCS pressure shall be maintained ≤ 2735 psig.

2.2 SL Violations

2.2.1 If SL 2.1.1 is violated, restore compliance and be in MODE 3 within 1 hour.

2.2.2 If SL 2.1.2 is violated:

2.2.2.1 In MODE 1 or 2, restore compliance and be in MODE 3 within 1 hour.

2.2.2.2 In MODE 3, 4, or 5, restore compliance within 5 minutes.

3.3 INSTRUMENTATION

3.3.1 Reactor Trip System (RTS) Instrumentation

LCO 3.3.1 The RTS instrumentation for each Function in Table 3.3.1-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.1-1.

ACTIONS

- NOTE -

Separate Condition entry is allowed for each Function.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more Functions with one channel inoperable. OR Two source range channels inoperable.	A.1 Enter the Condition referenced in Table 3.3.1-1 for the channel(s).	Immediately
B. As required by Required Action A.1 and referenced by Table 3.3.1-1.	B.1 Restore channel to OPERABLE status.	48 hours
C. Required Action and associated Completion Time of Condition B not met.	C.1 Be in MODE 3.	6 hours
	AND	
	C.2 Initiate action to fully insert all rods.	6 hours
	AND	
	C.3 Place Control Rod Drive System in a condition incapable of rod withdrawal.	7 hours

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. As required by Required Action A.1 and referenced by Table 3.3.1-1.	D.1 - NOTE - The inoperable channel may be bypassed for up to 4 hours for surveillance testing of other channels. - - - - - - - - - - - - - - - - - - - Place channel in trip.	6 hours
E. As required by Required Action A.1 and referenced by Table 3.3.1-1.	E.1 Reduce THERMAL POWER to < 5E-11 amps.	2 hours
	<u>OR</u>	
	E.2 - NOTE - Required Action E.2 is not applicable when: a. Two channels are inoperable, or b. THERMAL POWER is < 5E-11 amps. - - - - - - - - - - - - - - - - - - - Increase THERMAL POWER to ≥ 8% RTP.	2 hours
F. As required by Required Action A.1 and referenced by Table 3.3.1-1.	F.1 Open RTBs and RTBBs upon discovery of two inoperable channels.	Immediately upon discovery of two inoperable channels
	<u>AND</u>	
	F.2 Suspend operations involving positive reactivity additions.	Immediately
	<u>AND</u>	
	F.3 Restore channel to OPERABLE status.	48 hours

CONDITION		REQUIRED ACTION		COMPLETION TIME
G.	Required Action and associated Completion Time of Condition D, E, or F is not met.	G.1	Be in MODE 3.	6 hours
H.	As required by Required Action A.1 and referenced by Table 3.3.1-1.	H.1	Restore at least one channel to OPERABLE status upon discovery of two inoperable channels.	1 hour from discovery of two inoperable channels
		AND		
		H.2	Suspend operations involving positive reactivity additions.	Immediately
		AND		
		H.3	Restore channel to OPERABLE status.	48 hours
I.	Required Action and associated Completion Time of Condition H not met.	I.1	Initiate action to fully insert all rods.	Immediately
		AND		
		I.2	Place the Control Rod Drive System in a condition incapable of rod withdrawal.	1 hour
J.	As required by Required Action A.1 and referenced by Table 3.3.1-1.	J.1	Suspend operations involving positive reactivity additions.	Immediately
		AND		
		J.2	Perform SR 3.1.1.1.	12 hours AND Once per 12 hours thereafter

CONDITION		REQUIRED ACTION		COMPLETION TIME
K.	As required by Required Action A.1 and referenced by Table 3.3.1-1.	K.1	- NOTE - The inoperable channel may be bypassed for up to 4 hours for surveillance testing of other channels. Place channel in trip.	6 hours
L.	Required Action and associated Completion Time of Condition K not met.	L.1	Reduce THERMAL POWER to < 8.5% RTP.	6 hours
M.	As required by Required Action A.1 and referenced by Table 3.3.1-1.	M.1	- NOTE - The inoperable channel may be bypassed for up to 4 hours for surveillance testing of other channels. Place channel in trip.	6 hours
N.	As required by Required Action A.1 and referenced by Table 3.3.1-1.	N.1	Restore channel to OPERABLE status.	6 hours
O.	Required Action and associated Completion Time of Condition M or N not met.	O.1	Reduce THERMAL POWER to < 50% RTP.	6 hours
P.	As required by Required Action A.1 and referenced by Table 3.3.1-1.	P.1	- NOTE - The inoperable channel may be bypassed for up to 4 hours for surveillance testing of other channels. Place channel in trip.	6 hours

CONDITION	REQUIRED ACTION		COMPLETION TIME
Q. Required Action and Associated Completion Time of Condition P not met.	Q.1	Reduce THERMAL POWER to < 50% RTP.	6 hours
	AND		
	Q.2.1	Verify Steam Dump System is OPERABLE.	7 hours
		OR	
	Q.2.2	Reduce THERMAL POWER to < 8% RTP.	7 hours
R. As required by Required Action A.1 and referenced by Table 3.3.1-1.	R.1	- NOTE - One train may be bypassed for up to 4 hours for surveillance testing provided the other train is OPERABLE.	
		Restore train to OPERABLE status.	6 hours
S. As required by Required Action A.1 and referenced by Table 3.3.1-1.	S.1	Verify interlock is in required state for existing plant conditions.	1 hour
	OR		
	S.2	Declare associated RTS Function channel(s) inoperable.	1 hour

CONDITION	REQUIRED ACTION		COMPLETION TIME
T. As required by Required Action A.1 and referenced by Table 3.3.1-1.	T.1	- NOTE - 1. One train may be bypassed for up to 2 hours for surveillance testing, provided the other train is OPERABLE. 2. One RTB may be bypassed for up to 6 hours for maintenance on undervoltage or shunt trip mechanisms, provided the other train is OPERABLE. Restore train to OPERABLE status.	1 hour
U. As required by Required Action A.1 and referenced by Table 3.3.1-1.	U.1	Restore at least one trip mechanism to OPERABLE status upon discovery of two RTBs with inoperable trip mechanisms.	1 hour from discovery of two inoperable trip mechanisms
	<u>AND</u>		
	U.2	Restore trip mechanism to OPERABLE status.	48 hours
V. Required Action and associated Completion Time of Condition R, S, T, or U not met.	V.1	Be in MODE 3.	6 hours
W. As required by Required Action A.1 and referenced by Table 3.3.1-1.	W.1	Restore at least one trip mechanism to OPERABLE status upon discovery of two RTBs with inoperable trip mechanisms.	1 hour from discovery of two inoperable trip mechanisms
	<u>AND</u>		

CONDITION	REQUIRED ACTION		COMPLETION TIME
	W.2	Restore trip mechanism or train to OPERABLE status.	48 hours
X. Required Action and associated Completion Time of Condition W not met.	X.1	Initiate action to fully insert all rods.	Immediately
	AND		
	X.2	Place the Control Rod Drive System in a Condition incapable of rod withdrawal.	1 hour

SURVEILLANCE REQUIREMENTS

- NOTE -
Refer to Table 3.3.1-1 to determine which SRs apply for each RTS Function.

SURVEILLANCE		FREQUENCY
SR 3.3.1.1	Perform CHANNEL CHECK.	12 hours
SR 3.3.1.2	- NOTE - Required to be performed within 12 hours after THERMAL POWER is ≥ 50% RTP.	
	Compare results of calorimetric heat balance calculation to Nuclear Instrumentation System (NIS) channel output and adjust if calorimetric power is > 2% higher than indicated NIS power.	24 hours
SR 3.3.1.3	- NOTE - 1. Required to be performed within 7 days after THERMAL POWER is ≥ 50% RTP but prior to exceeding 90% RTP following each refueling and if the Surveillance has not been performed within the last 31 EFPD. 2. Performance of SR 3.3.1.6 satisfies this SR.	
	Compare results of the incore detector measurements to NIS AFD and adjust if absolute difference is ≥ 3%.	31 effective full power days (EFPD)

SURVEILLANCE		FREQUENCY
SR 3.3.1.4	Perform TADOT.	31 days on a STAGGERED TEST BASIS
SR 3.3.1.5	Perform ACTUATION LOGIC TEST.	31 days on a STAGGERED TEST BASIS
SR 3.3.1.6	- NOTE - Not required to be performed until 7 days after THERMAL POWER is ≥ 50% RTP, but prior to exceeding 90% RTP following each refueling. Calibrate excore channels to agree with incore detector measurements.	92 EFPD
SR 3.3.1.7	- NOTE - Not required to be performed for source range instrumentation prior to entering MODE 3 from MODE 2 until 4 hours after entering MODE 3. Perform COT.	92 days
SR 3.3.1.8	- NOTE - 1. Not required for power range and intermediate range instrumentation until 4 hours after reducing power < 6% RTP. 2. Not required for source range instrumentation until 4 hours after reducing power < 5E-11 amps. Perform COT.	92 days
SR 3.3.1.9	- NOTE - Setpoint verification is not required. Perform TADOT.	92 days

	SURVEILLANCE	FREQUENCY
SR 3.3.1.10	- NOTE - Neutron detectors are excluded. Perform CHANNEL CALIBRATION.	24 months
SR 3.3.1.11	Perform TADOT.	24 months
SR 3.3.1.12	- NOTE - Setpoint verification is not required. Perform TADOT.	Prior to reactor startup if not performed within previous 31 days
SR 3.3.1.13	Perform COT.	24 months

Table 3.3.1-1
Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Manual Reactor Trip	1, 2, $3^{(a)}$, $4^{(a)}$, $5^{(a)}$	2	B,C	SR 3.3.1.11	NA
2. Power Range Neutron Flux					
a. High	1, 2	4	D,G	SR 3.3.1.1 SR 3.3.1.2 SR 3.3.1.7 SR 3.3.1.10	≤ 113.4% RTP
b. Low	$1^{(b)}$, 2	4	D,G	SR 3.3.1.1 SR 3.3.1.8 SR 3.3.1.10	≤ 30.4% RTP
3. Intermediate Range Neutron Flux	$1^{(b)}$, 2	2	E,G	SR 3.3.1.1 SR 3.3.1.8 SR 3.3.1.10	(c)
4. Source Range Neutron Flux	$2^{(d)}$	2	F,G	SR 3.3.1.1 SR 3.3.1.8 SR 3.3.1.10	(c)
	$3^{(a)}$, $4^{(a)}$, $5^{(a)}$	2	H,I	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10	(c)
	$3^{(e)}$, $4^{(e)}$, $5^{(e)}$	1	J	SR 3.3.1.1 SR 3.3.1.10	NA
5. Overtemperature ΔT	1, 2	4	D,G	SR 3.3.1.1 SR 3.3.1.3 SR 3.3.1.6 SR 3.3.1.7 SR 3.3.1.10	Refer to Note 1

Table 3.3.1-1
Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
6. Overpower ΔT	1, 2	4	D,G	SR 3.3.1.1 SR 3.3.1.3 SR 3.3.1.6 SR 3.3.1.7 SR 3.3.1.10	Refer to Note 2
7. Pressurizer Pressure					
a. Low	1(f)	4	K,L	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10	≥ 1777 psig
b. High	1, 2	3	D,G	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10	≤ 2406 psig
8. Pressurizer Water Level-High	1, 2	3	D,G	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10	≤ 98.3%
9. Reactor Coolant Flow-Low					
a. Single Loop	1(g)	3 per loop	M,O	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10	≥ 88.7%
b. Two Loops	1(h)	3 per loop	K,L	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10	≥ 88.7%
10. Reactor Coolant Pump (RCP) Breaker Position					
a. Single Loop	1(g)	1 per RCP	N,O	SR 3.3.1.11	NA
b. Two Loops	1(i)	1 per RCP	K,L	SR 3.3.1.11	NA

Table 3.3.1-1
Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
11. Undervoltage- Bus 11A and 11B	1(f)	2 per bus	K,L	SR 3.3.1.9 SR 3.3.1.10	(c)
12. Underfrequency- Bus 11A and 11B	1(f)	2 per bus	K,L	SR 3.3.1.9 SR 3.3.1.10	≥ 57.2 HZ
13. Steam Generator (SG) Water Level- Low Low	1, 2	3 per SG	D,G	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10	≥ 12.4%
14. Turbine Trip					
a. Low Autostop Oil Pressure	1(j)(k)	3	P,Q	SR 3.3.1.10 SR 3.3.1.12	(c)
b. Turbine Stop Valve Closure	1(j)(k)	2	P,Q	SR 3.3.1.12	NA
15. Safety Injection (SI) Input from Engineered Safety Feature Actuation System (ESFAS)	1, 2	2	R,V	SR 3.3.1.11	NA

Table 3.3.1-1
Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
16. Reactor Trip System Interlocks					
a. Intermediate Range Neutron Flux, P-6	2[(d)]	2	S,V	SR 3.3.1.10 SR 3.3.1.13	≥ 4E-11 amp
b. Low Power Reactor Trips Block, P-7	1[(f)]	4 (power range only)	S,V	SR 3.3.1.10 SR 3.3.1.13	≤ 9.3% RTP
c. Power Range Neutron Flux, P-8	1[(g)]	4	S,V	SR 3.3.1.10 SR 3.3.1.13	≤ 50.3% RTP
d. Power Range Neutron Flux, P-9	1[(k)]	4	S,V	SR 3.3.1.10 SR 3.3.1.13	≤ 51.3% RTP
	1[(j)]	4	S,V	SR 3.3.1.10 SR 3.3.1.13	≤ 9.3% RTP
e. Power Range Neutron Flux, P-10	1[(b)], 2	4	S,V	SR 3.3.1.10 SR 3.3.1.13	≥ 4.7% RTP
17. Reactor Trip Breakers[(l)]	1, 2 3[(a)], 4[(a)], 5[(a)]	2 trains 2 trains	T,V W,X	SR 3.3.1.4 SR 3.3.1.4	NA NA
18. Reactor Trip Breaker Undervoltage and Shunt Trip Mechanisms	1, 2 3[(a)], 4[(a)], 5[(a)]	1 each per RTB 1 each per RTB	U,V W,X	SR 3.3.1.4 SR 3.3.1.4	NA NA
19. Automatic Trip Logic	1, 2 3[(a)], 4[(a)], 5[(a)]	2 trains 2 trains	R,V W,X	SR 3.3.1.5 SR 3.3.1.5	NA NA

(a) With Control Rod Drive (CRD) System capable of rod withdrawal or all rods not fully inserted.

(b) THERMAL POWER < 6% RTP.

(c) UFSAR Table 7.2-3.

(d) Both Intermediate Range channels < 5E-11 amps.

(e) With CRD System incapable of withdrawal and all rods fully inserted. In this condition, the Source Range Neutron Flux function does not provide a reactor trip, only indication.

(f) THERMAL POWER ≥ 8.5% RTP.

(g) THERMAL POWER ≥ 50% RTP.

(h) THERMAL POWER ≥ 8.5% RTP and Reactor Coolant Flow-Low (Single Loop) trip Function blocked.

(i) THERMAL POWER ≥ 8.5% RTP and RCP Breaker Position (Single Loop) trip Function blocked.

(j) THERMAL POWER > 8% RTP, and either no circulating water pump breakers closed, or condenser vacuum ≤ 20".

(k) THERMAL POWER ≥ 50% RTP, 1 of 2 circulating water pump breakers closed, and condenser vacuum > 20".

(l) Including any reactor trip bypass breakers that are racked in and closed for bypassing an RTB.

Table 3.3.1-1 (Note 1)
Overtemperature ΔT

- NOTE -

The Overtemperature ΔT Function Allowable Value shall not exceed the following Nominal Trip Setpoint by more than 2.5% of ΔT span.

$$\text{Overtemperature } \Delta T \leq \Delta T_0 \{K_1 + K_2 (P-P') - K_3 (T-T') [(1+\tau_1 s) / (1+\tau_2 s)] - f(\Delta I)\}$$

Where:

ΔT is measured RCS ΔT, °F.
ΔT_0 is the indicated ΔT at RTP, °F.

s is the Laplace transform operator, sec^{-1}.

T is the measured RCS average temperature, °F.
T' is the nominal T_{avg} at RTP, °F.

P is the measured pressurizer pressure, psig.
P' is the nominal RCS operating pressure, psig.

K_1 is the Overtemperature ΔT reactor trip setpoint, [*].
K_2 is the Overtemperature ΔT reactor trip depressurization setpoint penalty coefficient, [*]/psi.
K_3 is the Overtemperature ΔT reactor trip heatup setpoint penalty coefficient, [*]/°F.

τ_1 is the measured lead time constant, [*] seconds.
τ_2 is the measured lag time constant, [*] seconds.

$f(\Delta I)$ is a function of the indicated difference between the top and bottom detectors of the Power Range Neutron Flux channels where q_t and q_b are the percent power in the top and bottom halves of the core, respectively, and $q_t + q_b$ is the total THERMAL POWER in percent RTP.

$f(\Delta I) = 0$	when $q_t - q_b$ is $\leq$ [*]% RTP
$f(\Delta I) = [*] \{(q_t - q_b) - [*]\}$	when $q_t - q_b$ is > [*]% RTP

* These values denoted with [*] are specified in the COLR.

Table 3.3.1-1 (Note 2)
Overpower ΔT

- NOTE -

The Overpower ΔT Function Allowable Value shall not exceed the following Nominal Trip Setpoint by more than 2.0% of ΔT span.

Overpower $\Delta T \leq \Delta T_0 \{K_4 - K_5 (T-T') - K_6 [(\tau_3 sT) / (\tau_3 s+1)] - f(\Delta I)\}$

Where:

ΔT is measured RCS ΔT, °F.
ΔT_0 is the indicated ΔT at RTP, °F.

s is the Laplace transform operator, sec^{-1}.

T is the measured RCS average temperature, °F.
T' is the nominal T_{avg} at RTP, °F.

K_4 is the Overpower ΔT reactor trip setpoint, [*].
K_5 is the Overpower ΔT reactor trip heatup setpoint penalty coefficient which is:
[*]/°F for $T < T'$ and;
[*]/°F for $T \geq T'$.
K_6 is the Overpower ΔT reactor trip thermal time delay setpoint penalty which is:
[*]/°F for increasing T and;
[*]/°F for decreasing T.

τ_3 is the measured impulse/lag time constant, [*] seconds.

$f(\Delta I)$ is a function of the indicated difference between the top and bottom detectors of the Power Range Neutron Flux channels where q_t and q_b are the percent power in the top and bottom halves of the core, respectively, and $q_t + q_b$ is the total THERMAL POWER in percent RTP.

$f(\Delta I)$ = [*] when $q_t - q_b$ is $\leq$ [*]% RTP

$f(\Delta I)$ = [*] {($q_t - q_b$) - [*]} when $q_t - q_b$ is > [*]% RTP

* These values denoted with [*] are specified in the COLR.

3.3 INSTRUMENTATION

3.3.2 Engineered Safety Feature Actuation System (ESFAS) Instrumentation

LCO 3.3.2 The ESFAS instrumentation for each Function in Table 3.3.2-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.2-1.

ACTIONS

- NOTE -

Separate Condition entry is allowed for each Function.

CONDITION		REQUIRED ACTION		COMPLETION TIME
A.	One or more Functions with one channel or train inoperable.	A.1	Enter the Condition referenced in Table 3.3.2-1 for the channel or train.	Immediately
B.	As required by Required Action A.1 and referenced by Table 3.3.2-1.	B.1	Restore channel to OPERABLE status.	48 hours
C.	Required Action and associated Completion Time of Condition B not met.	C.1	Be in MODE 2.	6 hours
D.	As required by Required Action A.1 and referenced by Table 3.3.2-1.	D.1	Restore channel to OPERABLE status.	48 hours
E.	As required by Required Action A.1 and referenced by Table 3.3.2-1.	E.1	Restore train to OPERABLE status.	6 hours

CONDITION	REQUIRED ACTION		COMPLETION TIME
F. As required by Required Action A.1 and referenced by Table 3.3.2-1.	F.1	- NOTE - The inoperable channel may be bypassed for up to 4 hours for surveillance testing of the other channels. Place channel in trip.	6 hours
G. Required Action and associated Completion Time of Condition D, E, or F not met.	G.1	Be in MODE 3.	6 hours
	<u>AND</u>		
	G.2	Be in MODE 4.	12 hours
H. As required by Required Action A.1 and referenced by Table 3.3.2-1.	H.1	Restore channel to OPERABLE status.	48 hours
I. As required by Required Action A.1 and referenced by Table 3.3.2-1.	I.1	Restore train to OPERABLE status.	6 hours
J. As required by Required Action A.1 and referenced by Table 3.3.2-1.	J.1	- NOTE - The inoperable channel may be bypassed for up to 4 hours for surveillance testing of the other channels. Place channel in trip.	6 hours
K. Required Action and associated Completion Time of Condition H, I, or J not met.	K.1	Be in MODE 3.	6 hours
	<u>AND</u>		
	K.2	Be in MODE 5.	36 hours

CONDITION	REQUIRED ACTION		COMPLETION TIME
L. As required by Required Action A.1 and referenced by Table 3.3.2-1.	L.1	- NOTE - The inoperable channel may be bypassed for up to 4 hours for surveillance testing of the other channels. Place channel in trip.	6 hours
M. Required Action and associated Completion Time of Condition L not met.	M.1	Be in MODE 3.	6 hours
	<u>AND</u>		
	M.2	Reduce pressurizer pressure to < 2000 psig.	12 hours
N. As required by Required Action A.1 and referenced by Table 3.3.2-1.	N.1	Declare associated Auxiliary Feedwater pump inoperable and enter applicable condition(s) of LCO 3.7.5, "Auxiliary Feedwater (AFW) System."	Immediately

SURVEILLANCE REQUIREMENTS

- NOTE -
Refer to Table 3.3.2-1 to determine which SRs apply for each ESFAS Function.

SURVEILLANCE		FREQUENCY
SR 3.3.2.1	Perform CHANNEL CHECK.	12 hours
SR 3.3.2.2	Perform COT.	92 days
SR 3.3.2.3	- NOTE - Verification of relay setpoints not required. Perform TADOT.	92 days

	SURVEILLANCE	FREQUENCY
SR 3.3.2.4	- NOTE - Verification of relay setpoints not required. Perform TADOT.	24 months
SR 3.3.2.5	Perform CHANNEL CALIBRATION.	24 months
SR 3.3.2.6	Verify the Pressurizer Pressure-Low and Steam Line Pressure-Low Functions are not bypassed when pressurizer pressure > 2000 psig.	24 months
SR 3.3.2.7	Perform ACTUATION LOGIC TEST.	24 months

Table 3.3.2-1
Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Safety Injection					
a. Manual Initiation	1,2,3,4	2	D,G	SR 3.3.2.4	NA
b. Automatic Actuation Logic and Actuation Relays	1,2,3,4	2 trains	I,K	SR 3.3.2.7	NA
c. Containment Pressure-High	1,2,3,4	3	J,K	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.5	≤ 5.71 psig
d. Pressurizer Pressure-Low	1,2,3[(a)]	3	L,M	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.5 SR 3.3.2.6	≥ 1731 psig
e. Steam Line Pressure-Low	1,2,3[(a)]	3 per steam line	L,M	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.5 SR 3.3.2.6	≥ 370.7 psig

Table 3.3.2-1
Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
2. Containment Spray					
a. Manual Initiation					
Left pushbutton	1,2,3,4	1	H,K	SR 3.3.2.4	NA
Right pushbutton	1,2,3,4	1	H,K	SR 3.3.2.4	NA
b. Automatic Actuation Logic and Actuation Relays	1,2,3,4	2 trains	I,K	SR 3.3.2.7	NA
c. Containment Pressure-High High	1,2,3,4	3 per set	J,K	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.5	≤ 32.21 psig (narrow range) ≤ 31.06 psig (wide range)
3. Containment Isolation					
a. Manual Initiation	1,2,3,4,(b)	2	H,K	SR 3.3.2.4	NA
b. Automatic Actuation Logic and Actuation Relays	1,2,3,4	2 trains	I,K	SR 3.3.2.7	NA
c. Safety Injection	Refer to Function 1 (Safety Injection) for all automatic initiation functions and requirements.				

Table 3.3.2-1
Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
4. Steam Line Isolation					
a. Manual Initiation	1,2(c),3(c)	1 per loop	D,G	SR 3.3.2.4	NA
b. Automatic Actuation Logic and Actuation Relays	1,2(c),3(c)	2 trains	E,G	SR 3.3.2.7	NA
c. Containment Pressure-High High	1,2(c),3(c)	3	F,G	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.5	≤ 20.46 psig
d. High Steam Flow	1,2(c),3(c)	2 per steam line	F,G	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.5	≤ 0.56E6 lbm/hr @ 1005 psig
Coincident with Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.				
and					
Coincident with T_{avg}-Low	1,2(c),3(c)	2 per loop	F,G	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.5	≥ 544.1°F
e. High-High Steam Flow	1,2(c),3(c)	2 per steam line	F,G	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.5	≤ 3.64E6 lbm/hr @ 755 psig
Coincident with Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.				

Table 3.3.2-1
Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
5. Feedwater Isolation					
a. Automatic Actuation Logic and Actuation Relays	1,2(d),3(d)	2 trains	E,G	SR 3.3.2.7	NA
b. SG Water Level-High	1,2(d),3(d)	3 per SG	F,G	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.5	≤ 92.7%
c. Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.				

Table 3.3.2-1
Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
6. Auxiliary Feedwater (AFW)					
a. Manual Initiation					
AFW	1,2,3	1 per pump	N	SR 3.3.2.4	NA
Standby AFW	1,2,3	1 per pump	N	SR 3.3.2.4	NA
b. Automatic Actuation Logic and Actuation Relays	1,2,3	2 trains	E,G	SR 3.3.2.7	NA
c. SG Water Level-Low Low	1,2,3	3 per SG	F,G	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.5	≥ 12.4%
d. Safety Injection (Motor driven pumps only)	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.				
e. Undervoltage - Bus 11A and 11B (Turbine driven pump only)	1,2,3	2 per bus	D,G	SR 3.3.2.3 SR 3.3.2.5	≥ 2454 V with ≤ 3.6 sec time delay
f. Trip of Both Main Feedwater Pumps (Motor driven pumps only)	1	2 per MFW pump	B,C	SR 3.3.2.4	NA

(a) Pressurizer Pressure ≥ 2000 psig.

