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June 2, 1982

Re: Indian Point Unit No. 2  
Docket No. 50-247

Director of Nuclear Reactor Regulation  
U. S. Nuclear Regulatory Commission  
Washington, D. C. 20555

ATTN: Mr. Steven A. Varga, Chief  
Operating Reactors Branch No. 1  
Division of Licensing

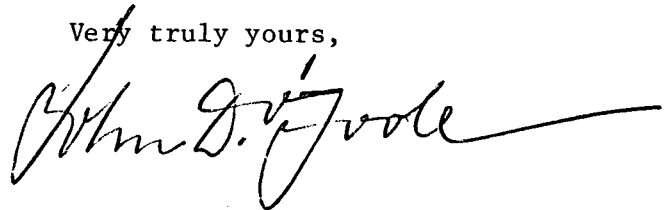
Dear Mr. Varga:

Attachment A to this letter provides our response to your February 25, 1982 request for additional information regarding our implementation of NUREG-0737 Item II.B.1, Reactor Coolant System Vents.

Be advised that Con Edison, consistent with the schedular requirement of 10 CFR 50.44 (c) (3) (iii), now intends to complete Item II.B.1 during the upcoming Cycle 5/6 refueling outage presently scheduled to commence in September, 1982.

Should you or your staff have any questions, please contact us.

Very truly yours,



Attach:

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ADDITIONAL INFORMATION

RE

IMPLEMENTATION OF NUREG-0737 ITEM II.B.1  
REACTOR COOLANT SYSTEM VENTS.

Docket # 50-247

Control # 8206080318

Date 06-02-82 of Document:

REGULATORY DOCKET FILE

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ATTACHMENT A

RESPONSE TO FEBRUARY 25, 1982  
REQUEST FOR ADDITIONAL INFORMATION  
FOR INDIAN POINT 2

REQUEST NO. 1:

Verify that the "existing remote operated vent system" for the pressurizer referenced on p. 39 of your December 31, 1979 letter is the power operated relief valve (PORV) system. Also, describe the provisions for positive position indication in the control room for the block valve on the PORV system (reference NUREG-0737 Item II.B.1 Clarification A(5)).

RESPONSE:

The existing remote operated vent system for the pressurizer referred to on page 39 of our December 31, 1979 letter is the power operated relief valve (PORV) system. This is also noted in our October 17, 1979 submittal (page 40). Positive position indication for the PORV block valves is provided by indicator lights in the control room which receive signals directly from the torque switches associated with their Limitorque operators.

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REQUEST NO. 2:

It is the NRC position that the remote reactor head vent (RRHV) system must not lead to an unacceptable increase in the probability of a LOCA and that, when practical, the vent system should be smaller than the size corresponding to the definition of a LOCA (10 CFR Part 50, Appendix A) in order to minimize the challenges to the emergency core cooling system (ECCS) (reference NUREG-0737 Item II.B.1 Clarification A(4)). Since on p. 41 of your December 31, 1979 letter you imply actuation of the safety injection system in the event of inadvertent opening of the RRHV system, verify that an analysis has been performed showing compliance with 10 CFR Part 50.46, or that the 3/4" diameter size has been considered in a previous LOCA analysis and found acceptable. Also, since there is a considerable run a piping upstream of the series isolation valves, justify why a flow restriction orifice was not installed close to the reactor vessel in order to limit the amount of new LOCA-sized piping.

RESPONSE:

Consistent with NUREG-0737 Item II.B.1 Clarification A(4), the new Remote Reactor Head Vent (RRHV) system was designed such that in the event of inadvertent opening or line breaks, normal makeup charging flow from the chemical and volume control system (CVCS) is capable of precluding actuation of the safety injection system. The original reactor vessel head vent consisted of a 3/4" line with a manual (locally operated) shutoff valve and bolted blind flange and was used only for routine operations when the reactor was shutdown. To install the new remotely-operated head vent system, the blind flange was removed and additional 9/16" tubing was run from the existing 3/4" line to the new motor-operated head vent valves. As is stated in response to Request No. 5 in this package, the new portions of the system were designed and constructed to the same criteria as the original Indian Point 2 pressure boundary components.

Section 14.3 (See page 14.3.25) of the Indian Point Unit No. 2 FSAR addresses small breaks within the primary system pressure boundary, including a 3/4" break, and to what extent they can be accommodated by the normal makeup system (i.e., CVCS charging pumps).

Note that the new portions of the RRHV are smaller in diameter (9/16" vs 3/4") and bounded by the assessment in the FSAR.

Nonetheless, a specific calculation has been performed for the worst case break location for the new vent system (i.e., the interface between the new 9/16" tubing and the original 3/4" head vent piping). This calculation determined that even at this worst case location, the break flow would be well within the capacity of two (2) CVCS charging pumps without actuating safeguards equipment. Thus, failure of the new vent system would not result in a break size corresponding to the definition of a LOCA. Since the size of the new vent line is smaller than the size corresponding to the definition of a LOCA, there is no increase in the probability of a LOCA and a flow restriction orifice was deemed unnecessary.

Because of the above mentioned considerations, the new RRHV system is not subject to a LOCA evaluation as per the 10 CFR Part 50.46 ECCS Acceptance Criteria. However, our July 13, 1976 letter to Robert W. Reid from William J. Cahill, Jr. provided a small break LOCA analysis for the Indian Point Unit 2. The results of that analysis demonstrated that for 3", 4" and 6" cold leg breaks, the ECCS Acceptance Criteria described in 10 CFR Part 50.46 and Appendix K to 10 CFR Part 50 are satisfied. Furthermore, WCAP 8356, WCAP 8399, and WCAP 9600 provide additional small breaks analysis to identify the most limiting small breaks under 10 CFR 50, Appendix K criteria. It should be noted that any postulated break in the RRHV system is bounded by the evaluations found in these analyses.

REQUEST No 3:

It is the NRC position that a degree of redundancy should be provided by powering different vents from different emergency buses (reference NUREG-0737 Item II.B.1 Changes to Previous Requirements and Guidance (4)). Since the PORV and block valves are required to be supplied with diverse emergency power sources, and the RRHV valves are supplied by diverse emergency power sources, a failure of one emergency power train could render both vent systems inoperable. Describe how the vent system will be modified to provide the necessary degree of redundancy (i.e., at least one vent path remains functional after the failure of one emergency power train) yet still prevent inadvertent or irreversible vent actuation.

