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L-04-019

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: Beaver Valley Power Station, Unit No. 2
BV-2 Docket No. 50-412, License No. NPF-73
Proposed Revision to the Previously Approved Deviation From Branch Technical Position (BTP) CMEB 9.5-1

FirstEnergy Nuclear Operating Company (FENOC) hereby requests review and approval of a revision to a previously approved deviation from Branch Technical Position (BTP) CMEB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants."

During original plant licensing of Beaver Valley Power Station Unit No. 2 (BVPS-2), a deviation from the requirements of BTP CMEB 9.5-1, Section C.5.b, "Safe Shutdown Capability," associated with the Power Operated Relief Valves (PORVs) and block valve circuits, was requested and granted. Based on NRC guidance for postulating multiple hot shorts for Hi/Lo pressure interfaces, it has been determined that sufficient measures were not provided to preclude a postulated fire-induced LOCA, since external cable-to-cable fire-induced hot shorts of the PORV circuits and the simultaneous failure of the PORV block valves were not fully considered.

Although the non-conforming condition exists, the condition and the potential consequences have been analyzed and it has been determined that the postulated condition does not adversely impact the plant's safe shutdown capability and hence is not a significant degradation of plant safety.

Attachment 1 provides the details and justification for the proposed change.

There are no regulatory commitments contained in this letter. If there are any questions concerning this submittal, please contact Mr. Larry R. Freeland, Manager, Regulatory Affairs/Performance Improvement at 724-682-5284.

Sincerely,

L. William Pearce

E-9

Attachment

c: Mr. T. G. Colburn, NRR Senior Project Manager
Mr. P. C. Cataldo, NRC Sr. Resident Inspector
Mr. H. J. Miller, NRC Region I Administrator

Attachment 1

Beaver Valley Power Station, Unit No. 2

Proposed Revision to the Previously Approved Deviation From Branch Technical Position (BTP) CMEB 9.5-1, Section C.5.b

REQUEST FOR A DEVIATION

FirstEnergy Nuclear Operating Company (FENOC) requests the review and approval of a revision to a previously approved deviation from Branch Technical Position (BTP) CMEB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," Section C.5.b, "Safe Shutdown Capability."

During original plant licensing of Beaver Valley Power Station Unit No. 2 (BVPS-2), a deviation from the requirements of BTP CMEB 9.5-1, Section C.5.b. "Safe Shutdown Capabilities," associated with the PORVs and block valve circuitry, was requested and granted. The NRC Safety Evaluation Report (Reference 3) states that the BVPS-2 FSAR identified 11 areas in which deviations from the separation criteria of BTP CMEB 9.5-1, Section C.5.b exist and these were found to be acceptable deviations.

The BVPS-2 UFSAR, Section 9.5A.2, "Differences from Branch Technical Position CMEB 9.5-1" under the noted differences from Section C.5.b, states in part, that Pressurizer Power Operated Relief Valves (PORVs) 2RCS*PCV455C, D, and 456 are supplied by cables subject to hot shorts, internal to the cable only, that could result in a spurious action of the PORV. The deviation specifically identifies the fire-induced hot short scenario for a fire in RC-1 (Reactor Containment area), however the circuitry for the PORVs could be affected in other fire areas (see Table 1).

The manual actions for de-energizing the PORVs and procedurally addressing this concern were documented in the NRC Safety Evaluation Report (Reference 3) and accepted as an acceptable method to achieve safe shutdown.

Even though there is a very low likelihood of multiple shorts causing a spurious PORV actuation in an ungrounded DC circuit, the existing actions to prevent re-energizing the circuit and causing a spurious actuation of the PORVs is not consistent with the NRC guidance for high-low pressure interface valves.

Generic Letter 86-10 indicates that multiple hot shorts must be postulated for Hi/Lo pressure interface valves. It has been determined that sufficient measures were not provided to preclude a postulated fire-induced LOCA, since external cable-to-cable fire-induced hot shorts of the PORV circuits and the simultaneous failure of the PORV block valves were not considered.