(b) During CORE ALTERATIONS and movement of irradiated fuel assemblies within containment.

(c) Except when both MSIVs are closed and de-activated.

(d) Except when all Main Feedwater Regulating and associated bypass valves are closed and de-activated or isolated by a closed manual valve.

3.3 INSTRUMENTATION

3.3.4 Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation

LCO 3.3.4 Each 480 V safeguards bus shall have two OPERABLE channels of LOP DG Start Instrumentation.

APPLICABILITY: MODES 1, 2, 3, and 4,
When associated DG is required to be OPERABLE by LCO 3.8.2, "AC Sources - MODES 5 and 6."

ACTIONS

- NOTE -
Separate Condition entry is allowed for each 480 V safeguards bus.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more 480 V bus(es) with one channel inoperable.	A.1 Place channel(s) in trip.	6 hours
B. Required Action and associated Completion Time of Condition A not met. <u>OR</u> One or more 480 V bus(es) with two channels inoperable.	B.1 Enter applicable Condition(s) and Required Action(s) for the associated DG made inoperable by LOP DG start instrumentation.	Immediately

SURVEILLANCE REQUIREMENTS

- NOTE -

When a channel is placed in an inoperable status solely for the performance of required Surveillances, entry into the associated Conditions and Required Actions may be delayed for up to 4 hours provided the second channel maintains LOP DG start capability.

SURVEILLANCE		FREQUENCY
SR 3.3.4.1	Perform TADOT.	31 days
SR 3.3.4.2	Perform CHANNEL CALIBRATION with Allowable Value for each 480 V bus as follows: a. Loss of voltage Allowable Value ≥ 369.2 V and ≤ 382.4 V with a time delay of ≥ 1.50 seconds and ≤ 2.75 seconds. b. Degraded voltage Allowable Value ≥ 414.8 V and ≤ 431.2 V with a time delay of ≥ 30.7 seconds and ≤ 1520 seconds (@ 416.8 V) and ≥ 25.1 seconds and ≤ 475 seconds (@ 368 V).	24 months

3.3 INSTRUMENTATION

3.3.5 Containment Ventilation Isolation Instrumentation

LCO 3.3.5 The Containment Ventilation Isolation instrumentation for each Function in Table 3.3.5-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.5-1.

ACTIONS

- NOTE -
Separate Condition entry is allowed for each Function.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One radiation monitoring channel inoperable.	A.1 Restore the affected channel to OPERABLE status.	4 hours
B. - NOTE - Only applicable in MODE 1, 2, 3, or 4. One or more Functions with one or more manual or automatic actuation trains inoperable. OR Both radiation monitoring channels inoperable. OR Required Action and associated Completion Time of Condition A not met.	B.1 Enter applicable Conditions and Required Actions of LCO 3.6.3, "Containment Isolation Boundaries," for containment mini-purge isolation valves made inoperable by isolation instrumentation.	Immediately

CONDITION	REQUIRED ACTION		COMPLETION TIME
C. ------------------------------ - NOTE - Only applicable during CORE ALTERATIONS or movement of irradiated fuel assemblies within containment. ------------------------------ One or more Functions with one or more manual or automatic actuation trains inoperable. <u>OR</u> Both radiation monitoring channels inoperable. <u>OR</u> Required Action and associated Completion Time for Condition A not met.	C.1	Place and maintain containment purge and exhaust valves in closed position.	Immediately
	<u>OR</u>		
	C.2	Enter applicable Conditions and Required Actions of LCO 3.9.3, "Containment Penetrations," for containment purge and exhaust isolation valves made inoperable by isolation instrumentation.	Immediately

SURVEILLANCE REQUIREMENTS

- NOTE -

Refer to Table 3.3.5-1 to determine which SRs apply for each Containment Ventilation Isolation Function.

SURVEILLANCE		FREQUENCY
SR 3.3.5.1	Perform CHANNEL CHECK.	24 hours
SR 3.3.5.2	Perform COT.	92 days
SR 3.3.5.3	Perform ACTUATION LOGIC TEST.	24 months
SR 3.3.5.4	Perform CHANNEL CALIBRATION.	24 months

Table 3.3.5-1
Containment Ventilation Isolation Instrumentation

FUNCTION	APPLICABLE MODES AND OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Automatic Actuation Logic and Actuation Relays	1,2,3,4,[a]	2 trains	SR 3.3.5.3	NA
2. Containment Radiation				
a. Gaseous	1,2,3,4,[a]	1	SR 3.3.5.1 SR 3.3.5.2 SR 3.3.5.4	[b]
b. Particulate	1,2,3,4,[a]	1	SR 3.3.5.1 SR 3.3.5.2 SR 3.3.5.4	[b]
3. Containment Isolation - Manual Initiation	Refer to LCO 3.3.2, "ESFAS Instrumentation," Function 3.a, for all initiation functions and requirements.			
4. Containment Spray - Manual Initiation	Refer to LCO 3.3.2, "ESFAS Instrumentation," Function 2.a, for all initiation functions and requirements.			
5. Safety Injection	Refer to LCO 3.3.2, "ESFAS Instrumentation," Function 1, for all initiation functions and requirements.			

(a) During CORE ALTERATIONS and movement of irradiated fuel assemblies within containment.

(b) Per Radiological Effluent Controls Program.

5.0 ADMINISTRATIVE CONTROLS

5.6 Reporting Requirements

The following reports shall be submitted in accordance with 10 CFR 50.4.

5.6.1 Occupational Radiation Exposure Report

A tabulation on an annual basis of the number of station, utility, and other personnel (including contractors) receiving exposures > 100 mrem/yr and their associated man rem exposure according to work and job functions (e.g., reactor operations and surveillance, inservice inspection, routine maintenance, special maintenance, waste processing, and refueling). This tabulation supplements the requirements of 10 CFR 20.2206. The dose assignments to various duty functions may be estimated based on pocket dosimeter, thermoluminescent dosimeter (TLD), or film badge measurements. Small exposures totalling < 20% of the individual total dose need not be accounted for. In the aggregate, at least 80% of the total whole body dose received from external sources should be assigned to specific major work functions. The report shall be submitted on or before April 30 of each year.

5.6.2 Annual Radiological Environmental Operating Report

The Annual Radiological Environmental Operating Report covering the operation of the plant during the previous calendar year shall be submitted by May 15 of each year. The report shall include summaries, interpretations, and analyses of trends of the results of the radiological environmental monitoring activities for the reporting period. The material provided shall be consistent with the objectives outlined in the Offsite Dose Calculation Manual (ODCM), and in 10 CFR 50, Appendix I, Sections IV.B.2, IV.B.3, and IV.C.

The Annual Radiological Environmental Operating Report shall include the results of analyses of all radiological environmental samples and of all environmental radiation measurements taken during the period pursuant to the locations specified in the table and figures in the ODCM, as well as summarized and tabulated results of these analyses and measurements in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979. In the event that some individual results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted in a supplementary report as soon as possible.

5.6.3 Radioactive Effluent Release Report

The Radioactive Effluent Release Report covering the operation of the plant shall be submitted in accordance with 10 CFR 50.36a. The report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the plant. The material provided shall be consistent with the objectives outlined in the ODCM and in conformance with 10 CFR 50.36a and 10 CFR 50, Appendix I, Section IV.B.1.

5.6.4 Monthly Operating Reports

Routine reports of operating statistics and shutdown experience, including documentation of all challenges to the pressurizer power operated relief valves or pressurizer safety valves, shall be submitted on a monthly basis no later than the 15th of each month following the calendar month covered by the report.

5.6.5 CORE OPERATING LIMITS REPORT (COLR)

The following administrative requirements apply to the COLR:

a. Core operating limits shall be established prior to each reload cycle, or prior to any remaining portion of a reload cycle, and shall be documented in the COLR for the following:

2.1,	"Safety Limits (SLs)";
LCO 3.1.1,	"SHUTDOWN MARGIN (SDM)";
LCO 3.1.3,	"MODERATOR TEMPERATURE COEFFICIENT (MTC)";
LCO 3.1.5,	"Shutdown Bank Insertion Limit";
LCO 3.1.6,	"Control Bank Insertion Limits";
LCO 3.2.1,	"Heat Flux Hot Channel Factor ($F_Q(Z)$)";
LCO 3.2.2,	"Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)";
LCO 3.2.3,	"AXIAL FLUX DIFFERENCE (AFD)";
LCO 3.3.1,	"Reactor Protection System (RPS) Instrumentation";
LCO 3.4.1,	"RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits"; and
LCO 3.9.1,	"Boron Concentration."

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. WCAP-9272-P-A, "Westinghouse Reload Safety Evaluation Methodology," July 1985.
   (Methodology for 2.1, LCO 3.1.1, LCO 3.1.3, LCO 3.1.5, LCO 3.1.6, LCO 3.2.1, LCO 3.2.2, LCO 3.2.3, and LCO 3.9.1.)

2. WCAP-13677-P-A, "10 CFR 50.46 Evaluation Model Report: WCOBRA/TRAC Two-Loop Upper Plenum Injection Model Updates to Support ZIRLO™ Cladding Option," February 1994.
   (Methodology for LCO 3.2.1.)

3. WCAP-8385, "Power Distribution Control and Load Following Procedures - Topical Report," September 1974.
   (Methodology for LCO 3.2.3.)

4. WCAP-12610-P-A, "VANTAGE + Fuel Assembly Reference Core Report," April 1995.
   (Methodology for LCO 3.2.1.)

5. WCAP 11397-P-A, "Revised Thermal Design Procedure," April 1989.
   (Methodology for LCO 3.4.1 when using RTDP.)

6. WCAP-10054-P-A and WCAP-10081-A, "Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code," August 1985.
   (Methodology for LCO 3.2.1.)

7. WCAP-10924-P-A, Volume 1, Revision 1, "Westinghouse Large-Break LOCA Best-Estimate Methodology, Volume 1: Model Description and Validation Responses to NRC Questions," and Addenda 1,2,3, December 1988.
   (Methodology for LCO 3.2.1.)

8. WCAP-10924-P-A, Volume 2, Revision 2, "Westinghouse Large-Break LOCA Best-Estimate Methodology, Volume 2: Application to Two-Loop PWRs Equipped with Upper Plenum Injection," and Addendum 1, December 1988.
   (Methodology for LCO 3.2.1.)

9. WCAP-10924-P-A, Volume 1, Revision 1, Addendum 4, "Westinghouse Large-Break LOCA Best-Estimate Methodology, Volume 1: Model Description and Validation, Addendum 4: Model Revisions," March 1991.
   (Methodology for LCO 3.2.1.)

10. WCAP-8745, "Design Basis for the Thermal Overpower Delta T and Thermal Overtemperature Delta T Trip Functions," March 1977.
(Methodology for LCO 3.3.1.)

c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.

d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

5.6.6 Reactor Coolant System (RCS) PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR)

The following administrative requirements apply to the PTLR:

a. RCS pressure and temperature limits for heatup, cooldown, criticality, and hydrostatic testing as well as heatup and cooldown rates shall be established and documented in the PTLR for the following:

LCO 3.4.3, "RCS Pressure and Temperature (P/T) Limits"

b. The power operated relief valve lift settings required to support the Low Temperature Overpressure Protection (LTOP) System, and the LTOP enable temperature shall be established and documented in the PTLR for the following:

LCO 3.4.6, "RCS Loops - MODE 4";

LCO 3.4.7, "RCS Loops - MODE 5, Loops Filled";

LCO 3.4.10, "Pressurizer Safety Valves"; and

LCO 3.4.12, "LTOP System."

c. The analytical methods used to determine the RCS pressure and temperature and LTOP limits shall be those previously reviewed and approved by the NRC in NRC letter, "R.E. Ginna - Acceptance for Referencing of Pressure Temperature Limits Report, Revision 2 (TAC No. M96529)," dated November 28, 1997. Specifically, the methodology is described in the following documents:

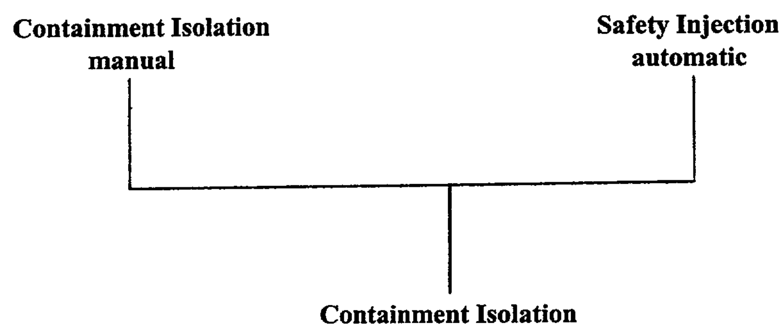
1. Letter from R.C. Mecredy, Rochester Gas and Electric Corporation (RG&E), to Document Control Desk, NRC, Attention: Guy S. Vissing, "Application for Facility Operating License, Revision to Reactor Coolant System (RCS) Pressure and Temperature Limits Report (PTLR) Administrative Controls Requirements," Attachment VI, September 29, 1997, as supplemented by letter from R.C. Mecredy, RG&E, to Guy S. Vissing, NRC, "Corrections to Proposed Low Temperature Overpressure Protection System Technical Specification," October 8, 1997.

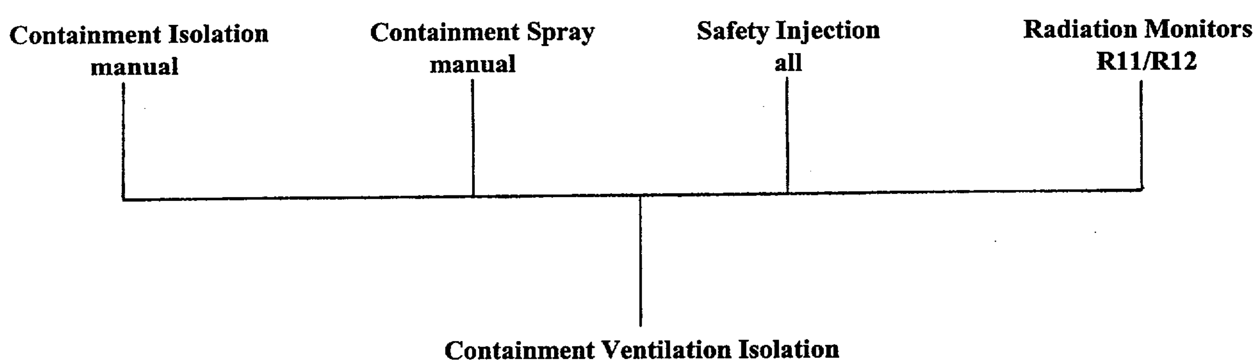
2. WCAP-14040-NP-A, "Methodology used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves," Sections 1 and 2, January, 1996.

d. The PTLR shall be provided to the NRC upon issuance for each reactor vessel fluence period and for revisions or supplement thereto.

Attachment VI
R.E. Ginna Nuclear Power Plant

Simplified Containment Isolation and Containment Ventilation Isolation Diagram





(Derived from UFSAR Figure 7.3-1, Sheets 1 and 2)

Enclosure 1
R.E. Ginna Nuclear Power Plant

EP-3-S-0505, Instrument Setpoint/Loop Accuracy Calculation Methodology

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NUCLEAR ENGINEERING SERVICES

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RESPONSIBLE MANAGER

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TABLE OF CONTENTS

1.0 <u>Introduction</u>

1.1 Purpose and Scope

This design standard was prepared to establish a consistent methodology for use in the preparation of instrument setpoint and uncertainty calculations. It also establishes definitions and relationships between safety and non-safety system process parameter limitations, and setpoints for actuation and control.

A systematic method of identifying and combining instrument uncertainties is necessary to ensure that vital plant protective features are actuated at the appropriate values of process parameters during normal and accident conditions. Safety limits have been established, through the process of accident analysis, which require actuation of plant protective features. Ensuring that these protective features operate as assumed in the accident analysis provides assurance that safety limits will not be exceeded.

The scope of application of methods described in this design standard is generally limited to the determination of values for the following:

- Safety-related setpoints
- Critical values in the Ginna Station Emergency Operating Procedures (EOP's)
- Selected setpoints and surveillance acceptance criteria contained in the Ginna Station Improved Technical Specifications (ITS).

It is not intended that these methods be applied in the determination of non-safety related setpoints. However, these methods may be used for setpoint determinations and in other applications where measurement uncertainties require formal documentation. Conversely, application of these methods may be exempted if it can be shown that the setpoint of a safety-related device serves no significant safety function as defined in IP-CON-3. Application of these methods may also be exempted if the function of the value or setpoint addresses conditions which are beyond the design basis of the plant.

Determination of response times (instrument, mechanical, hydraulic, thermo-hydraulic, etc.) is not included in the scope of this design standard. Design bases response times are included in the accident analyses and other calculations and analyses where required. This methodology does not apply to electronic controller proportional, derivative, or integral values, relay applications (i.e., time delay relays, motor-operated valve torque switches, protective relays, etc.), spring cans and snubber setpoints, or to mechanical relief valve setpoints.

2.0 References

2.1 Source Documents

2.1.1 10CFR50.36, Code Of Federal Regulations, Title 10, section 50.36, "Technical Specifications".

2.1.2 10CFR50 Appendix A, Code Of Federal Regulations, Title 10, "General Design Criteria For Nuclear Power Plants".

2.1.3 Ginna Updated Final Safety Analysis Report (UFSAR)

2.1.4 Ginna Improved Technical Specifications

2.1.5 NO-CON Configuration Management

2.2 Developmental Documents

2.2.1 ANSI/ISA S67.04, Part I and II - 1994, Setpoints for Nuclear Safety-Related Instrumentation.

2.2.2 ISA dTR 67.04.09, Graded Approaches to Setpoint Determination, Draft Technical Report, Draft 2, November 1996.

2.2.3 Ginna Setpoint Project Plan No. 99-0001, Rev 0, dated July 16, 1999.

2.2.4 INPO 84-026, Setpoint Change Control Program, Rev. 1, dated June 1986.

2.2.5 NUREG - 0800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, Chapter 7, Instrumentation and Controls (BTP HICB-12)

2.2.6 NRC Regulatory Guide 1.105, Rev 0, 1 and 2 and Draft Regulatory Guide DG - 1045 (Proposed Revision 3 to Regulatory Guide 1.105) Setpoints for Safety - Related Instrumentation.

2.2.7 ODCM, Ginna Offsite Dose Calculation Manual

2.2.8 Regulatory Guide 13.79. Qualification of Class 1E Equipment for Nuclear Power Plants

2.2.9 Regulatory Guide 1.97, Instrumentation for Light Water Reactors (LWR)to Assess Plant Conditions During and Following an Accident

2.2.10 NUREG 0588, EQ of Safety Related Electrical Equipment

2.2.11 NUREG 0737 Supplement 1, Clarification of TMI Action Plan Requirements

2.2.12 Generic Letter 88-07. "Electrical Equipment EQ Relating to 10 CFR 50.49"

2.2.13 Generic Letter 89-14, "Removal of Limit on Extending Surveillance Intervals"

2.2.14 IE Notice 84-54, "Deficiencies in Design Basis Documents and Calculations Supporting Design"

2.2.15 IE Notice 89-68, "Evaluation of Instrument Setpoints During Modifications"

2.2.16 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

2.2.17 Fluid Meters- Their Theory and Application, Report of ASME Research Committee on Fluid Meters, Sixth Edition. New York, American Society of Mechanical Engineers, 1971

2.2.18 Measurement of Fluid Flow in Pipes Using Orifices, Nozzles. and Venturis, ASME MFC-3M-1985

2.2.19 ANSI/ISA-S51.1-1979, Process Instrumentation Terminology

2.2.20 ASTM E178-94, Standard Practice for Dealing With Outlying Observations

2.2.21 ANSI N15.15-1974, American National Standard Assessment of the Assumption of Normality

2.2.22 NRC NUREG 1475, Applying Statistics

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

2.3 **Use Documents**

2.3.1 IP-DES-2, Plant Change Process

2.3.2 EP-3-P-0122, Design Analysis (Engineering Procedure)

2.3.3 EP-3-P-0154, Review and Approval of Vendor Design Analysis

2.3.4 EP-3-P-0172, Document Update Form

2.3.5 EP-3-S-901, Records and Document Control

2.3.6 IP-MTE-1, Calibration and Control of Measuring and Test Equipment

2.3.7 IP-CAP-1, Abnormal Condition Tracking Initiation or Notification(Action Report)

2.3.8 RG&E Memo of March 29, 1990, from Gary Cain to R. Baker regarding request for letter stating calibration accuracies of Digital Multi-Function Meters.

| 2.3.9 IP-DES-4, Setpoint Change Process

3.0 Requirements

| This Standard shall be used in conjunction with EP-3-P-122, EP-3-P-0154, EP-P-0172, IP-
| DES-2 AND IP-DES-4 as applicable to document the RG&E setpoint/loop accuracy calculations for instrumentation and electrical equipment at Ginna Station.

4.0 Responsibilities

4.1 Assigned Engineer

The assigned Engineer shall:

- Prepare setpoint/loop accuracy calculations and revisions to existing calculations per EP-3-P-0122 or EP-3-P-0154, as required, following the guidance in this document.
- Transmit new/revised setpoint/loop accuracy calculations to records managment in accordance with EP-3-S-901.
- Update configuration documentation as required in accordance wth EP-3-P-0172.

4.2 Review Engineer

The assigned Review Engineer shall:

- Review each assigned calculation in accordance with EP-3P-0122 OR EP-3-P-0154 as applicable.

5.0 Standard Methodology

This methodology for the calculation of instrument loop uncertainty and setpoints is based on ANSI/ISA Standard S67.04-1994 Part I & II, "Setpoints for Nuclear Safety-Related Instrumentation". The Nuclear Regulatory Commission has endorsed the methods described in ANSI/ISA Standard S67.04-1988 through Regulatory Guide 1.105, Revision 2, "Instrument Setpoints For Safety-Related Systems" (Reference 2.2.7). In addition, the NRC has participated in the development of ISA S67.04-1994 and is expected to endorse it in the near future, through Regulatory Guide 1.105, Revision 3.

Calculations using the methods described in the design standard are prepared in accordance with the requirements of Ginna Engineering Procedure EP-3-P-122 Rev. 04, "Design Analysis" and Procedure EP-3-P-0154, Rev. 02, "Review and Approval of Vendor Design Analysis.

Preparation of instrument setpoint and uncertainty calculations involves a number of steps.

The first step is establishing the function that is being accomplished by the value being addressed in the calculation. Although not addressed in this design standard, proper definition of the function is paramount in the setpoint and/or uncertainty determination.

The next step is to establish how the measurement is made. For automatic setpoints, this would require the configuration of the instrument loop be defined. For other types of uncertainty calculations, the procedure used to perform the measurement should be referenced or established.

The next step is to identify the sources of uncertainty related to the measurement. Section 5.1 provides a discussion of typical sources of uncertainty and references which may be consulted to establish values for each source of uncertainty.

After the sources of uncertainty are identified, each of the uncertainty terms must be classified with respect to the type of uncertainty each represents. Section 5.2 discusses various characteristics of uncertainties.

Once the uncertainty terms have been identified and classified, the next step is to combine the terms into an overall uncertainty value. Section 5.3 discusses methods of combining uncertainty terms.

Section 5.4 describes the conversion of the uncertainty value into a setpoint.

Section 5.5 discusses the determination of plant specific allowances for drift and certain other uncertainty terms.

Section 5.6 discusses determination of setpoints using non-explicit methods.

Section 5.7 provides guidelines on documenting the calculation with respect to the instructions in procedure for preparing design calculations.

The setpoint methodology presented here identifies typical sources of instrument uncertainty, sources to establish values for the uncertainty terms, guidance on classifying the uncertainty terms, and presents methods for combining these uncertainty terms into an overall value. For most applications, it is expected that combination of the uncertainty terms can be accomplished using Square Root Sum of the Squares method (SRSS) and/or algebraic sums. Combination of uncertainty terms via the Monte Carlo method can be used for any type of problem where it is impractical to use SRSS.

5.1 Sources of Uncertainty

This section describes typical sources of uncertainties related to instrument loops. Guidance relative to where the input data should be obtained is also provided. Although it is required that the preparer of an uncertainty or setpoint calculation consider each source of uncertainty addressed in this section, not every uncertainty term will be applicable to every instrument. The preparer should provide a discussion sufficient to explain the rationale for any uncertainty term which is not quantified in the uncertainty calculation.

When beginning a new calculation it is important to understand input data used in previous calculations. Existing setpoint calculations should be reviewed and similar calculations identified. Consistent data should be utilized unless a need to change an approved calculation is identified.

Device data includes data which is associated with a particular device. This includes the following:

- Manufacturer
- Model
- Calibrated span
- Location
- Head Correction
- Reference leg
- Configuration

Data to support the calculation may be obtained from many sources including vendor supplied data, data from other Ginna calculations and data developed by Ginna (eg: component specific drift data). In some cases, data may not be available without performing extensive testing and/or analyses. In these cases, assumptions may be made and documented in the calculation package, in accordance with EP-3P-0122 and EP-3-P-0154.

5.1.1 Instrumentation Effects

5.1.1.1 Reference Accuracy

The reference accuracy of a device is the quantity that defines a limit that errors will not exceed when a device is used under specified operating conditions. The reference accuracy includes the combined effects of hysteresis, linearity, and repeatability and is almost always specified by the manufacturer. Accuracy cannot be adjusted or otherwise affected by the act of instrument calibration. Typically, the reference accuracy is used as the performance specification (setting tolerance) which the instrument is tested against during calibration. For loops with multiple components, the individual accuracy terms need to be identified for each component.

