UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MEMORANDUM FOR: Carl H. Berlinger, Chief
Generic Communications Branch
Division of Operational Events Assessment

FROM: Faust Rosa, Chief
Electrical Systems Branch
Division of Systems Technology

SUBJECT: LOSS OF OFFSITE POWER RESULTING FROM A LACK OF PREVENTIVE MAINTENANCE AND INADEQUATE PERSONNEL TRAINING

The Electrical Systems Branch, with editorial assistance, has prepared the enclosed draft information notice on loss of offsite power resulting from both lack of preventive maintenance on the electrical bus ducts and inadequate personnel training to troubleshoot the grounding problem. This condition was discovered at Brunswick Unit 2 on June 17, 1989.

Based on the recent event at Brunswick, we recommend that the final information notice be sent to all licensees.

Faust Rosa

Faust Rosa, Chief
Electrical Systems Branch
Division of Systems Technology

Enclosure:
As stated

cc: A. Thadani
C. Rossi
R. Kendall

Contact:
P. Kang, SELB/DST
X20812

1/28/91

9001090062-XA

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

DECEMBER XX, 1989

NRC INFORMATION NOTICE NO. 89-XX: LOSS OF OFFSITE POWER RESULTING FROM A LACK OF PREVENTIVE MAINTENANCE AND INADEQUATE PERSONNEL TRAINING

Addressees:

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose:

This information notice is intended to alert addressees to potential problems of losing offsite power resulting from both a lack of preventive maintenance on electrical bus ducts and inadequate personnel training to troubleshoot grounding problems. It is expected that recipients will review this information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On June 17, 1989, while Brunswick Unit 2 was at 100 percent power, an inadequate water drainage in a 4-kV bus duct between the startup auxiliary transformer (SAT) and the turbine building caused a high impedance ground fault on the secondary side of the SAT. Because there was a possibility of losing the SAT as a result of this ground fault, operators began to reduce the power level of the reactor and started troubleshooting the grounding problem. In an effort to verify and clear the ground condition, the maintenance crew improperly placed a jumper across the primary side of the grounding transformer thinking it was a current transformer. This procedure created a low impedance ground path for the already present ground and allowed a high ground fault current to flow into the grounded bus duct. As a result, the SAT was isolated by the transformer differential protection scheme. Two reactor recirculation pumps (RRPs) are normally fed from the SAT. Upon loss of the RRPs, the licensee was required, as specified by NRC Bulletin 88-07, to initiate a manual reactor scram. This was done to prevent a possible reactor instability and core oscillations.

Following the reactor scram and subsequent turbine shutdown, power to the Class 1E buses that are normally fed from the unit auxiliary transformer (UAT) was lost, resulting in a loss of offsite power (LOOP) to the unit (on a unit shutdown, the class 1E buses are transferred from the UAT to the SAT). The diesel generators for both units auto-started as designed. Approximately 9 hours later, power to the Class 1E buses was restored by backfeeding from the UAT through the main transformer (the delayed offsite power source).

Discussion:

A ground fault on the secondary side of the SAT occurred as a result of the licensee's failure to open the drains of the SAT bus ducts. Also, inadequate training of maintenance personnel to troubleshoot the high resistance neutral grounding system and a lack of proper annunciator response for the electrical ground contributed to this event. After shutdown of the reactor, a loss of offsite power to the balance-of-plant buses lasted approximately 6 hours, while the recovery of offsite power to the Class 1E buses took an additional 3 hours. This situation resulted from a lack of procedural guidance for backfeeding through the main transformer to the UAT with the SAT out of service.

The following corrective actions are being undertaken:

1. The licensee has developed a preventive maintenance to assure that bus ducts are regularly inspected, cleaned, and maintained.

2. The licensee has provided training to the appropriate plant personnel on the ground detection and clearing methods.

3. Since the restoration of the offsite power source by backfeeding through the main transformer involves removal of the main generator linkage and takes about 9 hours (see Figure 1 attached), the licensee will establish appropriate procedures and a time limit for restoring offsite power, after the loss of the SAT, to satisfy General Design Criterion (GDC)-17. (GDC-17 requires that the time to restore offsite power should be less than the time required to assure specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary.)

4. The licensee will explore additional offsite power sources through a variety of paths. This exploration may include a crosstie to an adjacent unit if available, as well as installing a new offsite line.

