ENCLOSURE 2

MFN 05-151

Licensing Topical Reports – Non Proprietary Versions

- NEDO-33232, Revision 1, *Safety System Logic and Control Reactor Trip and Isolation Function (SSLC/RTIF) System Performance Specification*, December, 2005
- NEDO-33233, Revision 1, *Safety System Logic and Control Reactor Trip and Isolation Function (SSLC/RTIF) – Hardware and Software Specification*, December, 2005
- NEDO-33234, Revision 1, *Reactor Trip and Isolation Function Digital Trip Module Function Software Design Specification*, December, 2005

GE Energy
Nuclear

NEDO-33232
Revision 1
Class I
eDRF 0000-0048-8110
December 2005

LICENSING TOPICAL REPORT

SAFETY SYSTEM LOGIC AND CONTROL REACTOR TRIP AND ISOLATION FUNCTION (SSLC/RTIF) SYSTEM PERFORMANCE SPECIFICATION

NON PROPRIETARY INFORMATION NOTICE

This is the non proprietary version of NEDE-33232P, Revision 1, which has the proprietary information extracted. Information which has removed is indicated by open and closed double brackets as follows: [[ ]].

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

PLEASE READ CAREFULLY

The information contained in this document is furnished for the purpose of supporting the NRC review of the certification of the ESBWR, with the information here being used as ABWR supporting reference. The only undertakings of General Electric Company with respect to information in this document are contained in contracts between General Electric Company and any participating utilities, and nothing contained in this document shall be construed as changing those contracts. The use of this information by anyone other than that for which it is intended is not authorized; and with respect to **any unauthorized use**, General Electric Company makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

Table of Contents

1 SCOPE

This specification defines the design and performance characteristics and application limits for the ABWR NUMAC Reactor Trip and Isolation Function (RTIF) System. The purpose of this document is to identify and document system level requirements involving multiple instruments, not to duplicate the individual instrument requirements as defined in the Instrument Performance Specifications or data transfer requirements as defined in the protocol specifications. The focus of this document is the system requirements for the software. Descriptions and requirements for the hardware design of the RTIF instruments can be found in the individual Instrument Performance Specifications, listed in Section 2.2.1.

Included in this document are definitions of the interfaces that are external to the RTIF system, logic processing required of each instrument to implement the system functions and the internal interfaces and data flow between RTIF instruments. System timing is also discussed as is an overview of the functions required of the individual instruments. Specific processing is defined in the relevant Instrument Performance Specifications.

Section 3 of this document includes a discussion of the overall system operation and is not requirements focused. Much of this section is to provide background information and clarification to the engineers responsible for individual instruments. Section 4 contains the requirements that apply to the entire system.

The focus of this specification is the primary trip path in RTIF, as defined in Section 4, and the instruments directly involved in determining the trip state. Those instruments are the Remote Multiplexing Unit (RMU), the Digital Trip Module (DTM), the Trip Logic Unit (TLU) and the Communications Interface Module (CIM). Other RTIF instruments are mentioned in this document only for information and a detailed analysis of the logic relating to these other instruments, specifically the OLUs and the Load Drivers, is outside the scope of this specification.

2 REQUIREMENTS AND SUPPORTING DOCUMENTS

2.1 SYSTEM APPLICATION REQUIREMENTS

The ABWR NUMAC Reactor Trip and Isolation Function (RTIF) System, is designed to meet the requirements specified in the following documents:

a) RTIF Hardware/Software Specification, 1C74-4710-0001

b) SSLC/RTIF System Block Diagram, 105E2812

c) Reactor Protection System Logic, 1C71-K1000

d) Leak Detection and Isolation System Logic, 1C73-K1000

e) SSLC Logic, 1C74-K1000

f) Main Steam System Logic, 1B21-K1000

g) Ctrl Rod Drive System Logic, 1C12-K1000

h) Reactor Bldg System Logic, 1T41-K1000

i) Cntmt Monitoring Logic, 1T62-K1000

j) SSLC/RTIF System Elementary Diagram, 105E3586

k) CMS Hardware/Software Specification, 1T62-4710-0001

2.2 SUPPORTING DOCUMENTS

The following specifications form an extension of this specification:

a) RTIF LDU User's Manual	26A6018
b) RTIF FDDI Communication Protocol Specification	26A5267
c) RTIF Trip Logic Unit Performance Specification	26A5260
d) RTIF Remote Multiplexing Unit Performance Specification	26A5262
e) RTIF Bypass Unit Performance Specification	26A5261
f) RTIF Digital Trip Module Performance Specification	26A5233
g) MSIV Output Logic Unit Performance Specification	26A5913
h) RTIF RPS Output Logic Unit Performance Specification	26A5933
i) RPS/MSIV Load Driver Performance Specification	26A5341
j) RTIF Communication Interface Module Performance Specification	26A5265
k) SSLC/RTIF Local Display Unit (LDU) Performance Specification	26A5998
l) SSLC/RTIF CIM to MVD Communication Protocol Specification	26A5268
m) RTIF RS-485 Communication Protocol Specification	26A5264
RTIF OLU/LD Module Communication Protocol Specification	26A5494

2.3 DESIGN REQUIREMENTS – GE DOCUMENTS

a) NUMAC Requirements Specification	23A5082
b) NUMAC Software Management Plan	23A5162
c) ABWR DCIS Software Management Plan	0A51-4500

3 DESCRIPTION

3.1 GENERAL DESCRIPTION

The Safety System Logic and Control (SSLC) Reactor Trip and Isolation Functions (RTIF) are part of the overall ABWR plant operation.

3.1.1 Purpose of RTIF

This system performs the Reactor Protection System (RPS) functions and the Main Steam Isolation Valve (MSIV) Closure functions of the plant. Additionally, it performs the Suppression Pool Temperature Monitoring (SPTM) of the SSLC system.

Bypass handling, SSLC surveillance and self-test functions are also a part of this system.

3.1.1.1 RPS Auto SCRAM

A primary responsibility of the RTIF system is to produce the Reactor Protection System Division Auto Scram signal. This "trip" signal is based on sensor inputs to the RMU and DTM instruments, operator entered setpoints and exclusionary bypass and control logic.

3.1.1.2 MSIV Auto Isolation

A primary responsibility of the RTIF system is to produce the Main Steam Isolation Valve Division Auto Isolation signal. This "trip" signal is based on sensor inputs to the RMU and DTM instruments, operator entered setpoints and exclusionary bypass and control logic.

3.1.1.3 Data to External Systems

The RTIF is also responsible for providing necessary data to external systems; safety and non-safety. In addition to data transmitted directly as digital or analog outputs, considerable data is provided to the 1E display and ESF CIM and the Multi-Vendor Data Acquisition System (MVD)/Personal Computer Multi-Vendor Data Acquisition System (PC-MVD) as described in references 2.2l) and 2.2m). This interface is via the Communications Interface Module (CIM) as described in section 3.2.2.4, "Communications Interface Module (CIM)".

[[

]]

3.1.2 Relationship to Logic Diagrams

The designated input for the RTIF development process, according to reference 2.3c), is reference 2.1a), "RTIF Hardware/Software Specification, 1C74-4710-0001 . However, much of the actual logic required for implementation is defined only in the Logic Diagrams as listed in references 2.1c) through 2.1i). The logic diagrams use the "assertive low" logic convention where the Logic 1 state of a signal represents the Not Tripped state and a Logic 0 represents the Tripped state. Should power fail, the logic will revert to the tripped state ("fail safe"). For RTIF implementation, software development is based on Logic 1 state representing an event, in this case the Tripped state. The safe state handling remains the same.

In order to ensure that the software developed in positive logic is a true representation of the Logic Diagrams, this document translates the Logic Diagrams to provide an equivalent positive logic requirement for each trip signal.

Several general statements relating to the logic can be made:

- Most inversions shown in the logic on RTIF Trip signals going to the CIM are not required in software. [[
  ]]
- The 3 out of 4 voting called for in the Logic Diagrams looks for 3 of the 4 input signals to be untripped in order to produce an untripped output as described in the logic diagrams. [[
  ]]
- [[
  ]]

3.1.3 State Handling

[[

-]]

3.2 SYSTEM DESCRIPTION

This system is a collection of instruments that operate together to accomplish the functions described in section 3.1.1. While the instruments work together and share data, they operate independently, so that a failure in one instrument will not impact the operation of another.

[[

]]

3.2.1 Defense in Depth

The RTIF/SSLC consists of four safety divisions, each one operating independently. To a large extent, the safety divisions are identical, providing a system of checks to ensure that a failure in one division will not adversely impact the trip output of the system.

Each RMU/DTM pair receives and evaluates signals from its home division only. However, the trip outputs of the DTM are sent to all four TLUs (the TLU in its home division and the TLUs in the remaining three divisions) for voting of the trip signals. The TLU evaluates the trips from the DTM in its home division and the trips from the remaining three divisions and produces a single "Divisional Trip" for each input that is then evaluated to produce the Divisional RPS Auto SCRAM Trip or Divisional MSIV Auto Isolation Trip (depending on the input) as described in section 4.2.1, "Two-out-of-four Voting". The TLU then provides this divisional signal to the appropriate OLU in its home division. Once evaluated, the signal is provided by the OLU to the corresponding Load Drivers.