With regard to bistables, trip units and switches, only the vendor specification for repeatability should be considered. Hysteresis and linearity may be ignored, since the setpoint is only approached from one direction and the unit is adjusted at only one point, the setpoint. Accuracy data is almost always available from the vendor. In the event this data is not available, a value equal to the setting tolerance may be used. The effects of reference accuracy are not transitory nor are they eliminated by periodic calibration.

Some instrument manufacturers specify instrument performance in terms of the maximum range of the instrument's capabilities. In order to evaluate the specification with respect to a particular instrument calibration span, it may be necessary to multiply the specification by the turndown ratio when calculating uncertainty in terms of % calibrated span.

This methodology describes the sources of instrument and loop uncertainty in terms of loop span which corresponds to the calibrated span of the sensor. While this convention is valid for all loop devices with analog outputs, it is invalid for loop devices with digital outputs (e.g., bistables, trip units. switches, etc.). Since these devices are calibrated (setpoint adjustment) at only one point, there is no span that can be associated with the device. For the purposes of this methodology, the nominal setpoint of a switch or bistable will be used wherever calibrated span is required. Also, the instrument's maximum setpoint capability shall be used wherever maximum span is required.

5.1.1.2 Primary Element Accuracy

The primary element accuracy is the accuracy associated with the component that quantitatively converts the measured variable into a form suitable for measurement by the associated instrumentation. Typically, this term refers to components which are not electrical devices. Examples of common primary elements are elbow taps, orifice plates, and flow venturis.

The accuracy of the primary element associated with the conversion of the measured variable must be considered in the determination of the instrument loop uncertainty. Primary element accuracy values can be obtained from vendor performance specifications, specific testing, or ASME design requirements provided the component is constructed and installed per the ASME requirements.

Since the value of the primary element accuracy is related to a specific set of reference process conditions, it is essential that these reference process conditions be identified along with the primary element accuracy. For example, the differential pressure developed by an orifice plate varies significantly as the density of the fluid varies. Since temperature changes can effect the density of fluids, the primary element accuracy is only valid for a specific process fluid temperature. The potential differences due to changes in the process from the primary element reference conditions are taken into account in the determination of the process measurement effects. The effects of primary element accuracy are not transitory nor are they eliminated by periodic calibration.

5.1.1.3 Drift Allowance

Drift is an undesired change in the component output over time, which is unrelated to the input. The drift allowance is normally determined by analysis of historical calibration data per a statistical data base as described in Section 5.5 in this procedure. At least three calibration intervals are required to utilize this data base. If three calibration intervals have not been completed the vendor specified drift value should be used. Drift specified by the instrument manufacturer may be based on testing by the vendor under laboratory conditions. If drift data is not available from the manufacturer, a specific analysis should be performed to quantify experienced drift values, following the methodology provided in Section 5.5. Manufacturer's data may not be used if a specific analysis indicates the manufacturer's data to be nonconservative.

Since time is a critical parameter in determining the drift allowance, it can be assumed that the drift of a component is zero immediately following calibration and increases to the value specified by the manufacturer over the interval specified by the manufacturer. Subsequent calibration of the component resets the drift to zero. The calibration interval can be established through review of the Repetitive Maintenance Work Orders.

The interval over which the drift allowance is specified by the manufacturer may not be consistent with the desired calibration interval. Normally, any changes in the drift allowance shall be determined utilizing a statistical package (such as CRS Engineering Instrument History Analysis Software) described in section 5.5. Alternatively, the drift allowance and interval may be increased by either increasing the allowance and interval linearly to the desired calibration interval,by combining the drift allowance using SRSS while increasing the interval linearly.

When using manufacturer's drift values, the drift allowance may be increased linearly as follows,

$Da_{extended} = (Da_{specified} \times t_{extended})/t_{specified}$ Eq 5.1-1

where:

$Da_{specified}$ = drift allowance specified by manufacturer

$t_{specified}$ = time interval specified by manufacturer over which the drift allowance applies
$t_{extended}$ = desired calibration interval
$Da_{extended}$ = drift allowance over desired calibration interval

The equation for increasing the time interval for the drift allowance using SRSS follows.

$Da_{extended} = (n \times Da_{specified}{}^{2})^{1/2}$ Eq 5.1-2

where:

n = the next largest integer from
$t_{extended} / t_{specified}$

Of course, using SRSS results in a smaller allowance, however, in order to use SRSS, the drift over the specified interval must be random, approximately normally distributed and centered about zero. Also, the drift from interval to interval must be independent. The effects of drift are not transitory, however, they are eliminated by periodic calibration.

Determination of the drift allowance requires consideration of the time period between calibrations. The calibration interval can generally be obtained from the scheduling of the repetitive maintenance work order. As a minimum, a calibration interval of at least 30 months (24 months plus 25%) should be used for Ginna ITS parameters.

5.1.1.4 Power Supply Allowance

The Power Supply Allowance is the expected variations in the output of an instrument associated with expected variations in the power supply to the instrument. Changes in output of the power supply associated with a device may produce an uncertainty with respect to device performance. Typically, the relationship between variations in the power supply and the output of an instrument is provided in the manufacturer's performance specifications. The expected variations in the output of the power supply can usually be obtained from the performance specifications for the power supply. Variations in bus voltage that impact the power supply voltage should also be taken into account. Typically, this allowance is very small in comparison to other instrument loop uncertainties. The effects of power supply variations are transitory, however, they are not eliminated by periodic calibration.

5.1.1.5 Static Pressure Allowance

The static pressure allowance is an allowance to accommodate expected variations in the output of a differential pressure device due to calibrating the device at atmospheric pressure and using the differential pressure sensor to monitor differential pressure in a pressurized system or component. The term "static pressure" applies to the nominal pressure of the process where the differential pressure device functions. The static pressure may cause both a zero shift and a change in the gain (span) of the sensor.

Generally, the manufacturer provides instructions to correct the calibration of the differential pressure sensor for the static pressure. If these instructions are reflected in the calibration procedure for the differential pressure sensor of interest, then only the expected variations in the output of the sensor due to expected variations in the process pressure need to be considered. Typically, the resulting variations in the output can be treated as random, independent, normally distributed and centered about zero. However, if the calibration procedure does not include correction for static pressure, it may be necessary to treat the output change resulting from the total difference between the maximum operating pressure and the static pressure at calibration conditions. The resulting variations may not be zero-centered and, in general, should be added algebraically. The effects of static pressure are transitory, however, they are not eliminated by periodic calibration.

5.1.1.6 Overpressure Allowance

Overpressure allowance is an allowance for exceeding the design pressure of an instrument or primary element. An allowance for overpressure effects does not need to be considered in determining instrument loop uncertainty, based on the following:

a) In order for an instrument to experience an over pressure condition while the plant is operating, the process must exceed its design capabilities. If the instrumentation is matched to the process design capabilities, it follows that the system's instrumentation must have already performed any necessary safety-related functions.

b) It would be inconsistent with the overall approach of this methodology to consider uncertainties due to conditions which occur in an accident scenario after the required safety-related instrument functions.

c) The pressure limits for the installed electronic transmitters meet or exceed the design pressures of the systems in which they are installed.

5.1.1.7 Overrange Allowance

Overrange allowance is an allowance to account for a sensor or primary element that is exposed to conditions beyond its calibrated span. While an overpressure condition is not expected to occur, instruments may be exposed to overrange conditions by design. Typically, this allowance is of concern for pressure sensors and differential pressure sensors and does not apply to temperature sensors. Devices exposed to overrange conditions on a continuous basis may exhibit an error associated with this condition. Typically, the manufacturer's performance specifications will describe this error if applicable to the sensor. The effects of overrange are not transitory, however, they are eliminated by periodic calibration.

5.1.1.8 Vibration Allowance

The instrument installation requirements for Ginna are such that the instruments are generally mounted on walls, panels, or floor-mounted supports and the vibration of instrumentation is not significant. The allowance for vibration for these types of installations may assumed to be negligible.

Occasionally, instruments are mounted on components such as pipes, valves and pumps and may be subjected to significant amounts of vibration. Where the installation of an instrument causes it to be subjected to significant amounts of vibration, an allowance for vibration should be included in the determination of the instrument loop uncertainty. The effects of normal vibration are apparent in the historical calibration data and are not distinguishable from the effects of drift and calibration uncertainties. This allowance can be determined from manufacturer's data or from analysis of historical calibration data. The effects of normal vibration are not transitory, however, they are eliminated by periodic calibration.

5.1.2 Normal Environmental Effects

Environmental effects are the expected variations in the output of an instrument that can be attributed to changes in the temperature, humidity, pressure, and radiation at the location of the component. Normal environmental effects refers to changes in environmental conditions that can be expected when the unit is operating as designed (including shutdown periods). Accident environmental effects are discussed elsewhere in this procedure.

Two factors determine the magnitude of the allowance, the magnitude of the change in the environmental condition from the expected environmental condition at the time of calibration, and the sensitivity of the component to the change in the environmental condition. UFSAR Table 3.11-1 and Chapter 3 and 6, are typically the best available source of data regarding normal environmental conditions.

5.1.2.1 Temperature Allowance, Normal Environment

To determine the temperature allowance for an instrument loop, the following parameters must be established:

- the physical location of each loop component
- the expected variations in the ambient temperature between calibration and normal operation (or shutdown, if applicable) for each location, and
- the sensitivity of each component to changes in the ambient temperature.

The physical location of loop components can be established from controlled design documents or by walkdown. Manufacturer performance specifications generally provide information regarding the sensitivity of each component to changes in the ambient temperature. If this information is unavailable from the manufacturer, an assumption of the temperature allowance equal to the reference accuracy of the component may be warranted.

The magnitude of the temperature effect of a component is influenced by the change in ambient temperature. The effect of ambient temperature on instrument calibration is transitory, i.e., if the temperature change is reduced, then the temperature effect is reduced. However, temperature effects are not impacted by periodic calibration.

It is important to note that the change in the temperature between calibration and operating conditions is the parameter of interest. Therefore, if an instrument is located inside an enclosure (cabinet or panel), it is only necessary to consider the change in the room temperature, since the internal enclosure temperature will change as a function of the room temperature. This presumes that the relationship between the internal enclosure temperature and the room temperature is not altered by the calibration process.

5.1.2.2 Humidity Allowance, Normal Environment

To determine the humidity allowance for an instrument loop, the following parameters must be established

- the physical location of each loop component
- the expected variations in the ambient humidity between calibration and normal operation (or shutdown, if applicable) for each location, and
- the sensitivity of each component to changes in the ambient humidity.

The physical location of loop components can be established from controlled design documents or by walkdown. Manufacturer performance specifications generally do not provide information regarding the sensitivity of components to changes in the ambient humidity. Modern electronic equipment is typically not affected by changes in humidity during normal operating conditions. If specific data is not available from the manufacturer, it may be assumed that the temperature allowance also includes the effects due to humidity. The effect of ambient humidity on instrument calibration is transitory, i.e., if the humidity change is reduced, then the humidity effect is reduced.

5.1.2.3 Radiation Allowance, Normal Environment

To determine the radiation allowance for an instrument loop, the following parameters must be established:

- the physical location of each loop component
- the expected radiation total integrated dose (TID) between calibration intervals for each location, and
- the sensitivity of each component to total integrated dose (TID).

The physical location of loop components can be established from controlled design documents or by walkdown. Manufacturer performance specifications generally do not provide information regarding the sensitivity of components to TID. Effects of normal radiation exposure between calibration intervals can be assumed to be included within the drift allowance barring specific data to the contrary. The effect of normal radiation dose on instrument calibration is believed to be cumulative, i.e., if the radiation dose rate is reduced, then the radiation effect does not decrease and may continue to increase with increasing TID. However, normal radiation effects are eliminated by periodic calibration.

5.1.2.4 Ambient Pressure Allowance, Normal Environment

To determine the ambient pressure allowance for an instrument loop, the following parameters must be established:

- the physical location of each loop component
- the expected variations in the ambient pressure between calibration and normal operation (or shutdown, if applicable) for each location, and
- the sensitivity of each component to changes in the ambient pressure.

Changes in ambient pressure only affect devices which function by measuring pressure in a system or component with respect to the ambient pressure. Gage pressure transmitters are the most common type of device that is impacted by ambient pressure changes, however, some temperature sensing devices operate by measuring the pressure of a gas in a sealed capillary .

The physical location of loop components can be established from controlled design documents or by walkdown. Manufacturer performance specifications generally do not provide information regarding the sensitivity of components to changes in the ambient pressure. If this information is unavailable from the manufacturer, the sensitivity of the component to ambient pressure changes can be assumed to be a 1:1.

The magnitude of the ambient pressure effect of a component is influenced by the change in ambient pressure. The effect of ambient pressure on instrument calibration is transitory, i.e., if the ambient pressure change is reduced, then the ambient pressure effect is reduced. However, ambient pressure effects are not impacted by periodic calibration.

5.1.3 Accident Environmental Effects

Environmental effects are the expected variations in the output of an instrument that can be attributed to changes in the temperature, humidity, pressure, and radiation at the location of the component. Accident environmental conditions can also significantly affect the output of an instrument loop due to decreasing the cable insulation resistance. Accident environmental effects refers to changes in instrument loop outputs due to changes in environmental conditions that can be expected when a unit is experiencing an upset condition. Normal environmental effects are discussed elsewhere in this design standard. Depending upon the function of the instrument loop and the scope of the calculation, accident environmental effects may or may not be addressed.

Two factors determine the magnitude of the allowance, the magnitude of the change in the environmental condition from the expected environmental condition at the time of calibration, and the sensitivity of the component to the change in the environmental condition. UFSAR Table 3.11-1 and Chapters 3 and 6, are the best available source of data regarding accident environmental conditions. However, it must be noted that the UFSAR identifies the worst case environmental conditions that would be expected. Consideration must be given with respect to the actual function of the instrument loop. For example, if the instrument loop must actuate prior to or at the initial period of the accident, then the environmental conditions may not be relevant.

5.1.3.1 Temperature Allowance, Accident Environment

To determine the temperature allowance for an instrument loop, the following parameters must be established:

- the physical location of each loop component
- the expected variation in the ambient temperature between calibration and the ambient temperature during the upset condition, and
- the sensitivity of each component to changes in the ambient temperature.

The physical location of loop components can be established from controlled design documents or by walkdown. Environmental qualification test reports generally provide information regarding the sensitivity of components exposed to upset ambient temperature conditions.

The magnitude of the accident temperature effect of a component is influenced by the change in ambient temperature during the upset condition. The effect of ambient temperature on instrument calibration is transitory, i.e., if the temperature change is reduced, then the temperature effect is reduced. Accident temperature effects need not be considered for temperature levels which occur after the loop has completed it's required function in the accident scenario. However, accident temperature effects are not impacted by periodic calibration.

5.1.3.2 Humidity Allowance, Accident Environment

Accident humidity allowance deals with the humidity and steam/chemical spray effects from the normal humidity values present during instrument calibration to the postulated humidity and steam/chemical spray environment during an accident. To determine the humidity allowance for an instrument loop, the following parameters must be established:

- the physical location of each loop component
- the expected variations in the ambient humidity between calibration and the ambient humidity and steam/chemical spray effects during the upset condition, and
- the sensitivity of each component to changes in the ambient humidity and steam/chemical spray effects.

The physical location of loop components can be established from controlled design documents or by walkdown. Environmental qualification test reports generally provide information regarding the sensitivity of components exposed to upset ambient humidity and steam/chemical spray conditions if required.

The effect of ambient humidity on instrument calibration is transitory, i.e., if the humidity change is reduced, then the humidity effect is reduced. Accident humidity effects need not be considered for humidity levels which occur after the loop has completed it's required function in the accident scenario. However, accident humidity effects are not impacted by periodic calibration.

5.1.3.3 Radiation Allowance, Accident Environment

To determine the accident radiation allowance for an instrument loop, the following parameters must be established:

- the physical location of each loop component
- the expected radiation total integrated dose (TID)
- between calibration intervals for each location up to the time that the component is required to function, and
- the sensitivity of each component to total integrated dose (TID).

The physical location of loop components can be established from controlled design documents or by walkdown. Environmental qualification test reports generally provide information regarding the sensitivity of components exposed to upset radiation dose. The effect of accident radiation dose on instrument calibration is believed to be cumulative, i.e., if the radiation dose rate is reduced, then the radiation effect does not decrease and may continue to increase with increasing TID. Accident radiation effects need not be considered for TID levels greater than those which occur after the loop has completed its required function in the accident scenario. However, accident radiation effects may be eliminated by periodic calibration.

5.1.3.4 Ambient Pressure Allowance, Accident Environment

To determine the accident ambient pressure allowance for an instrument loop, the following parameters must be established:

- the physical location of each loop component
- the expected variations in the ambient pressure between calibration and the ambient pressure during the upset condition, and
- the sensitivity of each component to changes in the ambient pressure.

Changes in ambient pressure only affect devices which function by measuring pressure in a system or component with respect to the ambient pressure. Gage pressure transmitters are the most common type of device that is impacted by ambient pressure changes, however, some temperature sensing devices operate by measuring the pressure of a gas in a sealed capillary.

The physical location of loop components can be established from controlled design documents or by walkdown. Environmental qualification test reports generally provide information regarding the sensitivity of components exposed to upset ambient pressure conditions. If this information is unavailable from the manufacturer, the sensitivity of the component to ambient pressure changes can be assumed to be a 1:1.

The magnitude of the ambient pressure effect of a component is influenced by the change in ambient pressure. The effect of ambient pressure on instrument calibration is transitory, i.e., if the ambient pressure change is reduced, then the ambient pressure effect is reduced. However, ambient pressure effects are not impacted by periodic calibration.

5.1.3.5 Insulation Resistance Allowance, Accident Environment

To determine the insulation resistance allowance, the following information must be established:

- Principle of operation of the sensor
- The expected variations in the environmental conditions during the upset condition
- Configuration and the insulation resistance of the components exposed to the accident environment conditions under the applicable environmental conditions.

In order to determine the allowance for decreased insulation resistance (IR), how the IR influences the signal must be understood. This determines how to calculate the effect of the IR and how to apply the effect to the overall loop uncertainty. Figures 5.1 and 5.2 show typical configuration of loop components for an electronic transmitter and an resistance temperature detector (RTD). Electronic transmitters regulate the current through the loop based on the sensed process condition. Therefore, decreased insulation resistance may cause an increase in the loop current. For RTD loops, decreased insulation resistance may cause an apparent lower RTD resistance that the temperature transmitter may interpret as a lower temperature.

The physical location of loop components can be established from controlled design documents or by walkdown.

Typically, there are five components that should be considered to possibly produce a reduction in IR in harsh environments. They are:

- Containment penetration leakage
- Cable insulation leakage
- Cable splice leakage
- Terminal block leakage
- Sealing device leakage

Environmental qualification test reports generally provide information regarding the changes in IR of components exposed to upset environmental conditions.

The effect due to insulation resistance should be calculated based on the worst expected conditions under which the equipment is required to function. A generic calculation may be performed for like devices utilizing the same make and model cable. The effect of insulation resistance decrease on instrument loop performance is transitory, i.e., if the insulation resistance is increased, then the insulation resistance effect is reduced. Radiation effects on IR are generally permanent, however, temperature effects are generally transitory. Insulation resistance effects are not impacted by periodic calibration.

Insulation Resistance effects (IR) will normally impact the output in a single direction. Therefore, IR should normally be combined using algebraic sum. Since IR values may be randomly distributed over a range of values, it may be possible to justify combining IR terms using a combination of SRSS and algebraic sum.

Figure 5.1 and 5.2

FIGURE 5.1

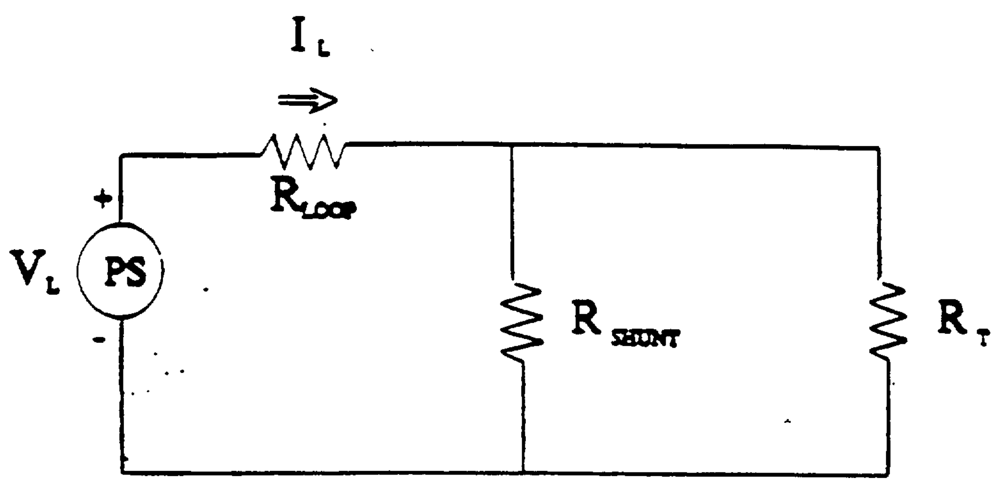
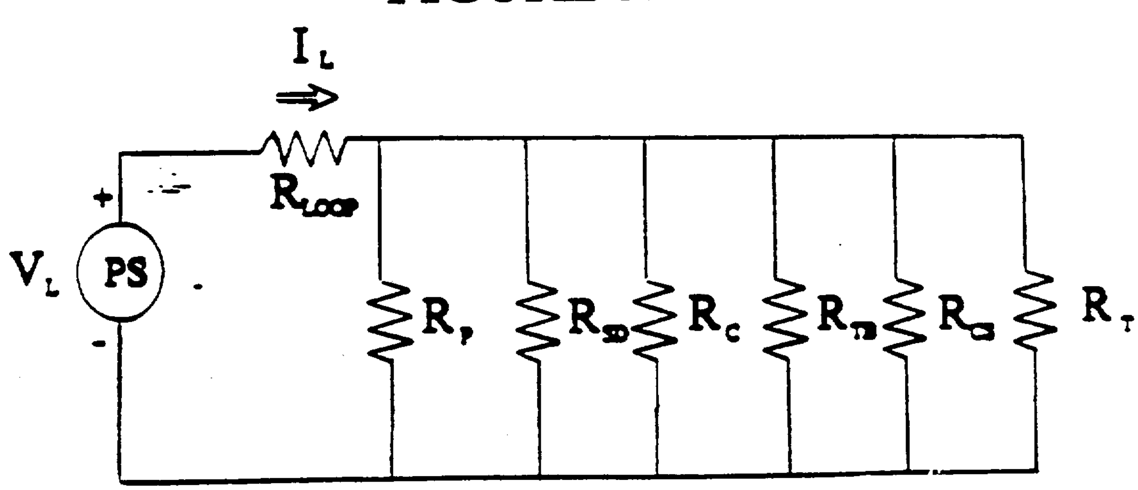


FIGURE 5.2



5.1.4 Seismic Allowance

Some instrumentation experiences a change in accuracy performance when exposed to equipment or seismic vibration. The vibration can cause minor changes in instrument calibration settings, component connections, and/or sensor response. The seismic effect may have different values for post-seismic and during a seismic event. Care must be taken in establishing loop functional requirements, so as to establish loop accuracy under the conditions needed.

The licensing design basis for Ginna does not require both seismic and an accident condition to be analyzed concurrently except for certain piping loads. That is, it is not considered feasible that both a seismic event and a design basis accident would happen at the same time. This allows either the SE or accident effects to be eliminated whenever a component is required to operate both under seismic conditions and under accident conditions. Therefore, whenever an instrument is required to operate for a seismic event and for accident conditions, the greater of either the SE or the accident effects should used in the uncertainty calculation.

The Ginna components that have been designed to withstand a seismic event are identified as Seismic Class 1. However, some of these devices are intended to operate during or post-seismic and some are only intended not to fail. That is, some devices are intended not to change state or cause accident conditions because of the seismic event. Such devices are not required to operate for the seismic event. They are just designed not to fail due to seismic causes.

The SE uncertainty should be determined for all components that are designated Seismic Class 1. If the inclusion of this effect becomes too restrictive, it may be justified to delete it based on the instrument's actual function during a seismic event (i.e. it's only designed not to fail vs. operate).

The seismic profile which the component was tested and qualified to must be compared to the Ginna specific profile to ensure that the test conditions envelope the Ginna conditions. Seismic profiles for Ginna for Seismic Category 1 instrumentation are discussed in Section 3.10 of the UFSAR. The seismic effect should be considered a random error term unless otherwise indicated by the manufacturer.

5.1.5 Measurement and Test Equipment Allowance

The Measurement and Test Equipment (M&TE) allowance is an allowance to account for the uncertainties related to the M&TE requirements of the periodic calibration of an instrument loop. In order to determine the M&TE allowance, the calibration method must be established. This can be accomplished through review of the calibration procedure. For electronic instrument loops, this calibration is accomplished using two procedures with the transmitters being calibrated independently of the balance of the loop. Transmitters and sensors are generally calibrated in accordance with the requirements of the calibration procedure that addresses the make/model of the sensor or transmitters.

Measurement and Test Equipment (M&TE) is the general name given to all of the equipment required to calibrate instrumentation. The M&TE includes voltmeters, ammeters, resistance decade boxes, test gauges, deadweight testers, etc. All of the M&TE must be controlled and calibrated to known standards. The calibration of M&TE must be to highly accurate precision standards which are traceable to the National Bureau of Standards (NBS). This provides a known basis for M&TE accuracy and allows determination of the M&TE effects on plant instrumentation.

For Ginna, the resulting M&TE accuracies may be prescribed by the applicable Test Instrumentation Calibration Procedures (TICP's) or the applicable vendor manual. Additionally, the M&TE accuracies for the digital multi-function meters used at Ginna are summarized in a March 29, 1990 memo from Gary Cain to Dick Baker (see references section 2.0). Refer to the specific test instrumentation calibration procedure or vendor manual for the accuracies of other M&TE.