RESPONSE:

As shown schematically in Figure 1, the RRHV valves and the PORVs and block valves are supplied with diverse and independent emergency power sources (indicated by parenthesis) such that: (a) at least one vent path remains functional after the single failure of an emergency power train, and (b) inadvertent or irreversible vent actuation cannot result from the malfunction of a single power train.

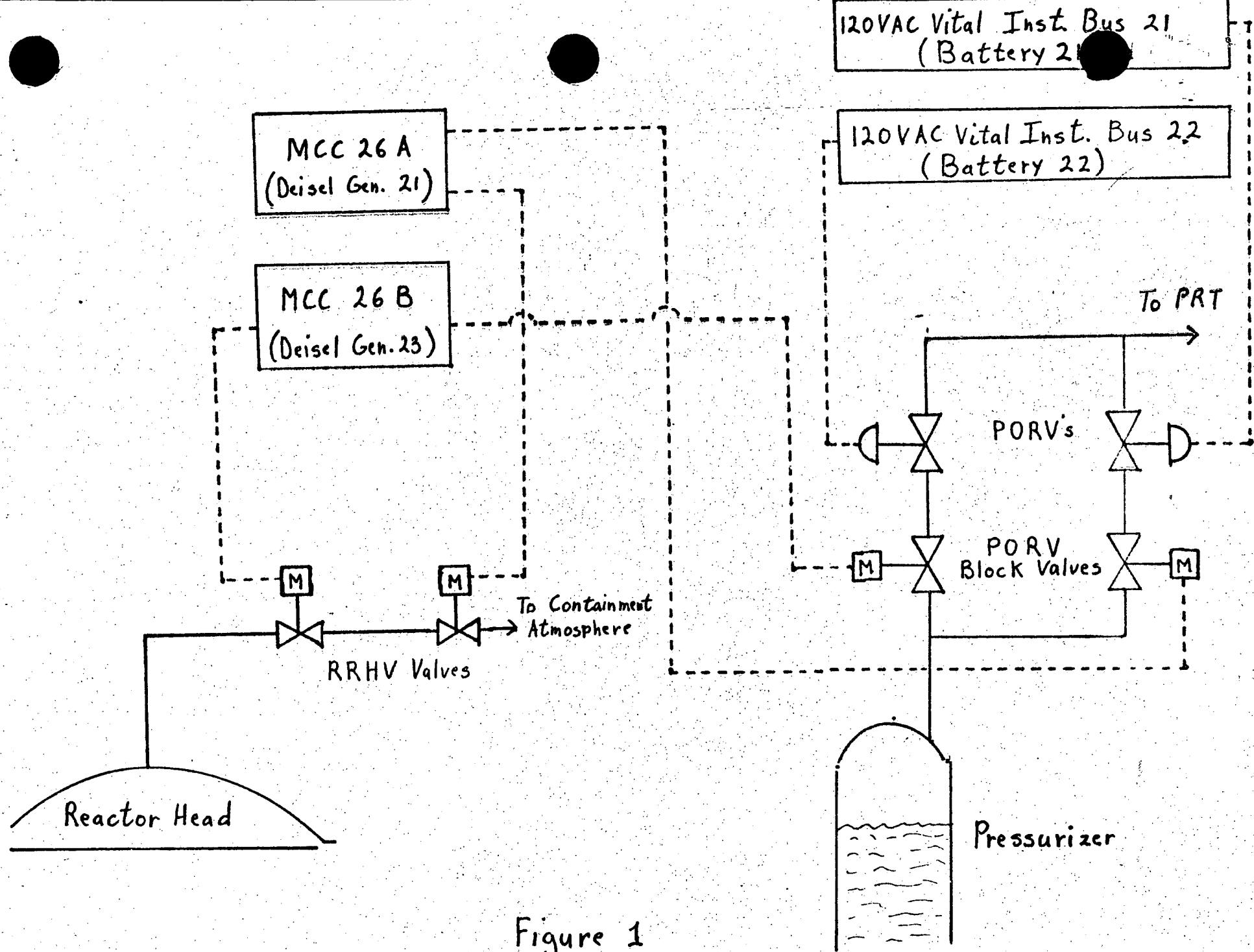


Figure 1

REQUEST No. 4:

Positive position indication (both open and closed) must be provided for each RRHV system valve. Since this cannot be accomplished unambiguously by the one acoustic flow detector, describe how positive position indication will be provided in the control room for each RRHV valve (reference NUREG-0737 Item II.B.1 Clarification A(5)).

RESPONSE:

In addition to the positive position indication for valves open provided by the acoustic flow monitor, position lights are provided in the control room for each valve for both open and close indication. These position lights receive signals from the torque switches associated with the valve Limitorque motor operators.



REQUEST No. 5:

The following items apply to the portions of the RRHV system that form a part of the reactor coolant pressure boundary, up to and including the second normally closed valve (reference NUREG-0737 Item II.B.1 Clarification A.(7)):

- a. Provide the design temperature and pressure of the piping, valves, and components.

RESPONSE:

The design temperature and pressure of the piping, valves, and components are as follows:

- |     |             |                     |           |
|-----|-------------|---------------------|-----------|
| (1) | Class 2501R | design pressure:    | 2580 psig |
|     | "           | design temperature: | 650°F     |
| (2) | Class 2505R | design pressure:    | 2500 psig |
|     | "           | design temperature: | 650°F     |

- b. Verify that the piping, valves, components, and supports are classified Seismic Category I and Safety Class 2 (Safety Class I where the size corresponds to the 10CFR Part 50 Appendix A definition of a loss-of-coolant accident).

RESPONSE:

Indian Point Unit No. 2 was designed and constructed prior to the issuance of the ASME Safety Class designations. Nevertheless, the RRHV System piping, valves, components, and supports are classified Seismic Category I and Con Edison Class A and have been designed and installed in accordance with the original requirements for reactor coolant pressure boundary installations.

- c. Demonstrate that the acoustic flow detection instrumentation has sufficient sensitivity to detect and measure RRHV system isolation valve seat leakage or describe other instrumentation to monitor potential valve seat leakage (reference Appendix A to 10 CFR Part 50, General Design Criterion 30).