The system is designed such that a failure of one division will not prevent a trip or cause a false trip.

3.2.2 Instrument Description

3.2.2.1 Remote Multiplexing Unit (RMU)

3.2.2.1.1 Instrument Purpose

The Remote Multiplexing Unit (RMU) in the RTIF system that performs the function of collecting sensor inputs in the Reactor Building for a safety division and applying calibration and filtering to the sensor data. Additional processing takes place on the Suppression Pool Temperature Monitoring (SPTM) inputs. [[

]]

3.2.2.1.2 RMU-DTM Relationship

The RMU communicates only with the DTM in its own safety division. The DTM is responsible for providing all data supplied by the RMU and the RMU status to other instruments in the RTIF/SSLC subsystem as required.

3.2.2.1.3 Display

The RMU has a nonsafety-related dedicated Local Display Unit (LDU) and a safety-related Electro-luminescent Display (ELD). [[

]]

3.2.2.2 Digital Trip Module (DTM)

3.2.2.2.1 Instrument Purpose

The primary function of the Digital Trip Module (DTM) in the RTIF system is to convert inputs for a safety division to engineering units, compare data to user entered set points and determine and report trip conditions. [[

]]

All data collected, directly and from the RMU, and the result of trip determination are provided to the other instruments in the RTIF system.

3.2.2.2.2 RMU-DTM Relationship

The DTM is responsible for monitoring the status of the RMU and providing RMU status and input information to the other instruments in the RTIF/SSLC subsystem as required.

3.2.2.2.3 Display

User communication with the DTM is accomplished via the RTIF Panel nonsafety-related Local Display Unit (LDU) and the safety-related Electro-luminescent Display (ELD). [[

]]

3.2.2.3 Trip Logic Unit (TLU)

3.2.2.3.1 Instrument Purpose

The Trip Logic Unit (TLU) in the RTIF system performs the primary function of determining the trip state of the two primary system trips; RPS Auto SCRAM and MSIV Isolation. The TLU receives trip data from the DTMs in all four safety divisions, performs the two-out-of-four voting (as described in section 4.2.1, "Two-out-of-four Voting") and bypass handling to produce the primary systems trips, then initiates the trip action by providing the trip requirement to the MSIV and RPS OLUs.

[[

]]

3.2.2.3.2 Display

User communication with the TLU is accomplished via the RTIF panel Local Display Unit (LDU). The LDU is used to perform any required calibration and display current status of the TLU and the trip state.

3.2.2.4 Communications Interface Module (CIM)

3.2.2.4.1 Instrument Purpose

The CIM is the divisional communications hub for the RTIF system, providing RTIF data to external systems for display and processing. Data is provided to the CIM directly from all instruments, except the RMU, which provides information via the DTM, for retransmission to the MVD and 1E displays and to other Safety Systems. Additionally, the CIM monitors and reports the overall RTIF system health for its home division.

3.2.2.4.2 Display

User communication with the CIM is accomplished via the RTIF panel Local Display Unit (LDU). The LDU is used to perform any required calibration and display current status of the CIM.

3.2.2.5 Output Logic Unit (OLU)

There are two types of OLUs: the Main Steam Isolation Valve (MSIV OLU) and the Reactor Protection Systems (RPS) OLU. The two units perform different functions.

3.2.2.5.1 MSIV OLU Instrument Purpose

The MSIV OLU acquires the MSIV Auto Isolation Trip signal from the TLU of the same division to generate the "Auto Isolation" output signals to the Load Drivers for actuation of the MSIVs. [[

]]

3.2.2.5.2 RPS OLU Instrument Purpose

The RPS OLU acquires the RPS Auto SCRAM Trip signal from the TLU of the same division to generate the "Auto SCRAM" output signals to the Load Drivers to interrupt electrical power to the scram solenoids. [[

]]

3.2.2.6 Load Driver (LD)

There are two types of Load Driver assemblies; MSIV and RPS.

3.2.2.6.1 MSIV Load Driver Instrument Purpose

The MSIV Load Driver assemblies receive the Auto Isolation signals from each of the divisional MSIV OLUs, perform the MSIV two-out-of-four output trip logic and initiate auto isolation on all four main steam lines, if required, by interrupting the current to the Inboard or Outboard (as appropriate) MSIV solenoids.

3.2.2.6.2 RPS Load Driver Instrument Purpose

The RPS Load Driver assemblies receive the Auto SCRAM signal from each of the divisional RPS OLUs, perform the RPS two-out-of-four output trip logic and initiate auto SCRAM on all four SCRAM groups, if required, by interrupting the current to the scram solenoids of the HCUs.

3.2.2.7 Bypass Unit (BPU)

There is one BPU per safety division that allows for manual bypass of the SSLC/RTIF functions in that safety division.

3.2.2.7.1 Instrument Purpose

The BPU reads the switch position for the Channel-Of-Sensors Bypass, TLU output bypass, MSL Isolation Special Bypass, and ATWS Logic Output Bypass, processes the inputs and retransmits the switch status as applied to its home division to the appropriate equipment [[

]]

4 REQUIREMENTS

4.1 TIMING OVERVIEW

The RTIF System is designed to provide SCRAM and Isolation trip signals rapidly enough to allow completion of an RPS SCRAM or MSIV Isolation trip (Load Drivers De-energized) actuation within the specified "Maximum Allowed Time to Trip" after a sensor input to the RMU or DTM has reached a trip level. The "Maximum Allowed Time to Trip" for each sensor input is specified in reference 2.1a) "RTIF Hardware/Software Specification, 1C74-4710-0001".

[[

]]

[[

]]

4.2 GENERAL DATA PROCESSING

The electrical and conversion processing, including filtering requirements and valid data ranges, required for each input in each instrument is well defined in the individual instrument IPSs. This section is concerned with the logical processing required i.e. trip outputs produced by each instrument, the timing of those outputs and the consequences of invalid data on the final result output. [[

[1] The DTM and TLU do directly receive some signals that feed the trip.

]]

Sections 4.3 and 4.4 describe the logic working backwards starting from the two trips that are the primary outputs from the RTIF system sent to the MSIV and RPS OLUs from the TLUs.

Section 4.5 describes other signals that do not flow into the two primary outputs. These signals may be required between instruments or may be provided for use by systems external to RTIF. The flow of each of these special signals is defined in the same manner as those used to create the primary trips.

No output to internal displays is discussed however any signal or calculated value, trip or otherwise, that leaves the RTIF system is identified along with the RTIF instrument with reporting responsibility. This includes all signals destined for the 1E display and the MVD.

The lowest level inputs (signals entering the RTIF system) are designated by a diamond bullet (◆) and the final outputs (signals leaving the RTIF system) are identified by an asterisk (✱). While logic internal to each instrument is discussed where appropriate, for testing purposes only the lowest level inputs and the final outputs are important.

[[

]]

4.2.1 Two-out-of-four Voting

The two-out-of-four voting performed by the TLU to produce the divisional trips described later in this section functions as follows:

- The output of each two-out-of-four voter is tripped when the corresponding trip inputs from at least two of the four divisions are in the tripped state OR
- The Channel Sensors from one safety division are bypassed, in which case the output is tripped when two of the three remaining divisions are in a tripped state.

4.2.1.1 Channel Of Sensors Bypass (Logic Diagram 1C74-K1001)

The Channel of Sensors Bypass is applied to the inputs to the two-out-of-four voting logic. This is a joystick type switch read by the BPU and sent to the TLU for use. There are five possible positions, equating to each of the four divisions and a No-Bypass position with only one position allowed at a time. If no valid mode is selected, the input will be treated as "faulted".

[[

]]

[[

]]

4.3 RPS AUTO SCRAM TRIP (LOGIC DIAGRAM 1C71-K1033)

As discussed in Section 3.1.1.1, "RPS Auto SCRAM", one of the primary requirements in the RTIF System is to produce and propagate the Reactor Protection System Automatic SCRAM Trip.

This trip is the result of the logical OR'ing of the inputs described below. That is, if any of these inputs is TRUE (i.e. a tripped condition exists), then the RPS Auto SCRAM Trip is TRUE. The logic processing is performed by the TLU instrument.

[[

]]

4.3.1 Div. RPV Narrow Range Water Level Low Trip (Logic Diagram 1C71-K1009)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU, based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). If the output of the two-out-of-four voting is tripped, the RPS Auto SCRAM Trip is tripped. All conditions that can cause this value to be TRUE will result in a RPS Auto SCRAM Trip.

[[

]]

4.3.1.1 RPV Narrow Range Water Level Low Trip and Channel Sensors Not Bypassed (Logic Diagram 1C71-K1009)

The trip signal received from the DTM in safety division I and the channel of sensors bypass for safety division I are combined logically so that the output is tripped if the water level is low and the channel A sensors are not bypassed. This logic in performed by the TLU.