The failure mechanism for this non-conformance could occur if a fire event caused an energized cable to short to the PORV control circuits (positive to positive, negative to negative), while simultaneously damaging the PORV block valve circuits to cause them to fail open or to fail in place. The potentially affected fire areas where the associated PORV circuitry could be affected due to fire-induced hot shorts are listed in the attached Table 1.

The analysis of the non-conforming condition and the potential consequences determined that the results of a fire induced spurious PORV opening does not adversely impact the plant's safe shutdown capability. Although the non-conforming condition exists, the postulated condition and the potential consequences have been analyzed and it has been determined that the condition would not result in an unrecoverable core damage condition that could adversely impact the plant's safe shutdown capability and hence is not a significant degradation of plant safety.

It is requested that the BVPS-2 deviation from BTP CMEB 9.5-1, Section C.5.b, be amended to include the postulated multiple hot shorts (Hi/Lo pressure interface) scenario for cable-to-cable (inter-cable) fire-induced hot shorts for the PORVs with the simultaneous failure of the PORV block valves. The deviation also needs to include the additional fire areas where the PORV circuitry could be affected.

BACKGROUND INFORMATION

REACTOR COOLANT SYSTEM (RCS) DEPRESSURIZATION VIA PORVs

The Pressurizer Power Operated Relief Valves (PORVs) 2RCS*PCV455C, D, and 456 depressurize the RCS during cooldown in preparation for residual heat removal system operation. These solenoid-operated fail-closed valves discharge to the pressurizer relief tank via a common header. Normally open block valves are installed upstream of each PORV to prevent leakage. Three depressurization paths via the PORVs are provided. (See attached Figure 2.3-1 from the BVPS-2 Fire Protection Safe Shutdown Report.) The PORVs limit RCS pressure during large power mismatches, prevent actuation of the fixed high pressure reactor trip, and limit undesirable pressurizer safety valve opening during normal plant (power) operation.

BRANCH TECHNICAL POSITION (BTP) CMEB 9.5-1

BTP CMEB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," states:

C.5.b. Safe Shutdown Capability

(1) Fire protection features should be provided for structures, systems, and components important to safe shutdown. These features should be capable of limiting fire damage so that:

(a) One train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control station(s) is free of fire damage; and

(b) Systems necessary to achieve and maintain cold shutdown from either the control room or emergency control station(s) can be repaired within 72 hours.

(2) To meet the guidelines of Position C5.b.1, one of the following means of ensuring that one of the redundant trains is free of fire damage should be provided:

(a) Separation of cables and equipment and associated circuits of redundant trains by a fire barrier having a 3-hour rating. Structural steel forming a part or supporting such fire barriers should be protected to provide fire resistance equivalent to that required of the barrier:

(b) Separation of cables and equipment and associated circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards. In addition, fire detectors and an automatic fire suppression system should be installed in the fire area; or

(c) Enclosure of cable and equipment and associated circuits of one redundant train in a fire barrier having a 1-hour rating. In addition, fire detectors and an automatic fire suppression system should be installed in the fire area.

NRC SAFETY EVALUATION REPORT SUPPLEMENT 5 (Reference 3) excerpts:

Safe Shutdown Capability

... For the identified associated circuits, the applicant provided circuit isolation and/or procedures to ensure that circuit failures would not prevent safe shutdown. For example, in order to prevent fire-induced spurious signals from causing loss-of-coolant accidents (LOCAs) from sources such as the RHR suction line or PORVs, the following measures are provided. The applicant will lock out power to one of the two series suction line isolation valves during power operation. Similarly, the operator will de-energize the pressurizer PORVs not controlled from the alternate shutdown panel and the reactor vessel head vent valves when using the post-fire alternate shutdown system, thereby preventing any fire-induced spurious actuation of these valves. ...

