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SUBJECT: Forwards addl info re response to reactor coolant pump tripping strategy issue,per NRC 880824 request.

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November 10, 1988

Docket Nos. STN 50-528/529/530

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References:
1. Letter from D. B. Karner, ANPP, to USNRC Document Control Desk, dated September 11, 1988 (161-01308). Subject: Schedule for Response to NRC Request for Additional Information - Reactor Coolant Pump Trip Strategy.
2. Letter from M. J. Davis, NRC, to D. B. Karner, ANPP, dated August 24, 1988. Subject: Request for Additional Information - Implementation of TMI Action Item II.K.3.5 - Automatic Trip of Reactor Coolant Pumps.
3. Letter from E. E. Van Brunt, Jr., ANPP, to USNRC Document Control Desk, dated June 27, 1988 (161-01140). Subject: Response to NRC Request for Information - Reactor Coolant Pump Trip Strategy.
4. Letter from E. E. Van Brunt, Jr., ANPP, to G. W. Knighton, NRC, dated September 10, 1985 (ANPP-33433). Subject: Post-LOCA Status of Reactor Coolant Pump Seal Cooling.

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Response to NRC Request for Additional Information - Reactor Coolant Pump Trip Strategy
File: 88-A-056-026

By Reference 2, the NRC Staff has requested additional information concerning ANPP's response to the Reactor Coolant Pump (RCP) tripping strategy issue. In response to this NRC request, ANPP informed the NRC Staff that the requested information would be provided by November 30, 1988. The purpose of this letter is to provide the requested additional information. The ANPP responses to the NRC questions are provided in the attachment to this letter. Please note that ANPP has previously responded to some of the NRC questions, (see Reference 4). The attached responses will refer to the previous responses where appropriate.

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1/1

If you have any additional questions on this matter, please contact Mr. A. C. Rogers at (602) 371-4041.

Very truly yours,

D. B. Karner
Executive Vice President

DBK/BJA/pvk
Attachment

cc: G. W. Knighton (all w/a)
T. L. Chan
M. J. Davis
J. B. Martin
T. J. Polich
A. C. Gehr

ATTACHMENT - ANPP RESPONSES TO NRC QUESTIONS

1. NRC QUESTION

Arizona Nuclear Power Project's (ANPP's) letter of November 24, 1986 did not clearly identify which of the criteria presented in CEN-268 was selected to trip the second set of pumps during a small break LOCA (SBLOCA) at Palo Verde, Units 1, 2, and 3 (PV-1,2,3). The submittal identified that the following parameters were used in the pump trip strategy: pressurizer pressure, reactor coolant system hot and cold leg temperatures, and subcooled margin monitor. Clarify how these parameters are used in the plant specific pump trip strategy.

Also, no reference was made to either containment radiation or secondary radiation alarms that would be used to distinguish between a SBLOCA and a steam generator tube rupture (SGTR). Clarify if either of these parameters are used to determine whether the second set of pumps should be tripped. If containment radiation is used, see question 2. If secondary radiation is used, then identify the instrumentation used to monitor it and provide the associated uncertainty.

If secondary radiation is not used at PV-1,2,3 or a satisfactory response to question 2 is not received, then note the following staff positions. First, the plant specific pump trip strategy for PV-1,2,3 is not in agreement with CEN-268. This is because the report states that two parameters are needed to distinguish between a SBLOCA and a non-LOCA event. Second, if only one parameter is used to determine when to trip the second set of pumps and this results in the second two pumps being tripped during the design basis SGTR, then the PV-1,2,3 pump trip strategy is not in compliance with SECY-82-475, which requires the pumps remain in operation for the design basis SGTR.

ANPP RESPONSE

The first portion of the NRC question requests that ANPP explain how pressurizer pressure, Reactor Coolant System (RCS) hot and cold leg temperatures, and the

subcooled margin monitor are used in the plant-specific RCP trip strategy. As described in the response to question #6 of Reference (3), pressurizer pressure and RCS hot and cold leg temperatures are used by the Qualified Safety Parameter Display System (QSPDS) to compute subcooled margin. Subcooled margin is displayed and is utilized in the decision to trip the second set of RCPs. Pressurizer pressure and RCS hot and cold leg temperatures are individually displayed and can be used for a manual computation of subcooled margin in the event that both independent trains of QSPDS fail. In either event, subcooled margin is the only parameter that is directly used for the decision to trip the second set of RCPs.