[[

]]

4.3.1.1.1 RPV Narrow Range Water Level Low Trip (Logic Diagram 1C71-K1001)

This is the trip signal sent from the DTM to all four divisional TLUs. The logic that produces this trip is performed by the DTM. This is a downscale trip. The output is tripped when the input signal in engineering units, RPV Narrow Range Water Level, is less than or equal to the setpoint value that has been entered by the user.

[[

]]

4.3.2 Div. RPV Dome Pressure High Trip (Logic Diagram 1C71-K1009)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). If the output of the two-out-of-four voting is tripped, the RPS Auto SCRAM Trip is tripped. All conditions that can cause this value to be TRUE will result in a RPS Auto SCRAM Trip.

[[

]]

4.3.2.1 RPV Dome Pressure High Trip and Channel Sensors Not Bypassed (Logic Diagram 1C71-K1009)

The trip signal received from the DTM in safety division I and the channel of sensors bypass for safety division I are combined logically so that the output is tripped if the pressure is high and the channel A sensors are not bypassed. This logic in performed by the TLU.

[[

]]

4.3.2.1.1 RPV Dome Pressure High Trip (Logic Diagram 1C71-K1001)

This is the trip signal sent from the DTM to all four divisional TLUs. The logic that produces this trip is performed by the DTM. This is an upscale trip. The output is tripped when the input signal in engineering units, RPV Dome Pressure, is greater than or equal to the setpoint value that has been entered by the user.

[[

]]

◆ **RPV Dome Pressure (Logic Diagram 1B21-K1002)**

This signal is sent from the RMU to the DTM where it is converted to engineering units. If the signal in the RMU is out of processing range, an "Invalid Data" indicator is sent to the DTM. If the converted data is out of range, the data is declared invalid.

4.3.3 Div. Drywell Pressure High Trip (Logic Diagram 1C71-K1013)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). If the output of the two-out-of-four voting is tripped, the RPS Auto SCRAM Trip is tripped. [[
]]

[[

]]

4.3.3.1 Drywell Pressure High Trip and Channel Sensors Not Bypassed (Logic Diagram 1C71-K1013)

The trip signal received from the DTM in safety division I and the channel of sensors bypass for safety division I are combined logically so that the output is tripped if the pressure is high and the channel A sensors are not bypassed. This logic in performed by the TLU.

[[

]]

4.3.3.1.1 Drywell Pressure High Trip (Logic Diagram 1C71-K1001)

This is the trip signal sent from the DTM to all four divisional TLUs. The logic that produces this trip is performed by the DTM. This is an upscale trip. The output is tripped when the input signal in engineering units, Drywell Pressure, is greater than or equal to the setpoint value that has been entered by the user.

[[

]]

◆ **Drywell Pressure (Logic Diagram 1T62-K1025)**

This signal is sent from the RMU to the DTM where it is converted to engineering units. If the signal in the RMU is out of processing range, an "Invalid Data" indicator is sent to the DTM. If the converted data is out of range, the data is declared invalid.

4.3.4 Div. CRD Charging Press. Low Tripped - Not Bypassed (Logic Diagram 1C71-K1013A)

The Divisional CRD Charging Pressure Low Trip is combined with the CRD Charging Pressure Trip Bypass as described below. If the Divisional CRD Charging Pressure Low is tripped and not Bypassed, the RPS Auto SCRAM Trip is tripped. All conditions that can cause this value to be TRUE will result in a RPS Auto SCRAM Trip. This logic is performed by the TLU.

[[

]]

4.3.4.1 Div. CRD Charging Press. Low Trip (Logic Diagram 1C71-K1013)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams).

[[

]]

4.3.4.1.1 CRD Charging Press. Low Trip and Channel Sensors Not Bypassed (Logic Diagram 1C71-K1013)

The trip signal received from the DTM in safety division I and the channel of sensors bypass for safety division I are combined logically so that the output is tripped if the pressure is low and the channel A sensors are not bypassed. This logic in performed by the TLU.

[[

]]

4.3.4.1.1.1 CRD Charging Press. Low Trip (Logic Diagram 1C71-K1001)

This is the delayed trip signal sent from the DTM to all four divisional TLUs. The logic that produces this trip and the delay are performed by the DTM. This is a downscale trip. The output is tripped when the input signal in engineering units, CRD Charging Pressure, is less than or equal to the setpoint value that has been entered by the user and the trip condition has been present for a duration as specified by the user. There is no delay in a reset situation.

[[

]]

◆ **CRD Charging Press. (Logic Diagram 1C12-K1015)**

This signal is sent from the RMU to the DTM where it is converted to engineering units. If the signal in the RMU is out of processing range, an "Invalid Data" indicator is sent to the DTM. If the converted data is out of range, the data is declared invalid.

[[
]]

4.3.4.2 Div. CRD Charging Press. Trip Bypass (Logic Diagram 1C71-K1013A)

This bypass is the result of the position of the CRD Charging Pressure Bypass switch and the current state of the system that either allows or disallows this bypass (Bypass Permissive). This logic is performed by the TLU.

[[

]]

4.3.4.2.1 Low CRD Charging Press. Trip Bypass Permissive (Logic Diagram 1C71-K1005A)

The CRD Charging Pressure can only be bypassed when the reactor is in certain operating modes, as described below. This permissive logic is performed by the TLU.

[[

]]

4.3.4.2.1.1 Reactor Mode (Logic Diagram 1C71-K1005, 1C71-K1005A)

The Reactor Mode Switch is received by the TLU as four inputs, as defined below. Only one of the inputs is valid at a time. It is possible for the position switch to read for none of the valid modes, in which case it will be treated as "faulted".[2]

[[

]]

4.3.4.2.1.1.1 Reactor in Run Mode (Logic Diagram 1C71-K1005A)

[[

]]

[[

[2] The Reactor Mode Switch must be in exactly one position at a time. If the TLU determines that more than one switch contact is closed or that all switch contacts are open, the previous Reactor Mode is maintained, and if the condition persists the TLU will generate an alarm.

]]

4.3.4.2.1.1.2 Reactor in Startup Mode (Logic Diagram 1C71-K1005A)

[[

]]

4.3.4.2.1.1.3 Reactor in Refuel Mode (Logic Diagram 1C71-K1005A)

[[

]]

4.3.4.2.1.1.4 Reactor in Shutdown Mode (Logic Diagram 1C71-K1005A)

[[

]]

4.3.4.2.1.1.5 Reactor Mode Switch Inputs (Logic Diagram 1C71-K1005)

◆ **Reactor Mode Switch in Run (Logic Diagram 1C71-K1005)**

[[

]]

◆ **Reactor Mode Switch in Shutdown (Logic Diagram 1C71-K1005)**

[[

]]

◆ **Reactor Mode Switch in Refuel (Logic Diagram 1C71-K1005)**

[[

]]

◆ **Reactor Mode Switch in Startup (Logic Diagram 1C71-K1005)**

[[

]]

4.3.4.2.2 CRD Charging Press. Bypass Switch Position (Logic Diagram 1C71-K1013A)

◆ **CRD Charging Press. Bypass Switch Position (Logic Diagram 1C71-K1013A)**

The CRD Charging Pressure Bypass Switch is read by the TLU directly.

[[

]]

4.3.5 Div. TSV/TCV Closure Trip and Not Bypassed (Logic Diagram 1C71-K1021A)

The Divisional TSV/TCV Closure Trip and Not Bypassed is the result of the Divisional TSV/TCV Closure Trip being combined with the TSV/TCV Closure Trip Bypass, provided by the DTM, as described below. If the Divisional TSV/TCV Closure is tripped and not bypassed, the RPS Auto SCRAM Trip is tripped. This logic is performed by the TLU.

[[

]]

4.3.5.1 Div. TSV/TCV Closure Trip (Logic Diagram 1C71-K1021A)

This trip is the result of two trips being combined then delayed before being checked against the bypass and applied to the Trip Output in section 4.4.5. The delay applied is to ensure that the trip has been present for a duration as specified by the user. There is no delay in a reset situation. This logic and the delay are performed by the TLU.

[[

]]

4.3.5.1.1 Div. TSV Closure Trip (Logic Diagram 1C71-K1021)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams).

[[

]]

4.3.5.1.2 TSV Closure Trip and Channel Sensors Not Bypassed (Logic Diagram 1C71-K1021)

The trip signal received from the DTM in safety division I and the channel of sensors bypass for safety division I are combined logically so that the output is tripped if the pressure is low and the channel A sensors are not bypassed. This logic is performed by the TLU.

[[

]]

4.3.5.1.2.1 TSV Closure Trip (Logic Diagram 1C71-K1001B)

The trip signal is based on the position of the Turbine Stop Valve. This logic is performed by the DTM.