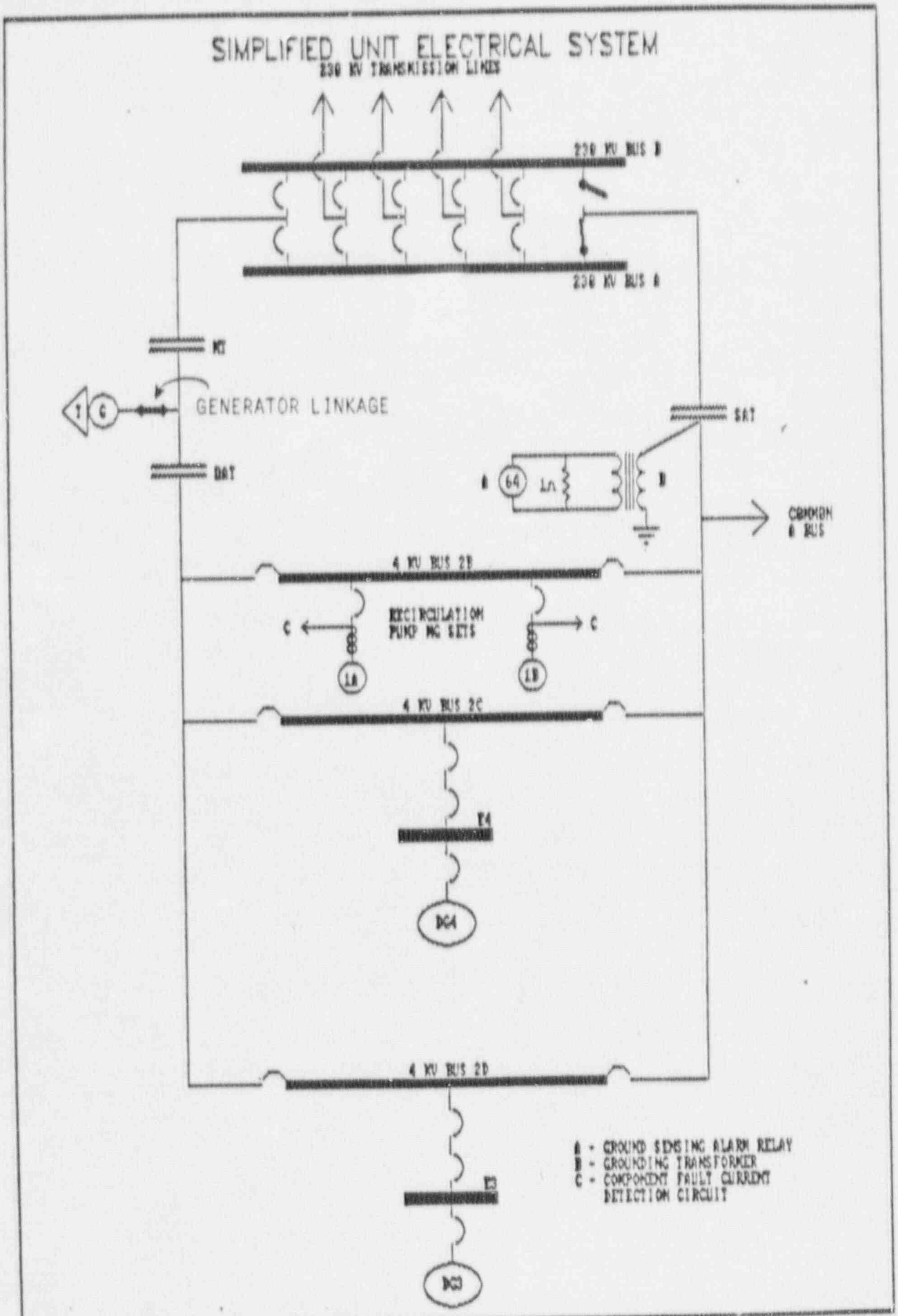
5. The licensee is also considering a procedure change to transfer the power source for the RRPs from the SAT to the UAT.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact the technical contact listed below or the regional administrator of the appropriate regional office.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contact:
Peter Kang, SELB/DST
(301) 492-0812

Attachments:
1. Figure 1
2. List of Recently Issued NRC Information Notices


SIMPLIFIED UNIT ELECTRICAL SYSTEM
230 KV TRANSMISSION LINES
230 KV BUS B
230 KV BUS A
MT
GENERATOR LINKAGE
T
G
UAT
SAT
A
64
1Ω
B
COMMON
A BUS
4 KV BUS 2B
RECIRCULATION
PUMP MG SETS
C
C
1A
1B
4 KV BUS 2C
E4
DG4
4 KV BUS 2D
E3
DG3
A - GROUND SENSING ALARM RELAY
B - GROUNDING TRANSFORMER
C - COMPONENT FAULT CURRENT
DETECTION CIRCUIT

Attachment 3

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

FEB 1 3 1990

MEMORANDUM FOR: Charles E. Rossi, Director
Division of Operational Events Asssement, NRR

FROM: Thomas M. Novak, Director
Division of Safety Programs, AEOD

SUBJECT: CROSBY LOW PRESSURE RELIEF VALVES

The enclosed study of Crosby low pressure relief valves highlights a significant issue regarding deficient maintenance of these protective devices that can lead to degradation of important safety systems. The recent extended blowdown of the primary system at Braidwood, Unit 1, is directly related to a problem with a Crosby low pressure relief valve in the residual heat removal system. The loss of coolant event represented a significant reduction of safety margin at the plant.

All relief valves have some type of adjustable ring that surrounds the nozzle discharge area and affects the lift and reseat characteristics of the valve. As discussed in the study, extended blowdown events observed at two plants were related to setting the ring too high, while observed valve disc assembly failure observed at a third plant was attributed to too low a ring setting. Both of these phenomena degrade the valve and impact the performance of the system to which they are attached. These systems include RHR and component cooling water.

