GENERAL ELECTRIC INFORMATION

CLASS I

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TECHNICAL SPECIFICATION IMPROVEMENT ANALYSIS FOR THE REACTOR PROTECTION SYSTEM FOR QUAD CITIES STATION, UNIT 2

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CONTENTS OF THIS REPORT

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TABLE OF CONTENTS

1. INTRODUCTION

This report extends the generic study of modifying the technical specification requirements of the Reactor Protection System (RPS) on a plant specific basis for Quad Cities Station, Unit 2 (QC2). The generic study (Reference 1) provides a technical basis to modify the surveillance test frequencies and allowable out-of-service time of the RPS from the generic technical specifications. The generic study also provides additional analyses of various known different RPS configurations to support the application of the generic basis on a plant specific basis. The generic basis and the supporting analyses were utilized in this plant specific evaluation. The results of the plant specific evaluation for QC2 are presented herein.

2. EVALUATION METHOD

The plant specific evaluation of the modification of the surveillance test frequencies and allowable out-of-service time of the RPS was performed in the following steps:

a. Gather plant specific information on the RPS from Commonwealth Edison Company (ComEd). The information includes the following:

   (1) Elementary Diagram of the RPS and related systems.
   (2) RPS description such as plant Final Safety Analysis Report (UFSAR).
   (3) Technical specifications on the RPS.
   (4) RPS surveillance test procedures.

   The latest revision of Items 1, 2 and 3 above were supplied by ComEd. Item 4 above was provided by ComEd in the form of a questionnaire identifying the differences between the procedure used in the generic evaluation and the procedure used at QC2. Section I of the checklist in Appendix A was used to identify the data source of the plant specific information.

b. Construct the plant specific RPS configuration from the plant specific information. Questions "A" through "H" in Section II of the checklist were used for this process.

c. Compare the plant specific RPS configuration with the generic RPS configuration using the generic RPS elementary diagram, RPS description, technical specification requirements, and other generic inputs. Section III of the checklist was used for this process.

d. Classify the differences into three categories:

   (1) Obvious items which have no effect on the reliability of the RPS. Examples of these "no effect" items are component name differences, symbol differences, and other minor non-functional differences. Disposition of the obvious "no effect" items does not require additional analysis.

   (2) Potential differences which require considerable engineering judgment for disposition because of the functional differences. Examples of these potential differences are separate channels for manual scram as opposed to non-separate channel in the generic plant and dual redundant contacts per sensor relay in the applicable trip channels as opposed to a single set of contacts in the generic plant. The disposition of such items would require engineering assessment as shown in Appendix K of Reference 1.

   (3) Potential differences which require additional analyses to evaluate the effect on the RPS reliability. Examples of such potential differences are using HFA relays as opposed to using both Potter and Brumfield relays and Agastat relays in the generic evaluation. Disposition of these items would require additional analyses to compare with the generic results. These analyses are documented in Reference 1.

e. Compile a list of plant specific differences of Category (2) and (3).

f. Assess the reliability effect of the differences identified in Step (e) on the generic results. The results of the assessment are documented in Section III of the checklist.

g. Document the results of the plant specific evaluation.

The above seven step process is documented in Appendix A of this report.

3. RESULTS OF RPS EVALUATION

The results of the plant specific evaluation of the RPS for QC2 are documented in Appendix A of this report. The results show that the RPS configuration of QC2 has the following differences which are classified Category (2) or (3):

*The term "generic model" means the RPS configuration used in the generic analysis.

o.

4. SUMMARY AND CONCLUSIONS

A plant specific evaluation of modifying the surveillance test frequencies and allowable out-of-service time of the RPS from the technical specifications of QC2 has been performed. The evaluation utilized the generic basis and the additional analyses documented in Reference 1. The results indicated that the RPS configuration for QC2 has several differences compared to the RPS configuration in the generic evaluation. These differences and the assessment of their effects on the RPS failure frequency are shown in Appendix A. The analysis reported in Reference 1 shows that these differences would not significantly affect the improvement in plant safety due to the changes in the technical specifications based on the generic analysis. Therefore, the generic analysis in Reference 1 is applicable to QC2.

5. REFERENCES

(1) "Technical Specification Improvement Analyses for BWR Reactor Protection System," General Electric Company, NEDC-30851P-A, March 1988.

(2) "BWR Owners' Group Response to NRC Generic Letter 83-28, Item 4.5.3," General Electric Company, NEDC-30844A, March 1988.