[[

]]

- **Turbine Stop Valve Open (Logic Diagram 1C71-K1001B)**

This is the inverse of the discrete signal sent from the DTM to all four divisional TLUs. The logic that produces this signal is performed by the DTM. [[
]]

[[

]]

4.3.5.1.3 Div. TCV Fast Closure Trip (Logic Diagram 1C71-K1021)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams).

[[

]]

4.3.5.1.3.1 TCV Fast Closure Trip and Channel Sensors Not Bypassed (Logic Diagram 1C71-K1021)

The trip signal received from the DTM in safety division I and the channel of sensors bypass for safety division I are combined logically so that the output is tripped if the water level is low and the channel A sensors are not bypassed. This logic in performed by the TLU.

[[

]]

4.3.5.1.3.1.1 TCV ETS Oil Pressure Low Trip (Logic Diagram 1C71-K1001B)

This is the trip signal sent from the DTM to all four divisional TLUs. The logic that produces this trip is performed by the DTM. This is a downscale trip. The output is tripped when the input signal in engineering units, TCV ETS Oil Pressure, is less than or equal to the setpoint value that has been entered by the user.

[[

]]

◆ **TCV ETS Oil Pressure (Logic Diagram 1C71-K1001B)**

This signal is read directly by the DTM and converted to engineering units. If the signal is out of processing range or the converted data is out of range, the data is declared invalid.

4.3.5.2 Channel TSV/TCV Closure Trip Bypass (Logic Diagram 1C71-K1001C)

This is an automatic operational bypass and is based on several factors that are combined logically as described below. The logic for this bypass is performed by the DTM and provided to the TLU for use. This bypass is shown on the logic page given but the algorithm for determining bypass is defined in the HSS in section 4.3.1.2 (6). The bypass is a channel signal that is used to bypass a divisional trip.

[[

]]

◆ **APRM Simulated Thermal Power (STP) (Logic Diagram 1C51-K1008)**

The STP is provided as a percentage of the rated reactor power directly to the DTM via communications paths. No interpretation of the signal is required.

◆ **BPV Inhibit Power Offset**

As entered by the user.

4.3.5.2.1 Main Condenser Vacuum Low (Pressure High) Trip (Logic Diagram 1C73-K1002)

This trip signal is used in the TSV/TCV Closure Trip Bypass calculation and is sent from the DTM to all four divisional TLUs. The logic that produces this trip is performed by the DTM. This is an upscale trip. The output is tripped when the input signal in engineering units, Main Condenser Vacuum Pressure, is greater than or equal to the setpoint value that has been entered by the user. Note that this is also called Main Condenser Vacuum Low since that is indicated by a rise in pressure.

[[

]]

◆ **Main Condenser Pressure (Logic Diagram 1B21-K1020)**

This signal is sent from the RMU to the DTM where it is converted to engineering units. If the signal in the RMU is out of processing range, an "Invalid Data" indicator is sent to the DTM. If the converted data is out of range, the data is declared invalid.

4.3.5.2.2 Number of Turbine Bypass Valves (TBV) open ≥ the number required (Logic Diagram 1C71-K1001C)

4.3.5.2.2.1 Number of Turbine Bypass Valves Open (Logic Diagram 1C71-K1001C)

The state of each of ten Turbine Bypass Valves (TBV) is read directly by the DTM and the total number open are calculated.

- **Turbine Bypass Valve 1A (Logic Diagram 1C71-K1001C)**

[[

]]

- **Turbine Bypass Valve 1B (Logic Diagram 1C71-K1001C)**

[[

]]

- **Turbine Bypass Valve 1C (Logic Diagram 1C71-K1001C)**

[[

]]

- **Turbine Bypass Valve 1D (Logic Diagram 1C71-K1001C)**

[[

]]

- **Turbine Bypass Valve 1E (Logic Diagram 1C71-K1001C)**

[[

]]

◆ **Turbine Bypass Valve 2A (Logic Diagram 1C71-K1001C)**

[[

]]

◆ **Turbine Bypass Valve 2B (Logic Diagram 1C71-K1001C)**

[[

]]

◆ **Turbine Bypass Valve 2C (Logic Diagram 1C71-K1001C)**

[[

]]

◆ **Turbine Bypass Valve 2D (Logic Diagram 1C71-K1001C)**

[[

]]

◆ **Turbine Bypass Valve 2E (Logic Diagram 1C71-K1001C)**

[[

]]

4.3.5.2.2.2 Number of Turbine Bypass Valves (TBV) Required

This represents the number of Turbine Bypass Valves (TBVs) that must be open at the current reactor power level. This number is based on the STP level defined in 4.4.5.2.1 and the BPV Inhibit Slope and BPV Inhibit Power Offset as entered by the user. [[

]]

4.3.6 Div. Seismic Activity High Trip (Logic Diagram 1C71-K1017A)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). If the output of the two-out-of-four voting is TRIPPED, the RPS Auto SCRAM Trip is tripped. All conditions that can cause this value to be TRUE will result in a RPS Auto SCRAM Trip.

[[

]]

4.3.6.1 Seismic Activity High Trip and Channel Sensors Not Bypassed (Logic Diagram 1C71-K1017A)

The trip signal received from the DTM in safety division I and the channel of sensors bypass for safety division I are combined logically so that the output is tripped if the activity is high and the channel A sensors are not bypassed. This logic in performed by the TLU.

[[

]]

4.3.6.1.1 Seismic Activity High Trip (Logic Diagram 1C71-K1017A)

This is the trip signal sent from the DTM to all four divisional TLUs. The logic that produces this trip is performed by the DTM. This is a logical trip based on the seismic activity at five sensors. The output is tripped when any of the input signals indicates high seismic activity.

[[

]]

◆ **Reactor Building Bottom Horizontal (X) Acceleration High (Logic Diagram 1C71-K1001A)**

[[

]]

◆ **Reactor Building Bottom Horizontal (Y) Acceleration High (Logic Diagram 1C71-K1001A)**

[[

]]

◆ **Reactor Building Bottom Vertical (Z) Acceleration High (Logic Diagram 1C71-K1001A)**

[[

]]

◆ **Reactor Building Top Horizontal (X) Acceleration High (Logic Diagram 1C71-K1001D)**

[[

]]

◆ **Reactor Building Top Horizontal (Y) Acceleration High (Logic Diagram 1C71-K1001D)**

[[

]]

4.3.7 Div. S/P Bulk Average Temperature High Trip (Logic Diagram 1C71-K1017)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). If the output of the two-out-of-four voting is tripped, the RPS Auto SCRAM Trip is tripped. All conditions that can cause this value to be TRUE will result in a RPS Auto SCRAM Trip.

[[

]]

4.3.7.1 S/P Bulk Average Temperature High Trip and Channel Sensors Not Bypassed (Logic Diagram 1C71-K1017)

The trip signal received from the DTM in safety division I and the channel of sensors bypass for safety division I are combined logically so that the output is tripped if the temperature level is high and the channel A sensors are not bypassed. This logic in performed by the TLU.

[[

]]

4.3.7.1.1 S/P Bulk Average Temperature High Trip (Logic Diagram 1C71-K1001A)

This is the trip signal sent from the DTM to all four divisional TLUs. The logic that produces this trip is performed by the DTM. This is an upscale trip. The output is tripped when the input data value, S/P Bulk Average Temperature, is greater than or equal to the setpoint value that has been entered by the user.

[[

]]

4.3.7.1.1.1 S/P Bulk Average Temperature (Logic Diagram 1C74-K1017A)

This data value is sent from the RMU to the DTM in engineering units. The DTM performs no conversion. The RMU averages the four Level Average Temperatures to produce this value. [[

]]

[[

]]

4.3.7.1.1.1.1 Level 1 Average Temperature (Logic Diagram 1C74-K1015)

This is the average of all temperatures at Level 1 in the Suppression Pool that are not bypassed or out of range. Note that the Level can also be bypassed in certain conditions. This operation is performed by the RMU.

[[

]]

- **Temperature Reading (A) at Level 1 (Logic Diagram 1T62-K1021)**

[[

]]

[[ ]]

- **Temperature Reading (B) at Level 1 (Logic Diagram 1T62-K1021)**

[[

]]

◆ **Temperature Reading (C) at Level 1 (Logic Diagram 1T62-K1021A)**

[[

]]

◆ **Temperature Reading (D) at Level 1 (Logic Diagram 1T62-K1021A)**

[[

]]

4.3.7.1.1.1.1.1 Level 1 Bypass (Logic Diagram 1C74-K1015)

The S/P Narrow range water level is compared with the level 1 setpoint. This is a downscale trip calculation and the bypass is TRUE if tripped.

[[

]]

◆ **S/P Narrow Range Water Level (Logic Diagram 1T62-K1025)**

Read by the RMU and converted to engineering units. If the signal in the RMU is out of processing range or the converted data is out of range, the data is declared invalid.

4.3.7.1.1.1.2 Level 2 Average Temperature (Logic Diagram 1C74-K1016)

This is the average of all temperatures at Level 2 in the Suppression Pool that are not bypassed or out of range. Note that the Level can also be bypassed in certain conditions. This operation is performed by the RMU.

