March 5, 1990

P137

MEMORANDUM FOR: Peter Tam, Beaver Valley Project Manager, NRR
Pete Wilson, Beaver Valley Resident Inspector, Reg I
Tom Scarborough, EMEB, DET, NRR
Earl Brown, ROAB, DSP, AEOD
Ted Cintula, ROAB, DSP, AEOD

THRU: Carl Berlinger, Chief, OGCB, DOEA, NRR

FROM: Vern Hodge, OGCB, DOEA, NRR

SUBJECT: REQUEST FOR COMMENTS ON PROPOSED INFORMATION NOTICE ON CHECK VALVE FAILURES

Please review and comment on the attached subject draft. You can reach me at 21169. Some of the statements are related to an internal memorandum of Duquesne Light, the Beaver Valley licensee. Accordingly, I am also requesting comment from the licensee through the NRR Project Manager and placing this draft in the Public Document Room.

/S/

Vern Hodge, OGCB, DOEA, NRR

Enclosure:
As stated

CONTACT: C. Vernon Hodge, NRR
492-1169

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Document Name: REQ CMT IN LEAKY CK VLVS

OGCB:DOEA:NRR	C/OGCB:DOEA:NRR
CVHodge	CHBerlinger
02/27/90	03/02/90

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March 5, 1990

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

February xx, 1990

NRC INFORMATION NOTICE NO. 90-XX: POTENTIAL SAFETY CONCERNS FROM LEAKING CHECK VALVES

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 resulting from intersystem leakage caused by faulty check valves. 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:

Beaver Valley Unit 2

On September 10, 1989 the licensee, Duquesne Light, observed high temperatures on the auxiliary feedwater (AFW) lines feeding the B and C steam generators (SGs) (Licensee Event Report (LER) 50-412/89-25). The high temperatures were eventually attributed to backleakage of main feedwater (MFW) from SG B through check valves in the AFW line feeding SG B. The valves were determined to be

improperly seated; the situation was corrected by flushing, taking into account thermal and waterhammer considerations. The licensee concluded that this event, which involved intra-system recirculation, carried no safety implications because the elevated temperatures would not have affected the system's performance of its design function. Maintenance work requests to inspect the faulty check valves have not been resolved at this time.

At the time of the event, the licensee was monitoring AFW pipe temperature at the pumps to check for steam binding (Ref. NRC Generic Letter 88-03, "Resolution of Generic Issue 93, 'Steam Binding of Auxiliary Feedwater Pumps'"). The licensee installed thermocouples in containment to monitor the temperature between check valves for detection of both steam binding and intra-system recirculation.

The licensee's safety analysis of this event disclosed several theoretical possibilities for potential safety problems if leakage occurs between systems at significantly different pressures through faulty check valves. Examples of such possibilities are backleakage of reactor coolant water into high pressure safety injection lines and backleakage of MFW into AFW lines. The situation could be complicated by potential pressure variations and potential sources of thermal stress. For example, potential pressure variation could arise from valving instability, pressure difference between SGs, hydraulic imbalances of reactor coolant pumps, plugged SG tubes, location of the pressurizer surge line, pressurizer level, branch line hydraulic conditions, loop pressure drops, and the status of reactor coolant pumps. Examples of potential sources of thermal stress include safety system actuation transients, thermal stratification, and inadequate cooling of AFW penetrations.

To counteract these possibilities, the licensee revised its leakage acceptance criteria to require no leakage through the first two series connected check valves in a branch line and to limit operating temperatures while meeting ASME Code Section XI limits and Technical Specification leakage limits. As noted above, the licensee installed thermocouples between AFW check valves for detection of both steam binding and intra-system recirculation. The licensee also plans to monitor branch line temperatures regularly to trend differences between lines, significant changes in steady state temperatures, and changes after a safety injection or shutdown of a reactor coolant pump during both reactor heatup and cooldown. Currently the licensee is evaluating repositioning thermocouples to locations between check valves on each safety injection line as well. Such repositioning would allow monitoring for intra-system recirculation, thermal stratification, and charging system bypass flow. During periods when a reactor coolant pump is shutdown, temperature at such a location would represent the maximum normal operating differential pressure across the safety injection check valves that could induce recirculation.

Calvert Cliffs Unit 2

In early 1988, the licensee, Baltimore Gas and Electric, had identified seat leakage in the Unit 2 check valve 2-MS-109 for isolation of the AFW turbine driven pump (AFWTP) 21 from the main steam header. On March 17, 1988, the licensee examined the internal structure of the valve and found an additional piece of metal, subsequently determined to have come from the internal structure of a check valve upstream, the check valve 2-MS-103 for isolation of SG 22 from the Unit 2 main steam header. Also observing additional damage in 2-MS-103, the licensee concluded that the valve would not have been able to perform its isolation function.

Disassembling the identical check valve 2-MS-106 for isolation of the other SG from the main steam header in Unit 2, the licensee found worn valve internals. Both these main steam isolation valves were Chapman/Crane 6 inch, 600 psi tilting disk check valves. The licensee replaced both of them in both Units 1 and 2 with Anchor/Darling 6 inch, 900 psi tilting disk check valves and reported the event to the NRC in LER 50-318/88-03.

On October 29, 1988, the licensee observed in a surveillance test that the replaced Unit 1 check valve 1-MS-103 for isolation of AFWTP 11 from SG 12 from Unit 1 main steam header leaked by. On disassembly of the valve, the licensee noted the disk was misaligned about 1/4 inch due to excessive wear of the hinge pins and bushing area. The licensee replace the valve with an identical valve and concluded the root cause was excessive cycling due to the leak by of an upstream isolation valve 1-MS-102 (not a check valve) two feet away. This event was reported in LER 50-317/88-14.