Safe Shutdown Components

Section C.5.b of BTP CMEB 9.5-1 identifies the separation criteria for redundant safe shutdown components. The applicant had originally intended to install new barriers for areas that do not meet these guidelines By letter dated March 27, 1985, the applicant stated that installation of these barriers would not be possible and that an alternative means of separation would be required, which would necessitate deviations from the SRP. Amendment 14 to the FSAR identified 11 areas in which deviations from the separation criteria exist. One of these areas, the charging pump room, was approved in SSER 3. The remaining deviations have been evaluated through Amendment 14 and during a site audit of January 27-30, 1987. The 10 deviations were found to be acceptable as identified ....

BVPS-2 UFSAR APPENDIX 9.5A

9.5A.2, "Differences from BTP CMEB 9.5-1," states in part:

*Pressurizer PORVs 2RCS*PCV455C, D, and 456 are supplied by multiconductor 125 V dc cables. These cables are subject to hot shorts, internal to the cable only, that could result in a spurious actuation of the PORV. To mitigate the consequences of a spurious actuation that would result in an uncontrolled depressurization, the circuit breaker for 2RCS*PCV455C, D and 456 will be opened at their respective power panels, on the first indication of fire in RC-1. In addition, circuit breakers for computer signal isolators will be opened, to deenergize all conductors in the cables. This effectively eliminates the hot short hazard, and causes the PORV to fail closed. Based on the guidelines for evaluating hot shorts, only one of the valves is subject to a hot short. The PORV block valves are not subject to fire induced hot shorts inside RC-1. The possibility does exist however, that the ability to operate the PORV block valves may be lost due to the same fire which results in the spurious opening of the PORV. The aforementioned "worst case" event provides additional justification for breaker opening to preclude or eliminate a PORV spurious opening.*

OVERVIEW

As stated in the BVPS-2 Fire Hazards Analysis, Safe Shutdown Evaluation, for each fire area, spurious operations were evaluated assuming that the plant's safe shutdown capability would not be adversely affected by a fire in any plant area which results in spurious actuation of the redundant valves in any one high-low pressure interface line (See BVPS-2 UFSAR page 9.5A-7). This included the Pressurizer PORVs. The BVPS-2 Fire Protection Program did acknowledge that the PORVs were subject to hot shorts, internal to the cable only, that could result in a spurious actuation of the PORV (See UFSAR excerpt above). Thus, a specific deviation was obtained for spurious actuation of PORVs. As noted above, the UFSAR states "To mitigate the consequence of a spurious actuation that would result in an uncontrolled depressurization, the circuit breaker for 2RCS*PCV455C, D and 456 will be opened at their respective power panels, on the first indication of a fire in RC-1. In addition, circuit breakers for computer signal isolators will be opened, to deenergize all conductors in the cables." Thus, these compensatory measures identified in the UFSAR effectively eliminate the hot (internal to the cable) short, and cause the PORVs to fail closed, and a stuck-open PORV did not have to be analyzed. This also includes not analyzing a stuck-open PORV due to a cable-to-cable or external hot short. Based on recent industry guidance (Draft Regulatory Issue Summary, RIS, Reference 6) that a cable-to-cable hot short may also cause spurious actuation of equipment, the previous compensatory measures (to manually de-energize the PORVs and block valves) may not be effective since the controls could be energized by external hot shorts resulting from a fire even though the power was removed remotely, and a PORV could be spuriously opened via inter-cable shorts.

Protection was not provided for PORV circuits to the extent required by these documents. The failure mechanism for this non-conformance would occur if a fire event caused an energized cable to short to the PORV control circuits (positive to positive, negative to

negative), while simultaneously damaging the PORV block valve circuits to cause them to fail open or to fail in place. The PORV block valves could also be damaged by the same fire which is postulated to cause spurious PORV operation, and therefore cannot be assumed to be available.

The important to safety function is maintaining the reactor coolant pressure boundary to achieve safe shutdown following a fire in any plant area. Open PORVs result in a loss of reactor coolant inventory (vapor space LOCA) which is not in full compliance with the licensing basis (BTP CMEB 9.5-1) and potentially could impair the post-fire safe shutdown capability.