The second portion of the NRC question requests ANPP to clarify what parameters are used in the decision to trip the second set of RCPs. PVNGS utilizes RCS subcooled margin as the single criterion in the decision to trip the second set of RCPs. As stated in the response to question #1 of Reference (3), containment radiation (and secondary plant radiation) are used in the diagnostic flow chart to diagnose the event and to implement the correct recovery procedure. The decision to trip the second set of RCPs is independent of event diagnosis and is based solely on RCS subcooled margin. If RCS subcooled margin is lost during an event (LOCA or non-LOCA), the RCPs will be tripped by the operator due to equipment integrity concerns. With inadequate RCS subcooled margin, concerns related to RCP NPSH requirements, vibration, cavitation, seal parameter limits, or motor faults may dictate that the RCPs be tripped regardless of the radiation monitoring indications. The decision to trip the RCPs based solely on RCS subcooled margin provides an inherently conservative basis for tripping the RCPs. The NRC Staff position implies that the use of one parameter for the decision is not in agreement with CEN-268. The RCP trip strategy of CEN-268 has been considered in revisions 2 and 3 of CEN-152. The PVNGS parameters for event diagnosis and RCP trip strategy are in conformance with the guidance included in revision 2 of CEN-152.

During a small break LOCA event, the tripping of the last two RCPs is a critical, time dependent decision. Using a single setpoint to determine if the last two RCPs should be tripped avoids the unnecessary complexity of requiring the operator to monitor and trend radiation indications. Additionally, high background and gaseous activities can add to the complexity of the decision process and can be potentially misleading to the operator. Time dependent decisions should be as expedient and simple to perform as possible. The single setpoint criterion is simple and conservative in that it will always result in a RCP trip when the RCS subcooled margin setpoint is exceeded.

The NRC Staff position implies that continued operation of at least two RCPs is required to mitigate a SGTR event. Continued RCP operation is not required to adequately mitigate any design basis event. In fact, the analysis of the SGTR event for PVNGS assumes a loss of offsite power which results in the loss of all four RCPs. The results of the SGTR analysis meet the applicable NRC acceptance criteria. Since RCP operation is not required to adequately mitigate non-LOCA events, continued RCP operation is best characterized as "desirable" since this would provide the operator with maximum flexibility for recovery actions and plant control. The NRC Staff position is also stated in SECY-82-475 as follows:

> "as a minimum, the pumps will remain running for those non-LOCA transients and accidents where forced convection cooling and pressurizer pressure control would enhance plant control. This would include steam generator tube ruptures up to approximately the design basis event (one tube)."

During a SGTR event, the break size will determine when RCS subcooled margin will be lost. For a range of break sizes, the charging pumps will maintain RCS inventory such that RCS subcooled margin is maintained and the RCPs are not tripped. For those break sizes where RCS subcooled margin is lost, the RCPs will

be tripped due to the equipment integrity concerns discussed previously. In this event, the equipment integrity concerns take precedence over the desire to keep RCPs operating for improved control. RCP restart is provided for in the procedures when RCS inventory control and subcooled margin are restored.

2. NRC QUESTION

Subsequent to ANPP's submittal of November 24, 1986, the Combustion Engineering Owners Group (CEOG) revised CEN-268 in May 1987. In CEN-268, Rev. 1, and CEN-268, Supplement 1, Rev. 1, it was stated that a containment radiation alarm was no longer recommended for use in the T2/L2 pump trip strategy. This was because containment radiation was determined not to have satisfactory sensitivity. If PV-1,2,3 use containment radiation in the plant specific pump trip strategy answer the following question.

In light of the recommendations in CEN-268, Rev. 1, justify continued use of containment radiation in the PV-1,2,3 pump trip strategy. Provide information to show the PV-1,2,3 containment radiation alarms are sufficiently sensitive to perform the function assigned them in the PV-1,2,3 plant specific T2/L2 pump trip strategy. Also, identify the instrumentation used to monitor containment radiation and provide the associated uncertainty.