[[

]]

◆ **Temperature Reading (A) at Level 2 (Logic Diagram 1T62-K1021)**

[[

]]

◆ **Temperature Reading (B) at Level 2 (Logic Diagram 1T62-K1021)**

[[

]]

◆ **Temperature Reading (C) at Level 2 (Logic Diagram 1T62-K1021A)**

[[

]]

◆ **Temperature Reading (D) at Level 2 (Logic Diagram 1T62-K1021A)**

[[

]]

4.3.7.1.1.1.2.1 Level 2 Bypass (Logic Diagram 1C74-K1015)

The S/P Narrow range water level is compared with the level 2 setpoint. This is a downscale trip calculation and the bypass is TRUE if tripped.

[[

]]

◆ **S/P Narrow Range Water Level (Logic Diagram 1T62-K1025)**

Read by the RMU and converted to engineering units.

4.3.7.1.1.1.3 Level 3 Average Temperature (Logic Diagram 1C74-K1016)

This is the average of all temperatures at Level 3 in the Suppression Pool that are not bypassed or out of range. This level may not be bypassed. This operation is performed by the RMU.

[[

]]

◆ **Temperature Reading (A) at Level 3 (Logic Diagram 1T62-K1021)**

[[

]]

◆ **Temperature Reading (B) at Level 3 (Logic Diagram 1T62-K1021)**

[[

]]

◆ **Temperature Reading (C) at Level 3 (Logic Diagram 1T62-K1021A)**

[[

]]

◆ **Temperature Reading (D) at Level 3 (Logic Diagram 1T62-K1021A)**

[[

]]

4.3.7.1.1.1.4 Level 4 Average Temperature (Logic Diagram 1C74-K1017)

This is the average of all temperatures at Level 4 in the Suppression Pool that are not bypassed or out of range. This level may not be bypassed. This operation is performed by the RMU.

[[

]]

- **Temperature Reading (A) at Level 4 (Logic Diagram 1T62-K1021)**

[[

]]

- **Temperature Reading (B) at Level 4 (Logic Diagram 1T62-K1021)**

[[

]]

- **Temperature Reading (C) at Level 4 (Logic Diagram 1T62-K1021A)**

[[

]]

- **Temperature Reading (D) at Level 4 (Logic Diagram 1T62-K1021A)**

[[

]]

4.3.8 Div. MSL Isolation Trip and Not Bypassed (Logic Diagram 1C71-K1025A)

[[

]]

[[

]]

4.3.8.1 Div. MSL Isolation Trip (Logic Diagram 1C71-K1025)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams).

[[

]]

4.3.8.1.1 MSL Isolation Trip and Channel Sensors Not Bypassed and No Special MSL Isolation Trip Bypass (Logic Diagram 1C71-K1025)

The trip signal received from the DTM in safety division I and the channel of sensors bypass for safety division I and the bypass state of the divisional Special MSL Isolation Trip Bypass are combined logically so that the output is tripped if the main steam line is isolated, the channel A sensors are not bypassed and the special MSL isolation trip bypass is not TRUE. This logic in performed by the TLU.

[[

]]

4.3.8.1.1.1 MSL Isolated Trip (LogicDiagram 1C71-K1001B)

This is the trip signal sent from the DTM to all four divisional TLUs. The logic that produces this trip is performed by the DTM. This is a discrete trip based on the positions of the inboard and outboard MSIV valves. The output is tripped when either of the input signals is in the CLOSED position, that is the input is NOT OPEN.

[[

]]

◆ **MSL Inboard MSIV >92% Open (Logic Diagram 1B21-K1001)**

This discrete input is read directly by the DTM and the logic that produces this trip is performed by the DTM.

[[

]]

◆ **MSL Outboard MSIV >92% Open (Logic Diagram 1B21-K1001)**

This discrete input is read directly by the DTM and the logic that produces this trip is performed by the DTM.

[[

]]

◆ **Special MSL Isolation Trip Bypass (Logic Diagram 1C74-K1005, Logic Diagram 1C74-K1001B)**

The Special MSL Isolation Trip Bypass Switch is a joystick type switch read by the TLU directly. There are five possible positions, equating to each of the four divisions and a No-Bypass position with only one position allowed at a time. It is possible for the position switch to read for none of the valid modes, in which case, it will be treated as "faulted". [[

]]

[[

]]

4.3.8.2 Div. MSL Isolation Trip Bypassed (Logic Diagram 1C71-K1025A)

This bypass is the result of Low RPV Dome Pressure and the current state of the system that either allows or disallows this bypass (Bypass Permissive). This logic is performed by the TLU.

[[

]]

4.3.8.2.1 MSL Isolation Trip Bypass Permissive (Logic Diagram 1C71-K1005A)

The MSL Isolation Trip can only be bypassed when the reactor is in certain operating modes, as described below. This permissive logic is performed by the TLU. This signal is not specifically reported.

[[

]]

4.3.8.2.1.1 Reactor Mode (Logic Diagram1C71-K1005, 1C71-K1005A)

This is the same signal described in 4.3.4.2.1.1. Refer to that section for further information about this signal.

4.3.8.2.2 RPV Dome Pressure Low (Logic Diagram 1C71-K1001)

This is a signal sent from the DTM to the TLU in its home division. The logic that produces this signal is performed by the DTM. This is a downscale trip. The output is tripped when the input signal in engineering units, RPV Dome Pressure, is less than or equal to the setpoint value that has been entered by the user.

[[

]]

◆ **RPV Dome Pressure (Logic Diagram 1B21-K1002)**

This signal is sent from the RMU to the DTM where it is converted to engineering units. If the signal in the RMU is out of processing range, an "Invalid Data" indicator is sent to the DTM. If the converted data is out of range, the data is declared invalid.

4.3.9 NMS Trip (Logic Diagram 1C71-K1029)

This trip is the result of the logical combining of all five trip inputs received by the TLU from the NMS system. This logic is performed by the TLU.

[[

]]

- **NMS SRNM Upscale Trip (Logic Diagram 1C71-K1029)**

This input is received from the NMS system as a hard contact.

[[

]]

- **NMS SRNM Period Trip (Logic Diagram 1C71-K1029)**

This input is received from the NMS system as a hard contact.

[[

]]

- **NMS APRM Trip (Logic Diagram 1C71-K1029)**

This input is received from the NMS system as a hard contact.

[[

]]

- **NMS OPRM Trip (Logic Diagram 1C71-K1029)**

This input is received from the NMS system as a hard contact.

[[

]]

- **NMS CFRC Trip (Logic Diagram 1C71-K1029)**

This input is received from the NMS system as a hard contact.

[[

]]

4.3.10 Automatic SCRAM Test Switch (Logic Diagram 1C71-K1033)

◆ **Automatic SCRAM Test Switch (Logic Diagram 1C71-K1033)**

This is a Divisional switch signal read by the TLU. No logic processing is required to produce this input to the RPS Auto SCRAM Trip logic. If the value of this signal is TRUE, the RPS Auto SCRAM Trip is tripped. All conditions that can cause this signal to be TRUE will result in a RPS Auto SCRAM Trip.

[[

]]

4.4 MSIV AUTO ISOLATION TRIP NOT BYPASSED (LOGIC DIAGRAM 1C73-K1050)

As discussed in Section 3.1.1.2, "MSIV Auto Isolation", one of the primary requirements in the RTIF System is to produce and propagate the Main Steam Isolation Valve Auto Isolation Trip.

[[

]]

◆ **Severe Accident MSIV/MS Drain Isolation Bypass Switch (Logic Diagram 1C74-K1001C)**

This is a Divisional switch signal read by the TLU. No logic processing is required to produce this bypass. If the value of this signal is TRUE, the MSIV Auto Isolation Trip is bypassed (not tripped).

[[

]]

◆ **MSIV Auto Isolation Trip (Logic Diagram 1C73-K1050)**

This trip is the result of the logical OR'ing of the inputs described below. That is, if any of these inputs is TRUE (i.e. a tripped condition exists), then the MSIV Auto Isolation Trip is TRUE. The logic processing is performed by the TLU instrument.

[[

]]

4.4.1 Div. MSL Tunnel Area Temperature (RB) High Trip (Logic Diagram 1C73-K1045A)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). This trip cannot be bypassed. If the output of the two-out-of-four voting is TRIPPED, the MSIV Auto Isolation Trip is tripped. All conditions that can cause this value to be TRUE will result in a MSIV Auto Isolation Trip.

[[

]]

4.4.1.1 MSL Tunnel Area Temperature (RB) High Trip and Channel Sensors Not Bypassed (Logic Diagram 1C73-K1045A)

[[

]]

[[

]]

4.4.1.1.1 MSL Tunnel Area Temperature (RB) High Trip (Logic Diagram 1C73-K1001)

[[

]]

- **MSL Tunnel Area Temperature (RB) (Logic Diagram 1T41-K1080)**

[[

]]

4.4.2 Div. MSL Tunnel Area Temperature (TB) High Trip (Logic Diagram 1C73-K1045)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). This trip cannot be bypassed. If the output of the two-out-of-four voting is TRIPPED, the MSIV Auto Isolation Trip is tripped. All conditions that can cause this value to be TRUE will result in a MSIV Auto Isolation Trip.