The event that the safety function provides protection against is a fire-induced LOCA.

JUSTIFICATION

Generic Letter 86-10 indicates that multiple hot shorts must be postulated for Hi/Lo pressure interface valves. Sufficient measures were not provided to preclude a postulated fire-induced LOCA, since external cable-to-cable fire-induced hot shorts of the PORV circuits and the simultaneous failure of the PORV block valves were not considered.

The failure mechanism for this non-conformance would occur if a fire event caused an energized cable to short to the PORV control circuits (positive to positive, negative to negative), while simultaneously damaging the PORV block valve circuits to cause them to fail open or to fail in place.

The important to safety function is maintaining the reactor coolant pressure boundary to achieve safe shutdown following a fire in any plant area. Open PORVs result in a loss of reactor coolant inventory (vapor space LOCA) which is not in full compliance with the licensing basis (BTP CMEB 9.5-1) and potentially could impair the post-fire safe shutdown capability.

Information supplied via Federal Register Vol 68, No. 159 (page 49532) on August 18, 2003 regarding hot shorts states: "Recent testing strongly suggests that fire-induced hot shorts will likely self-mitigate (e.g., short to ground) after some limited period of time. Available data remains sparse, but there are no known reports of a fire-induced hot short that lasted more than 20 minutes. This is of particular importance to devices such as air-operated valves (AOVs) or pressure-operated relief valves (PORVs) which return to their de-energized position upon mitigation of a hot short cable failure. Pending further research, inspectors should defer the consideration of such faults if they can verify that a spurious operation of up to 20 minutes duration will not compromise the ability of the plant to achieve hot shutdown." This same industry guidance notes that "Inter-cable

shorting for thermo-set cables is considered to be substantially less likely than intra-cable shorting. Hence, the inspection of potential spurious operation issues involving inter-cable shorting for thermo-set cables is being deferred pending additional research."

The circuits affected are ungrounded 125 VDC circuits. A single fire-induced cable-to-cable hot short will not result in spurious opening of the PORVs. In order to open a single PORV, a minimum of two conductor-to-conductor shorts of the proper polarity would be required. The draft RIS identifies inter-cable shorting for thermo-set cables as an item that is to be deferred at this time because of the low likelihood of occurrence. Inter-cable shorting would be unlikely in this described case because the energized conductors are in separate cables from the deenergized conductors. Therefore, the cables would be separated by cable jackets, in addition to the conductor insulation within the raceway, making a hot short less probable than a conductor-to-conductor short in the same cable.

Electric Power Research Institute (EPRI) Report TR-1003326, Characterization of Fire-Induced Circuit Faults: Results of Cable Fire Testing discusses the potential duration of spurious operation events. The test data used for the EPRI report shows that a majority of the circuit failures resulting in spurious operation had a duration of less than 1 minute. Less than 10% of all failures lasted more than 5 minutes, with the longest duration recorded for the tests equal to 10 minutes. From this it may be concluded that the chance of having two such faults at the same time on the specific conductors to cause a spurious actuation would be extremely unlikely.

Fire testing indicates that spurious actuations do not typically occur for 30 minutes or more, especially for thermoset cable, which is the applicable type cable for this BVPS Unit 2 application, allowing for additional operator action time, and time to detect and extinguish the fire before spurious actuations occur.

The probability of needing the PORVs to remain isolated during a fire in the postulated areas is 100 percent of the time. Since the total of the BVPS Unit 2 PRA fire initiating event frequencies for all of the postulated areas affected is 2.18E-03 per year, the probability of needing this safety function is then 2.18E-03.