The basic accuracy of M&TE is generally required to be equal to or better than the accuracy of the instrument to be calibrated by a ratio of 4:1 at Ginna (reference IP-MTE-1, "Calibration and Control of Measuring and Test Equipment"). M&TE accuracy must be converted to an equivalent instrument or loop accuracy value by factoring in M&TE range versus instrument or loop span.

Consider the following example:
A digital voltmeter (DVM) with an accuracy or ± 0.25% of its range is to be used to calibrate a pressure transmitter. Transmitter span is 4-20 mA. The DVM has a 0-20mA and a 0-50 mA range. The accuracy of the DVM in this application can vary depending on the DVM range used.

DVM accuracy = 0.25% of DVM range/ Transmitter span

Therefore, DVM accuracy on the 0-20 mA range is, 0.25% x 20 mA/ 16 mA = 0.31%

The DVM accuracy on the 0-50 mA range is,

0.25% x 50 mA/ 16 mA = 0.78%

As can be seen, not only is the basic accuracy of the M&TE important, but the proper selection of the M&TE range, as well. The final M&TE accuracy should be expressed in equivalent instrument or loop accuracy units.

In addition to the accuracy and range of the M&TE, another important consideration is how the calibration is performed and thus how the M&TE is applied. Generally, at Ginna, calibrations are performed device-by-device. For example, if a loop contains 8 devices and each device is calibrated individually, the overall M&TE uncertainty for each device must be considered.

For most calibrations, two pieces of M&TE must be used - one to provide an input test signal and one to read the resulting output. One exception is with indicators or recorders, where the "output" is directly read from the instrument being calibrated.

In summary, the above provide the general requirements for M&TE effects at Ginna. These requirements are contained in most calibration procedures for instrument loops. If this requirement does not exist in a calibration procedure which is related to an instrument calculation, the calculation should require that the calibration procedure be revised to include this requirement.

5.1.6 Setting Tolerance Allowance

The setting tolerance allowance is an allowance which accounts for the calibration procedure acceptance criteria, or setting tolerance. Setting tolerance is the acceptable parameter variation limits above or below the desired output for a given input standard associated with the calibration of the instrument channel. This may also be referred to as the tolerance or the width of the "as-left" band adjacent to the desired response. To minimize equipment wear and to provide for human factors considerations, a band, rather than a single value, should be specified in the calibration procedure. This may be a symmetrical band about a setpoint e.g. 109% +/-1%, or, in some cases, a nonsymmetrical band about a setpoint e.g. 110% +0%, -2%.

This calibration tolerance is usually based on the reference accuracy of the device being calibrated. The size of the calibration tolerance should be established based on the reference accuracy of the device, the limitations of the technician in adjusting the device and the need to minimize maintenance time.

The setting tolerance is not transitory nor impacted by periodic calibration.

Uncertainty determination includes ensuring that the proper scaling values are implemented in the loop components. Scaling with respect to a given channel may be simple or complex depending on the number and type of signal conditioning components/modules.

5.1.7 Process Measurement Allowance

Process measurement allowance is an allowance to account for uncertainties which influence the difference between the condition at the point of interest and the condition at the sensor. This is frequently a significant source of uncertainty in the indication or output of an instrument loop and requires careful consideration for each calculation. A few of the common process error terms are listed by sensor type.

Pressure sensors:
- Static head between the elevation of the tap and the elevation of the sensor
- Static head between the elevation of the tap and the elevation at the point of interest in the process
- Pressure differences due to flow between the location of the tap and the location at the point of interest in the process

Differential pressure sensors (level measurement applications)
- Variations in the reference leg conditions from changes in the temperature and/or pressure of the fluid in the reference leg or loss of fluid in the reference leg due to boiling, gas generation, and/or water accumulation
- Variations in the variable leg conditions from changes in the temperature and/or pressure of the process fluid
- Local flow-induced pressure effects at the taps
- Thermal expansion or contraction of the vessel may charge the vessel volume per unit height
- Thermal expansion or contraction of the vessel may change the distance between the taps
- Differential pressure sensors (flow measurement applications)
- Fluid density effects on the primary element (orifice plates, elbows, and venturis)

- Thermal expansion or contraction of the primary element
- Differences in elevation of the upstream and downstream taps
- Local pressure effects due to the configuration of the upstream and downstream piping

Temperature sensors:

- Temperature differences between the location of the sensor and the point of interest in the process. The differences may be caused by pumps, heat exchanges, and heat loss through insulation
- Temperature stratification in the process

Discussion of several of these process measurement effects follow.

5.1.7.1 Vessel/Reference Leg Temperature Effects on Differential Pressure Transmitters Used for Level Measurement

When differential pressure transmitters are used to measure liquid level in vessels, changes in density of the reference leg fluid, or vessel fluid, or both can cause uncertainties. This occurs because differential pressure transmitters respond to hydrostatic (head) pressures, which are directly proportional to the height of the liquid column multiplied by the liquid density. Therefore. measurement uncertainty may be induced in that, while the actual level in the vessel or reference leg remains constant, the liquid density changes are a function of pressure and temperature. This changes the pressure applied to the differential pressure transmitters, which makes the indicated level different from the actual level due to the fact that the transmitter by itself cannot distinguish the difference in pressure caused by the density effect.

The level measuring system is calibrated for assumed normal operating conditions. Typically, the vessels are closed (nonvented) and either contain a saturated mixture of steam and water with the reference leg filled with water, or the vessel contains water with a compressed gas overpressure with a dry (compressed gas) reference leg. Figure 5.3 shows a closed vessel containing a saturated steam/water mixture.

The differential pressure transmitter is calibrated to read level correctly at the assumed base conditions (SGWB, SGSB. etc.). As long as the actual vessel and reference leg conditions (SGWA, SGSA, etc.) remain the same as the base conditions for the system. the indicated level is a linear function of the measured differential pressure and no vessel/reference leg density effects are created. However, when the actual conditions differ from the base conditions, a level uncertainty (HU) is created. It is shown in Appendix B of Reference 2.2.1 that HU is equivalent to:

$$HU = [HR \times (SGRA - SGSA - SGRB + SGSB) + HW \times (SGSA - SGWA - SGSB + SGWB)]/(SGSB - SGWB) \quad \text{Eq. 5.1-3}$$

Figure 5.3

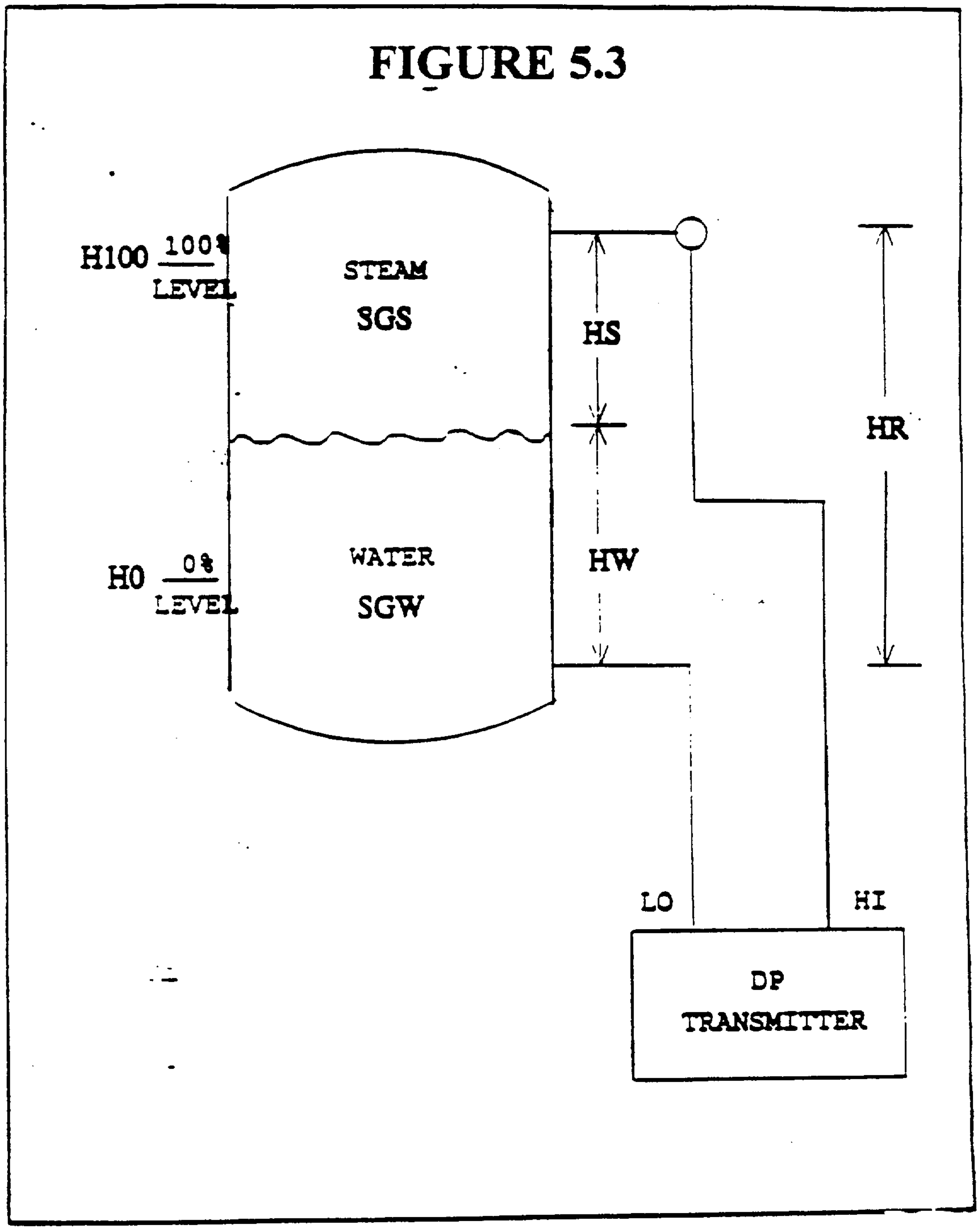


FIGURE 5.3
H100
100%
LEVEL
STEAM
SGS
HS
HR
H0
0%
LEVEL
WATER
SGW
HW
LO
HI
DP
TRANSMITTER

Because the denominator term in Eq. 5-1 decreases with increasing temperature, it is evident that the effect with rising vessel temperature. Furthermore, examination of the numerator of Eq. 5-1 reveals that the effect is maximized when HW is equal to H100. Examination of Eq. 5-1 reveals that an increasing reference leg temperature above the base conditions results in an increasing positive effect assuming vessel conditions remain constant.

The equation above calculates uncertainty in actual engineering units. If it is desired to work in percent span, the quantity HU should therefore be converted to percent span by dividing by (H100 - HO), and multiplying the results by 100%. In some cases, the actual distance between the level taps change due to the thermal expansion/contraction of the vessel walls. This should be investigated for large temperature changes to large vessels.

Appendix B to ANSI/ISA S67.04, Parts 1 & 2 provide more detail on this calculation uncertainty.

5.1.7.2 Uncertainties Related to Flow Orifices and Venturis

In many nuclear plant applications, process liquid and gas flow is measured using orifice plates or venturis tubes and differential pressure transmitters. The measurement of concern is either the volumetric or mass flow rate. The generally accepted standard for the mathematics of flow measurement is the ASME Fluid Meters, sixth edition.

Consider an orifice plate. From the ASME Fluid Meters, equations 1-5-36 and 1-5-37, the mass (mass) and volumetric (q_1) flow equations for an orifice plate at base conditions ρ_1 and T_1, are:

$\text{mass}(lb_m \text{ per sec}) = 0.099702[(CYd^2Fa)/(1-\beta^4)^{1/2}](h_w\rho_1)^{1/2}$ Eq 5.1-4

$q_1(\text{cfs}@\ \rho_1,T_1) = 0.099702[(CYd^2Fa)/(1-\beta^4)^{1/2}](h_{w/}\rho_1)^{1/2}$ Eq 5.1-5

OR (Converting to gallons per minute)

$q_1(\text{gpm}@\ \rho_1,T_1) = 44.75[(CYd^2Fa)/(1-\beta^4)^{1/2}](h_{w/}\rho_1)^{1/2}$ Eq 5.1-6

where,

C = Coefficient of discharge (actual rate of flow divided by the theoretical rate of flow).

Y = Expansion factor to account for effect of expansion of a gas. Note: For the case of a liquid. Y = 1.

d = Diameter of an orifice throat (inches).

Fa = Area factor to account for the thermal expansion of a primary element.

β = Ratio of a throat or orifice diameter to the pipe diameter.

h_w = Effective differential pressure (inches of water at 68°F).

ρ = Density of the fluid (lbm/ft^3) at specified conditions.

Additional equations are:

β = d/D_{pipe} (ASME Fluid Meters, Table 1-2-1) Eq 5.1-7

Fa = $1 + [2/(1-\beta^4)](\alpha_{PE} - \beta^4 \alpha_P)(t_{int} - t_{meas})$ Eq 5.1-8(ASME MFC-3M-1989, Eq. 17)

where,

D_{pipe} = Diameter of a pipe at a specified section(inches)
α_{PE} = Thermal expansion coefficient of the orifice material.
α_P = Thermal expansion coefficient of the pipe.
t_{int} = Temperature at condition of interest.
t_{meas} = Reference temperature of 68°F.

Examination of the equations shows that there are four factors which are of primary concern for evaluation of the flow orifice uncertainties. These are:

1. Fluid density changes, ρ. (Bias)

2. Area Factor, Fa. (Bias)

3. Coefficient of discharge, C.(Random)

4. Expansion factor for gases, Y. (Bias)

It is important to keep in mind the uncertainty relationship to hw or flow. The density is related to hw and the other factors to flow.

As an example, fluid density changes will be considered. As shown in Eq. 5.1-4 and 5.1-5. the density of the fluid has a direct influence on the indicated flow rate. Normally, a particular flow-metering installation is calibrated or sized for an assumed normal operating condition. As long as the actual flowing conditions match the designed density, related process errors should not be created. However, some systems such as safety injection perform dual roles in plant operation. During normal operation these systems can be aligned to low temperature sources of water. During the recirculation phase of a LOCA, the pump suction is shifted to the containment sump, which contains much higher temperature water.

If the flow measuring system has been calibrated for the normal low-temperature condition, significant process uncertainties can be induced under accident conditions, when the higher temperature water (lower density) is flowing.

To examine only the effects of fluid density changes (other parameter remaining constant), the general flow equation, Eq. 5.1-4 can be simplified to:

$q(GPM) = k_1 \, (h_w / \rho)^{1/2}$ Eq 5.1-9

where,

k_l = constant

ρ = density of the fluid

h_w = effective differential pressure

If the volumetric flow rate, q, is held constant, it is seen that a decrease in density will cause a decrease in the differential pressure (h_w) , which causes an uncertainty. This occurs because the differential pressure transmitter has been calibrated for a particular differential pressure corresponding to that flow rate. The lower h_w, causes the transmitter to indicate a lower flow rate. This differential pressure uncertainty (h_wU) is equal to:

$h_wU = h_w1 * [(\rho_t / \rho_{ref}) - 1]$ Eq 5.1-10

where,

h_w1 = The differential pressure at the flow rate of interest

P_t = Density at a temperature different than the reference conditions

P_{ref} = Density of the fluid at reference (base) calibration conditions

It is observed in Eq 5.1-10, which is the equation for density effects on volumetric flow, that the absolute effect is maximized when h_w1 is maximized. This occurs at the upper end of the calibrated differential pressure band for which the transmitter is calibrated. This is also maximum calibrated flow. The effect varies from negative values for temperatures above base values ($p_t < p_{ref}$), to zero for temperatures equal to the base value ($p_t = p_{ref}$)and finally to positive values for temperatures below the base value ($P_t > p_{ref}$) . For mass flow, the equation can be derived in a similar fashion. Note that this method derives from differential pressure error, which can be converted to a flow rate error using flow versus differential pressure relationship for the orifice.

Care should be exercised in categorizing uncertainties associated with fluid density changes. Typically, these uncertainties are treated as unidirectional biases. Since the effects of density changes may be accurately calculated, it may be possible to reduce, eliminate, or characterize as suitable to SRSS these uncertainties by providing corrections based on measurement of the density change.

Another potential source of uncertainties for venturis and orifice plates is due to turbulent flow effects upstream and/or downstream of the primary element. In Reference 2.2.18, ASME provides information on allowances for upstream and downstream piping configurations which may contribute to the measurement uncertainties. Figure 5.4 illustrates the pressure profile upstream and downstream of an orifice plate. Piping configurations which differ from the piping configuration assumed by the design, or during the initial calibration testing of the orifice plate. can alter this pressure profile and affect the sensed differential pressure.

Figure 5.4

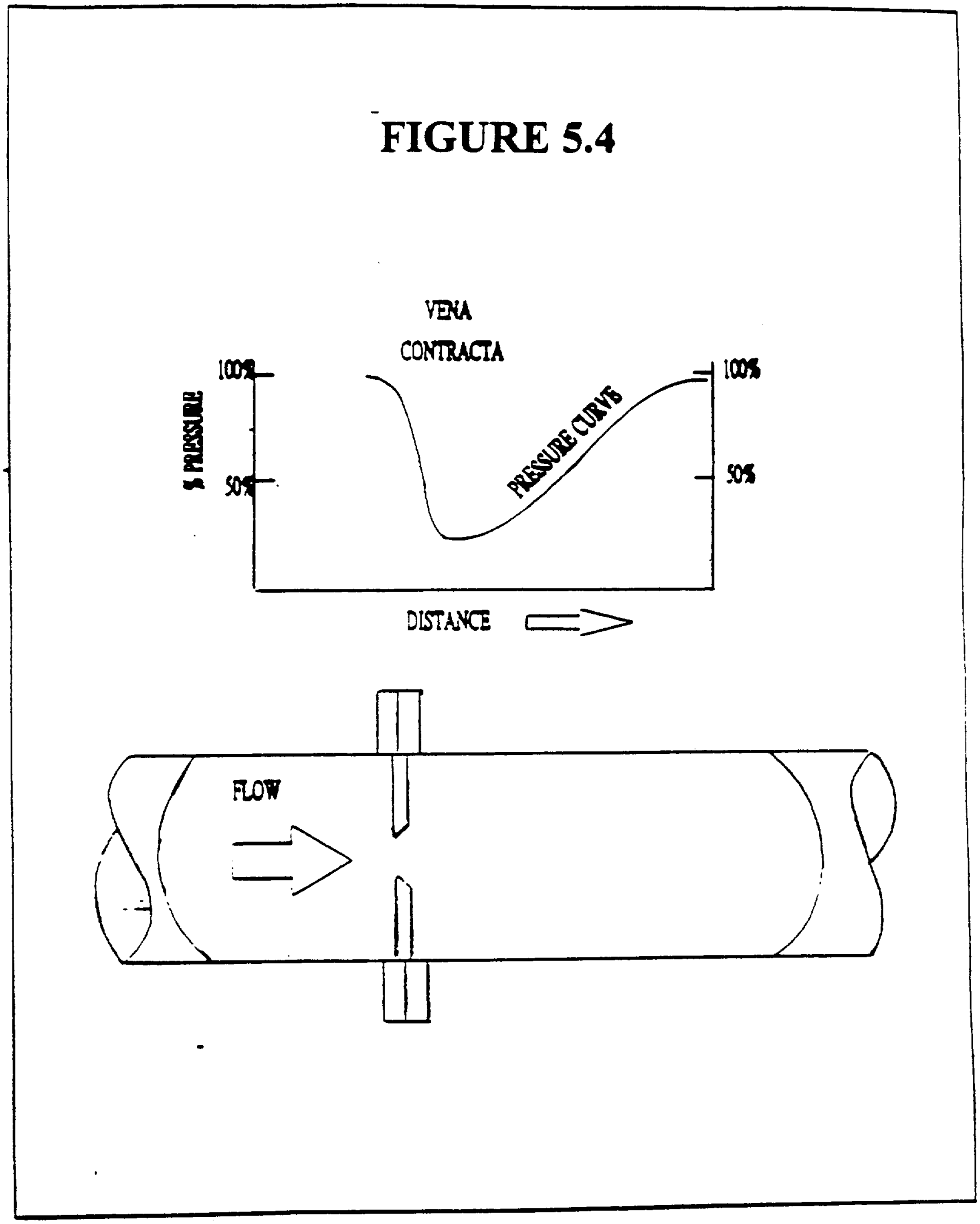


FIGURE 5.4
VENA
CONTRACTA
100%
50%
% PRESSURE
100%
50%
PRESSURE CURVE
DISTANCE
FLOW

5.1.7.3 Line Pressure Loss/Head Pressure Effects

The flow of liquids and gases through piping causes a drop in pressure due to fluid friction. Also, fluid pressure varies as a function of vertical elevation and density in fluid systems. If the point of interest in a process is different in either elevation or point in the flow stream from the sensing location, then uncertainties due to line pressure losses and/or head need to be considered. Most pressure transmitters are calibrated to reflect the pressure at the sensing location, therefore, separate consideration of the sensing line head effects are not required.

Figure 5.5 shows an example of a situation which requires consideration of both line pressure losses and head effects. If Point A in the figure is the point of interest, then the difference in static head between the sensing tap and the point of interest must be addressed. Likewise, any pressure drops due to fluid flow must also be considered. Determination of these effects should take into account limiting values of the fluid density.

The head effect/line loss errors are typically bias terms. The effect must be added or subtracted from the analysis limit, depending on the particular circumstances, to ensure that protective action occurs before exceeding the analysis limit. Careful consideration must be given in the determination of the sign. In Figure 5.5, the head effect would have a negative sign since the pressure at Point A would be higher than the pressure at the sensing location. The line loss effect would also be negative for the same reason. Since the effects of head and line loss may be accurately calculated, it may be possible to reduce, eliminate, or characterize as suitable to SRSS these uncertainties by providing corrections based on measurement of the density change.

Head and line loss effects generally apply to pressure transmitters, however, the installation of differential pressure devices should be reviewed with respect to the elevation of the high and low pressure taps. For example, if a differential pressure switch is monitoring the pressure drop across a heat exchanger, and if the taps are at different elevations, the tap elevation difference will introduce an offset in the sensed differential pressure. This differential pressure may contribute to the overall measurement uncertainty.

Figure 5.5

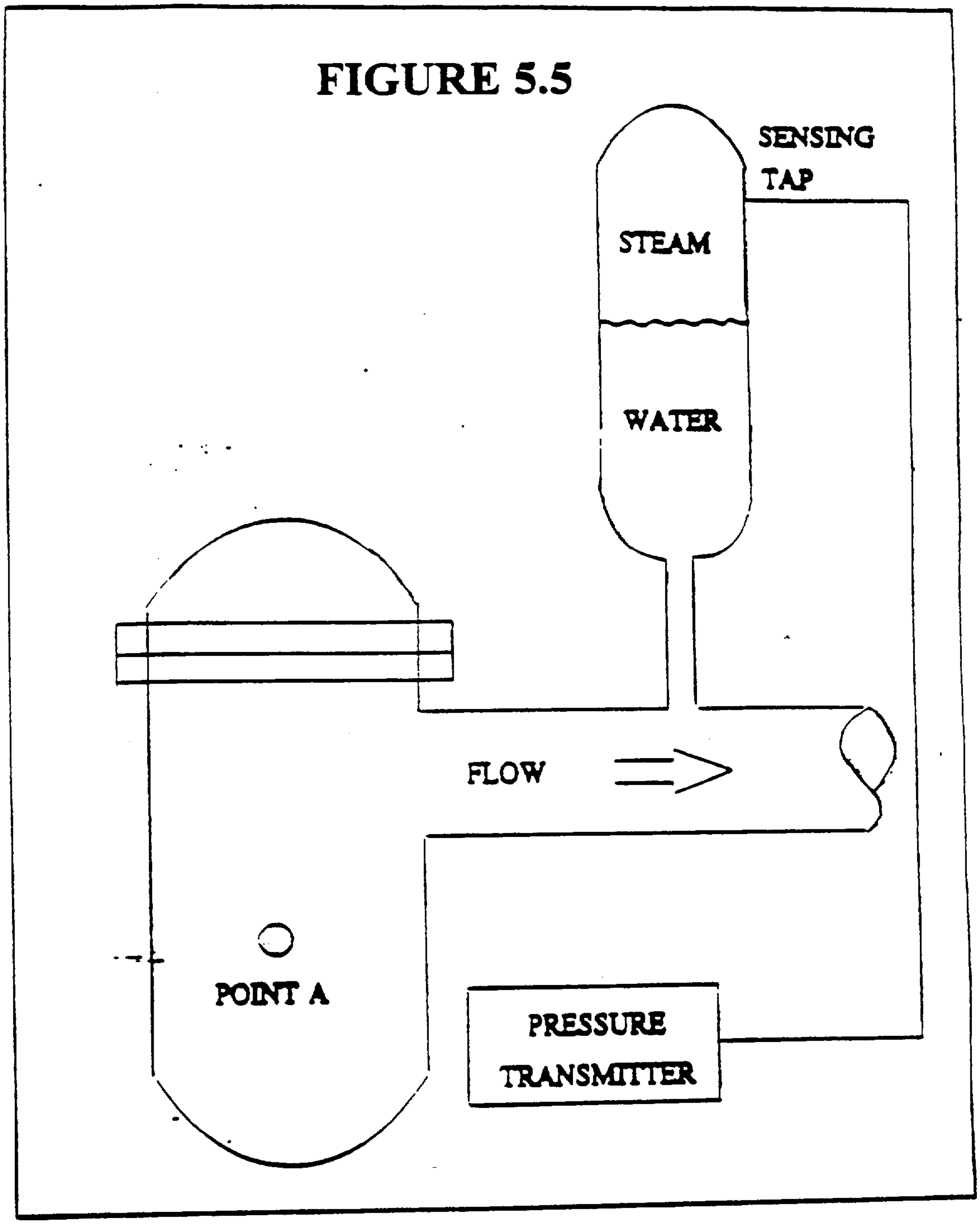


FIGURE 5.5
SENSING TAP
STEAM
WATER
FLOW
POINT A
PRESSURE TRANSMITTER

5.1.8 Readability Allowance

An allowance for the readability of an indicator should be included when the function of the loop or device requires that the indicator be read. For analog devices, the readability allowance is generally taken as equal to half of a minor division of the indicator. If a device includes provision to minimize parallax errors, it is not necessary to include allowances for parallax. For digital devices, the allowance is generally taken as equal to the resolution of the indicator.