APPENDIX A

RPS EVALUATION CHECKLIST FOR QUAD CITIES STATION, UNIT 2

Section I - RPS Plant Specific Data Source

Utility: Commonwealth Edison Company

Plant: Quad Cities Station, Unit 2

Source
Number

1. RPS Elementary 4E-2464, 5, 6, 7, 8, 9

2. RPS IED Not applicable

3. RPS MG Set Control System Elementary Not applicable

4. RPS Interconnection Scheme Elementary Not applicable

5. RPS Design Specification Not applicable

6. FSAR UFSAR Section 7.2

7. Technical Specifications Section 3 /4.1.A

8. Surveillance Test Procedure Checklist QDC 99-042

9. Others QCIS 0200-01, QCIS 0200-03, QCIS 0300-01, QCIS 0300-02, QCIS 0500-02, QCIS 0700-07, QCIS 1000-02, QCIS 1700-01, QCOS 0250-01, QCOS 0500-02, QCOS 0500-05, QOS 5600-01, QOS 5600-02

10. QC Station Test Procedures

Section II - RPS Configuration Data

A. RPS System	Data	Data* Source
1. Number of trip systems	2	(1)
2. Number of logic channels per trip system		
- For Automatic Scram	2	(1)
- For Manual Scram	1	(1)
3. Power supply source for each channel	MG Set	(6)
4. Operation mode		
- De-energize to trip	Yes	(6)
5. Logic arrangement		
- one-out-of-two twice	Yes	(1)
6. Electrical Protection Assemblies (EPAs)	Yes	(6)
7. Design requirement	IEEE-279	(6)

*The numbers shown in the Data Source column refer to the documents listed in Section I.

Section II - RPS Configuration Data

B. RPS Sensors

1. Identify the type, total number, and number per RPS channel for the following RPS sensors.

	Type	Total Number	Number/ RPS Channel	Data Source
- APRM	Analog	6[1]	2	(1)
- Turbine Stop Valve	Switch	4[2]	2	(1)
- Turbine Control Valve	Switch	8	2[3]	(1)
- MSIV Position	Switch	8	4	(1)
- MSL Radiation	Gamma Detector	4	1	(1)
- Level 8 (High Water Level)	N/A	N/A	N/A	(1)
- Level 3 (Low Water Level)	Analog	4	1	(1)
- SDV Level				
Type 1 (Analog)	dP	4	1[4]	(1)
Type 2 (Switch)	Thermal	4	1	(1)
- High Reactor Pressure	Switch	4	1	(1)
- High Drywell Pressure	Switch	4	1	(1)
- Manual Trip	Switch	2	1/Manual Channel	(1)
- Mode Switch Trip	Switch	1	1/Manual Channel	(1)
- Low Condenser Vacuum	Switch	4	1	(1)

(1) Two sensors shared between channels.
(2) Four sensors, eight switch contacts.
(3) One on low oil pressure, one on valve position.
(4) dP transmitter/trip unit also trips on failed instrumentation.

Section II - RPS Configuration Data

		Data Source
B.	RPS Sensors (Cont'd)	
2.	Turbine Stop Valve closure logic arrangement Closure of 3 out of 4 valves initiates scram	(6)
3.	Turbine Stop Valve closure monitoring Position switches	(6)
4.	Turbine Control Valve fast closure monitoring EHC Oil Pressure and Pressure at each Fast Acting Solenoid	(6)
5.	MSIV closure logic arrangement Isolation of 3 out of 4 steamlines initiates scram	(6)
6.	Diversity in SDV level sensors Yes, differential pressure and thermal switches	(6)
7.	Number of MSL 4	(6)
8.	List of available bypasses	(1)

- IRM Trip Bypass	Yes
- Noncoincident Neutron Monitoring System Trip Bypass	Yes
- RPV High Water Level RPS Trip Bypass	N/A
- Turbine Stop Valve RPS Trip Bypass	Yes
- Turbine Control Valve RPS Trip Bypass	Yes
- MSIV Closure RPS Trip Bypass	Yes
- SDV High Water Level Trip Bypass	Yes
- Reactor Mode Switch "Shutdown" mode Trip Bypass	Yes
- Condenser Low Vacuum	Yes

Section II - RPS Configuration Data

C. Sensor Relays	Data	Data Source
1. Types of relays	GE Type HFA	(10)
2. Number of pairs of contact per relay in the trip channel	2	(1)
3. List type of relay for each RPS sensor		(9)

	Potter & Brumfield	Agastat	HFA
- APRM			X
- Turbine Stop Valve			X
- Turbine Control Valve			X
- MSIV Position			X
- MSL Radiation			X
- Level 3 (Low Water Level)			X
- SDV Level			
Type 1 (Analog)			X
Type 2 (Switch)			X
- High Reactor Pressure			X
- High Drywell Pressure			X
- Manual Trip*			
- Mode Switch Trip*			
- Low Condenser Vacuum			X
- Level 8 (High Water Level)			N/A

* No relay, single contact of switch.