However, if a hot short occurs that causes an unisolated PORV LOCA (i.e., causes the PORV to open and prevents the associated PORV block valve to close) the resultant scenario is similar to a non-isolable small break LOCA. The probability of a multiple hot short is assumed to be 0.01 (0.1 x 0.1) based on NEI 00-01, Rev. 0, Table 4-2 (derived from EPRI Report 1006961) for Medium probability of occurrence (separate multi-conductor cables), BVPS use of thermo-set cables, and the fact that the postulated hot short would involve separate cables. Therefore, the conditional probability of having a non-isolable small break LOCA during one of the postulated fires modeled in the PRA is

0.01. This results in a total core damage frequency (CDF) of 3.46E-05 per year at BVPS-2, or an increase of just 3.3E-07 per year, and a total large early release frequency (LERF) of 1.14E-06 per year, or an increase in LERF of less than 4.0E-12 per year. This increase in CDF/LERF assumes that the manual operator actions (for de-energizing the circuit and/or closing the block valve) and fire brigade response is unsuccessful in preventing the fire induced spurious operation PORV LOCA. Typically, increases in CDF (or delta CDF) of less than 1.0E-06 and increases in LERF (or delta LERF) of less than 1.0E-07 are considered to be very small based on regulatory guidance (e.g., Regulatory Guide 1.174, Rev. 1). Therefore, the impact on CDF and LERF of this non-conforming condition that would result in a fire induced spurious PORV opening is likewise considered to be very small and of low risk significance.

CONCLUSION

The failure mechanism for this non-conformance could occur if a fire event caused an energized cable to short to the PORV control circuits (positive to positive, negative to negative), while simultaneously damaging the PORV block valve circuits to cause them to fail open or to fail in place. The potentially affected fire areas, where the associated PORV circuitry could be affected due to fire-induced hot shorts, are listed in the attached Table 1.

Although the non-conforming condition exists, the postulated condition and the potential consequences have been analyzed and it has been determined that the condition would not result in an unrecoverable core damage condition that could adversely impact the plant's safe shutdown capability and hence is not a significant degradation of plant safety.

It is requested that the BVPS-2 deviation from BTP CMEB 9.5-1, Section C.5.b, be amended to include the postulated multiple hot shorts (Hi/Lo pressure interface) scenario for cable-to-cable (inter-cable) fire-induced hot shorts for the PORVs with the simultaneous failure of the PORV block valves. The deviation also needs to include the additional fire areas where the PORV circuitry could be affected.

REFERENCES

1) NUREG-0800, USNRC Standard Review Plan, Section 9.5.1 Fire Protection Program
2) Branch Technical Position CMEB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants"
3) NUREG-1057, Supplement No. 5, Safety Evaluation Report related to the operation of Beaver Valley Power Station, Unit 2 (May 1987)
4) BVPS-2 Updated Final Safety Evaluation Report (UFSAR), Section 9.5A.2, "Differences from Branch Technical Position CMEB 9.5-1"

5) NRC Generic Letter 86-10, "Implementation of Fire Protection Requirements" (April 14, 1986)
6) Federal Register Vol. 68, No. 159, page 49532 (August 18, 2003), Draft NRC Regulatory Issue Summary, RIS

TABLE 1

List of BVPS Unit 2 fire areas potentially affected by the Postulated Fire-induced Hot Short Spurious Operation of the PORVs and associated Block Valves:

CB-1 Control Building Instrumentation and Relay Area
CB-2 Control Building Cable Spreading Room
CB-3 Control Building Main Control Room
CB-6 Control Building West Communication Room
CT-1 Cable Tunnel
CV-1 Cable Vault and Rod Control Area
CV-2 Cable vault and Rod Control Area (East)
CV-3 Cable vault and Rod Control Area (Elev. 755'6")
SB-1 Emergency Switchgear Room (Orange)
SB-2 Emergency Switchgear Room (Purple)
SB-3 Service Bldg. Cable Tray Area
ASP Alternative Shutdown Panel Room
RC-1 Reactor Containment