RESPONSE:

The acoustic flow monitor is not intended to be used to detect RRHV isolation valve seat leakage (Note that both isolation valves must leak to have any flow). Potential seat leakage through both valves will be vented directly to the containment atmosphere and be detected and monitored as part of the reactor coolant system leakage requirements specified in the Unit's technical specifications.

- d. Describe the materials of construction and verify that they are compatible with the reactor coolant chemistry and will be fabricated and tested in accordance with SRP Section 5.2.3, "Reactor Coolant Pressure Boundary Materials."

RESPONSE:

Material of construction of piping, valves, and fittings are stainless steels and are compatible with reactor coolant chemistry. The RRHV System components were installed consistent with the original plant reactor coolant pressure boundary design criteria, ASME and ANSI codes applicable to Indian Point 2.

REQUEST No. 6:

Verify that the following RRHV system failures have been analyzed and found not to prevent the essential operation of safety-related systems required for safe reactor shutdown or mitigation of the consequences of a design basis accident:

- a. Seismic failure of RRHV system components that are not designed to withstand the safe shutdown earthquake.

RESPONSE:

All components of the RRHV system are designed to Seismic Category I requirements.

- b. Postulated missiles generated by failure of RRHV system components.

RESPONSE:

During the design of the RRHV system, consideration was given to potential generation of missiles. Consequently, the system was installed such that it does not come in close proximity to and have the ability to damage safety-related systems required for safe reactor shutdown or mitigation of the consequences of a design basis accident.

- c. Fluid sprays from RRHV system component failures. Sprays from normally unpressurized portions of the RRHV system that are Seismic Category 1 and Safety Class 1, 2, or 3 and have instrumentation for detection of leakage from upstream isolation valves need not be considered.

RESPONSE:

Safety-related systems required for safe reactor shutdown or mitigation of the consequences of a design basis accident are not in close proximity to the RRHV components or its release point to the containment atmosphere. Therefore, fluid sprays from RRHV component failures would not render such systems inoperable.

REQUEST No.7:

Provide a reliability analysis consisting of a failure mode and effects analysis (FMEA) or equivalent qualitative analysis that shows that no single active component failure, human error, or test and maintenance action could result in inadvertent opening or failure to close after intentional opening of the RRHV system. Include in the analysis components in the associated power, instrumentation, and control systems as well as the electrical and mechanical components of the RRHV system. In particular, we are concerned with a failure or shorting of the one control valve switch shown on Figure S1-2 which could cause inadvertent and/or irreversible actuation of both RRHV valves. Also, describe the design features or administrative procedures, such as key locked control switches or removal of power to valves during normal operation, that will be employed to prevent inadvertent actuation of the RRHV system (reference NUREG-0737 Item II.B.1 Clarification A(7) and (8)).

RESPONSE:

A Fault Tree Analysis (FTA) was undertaken to determine if a single action could result in inadvertent opening or failure to close after intentional opening of the RRHV system. Two qualitative fault trees were developed with the following top events:

- o Inadvertent opening of the RRHV System.
- o Inability to close after intentionally opening the RRHV System.

The analysis considered the components in the associated power, instrumentation, and control systems as well as the electrical and mechanical components of the RRHV System.

A review of the fault trees (see Appendix A) and the cut-set descriptions (see Appendix B) demonstrates that there is no known single action that can cause either of the above events to occur. This conclusion is based primarily upon the physical and electrical independence of the motor

operated valves. Each valve is operated through independent and separate control circuits and selector switches. Shorting of one circuit or switch of one valve motor will not affect the integrity or operation of the other valve. Since the two valves are in series both must be opened to inadvertently vent and only one must be closed to stop venting.

REQUEST NO.8:

Demonstrate using engineering drawings (including isometrics) and design descriptions as appropriate, that nearby structures, systems, and components essential to safe shutdown of the reactor or mitigation of a design basis accident are capable of withstanding the effects of the anticipated mixtures of steam, liquid, and noncondensable gas discharging from the RRHV system.

RESPONSE:

Because of the location of the RRHV containment atmospheric release point (i.e., above the operating floor at E1-95'), the discharge of the system would not impinge on any structures, systems or components essential to safe shutdown of the reactor or mitigation of a design basis accident.

REQUEST No.9:

Verify that operability testing of RRHV and pressurizer venting system valves will be performed in accordance with subsection IWV of Section XI of the ASME Code for Category B valves (reference NUREG-0737 Item II.B.1 Clarification A(11)).

RESPONSE:

The pressurizer PORV's and block valves are presently tested in accordance with ASME Code Section XI requirements for Category B valves. When the RRHV system is made operational, the motor operated vent valves will also be tested as Category B valves.

REQUEST No. 10:

Submit operating guidelines for use of the RRHV and pressurizer venting system including the following:

- a. Guidelines to determine when the operator should and should not manually initiate venting, and information and instrumentation required for this determination (reference NUREG-0737 Item II.B.1 Clarification A(2)). The guidelines to determine whether or not to vent should cover a variety of the reactor coolant system conditions (e.g., pressures and temperatures). The effect of the containment hydrogen concentration on the decision to vent or to continue venting should also be addressed considering the balance between the need for increased core cooling and decreased containment integrity due to elevated hydrogen levels.
- b. Methods for determining the size and location of a noncondensable gas bubble (reference Position (2) and Clarification A (2)).
- c. Guidelines for operator use of the vents, including information and instrumentation available to the operator for initiating or terminating vent usage (reference Position (2)).
- d. Required operator actions in the event of inadvertent opening, or failure to close after opening, of the vents including a description of the provisions and instrumentation necessary to detect and correct these fault conditions (reference Position (2) and Clarification A.(2)).
- e. Methods which in lieu of venting will assure that sufficient liquid or steam will flow through the steam generator U-tube region so that decay heat can be effectively removed from the reactor coolant system (reference Clarification C.(2)).

RESPONSE:

As stated in Con Edison's July 1, 1981 submittal, Indian Point 2 plant specific procedures will be developed using the generic procedural instructions prepared by the Westinghouse Owners Group as guidance. This effort is to be integrated into the overall procedure revision program required by Item I.C.1 of NUREG-0737 to be completed by the first refueling outage after January 1, 1982.