5.2 Characteristics of Uncertainty

5.2.1 Random/Non-random Uncertainties

A random uncertainty is an uncertainty that has a chance of occurrence that is defined by it's associated probability distribution. A random uncertainty cannot be predicted based on conditions other than as defined by its probability distribution. Any uncertainty that is not random is defined as non-random. An uncertainty that is predictable based on a random event or condition can be considered random. Randomness is important when considering how to properly combine uncertainties.

5.2.2 Independent/Dependent Uncertainties

Independent uncertainty elements are uncertainties which do not interact with one another or are not a function a common parameter. Dependent uncertainty elements are uncertainties that are influenced by a common parameter. Within the elements of loop uncertainty, device uncertainties subjected to the same outside influences (ambient temperature, power supply. ambient pressure) are normally treated as dependent terms.

5.2.3 Distributions

It is important to classify the expected distribution of each uncertainty term in order that it can be appropriately combined with other terms. This section presents a short discussion on commonly encountered distributions and some significant parameters related to the distribution of uncertainties.

5.2.3.1 Normal

Most uncertainties can be considered to be normally distributed. Frequently, documentation to support the type of distribution is not available. In these cases, it is important that the analyst consider the uncertainty term with respect to features that would indicate that the term would not be normally distributed. Generally, it is not necessary that a term be able to pass statistical tests to be classified as normally distributed. Approximating a normal distribution is generally sufficient. Small deviations from a classical normal distribution will not normally adversely affect the results when combined with other uncertainty terms.

5.2.3.2 Uniform

Uniformly distributed uncertainty terms are also encountered. These terms are characterized by the value of the term having an equal probability of occurrence over the range of expected values. A common example of a uniformly distributed error term is the steps in an analog to digital (A/D) converter. The input has an equal chance of being any of the values over the range of the step width of the A/D.

5.2.3.3 Other

Other types of distributions associated with uncertainty terms are rare. An uncertainty term which is not normally or uniformly distributed must be carefully considered prior to combining it with other uncertainty terms.

5.2.3.4 Symmetric and Zero Centered

Symmetric and zero centered means that an uncertainty term has a mean of zero or near zero and is approximately symmetrical about zero. Any uncertainty term, regardless of the distribution of the term requires special consideration if it is not symmetrically centered about zero, even normally distributed terms.

5.2.4 Bias terms

Bias terms are terms which produce a known or predictable offset from zero. Generally, the result or output could be corrected to reflect these types of uncertainty terms.

5.3 Combination of Uncertainties

After the uncertainty terms have been defined, quantified, and classified, they can be combined to determine the overall uncertainty in the result or output. The combination of the uncertainty terms is generally accomplished using a combination of algebraic sums and root sum squares. This combination method provides a cost-effective way to determine the total uncertainty in a conservative manner. Other methods are also described in this section to handle unusual problems.

Where possible, all elements of device uncertainty should be calculated in terms of engineering units of the measurement channel output or the result.

5.3.1 Algebraic Sum

Algebraic sum refers to the determination of maximum loop uncertainty on the basis-of a "straight sum". This method effectively assumes that all uncertainties occur at the same time. at their maximum values, and all in both positive and negative directions. The uncertainty terms are presumed to have no statistical characteristics. While this method provides a high level of assurance that the derived uncertainty is conservative, it is likely that these results would be overly restrictive from an operational perspective. Uncertainty terms can always be conservatively combined using algebraic sum for linear problems.

$$a^+ = w^+ + x^+ + y^+ + z^+ \qquad \text{Eq 5.3-1}$$

$$a^- = w^- + x^- + y^- + z^- \qquad \text{Eq 5.3-2}$$

where: w, x, y, and z are uncertainty terms and a is the total uncertainty by algebraic sum. The superscripts reflect the positive and negative components of each of the terms.

It is important that only positive terms be combined with positive terms, and negative terms only combined with negative terms. Combining positive terms with negative terms effectively represents taking credit for an uncertainty term being at its maximum value, which is highly unlikely.

Typically, any terms which do not meet the requirements for combination using SRSS are combined using algebraic sum. Bias terms, terms that are not approximately normally distributed, and terms that are not zero-centered (such as IR) are normally combined using algebraic sum.

5.3.2 Square Root of the Sum of the Squares

Uncertainty terms may be combined using SRSS provided the terms are independent, random, approximately normally distributed about zero, and linear. Combining uncertainties using SRSS is done as follows.

$u^{+} = +(w^{+2} + x^{+2} + y^{+2} + z^{+2})^{1/2}$ Eq 5.3-3
$u^{-} = -(w^{-2} + x^{-2} + y^{-2} + z^{-2})^{1/2}$ Eq 5.3-4

where: w, x, y. and z are uncertainty terms and u is the total uncertainty

There are two types of dependent terms that may be combined using different combination methods. If the set of dependent terms are a function of a common parameter, then the set of terms should first be combined using algebraic sum. In equation form,

$d^{+} = d^{+}_{1} + d^{+}_{2} + \ldots + d^{+}_{n}$ Eq 5.3-5
$d^{-} = d^{-}_{1} + d^{-}_{2} + \ldots + d^{-}_{n}$ Eq 5.3-6

where d_1 through d_n represent uncertainty terms with a common dependency. The resulting total uncertainty related to the common dependency may be combined as shown above.

If the common influence causes the limits of the distribution of the uncertainties to increase or decrease uniformly in both directions, then these types of dependent terms may be combined using SRSS.

5.3.3 Non-Linear Functions

Combination of uncertainties for functions which are not linear requires special consideration. This problem is frequently encountered for instrument loops used for flow measurement and radiation monitors. Flow loops typically include a device that produces an output signal proportional to the square root of the input signal. Radiation monitors generally include a component which produces an output signal proportional the log of the input signal.

These types of problems can be addressed in a three step approach for each of the signal levels of interest. Using algebraic sum and/or SRSS, the total uncertainty at the input to the non-linear device can be determined at the particular signal level of interest. The uncertainties are frequently constant over the range of signal levels of interest, however, situations may be encountered where it is desirable to define unique uncertainties for each signal level.

Once the total uncertainty is defined at the input to the non-linear device, the uncertainties are propagated across the non-linear device To accomplish this propagation, the output of the device at the signal of interest is determined for three values:

1. without application uncertainties,
2. with application of positive uncertainties to the nominal input value, and
3. with application of negative uncertainties to the nominal input value. The positive and negative propagated uncertainties are determined by subtracting the propagated value without uncertainties from the positive and negative propagated values.

The final step is to combine the uncertainties downstream from the non-linear device with the positive and negative propagated uncertainties using SRSS and/or algebraic sum. Treatment of the uncertainties related to the non-linear device should be based an how the uncertainties are specified for that device. Typically, these uncertainties are specified as a function of the output of the nonlinear device and are treated as downstream uncertainties.

Handling of dependencies should be carefully considered for problems involving non-linear functions. A simplistic method is to combine all dependent uncertainties using algebraic sum at both the input and output of the non-linear device. An alternate method is use SRSS as described above but also establish the ratio of the dependent uncertainties to the total uncertainty at the input to the device, propagated the total uncertainty across the device and divide the propagated uncertainty into dependent and non-dependent terms using the ratio at the input to the non-linear device. The ratioed dependent terms can then be summed with downstream, like-dependent terms and then combined with other terms using SRSS, as appropriate.

5.3.4 Multiple Input Functions

Multiple input functions are devices which have more than one input device. These types of devices generally include functions which are non-linear and, therefore, should be handled accordingly. The signal levels at which the uncertainties are propagated should be done for all combinations of signal levels for which the calculation of the total uncertainty is expected to encompass.

5.3.5 Total Loop Uncertainty

Prior to combining terms, redundant terms should be reviewed to determine if one of the redundant terms can be eliminated. Also, all of the terms should be expressed in common units, preferably in the measurement units of the loop.

The following sign convention per ISA Standard ISA-S51.1 is used in the application of loop uncertainties.

u = Indication/Measured Signal - Ideal value Eq 5.3-7

It is important that the sign convention be established with respect to the result. Although this may be straightforward for simple problems, in cases with multiple inputs, one input may have a direct effect while another input may have an indirect effect.

Note: A positive error denotes that the indication of the instrument is greater than the ideal value.

Total loop uncertainty is calculated by first combining uncertainty terms with common dependency, and then combining all the terms which meet the conditions for combining terms using SRSS. Any remaining terms are then combined algebraically observing the requirement regarding only combining uncertainties with like signs.

$u^+ = +(r^{+2} + d^{+2})^{1/2} + a^+$ Eq 5.3-8

$u^- = -(r^{-2} + d^{-2})^{1/2} - a^-$ Eq 5.3-9

All of the individual uncertainty terms, which are combined using SRSS, should reflect bounding values with a 95% probability. Where confidence interval can be determined, it should also represent a 95% value. Equipment vendors usually provide performance data which reflects bounding values with a probability of at least 95% or a two standard deviation units (sigma) value. The uncertainty estimate resulting from combining the random terms by SRSS will then reflect a value which bounds the total uncertainty with a 95% probability. For conservatism, it may be assumed that published vendor specifications are 2 sigma values unless specific information is available to indicate otherwise. The individual preparing an uncertainty calculation may elect to adjust the performance specifications of various loop components to the same sigma value. If the uncertainty is being determined using sigma values from assumed normal distributions, then a three sigma error value may be multiplied by 2/3 to approximate the two sigma error value.

It is up to the individual performing the calculation to ensure that conditions assumed (i.e., values used for device uncertainty and the manner in which the elements of device and loop uncertainty are combined) are consistent with the instrumentation as installed. As shown below, this methodology is sensitive to changes in the values assumed for elements of device uncertainty and the manner in which terms are combined.

5.3.6 Monte Carlo

Monte Carlo is a general term for a method that is used primarily for problems which have at least some statistical component.

For most instrument uncertainty problems, the square root of the sum of the squares method (SRSS) is the method of choice for combination of uncertainties due to its simplicity. Combination of uncertainties through SRSS is limited to linear combination of uncertainties which can be approximated by a normal distribution. In some cases, some of the contributors to the uncertainty of the variables are not normally distributed and/or the combination method is a non-linear function. Therefore, combination of uncertainties using SRSS would require substantial use of approximation.

There are other methods that can be used to solve this type of problem. Frequently, the sensitivity of the independent variable to uncertainties associated with each dependent variable is calculated and the resulting uncertainties combined. Another method is through the use of the Taylor's series. Reasonable solutions using these approaches require approximation for dependent error effects and for variables which are not normally distributed.

Monte Carlo is a technique for the solution of problems which contain statistical components. The inputs to the problem are defined as well as the statistical characteristics of the variables. The problem or process is then modeled. Random values are generated for each variable, according to the statistical characteristic of each variable and the resulting simulated value is input into the model and results are calculated for that specific case. This process is repeated a large number of times and the characteristics of the results of the accumulated cases is analyzed.

5.3.7 Correction for Setpoints with a Single Side of Interest

For many safety-related setpoints, interest is only in the probability that a single value of the process parameter is not exceeded and the single value is approached only from one direction. A good example of such a process parameter is high pressurizer pressure at Ginna Station. The Analytical Limit is 2410 psig, as noted in the Ginna Technical Specifications. It is approached only from an increasing pressure direction.

In situations where additional operating margin is desired, the magnitude of the random uncertainty component may be reduced by accounting for a one-sided area of interest. If one is only interested in not exceeding a single value (i.e. +100% power), then the factor 1.645/K may be applied to the random uncertainty, where K represents the number of standard deviations (sigma) desired. For a 95% confidence level, 1.96 sigma is required and K = 1.96).

In practice this correction factor is applied only once to the total SRSS. The individual component uncertainty values should all be expressed in the common, desired confidence level (i.e. 1.96 sigma). For this example the correction factor (1.645/1.96) reduces to 0.839.

5.4 Setpoint and Allowable Value Determination

5.4.1 Sign Convention

It is important that only positive terms be combined with positive terms, and negative terms only combined with negative terms. Combining positive terms with negative terms effectively represents taking credit for an uncertainty term being at its maximum value, which is highly unlikely.

The following convention per ISA Standard ISA-S51.1 is used in the application of total loop uncertainties (TLUs):

TLU = Indication/Measured Signal - Ideal value Eq 5.4-1

A positive error denotes that the indication of the instrument is greater than the ideal value.

5.4.2 Analytical Limit

The analytical limit represents a value that the Ginna accident analysis assumes for the prescribed action. Establishing the analytical limit for a setpoint must carefully consider the overall function of the setpoint. Generally, the analytical limit is provided through design basis documents or other calculations. Setpoint determination is dependent on values established by analyses which are beyond the scope of this setpoint methodology. Specifically, safety limits and analytical limits were established during the design of the facility. The values of these terms may be found in a number of places, including the UFSAR and Technical Specifications, and in calculations performed by mechanical, electrical or nuclear engineering disciplines. In some cases a setpoint or value may be based on functions or on conditions which are beyond the design basis of the units. Functions and conditions which are beyond the design basis cannot be bounded or based on design basis limits. Therefore, these values may be established based solely on engineering judgement.

5.4.3 Setpoints Based on Operational Practicality

An analytical limit can usually be established for most setpoints where calculations are required to provide the design basis for the setpoint. Occasionally, it may be necessary to establish the design basis for a setpoint without benefit of having a specific analytical limit.

Under these circumstances, the basis for the setpoint may be defined as the minimum or maximum value which is practical from an operational perspective. Using this approach, an operating window is established which will allow for needed plant evolutions. This operating window can then be used in lieu of a specific analytical limit.

5.4.4 Setpoint Determination

The trip setpoint is determined by:

$t = a - |u^-| - m$ for an increasing setpoint Eq 5.4-2

or

$t = a + |u^+| + m$ for a decreasing setpoint Eq 5.4-3

where

t Trip setpoint
a Analysis limit
U^+ Positive uncertainty component
U^- Negative uncertainty component
m Margin

5.4.5 Sequenced Setpoints

In some instrument applications, the setpoint functions of multiple setpoints may be desired to, or required to, occur in a specific sequence. An example of two setpoint functions that are desired to occur in a specific sequence are most pretrip and trip setpoints. Trip setpoints may represent a significant nuclear safety function while pretrip setpoints are typically provided to warn operators that a trip is being approached which may not represent a nuclear safety function. An example of two setpoint functions that are required to occur in a specific sequence might be represented by the transfer from the safety injection mode to the recirculation mode. In this case, the isolation valves from the refueling water tank must close prior to initiating recirculation. Setpoints which are required to function in a specific sequence must be separated by a value which represents at least a 95% probability that the setpoints occur in the proper sequence. Of course, if the proper sequence is controlled by hardware interlocks or permissives, then this requirement does not apply to the calculated setpoints. Setpoints which are desired to function in a specific sequence are recommended to be separated by a value which represents a 95% probability that the setpoints occur in the proper sequence. Alternatively, the probability that proper sequencing may be determined to be less than 95% and deemed to be acceptable.

Frequently, sequenced setpoints share common loop components. Occasionally, the setpoints are completely independent from an instrument hardware perspective. To determine the separation of setpoints, it is not necessary to consider the uncertainties associated with common components. Only the uncertainties unique to each setpoint need to be considered. The minimum required separation may be calculated as follows.

$$s = (r^{+}_{unique1}{}^{2} + r^{+}_{unique2}{}^{2})^{1/2} + |a_{uniquel}| + |a_{unique2}| + h \qquad \text{Eq 5.4.-4}$$

where,

s = the minimum required separation

$r^{+}_{unique1}$ = the unique uncertainty terms which may be combined using SRSS for the lower (most limiting) setpoint, Setpoint 1.

$r^{+}_{unique2}$ = the unique uncertainty terms which may be combined using SRSS for the higher (least limiting) setpoint, Setpoint 2.

$a^{+}_{unique1}$ = the unique uncertainty terms which must be combined using algebraic sum for the lower
(most limiting) setpoint, Setpoint 1.

$a^{+}_{unique2}$ = the unique uncertainty terms which must be ombined using algebraic sum for the higher
(least limiting) setpoint, Setpoint 2.

h = the largest value of hysteresis unique to Setpoint 1 or Setpoint 2, when setpoints are actuated in opposing directions.

If the setpoints are both actuated in either the increasing or decreasing direction, it is not necessary to include the hysteresis term. If one setpoint is actuated in the increasing direction and the second setpoint is actuated in the decreasing direction, then the larger value of hysteresis unique to the two setpoints needs to be included. Hysteresis effects in common components do not need to be considered.

5.4.6 Spurious Actuations

Once a setpoint or value has been established, then potential for spurious operation or indication should be reviewed.

The trip setpoint is checked by using the following equations.

$n_u <= t - |u^+|$ for an increasing setpoint Eq 5.4-5

or

$n_1 >= t + |u^-|$ for a decreasing setpoint Eq 5.4-6

where

n_u = upper limit of the normal operating band

n_l = lower limit of the normal operating band

If these inequalities are not satisfied, the probability of spurious actuations should be approximated. This can be done by determining the difference between the upper or lower operating limit and the trip setpoint, dividing by the uncertainty, and using the normal distribution tables to convert to probability.

5.4.7 Unambiguous Setpoint Determinations

In some cases, it may be desirable to establish a setpoint or a value which provides an unambiguous indication of a process condition. An example is for high core exit thermocouple temperature alarm. This indication, along with other redundant and diverse indications and alarms, is used to warn the operator of the occurrence of inadequate core cooling under accident conditions. It is important that this alarm not be initiated spuriously as a spurious alarm would divert operator attention from overall accident management and potentially delay attaining cold shutdown conditions.

Another example is the value in emergency operating instructions to verify that sufficient Containment Spray flow exists. Periodic tests are conducted to validate the capacity of the Containment Spray pumps. Proper response to Engineered Safety Features Actuation System is also verified by periodic testing. It is important that the selected value not require the operator to investigate a potential low flow condition merely due to instrument uncertainties.

To deal with these types of situations, the setpoint or value may be determined in a manner that results in a setpoint or value being unambiguous.

The trip setpoint or value is determined by:

$t = a + |u^-| + m$ for an increasing setpoint Eq 5.4-7 or

$t = a - |u^{+}| - m$ for a decreasing setpoint Eq 5.4-8

Establishing the setpoint in this manner will provide a high degree of assurance that the setpoint will only actuate after the analysis limit has been obtained. It is important that application of the unambiguous method be limited to those situations where the proper system response is expected and/or confirmed by alternate indication, and where a spurious alarm or indication delay proper response. Specific justification for determining unambiguous setpoints and values must be provided.

5.4.8 Conversion of Trip Setpoint from Process to Signal Units

To support the performance of the initial setting and subsequent calibration and functional checks, the trip setpoint should be converted to signal units (volts, amps, counts, etc.), where applicable. This conversion is based on the calibration of the instrument loop components between the process through the bistable device.

5.4.9 Allowable Value Determination

The present revision of Improved Technical Specifications [ITS] (through Ammendment 74) does not specify Allowable Values for Reactor Trip System Instrumentation (Table 3.3.1-1). It does, however, specify Allowable Values for Engineered Safety Feature Actuation System Instrumentation (Table 3.3.2-1). This Allowable Value is analogous to the Analytical Limit. The discussion below on the determination of the Allowable Value does not pertain to the present revision of Improved Technical Specifications. The ITS will be revised such that both tables 3.3.1-1 and 3.3.2-1 will specify Allowable Values. The calculation methodology for determination of the Allowable Value will be as discussed below.

An Allowable Value is the limiting value that the Trip Setpoint can have when determined by a periodic test and still be capable of performing its design function. An Allowable Value differs from a Trip Setpoint because the periodic test eliminates some of the uncertainties, included in the Trip Setpoint determination at the time the periodic test is conducted. Definition of the uncertainties eliminated by the periodic test is the key to the determination of Allowable Values. If an instrument loop is tested by several different periodic tests, then different Allowable Values may exist for the same loop for each of the periodic tests.

In the methodology provided in this procedure, the ability of the instrument channel to perform its required protective function(s) is verified: the total instrument loop uncertainty (TLU) is determined by identifying and accounting for all uncertainties and effects, starting with an evaluation of the measured process, continuing with the process sensor and signal conditioning and ending at the final output device. The TLU includes process measurement effects, instrument accuracies, drift, tolerances, environmental effects etc. The Nominal Trip Setpoint is the bistable setting at which actuation of a protective device is desired to occur. The Analytical Limit is the maximum trip setpoint assumed in the Ginna Station Accident Analysis. The Analytical Limit minus the TLU is the Calculated Setpoint. The Calculated Setpoint is the maximum value at which the Nominal Setpoint would normally be allowed to be set. The allowable value is determined by subtracting (or adding depending on direction of interest) the COT uncertainty to the Calculated Trip Setpoint. This methodology for determining the allowable value is consistent with ISA-RP67.04-Part II-1994, Figure 6, Method 3. A channel must be considered inoperable if the As Found bistable trip setpoint is not within its allowable value.

In the Improved Technical Specifications (ITS), protective functions for the Reactor Trip System (RTS) and Engineered Safety Features Actuation System (ESFAS) are listed in Tables 3.3.1-1 and 3.3.2-1 respectively. To ensure and verify operability of these functions, the tables specify:

- <u>Required Number of Channels:</u> (self explanatory)
- <u>Allowable (Setpoint) Value:</u> Discussed under Surveillance Requirements - Channel Operability Test (COT) below
- <u>Surveillance Requirements:</u> The Surveillance Requirements applicable to the Setpoint Analyses are:

Channel Check: This is a visual comparison of redundant channel indicators typically performed once every 12 hours per Operations Procedures. Redundant indicator readings within a few percent of each other gives reasonable assurance that each instrument string from the process sensor to the indicator is operating within the combined instrument uncertainties calculated in the Setpoint Analyses. For indicator readings which deviate from redundant indicators more than a predetermined amount specified in the Operations Procedures, a Maintenance Work Order is initiated and the affected instrument channel discrepancy is investigated.

- Channel Operability Test (COT): The COT is the quarterly bistable trip test which checks the current calibration status of the bistable Nominal Trip Setpoint. Typically, only the bistable module is tested in the COT; other instruments in the loop are excluded. The Nominal Trip Setpoint is the bistable setting at which actuation of a protective function is desired to occur. During the COT, the As Found setpoint may deviate from the Nominal Trip Setpoint due to the net effects of random instrument uncertainty, calibration tolerance, drift, etc.. Since the COT is the most frequently performed calibration check, the ITS requires specification of an Allowable Setpoint Value in Tables 3.3.1-1 and 3.3.2-1 to determine operability. The Allowable Value takes into account those uncertainties associated with the COT. Operation with an As Found trip setpoint less conservative than the Nominal Trip Setpoint, but within the Allowable Value, is acceptable. A channel must be considered inoperable if the As Found trip setpoint is not within its Allowable Value. Allowable Values for the protective function(s) performed by this instrument channel are developed in the setpoint/uncertainty calculation. The Allowable Values in ITS Tables 3.3.1-1 and 3.3.2-1 are expressed in engineering units.

- Channel Calibration: The Channel Calibration individually tests each instrument in the entire instrument channel from the process sensor to each end device (i.e., bistable, indicator, etc.). These tests are typically performed once within each refueling cycle (i.e., 18 to 24 months). The bistable Allowable (Setpoint) Value is used to verify operability of only the bistable portion of the instrument channel, however, proper calibration of all instruments between the measured process and the bistable are also required to ensure that the protective function is performed within the Analytical Limit. An Allowable Value is assigned to the quarterly bistable trip setpoints in ITS Tables 3.3.1-1 and 3.3.2-1 as described above, however, there is no provision for specifying Allowable Values for upstream instrumentation providing the bistable input signals. To provide the protective function operability basis during Channel Calibration, a Total Instrument Uncertainty (TIU) for each individual instrument upstream of the bistables is calculated. The TIUs for these instruments are usually expressed in percent of span and include statistically combined individual instrument uncertainties such as accuracy, drift, calibration tolerance, and environmental effects for each upstream instrument. If an instrument As Found calibration is outside its TIU, an operability assessment which includes the most recent As Found calibrations of all instruments in the channel between the process sensor and the bistable must be performed to determine whether the Analytical Limit could have been exceeded. The TIUs for the instruments applicable to protective functions are developed and documented in the Setpoint/Uncertainty Analysis and displayed in the Equipment Database of the Configuration Management Information System (CMIS) for each applicable instrument.

In general, allowable values can be determined as follows.

For increasing setpoints,

Allowable value = Analytical Limit - TLU + COT

where COT = $(\text{drift}^2 + \text{accuracy}^2 + \text{setting tolerance}^2)^{1/2}$
Eq 5.4-9

For decreasing setpoints

Allowable value = Analytical Limit + TLU - COT

where COT = $(\text{drift}^2 + \text{accuracy}^2 + \text{setting tolerance}^2)^{1/2}$
Eq 5.4-10

Only the components of drift, accuracy and setting tolerance, which are included within the boundaries of the periodic test are to be included in the determination of the COT Uncertainty. Inclusion of other uncertainty terms in the determination of the COT Uncertainty should be specifically justified.

5.5 Plant Specific Instrument Drift Analysis

5.5.1 Overview

Instrument drift values for use in loop accuracy and setpoint calculations can be derived from manufacturer's specifications or from plant specific calibration history, if available. This section provides guidelines for the determination of plant specific and component specific drift values.