The valve manufacturer does not routinely receive operational data on these valves and has not issued any advisories on problems with these low pressure valves. The TMI accident stimulated significant effort on high pressure safety and relief valves attached to the reactor or steam generators, but this work has not carried over to valves on low pressure systems important to safety.

Also enclosed is a draft of a proposed information notice that we recommend be sent to all licensees to inform them of the benefits of proper maintenance of low pressure relief valves. For further information regarding this study, please contact S. Israel (x24437) of my staff.

J E Rosenthal for
Thomas M. Novak, Director
Division of Safety Programs, AEOD

Enclosure: As stated

cc w/enclossure:
T. Sullivan, NRR
F. Cherney, RES
M. Wegner, AEOD
E. Brach, NRR

9002220113 3p

AEOD/E90-02

CROSBY LOW PRESSURE RELIEF VALVES NOZZLE RING PROBLEMS

February 1990

By: S. Israel

Office for Analysis and Evaluation
of Operational Data

9002220116 13pp

SUMMARY

Extended blowdowns at three reactors while on residual heat removal were caused by defects in the low pressure relief valves attached to the systems. Incorrect nozzle ring setting was the major contributor to these events, which posed a reduction in safety margins at the plants. The report discusses procedural and personnel errors that impact the nozzle ring setting.

1. INTRODUCTION

The extended blowdown of the primary system that occurred at Braidwood while on the residual heat removal system highlighted the importance of proper maintenance of relief valves on low pressure systems. Similar events have occurred at other plants in the past five years. These valves generally have not received the attention given to the high pressure safety and relief valves on the reactor and steam generators, and yet, they can have a significant impact on the safety margin at the plant. Nozzle ring settings establish the blowdown characteristics of these valves and are determined during a functional test performed by the manufacturer prior to delivery.

Extended blowdown of these valves can result in a loss of function of the system to which they are attached and thus degrade the capability of the plant to achieve and maintain a safe shutdown condition. The severity of an event would, of course, depend on the availability of redundant systems to fulfill the degraded or lost safety function. This type of degradation could be particularly significant if it occurred during recovery from some other upset condition and thus impeded the recovery. Several related events at different plants are examined in this study to identify potential improvements in the maintenance of these valves.

2. DESCRIPTION OF EVENTS

Braidwood, Unit 1

An extended blowdown event occurred at Braidwood, Unit 1, during plant start-up operations on December 1, 1989 (Ref. 1). As a bubble was being drawn in the pressurizer and the pressure at the residual heat removal (RHR) pump suction was approaching 416 psig, a suction relief valve in one of the RHR lines suddenly opened and the primary system pressure dropped to about 270 psig over the next 18 minutes. The initial discharge rate was estimated to be about 900 gpm. The pressurizer level dropped off scale low 11 minutes into the event. The operators isolated one train of RHR fairly quickly to stop the loss of coolant, but determined about two hours later that they had isolated the wrong RHR train. Approximately 67,000 gallons of RWST water was injected into the primary system before the leak was finally isolated.

Subsequent investigation of the problem relief valve indicated that its set pressure was low by about 10% and the nozzle ring was set well above its correct position.

Braidwood, Unit 1

During shutdown operations at Braidwood, Unit 1, in March 1988, the operators noted excessive volume control tank make-up over a period of several hours (Ref. 2). Investigation revealed that the discharge line from the RHR suction relief valves was hot. The valve on one of the trains was agitated and the temperature of the discharge piping decreased; however, the piping in the redundant train stayed hot. Subsequent examination of the leaking relief valve indicated that it had a broken disc insert pin and a nozzle ring setting that was too low.

Haddam Neck

On December 4, 1986, one of the RHR suction relief valves opened following a pressure spike to 380 psig and failed to reseat until the pressure had decreased to 260 psig when the faulted RHR train was isolated ten minutes later (Ref. 3). Upon disassembly, it was noted that the nozzle ring was unmovable. The nozzle ring was found jammed in the highest locked position (125 notches above level). The original test report indicated that the nozzle ring should be set at 100 notches below level, which corresponds to a valve reseating at a pressure of 342 psig.

Foreign Reactor

In May 1985, about 25,000 gallons of reactor coolant was released to the containment sump through a RHR suction relief valve (Ref. 4). The primary system pressure stopped decreasing after about 30 minutes into the event when the RHR system was isolated. Inspection of the suction relief valves from both trains indicated that both had broken disc insert pins. One of the valves had a nozzle ring setting 366 notches below level instead of the manufacturer's original nozzle setting of 105 notches below level.