Attachment 1 to L-04-019 (continued)
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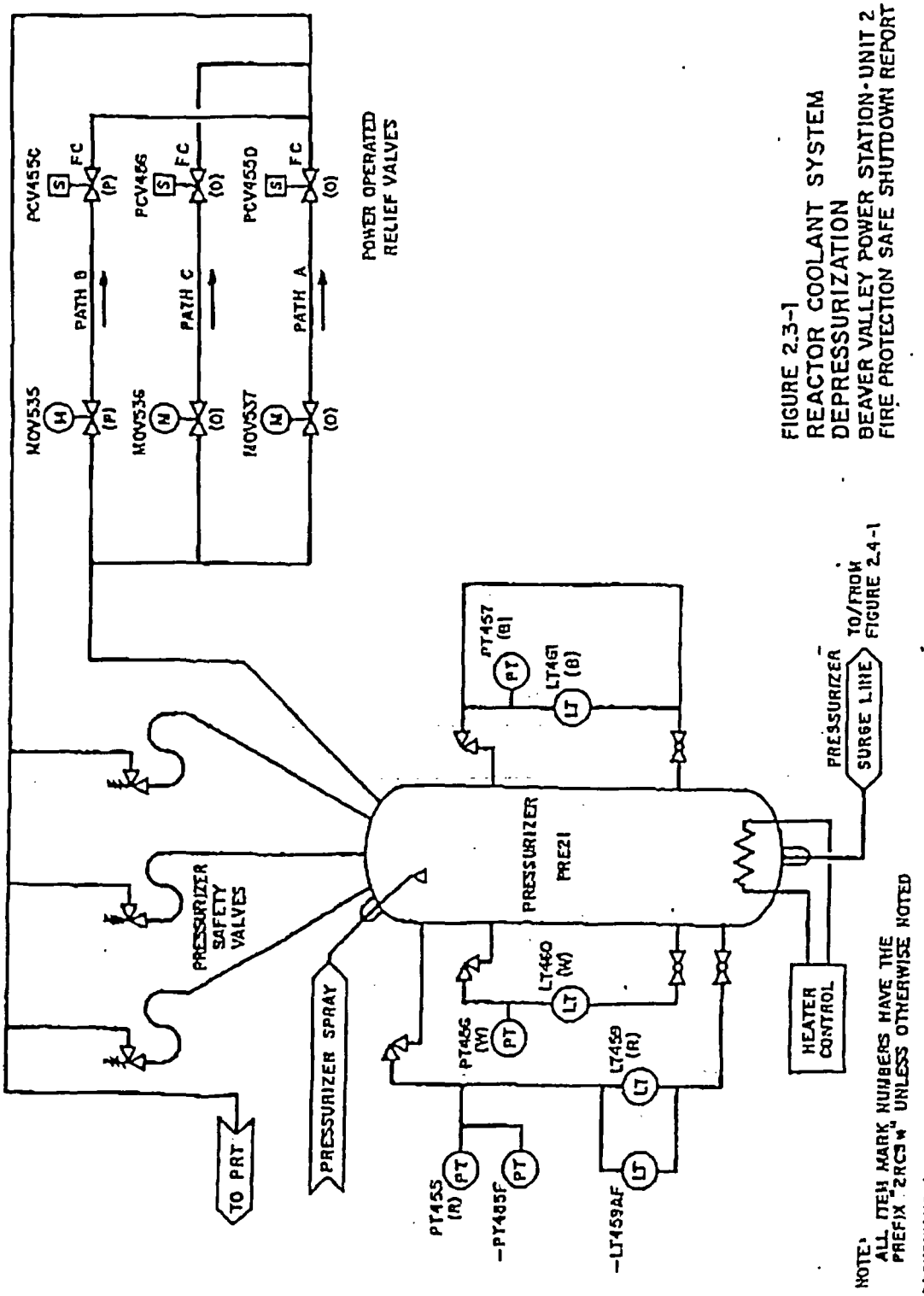

FIGURE 2.3-1
REACTOR COOLANT SYSTEM
DEPRESSURIZATION
BEAVER VALLEY POWER STATION - UNIT 2
FIRE PROTECTION SAFE SHUTDOWN REPORT