5.5.2 Theory

Regulatory Guide 1.105 (Reference 2.2.7). 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 these systems and components initiate automatic operation of appropriate systems to ensure that specified acceptable design limits are not exceeded.

95/95 values are values of drift which will bound 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. This means that 95% of all past, present, and future values of drift 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. 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.

5.5.3 Method of Analysis

The methods used to determine the experienced drift values are described in this section. A statistical data base or spreadsheet package (Example:CRS Engineering Instrument History Performance Analysis Software) can be used in place of manual methods for large volumes of data. Statistical methods described in "Statistics For Nuclear Engineers & Scientists, 1971" provide a guideline for determining the maximum values for experienced drift. In general, this method provides a 95/95 interval value for drift independent of the number of calibration intervals used in the determination.

5.5.4 Establish Scope

Analysis of drift data begins with establishing the scope of the analysis. At Ginna Station, drift analysis shall be performed on instrumentation or equipment that has been determined to require a setpoint/uncertainty analysis as per the Ginna Setpoint Control Verification Project (Project Plan No. 99-0001, July 1999). The instrumentation or equipment should be grouped by model number, environment and other effects which may cause one device to behave differently from a duplicate. These include the process, range, location, etc.

5.5.5 Development of the Data Base

Once the scope has been established, the next step is to obtain the as-found and as-left calibration data. The amount of calibration data recovered depends upon the type of distribution that is utilized to characterize the data. Generally, the data can be represented by a normal distribution. Only a limited amount of data is required since the methods compensate for the sample size. In order to avoid unnecessarily conservative values, at least 8 independent data points are recommended.

Once the calibration data has been recovered the next step is to determine the changes over the interval of interest. The calibration data for the instruments of interest should be entered into spreadsheet (from a speadsheet software package or CRS Engineering Instrument History Performance Analysis Software). This spreadsheet should include the "as-left" data from a calibration and the "as-found" data from a subsequent calibration. All data must be converted to a common base (e.g. % of span). In addition, the time interval between calibrations for these specific values must be recorded. These values should be recorded for each of the five points in a normal calibration, if this is the standard method for the calibration procedure. In general, it is acceptable to treat each of the available calibration points as independent. Next, we need to 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 are recovered. This difference may be standardized to a common time interval between calibrations, if there are significant differences between the calibration intervals within the data set. This may be done by dividing by the time interval and then multiplying to obtain a standardized interval. A unique spreadsheet can be constructed for each device resulting in several spreadsheets for a single evaluation. Each of these spreadsheets may contain multiple, one, or no calibration drift data values.

5.5.6 Analysis of Data by Model and Other Environmental Factors

Once the drift data is determined for individual devices, the data should be grouped by model with common environmental factors. Analyses should be performed on the main groupings (e.g, same model number and environment). Once the groupings are established, identical final editing and analyses on the data can be conducted. It is expected that most drift data would be normally distributed. A method for analyzing this data to determine 95/95 interval values follows. If, in conducting this analysis, it is determined that the data is not normally distributed, an alternative method is described. This method establishes arbitrary pass/fail criteria so that the successes and failures can be represented by a binomial distribution.

5.5.7 Normal Distribution of Drift Data

5.5.7.1 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 2.2.17 can be utilized. The extreme studentized deviate is calculated as

$$T = \left| \frac{X_e - X}{S} \right| \qquad \text{EQ 5.5-1}$$

where

T Extreme studentized deviate
x_e Extreme observation
x Mean

s Standard deviation of the same sample

If T exceeds the critical value given in Table XVI of Reference 2.2.17 at the 1% significance level (as an example), the extreme observation is considered to be an outlier. Once the outlier is identified, it is removed from the data base. Removal of outliers should be done with care not to remove valid data points. Reference 2.2.17 provides additional recommendations on the treatment of outliers.

5.5.7.2 Normality Tests

Once the edited data base is finalized and grouped, the Chi-Square Goodness of Fit Test (Reference Statistics For Nuclear Engineers & Scientists,1981) can be utilized to assure that the underlying distribution can 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 can only be applied to the groups with a large population (e.g., 30 or more data points)

Two statistical hypothesis-testing techniques, W and D Prime tests, are based on the same principle, comparison of a "linear combination" estimator of the population variance with the conventional "sum of the squared deviations" estimator of the population variance. The W test is for small sample sizes of 50 or less while the D Prime test is for sample sizes of 50 or more. Implementation of these tests should be in accordance with ANSI N15.15-1974.

5.5.7.3 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 "Statistics For Nuclear Engineers & Scientists,1981". 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 can be calculated as follows:

$x_{max} = |x| + Ks$ Eq 5.5-2

where

x_{max} Maximum expected drift with a 95% probability at the 95% confidence level x Sample mean

KA value from Reference 2.2.17, 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

5.5.8 Non-Normal Distributions

The following paragraphs describe one method of analyzing drift data where the underlying distribution cannot be demonstrated to be a normal distribution. One possible cause of the nonnormal distribution is that the drift of the component being measured is small with respect to the precision of the measurement. An instance that was encountered is that bistable setpoints were recorded to the nearest millivolt while the bistables seldom changed by that amount. This caused the drift data to be very peaked about zero.

5.5.8.1 Pass/Fail Criteria

To accommodate a non-normal distribution, arbitrary values for drift can be established which represent a pass/fall criteria. This criteria should not be confused with an acceptable value for drift relative to setpoint calculations. The pass/fall criteria can be adjusted to reflect a 95% probability of the drift data falling within the bounds at a 95% confidence level.

5.5.8.2 Confidence Interval

To analyze the calibration data, a specification is arbitrarily selected as a pass/fail criteria. The probability of the value falling within this criteria can then be estimated by

$P = x/n$ Eq.5.5-3

where,

P = probability of the value being
within the pass/fail criteria

X = number of values inside the pass/fail criteria
n = total number of 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 "Engineering Statistics, 2nd edition, Albert H. Bowker & Gerald J. Lieberman, 1972, Page 467, an exact confidence interval for P can be calculated as follows

$P_u = [(x+l)*F_{a/2:\ 2*(x+1),2*(n-x)}]/$
$[(n-x)+(x+1)*F_{a/2:2*(n-x+1),2*x}]$ Eq 5.5-4

$P_1 = x/[x+(n-x+l)*F_{a/2:2*(n-x+1),2*x}]$ Eq 5-5-5

Confidence interval,% = 100*(1-a) Eq 5.5-6

where,

$P_{u,1}$ = the minimum (1) and maximum (u) values of the probability that a value will fall inside the pass/fall criteria

a = Probability that the estimated probability will fall outside of the estimated confidence interval bounds

$F_{a/2:v1,v2}$ = 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 values 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.

5.5.9 Results

The results of the drift analyses of the main group should be assembled and reviewed. The drift value selected shall bound the results of the group.

5.6 Non-Explicit Setpoint Determination

For setpoints with no significant safety function a design calculation may be prepared in accordance with EP-3-P-0122 or EP-3-P-0154 as applicable that describes the function of the setpoint and documents the reason why the setpoint has no safety function. The analysis limit and instrument uncertainties may be discussed in the calculation to provide background information for the setpoint. The setpoint may be selected based solely upon past experience and engineering judgement. No explicit mathematical calculations are required.

5.7 **Documentation**

5.7.1 Documentation Requirements
All setpoint/uncertainty calculations shall be documented (as a Design Analysis) in accordance with EP-3-P-0122 or EP-3-P-0154 as applicable.

The appropriate forms from Appendix 8.1 shall be included in the "Analysis" Section (7.0) of the Design Analysis to document the data input for each calculation.

Configuration documents shall be updated as required per EP-3-P-0172 [Document Update Form (DUF)]

The new or revised setpoint/uncertainty calculations shall be submitted to Records Management in accordance with EP-3-S-0901.

6.0 Acronyms and Symbols

6.1 **Acronyms**

ECN	Engineering change notice
HELB	High energy line break
HVAC	Heating,ventilation,air conditioning
IR	Insulation resistance
LOCA	Loss of coolant accident
MDCN	Modification design change notice
M&TE	Measuring and test equipment
NS&L	Nuclear Safety and Licensing
NPSH	Net positive suction head
RCS	Reactor coolant system
RTD	Resistance temperature detector
SRSS	Square root sum of the squares
TID	Total integrated dose
TIU	Total Instrument Uncertainty
TLU	Total loop uncertainty
UFSAR	Updated Final Safety Analysis Report

6.2 **Symbols**

A	Basic reference accuracy allowance
A/D	Analog to digital conversion
AP	Accident pressure allowance
AR	Accident radiation allowance
Area	Cross-sectional area of the pipe
AT	Accident temperature allowance
AV	Allowable Value
AL	Analysis Limit

C	Coefficient of discharge (actual rate of flow divided by the theoretical rate of flow).
D	Drift allowance
Dpipe	Diameter of a pipe at a specified section (inches)
DP(or dP)	Differential pressure
dP	Differential pressure measured across the orifice
dP1	Differential pressure at the flow rate of interest
dPA	Actual differential pressure
dPB	Differential pressure at calibration conditions
Et	Result of combining all uncertainty terms using Monte Carlo
Er	Random uncertainty term determined by using Monte Carlo
Ecalc	Calculational uncertainty due to using Monte Carlo EbBias uncertainty term determined by using Monte Carlo
Fa	Area factor to account for the thermal expansion of a primary element.
HO	Height of water at the lower tap
H100	Height of water at the upper tap
HU	Level uncertainty
HR	Height of the reference leg
HW	Height of water
IR	Insulation resistance allowance
M	Margin allowance
MIS	Miscellaneous allowance
MTE	Measuring and test equipment allowance
NP	Normal pressure allowance
NR	Normal radiation allowance
NT	Normal temperature allowance
PM	Process measurement uncertainty allowance
PS	Power supply allowance
S	Seismic allowance
SGRA	Actual specific gravity of the reference leg fluid
SGRB	Specific gravity of the reference leg fluid at calibration conditions
SGSA	Actual specific gravity of the steam
SGSB	Specific gravity of the steam at calibration conditions
SGWA	Actual specific gravity of the water
SGWB	Specific gravity of the water at calibration conditions
SP	Static pressure allowance
ST	Setting tolerance allowance
T1	Temperature at orifice plate calibration conditions
TSP	Trip setpoint in process units
TSS	Trip setpoint in signal units(volts, etc.)
Turndown	Ratio of the maximum span to the calibrated span Ratio
W	Mass flow rate
Y	Expansion factor to account for effect of expansion of gas
a+	Result of combining positive uncertainty terms using addition
a-	Result of combining negative uncertainty terms using addition

ap	Thermal expansion coefficient of the pipe.
ape	Thermal expansion coefficient of the orifice material.
B	Ratio of a throat or orifice diameter to the pipe diameter.
d	Diameter of an orifice throat (inches).
d +	Result of combining positive uncertainty terms with a common dependency
d-	Result of combining negative uncertainty terms with a common dependency
d + n	nth common dependent uncertainty term, positive component
d-n	nth common dependent uncertainty term, negative component
da	Drift allowance specified by manufacturer
da extend	Drift allowance over desired calibration interval
h	Largest value of hysteresis unique to Setpoint I or Setpoint 2, when setpoints are actuated in opposing directions
hw	Effective differential pressure (inches of water at 68'F),
hw1	The differential pressure at the flow rate of interest
hwu	differential pressure uncertainty
k1	constant
m	Margin
mass	Mass flow rate
nu	Upper limit of the normal operating band
n1	Lower limit of the normal operating band
q1	Volumetric flow rate
P1	Pressure at orifice plate calibration conditions
r	Result of combining positive uncertainty terms using square root of the sum of the squares
r-	Result of combining negative uncertainty terms using square root of the sum of the squares
P	Density of the fluid (lbm/ft3) at specified conditions.
P1	Density at orifice plate calibration condititions
Pref	Density of the fluid at reference (base) calibration conditlons
Pt	Density at a temperature different than the reference conditions
s	Minimum required separation of cascading setpoints
t	Trip setpoint(calculated)
tint	Temperature at condition of interest.
tmeas	Reference temperature of 68'F.
textended	Desired calibration interval
tspecified	Time interval specified by manufacturer over which the drift allowance applies
u	Result of combining all uncertainty terms
v	Allowable value
W +	Uncertainty term, positive component
W-	Uncertainty term, negative component
X +	Uncertainty term, positive component
X-	Uncertainty term, negative component
Y +	Uncertainty term, positive component

Y	Uncertainty term, negative component
Z+	Uncertainty term. positive component
Z-	Uncertainty term, negative component

6.3 **Units**

BTU	British thermal units
cu ft	cubic feet
°F	degrees Fahrenheit
gs	acceleration in multiples of the acceleration of gravity
gal	gallons
gpm	gallons per minute
hr	hour
min	minute
psi	pounds per square inch
psig	pounds per square inch gage
psia	pounds per square inch absolute
psid	pounds per square inch differential
Sec	second
sq ft	square feet
sq in	square inch

7.0 Definition

Accuracy:
The degree of conformity of an indicated value to a recognized accepted standard value, or ideal value. The accuracy rating of the device is a number or quantity that defines a limit that errors will not exceed when a device is used under specified operating conditions. The accuracy rating includes the combined effects of hysteresis, dead band, linearity, and repeatability errors.

Allowable Value:
The limiting value that the trip setpoint can have when tested periodically, beyond which the instrument channel is declared inoperable and corrective action must be taken.

Ambient Pressure Allowance:
An allowance that accounts for possible variations in the output of an instrument due to the ambient environmental pressure variations that may be experienced.

Analytical Limit:
The limit of a measured or calculated variable established by the safety analysis or other document to ensure that a safety limit is not exceeded.

Assumption:
A text statement accepted or supposed as true without proof or demonstration (eg. test results). Assumptions should include engineering judgement and should include a reference to Ginna specific documentation where available.

Calibrated Span:
The absolute value of the difference between the maximum calibrated upper range value and the minimum calibrated lower range value.

Cable Leakage Allowance:
An allowance associated with possible leakage current from the instrument cable. Estimates of the effect of this leakage are generally based on test values obtained during environmental testing for the specific cable that is installed.

Channel Calibration:
Individual tests of each instrument in the entire instrument channel from the process sensor to each end device (eg: bistable, indicator etc.) As specified in ITS.

Channel Check:
This is a visual comparison of redundant channel indicators typically performed once every 12 hours per Operations procedures.

COT:
Bistable trip tests which check the current calibration status of the bistable Nominal Trip Setpoint as specified in ITS.

COT Uncertainty:
That uncertainty associated with the channel operability test, which typically includes calibration setting tolerance, accuracy and drift values. Typically, only the bistable is tested in the COT.

Dependent Uncertainty Elements:
Dependent uncertainty elements are uncertainties that are influenced by a common parameter.

Drift Allowance:
The combined allowance associated with the stability of the sensor and rack equipment. An undesired change in the component output over time, which is unrelated to the input.

Humidity Allowance:
The allowance associated with the humidity/steam/chemical spray environment for the specific instrument, as determined for both normal and accident conditions.

Independent Uncertainty Elements:
Independent uncertainty elements are uncertainties which do not interact with one another or are not a function a common parameter.

Insulation Resistance Allowance:
Summation of the allowances associated with electrical current leakage from the cable, cable splices, cable seal devices, penetrations, and terminal blocks.

Margin:
An allowance, determined by the analyst, to assure that the result of the calculation is conservative.

Normal Operation, Lower Limit:
The minimum value the process parameter may attain during normal operation, based on administrative guidelines, that will not result in the occurrence of an alarm, protective trip, or abnormal plant condition.

Normal Operation, Upper Limit:
The maximum value the process parameter may attain during normal operation, based on administrative guidelines, that will not result in the occurrence of an alarm, protective trip, or abnormal plant condition.

Operating Margin:
The allowance between the trip setpoint and the Normal Operation upper or lower limit that is determined necessary to avoid inadvertent trips resulting from signal noise. process uncertainties and measurement uncertainties.

Overpressure Effect:
Effect on an electromechanical device which experiences a pressure transient which exceeds the vendor design pressure for the device.

Overrange Effect:
The effect on an electromechanical device resulting from continuous operation in an overranged condition (but less than the vendor design pressure for the device).

Penetration Leakage Allowance:
An allowance associated with possible leakage current by a Containment penetration assembly. Estimates of the effect of this leakage are generally based on test values obtained during environmental testing for the specific type of penetration assembly that is installed.

Power Supply Allowance:
The expected variations in the output of an instrument associated with expected variations in the power supply to the instrument.

Primary Element Accuracy:
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,venturis, etc.).

Process Measurement Allowance:
An allowance that accounts for measurement errors between the point of interest in the process and the location of the sensor, and process conditions which may cause unwanted variations in the output of the sensor. Examples are the effect of fluid stratification on temperature measurements and the effect of changing fluid density on level measurements.

Radiation Allowance:
An allowance associated with possible variations in the output of an instrument as a result of exposure of the instrument to radiation. Estimates of these output variations for radiation dose rates in excess of 105 Rads are generally based on test values obtained during testing of the specific type of instrument that is installed.

Random Error:

Errors which cannot be predicted except on a statistical basis. They occur wholly due to chance and can be expressed by a probabilistic distribution. In most instrument applications, random errors occur with a frequency that approximates a normal distribution. For such a distribution, 95% of all errors fall within 1.96 standard deviations of the mean.

Range:
The difference between the minimum, and maximum values over which an instrument is designed to operate.

Readability Allowance:
An allowance that accounts for the ability to resolve the value displayed by an indicator.

Repeatability:
The closeness of agreement among a number of consecutive measurements of the output for the same value of the input under the same operating conditions. approaching from the same direction for full range traverses.

Safety Limit:
A limit on an important process variable that is necessary to reasonably protect the integrity of physical barriers that guard against the uncontrolled release of radioactivity.

Safety-Related Setpoint:
The setting of a Safety-Related device where an analog to digital conversion takes place. Typically. these devices are switches, bistables, and computers.

Seismic Allowance:
An allowance associated with the specific instrument to account for variations in the output of the instrument when subjected to seismic activity. Estimates of these output variations for seismic events which exceed accelerations of 0.15 g's are generally based on test values obtained during testing of the specific type of instrument that is installed.

Sensitivity Analysis:
An analysis that determines the degree of variation in the results as a result of variation in the input parameters.

Setting Tolerance:
The acceptance criteria used by the instrument technician when performing instrument calibrations to determine the acceptability of a calibration. Results of an instrument calibration or calibration check within this band requires no further adjustment of the instrument.

Setting Tolerance Allowance:
An allowance that accounts for the setting tolerance.

Splice Leakage Allowance:
An allowance associated with variations in the output of an instrument due to leakage current exhibited by a cable splice. Estimates of the effect of this leakage are generally based on test values obtained during environmental testing for the specific type of splice that is installed, and the total number of spices in the instrument loop.

Static Pressure:
The nominal process pressure applied to a differential pressure device during normal operating conditions.

Static Pressure Allowance:
An allowance that accounts for variations in the out put of a differential pressure device due to the nominal process pressure that is applied and/or variations in the process pressure under expected transients. Compensation for nominal static pressure effects can be made during calibration of the instrument.

Systematic Error:
The error which remains constant in absolute value and sign or varies according to a definite law when process conditions change. These errors may be due to incorrect reference standards, installation evaluation differences, non linearity, or range suppression. This error is not considered to be caused by chance.

Temperature Allowance:
An allowance that accounts for variations in the out put of an instrument as a result of changes in the Ambient environmental temperature. Estimates of these Output variations for temperatures in excess of 150'F are generally based on test values obtained during testing of the specific type of instrument that is installed.

Terminal Block Leakage Allowance:
An allowance associated with variations in the output of an instrument due to leakage current exhibited by terminal blocks installed in the instrument loop. Estimates of the effect of this leakage are generally based on test values obtained during environmental testing for the specific type of terminal blocks that are installed.

Trip Setpoint:
A predetermined level at which a bistable device changes state to indicate that the quantity under surveillance has reached the selected value.

Turndown Ratio:
The ratio of maximum span to calibrated span for an instrument.

8.0 Appendices

8.1 Forms

FORM 1:	INSTRUMENT CHANNEL PERFORMANCE REQUIREMENTS, LIMITS AND DESIGN BASIS
FORM 2:	INSTRUMENT CHANNEL COMPONENT SPECIFICATION
FORM 3:	TRANSMITTER ACCIDENT UNCERTAINTIES
FORM 4:	SEISMIC UNCERTAINTIES
FORM 5:	ACCIDENT CURRENT LEAKAGE
FORM 6:	PROCESS MEASUREMENT UNCERTAINTY
FORM 7:	MEASUREMENT AND TEST EQUIPMENT UNCERTAINTY
FORM 8:	RACK EQUIPMENT UNCERTAINTY
FORM 9:	SENSOR UNCERTAINTY
FORM 10:	DRIFT UNCERTAINTY
FORM 11:	TOLERANCE UNCERTAINTY

FORM 1: Instrument Channel Performance Requirements, Limits and Design Bases

Documents Reviewed	Requirements, Limits, Design Bases	Associated Instrument Channel Path Name
Improved Tech. Specs.		
Ginna Station UFSAR		
NUREG 0737 / RG 1.97 (UFSAR Table 7.5-1)		
EQ Master List (IP-EQP-1)		
Seismic Qualification		
EOPs		
Other		

FORM 2: Instrument Channel Component Specifications

EIN:	DESCRIPTION:	
Specification	**Data**	**Source**
Manufacturer / Model No.		
Input Range	(give both engineering and signal units if applicable)	
Output Range	(give both engineering and signal units if applicable)	
Input/Output Conversion Type	(e.g. linear with zero gain, linear with gain, square root, function curve, summer, etc.)	
Safety Classification	(e.g. SC-3, SS, NS)	
Setpoint	(e.g. increasing, decreasing, differential)	
Location	(e.g. building / room / elevation / rack or panel)	

Per:______________ **Design Limit =**__________

FORM 3: Transmitter Accident Uncertainties(AE)

Accident Effect	Uncertainty	Reference/Section
Temperature Effect(Te)		
Pressure Effect(Pe)		
Radiation Effect(Re)		
Steam/Chem Spray(S/Ce)		
Accident Bias(AB_1)		
Combined Random Accident Effect($Crae_1$) (per IEEE 323 tests)		
Accident Bias(AB_2) *		
Combined Random Accident Effect($Crae_2$) (per IEEE 323 tests) *		
Accident Bias(AB_3)		

FORM 4: Seismic Uncertainties (SE)

Seismic Effect	Uncertainty	Reference/Section
Pressure Transmitter (Se_{sensor})		
Current to Current Repeater (Se_1)		
Indicator (Se_2)		
Alarm Bistable (Se_4)		
Alarm Bistable (Se_5)		
Alarm Bistable (Se_6)		

FORM 5: Documenting the Components of the Accident Current Leakage Effect (CLU)

Associated Equipment Accident Effects	Uncertainty	Reference/Section
Cable Leakage(Cl)		
Splice Leakage(Sl)		
Penetration Leakage(Pl)		
Term Block Leakage(TBl)		
Conduit Seal Leakage(CSl)		
Total		

FORM 6: Process Measurement Uncertainty (PMA)

	Uncertainty	
Process Measurement Accuracy (Pma_{1b})		
Primary Element Accuracy (Pea)		

FORM 7: Measurement and Test Equipment Uncertainty (M&TEU)

M&TEU	Uncertainty	Reference/Section
Sensor Calibration Effect (Sce_1)		
Sensor Calibration Effect (Sce_2)		
Rack Equipment Calibration Effect (Rce_1)		
Rack Equipment Calibration Effect (Rce_2)		
Rack Equipment Calibration Effect (Rce_4)		
Rack Equipment Calibration Effect (Rce_5)		
Rack Equipment Calibration Effect (Rce_6)		
Rack Equipment Calibration Effect (Rce_7)		
Rack Equipment Calibration Effect (Rce_8)		

FORM 8: Documenting Rack Equipment Uncertainty (REU)

REU	Uncertainty	Reference/Section
Rack Equipment Accuracy (Rea_1)		
Rack Equipment Accuracy (Rea_2)		
Rack Equipment Accuracy (Rea_4)		
Rack Equipment Accuracy (Rea_5)		
Rack Equipment Accuracy (Rea_6)		
Rack Temperature Effect		
Rack Power Supply Effect (Rpse)		
Readability (Rme)		

FORM 9: Documenting Sensor Uncertainty (SU)

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

FORM 10: Documenting Drift Uncertainty (DU)

	Uncertainty	Reference/Section
Sensor Drift(Sd)		
Rack Equipment Drift (Red_1) Path 1		
Rack Equipment Drift (Red_2) Path 2		
Rack Equipment Drift (Red_3) Path 3		
Rack Equipment Drift (Red_4) Path 4		

FORM 11: Documenting Tolerance Uncertainty (TU)

Tolerance	Uncertainty	Reference/Section
Sensor Tolerance Effect (St)		
Rack Equipment Tolerance (Ret_1)		
Rack Equipment Tolerance (Ret_4)		
Rack Equipment Tolerance (Ret_5)		
Rack Equipment Tolerance (Ret_6)		

Enclosure 2
R.E. Ginna Nuclear Power Plant

DA EE-92-041-21
Instrument Loop Performance Evaluation and Setpoint Verification
Instrument Loop Number CV P945

D0796906

Design Analysis

Ginna Station

Instrument Loop Performance Evaluation and Setpoint Verification

Instrument Loop Number CV P945

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

DA EE-92-041-21

EWR 5126

Revision 3

November 29, 1999

Prepared by:	John R Guider [signature], Design Engineer	11/29/99	Date
Reviewed by:	RW Eliasz [signature], Reactor Engineering & Analysis	12/1/99	Date
Reviewed by:	[signature], Nuclear Safety & Licensing	1/4/00	Date
Approved by:	[signature], Independent Review Engineer	1/6/00	Date

TECHNICAL INPUT FORM					
EIN	PT-945, PT-947, PT-949,PQ-945, PQ-947, PQ-949, PM-945, PM-947, PM-949, PC-945A/B, PC-947A/B, PC-949A/B, PI-945, PI-947, PI-949, CPI-TRIP-TEST-5.10, CPI-TRIP-TEST-5.20, CPI-TRIP-TEST-5.30, CPI-TRIP-TEST-5.40				
KEYWORDS	Setpoint, Instrumentation, Containment, Reactor Trip,Uncertainty				
CROSS REF	CPI-PRESS-945, CPI-PT-945, CPI-PRESS-947, CPI-PT-947, CPI-PRESS-949, CPI-PT-949, DA EE-95-136				
PSSL 42	EWR/ OTHER 5126 Proj Plan 99-0001	PROPRIETARY	YES	NO	X
COMMENT					
SUPERSEDES					

REVISION STATUS SHEET

Revision Number	Affected Sections	Description of Revision
0	N/A	Original
1	1.0, 2.0, 5.1.1 10.2, 11.0	PCAQ Resolution
2	1.0, 2.0, 5.1.1, 5.2.3, 7.1.2, 7.3.1, 10.1, 10.2, 10.3, 11.0	Update references, Add Section 10.3
3	1.0, 2.0, 3.0, 10.2, 10.3 10.3.1, 10.3.2 10.3.3	Updated references, revised calculation to reflect new methodology for calculating the Allowable Value. Added comments pertaining to new drift study performed July 99.