ANPP RESPONSE

As discussed in the response to question #1, containment radiation alarms are not used in the decision to trip the second set of RCPs. The decision to trip the second set of RCPs is based solely on RCS subcooled margin. Containment and secondary plant radiation are used in the diagnostic flow chart to diagnose the event and to implement the appropriate recovery procedure.

3. <u>NRC QUESTION</u>

In CEN-268, Rev. 1, CEOG stated that containment isolation could cause the loss of pump cooling water and continued operation under these conditions could result in reactor coolant pump (RCP) damage. Timely operator action could restore essential water service and prevent pump damage. Each utility was to review its plant specific pump cooling water service system requirements and make any changes necessary. On April 23, 1985, the licensees with CE plants were sent a request for additional information on this area. In Generic Letter 86-06, the staff stated the response to this request for information was not available for PV-1 and the review of this item would be completed as part of the plant specific implementation SE review. The submittals for PV-1,2,3 have not addressed this issue. Therefore, provide the following information.

a. Identify the essential water services required for pump operation. Does any containment isolation signal or other signal, such as a safety injection actuation signal, terminate any of these services? If so, identify the signals and systems affected.

b. If essential water services are terminated, describe the operator guidelines, training, and procedures in place or to be implemented which assure these services are restored in a timely manner to prevent seal or pump damage or failure once a non-LOCA situation is confirmed. How long would it take to restore these water services? What would be the operator response if required water services could not be restored?

c. Usually RCP cooling water service is provided for both seal injection and component cooling (such as motor bearings). Are both component cooling water and seal injection required for pump operation or is it possible to operate the RCPs with only one of these services? If cooling water services to the pumps were terminated, would seal injection or

component cooling be restored first?

d. Confirm that containment isolation with continued RCP operation will not lead to seal or pump damage or failure. Include a description of the technical basis for reaching this conclusion.

ANPP RESPONSE

The responses to several portions of this question have been provided previously in Reference 4. The following responses provide the new information requested by the NRC Staff and are intended to supplement the previous responses.

a. The essential water services required for normal operation of the RCPs during power production are seal injection and component cooling water. Seal injection water is provided by the charging pumps. Seal injection is expected to be available post-accident since the charging pumps are safety-grade and are supplied with emergency power. Additionally, the motor operated containment isolation valve on the seal injection header is not closed by any safety signals. Although seal injection should be available post-accident, it is not required for continued RCP operation during an accident. For accident situations, seal injection is desirable since it will prevent intrusion of contaminants into the seal area which could reduce the seal life.

   Component cooling water is used by the RCPs for seal cooling, thrust bearing cooling, motor bearing cooling, and motor outlet air cooling. Component cooling water is normally supplied by the Nuclear Cooling Water System (NCWS). The NCWS is not a safety-grade system. However, component cooling water can be supplied to the RCPs by the safety-grade Essential Cooling Water System (ECWS) should NCWS not be available. Component cooling water (either NCWS or ECWS) is

required for continued RCP operation.

For the PVNGS design, a Containment Isolation Actuation Signal (CIAS) does not interrupt component cooling water flow to the RCPs. The containment isolation valves on the component cooling water lines are automatically closed by a Containment Spray Actuation Signal (CSAS). The CIAS signal is automatically initiated when containment internal pressure exceeds 3.0 psig or when RCS pressure falls below 1837 psia. The CSAS signal is automatically initiated when containment internal pressure exceeds 8.5 psig. The difference in the setpoints between the CIAS and CSAS signals allows for continued RCP operation during smaller break size LOCAs while ensuring that the containment is properly isolated for the design basis large break LOCA.

b. A response to this question was provided in Reference 4. The only information not provided in Reference 4 was how long it would take to restore essential water services once they are terminated and what the response of the operator would be if water services could not be restored. In response to this request, the only essential water service that would be terminated by a CSAS signal is component cooling water (i.e., NCWS). There are three containment isolation valves (one valve on the supply line and two on the return line) in the NCWS system that would automatically close upon receipt of a CSAS signal. Component cooling water could be restored by opening these valves. This is a fairly simple operator action that can be performed from the control room. For each valve, the operator must place the control room handswitch in the override position. Then the handswitch is taken to the open position to open the valve. This operator action can be accomplished within a couple of minutes after the operator recognizes the need to restore component cooling water to the RCPs. If the operator was unable to

restore component cooling water, the RCPs would be tripped.