[[

]]

4.4.2.1 MSL Tunnel Area Temperature (TB) High Trip and Channel Sensors Not Bypassed (Logic Diagram 1C73-K1045)

[[

]]

4.4.2.1.1 MSL Tunnel Area Temperature (TB) High Trip (Logic Diagram 1C73-K1001)

[[

]]

- **MSL Tunnel Area Temperature (TB) (Logic Diagram 1T41-K1064)**

[[

]]

4.4.3 Div. MSL Turbine Area Temperature High Trip (Logic Diagram 1C73-K1045)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). This trip cannot be bypassed. If the output of the two-out-of-four voting is TRIPPED, the MSIV Auto Isolation Trip is tripped. All conditions that can cause this value to be TRUE will result in a MSIV Auto Isolation Trip.

[[

]]

4.4.3.1 MSL Turbine Area Temperature High Trip and Channel Sensors Not Bypassed (Logic Diagram 1C73-K1045)

[[

]]

4.4.3.1.1 MSL Turbine Area Temperature High Trip (Logic Diagram 1C73-K1001)

[[

]]

4.4.3.1.1.1 MSL Turbine Area Temperature 1 High Trip (Logic Diagram 1C73-K1011)

[[

]]

◆ **MSL Turbine Area Temperature 1 (Logic Diagram 1C73-K1011)**

[[

]]

4.4.3.1.1.2 MSL Turbine Area Temperature 2 High Trip (Logic Diagram 1C73-K1011)

[[

]]

- **MSL Turbine Area Temperature 2 (Logic Diagram 1C73-K1011)**

[[

]]

4.4.3.1.1.3 MSL Turbine Area Temperature 3 High Trip (Logic Diagram 1C73-K1011)

[[

]]

- **MSL Turbine Area Temperature 3 (Logic Diagram 1C73-K1011)**

[[

]]

4.4.3.1.1.4 MSL Turbine Area Temperature 4 High Trip (Logic Diagram 1C73-K1011)

[[

]]

◆ **MSL Turbine Area Temperature 4 (Logic Diagram 1C73-K1011)**

[[

]]

4.4.3.1.1.5 MSL Turbine Area Temperature 5 High Trip (Logic Diagram 1C73-K1011)

[[

]]

[[

]]

◆ **MSL Turbine Area Temperature 5 (Logic Diagram 1C73-K1011)**

[[

]]

4.4.3.1.1.6 MSL Turbine Area Temperature 6 High Trip (Logic Diagram 1C73-K1011)

[[

]]

[[

]]

◆ **MSL Turbine Area Temperature 6 (Logic Diagram 1C73-K1011)**

[[

]]

4.4.3.1.1.7 MSL Turbine Area Temperature 7 High Trip (Logic Diagram 1C73-K1011)

[[

]]

[[

]]

◆ **MSL Turbine Area Temperature 7 (Logic Diagram 1C73-K1011)**

[[

]]

4.4.3.1.1.8 MSL Turbine Area Temperature 8 High Trip (Logic Diagram 1C73-K1011)

[[

]]

◆ **MSL Turbine Area Temperature 8 (Logic Diagram 1C73-K1011)**

[[

]]

4.4.3.1.1.9 MSL Turbine Area Temperature 9 High Trip (Logic Diagram 1C73-K1011)

[[

]]

◆ **MSL Turbine Area Temperature 9 (Logic Diagram 1C73-K1011)**

[[

]]

[[ ]]

4.4.4 Div. RPV Wide Range Water Level Low Trip (Logic Diagram 1C73-K1046)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). This trip cannot be bypassed. If the output of the two-out-of-four voting is TRIPPED, the MSIV Auto Isolation Trip is tripped. All conditions that can cause this value to be TRUE will result in a MSIV Auto Isolation Trip.

[[

]]

4.4.4.1 RPV Wide Range Water Level Low Trip and Channel Sensors Not Bypassed (Logic Diagram 1C73-K1046)

[[

]]

4.4.4.1.1 RPV Wide Range Water Level Low Trip (Logic Diagram 1C73-K1001)

[[

]]

◆ **RPV Wide Range Water Level (Logic Diagram 1B21-K1002)**

[[

]]

4.4.5 Div. MSL A Steam Flow High Trip (Logic Diagram 1C73-K1048)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). This trip cannot be bypassed. If the output of the two-out-of-four voting is TRIPPED, the MSIV Auto Isolation Trip is tripped. All conditions that can cause this value to be TRUE will result in a MSIV Auto Isolation Trip.

[[

]]

4.4.5.1 MSL A Steam Flow High Trip and Channel Sensors Not Bypassed (Logic Diagram 1C73-K1048)

[[

]]

4.4.5.1.1 MSL A Steam Flow High Trip (Logic Diagram 1C73-K1002)

[[

]]

◆ **MSL A Steam Flow (Logic Diagram 1B21-K1026)**

[[

]]

4.4.6 Div. MSL B Steam Flow High Trip (Logic Diagram 1C73-K1048)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). This trip cannot be bypassed. If the output of the two-out-of-four voting is TRIPPED, the MSIV Auto Isolation Trip is tripped. All conditions that can cause this value to be TRUE will result in a MSIV Auto Isolation Trip.

[[

]]

4.4.6.1 MSL B Steam Flow High Trip and Channel Sensors Not Bypassed (Logic Diagram 1C73-K1048)

[[

]]

4.4.6.1.1 MSL B Steam Flow High Trip (Logic Diagram 1C73-K1003)

[[

]]

◆ **MSL B Steam Flow (Logic Diagram 1B21-K1026)**

[[

]]

4.4.7 Div. MSL C Steam Flow High Trip (Logic Diagram 1C73-K1049)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). This trip cannot be bypassed. If the output of the two-out-of-four voting is TRIPPED, the MSIV Auto Isolation Trip is tripped. All conditions that can cause this value to be TRUE will result in a MSIV Auto Isolation Trip.

[[

]]

4.4.7.1 MSL C Steam Flow High Trip and Channel Sensors Not Bypassed (Logic Diagram 1C73-K1049)

[[

]]

4.4.7.1.1 MSL C Steam Flow High Trip (Logic Diagram 1C73-K1003)

[[

]]

- **MSL C Steam Flow (Logic Diagram 1B21-K1026)**

[[

]]

4.4.8 Div. MSL D Steam Flow High Trip (Logic Diagram 1C73-K1049)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams). This trip cannot be bypassed. If the output of the two-out-of-four voting is TRIPPED, the MSIV Auto Isolation Trip is tripped. All conditions that can cause this value to be TRUE will result in a MSIV Auto Isolation Trip.

[[

]]

4.4.8.1 MSL D Steam Flow High Trip and Channel Sensors Not Bypassed (Logic Diagram 1C73-K1049)

[[

]]

4.4.8.1.1 MSL D Steam Flow High Trip (Logic Diagram 1C73-K1003)

[[

]]

◆ **MSL D Steam Flow (Logic Diagram 1B21-K1026)**

[[

]]

4.4.9 Div. MSL Turb. Inlet Press. Low Tripped - Not Bypassed (Logic Diagram 1C73-K1046)

The Divisional MSL Turbine Inlet Pressure Low Trip is combined with the bypass based on Reactor Mode as described below. If the Divisional MSL Turbine Inlet Pressure Low is TRIPPED and not Bypassed, the MSIV Auto Isolation Trip is tripped. All conditions that can cause this value to be TRUE will result in a MSIV Auto Isolation Trip. This logic is performed by the TLU.

[[

]]

4.4.9.1 Div. MSL Turb. Inlet Press. Low Tripped (Logic Diagram 1C73-K1046)

[[

]]

4.4.9.1.1 MSL Turb. Inlet Press. Low Trip and Channel Sensors Not Bypassed (Logic Diagram 1C73-K1046)

[[

]]

4.4.9.1.1.1 MSL Turb. Inlet Press. Low Trip (Logic Diagram 1C73-K1002)

[[

]]

[[

]]

◆ **MSL Turb. Inlet Press. (Logic Diagram 1B21-K1020)**

[[

]]

4.4.9.2 Reactor Mode (Logic Diagram 1C71-K1005A)

This is the same signal described in 4.3.4.2.1.1. Refer to that section for further information about this signal.

4.4.10 Div. Main Cond. Vacuum Low (Pressure High) Tripped - Not Bypassed (Logic Diagram 1C73-K1047)

The Divisional Main Condenser Vacuum Low Trip is combined with the bypass based on multiple inputs as described below. If the Divisional Main Condenser Vacuum Low is TRIPPED and not Bypassed, the MSIV Auto Isolation Trip is tripped. All conditions that can cause this value to be TRUE will result in a MSIV Auto Isolation Trip. This logic is performed by the TLU. [[
]]

[[

]]

4.4.10.1 Div. Main Cond. Vacuum Low (Pressure High) Tripped (Logic Diagram 1C73-K1047)

This trip is the result of two-out-of-four logic as described in section 4.2.1, "Two-out-of-four Voting" performed in the TLU based on the trip input from the DTM in each safety division (referred to as Chan A, Chan B, Chan C and Chan D in the logic diagrams).