The licensee's safety analysis indicated that in a steam line break, the steam generator thought to have an operable isolation check valve would really be partially blown down through the equivalent of an additional 0.2 ft^2 break. This analysis is further discussed in "Failure of Steam Generator Isolation Check Valve," AEOD/E906, August 30, 1989.* Additional guidance applicable to these events is given in NRC Generic Letter 89-04, "Guidance On Developing Acceptable Inservice Testing Programs."

Discussion:

The NRC has issued a number of generic communications, listed in Attachment 1, on the subject of faulty check valves since 1979. The Nuclear Plant Reliability Data System contains reports over at least half that time period of 286

check valves failures, 22 of which can be identified with potential intersystem leakage.

Recently industry has initiated several efforts to improve performance of check valves. Activities of the Nuclear Industry Check Valve Group (NIC) and the standards writing ASME Operations and Maintenance Committee OM-22 are especially noteworthy. The NRC is keenly interested in the success of these efforts.

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

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

Technical Contacts: Vern Hodge
(301) 492-1169

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

*This study is available in the NRC Public Document Room, 2120 L Street N.W., Washington DC.

Document Name: INF ON LEAKY CHECK VALVES

OGCB:DOEA:NRR	RPB:ARM	C/OGCB:DOEA:NRR	D/DOEA:NRR
CVHodge	TechEd	CHBerlinger	CERossi
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LIST OF GENERIC COMMUNICATIONS ON CHECK VALVES

Generic Communication	Date Issued	Title
IEB 79-04	03/30/79	Incorrect Weights for Swing Check Valves Manufactured by Velan Engineering Corporation
IEB 80-01	01/11/80	Operability of ADS Valve Pneumatic Supply
IEB 83-03	03/10/83	Check Valve Failures in Raw Water Cooling Systems of Diesel Generators
IEB 85-01	10/29/85	Steam Binding of Auxiliary Feedwater Pumps
BULL 89-02	07/19/89	Stress Corrosion Cracking of High-Hardness Type 410 Stainless Steel Internal Preloaded Bolting in Anchor Darling S350W Swing Check Valves or Valves of Similar Design
IEC 77-14	11/22/77	Separation of Contaminated Water Systems from Noncontaminated Plant Systems
IEC 78-15	07/20/78	Tilting Disc Check Valves Fail to Close with Gravity in Vertical Position
IEIN 79-08	03/28/79	Interconnection of Contaminated Systems with Service Air Systems Used as the Source of Breathing Air
IEIN 80-16	04/29/80	Shaft Seal Packing Causes Binding in Main Steam Swing Disc Check and Isolation Valves
IEIN 80-41	11/10/80	Failure of Swing Check Valve in the Decay Heat Removal System at Davis-Besse Unit No. 1
IEIN 81-27	09/03/81	Flammable Gas Mixtures in the Waste Gas Decay Tanks in PWR Plants
IEIN 81-30	09/28/81	Velan Swing Check Valves
IEIN 81-35	12/02/81	Check Valve Failures
IEIN 82-08	03/26/82	Check Valve Failures on Diesel Generator Engine Cooling System
IEIN 82-20	06/28/82	Check Valve Problems
IEIN 82-26	07/22/82	RCIC and HPCI Turbine Exhaust Check Valve Failures
IEIN 82-35	08/25/82	Failure of Three Check Valves on High Pressure Injection Lines to Pass Flow

IEIN 83-06	02/24/83	Nonidentical Replacement Parts
IEIN 83-26	05/03/83	Failure of Safety/Relef Valve Discharge Line Vacuum Breakers
IEIN 83-54	08/11/83	Common Mode Failure of Main Steam Isolation Nonreturn Check Valves
IEIN 84-06	01/25/84	Steam Binding of Auxiliary Feedwater Pumps
IEIN 84-12	02/27/84	Failure of Soft Seat Valve Seals
IEIN 84-74	09/28/84	Isolation of Reactor Coolant System From Low-Pressure Systems Outside Containment
IEIN 85-35	04/30/85	Failure of Air Check Valves to Seat
IN 85-35 supp 1	05/17/88	Failure of Air Check Valves to Seat
IEIN 86-01	01/03/86	Failure of Main Feedwater Check Valves Causes Loss of Feedwater System Integrity and Water-Hammer Damage
IEIN 86-09	02/03/86	Failure of Check and Stop Check Valves Subjected to Low Flow Conditions
IEIN 86-40	06/05/86	Degraded Ability to Isolate the Reactor Coolant System from Low-Pressure Coolant Systems in BWRs
IEIN 86-106	12/16/86	Feedwater Line Break
IEIN 86-106 supp 1	02/13/87	Feedwater Line Break
IEIN 86-106 supp 2	03/18/87	Feedwater Line Break
IN 88-70	08/29/88	Check Valve Inservice Testing Program Deficiencies
IN 88-85	10/14/88	Broken Retaining Block Studs on Anchor Darling Check Valves
IN 89-36	04/04/89	Excessive Temperature in Emergency Core Cooling System Piping Located Outside Containment
IN 89-41	04/20/89	Operator Response to Pressurization of Low-Pressure Interfacing Systems
IN 89-55	06/30/89	Degradation of Containment Isolation Capability by a High-Energy Line Break
IN 89-62	06/31/89	Malfunction of Borg-Warner Pressure Seal Bonnet Check Valves Caused by Vertical Misalignment of Disk