Section II - RPS Configuration Data

D. Scram Contactors	Data	Data Source
1. Type of scram contactors	GE Type CR105	(6)
2. Total number of scram contactors	8*	(1)
3. Number of scram contactors per channel	2	(1)

* The above 8 scram contactors are for the auto trip systems only. The manual scram channels have their own scram contactors (total of four contactors with two per channel).

Section II - RPS Configuration Data

E. Air Pilot Solenoid Valves	Data	Data Source
1. Number of solenoid valves per control rod drive	2	(6)
2. Number of solenoid operators per valve	1	(6)

Section II - RPS Configuration Data

F.	Backup Scram	Data	Data Source
1.	Type of scram contactors for backup scram valves	GE Type CR105	(6)
2.	Number of scram contactors per backup scram valve	6	(1)
3.	Same RPS scram contactors are used to actuate backup scram valves	Yes	(1)
4.	Operator mode - energized to trip	Yes	(1)
5.	Test requirement for backup scram valves	Not specified in Tech. Spec.	(7)

Section II - RPS Configuration Data

G. RPS Tech. Spec. Requirements	Data Source
1. Calibration Frequency for LPRM At least once per 2000 effective full power hours	(7)
2. Calibration frequency for trip units. Trip Unit - Once a month Transmitter - Once per 18 months	(7)
3. Frequency of Logic System Functional Tests Once per 18 months	(7)
4. Allowable time to place an inoperable channel or trip system in the tripped conditions when the number of operable channels is less than the required minimum operable channels per trip system. 1 hour	(7)
Exception to Item 4. 2 hours if placing the channel in the tripped condition would cause the trip function to occur.	(7)
6. Allowable time to place a trip system in the tripped conditions when the number of operable channels is less than the required minimum operable channels for both trip systems. 1 hour	(7)
7. Exception to Item 6 due to surveillance test. - 2 hours	(7)
8. Complete the Table on the following page.	

REACTOR PROTECTION SYSTEM INSTRUMENTATION REQUIREMENTS

Functional Unit	Channel Check		Channel Functional Test		Channel Calibration		Minimum Operable Channels Per Trip System	
	Generic Model	Plant Specific	Generic Model	Plant Specific	Generic Model	Plant Specific	Generic Model	Plant Specific
1. Average Power Range Monitor:								
a. Flow Biased Simulated Thermal Power - High	S,D	S/D	S/U,W	W	W,SA,R	W,SA	3	2
b. Neutron Flux - High	S	S	S/U,W	W	W,SA	W,SA	3	2
c. Inoperative	N/A	N/A	W	W	N/A	N/A	3	2
2. Reactor Vessel Steam Dome Pressure - High	S	N/A	M	M	R	Q	2	2
3. Reactor Vessel Water Level - Low, Level 3	S	D	M	M	R	E[(1)]	2	2
4. Reactor Vessel Water Level - High, Level 8	S	N/A	M	N/A	R	N/A	2	N/A
5. Main Steam Line Isolation Valve - Closure	N/A	N/A	M	M	R	E	4	4
6. Main Steam Line Radiation - High	S	S	M	M	R	E[(2)]	2	2
7. Drywell Pressure - High	S	N/A	M	M	R	Q	2	2
8. Main Condenser Vacuum - Low	N/A	N/A	N/A	M	N/A	Q	N/A	2

REACTOR PROTECTION SYSTEM INSTRUMENTATION REQUIREMENTS

Functional Unit	Channel Check		Channel Functional Test		Channel Calibration		Minimum Operable Channels Per Trip System	
	Generic Model	Plant Specific	Generic Model	Plant Specific	Generic Model	Plant Specific	Generic Model	Plant Specific
9. Scram Discharge Volume Water Level - High								
Type 1 - Analog[3]	S	N/A	M	Q	R	E	2	2
Type 2 - Switch[3]	N/A	N/A	M	Q	R	N/A	2	2
10. Turbine Stop Valve - Closure	N/A	N/A	M	M	R	E	4	4
11. Turbine Control Valve Fast Closure Valve Trip System Oil Pressure - Low	N/A	N/A	M	M	R	Q	2	2
12. Turbine Control Valve Fast Closure	N/A	N/A	N/A	M	N/A	E	N/A	2
13. Reactor Mode Switch Shutdown Position	N/A	N/A	R	E	N/A	N/A	2	1
14. Manual Scram	N/A	N/A	M	M	N/A	N/A	2	1

S = Shift
D = Daily
W = Weekly
S/U = Startup
M = Monthly
Q = Quarterly
R = Refueling Outage
N/A = Not Applicable
SA = Semiannually
E = 18 months

(1) Trip units are calibrated at least once per 31 days and transmitters are calibrated at the frequency identified in the table.