3. DISCUSSION

All of the valves involved in the referenced events were Crosby relief valves, Model JB-35-TD-WR-B, which is used in a number of nuclear plants in the U.S. As shown in Fig. 1, the valve nozzle (about 1.5 to 2 in. diam.), which forms the valve seat, is surrounded by a ring that is screwed on the nozzle. The valve disc insert, connected to the spindle by an insert pin, is surrounded by a disc ring that is also held in place by the insert pin. The spindle is spring loaded to push the disc insert against the valve nozzle. The nozzle ring is sufficiently long to guide the disc assembly when the valve is actuated. A bellows surrounds the spindle above the disc assembly to negate the impact of back pressure on the valve lift point.

When the valve lifts, the jet emanating from the nozzle gives up its axial momentum inside the nozzle ring and then discharges laterally through holes in the nozzle ring into the cavity formed by the valve body. The nozzle ring is set during a functional test by the manufacturer to provide the design discharge flow at full lift conditions. This setting also establishes the valve blowdown pressure when the valve reseats. Design flow capacity is achieved at a pressure differential across the valve about 10 percent above the set pressure. Blowdown or reseat pressure is about 10 percent below the set pressure.

Based on the manufacturer's test reports for the Braidwood valves, the nozzle ring position should be set about 105 notches below a level position which is about 230 notches below the highest locked position. The highest locked position for the nozzle ring is determined by rotating the ring until there is contact between the ring and the bellows protector located above the nozzle. Backing off about 230 notches from this position should result in the lower edge of the holes in the nozzle ring being at the elevation of the nozzle surface as shown in Fig. 2. This is designated the level position. The proper ring position is about 105 notches lower than the level position so the holes in the nozzle ring straddle the nozzle surface as shown in Fig. 2. The nozzle ring is rotated by using a screw driver through a hole in the back side of the valve to move notches around the ring circumference. There are 18 to 30 notches around the nozzle ring for the valves of interest. There are about 24 turns per inch.

The nozzle ring is set by the manufacturer prior to delivery and locked in place by a set screw that engages a notch in the ring. Only valve maintenance requiring disassembly would disturb the nozzle ring setting. The manufacturer's instruction for fixing the ring setting is to run the valve up to the stop while counting notches before disassembly. The number of notches is to be recorded. During reassembly, the process is reversed. The nozzle ring is run up to the stop and backed off the number of notches previously recorded. The process is straight-forward, but it requires counting out 300 to 400 notches in both directions and mistakes are cumulative over the number of maintenance activities performed. There is no visual marking that would indicate that the ring was in the right or wrong position.

The 1988 Braidwood event initiated an examination of all five RHR suction relief valves at the site. Four of the five valves had nozzle rings set low by 20 to 150 notches, with the referenced valve in the LER being low by about 90 notches. Corrective maintenance was performed on two of these valves in the 1988 time frame to repair the broken disc insert pin on the referenced valve and to replace a damaged nozzle on another valve. This is similar to the outcome at the foreign plant where broken disc insert pins had to be replaced on both valves and both valves had low ring settings, although only one appeared excessive. Thus, there appears to be some correspondence between damaged valves and low nozzle ring settings.

One hypothesis is that a low nozzle ring setting results in valve chatter that ultimately causes disc insert pin failure. An analysis of pin loads and cycles necessary to cause pin failure has not been developed. Valve chatter leading to failure can also occur if there is significant pressure drop in the inlet pipe to the valve. In this situation, there would be a dynamic interaction between the system pressure drop and the valve accumulation and blowdown characteristics. Another hypothesis is that excessive valve gagging loads during system hydro tests may have damaged the valves. The valve failures discussed above occurred during plant shakedown prior to initial criticality or within the first operating cycle. Excessive gagging would be consistent with the observed pin failure in a Braidwood relief valve that had the correct nozzle ring setting.

The fifth valve at Braidwood had a nozzle ring set high by about 300 notches in 1988. The bellows in this valve was repaired at the time the incorrect nozzle ring setting was noted. A high nozzle ring setting was found on the faulted RHR suction relief valve that caused the extended blowdown event at Braidwood in 1989 (Ref. 1). The cause of this high setting was attributed to mechanic error apparently as the result of using different ring setting methods in the same maintenance activity. An extended blowdown also occurred at Haddam Neck in 1986 through an open relief valve that had a nozzle ring set too high (Ref. 3). In this instance, the cause of the incorrect ring setting was not determined.

Relief valves manufactured by Crosby have caused extended blowdowns of low pressure systems at other plants. An event occurred at Salem in 1981 (Ref. 5) and the depressurization lasted over an hour before the RHR system was isolated. A similar event occurred at Farley in 1987 (Ref. 6). An extended blowdown of the component cooling water system at Byron occurred in 1986 (Ref. 7). It was noted that the nozzle ring was incorrectly adjusted in that event. The exact cause of the extended blowdowns was not addressed in these reports; however, they reenforce a continuing concern about degraded system function due to poor relief valve performance.

Timely isolation of the affected train varies considerably and may be a function of monitoring instrumentation and system lineup. In some plants, the relief valves discharge to the pressurizer relief tank which is monitored and alarmed in the control room. Some plants have acoustic monitors on the discharge side of the relief valves which provide positive indications when a valve lifts. Other plants have less monitoring capability which considerably hampers the diagnosis of an extended blowdown event.