INSTRUMENT PERFORMANCE EVALUATION AND SETPOINT VERIFICATION

TABLE OF CONTENTS

INSTRUMENT PERFORMANCE EVALUATION AND SETPOINT VERIFICATION

Instrument Loop Identification

Calibration Procedure No.

CPI-PRESS-945, CPI-PT-945
CPI-TRIP-TEST-5.10

Description:

Calibration of the Containment Pressure Loop 945

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

1. PT-945
2. PQ-945
3. PM-945
4. TP/945
5. PC-945A/B
6. PI-945

1.0 Purpose

The purpose of this calculation is to determine the overall loop uncertainty associated with instrument channel CV P945 for the monitoring of containment pressure. This loop provides an input to the containment spray logic, as well as various Engineered Safety Features (ESF) Actuation circuits. Containment pressure instrument loops P947 and P949 are redundant and equivalent to loop P945. This analysis is therefore applicable to instrument loops P947 and P949 also.

The containment spray logic initiation consists of redundant sets of two-out-of-three "AND" gates for four channels (six instrument loops) of containment pressure inputs. These sets are arranged such that two of three inputs from both sets are required to initiate containment spray. Additionally, containment pressure indication is provided to control room operators as a post accident monitoring instrument channel.

In addition to providing input to containment spray initiation, this loop also provides input to a similar two-out-three logic (taken only once) for input to the ESF actuation circuits for input to Steam Line/Feedwater Isolation circuits, Reactor Trip logic, Emergency Diesel Start circuitry, Safeguards Sequence circuits, Containment Isolation, Non-Safeguards Isolation Valve logic, and Containment Ventilation Isolation circuits.

The Safety-Related portion of this loop is comprised of the differential pressure transmitter, power supply, current repeater, pressure indicator, and a duplex alarm bistable. This portion of the process loop is the subject of this analysis. Revision 1 of this analysis is for resolution of PCAQ 93-012.

Revision 2 of this analysis is for the following purposes:

- Update of references to procedures, UFSAR, Improved Technical Specifications (ITS), Vendor Technical Documents, etc.
- Addition of new section for determination of Allowable Values for ITS Tables 3.3.1-1 and 3.3.2-1.
- Minor format changes per current Engineering Procedure for preparation of Design Analyses.

Revision 3 of this analysis is for the following purposes:

- Changed the methodology for calculating the Allowable Value (per ISA 67.04) in Section 10.3.
- Updated instrumentation drift values as per DA-EE-95-109, (Existing drift values are acceptable as they bound the updated values).
- Updated the references to include the updated instrument drift study DA-EE-95-109.

2.0 References

1. UFSAR Table 7.5-1, "Regulatory Guide 1.97 Revision 3/NUREG-0737 Comparison Table".

2. Regulatory Guide 1.97, "Instrumentation for Light Water-Cooled Nuclear Plants to Assess Plant and Environs Conditions During and Following an Accident", (Rev. 3, Dated May, 1983).

3. Improved Technical Specifications, R.E. Ginna Nuclear Power Plant.

Table 3.3.1-1	Reactor Trip Instrumentation
Table 3.3.2-1	Engineered Safety Feature Instrumentation
Table 3.3.3-1	Post Accident Monitoring Instrumentation
COLR	Core Operating Limits Report (COLR)

4. CPI-PRESS-945, "Calibration of the Containment Pressure Loop 945 Rack Instrumentation".

5. CPI-PT-945, "Calibration of the Containment Pressure Transmitter PT-945".

6. TICP-3, Category II Pneumatic Calibrators.

7. TICP-4, "Category II Digital Multifunction Meter".

8. Foxboro Drawing No. BD-12, and BD-14.

9. VTD-F0180-4008 and VTD-F0180-4022: N-11 and N-E13 Series Nuclear Electronic Pressure Transmitters, Product Specifications, PSS 9-1B1 A, Foxboro Co. 1984.

10. VTD-F0180-4398: Foxboro Model 610A Power Supply, Instruction 18-196, June, '67, (Ref. F180-0006-A02).

11. CV P945 Precalculation Instrument Review Checklist, Dated 11/05/92.

12. VTD-W0120-6901: Westinghouse Instructions I.L. 43-252C, "252 Line Switchboard Edgewise Instruments, Five Inch Classification", dated March 1968. (W120-5027-A02)

13. "Primary Containment Pressure Loop PT-945 Instrument Loop Wiring Diagram", Drawing No. 11302-265, Sheet 1 of 2.

14. Guidelines for Instrument Loop Performance Evaluation and Setpoint Verification, Rev. 1.

15. CV P945 - Block Diagram, Figure 1, Drawing No. CVP945.DWG.

16. Foxboro Instrument Connection Diagram, CD-3, Sheet 2.

17. Logic Diagram Safeguards Actuation Signals, Drawing No.33013-1353, Sheet 6.

18. Memo from Gary A. Cain to Mr. Baker, "Request for letter stating calibration accuracies of Digital Multifunction Meters", Dated March 29, 1990.

19. Logic Diagram Safeguards Actuation Signals, Drawing No.33013-1353, Sheet 7.

20. "Design Review of Plant Shielding and Environmental Qualification of Equipment for Spaces/Systems which may be used in Post Accident Operations Outside Containment at R.E. Ginna Nuclear Power Plant", Rochester Gas and Electric Corporation, Dated 12/79.

21. RG&E UFSAR Tables:

3.11-1	Environmental Service Conditions for Equipment Designed to Mitigate Design Basis Events.
7.2-1	List for Reactor Trip, ESF Actuation, and Containment Isolation.
7.5-1	USNRC regulatory Guide 1.97 Post-Accident Monitoring Instrumentation.

22. EQ Package #5, Wyle Test Report No. 45592-4.

23. EOP Setpoint Database.

24. QOAAC11 - Rev. A, "Wyle Test Report No. 45592-4", Dated 5/18/83.

25. Foxboro test report No. T4-1030, Seismic Vibration Test of Specific "H" Line Instruments, Dated 9/26/75.

26. Test Report of Seismic Vibration Testing of Specific Foxboro Instrumentation, Dept. 383, Test Report No. TI-1070A, Dated 6/25/74.

27. VTD-F0180-4308 and VTD-F0180-4309: Model 66B Current Repeater Specifications, The Foxboro Co., Dated 3/65.

28. VTD-F0180-4337 and VTD-F0180-4342: MI 18-370, Model 63S Rack Mounted Alarms Style A Specifications, The Foxboro Co., Dated 1/66.

29. RG&E UFSAR; Chapter 15, Section 6, "Containment Pressure vs. Time for LOCA".

30. PCAQ 93-012, Dated 6/10/93.

31. Instrument Society of America ISA RP 67.04, "Methodologies for the Determination of Setpoints for Nuclear Safety Related Instrumentation".

32. CPI-TRIP-TEST-5.10: Reactor Protection System Trip Test/Calibration for Channel 1 (Red) Bistable Alarms.

33. DA-EE-95-109, Evaluation of 24 Month Instrument Surveillance Intervals.

3.0 Assumptions

1. The following inaccuracies for each component were assumed:

   Transmitter PT-945 drift 0.5% Full Scale will be used for a 30 month interval.

   Pressure effect is negligible.

   Indicator PI-945

readability	=	½ subdivision (Ref. No. 14)
	=	½ (1.2 psig)
	=	0.6 psig or 1% Full Scale
temperature effect	=	0

   Rack Equipment drift 1.0% for 30 months (Full Scale)

   Test Point TP-945: Resistor tolerance is ±1.0%

   Basis:
   The drift term of 0.5% for 30 months for the transmitter is conservative based on industry experience, and the fact drift is not a linear function accumulating most of the term in the first few weeks following calibration. An updated drift study was performed July 99. The result is bounded by the value already used in this calculation.

   Pressure effect on the transmitter is negligible since during a high energy line break in the Auxiliary Building, a concurrent accident inside containment does not need to be postulated. For an accident inside containment, the Auxiliary Building does not experience an increase in pressure.

   Refer to Reference 14; Section 10.5.2.3; readability has been selected from the guidance provided in this section.

   Rack equipment temperature effect is considered negligible since the indicator and rack equipment are located in a controlled environment.

   Rack equipment drift of ±1.0% is conservative. An updated drift study was performed July 99.The result is bounded by the value already used in this calculation.

   Test resistor tolerance of ±1.0% is conservative. The 10 OHM wire wound resistors have a manufacturers specified tolerance of ±0.1%.

2. Assume the power supply effect is negligible.

   Basis:
   Based on similar equipment specifications and on sound engineering judgement, the power supply effect is considered negligible. For the same reason, resistive elements in modules and conductors have negligible effect on loop accuracy as long as the load is within the range specified for the transmitter and power supply.

3. Assume the seismic effect of bistable PC-945A/B is ±1.0% Full Scale.

   Basis:
   Based on Reference 25, the results of seismic testing of a similar Foxboro alarm module, Alarm Model No. 63U, will be utilized.

4. The temperature effect on the test point resistors TP/945 is negligible.

   Basis
   The test point resistors are located in the Control & Relay Rooms which are controlled environments. The normal temperature in these rooms is normally 70°F to 77°F; therefore, any changes in resistance due to temperature are insignificant.

5. Assume temperature effect on the transmitter is a linear uncertainty function.

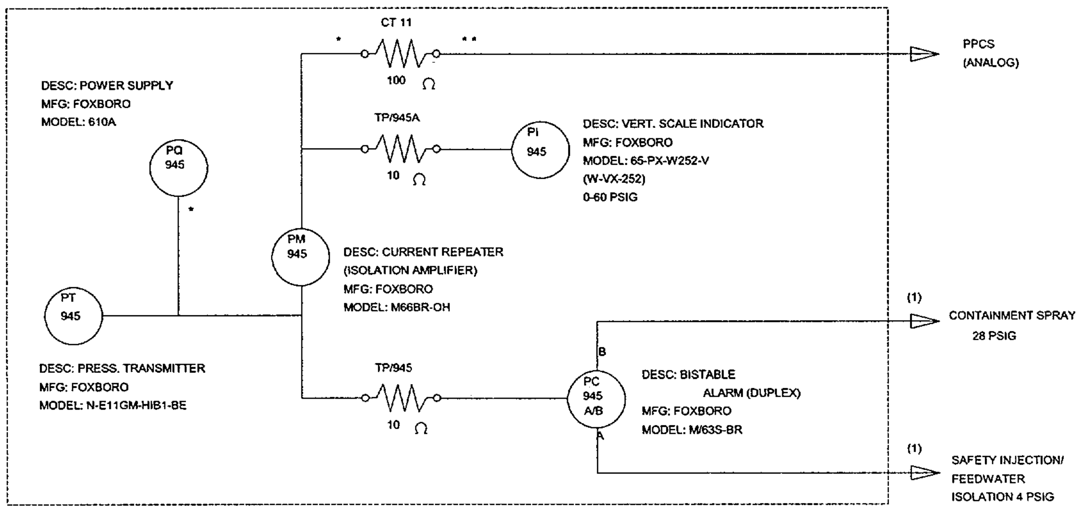
   Basis:
   Assumption is based on sound engineering judgement and previous experience.

6. The pressure transmitter is not exposed to a significant level of radiation during accident conditions. Therefore, although the transmitter is EQ qualified, minimal radiation uncertainty is required.

   Basis:
   As stated in Reference 20, transmitter PT-945 is located in an area with a negligible increase in total dose during accident conditions. Therefore, the dose is insignificant when compared to the nuclear qualification of E-10 series Foxboro transmitters which only considers doses greater than 10^4 Rads. However, for conservatism, from Reference 24, the greatest uncertainty for a Foxboro E11GM transmitter for a radiation dose of 1.2×10^4 will be utilized.

4.0 Block Diagram and Scope of Analysis

Ref# 15; Block Diagram CV P945



* DEVICE MAY NOT AFFECT LOOP ACCURACY

** DEVICE OUTPUT IS NOT WITHIN THE SCOPE OF ANALYSIS

NOTE:

(1) ENGINEERED SAFETY FEATURE ACTUATION RELAY LOGIC IS ASSUMED TO ACTUATE INSTANTANEOUSLY UPON ALARM OF BISTABLE PC 945 A/B. THE BISTABLE OUTPUT IS ASSUMED TO BE AN "IDEAL" STEP FUNCTION.

LEGEND

------------------- SCOPE BOUNDARY

CV P945 - BLOCK DIAGRAM

FIGURE 1

CVP945.DWG

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

This loop provides input to the Engineered Safety Features (ESF) Actuation System (Safeguards Actuation Signals) as follows:

At a containment pressure of 4 psig, bistable PC-945A provides one of three logic inputs to a two-out-of-three logic circuit. Initially, this results in the operators at the MCB receiving a containment HI pressure PC945A alarm, as well as a containment pressure channel alert. Upon receiving two of the three logic inputs to the ESF logic circuitry, the ESF logic performs the following:

- Satisfies a one-out-of-four "OR" gate and subsequent one-out-of-two "OR" gate initiating Feedwater Isolation; thereby, isolating the main feedwater system from the steam generators and tripping the main feedwater pumps.
- Initiates Reactor Trip logic by a one-out-of-four "OR" gate and subsequent one-out-of-two "OR" gate.
- Initiates Containment Isolation by a one-out-of-four "OR" gate and subsequent one-out-of-two "OR" gate and two-out-of-two "AND" gate.
- Satisfies a one-out-of-four "OR" gate and subsequent one-out-of-two "OR" gate initiating Safeguards Sequence logic.
- Starts the Emergency Diesel Generator by satisfying a one-out-of-four "OR" gate and subsequent one-out-of-two "OR" gate.
- Inputs one signal of the two required for isolation of the Main Steam Line System.
- Supplies one of the two inputs required to initiate the Non-Safeguards Isolation Valves circuitry.
- Satisfies a one-out-of-four "OR" gate and subsequent one-out-of-two "OR" gate and one-out-of-four "OR" gate required to initiate the Containment Ventilation Isolation logic.

If pressure increases to 28 psig or greater, bistable PC-945B will provide input to the containment spray logic resulting in the operators at the MCB receiving a containment HI-HI pressure alarm, as well as a containment pressure channel alert. The containment spray logic initiation consists of redundant sets of two-out-of-three "AND" gates for four channels (six instrument loops) of containment pressure inputs. These sets are arranged such that two of three inputs from both sets are required to initiate containment spray. This loop provides one signal to one of the sets of two-out-of-three logic.

4.1.2 Control

This loop does not perform any control functions.

4.1.3 Indication

Pressure channel 945 provides control room indication (PI-945) of the containment pressure during both normal plant operation and accident conditions for plant operating personnel. This function of the instrument loop is safety-related, and hence, included in this analysis.

Three alarms are provided to control room operators by this pressure loop. These alarms are "CONMT HI PRESS PC945A" at 4 psig, "CONMT HI-HI PRESS PC945B" at 28 psig, and "Containment Pressure Channel Alert" upon receipt of either of the two previously mentioned alarms.

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:

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

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

UFSAR Table 7.5-1 lists Containment Pressure Transmitter PT-945 as an NRC Category 1, Type A Variable. Type A Variables are those variables to be monitored that provide the primary information required to permit the control room operator to take specific manually controlled actions for which no automatic control is provided and that are required for safety systems to accomplish their safety function for design basis accident events. Category 1 variables require Class 1E power, seismic and nuclear qualifications as stated in Table 1 "Design and Qualification Criteria for Instrumentation" of Regulatory Guide 1.97.

Yes EQ (per the 10 CFR 50.49 list)

Pressure transmitter PT-945 is identified as requiring Environmental Qualification. The pressure transmitter is Foxboro nuclear qualified and has been environmentally qualified through a Foxboro Qualification test program (Reference 22).

_SC1_ Seismic Category (Seismic Class I/ Structural Integrity Only / NS)

As identified by RG 1.97, this component is a Category I variable and, as such, requires seismic qualification.

YES Technical Specifications

As identified by a review of Table 3.3.2-1 of the Technical Specifications, this instrument channel is Tech. Spec. related. This pressure channel is identified in Table 3.3.2-1 as Engineered Safety Feature Actuation Instrumentation. Per Reference 4, this instrument channel provides trip signals at nominal setpoint values of 4 psig for Safety Injection and 28 psig for Containment Spray Initiation. The Analytical Limits provided in the COLR for these functions are 6 psig for Safety Injection and 32.5 psig for Containment spray.

Yes UFSAR

Per a review of Sections 7.2, 7.3 and Tables 7.4-2 and 7.5-1 of the UFSAR, this pressure channel has been identified as providing logic inputs to Safety Injection and Containment spray.

Yes EOPs

Per a Review of the Emergency Operating Procedures Setpoint Database, there are four setpoints associated with containment pressure loops. The four setpoints are discussed below:

EOP NO.	Setpoint Value	Basis
M.3	4 psig	Maximum containment pressure for resetting the containment spray signal, including allowance for normal channel accuracy. This value is used to determine if containment spray pumps can be stopped to minimize RWST depletion and NaOH addition. If containment spray has been previously actuated, it is allowed to continue to operate until normal containment temperatures are established. This minimizes adverse environmental errors associated with high containment pressure. Adverse containment pressure is assumed to exist when containment pressure is greater than 4 psig. At containment pressures above 4 psig, the containment spray system, if previously actuated at 28 psig, will continue to operate during adverse containment conditions to provide spray for pressure mitigation, iodine removal and control of sump pH through sodium hydroxide addition, as described in UFSAR Chapters 6 and 15.
M.1	18 psig	This containment pressure setpoint is used to determine if main steamlines should be isolated.
M.2	28 psig	This setpoint is used to determine if Containment Spray should be actuated.
M.4	60 psig	Design pressure of the containment. This value is used as a red path entry condition to FR-Z.1, "Response to containment high Pressure".
M.13	4 psig	Containment pressure transition criteria between _Normal_ and _Adverse_ containment condition classifications. This value is used to determine when _Normal_ instrument uncertainties apply and when allowances for environmental effects must be considered.

5.1.2 Description of Process Parameter:

Under normal conditions:
(Reference 21)

Temperature:	60°F-120°F
Pressure:	0 psig
Humidity	50% Nominal
Radiation	Less than 1 rad/hr general area

Under test conditions:

Same as normal conditions.

Under accident conditions, including which accidents:

Temperature:	286°F (maximum)
Pressure:	60 psig (design)
Humidity	100%
Radiation	1.47×10^7 rads gamma 2.13×10^8 rads beta

5.1.3 Description of Limits

See Section 5.1.1 for a discussion on EOP setpoints.

5.2 Documenting the Environmental Conditions Associated With the Process Parameter

5.2.1 Identification of the Sensor Location:

Auxiliary Building, Intermediate Level, on the Containment Wall near SFP Heat exchanger (Reference 5)

5.2.2 Description of Environmental Service Conditions for the Sensor:

5.2.2.1 Normal

5.2.2.1.1 Normal Operation, Auxiliary Building - Intermediate Floor

Reference #21 UFSAR Table 3.11-1.

Temperature:	50°F to 104°F
Pressure:	Atmospheric
Humidity:	60% Nominal
Radiation:	Less than 10 mrad/hr general, with areas near residual heat removal piping less than 100 mrad/hr during shutdown operation.

5.2.2.1.2 During Calibration

Same as Normal Operation above.

5.2.2.2 Accident Auxiliary Building - LOCA (One train of ESF cooling operating)

Reference #21 UFSAR Table 3.11-1.

Temperature:	50°F to 104°F
Pressure:	Atmospheric
Humidity:	60% Nominal
Radiation:	Intermediate Floor: Near Bus 16 and MCC 1D and 1M; 900 rad total
Flooding:	8"

Accident Auxiliary Building - Based upon high-energy line breaks or moderate line breaks:

Reference #21 UFSAR Table 3.11-1.

Temperature:	150°F
Pressure:	0.1 psig
Humidity:	≈100%
Radiation:	N/A
Flooding:	0"

Accident Auxiliary Building - (LOCA or steam line break in containment) (No ESF cooling operating-maximum design temperature day)

Reference #21 UFSAR Table 3.11-1.

Temperature: Intermediate level - Peak of 103°F within 20 hours; cycles between 95°F and 103°F long term

5.2.3 Identification of Other Components Locations:
Reference #4 Calibration Procedure No. CPI-PRESS-945.

Instrument	Location
PQ-945 Power Supply	CR, RPS Channel 1, Rack R2
PC-945A/B Bistable	CR, RPS Channel 1, Rack R2
PM-945 Repeater	CR, RPS Channel 1, Rack R2
PI-945 Indicator	Main Control Board, Left Front Section

5.2.4 Description of Environmental Service Conditions for Other Components:

5.2.4.1 Normal

5.2.4.1.1 Normal Operation: Main Control Room, Relay Room

Reference #21 UFSAR Table 3.11-1.

Temperature: 50°F to 104°F (Usually 70°F to 78°F)
Pressure: Atmospheric
Humidity: 60% Nominal
Radiation: Negligible

5.2.4.1.2 During Calibration

Same as Normal Operation Above.

5.2.4.2 Accident, Main Control Room

Reference #21 UFSAR Table 3.11-1.

Temperature: Less than 104°F
Pressure: Atmospheric
Humidity: 60% Nominal
Radiation: Negligible
Flooding: N/A

6.0 Description of the Existing Instrument Loop Configuration

6.1 Summary of Process Measurement

6.1.1 Primary Element Information N/A

Manufacturer/Model No. N/A

Size N/A

Specifications N/A

Ref. # N/A Section N/A

Piping Configuration/Element Description

N/A

Ref. # N/A Section N/A

6.1.2 Sensor Information - Tag No. PT-945

6.1.2.1 Manufacturer/Model No. Foxboro N-E11GM-HIB1-BE Pressure Transmitter

Ref. # 11 Section N/A

6.1.2.2 Sensor Range -15 to 350 psi
Ref. 9 Sec. N/A
Sensor Span 60 psi
Ref. 5 Sec. N/A

6.1.3 Sensor Environmental Limits:

Description of Limits:

Press.	85 psi	Ref. 9	Sec. N/A
Temp.	0 to 420°F	Ref. 9	Sec. N/A
Radiation	2×10^8 TID	Ref. 9	Sec. N/A
Humidity	100%	Ref. 9	Sec. N/A

6.1.4 Associated Equipment Environmental Limits:
Reference the Appropriate EQ Block Diagram
EQ Block Diagram: N/A

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.
PM-945	Foxboro/M66BR-OH	11
PI-945	Westinghouse/VX-W252	11
PC-945A/B	Foxboro/63S-BR	11

6.2.1.2

Tag #	Input/Output	Ref.
PT-945	0-60 psig/ 10-50 mADC	5
PM-945	10-50 mADC / 10-50 mADC	4
PI-945	10-50 mADC / 0-60 psig	4

6.3 Scaling

6.3.1 Performing the Conversions:

Containment Pressure is sensed by pressure transmitter PT-945, located in the auxiliary building, via a sensing line routed through a containment penetration. The differential pressure transmitter converts 0 - 60 psig, as sensed by a diaphragm, into a 10 - 50 mADC signal. This signal is sent to a dual setpoint bistable which is used as an input to the Safeguards Actuation Signals logic circuitry.

Current repeater PM-945 is used to produce a second current loop which reproduces the signal generated by the pressure transmitter and sends the signal to a pressure indicator located in the main control room. Pressure indicator PI-945 receives the 10 - 50 mADC signal from the current repeater and converts it into a pressure indication of 0 - 60 psig.

7.0 Evaluation of Existing Instrument Loop Configuration Against Documented

Performance Requirements

7.1 Evaluating the Loop Configuration

7.1.1 Conformance with Design Basis Performance Requirements:

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

Explain: The range, location of readout, and classification of the loop are consistent with the design basis requirements for providing indication in the control room for accident monitoring, as well as to providing a logic input to the Safeguards Actuation circuitry. The power for this loop comes from Panel MQ-400A, Breaker 1, which is backed by the Diesel Generator and meets Regulatory Guide 1.97 requirements. The transmitter is qualified for nuclear service.

Safety Classification	- SR
RG 1.97	- Yes
EQ	- Yes
Seismic	- Yes
Tech. Spec.	- Yes
UFSAR	- Yes

7.1.2 Performance of Safety Related or Safety Significant Functions:

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

Explain: This loop provides two inputs to the Safeguards Actuation Signals logic. Upon receiving two out of three logic inputs for the "Hi" setpoint at 4 psig, a signal is generated for use in initiating Safety Injection. The second input at 28 psig is for the containment spray logic consisting of a two-out-three taken twice logic to initiate containment spray. Additionally, a containment pressure indicator is provided for the control room operators as a post-accident monitoring instrument. The design of this loop adequately ensures these functions are accomplished.

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?

Explain: The loop configuration shown in the calibration procedure is consistent with the applicable design drawings. Model numbers have been provided on the Precalculation Instrument Checklist.