c. As stated in the response to question 3.a, only component cooling water is required for RCP operation. The RCPs can be operated for an indefinite period of time without seal injection water provided that component cooling water is available. The RCPs may be operated for a maximum of 10 minutes without component cooling water. Operation for longer periods of time could result in damage to the thrust bearing assemblies. If both seal injection and component cooling were lost, the operating procedures direct the operator to manually trip the RCPs within one minute. In the case where both seal injection and component cooling water are lost, the operator's first priority would be to restore component cooling water to the RCPs.

d. The response to this question was provided in Reference 4.

4. NRC QUESTION

Because RCP trip is required for LOCAs, assurance must be provided that RCP trip will occur when required. To address this concern, provide the following information:

a. Identify the components required to trip the pumps. Include relays, power supplies, breakers, or other equipment. Address equipment reliability, alternate trip methods, and operator training. How much time are the operators allowed to try and trip the RCPs from the control room before they use an alternate trip method? How much time is required to travel to an alternate trip location?

b. If necessary, as the result of the location of any critical component, include the effects of adverse conditions inside or outside containment on RCP trip reliability. Describe the basis for the adverse conditions selected.

ANPP RESPONSE

The four RCPs receive power from two separate non-Class 1E busses. RCPs 1A and 2A are fed from 13.8 kV bus NAN-S01 while RCPs 1B and 2B are fed from 13.8 kV bus NAN-S02. Figure 1 shows the power supply arrangement for the RCPs. The 13.8 kV switchgear NAN-S01 and NAN-S02 are physically located in the switchgear room at the plant southwest corner of the turbine building (i.e., the corner of the turbine building closest to the control building as shown in Figure 2). The switchgear room is located at the grade elevation. As described in the following paragraphs, the RCPs can be tripped locally at the breaker. The breakers for the RCPs are located in the switchgear room. The switchgear room is considered a mild environment that should be accessible at all times during accident situations. If necessary, an operator can be sent to the switchgear room to open the RCP circuit breakers. Due to the proximity of the switchgear room to the

main control room, the operator can reach this alternate trip location in less than 5 minutes.

The operators can use any of the following three methods to stop the RCPs during a LOCA event:

1) The primary breaker trip control is located on panel B04 in the main control room. Each RCP is provided with a breaker control switch which is designated as control switch CS-2. A simplified elementary diagram showing the RCP breaker trip circuitry is shown in Figure 3. When the operator takes control switch CS-2 to the stop position, contact 2-2C closes. This energizes the "TR" relay (GE type HGA relay) which closes the TR relay contact 1-7. This energizes the breaker trip coil (52/TC) which trips the circuit breaker.