[[

]]

4.4.10.1.1 Main Cond. Vacuum Low (Pressure High) Trip and Channel Sensors Not Bypassed (Logic Diagram 1C73-K1047)

[[

]]

[[

]]

4.4.10.1.1.1 Main Cond. Vacuum Low (Pressure High) Trip (Logic Diagram 1C73-K1002)

[[

]]

◆ **Main Cond. Vacuum (Logic Diagram 1B21-K1020)**

[[

]]

4.4.10.2 Main Cond. Low Vacuum Bypass (Logic Diagram 1C73-K1047)

[[

]]

◆ **TSV Not >90% Open (Logic Diagram 1C71-K1001B)**

[[

]]

4.4.10.2.1 RPV Dome Pressure Low (Logic Diagram 1C71-K1025A, 1C71-K1001)

[[

]]

◆ **RPV Dome Pressure (Logic Diagram 1B21-K1002)**

[[

]]

4.4.10.2.1.1Reactor Mode (Logic Diagram 1C71-K1005A)

[[

]]

4.4.10.2.2 Main Condenser Low Vacuum Bypass Switch Position (Logic Diagram 1C73-K1047)

◆ **Main Condenser Low Vacuum Bypass Switch Position (Logic Diagram 1C73-K1047)**

[[

]]

4.4.11 Automatic Isolation Trip Test Switch (Logic Diagram 1C73-K1050)

◆ **Automatic Isolation Trip Test Switch (Logic Diagram 1C73-K1050)**

This is a Divisional switch signal read by the TLU. No logic processing is required to produce this input to the MSIV Auto Isolation Trip logic. If the value of this signal is TRUE, the MSIV Auto Isolation Trip is tripped. All conditions that can cause this signal to be TRUE will result in a MSIV Auto Isolation Trip.

[[

]]

4.5 OTHER SIGNALS

These are signals that are processed by the RTIF system but are not contributors to the two primary output trips, the RPS SCRAM trip and the MSIV Auto Isolation trip.

4.5.1 CRD Charging Press. Rod Block Trip (Logic Diagram 1C71-K1001D)

* CRD Charging Press. Rod Block Trip (Logic Diagram 1C71-K1001D)

This is a trip signal that is a hard optical output from the DTM to the RCIS RAPI Channels A and B. The logic that produces this trip is performed by the DTM. This is a downscale trip. The output is tripped when the input signal in engineering units, CRD Charging Pressure, is less than or equal to the setpoint value that has been entered by the user.

[[

]]

◆ **CRD Charging Press. (Logic Diagram 1C12-K1015)**

This signal is sent from the RMU to the DTM where it is converted to engineering units. If the signal in the RMU is out of processing range, an "Invalid Data" indicator is sent to the DTM. If the converted data is out of range, the data is declared invalid.

4.5.2 End of Cycle RPT Command Signal (Logic Diagram 1C71-K1021A)

This signal is the same as the TSV Closure, TCV Fast Closure Trip After Delay and Bypass have been applied. This signal is as described in Section 4.3.5. Refer to that section for further information.

[[

]]

4.5.3 Channel CRD Charging Pressure Switch in Bypass with the Reactor in Run Mode or Startup Mode (Logic Diagram 1C71-K1013A)

This signal is reporting a condition where the bypass has been set via the bypass switch but the bypass is not permitted at this time due to Reactor Mode.

[[

]]

4.5.3.1 CRD Charging Press. Bypass Switch Position (Logic Diagram 1C71-K1013A)

This signal is as described in Section 4.3.4.2.2. Refer to that section for further information.

4.5.3.2 Low CRD Charging Press. Trip Bypass Permissive (Logic Diagram 1C71-K1005A)

This signal is as described in Section 4.3.4.2.1. Refer to that section for further information.

4.5.4 RPS Auto SCRAM Tripped Condition with Channel Sensors Bypassed (Logic Diagram 1C71-K1033)

This trip is the result of the channel RPS Auto SCRAM trip and the Channel of Sensors Bypass both being TRUE for this division. The logic processing is performed by the TLU instrument. This trip is reported only and does not feed any other trip or output.

[[

]]

4.5.4.1 RPS Auto SCRAM Tripped Condition (Logic Diagram 1C71-K1033)

This trip is the result of the logical OR'ing of the inputs described below. That is, if any of these inputs is TRUE (i.e. a tripped condition exists) then this logic is TRUE. Processing is performed by the TLU instrument.

[[

]]

4.5.4.1.1 Channel RPV Narrow Range Water Level Sensor Trip (Logic Diagram 1C71-K1009)

[[

]]

4.5.4.1.2 Channel RPV Dome Pressure Sensor Trip (Logic Diagram 1C71-K1009)

[[

]]

4.5.4.1.3 Channel Drywell Pressure Sensor Trip (Logic Diagram 1C71-K1013)

[[

]]

4.5.4.1.4 Channel CRD Charging Pressure Sensor Trip (Logic Diagram 1C71-K1013)

[[

]]

4.5.4.1.5 Channel TSV Closure Sensor Trip (Logic Diagram 1C71-K1021)

[[

]]

4.5.4.1.6 Channel TCV Fast Closure Sensor Trip (Logic Diagram 1C71-K1021)

[[

]]

4.5.4.1.7 Channel Acceleration Instrument Sensor Trip (Logic Diagram 1C71-K1017A)

[[

]]

4.5.4.1.8 Channel S/P Bulk Average Sensor Trip (Logic Diagram 1C71-K1017)

[[

]]

4.5.4.1.9 Channel MSL Isolation Sensor Trip (Logic Diagram 1C71-K1025)

[[

]]

4.5.4.2 Channel Of Sensors Bypass (Logic Diagram 1C74-K1001)

[[ ]]

4.5.5 MSIV Auto Isolation Tripped Condition with Channel Sensors Bypassed (Logic Diagram 1C73-K1050)

This trip is the result of the channel MSIV Auto Isolation trip and the Channel of Sensors Bypass both being TRUE for this division. The logic processing is performed by the TLU instrument. This trip is reported only and does not feed any other trip or output.

[[

]]

4.5.5.1 MSIV Auto Isolation Tripped Condition (Logic Diagram 1C73-K1050)

This trip is the result of the logical OR'ing of the inputs described below. That is, if any of these inputs is TRUE (i.e. a tripped condition exists) then this logic is TRUE. Processing is performed by the TLU instrument.

[[

]]

4.5.5.1.1 Channel MSL Tunnel RB Side Amb Temperature Sensor Trip (Logic Diagram 1C73-K1045A)

[[

]]

4.5.5.1.2 Channel MSL Tunnel TB Side Amb Temperature Sensor Trip (Logic Diagram 1C73-K1045)

[[

]]

4.5.5.1.3 Channel MSL Turbine Area Amb Temperature Sensor Trip (Logic Diagram 1C73-K1045)

[[

]]

4.5.5.1.4 Channel RPV Wide Range Water Level Sensor Trip (Logic Diagram 1C73-K1046)[f]

[[

]]

4.5.5.1.5 Channel MSL (A) Flow Sensor Trip (Logic Diagram 1C73-K1048)

[[

]]

4.5.5.1.6 Channel MSL (B) Flow Sensor Trip (Logic Diagram 1C73-K1048)

[[

]]

4.5.5.1.7 Channel MSL (C) Flow Sensor Trip (Logic Diagram 1C73-K1049)

[[

]]

4.5.5.1.8 Channel MSL (D) Flow Sensor Trip (Logic Diagram 1C73-K1049)

[[

]]

4.5.5.1.9 Channel MSL Turbine Inlet Pressure Sensor Trip (Logic Diagram 1C73-K1046)

[[

]]

4.5.5.1.10 Channel Main Condenser Vacuum Sensor Trip (Logic Diagram 1C73-K1047)

[[

]]

4.5.5.2 Channel Of Sensors Bypass (Logic Diagram 1C74-K1001)

This signal is as described in Section 4.2.1.1. Refer to that section for further information.

4.5.6 Channel Inboard MSIV > 90% (Open) LED (Logic Diagram 1B21-K1001)

This is the status of the Channel Inboard MSIV > 90% Open Signal. This is not a trip at this point. In the logic, the DTM is responsible for processing the input and the TLU for the output, however a cleaner design would be for the DTM to provide the status and the TLU to determine the LED states. Note that the TLU in Division II is responsible for all Inboard statuses and that there is an Inboard signal for each channel with two LEDs per signal. [[
]]

[[

]]

4.5.6.1 Channel Inboard MSIV > 90% Open (Logic Diagram 1B21-K1001)

- **Channel Inboard MSIV > 90% Open (Logic Diagram 1B21-K1001)**

This discrete input is read directly by the DTM and the logic that produces this trip is performed by the DTM. The DTM provides the Inboard trip to the TLUs in Divisions II and IV.