Extended blowdowns caused by relief valve deficiencies reduce the safety margins at plants because of degradation of systems needed to respond to potential plant events and accidents. For instance, blowdown of the component cooling water system would impact post LOCA heat removal at most PWRs. Degradation of the RHR system because of defective relief valves compromises a plant's ability to achieve cold shutdown following an extended loss of offsite power event or a steam generator tube rupture accident. Similarly a leaking relief valve in the RHR system could defeat long term core cooling following a LOCA.

An incorrect nozzle ring setting on a relief valve adversely affects the valve's characteristics and can result in uncontrolled leakage or discharge from the valve as noted in the above discussion. A low setting may produce valve chatter and ultimate valve failure leading to uncontrolled leakage. A very high nozzle setting may eliminate the ventilation area at the nozzle surface provided by the holes in the nozzle ring as indicated in Fig. 3. Under these conditions, the valve reseat may be significantly delayed because of the cushion of water trapped under the valve disc assembly.

The process of setting the nozzle ring using a screw driver and counting several hundred notches is prone to error. Albeit, the manufacturer believes it is a simple procedure that can be performed satisfactorily on a work bench where a second mechanic can count notches moved by looking through the valve discharge port. Valve maintenance would ordinarily take place on a bench because of the need to perform a set pressure test after maintenance. The discrepancies in nozzle ring settings noted above do not definitively identify the screw driver-notch counting process as the source of error versus incorrect procedures given to the mechanic or some other form of misinformation introduced into the process. Consequently, all aspects of the process may need improvement to reduce errors.

Examination of nozzle adjustment procedures has indicated potential confusion in directions. As noted earlier, including two different procedures for setting the nozzle ring in the same maintenance work package introduces an unnecessary source of error. In fact, it is unclear why there should even be two procedures available to perform the same task. The directions themselves can introduce confusion when they state "turn the nozzle ring to the right (counter clockwise)", when the mechanic is looking edgewise at the notched ring and axial movement is very slow. Clockwise or counter-clockwise may not be obvious.

4. CONCLUSIONS

An incorrect nozzle ring setting on a low pressure relief valve degrades valve performance sufficiently to cause excessive valve leakage or discharge after being actuated. Excessive valve discharge adversely affects safety system functions and consequently reduces the margin of safety at a plant. The ring setting process is prone to errors because of confusion introduced by the procedures or errors in using the procedures. Errors could be greatly reduced by using visual marks to set the ring or better defining or controlling the present ring adjustment process.