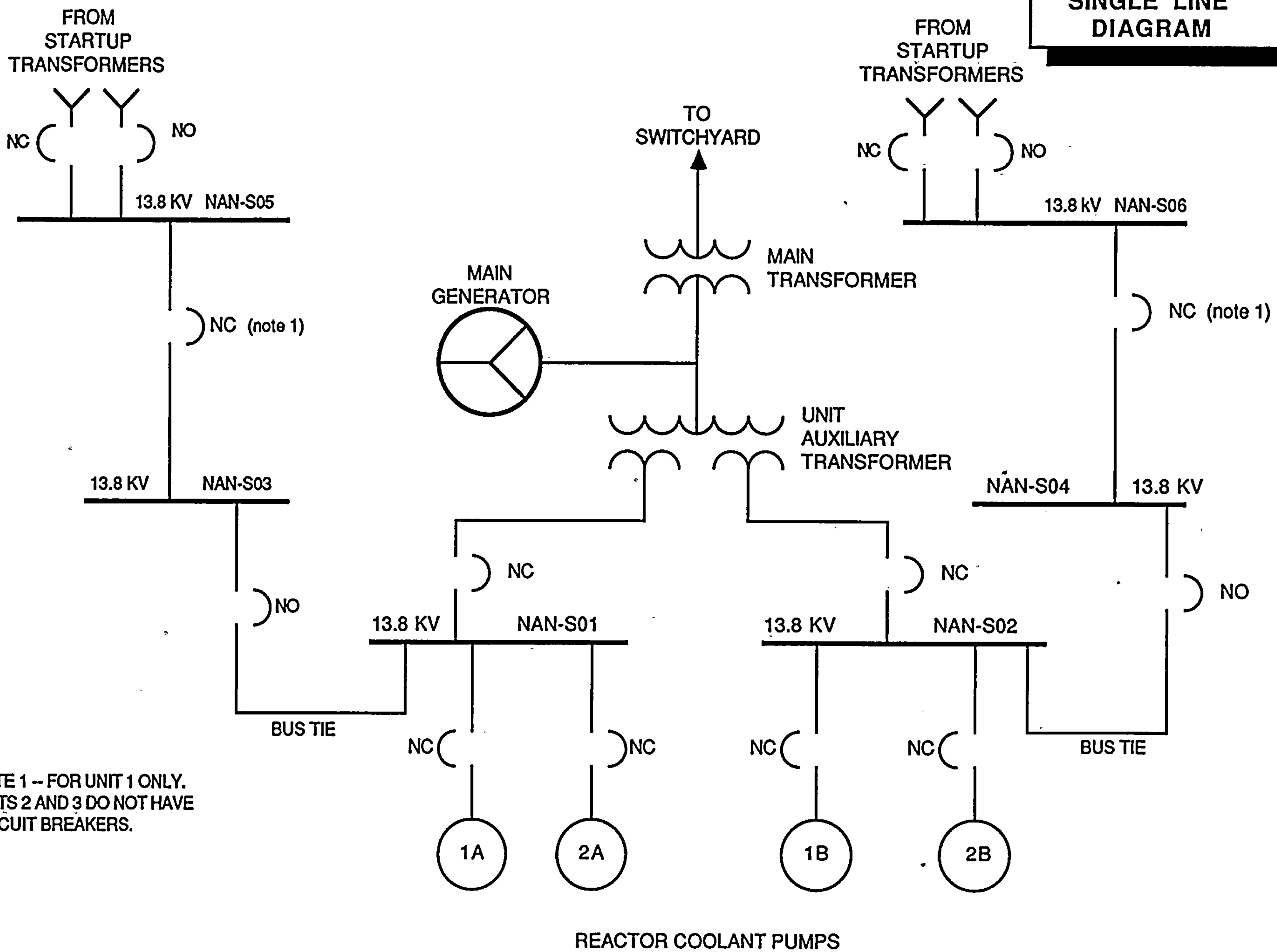
2) The operator can also stop the RCP by using the local control switch CS-1. Breaker control switch CS-1 is mounted at the 13.8 kV switchgear. When breaker control switch CS-1 is taken to the stop position, contact 1-1T closes which trips the circuit breaker.

3) Note that both electrical methods of stopping the RCPs require that the 125 VDC power supply be available. As shown in Figure 3, the 125 VDC control power is supplied from 125 VDC distribution panel E-NKN-D44. During a loss of offsite power event, this distribution panel would normally be available and would be supplied from 125 VDC batteries. In the unlikely event that the 125 VDC control power is lost, the RCP breakers could be tripped locally at the switchgear by pushing the breaker trip lever.

The previous discussion identified several components that are used in the RCP

trip operations. The RCP circuit breakers are GE Magne-Blast circuit breakers (model# AM-13.8-1000, 1200 amps). The control switches are GE type SBM switches (models 10CD526 and 10CG028). The "TR" relay is a GE type HGA relay. As stated in Reference 4, these components are judged to be highly reliable since they have a proven track record of high reliability in other power plant applications. Additionally, some of the components are similar to components that have been qualified for and used in Class 1E applications. There should be no adverse effect on the RCP trip reliability during accident conditions since the control circuitry for the RCP breakers is located in a mild environment.