Also, as discussed in our July 1, 1981 submittal, we are still awaiting the issuance of model technical specifications by the Staff before we propose RRHV system technical specifications for Indian Point 2.



REQUEST No. 11:

Verify that all displays (including alarms) and controls, added to the control room as a result of the TMI Action Plan requirement for reactor coolant system vents, have been or will be considered in the human factors analysis required by NUREG-0737 Item I.D.1, "Control-Room Design Reviews."

RESPONSE:

The RRHV system displays and controls in the Central Control Room were considered in an overall review of human factors engineering of the Central Control Room. A detailed discussion of the completed review was provided with our February 11, 1982 submittal.

## APPENDIX A

### FAULT TREE DIAGRAMS

- A 1            Inadvertent Opening of RRHV Line
- A 2.1        Inability to Remotely Close Motor Operated  
              Valve After Venting
- A 2.2        Inability to Close - Failure of Control Circuit

## APPENDIX B

### MINIMUM CUT-SET DESCRIPTIONS

- B 1        Inadvertant Opening of RRHV Line
- B 2        Inability to Remotely  
            Close Motor Operated Valve  
            After Venting (Includes Control Circuit)

B1 INADVERTENT OPENING RRHV VALVE

# LISTING OF CUT SETS

SET NO

PRIMARY EVENT DESCRIPTIONS

- 1      U18      CIRCUIT FAILURE VALVE A OPENED  
      U20      CIRCUIT FAILURE VALVE B OPENED
- 2      U11      INSTRUMENT FAILURE INDICATES POSSIBLE VOID  
      U12      OPERATOR FAILS TO FOLLOW PROCEDURE TO VERIFY
- 3      PE7      OPERATOR FAILS TO CLOSE VALVE-IGNORES INDICATION  
      U18      CIRCUIT FAILURE VALVE A OPENED  
      PE9      OPERATOR UNKNOWNLY MOVES SWITCH B TO OPEN POS.
- 4      PE7      OPERATOR FAILS TO CLOSE VALVE-IGNORES INDICATION  
      PE8      OPERATOR UNKNOWNLY MOVES SWITCH A TO OPEN POS.  
      U20      CIRCUIT FAILURE VALVE B OPENED
- 5      PE7      OPERATOR FAILS TO CLOSE VALVE-IGNORES INDICATION  
      PE8      OPERATOR UNKNOWNLY MOVES SWITCH A TO OPEN POS.  
      PE9      OPERATOR UNKNOWNLY MOVES SWITCH B TO OPEN POS.
- 6      PE15      OPERATOR FAILS TO SEE POSITION LIGHT  
      PE13      OPERATOR FAILS TO "SEE" CHANGE IN SWITCH POS.  
      PE14      OPERATOR FAILS TO SEE CHANGE IN PARAMETER  
      PE8      OPERATOR UNKNOWNLY MOVES SWITCH A TO OPEN POS.  
      PE9      OPERATOR UNKNOWNLY MOVES SWITCH B TO OPEN POS.
- 7      PE16      VALVE A POSITION LIGHT OUT  
      PE13      OPERATOR FAILS TO "SEE" CHANGE IN SWITCH POS.  
      PE14      OPERATOR FAILS TO SEE CHANGE IN PARAMETER  
      PE8      OPERATOR UNKNOWNLY MOVES SWITCH A TO OPEN POS.  
      U20      CIRCUIT FAILURE VALVE B OPENED
- 8      PE15      OPERATOR FAILS TO SEE POSITION LIGHT  
      PE13      OPERATOR FAILS TO "SEE" CHANGE IN SWITCH POS.  
      PE14      OPERATOR FAILS TO SEE CHANGE IN PARAMETER  
      PE8      OPERATOR UNKNOWNLY MOVES SWITCH A TO OPEN POS.  
      U20      CIRCUIT FAILURE VALVE B OPENED
- 9      PE15      OPERATOR FAILS TO SEE POSITION LIGHT  
      PE13      OPERATOR FAILS TO "SEE" CHANGE IN SWITCH POS.  
      PE14      OPERATOR FAILS TO SEE CHANGE IN PARAMETER  
      U18      CIRCUIT FAILURE VALVE A OPENED  
      PE9      OPERATOR UNKNOWNLY MOVES SWITCH B TO OPEN POS.
- 10     PE13      OPERATOR FAILS TO "SEE" CHANGE IN SWITCH POS.  
      PE14      OPERATOR FAILS TO SEE CHANGE IN PARAMETER  
      U18      CIRCUIT FAILURE VALVE A OPENED

- PE17 VALVE B POSITION LIGHT OUT  
PE9 OPERATOR UNKNOWINGLY MOVES SWITCH B TO OPEN POS.
- 11 PE1 NORMAL AND EMERGENCY VENTS NOT SEPARATED  
PE2 ISOLATION VALVE A LEFT OPEN  
PE3 ISOLATION VALVE B LEFT OPEN  
PE4 OPERATOR DOES NOT REACT TO INSTRUMENTATION  
PE6 PROCEDURE CHECKLIST NOT VERIFIED
- 12 PE2 ISOLATION VALVE A LEFT OPEN  
PE3 ISOLATION VALVE B LEFT OPEN  
PE6 PROCEDURE CHECKLIST NOT VERIFIED  
H19 NORMAL AND EMERGENCY VENTS SEPARATED  
PE5 CAP IS NOT INSTALLED AT VENT END
- 13 PE16 VALVE A POSITION LIGHT OUT  
PE13 OPERATOR FAILS TO "SEE" CHANGE IN SWITCH POS.  
PE14 OPERATOR FAILS TO SEE CHANGE IN PARAMETER  
PE8 OPERATOR UNKNOWINGLY MOVES SWITCH A TO OPEN POS.  
PE17 VALVE B POSITION LIGHT OUT  
PE9 OPERATOR UNKNOWINGLY MOVES SWITCH B TO OPEN POS.