7.2 Evaluating the Loop's Measurement Capability

7.2.1 Evaluating the Range/Span:

Is the calibrated span of the sensor and any indication devices (indicators, recorders, computer output points) broad enough to envelope all of the EOP action statements in Section 5.1.1 and the limits in Section 5.1.3?

Explain: The calibrated range of the pressure transmitter and indicator is 0 - 60 psig. As stated in Section 5.1.3, the design pressure of the containment is 60 psig; therefore, the calibrated span of the sensor and indicator envelope all EOP setpoints in Section 5.1.1 and the limits specified in Section 5.1.3.

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

Explain: See Section 7.2.1 above.

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: The operator action points stated in the EOPs are in psig which corresponds with the scale of the control room indicator and the setting of bistable PC-945A/B and are consistent with the applicable calibration procedures.

7.3 Evaluating the Calibration

7.3.1 Reviewing the Calibrated Components:

Is every applicable component and output calibrated?

Explain: Procedure CPI-PRESS-945 and CPI-PT-945 ensures the calibration of the applicable safety related components.

7.3.2 Reviewing the Primary Element:

The pressure channel contains no primary element.

Explain: N/A

7.3.3 Reviewing the Direction of Interest:

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

Explain: The calibration procedure ensures the calibration of all components in the direction of interest. The pressure transmitter, repeater and indicator are calibrated both upscale and downscale. The bistable is calibrated upscale for setting and checked downscale for resetting.

7.3.4 Evaluating the Scaling:

Are the scaling equations and constants described in Section 6.3 consistent with the existing system performance requirements?

Explain: The scaling equations and factors are consistent with the system performance requirements.

7.3.5 Evaluating 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 (See Section 9.9).

Explain: No head corrections are required for this loop.

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)*	N/A	N/A
Pressure Effect (Pe)	N/A	N/A
Radiation Effect (Re)	.41% Full Scale	Reference 20,24/ Assumption 6
Steam/Chem Spray (S/Ce)	N/A	N/A
Combined Random Accident Effect (CRAE) (per IEEE 323 tests)	N/A	N/A
Accident Bias(AB)	N/A	N/A

* The peak temperature in the Auxiliary Building for an accident inside containment is bounded by the normal design temperature of the building. This parameter is not required to be monitored for accident mitigation for a high energy line break inside the Auxiliary Building. Therefore, this term is not applicable.

8.1.2 Seismic Event

Seismic Effect	Uncertainty	Ref/Section
Pressure Transmitter PT-945	±1.0% Full Scale	Reference 24
Current Repeater PM-945	±0.2% Full Scale	Reference 25
Bistable PC-945A/B	±1.0% Full Scale	Reference 25/Assumption 3
Pressure Indicator PI-945	±1.7% Full Scale	Reference 26

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

Associated Equipment Accident Effects	Uncertainty	Ref/Section
Cable Leakage(Cl)	N/A	N/A
Splice Leakage(Sl)	N/A	N/A
Penetration Leakage(Pl)	N/A	N/A
Term Block Leakage(TBl)	N/A	N/A
Conduit Seal Leakage(CSl)	N/A	N/A

8.3 Determining the Components of Process Measurement Uncertainty (PMU):

8.3.1 Documenting the Components of Process Measurement Uncertainty (PMU)

N/A: This loop does not contain a primary element.

	Uncertainty	Ref/Section
Primary Element Accuracy(Pea)	N/A	N/A

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

For each component, identify the type of M&TE used for the calibration, the uncertainty attributed to the M&TE, and the associated reference/section numbers that provided the M&TE information.

Tag No Test Equipment/Model No.

PT-945 1) Hewlett-Packard/3466A Multimeter

Calibration of digital voltmeters per the requirements of TICP-4 is ±0.1% of input (full scale) plus 1 count (insignificant)

Accuracy	=	± .1% Full Scale (Reference 7)
Sce_1	=	± .1% Full Scale

PT-945 2) Deadweight Tester; 0-205 psig; 1/10 Head:

Accuracy	=	± .3 psig (Reference 8)
Sce_2	=	± .3/60 psig
Sce_2	=	± .50% Full Scale

PM-945 3) Two Hewlett-Packard/3466A Multimeters

Calibration of digital voltmeters per the requirements of TICP-4 is ±0.1% of input (full scale) plus 1 count (insignificant)

Accuracy	=	± .1% Full Scale
Rce_1	=	± .2% Full Scale

PC-945A/B 4) One Hewlett-Packard/3466A Multimeter

Calibration of digital voltmeters per the requirements of TICP-4 is ±0.1% of input (full scale) plus 1 count (insignificant)

Accuracy	=	± .1% Full Scale
Rce_2	=	± .1% Full Scale

TP/945 4) 10Ω Test Resistor TP/945 is used as a calibration point to convert the 10 - 50 mADC signal from the current generator into a 100 - 500 mVDC test point for monitoring. (Assumption 1)

Rce_3	=	± 1.0% Full Scale

PI-945 5) One Hewlett-Packard/3466A Multimeter

Calibration of digital voltmeters per the requirements of TICP-4 is ±0.1% of input (full scale) plus 1 count (insignificant)

Accuracy	=	± .1% Full Scale
Rce_4	=	± .1% Full Scale

TP/945A 6) 10Ω Test Resistor TP/945A is used as a calibration point to convert the 10 - 50 mADC signal from the current generator into a 100 - 500 mVDC test point for monitoring. (Assumption 1)

Rce_5	=	1.0% Full Scale

8.4.1.1 Determining the Calibration Uncertainties (M&TEU):(con't)

	Uncertainty	Ref/Section
Sensor Calibration Effect (Sce_1)	±0.1% Full Scale	This Calc./8.4
Sensor Calibration Effect (Sce_2)	±0.5% Full Scale	This Calc./8.4
Rack Equipment Calibration Effect (Rce_1) PM-945	±0.2% Full Scale	This Calc./8.4
Rack Equipment Calibration Effect (Rce_2) PC-945A/B	±0.1% Full Scale	This Calc./8.4
Rack Equipment Calibration Effect (Rce_3) TP/945	±1.0% Full Scale	This Calc./8.4
Rack Equipment Calibration Effect (Rce_4) PI-945	±0.1% Full Scale	This Calc./8.4
Rack Equipment Calibration Effect (Rce_5) TP/945A	±1.0% Full Scale	This Calc./8.4

8.5 Documenting Rack Equipment Uncertainty (REU)

	Uncertainty	Ref/Section
Rack Equipment Accuracy(Rea_1) PM-945	±0.6% Full Scale **	Reference 27
Rack Equipment Accuracy(Rea_2) PC-945	±0.6% Full Scale **	Reference 28
Rack Equipment Accuracy(Rea_3) PI-945	±1.5% Full Scale	Reference 12
Rack Temperature Effect(Rte)	Negligible	Assumption 1
Rack Power Supply Effect(Rpse)	Negligible	Assumption 2
Rack Miscellaneous Effect(Rme) (Readability)	±1.0% Full Scale	Reference 14/ 10.5.2.3

** Includes effect of Accuracy (0.5%) and Repeatability (0.1%).

8.6 Documenting Sensor Uncertainty (SU)

Sensor Temperature Effect

Ste = ±1% (ΔT Design Temp. of Bldg. / 110° F [Ref.24, Assumption 5])
Ste = ±.01 (27°F / 110°F)
Ste = ±.25% Full Scale

	Uncertainty	Ref/Section
Sensor Accuracy(Sa)	±.65% Full Scale ***	Reference 9
Sensor Static Pressure Effect(Sspe)	Negligible	Assumption 1
Sensor Temperature Effect (Ste)	±.25% Full Scale	Reference 24/ Assumption 5
Sensor Power Supply Effect (Spse)	Negligible	Assumption 2

*** Includes effect of Accuracy (0.5%) and Reproducibility (0.15%).

8.7 Documenting Drift Uncertainty (DU)

	Uncertainty	Ref/Section
Sensor Drift (Sd)	±0.5% Full Scale	Assumption 1
Rack Equipment Drift (Red)	±1.0% Full Scale	Assumption 1

8.8 Documenting Tolerance Uncertainty (TU)

	Uncertainty	Ref/Section
Sensor Tolerance (St)	±1.0% Full Scale	Reference 5
Rack Equipment Tolerance (Ret_1) PM-945	±1.0% Full Scale	Reference 4
Rack Equipment Tolerance (Ret_2) PC-945	±1.0% Full Scale	Reference 4
Rack Equipment Tolerance (Ret_3) PI-945	±2.0% Full Scale	Reference 4

9.0 Loop Uncertainty Evaluation

9.1 Process Measurement Uncertainty (PMU)

PMU = 0

9.2 Measurement and Test Equipment Uncertainty (M&TEU)

Indicator:

$M\&TEU = \pm[(Sce_1)^2 + (Sce_2)^2 + (Rce_1)^2 + (Rce_5)^2 + (Rce_4)^2]^{1/2}$

$M\&TEU = \pm[(.1)^2 + (.5)^2 + (.2)^2 + (1.0)^2 + (.1)^2]^{1/2}$

M&TEU = ±1.14% Full Scale

Bistable:

$M\&TEU = \pm[(Sce_1)^2 + (Sce_2)^2 + (Rce_2)^2 + (Rce_3)^2]^{1/2}$

$M\&TEU = \pm[(.1)^2 + (.5)^2 + (.1)^2 + (1.0)^2]^{1/2}$

M&TEU = ±1.13% Full Scale

9.3 Determining the Accident Environmental Uncertainties (AEU)

For Pipe Breaks:

$AEUp = [(Te)^2 + (Re)^2 + (Pe)^2 + (S/Ce)^2]^{1/2} \pm AB$

$AEUp = [(0)^2 + (.41)^2 + (0)^2 + (0)^2]^{1/2} \pm 0$

AEUp = ±.41% Full Scale

Seismic: Indicator

$AEUs = \pm[(Se_{sensor})^2 + (Se_{indicator})^2 + (Se_{I/I\ repeater})^2]^{1/2}$

$AEUs = \pm[(1.0)^2 + (1.7)^2 + (.2)^2]^{1/2}$

AEUs = ± 1.98% Full Scale

Seismic: Bistable

$AEUs = \pm[(Se_{sensor})^2 + (Se_{bistable})^2]^{1/2}$

$AEUs = \pm[(1.0)^2 + (1.0)^2]^{1/2}$

AEUs = ± 1.41% Full Scale

9.4 Accident Current Leakage Effect (CLU)

This Section is not applicable

CLU = Cl + Sl + Pl + TBl + CSl

CLU = 0

9.5 Rack Equipment Uncertainty (REU)

Indicator:

REU $= \pm[(Rea_1)^2 + (Rea_3)^2 + (Rme)^2]^{1/2}$

REU $= \pm[(.6)^2 + (1.5)^2 + (1.0)^2]^{1/2}$

REU = ± 1.9% Full Scale

Bistable:

REU $= \pm[(Rea_2)^2]^{1/2}$

REU $= \pm[(.6)^2]^{1/2}$

REU = ± .6% Full Scale

9.6 Sensor Uncertainty (SU)

Applies to Bistable and Indicator

SU $= \pm[(Sspe)^2 + (Ste)^2 + (Sa)^2]^{1/2}$

SU $= \pm[(0)^2 + (0.25)^2 + (.65)^2]^{1/2}$

SU = ±.70% Full Scale

9.7 Drift Uncertainty (DU)

Applies to Bistable and Indicator

DU $= \pm[(Sd)^2 + (Red)^2]^{1/2}$

DU $= \pm[(.5)^2 + (1.0)^2]^{1/2}$

DU = ±1.12% Full Scale

9.8 Tolerance Uncertainty (TU)

Indicator:

TU $= \pm[(St)^2 + (Ret_1)^2 + (Ret_3)^2]^{1/2}$

TU $= \pm[(1)^2 + (1)^2 + (2)^2]^{1/2}$

TU $= \pm 2.45\%$ Full Scale

Bistable:

TU $= \pm[(St)^2 + (Ret_2)^2]^{1/2}$

TU $= \pm[(1)^2 + (1)^2]^{1/2}$

TU $= \pm 1.41\%$ Full Scale

9.9 Calculating the Total Loop Uncertainties

TLU Normal Indicator:

$$TLU = CLU \pm(M\&TEU^2 + REU^2 + SU^2 + DU^2 + TU^2)^{1/2}$$

$$TLU = 0.0 \pm(1.14^2 + 1.90^2 + 0.70^2 + 1.12^2 + 2.45^2)^{1/2}$$

$$TLU = \pm(12.66)^{1/2}$$

$$TLU = \pm (3.56)\% \text{ Full Scale}$$

TLU Normal Bistable:

$$TLU = CLU \pm(M\&TEU^2 + REU^2 + SU^2 + DU^2 + TU^2)^{1/2}$$

$$TLU = 0.0 \pm(1.13^2 + 0.6^2 + 0.70^2 + 1.12^2 + 1.41^2)^{1/2}$$

$$TLU = \pm(5.37)^{1/2}$$

$$TLU = \pm (2.32)\% \text{ Full Scale}$$

TLU Accident Indicator:

$$TLU = CLU \pm(AEUp^2 + M\&TEU^2 + REU^2 + SU^2 + DU^2 + TU^2)^{1/2}$$

$$TLU = 0.0 \pm(.41^2 + 1.14^2 + 1.9^2 + 0.70^2 + 1.12^2 + 2.45^2)^{1/2}$$

$$TLU = \pm(12.8)^{1/2}$$

$$TLU = \pm (3.58)\% \text{ Full Scale}$$

TLU Accident Bistable:

$$TLU = CLU \pm(AEUp^2 + M\&TEU^2 + REU^2 + SU^2 + DU^2 + TU^2)^{1/2}$$

$$TLU = 0.0 \pm(.41^2 + 1.13^2 + 0.06^2 + 0.70^2 + 1.12^2 + 1.41^2 + 0.0^2)^{1/2}$$

$$TLU = \pm(5.54)^{1/2}$$

$$TLU = \pm (2.35)\% \text{ Full Scale}$$

TLU Seismic Indicator:

$$TLU = CLU \pm(AEUs^2 + M\&TEU^2 + REU^2 + SU^2 + DU^2 + TU^2)^{1/2}$$

$$TLU = 0.0 \pm(1.98^2 + 1.14^2 + 1.9^2 + 0.70^2 + 1.12^2 + 2.45^2)^{1/2}$$

$$TLU = \pm(16.6)^{1/2}$$

$$TLU = \pm (4.07)\% \text{ Full Scale}$$

TLU Seismic Bistable:

$$TLU = CLU \pm(AEUs^2 + M\&TEU^2 + REU^2 + SU^2 + DU^2 + TU^2)^{1/2}$$

$$TLU = 0.0 \pm(1.41^2 + 1.13^2 + 0.6^2 + 0.70^2 + 1.12^2 + 1.41^2)^{1/2}$$

$$TLU = \pm(7.36)^{1/2}$$

$$TLU = \pm (2.71)\% \text{ Full Scale}$$

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

TLUs = The Total Loop Uncertainty Seismic
TLUa = The Total Loop Uncertainty Accident
CLU = 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 (or any Bias)
M&TEU= Measurement and Test Equipment Uncertainty

End Device	Normal	Seismic TLU	Acc. TLU
PI-945	-3.56% (low)	-4.07% (low)	-3.58% (low)
	+3.56% (high)	+4.07% (high)	+3.58% (high)
PC-945	-2.32% (low)	-2.71% (low)	-2.35% (low)
	+2.32% (high)	+2.71% (high)	+2.35% (high)

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.

Tag No.	Reference Accuracy	Calibration Tolerance
PT-945	.65%	1.0%
PM-945	.60%	1.0%
PC-945A&B	.60%	1.0%
PI-945	1.5%	2.0%

10.0 Setpoint Evaluations

10.1 Assigning the Limits

For each instrument function, identify the associated limits and limit type.

Output Device	Limit Value	Type of Limit
PC-945A	6 psig	Analytic. Limit
PC-945B	32.5 psig	Analytic. 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.

EOP Setpoint M.13

EOP setpoint M.13 is used for the determination of the Containment Pressure transition criteria between Normal and Adverse containment condition classifications. This value is used to determine when Normal instrument uncertainties apply and when allowances for environmental effects must be considered.

The indicator uncertainty value is calculated as follows:

The transmitter, repeater and indicator calibration tolerances are greater than their accuracies, therefore, the instrument accuracies do not have to be considered when calculating the Total Loop Uncertainty (TLU). This is in accordance with ISA-RP67.04-Part II, 1994, section 6.2.6.2. Also, since the manufacturers tolerance on the test point resistor is +/-0.1%, a tolerance value of +/- 0.25% will be conservatively used.

TLU Accident Indicator:

$$TLU = CLU \pm(AEUp^2 + M\&TEU^2 + REU^2 + SU^2 + DU^2 + TU^2)^{1/2}$$

$$TLU = 0.0 \pm(.41^2 + 0.61^2 + 1.0^2 + 0.25^2 + 1.12^2 + 2.45^2)^{1/2}$$

$$TLU = \pm(8.85)^{1/2}$$

TLU = ± (2.98)% Full Scale

TLU = ± (0.0298) 60 psig = +/-1.79 psig

The M.13 basis specifies a containment temperature of 170 degrees Farenheit as the transition point from Normal to Adverse containment. This corresponds to a containment pressure of 5.6 psig. Subtracting the 1.79 psig uncertainty from the containment pressure channel results in 5.6 - 1.79 = 3.81 psig. Since the readability of indicator PI-945 is +/- 0.6 psig a value of 4 psig is acceptable for use in the EOP's.

EOP Setpoint M.3

Since the instrument uncertainty is accounted for in the analysis of the M.13 setpoint, it does not have to be considered again for the M.3 setpoint. Therefore, the M.3 setpoint of 4 psig is acceptable.

Safety Injection and Containment Spray Setpoints

The calculated (maximum acceptable) pressure setpoints for Safety Injection and Containment Spray are 6 psig and 32.5 psig respectively minus the total normal loop uncertainties (TLU). These values are based on the accident analysis values specified in the COLR. Analysis of these setpoints is provided below:

4 PSIG Trip for Safety Injection/Feedwater Isolation, etc.:

Calculated Setpoint = Limit - TLU (Normal)

= 6 psig - (0.0232 x 60) psig

= 6 psig - 1.39 psig

= 4.61 psig

The nominal 4 psig setpoint is less than the calculated setpoint (4.61 psig), therefore this setpoint is acceptable. This evaluation resolves PCAQ 93-012.

28 PSIG Trip for Containment Spray Initiation:

Calculated Setpoint = Limit - TLU (Normal)

= 32.5 psig - (0.0232 x 60) psig

= 32.5 psig - 1.39 psig

= 31.11 psig

The nominal 28 psig setpoint is less than the calculated (maximum acceptable) setpoint (31.12 psig) therefore, this setpoint is acceptable.

Output Device	Setpoint (INC / DEC)	Calculated Setpoint
PC-945A	4 psig (INC)	4.61 psig (INC)
PC-945B	28 psig (INC)	31.11 psig (INC)

10.3 Operability Determination of RTS and ESFAS Functions for ITS Tables 3.3.1-1 and 3.3.2-1

10.3.1 Discussion of Instrument Allowable Values and TLU:

In the foregoing sections of this Setpoint Analysis, the ability of the instrument channel to perform its required protective function (s) is verified: the total instrument loop uncertainty (TLU) is determined by identifying and accounting for all uncertainties and effects, starting with an evaluation of the measured process, continuing with the process sensor and signal conditioning and ending at the final output device. The TLU includes process measurement effects, instrument accuracies, drift, tolerances, environmental effects etc. The Nominal trip setpoint is the bistable setting at which actuation of a protective device is desired to occur.The analytical limit is the maximum trip setpoint assumed in the Ginna Station Accident Analysis. The Analytical Limit minus the TLU is the calculated setpoint. The calculated setpoint is the maximum value at which the Nominal setpoint would normally be allowed to be set. The Allowable Value is determined by subtracting (or adding depending on direction of interest) the COT uncertainty to the calculated setpoint. This methodology for determining the Allowable Value is consistent with ISA-67.04-Part II-1994, Figure 6, Method 3. A channel must be considered inoperable if the As Found bistable trip setpoint is not within its allowable value. Reference procedure EP-3-S-0504 Ginna Station Setpoint Methodology for a description of the setpoint methodology and definitions of terms.

10.3.2 Determination of Allowable Values:

Allowable Values will be based on combined instrument uncertainties associated with the quarterly channel operability test (COT). The COT for this channel is performed under CPI-TRIP-TEST-5.10 (Reference 32). The COT involves the following instrument loop components (Note: the loop power supply does not affect loop uncertainty per Assumption 3.2):

PC-945A/B:	Bistable
TP/945:	Test Point Resistor

Protective Functions: Safety Injection
Containment Spray

Component Uncertainties From Section 8.0:

Component	Uncertainty Type	Uncertainty Value
TP/945	Test Point Resistor	± 1.0% Full Scale
PC-945A/B	Accuracy	± 0.6% Full Scale
PC-945A/B	Drift	± 1.0% Full Scale
PC-945A/B	Calibration Tolerance	± 1.0% Full Scale
PC-945A/B	M&TE: DVM Accuracy	± 0.1% Full Scale

* COT Uncertainty does not include M&TE uncertainty.

COT Uncertainty = $(1^2 + .6^2 + 1^2 + 1^2)^{1/2}$ = ± 1.833% Full Scale
COT Uncertainty = .01833 x 60 psig = ± 1.1 psig

<u>Allowable Values for ITS Table 3.3.1-1:</u>

Safety Injection Allowable Value =

Analytical Limit - TLU + COT

Allowable Value = 6 - 1.39 + 1.1 = 5.71 psig

Containment Spray Allowable Value =

Analytical Limit - TLU + COT

Allowable Value = 32.5 - 1.39 + 1.1 = 32.21 psig

10.3.3 Determination of Total Instrument Uncertainties (TIUs):

TIUs will be based on combined individual instrument uncertainties associated with the Channel Calibration Tests. The Channel Calibration Tests for this channel are performed under CPI-PT-945 and CPI-PRESS-945 (References 4 and 5). The Channel Calibration Tests involve the following protective function instruments upstream of the components evaluated in Section 10.3.2:

PT-945 Pressure Transmitter

Protective Functions: Safety Injection
Containment Spray

Component Uncertainties From Section 8.0:

Component	Uncertainty Type	Uncertainty Value
PT-945	M&TE: DVM Accuracy	± 0.1% Full Scale
PT-945	M&TE: Deadweight Tester	± 0.5% Full Scale
PT-945	Accuracy	± 0.65% Full Scale
PT-945	Drift	± 0.5% Full Scale
PT-945	Calibration Tolerance	± 1.0% Full Scale
PT-945	Temperature Effect	± 0.25% Full Scale

$TIU = (.1^2 + .5^2 + .65^2 + .5^2 + 1^2 + .25^2)^{1/2} = \pm 1.41\%$ Full Scale

TIU for PT-945 = ± 1.41% Full Scale

From Section 10.3.2:

Note: The DVM Uncertainty must be added to the COT Uncertainty to calculate the TIU for bistable PC-945A/B.

$TIU = (1^2 + .6^2 + 1^2 + 1^2 + .1^2)^{1/2} = \pm 1.836\%$ Full Scale

TIU for PC-945A/B = ± 1.84% Full Scale

11.0 Conclusion

A review of the instrument loop performance requirements against the existing loop configuration for CV P945 was conducted by this evaluation. The results of this review determined the safety related pressure channel CV P945 and redundant channels P947 and P949 will provide satisfactory input to the Safety Injection and Containment Spray Initiation logic circuits. Additionally, pressure indicator PI-945 provides adequate indication for normal operation and accident monitoring for control room personnel.

A review of the adequacy of the calibration activities and calibration procedure CPI-PT-945, "Calibration of the Containment Pressure Transmitter", and calibration procedure CPI-PRESS-945, "Calibration of Containment Pressure Loop 945 Rack Instrumentation", was also conducted under this Instrument Loop Performance Evaluation. All applicable safety related components are adequately calibrated up and down scale using correct calibration techniques. (See Section 10.2 for discussion of bistable setpoints)

The normal indicator total loop uncertainty of ±3.56% means the indicated containment pressure could read 2.13 psig higher or lower than actual containment pressure. This indication is used primarily for trending the accident mitigation process; therefore, this uncertainty should not pose any operational concerns.

The normal bistable total loop uncertainty of ±2.32% means the 4 psig isolation trip signal could occur within the pressure range of 2.6 psig to 5.4 psig, and the containment spray signal could occur within the pressure range of 26.6 psig to 29.4 psig. Both of these ranges are within the Analytical Limit used in the Accident Analysis.

Allowable Setpoint values for ITS Setpoint Tables 3.3.1-1 and 3.3.2-1 and Total Instrument Uncertainties (TIUs) for instruments performing protective functions are determined in section 10.3.

PCAQ Resolution:

PCAQ 93-012 was issued on 6/10/93 and stated the following:

Per UFSAR Table 7.3-1, the maximum allowable pressure setpoint for Containment Pressure Bistable PC-945A is ≤ 5 psig. PC-945A actuates Safety Injection and Feedwater isolation. The actual calibrated setpoint for PC-945A is 4.0 psig. Under Ewr 5126, Setpoint Verification Project, Design Analysis DA-EE-92-041-21 concludes that a calibrated setpoint of ≤ 3.61 psig is required to account for instrument error and ensure that the 5 psig limit is not exceeded. Due to instrument uncertainty, the UFSAR maximum allowable Containment Pressure setpoint of $\leq$ 5 psig may be exceeded. Recommend reducing the calibration setpoint of PC-945A to 3.0 psig.

PCAQ 93-012 has been resolved per the following:

The analytical limits as specified in the COLR (the UFSAR has been revised and no longer specifies these limits) are 6.0 psig for Safety Injection and 32.5 psig for Containment spray. The calculated instrument uncertainty is within these limits.