5. REFERENCES

1. U.S. Nuclear Regulatory Commission, Inspection Report 50-456/89-xx, Braidwood, Unit 1, December 28,1989.

2. Commonwealth Edison Company, Licensee Event Report 50-456/88-008, Braidwood, Unit 1, April 25, 1988.

3. Northeast Utilities, Licensee Event Report 50-213/86-046, Rev. 2, Haddam Neck, December 8, 1988.

4. OECD Nuclear Energy Agency, Proprietary, October 1, 1986.

5. Public Service Electric and Gas Company, Licensee Event Report 50-311/81-41, Salem, Unit 2, July 9, 1981.

6. Alabama Power Company, Licensee Event Report 50-364/87-008, Farley, Unit 2, 2, December 23, 1987.

7. Commonwealth Edison Company, Licensee Event Report 50-455/86-001, Byron, Unit 2, December 19, 1986.

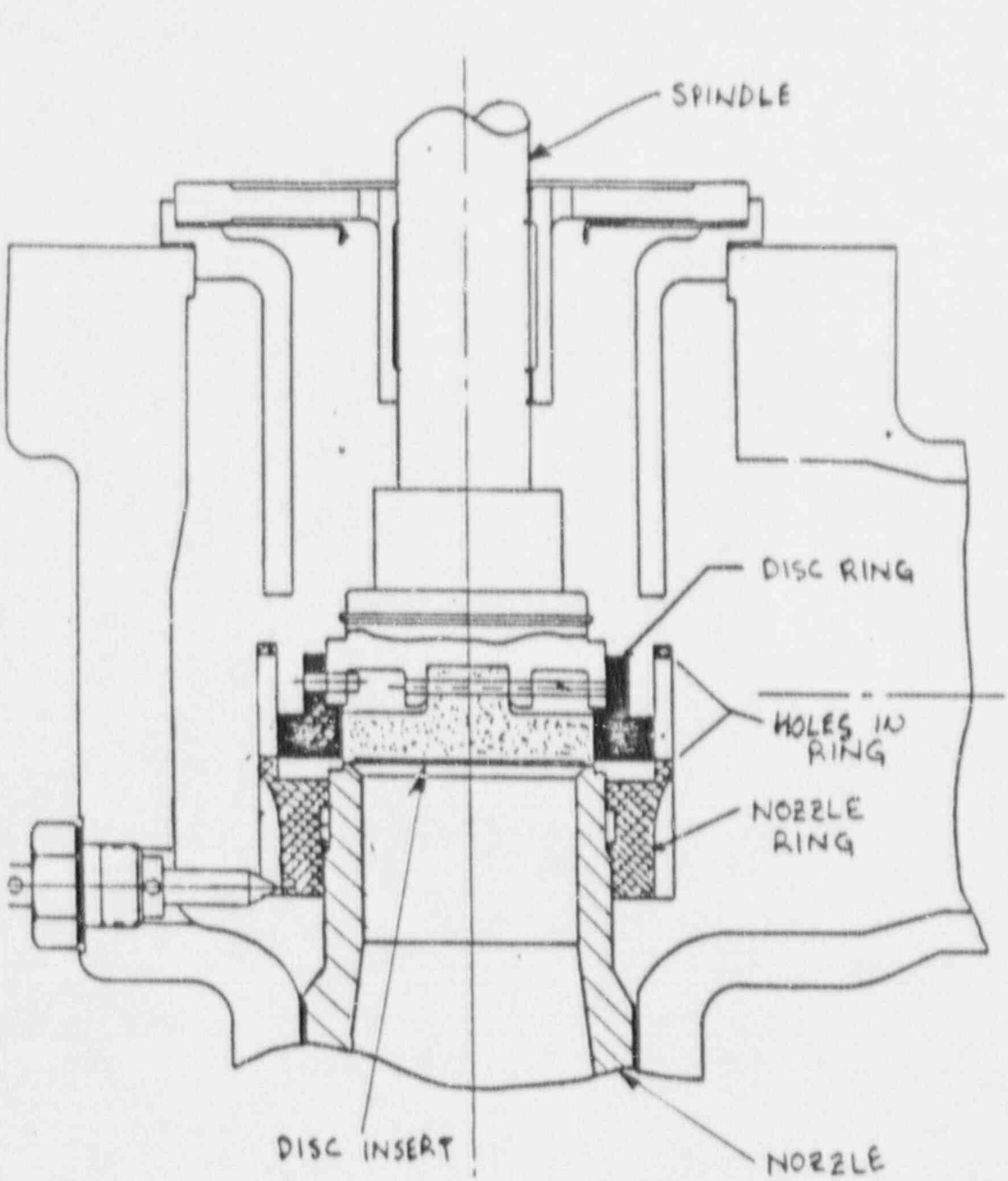


FIG. 1 VALVE CUTAWAY

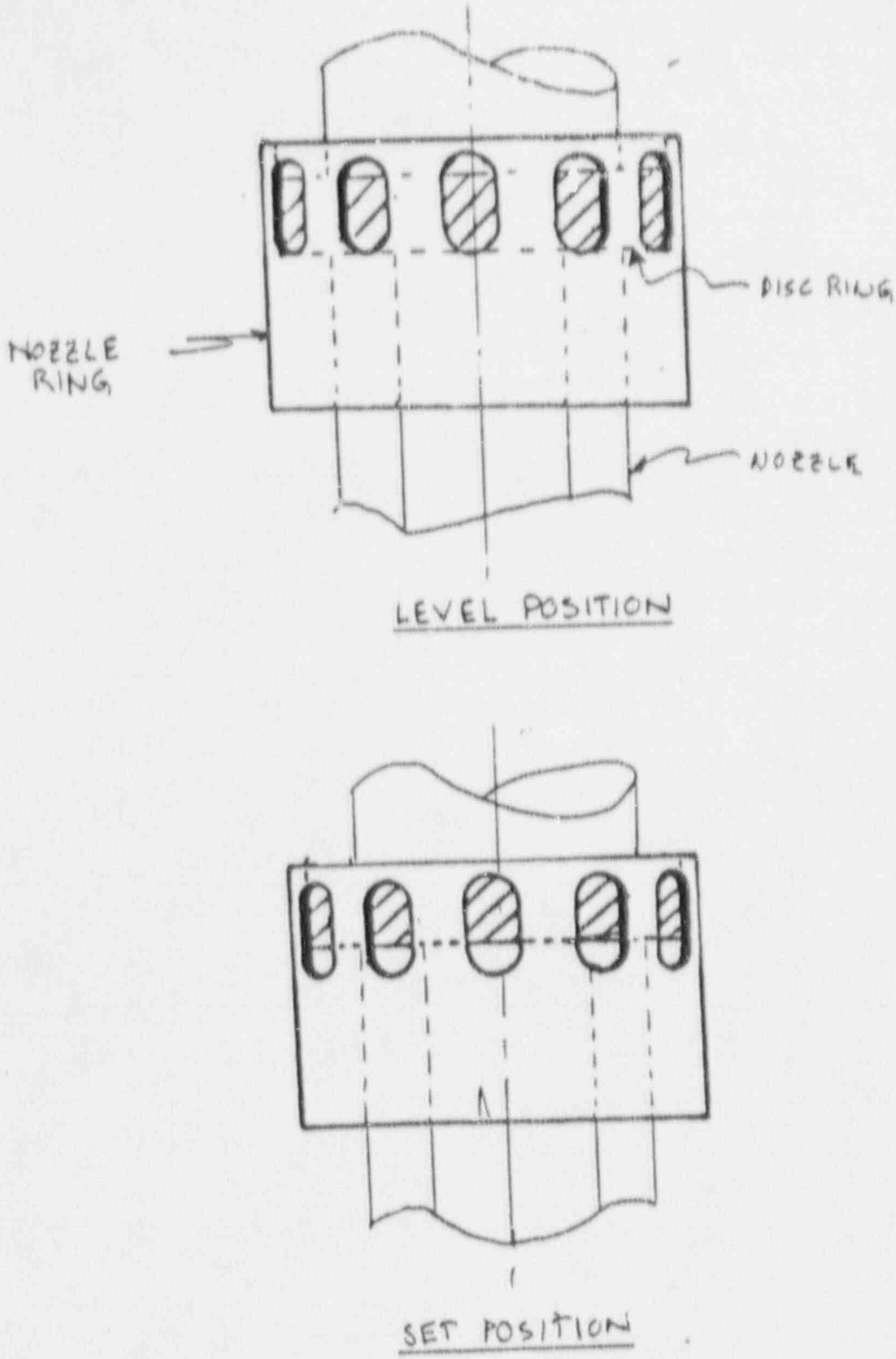


FIG. 2 RING SETTING

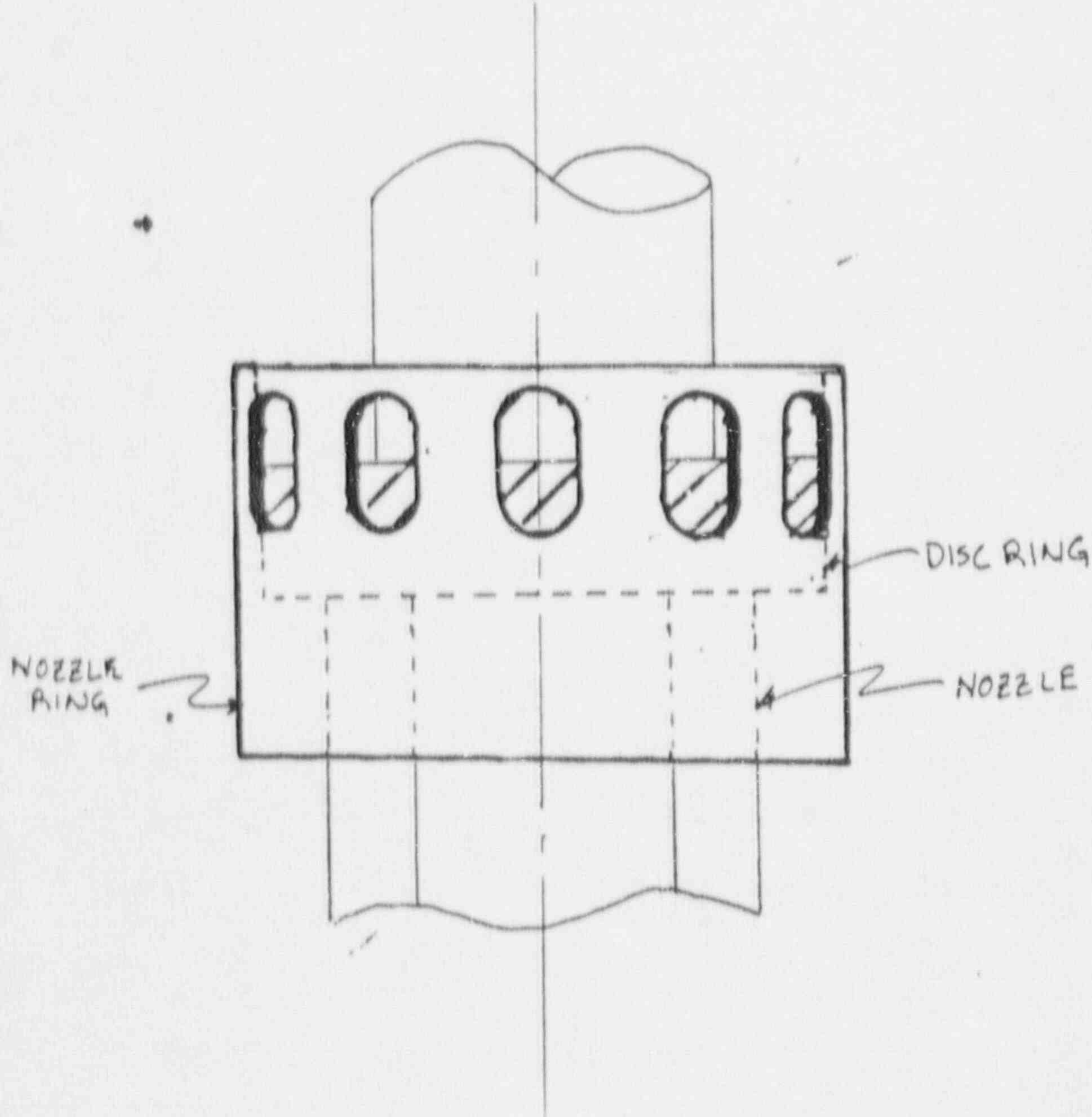


FIG. 3 RING SETTING
TOO HIGH

DRAFT

NRC INFORMATION NOTICE: CROSBY LOW PRESSURE RELIEF VALVES

Purpose:

This information notice is intended to alert addressees to potential problems resulting from inadequate control of maintenance of Crosby or similar low pressure relief valves in operating nuclear plants. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

Braidwood

An extended blowdown event occurred at Braidwood, Unit 1, during plant start-up operations in December, 1989. As a bubble was being drawn in the pressurizer, a suction relief valve in one of the RHR trains suddenly opened and the primary system dropped to about 270 psig (well below the expected reseat pressure) over the next 18 minutes. Approximately 67,000 gallons of water was injected into the primary system before the correct RHR train was isolated about two hours later.

Maintenance was performed on the deficient RHR relief valve about 18 months earlier when it was installed in the plant. At that time, the licensee discovered all the RHR suction relief valves at the site had nozzle ring settings well below the original positions and used a temporary set of instructions to adjust the rings to the proper positions. The temporary instructions differed significantly in form from the existing formal procedures for nozzle ring adjustment. Both sets of instructions were contained in the same work package used to perform corrective maintenance for the valve that subsequently hung open. The mechanic apparently confused the two set of instructions and wound up setting the nozzle ring about 220 notches above its proper position.

Haddam Neck

In 1986, one of the RHR suction relief valves opened following a pressure spike to 380 psig and failed to reseat until the pressure decreased to 260 psig about 10 minutes later when the faulted RHR train was isolated. Upon disassembly, it was noted that the nozzle ring was unmovable. The nozzle ring was found jammed in the highest locked position about 225 notches above its proper position. The expected reseat pressure for the valve was 342 psig.

Foreign Reactor

In May 1985, about 25,000 gallons of reactor coolant was released to the containment sump through a RHR suction relief valve. The primary system pressure stopped decreasing about 30 minutes into the event when the RHR system was isolated. Inspection of the suction relief valves indicated broken disc insert pins in both trains. One of the valves had a nozzle ring setting 261 notches below its proper position.

Discussion:

All of the valves involved in the referenced events were Crosby relief valves, Model JB-35-TD-WR-B, which is used in a number of nuclear plants in the U.S. The valve inlet nozzle (about 1.5 to 2 in. diam.), which forms the valve seat, is surrounded by a ring that is screwed on the nozzle. The valve disc insert, connected to the spindle by an insert pin, is surrounded by a disc ring that is also held in place by the insert pin. The spindle is spring loaded to provide the necessary valve isolation force. The nozzle ring is sufficiently long to guide the disc assembly when the valve is actuated. A bellows surrounds the spindle above the disc assembly to negate the impact of back pressure on the valve lift point.

The nozzle ring is set by the manufacturer prior to delivery and locked in place by a set screw that engages a notch in the ring. Only valve maintenance requiring disassembly would disturb the nozzle ring setting. The manufacturer's instruction for fixing the ring setting is to run the valve up to the stop while counting notches before disassembly. The number of notches is to be recorded. During reassembly, the process is reversed. The nozzle ring is run up to the stop and backed off the number of notches previously recorded. The process is straight-forward, but it requires counting out 300 to 400 notches in both directions and mistakes are cumulative over the number of maintenance activities performed. There is no visual marking that would indicate that the ring was in the wrong position.

An incorrect nozzle ring setting on a relief valve adversely affects the valve's characteristics and can result in uncontrolled leakage or discharge from the valve as noted in the above discussion. A low setting may produce valve chatter and ultimate valve failure leading to uncontrolled leakage. A very high nozzle setting may eliminate the ventilation area at the nozzle surface provided by the holes in the nozzle ring. Under these conditions, the valve reseat may be significantly delayed because of the cushion of water trapped under the valve disc assembly. Some plants have monitoring systems that would identify an open relief valve in these low pressure systems.

Examination of nozzle adjustment procedures has indicated potential confusion in directions. Including two different procedures for setting the nozzle ring in the same maintenance work package introduces an unnecessary source of error. The directions themselves can introduce confusion when they include terms like move to the right (counter-clockwise) XX notches or move up XX notches, when the mechanic is looking edgewise at the notched ring and axial movement is very slow. Up and down may not be immediately obvious. Similarly, clockwise or counter-clockwise may also not be obvious.

The process of setting the nozzle ring using a screw driver and counting several hundred notches is prone to error. The discrepancies in nozzle ring settings noted above do not definitively identify the screw driver-notch counting process as the source of error versus incorrect procedures given to the mechanic or some other form of misinformation introduced into the process. A mechanical location indicator (such as scribe line) would simplify the process and make it inspectable. Consequently, all aspects of the process may need improvement to reduce errors.

This information notice requires no specific action or written response. If you have any questions about this matter, please contact one of the technical contacts listed below or the appropriate NRR project manager.

Technical Contact: Sanford Israel, AEOD
(301) 492-4437

Attachment 4