(2) A current source provides an instrument channel alignment every 3 month.

(3) For QC2, Type 1 sensor is a thermal indicator trip unit and Type 2 sensor is a differential pressure trip unit.

Section II - RPS Configuration Data (Cont'd)

H. RPS Surveillance Tests Procedure	Data Source
1. The following components are all tested as part of an individual channel functional test:	(8)

a. Individual channel sensor(s), e.g., Transmitters and Trip Units, switches, flux or radiation sensors.

b. Associated logic relay(s)

c. Associated scram contactors

List any plant specific differences from the above.

RESPONSE

a) In most cases yes - some radiation sensors are not part of a functional test.

b) During logic test procedure.

c) No testing as part of channel functional tests.

2. When an individual sensor channel is in test or repair, is associated logic channel tripped or is the sensor channel jumpered? State which of the two conditions applies to your plant. If any other condition exists in your plant, describe. (8)

RESPONSE

During functional testing, a test box is used to jumper the contacts in the logic channel. The test box also has a light to indicate the opening/closing of the sensor channel logic contacts.

Section II - RPS Configuration Data (Cont'd)

Data Source

H. RPS Surveillance Tests Procedure (Cont'd)

3. For those plants which do not place individual channels in a tripped condition during test or repair, it is assumed in the GE analysis that only the individual sensor and associated logic relay is placed in an inoperable condition during test or repair of the individual channel. If this assumption is not true for your plant, list the components (from sensor to scram contactors) which are placed in inoperable condition during test or repair. (8)

RESPONSE

Assumption is true with the test box installed.

4. The following number of individual scram contactor actuations are assumed in the GE analyses for each channel functional test: (8)

   a. APRM channel functional tests - zero (0) actuations per scram contactor pair in each trip logic channel.

   b. MSIV closure channel function tests - zero (0) actuations per scram contactor pair in each trip logic channel.

   c. Other channel functional tests - zero (0) actuation per scram contactor pair in each trip logic channel.

   List any differences from the above for your specific plant.

RESPONSE

Quad Cities Unit 2 uses a testing device known as a RPS Test Box. This test box consists of a 2.5V lamp in parallel with a 3 ohm 1% 10 watt resistor. This test box is connected in parallel to the HFA contacts in the Logic Subchannel for each sensor during functional testing. The Test Box is not used for Manual Scram, Mode Switch in Shutdown, MSIV, and Turbine Stop Valve Testing. The Test Box prevents that sensor from actuating the scram contactors in that RPS subchannel. This results in 0 (zero) scram contactor actuations due to Channel Functional testing

Section II - RPS Configuration Data (Cont'd)

H. RPS Surveillance Tests Procedure (Cont'd) — Data Source

of required RPS functions. It is noted that the scram contactors do get actuated on a monthly basis by MSIV Functional test procedure, but not by the MSIV functional test itself. An additional section at the end of the procedure uses the RPS Subchannel test switches to test logic channels A1, A2, B1, and B2. All of the Channel Functional Testing done on a monthly basis results in 1 (one) actuation of each scram contactor per month. The scram contactors used for Manual and Mode Switch in Shutdown are actuated 3 (three) times per Cycle.

5. Do plant procedures allow simultaneous inoperable conditions (failed condition) of diverse sensors in a given logic channel? (8)

RESPONSE

No, the above conditions are not allowed.