B2 INABILITY TO CLOSE MOTOR OPERATED VALVE AFTER VENTING

# LISTING OF CUT SETS

SET NO

PRIMARY EVENT DESCRIPTIONS

- 1      PE114A      INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 2      PE101A      INTERNAL FAILURE IN VALVE A  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 3      PE102A      TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 4      PE109A      CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 5      PE110A      TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 6      PE111A      SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 7      PE112A      CONTACT 49 FAILS OPEN - VALVE A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 8      PE113A      THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 9      PE120A      CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 10     PE121A      CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 11     PE122A      CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 12     PE116A      INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 13     PE117A      CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
  
- 14     PE118A      CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT  
          PE114B      INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT



- 15 PE119A CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT  
PE114B INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
- 16 PE115A INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT  
PE114B INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
- 17 PE106A TRANSFORMER X1 FAILS - VALVE A CCT  
PE114B INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
- 18 PE107A FUSE 10A OPENS PREMATURELY - VALVE A CCT  
PE114B INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
- 19 PE108A SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT  
PE114B INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
- 20 PE103A COMPONENT FAILURE IN VALVE A MOTOR  
PE114B INTRINSIC FAILURE OF COIL 42(C) - VALVE B CCT
- 21 PE114A INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 22 PE114A INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT  
PE102B TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
- 23 PE114A INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT  
PE109B CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
- 24 PE114A INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT  
PE110B TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 25 PE114A INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 26 PE114A INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT  
PE112B CONTACT 49 FAILS OPEN - VALVE B CCT
- 27 PE114A INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT  
PE113B THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
- 28 PE114A INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT  
PE120B CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
- 29 PE114A INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT

	PE1218	CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
30	PE114A PE1228	INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
31	PE114A PE1168	INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
32	PE114A PE1178	INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
33	PE114A PE1188	INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
34	PE114A PE1198	INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
35	PE114A PE1158	INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
36	PE114A PE1068	INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
37	PE114A PE1078	INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
38	PE114A PE1088	INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
39	PE114A PE1038	INTRINSIC FAILURE OF COIL 42(C) - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
40	PE101A PE101B	INTERNAL FAILURE IN VALVE A INTERNAL FAILURE IN VALVE B
41	PE102A PE101B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS INTERNAL FAILURE IN VALVE B
42	PE109A PE101B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT INTERNAL FAILURE IN VALVE B
43	PE110A PE101B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT INTERNAL FAILURE IN VALVE B

- 44 PE111A SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 45 PE112A CONTACT 49 FAILS OPEN - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 46 PE113A THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 47 PE120A CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 48 PE121A CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT  
~~PE101B INTERNAL FAILURE IN VALVE B~~
- 49 PE122A CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT  
~~PE101B INTERNAL FAILURE IN VALVE B~~
- 50 PE116A INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 51 PE117A CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 52 PE118A CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 53 PE119A CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 54 PE115A INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 55 PE106A TRANSFORMER X1 FAILS - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 56 PE107A FUSE 10A OPENS PREMATURELY - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 57 PE108A SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT  
PE101B INTERNAL FAILURE IN VALVE B
- 58 PE103A COMPONENT FAILURE IN VALVE A MOTOR  
PE101B INTERNAL FAILURE IN VALVE B

59	PE101A PE102B	INTERNAL FAILURE IN VALVE A TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
60	PE102A PE102B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
61	PE109A PE102B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
62	PE110A PE102B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
63	PE111A PE102B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
64	PE112A PE102B	CONTACT 49 FAILS OPEN - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
65	PE113A PE102B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
66	PE120A PE102B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
67	PE121A PE102B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
68	PE122A PE102B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
69	PE116A PE102B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
70	PE117A PE102B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
71	PE118A PE102B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
72	PE119A PE102B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
73	PE115A PE102B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS

74	PE106A PE102B	TRANSFORMER X1 FAILS - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
75	PE107A PE102B	FUSE 10A OPENS PREMATURELY - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
76	PE108A PE102B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
77	PE103A PE102B	COMPONENT FAILURE IN VALVE A MOTOR TORQUE LIMIT SWITCH FAILURE - VALVE B JAMS
78	PE101A PE109B	INTERNAL FAILURE IN VALVE A CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
79	PE102A PE109B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
80	PE109A PE109B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
81	PE110A PE109B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
82	PE111A PE109B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
83	PE112A PE109B	CONTACT 49 FAILS OPEN - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
84	PE113A PE109B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
85	PE120A PE109B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
86	PE121A PE109B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
87	PE122A PE109B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
88	PE116A	INTRINSIC FAILURE OF COIL 42B(0) - VALVE A CCT

	PE109B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
89	PE117A PE109B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
90	PE118A PE109B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
91	PE119A PE109B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
92	PE115A PE109B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
93	PE106A PE109B	TRANSFORMER X1 FAILS - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
94	PE107A PE109B	FUSE 10A OPENS PREMATURELY - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
95	PE108A PE109B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
96	PE103A PE109B	COMPONENT FAILURE IN VALVE A MOTOR CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - B CCT
97	PE101A PE110B	INTERNAL FAILURE IN VALVE A TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
98	PE102A PE110B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
99	PE109A PE110B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
100	PE110A PE110B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
101	PE111A PE110B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
102	PE112A PE110B	CONTACT 49 FAILS OPEN - VALVE A CCT TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT

- 103 PE113A THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 104 PE120A CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 105 PE121A CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 106 PE122A CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 107 PE116A INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 108 PE117A CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 109 PE118A CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 110 PE119A CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 111 PE115A INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 112 PE106A TRANSFORMER X1 FAILS - VALVE A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 113 PE107A FUSE 10A OPENS PREMATURELY - VALVE A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 114 PE108A SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 115 PE103A COMPONENT FAILURE IN VALVE A MOTOR  
PE1108 TORQUE SWITCH 17 FAILS TO CLOSE - VALVE B CCT
- 116 PE101A INTERNAL FAILURE IN VALVE A  
PE1118 SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 117 PE102A TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS  
PE1118 SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT

- 118 PE109A CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 119 PE110A TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 120 PE111A SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 121 PE112A CONTACT 49 FAILS OPEN - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 122 PE113A THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 123 PE120A CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 124 PE121A CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 125 PE122A CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 126 PE116A INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 127 PE117A CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 128 PE118A CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 129 PE119A CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 130 PE115A INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 131 PE106A TRANSFORMER X1 FAILS - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
- 132 PE107A FUSE 10A OPENS PREMATURELY - VALVE A CCT  
PE111B SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT



133	PE108A PE111B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
134	PE103A PE111B	COMPONENT FAILURE IN VALVE A MOTOR SHORT CIRCUIT OPENS 480 V FUSES - VALVE B CCT
135	PE101A PE112B	INTERNAL FAILURE IN VALVE A CONTACT 49 FAILS OPEN - VALVE B CCT
136	PE102A PE112B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS CONTACT 49 FAILS OPEN - VALVE B CCT
137	PE109A PE112B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT CONTACT 49 FAILS OPEN - VALVE B CCT
138	PE110A PE112B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT CONTACT 49 FAILS OPEN - VALVE B CCT
139	PE111A PE112B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT CONTACT 49 FAILS OPEN - VALVE B CCT
140	PE112A PE112B	CONTACT 49 FAILS OPEN - VALVE A CCT CONTACT 49 FAILS OPEN - VALVE B CCT
141	PE113A PE112B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT CONTACT 49 FAILS OPEN - VALVE B CCT
142	PE120A PE112B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT CONTACT 49 FAILS OPEN - VALVE B CCT
143	PE121A PE112B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT CONTACT 49 FAILS OPEN - VALVE B CCT
144	PE122A PE112B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT CONTACT 49 FAILS OPEN - VALVE B CCT
145	PE116A PE112B	INTRINSIC FAILURE OF COIL 42B(0) - VALVE A CCT CONTACT 49 FAILS OPEN - VALVE B CCT
146	PE117A PE112B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT CONTACT 49 FAILS OPEN - VALVE B CCT
147	PE118A	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT

	PE112B	CONTACT 49 FAILS OPEN -VALVE B CCT
148	PE119A PE112B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT CONTACT 49 FAILS OPEN -VALVE B CCT
149	PE115A PE112B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT CONTACT 49 FAILS OPEN -VALVE B CCT
150	PE106A PE112B	TRANSFORMER X1 FAILS - VALVE A CCT CONTACT 49 FAILS OPEN -VALVE B CCT
151	PE107A PE112B	FUSE 10A OPENS PREMATURELY - VALVE A CCT CONTACT 49 FAILS OPEN -VALVE B CCT
152	PE108A PE112B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT CONTACT 49 FAILS OPEN -VALVE B CCT
153	PE103A PE112B	COMPONENT FAILURE IN VALVE A MOTOR CONTACT 49 FAILS OPEN -VALVE B CCT
154	PE101A PE113B	INTERNAL FAILURE IN VALVE A THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
155	PE102A PE113B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
156	PE109A PE113B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
157	PE110A PE113B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
158	PE111A PE113B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
159	PE112A PE113B	CONTACT 49 FAILS OPEN -VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
160	PE113A PE113B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
161	PE120A PE113B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT

162	PE121A PE113B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
163	PE122A PE113B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
164	PE116A PE113B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
165	PE117A PE113B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
166	PE118A PE113B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
167	PE119A PE113B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
168	PE115A PE113B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
169	PE106A PE113B	TRANSFORMER X1 FAILS - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
170	PE107A PE113B	FUSE 10A OPENS PREMATURELY - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
171	PE108A PE113B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
172	PE103A PE113B	COMPONENT FAILURE IN VALVE A MOTOR THERMAL COILS GIVE FALSE SIGNAL TO OPEN - B CCT
173	PE101A PE120B	INTERNAL FAILURE IN VALVE A CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
174	PE102A PE120B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
175	PE109A PE120B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
176	PE110A PE120B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT

177	PE111A PE120B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
178	PE112A PE120B	CONTACT 49 FAILS OPEN - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
179	PE113A PE120B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
180	PE120A PE120B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
181	PE121A PE120B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
182	PE122A PE120B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
183	PE116A PE120B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
184	PE117A PE120B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
185	PE118A PE120B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
186	PE119A PE120B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
187	PE115A PE120B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
188	PE106A PE120B	TRANSFORMER X1 FAILS - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
189	PE107A PE120B	FUSE 10A OPENS PREMATURELY - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
190	PE108A PE120B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT
191	PE103A PE120B	COMPONENT FAILURE IN VALVE A MOTOR CONTACT ON A PHASE FAILS TO OPEN - VALVE B CCT

- 192 PE101A INTERNAL FAILURE IN VALVE A  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 193 PE102A TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 194 PE109A CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 195 PE110A TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 196 PE111A SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 197 PE112A CONTACT 49 FAILS OPEN - VALVE A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 198 PE113A THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 199 PE120A CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 200 PE121A CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 201 PE122A CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 202 PE116A INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 203 PE117A CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 204 PE118A CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 205 PE119A CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT  
PE121B CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
- 206 PE115A INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT

	PE1218	CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
207	PE106A PE1218	TRANSFORMER X1 FAILS - VALVE A CCT CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
208	PE107A PE1218	FUSE 10A OPENS PREMATURELY - VALVE A CCT CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
209	PE108A PE1218	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
210	PE103A PE1218	COMPONENT FAILURE IN VALVE A MOTOR CONTACT ON B PHASE FAILS TO OPEN - VALVE B CCT
211	PE101A PE122B	INTERNAL FAILURE IN VALVE A CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
212	PE102A PE122B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
213	PE109A PE122B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
214	PE110A PE122B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
215	PE111A PE122B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
216	PE112A PE122B	CONTACT 49 FAILS OPEN - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
217	PE113A PE122B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
218	PE120A PE122B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
219	PE121A PE122B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
220	PE122A PE122B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT

221	PE116A PE122B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
222	PE117A PE122B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
223	PE118A PE122B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
224	PE119A PE122B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
225	PE115A PE122B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
226	PE106A PE122B	TRANSFORMER X1 FAILS - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
227	PE107A PE122B	FUSE 10A OPENS PREMATURELY - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
228	PE108A PE122B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
229	PE103A PE122B	COMPONENT FAILURE IN VALVE A MOTOR CONTACT ON C PHASE FAILS TO OPEN - VALVE B CCT
230	PE101A PE116B	INTERNAL FAILURE IN VALVE A INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
231	PE102A PE116B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
232	PE109A PE116B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
233	PE110A PE116B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
234	PE111A PE116B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
235	PE112A PE116B	CONTACT 49 FAILS OPEN - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT

236	PE113A PE116B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
237	PE120A PE116B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
238	PE121A PE116B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
239	PE122A PE116B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
240	PE116A PE116B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
241	PE117A PE116B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
242	PE118A PE116B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
243	PE119A PE116B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
244	PE115A PE116B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
245	PE106A PE116B	TRANSFORMER X1 FAILS - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
246	PE107A PE116B	FUSE 10A OPENS PREMATURELY - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
247	PE108A PE116B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
248	PE103A PE116B	COMPONENT FAILURE IN VALVE A MOTOR INTRINSIC FAILURE OF COIL 42B(O) - VALVE B CCT
249	PE101A PE117B	INTERNAL FAILURE IN VALVE A CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
250	PE102A PE117B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT



251	PE109A PE117B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
252	PE110A PE117B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
253	PE111A PE117B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
254	PE112A PE117B	CONTACT 49 FAILS OPEN - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
255	PE113A PE117B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
256	PE120A PE117B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
257	PE121A PE117B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
258	PE122A PE117B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
259	PE116A PE117B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
260	PE117A PE117B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
261	PE118A PE117B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
262	PE119A PE117B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
263	PE115A PE117B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
264	PE106A PE117B	TRANSFORMER X1 FAILS - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
265	PE107A	FUSE 10A OPENS PREMATURELY - VALVE A CCT

	PE1178	CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
266	PE108A PE1178	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
267	PE103A PE1178	COMPONENT FAILURE IN VALVE A MOTOR CONTACT ON A PHASE WILL NOT CLOSE - VALVE B CCT
268	PE101A PE1188	INTERNAL FAILURE IN VALVE A CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
269	PE102A PE1188	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
270	PE109A PE1188	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
271	PE110A PE1188	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
272	PE111A PE1188	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
273	PE112A PE1188	CONTACT 49 FAILS OPEN - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
274	PE113A PE1188	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
275	PE120A PE1188	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
276	PE121A PE1188	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
277	PE122A PE1188	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
278	PE116A PE1188	INTRINSIC FAILURE OF COIL 42B(0) - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
279	PE117A PE1188	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT

280	PE118A PE118B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
281	PE119A PE118B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
282	PE115A PE118B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
283	PE106A PE118B	TRANSFORMER X1 FAILS - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
284	PE107A PE118B	FUSE 10A OPENS PREMATURELY - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
285	PE108A PE118B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
286	PE103A PE118B	COMPONENT FAILURE IN VALVE A MOTOR CONTACT ON B PHASE WILL NOT CLOSE - VALVE B CCT
287	PE101A PE119B	INTERNAL FAILURE IN VALVE A CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
288	PE102A PE119B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
289	PE109A PE119B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
290	PE110A PE119B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
291	PE111A PE119B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
292	PE112A PE119B	CONTACT 49 FAILS OPEN - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
293	PE113A PE119B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
294	PE120A PE119B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT

295	PE121A PE119B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
296	PE122A PE119B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
297	PE116A PE119B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
298	PE117A PE119B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
299	PE118A PE119B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
300	PE119A PE119B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
301	PE115A PE119B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
302	PE106A PE119B	TRANSFORMER X1 FAILS - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
303	PE107A PE119B	FUSE 10A OPENS PREMATURELY - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
304	PE108A PE119B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
305	PE103A PE119B	COMPONENT FAILURE IN VALVE A MOTOR CONTACT ON C PHASE WILL NOT CLOSE - VALVE B CCT
306	PE101A PE115B	INTERNAL FAILURE IN VALVE A INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
307	PE102A PE115B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
308	PE109A PE115B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
309	PE110A PE115B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT

310	PE111A PE115B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
311	PE112A PE115B	CONTACT 49 FAILS OPEN - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
312	PE113A PE115B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
313	PE120A PE115B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
314	PE121A PE115B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
315	PE122A PE115B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
316	PE116A PE115B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
317	PE117A PE115B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
318	PE118A PE115B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
319	PE119A PE115B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
320	PE115A PE115B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
321	PE106A PE115B	TRANSFORMER X1 FAILS - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
322	PE107A PE115B	FUSE 10A OPENS PREMATURELY - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
323	PE108A PE115B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
324	PE103A	COMPONENT FAILURE IN VALVE A MOTOR

	PE115B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE B CCT
325	PE101A PE106B	INTERNAL FAILURE IN VALVE A TRANSFORMER X1 FAILS - VALVE B CCT
326	PE102A PE106B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS TRANSFORMER X1 FAILS - VALVE B CCT
327	PE109A PE106B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT TRANSFORMER X1 FAILS - VALVE B CCT
328	PE110A PE106B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
329	PE111A PE106B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
330	PE112A PE106B	CONTACT 49 FAILS OPEN - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
331	PE113A PE106B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT TRANSFORMER X1 FAILS - VALVE B CCT
332	PE120A PE106B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
333	PE121A PE106B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
334	PE122A PE106B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
335	PE116A PE106B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
336	PE117A PE106B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
337	PE118A PE106B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
338	PE119A PE106B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT

339	PE115A PE106B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
340	PE106A PE106B	TRANSFORMER X1 FAILS - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
341	PE107A PE106B	FUSE 10A OPENS PREMATURELY - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
342	PE108A PE106B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT TRANSFORMER X1 FAILS - VALVE B CCT
343	PE103A PE106B	COMPONENT FAILURE IN VALVE A MOTOR TRANSFORMER X1 FAILS - VALVE B CCT
344	PE101A PE107B	INTERNAL FAILURE IN VALVE A FUSE 10A OPENS PREMATURELY - VALVE B CCT
345	PE102A PE107B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS FUSE 10A OPENS PREMATURELY - VALVE B CCT
346	PE109A PE107B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
347	PE110A PE107B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
348	PE111A PE107B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
349	PE112A PE107B	CONTACT 49 FAILS OPEN - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
350	PE113A PE107B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
351	PE120A PE107B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
352	PE121A PE107B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
353	PE122A PE107B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT

354	PE116A PE107B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
355	PE117A PE107B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
356	PE118A PE107B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
357	PE119A PE107B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
358	PE115A PE107B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
359	PE106A PE107B	TRANSFORMER X1 FAILS - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
360	PE107A PE107B	FUSE 10A OPENS PREMATURELY - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
361	PE108A PE107B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT FUSE 10A OPENS PREMATURELY - VALVE B CCT
362	PE103A PE107B	COMPONENT FAILURE IN VALVE A MOTOR FUSE 10A OPENS PREMATURELY - VALVE B CCT
363	PE101A PE108B	INTERNAL FAILURE IN VALVE A SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
364	PE102A PE108B	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
365	PE109A PE108B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
366	PE110A PE108B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
367	PE111A PE108B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
368	PE112A PE108B	CONTACT 49 FAILS OPEN - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT



369	PE113A PE108B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
370	PE120A PE108B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
371	PE121A PE108B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
372	PE122A PE108B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
373	PE116A PE108B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
374	PE117A PE108B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
375	PE118A PE108B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
376	PE119A PE108B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
377	PE115A PE108B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
378	PE106A PE108B	TRANSFORMER X1 FAILS - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
379	PE107A PE108B	FUSE 10A OPENS PREMATURELY - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
380	PE108A PE108B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
381	PE103A PE108B	COMPONENT FAILURE IN VALVE A MOTOR SELECTOR SWITCH FAILS TO CLOSE - VALVE B CCT
382	PE101A PE103B	INTERNAL FAILURE IN VALVE A COMPONENT FAILURE IN VALVE B MOTOR
383	PE102A	TORQUE LIMIT SWITCH FAILURE - VALVE A JAMS

	PE103B	COMPONENT FAILURE IN VALVE B MOTOR
384	PE109A PE103B	CONTACT 1 OF LIMIT SWITCH FAILS TO CLOSE - A CCT COMPONENT FAILURE IN VALVE B MOTOR
385	PE110A PE103B	TORQUE SWITCH 17 FAILS TO CLOSE - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
386	PE111A PE103B	SHORT CIRCUIT OPENS 480 V FUSES - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
387	PE112A PE103B	CONTACT 49 FAILS OPEN - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
388	PE113A PE103B	THERMAL COILS GIVE FALSE SIGNAL TO OPEN - A CCT COMPONENT FAILURE IN VALVE B MOTOR
389	PE120A PE103B	CONTACT ON A PHASE FAILS TO OPEN - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
390	PE121A PE103B	CONTACT ON B PHASE FAILS TO OPEN - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
391	PE122A PE103B	CONTACT ON C PHASE FAILS TO OPEN - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
392	PE116A PE103B	INTRINSIC FAILURE OF COIL 42B(O) - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
393	PE117A PE103B	CONTACT ON A PHASE WILL NOT CLOSE - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
394	PE118A PE103B	CONTACT ON B PHASE WILL NOT CLOSE - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
395	PE119A PE103B	CONTACT ON C PHASE WILL NOT CLOSE - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
396	PE115A PE103B	INTRINSIC FAILURE OF COIL 42A(C) - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
397	PE106A PE103B	TRANSFORMER X1 FAILS - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR

398	PE107A PE103B	FUSE 10A OPENS PREMATURELY - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
399	PE108A PE103B	SELECTOR SWITCH FAILS TO CLOSE - VALVE A CCT COMPONENT FAILURE IN VALVE B MOTOR
400	PE103A PE103B	COMPONENT FAILURE IN VALVE A MOTOR COMPONENT FAILURE IN VALVE B MOTOR
401	PE104B PE104A	NO CONTACT ON AT LEAST 1 DISCONNECT POLE (26B) NO CONTACT ON AT LEAST 1 DISCONNECT POLE (26A)
402	PE105B PE104A	1 OR MORE PRIMARY FUSES FAIL (26B) NO CONTACT ON AT LEAST 1 DISCONNECT POLE (26A)
403	PE104B PE105A	NO CONTACT ON AT LEAST 1 DISCONNECT POLE (26B) 1 OR MORE PRIMARY FUSES FAIL (26A)
404	PE105B PE105A	1 OR MORE PRIMARY FUSES FAIL (26B) 1 OR MORE PRIMARY FUSES FAIL (26A)
405	U1 U2 U3 U4	FAILURE OF NORMAL IN HOUSE GENERATION FAILURE OF OFF-SITE POWER SOURCE FAILURE OF ON-SITE GAS TURBINE FAILURE OF ON-SITE EMERGENCY DIESELS

# A U L T T R E E \*\*\*

VERSION 04/30/1982

## A COMPUTER PROGRAM FOR FAULT TREE ANALYSIS

### \*\*\* USER INPUT \*\*\*

INADVERTANT OPENING RRMV VALVE

G2	AND	0 5	PE1	PE2	CUT	4	0	1	0	1G1
G3	AND	0 5	PE2	PE3	H19		PE4		PE6	
G14	OR	0 2	PE15	PE16			PE5		PE6	
G12	AND	1 2	G14	PE13	PE14					
G10	OR	1 1	G12	PE7						
G7	AND	1 1	G10	PE8						
G8	AND	0 2	U11	U12						
G5	OR	2 1	G7	G8	U18					
G15	OR	0 2	PE15	PE17						
G13	AND	1 2	G15	PE13	PE14					
G11	OR	1 1	G13	PE7						
G9	AND	1 1	G11	PE9						
G6	OR	2 1	G8	G9	U20					
G4	AND	2 0	G5	G6						
G1	OR	3 0	G2	G3	G4					

NUMBER OF GATES = 15  
NUMBER OF EVENTS = 19

# CUT SET EVALUATION

## CUT SETS

### CUT SETS WITH 2 COMPONENTS

NO	COMPONENTS
1)	U18 U20
2)	U11 U12

### CUT SETS WITH 3 COMPONENTS

NO	COMPONENTS
3)	PE7 U18 PE9
4)	PE7 PE8 U20
5)	PE7 PE8 PE9

### CUT SETS WITH 5 COMPONENTS

NO	COMPONENTS
6)	PE15 PE13 PE14 PE8 PE9
7)	PE16 PE13 PE14 PE8 U20
8)	PE15 PE13 PE14 PE8 U20
9)	PE15 PE13 PE14 U18 PE9
10)	PE13 PE14 U18 PE17 PE9
11)	PE1 PE2 PE3 PE4 PE6
12)	PE2 PE3 PE6 H19 PE5

### CUT SETS WITH 6 COMPONENTS

NO	COMPONENTS
13)	PE16 PE13 PE14 PE8 PE17 PE9