FIGURE 1
SINGLE LINE
DIAGRAM



NOTE 1 -- FOR UNIT 1 ONLY.
UNITS 2 AND 3 DO NOT HAVE
CIRCUIT BREAKERS.

FIGURE 2
GENERAL ARRANGEMENT

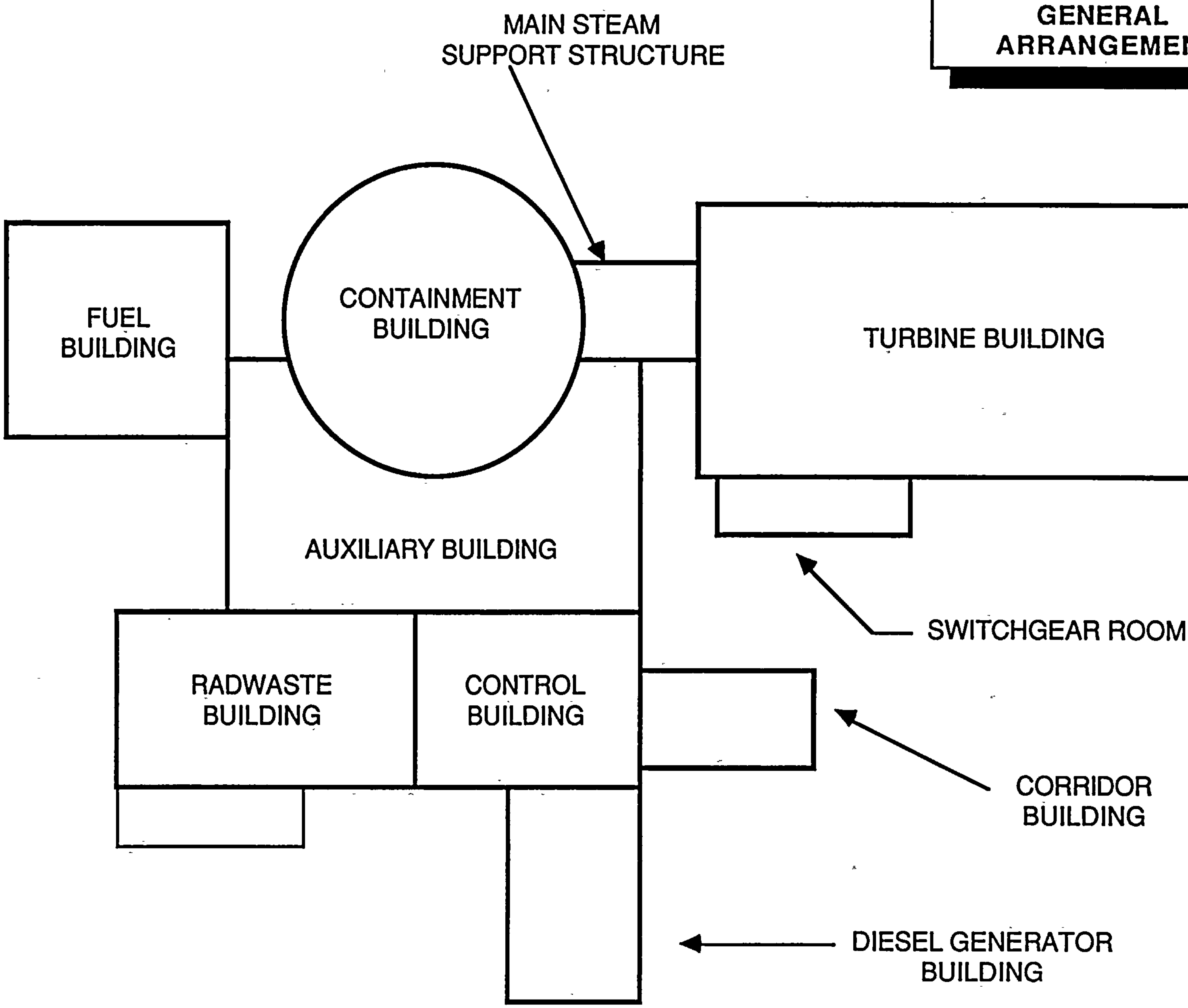


FIGURE 3
RCP TRIP
CIRCUITRY