Section III - Assessed Reliability Effect of RPS Configuration Differences

BWR Generic Model	Plant Specific Difference	Assessed Reliability Effect
A. RPS System		
1. Generic model has two trip systems.	No difference	
2. Generic model has two logic channels per trip system for automatic scram.	No difference	
3. During operation, the trip systems are energized and trip when de-energized.	No difference	
4. The RPS logic is one-out-of-two twice, i.e., one out of two logic channels will trip an individual system and trip of both systems is required for scram.	No difference	
5. Generic model has Electrical Protection Assemblies (EPAs).	No difference	

Section III - Assessed Reliability Effect of RPS Configuration Differences

BWR Generic Model	Plant Specific Difference	Assessed Reliability Effect
6. Each RPS channel can be manually tripped from the Control Room using the manual scram circuits.	Separate channel for manual scram, but each auto-scram channel can be manually tripped by interrupting the power to the RPS.	
B. Sensors		
1. Generic model has Analog Trip Unit/ Transmitter for. pressure and level sensors.	Switches used for pressure sensors.	
2. Minimum number of sensors is one per RPS channel for each scram variable.	No difference	
3. Generic model has eight APRM monitors with two per RPS channel.	Six APRM monitors with two monitors shared by two channels.	
4. Stop Valve Closure trip logic is a reduced two-of-four required for trip.	No difference	
5. Stop Valve Closure is monitored by limit switches.	No difference	

Section III - Assessed Reliability Effect of RPS Configuration Differences

BWR Generic Model	Plant Specific Difference	Assessed Reliability Effect
6. Turbine Control Valve fast closure is monitored by control oil pressure.	Turbine control valve fast closure is monitored by two different types of pressure switches (pressure on each fast acting solenoid and low EHC fluid pressure).	
7. MSIV closure trip logic requires isolation of three out of four steam lines to scram.	No difference	
8. Generic model has a level 8 (High Reactor Water Level) Trip.	No Level 8 trip	
9. Generic model has diverse Scram Discharge Volume (SDV) level sensors.	No difference	
10. Generic model has 4 main steamlines.	No difference	
11. Generic model does not have a direct scram on low condenser vacuum.	Plant has a direct scram on low condenser vacuum.	

Section III - Assessed Reliability Effect of RPS Configuration Differences

BWR Generic Model	Plant Specific Difference	Assessed Reliability Effect
C. Sensor Relays		
1. For all transients there are at least two scram variables with different type logic relays (either Agastat or Potter & Brumfield).	All scram variables have HFA type relays.	
2. Each sensor relay has a single pair of contacts in the applicable trip channel.	Each sensor has two pairs of contacts in the applicable trip channel.	
The generic model has a switch that actuates a trip relay in the manual and mode switch circuits.	QC 2 has a single contact of a switch to trip the manual and mode switch circuits.	
D. Scram Contactors		
1. All scram contactors are one type (GE Type CR105).	No difference	
2. Eight scram contactors (two per RPS channel) perform the trip function.	No difference	
E. Air Pilot Solenoid Valves		
1. Generic model has dual solenoid operators for each individual HCU air pilot valve. De-energizing both solenoids results in a scram of the individual control rod.	Two HCU valves with single solenoid operators. Tripping of both valves is required for individual control rod scram.	

Section III - Assessed Reliability Effect of RPS Configuration Differences

BWR Generic Model	Plant Specific Difference	Assessed Reliability Effect
F. Backup Scram		
1. Actuation of backup scram valves are controlled by same output scram contactors as RPS.	Backup scram valves actuations are controlled by scram contactors from both the manual and auto-scram system.	
2. Trip logic for backup scram valves is an energized to trip versus de-energized to trip for individual HCU air pilot valves.	No difference	
3. Backup scram valves are tested during shutdown at least once per 18 months.	Test requirements for the backup scram valves are not specified in the plant Technical Specifications. However, the backup scram valves are tested at least once every 18 months as part of the IST program.	

Section III - Assessed Reliability Effect of RPS Configuration Differences

BWR Generic Model	Plant Specific Difference	Assessed Reliability Effect
G. Technical Specifications and Surveillance Test Procedure:		
1. Generic model uses BWR6 Standard Technical Specifications which requires: Allowable out-of-service time: 1 hr Test time: 2 hrs Test frequency: 1W for APRM 1M for others Calibration frequency: 1M for trip units R for transmitters	See Section II.G of this Appendix for plant specific differences.	
2. Generic model assumes two actuations per scram contactor pair in each trip logic channel for the APRM channel functional test and four actuations for the MSIV Closure Channel functional tests, and one actuation for the other scram variables. This leads to 272 total actuations of each scram contactor per year.	The scram contactors in the auto scram circuit are tested once per month (12 times per year).	

Section III - Assessed Reliability Effect of RPS Configuration Differences

BWR Generic Model	Plant Specific Difference	Assessed Reliability Effect
G. Technical Specifications and Surveillance Test Procedure: (Cont'd)		
Generic model assumes weekly testing of scram contactors in the auto scram circuit.	The scram contactors in the auto scram circuit are tested once per month (12 times per year).	