[[

]]

4.5.7 Channel Inboard MSIV Not > 90% (Close) LED (Logic Diagram 1B21-K1001)

This is the status of the Channel Inboard MSIV > 90% Open Signal. [[

]]

[[

]]

4.5.7.1 Channel Inboard MSIV > 90% Open (Logic Diagram 1B21-K1001)

◆ **Channel Inboard MSIV > 90% Open (Logic Diagram 1B21-K1001)**

This discrete input is read directly by the DTM and the logic that produces this trip is performed by the DTM. The DTM provides the Inboard trip to the TLUs in Divisions II and IV.

[[

]]

4.5.8 Channel Outboard MSIV > 90% (Open) LED (Logic Diagram 1B21-K1001)

This is the status of the Channel Outboard MSIV > 90% Open Signal. [[

]]

[[

]]

4.5.8.1 Channel Outboard MSIV > 90% Open (Logic Diagram 1B21-K1001)

◆ **Channel Outboard MSIV > 90% Open (Logic Diagram 1B21-K1001)**

This discrete input is read directly by the DTM and the logic that produces this trip is performed by the DTM. The DTM provides the Outboard trip to the TLUs in Divisions I and III.

[[

]]

4.5.9 Channel Outboard MSIV Not > 90% (Close) LED (Logic Diagram 1B21-K1001)

This is the status of the Channel Outboard MSIV > 90% Open Signal. [[

]]

[[

]]

4.5.9.1 Channel Outboard MSIV > 90% Open (Logic Diagram 1B21-K1001)

◆ **Channel Outboard MSIV > 90% Open (Logic Diagram 1B21-K1001)**

This discrete input is read directly by the DTM and the logic that produces this trip is performed by the DTM. The DTM provides the Outboard trip to the TLUs in Divisions I and III.

[[

]]

4.5.10 RTIF Health (Logic Diagram 1C74-K1005B)

This signal is calculated by the CIM based on inputs from each instrument and its own status then sent to the 1E display. The inputs used in the determination are not part of the system logic, so this is here for information.

[[

]]

4.6 TIME TO TRIP

The overall time to trip for a signal is the time it takes after a monitored process variable reaches its trip point to the time that the load drivers de-energize; producing a RPS Auto SCRAM Trip or a MSIV Auto Isolation Trip. [[

]]

[[

]]

4.6.1 Analog Input Signals

Analog signals are the most time critical signals in the SSLC/RTIF system. For these signals, several time factors must be considered in determining the worst case time to trip, including the software filtering being applied, the delay inherent due to sensor response, any fixed processing delays (specifically the ASP delay), applicable delays due to signal splitting and the software processing overhead for the processing path of a specific signal.

[[

]]

[[

[3] This additional delay applies to the "shared" signals as discussed in 2.1a). These are: RPV Narrow Range Water Level and RPV Dome Pressure.

]]

[[

]]

4.6.2 Discrete Input Signals

While digital (discrete) inputs are filtered by the software to allow settling (debounce) time on some contacts, this filtering is applied only on a contact transitioning to a "closed" state. In that case, the state must have been present for two consecutive reads and it will be reported on the second valid read. There is no debounce on the transition to an "open" state.

[[

]]

[4] Time in seconds.

[5] From the table.

[6] From the table.

[7] The Software Filter Sample Period (fixed).

4.6.3 Thermocouple Input Signals

Thermocouple signals are the least time critical signals in the SSLC/RTIF system, due to the nature of temperature fluctuation. [[

]]

4.6.4 Calculation Tables

These tables provide the variable inputs and the calculated System response time for each individual signal in the system.

[[

[8] All maximum system response times are from reference 2.1a) except for S/P Narrow Range Water Level and Drywell Pressure which are found in reference 2.1k).

[9] No software filtering is applied.

		]]

[[

]]

[10] All maximum system response times are from reference 2.1a) except for S/P Narrow Range Water Level and Drywell Pressure which are found in reference 2.1k).

APPENDIX A ACRONYMS AND ABBREVIATIONS

°C	Degrees Centigrade
Ω	Ohm
µA	MicroAmperes
µV	Microvolts
A/D	Analog-to-Digital (Converter)
ANSI	American National Standards Institute
ASP	Automatic Signal Processor
Auto	Automatic
BNC	British Naval Connector
cm	Centimeters
CJR	Cold Junction Reference
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CRD	Control Rod Drive
D/A	Digital-to-Analog (Converter)
DCIS	Distributed Control & Information System
deg C	Degrees Centigrade
DSP	Digital Signal Processor
DTM	Digital Trip Module
EL	Electro-Luminescent
ELD	Electro-Luminescent Display

EMI	Electromagnetic Interference
EPRI	Electric Power Research Institute
EPROM	Erasable Programmable Read-Only Memory
FDDI	Fiber Direct Data Interface
F/O	Fiber Optic
GE	General Electric
HSS	SSLC/RTIF Hardware/Software Specification
Hz	Hertz
ICD	Interface Control Drawing
ID	Identification
IEEE	Institute of Electrical and Electronics Engineers
INOP	Inoperative
INOP-CAL	Inoperative-Calibrate
INOP-SET	Inoperative-Set Parameters
I/O	Input/Output
IPS	Instrument Performance Specification
ITS-90	International Temperature Scale of 1990
KHz	Kilo Hertz
LDI	Leak Detection & Isolation
LDU	Local Display Unit
LED	Light Emitting Diode
LVPS	Low Voltage Power Supply
mA	MilliAmperes

MIL-HDBK	Military Handbook
MIL-STD	Military Standard
msec	Milliseconds
MSIV	Main Steam Isolation Valve
MSL	Main Steam Line
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
mV	Millivolt
N/A	Not Applicable
NR	Narrow Range
NRC	Nuclear Regulatory Commission
NUMAC	Nuclear Measurement Analysis and Control
NVRAM	Non-Volatile Random Access Memory
OK	Okay
PCB	Printed Circuit Board
RAM	Random Access Memory
RC	Resistor Capacitor
ROM	Read Only Memory
RB	Reactor Building
RMU	Remote Multiplexing Unit
RPS	Reactor Protection System
RPV	Reactor Pressure Vessel
RTIF	Reactor Trip and Isolation Function

RX	Receiver or Receive
SCRAM	Safety Control Rod Axe Man (Reactor Trip - Safety Control Rod Insertion)
S/P	Suppression Pool
SPT	Suppression Pool Temperature
SPTM	Suppression Pool Temperature Monitor
SSLC	Safety System Logic and Control
TB	Turbine Building
T/C	Thermocouple
TLU	Trip Logic Unit
TTL	Transistor-Transistor Logic
TX	Transmitter or Transmit
V	Volts
Vdc	Volts Direct Current

APPENDIX B TRACEABILITY MATRIX

The traceability to the Logic Diagrams in this table is representative and points to Safety Division I information.[[

[11] Unless otherwise specified, this refers to information in Reference 2.1a), "RTIF Hardware/Software Specification, [[
]]

[12] HSS has Inboard and Outboard mixed up relative to the Logic Diagrams.

]]

[13] Reference 2.1k), "CMS Hardware/Software Specification, [[ ]]

APPENDIX C EXTERNAL RTIF DATA FLOW DIAGRAM

[[

External Data Flow
RTIF System

Key on following pages

]]

[[

]]

APPENDIX D INTERNAL RTIF DATA FLOW DIAGRAM

[[

Internal Data Flow
RTIF System
Key on following pages

]]

[[

]]

APPENDIX E SOFTWARE DELAY TIMING ANALYSIS

A software delay timing analysis was performed based on the following anticipated software design timing requirements. Note that these times are based on planned design, not empirical data. All software processing times are the maximum time the task is expected to take. It is anticipated that the task will complete well within the processing time given, therefore it is possible for the reported "best case" times to be bettered in some circumstances. The "best case" time is given as a guide, not a requirement.

E.1RMU Input Signals

E.1.1 Discrete and Analog Timing Analysis

[[

[14] [[ ]]

]]

[15] [[ ]]

[[

]]

[[

]]

E.1.2 Thermocouple Timing Analysis

[[

]]

16 [[

]]

17 [[ ]]

[[

]]

[[

]]

[[

]]

E.2DTM Input Signals

E.2.1 Discrete and Analog Timing Analysis

[[

]]

---

18 [[ ]]

19 [[ ]]

[[

]]

[[

]]

[[

]]

[[

]]

E.2.2 Thermocouple Timing Analysis

[[

]]

---

[20] [[

]]

[21] [[ ]]

[[

]]

[[

]]

[[

]]

APPENDIX F INPUT SUMMARY – EXTERNAL AND USER

[[

{3}]]

APPENDIX G SIGNAL NAME CROSS REFERENCE

[[

[22] "x" means 4 point ids, A,B,C,D "z" means 4 point ids, E,F,G,H

{3}]]