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

December 18, 1990

NRC INFORMATION NOTICE NO. 90-78: PREVIOUSLY UNIDENTIFIED RELEASE PATH FROM BOILING WATER REACTOR CONTROL ROD HYDRAULIC UNITS

Addressees:

All holders of operating licenses or construction permits for boiling water reactors (BWRs).

Purpose:

This information notice is intended to alert addressees to potential problems pertaining to a previously unidentified release path from the control rod drive hydraulic systems in boiling water reactors that may lead to design basis accident radiation doses significantly exceeding the values specified in the Final Safety Analysis Report. 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:

In June 1989, a design review for unmonitored release paths at Washington Nuclear Power Plant Unit 2 resulted in the discovery of a previously unidentified radiation release path in the control rod drive hydraulic system. This path is postulated to result from the following sequence of conditions. The two control rod drive pumps are shut down following a design basis accident. There is a break outside of the reactor building (secondary containment) in the non-seismically qualified piping or tankage to which the control rod hydraulic system is connected (see Figure 1). Reactor coolant leaks past the double seals in any of the 185 control rod drives and the valves in their associated hydraulic control units. The leakage flows back through one or more of the four headers connecting each of the 185 hydraulic control units to the common control rod drive (CRD) pump header. The leakage then flows through the CRD pump header and the control rod drive pumps to the break or the condensate storage tank located outside of the reactor building.

Much of the pathway to the condensate storage tank lies outside of the reactor building and includes piping that is not seismically qualified. In addition, this piping passes close to the air intakes for the control room ventilation system. Consequently, a failure of the supply piping for the drive pumps

during an accident would not only greatly increase the potential external release, but could increase the radiation dose to the control room operators. General Electric-Nuclear Energy performed calculations for the newly postulated release path for a design basis accident with concurrent failure of the non-seismically qualified supply piping for the control rod drive system at Washington Nuclear Power Plant Unit 2. The calculations incorporated the source terms specified in Regulatory Guide 1.3 and assumed that 10% of the iodine would escape as a gas from the liquid release. These calculations produced a 30-day thyroid dose for control room operators of 121 rem per gpm of leakage, a 30-day thyroid dose at the outer boundary of the low-population zone of 86 rem per gpm of leakage, and a 2-hour thyroid dose at the exclusion zone boundary of 36 rem per gpm of leakage. A generic communication discussing this concern was sent by General Electric-Nuclear Energy to each BWR utility in July 1989.

Discussion:

For the control rod hydraulic systems at General Electric boiling water reactors, the inboard isolation for the primary containment is provided by the double seals in the control rod drives, and the outboard isolation for the primary containment is provided by valves within the hydraulic control units. However, past leak tests of the rod drive seals that were performed by General Electric produced a maximum of 5 gpm per drive. Leakage from the hydraulic control units can also be significant.

As shown in Figure 1, four paths lead from each of the 185 hydraulic control units to the common CRD pump header. Three of these paths, the accumulator charging header, the drive header and the cooling header include check valves to prevent the return of water from the hydraulic units. In addition, water escaping through the accumulator charging header must leak through the insert side scram valve, and water escaping through the drive header must leak through one of the directional control valves. However, the check valve in the exhaust header is oriented so as to permit the flow of water back to the CRD pump header. The exhaust water then flows via the CRD pump header back to the reactor vessel (or, as at Washington Nuclear Power Plant Unit 2, to the reactor water cleanup system) along with the excess pump flow. Therefore, only one normally closed valve prevents water that is leaking out of each of the 185 control rod drives from returning through the associated exhaust header to the CRD pump header. During startup testing at Limerick Unit 1, and at Susquehanna Unit 1, the total leakage from all of the hydraulic control units combined was measured at 5 gpm and 11 gpm, respectively. Both of these reactors include additional check valves at the discharge of the control rod drive pump (area A in Figure 1). A partial audit by the NRC staff indicates that many of the newer BWR plants have check valves installed in the discharge pipe of the control rod drive pumps. However, this audit also showed that other BWR plants, mostly the earlier ones, did not have such check valves. The control rod drive system for BWR/6 plants is designed with a testable check valve and a motor-operated isolation valve. Therefore, this pathway is applicable to pre-BWR/6 plants only.

Combining the General Electric dose calculations for the postulated path with the leak rates measured from the hydraulic units at either Limerick or Susquehanna produces dose rates significantly in excess of the values in the Final Safety Analysis Report. Independent calculations by the NRC staff produced offsite dose values that were comparable to the General Electric results. Radiation release by this path is not possible as long as the control rod drive pumps are kept running. However, continued operation of these pumps following an accident cannot be assured, particularly if the non-seismically qualified suction piping were to fail.

This problem was resolved at Washington Nuclear Power Plant Unit 2 by the installation of two check valves in series in the common discharge pipe from the control rod drive pumps (at area A in Figure 1) to prevent backflow out of the reactor building (secondary containment). The Washington Nuclear Power Plant Unit 2 installation includes provisions for leak testing the valves and a leak rate criterion of 0.01 gpm was established for these valves.

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

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

Technical Contacts: Charles R. Nichols, NRR
(301) 492-0854

Donald C. Kirkpatrick, NRR
(301) 492-1849

Attachments:
1. Figure 1. BWR Control Rod Drive System
2. List of Recently Issued NRC Information Notices

Note: At Washington Nuclear Power Plant, Unit 2, the control rod drive return water is piped to the reactor water cleanup system

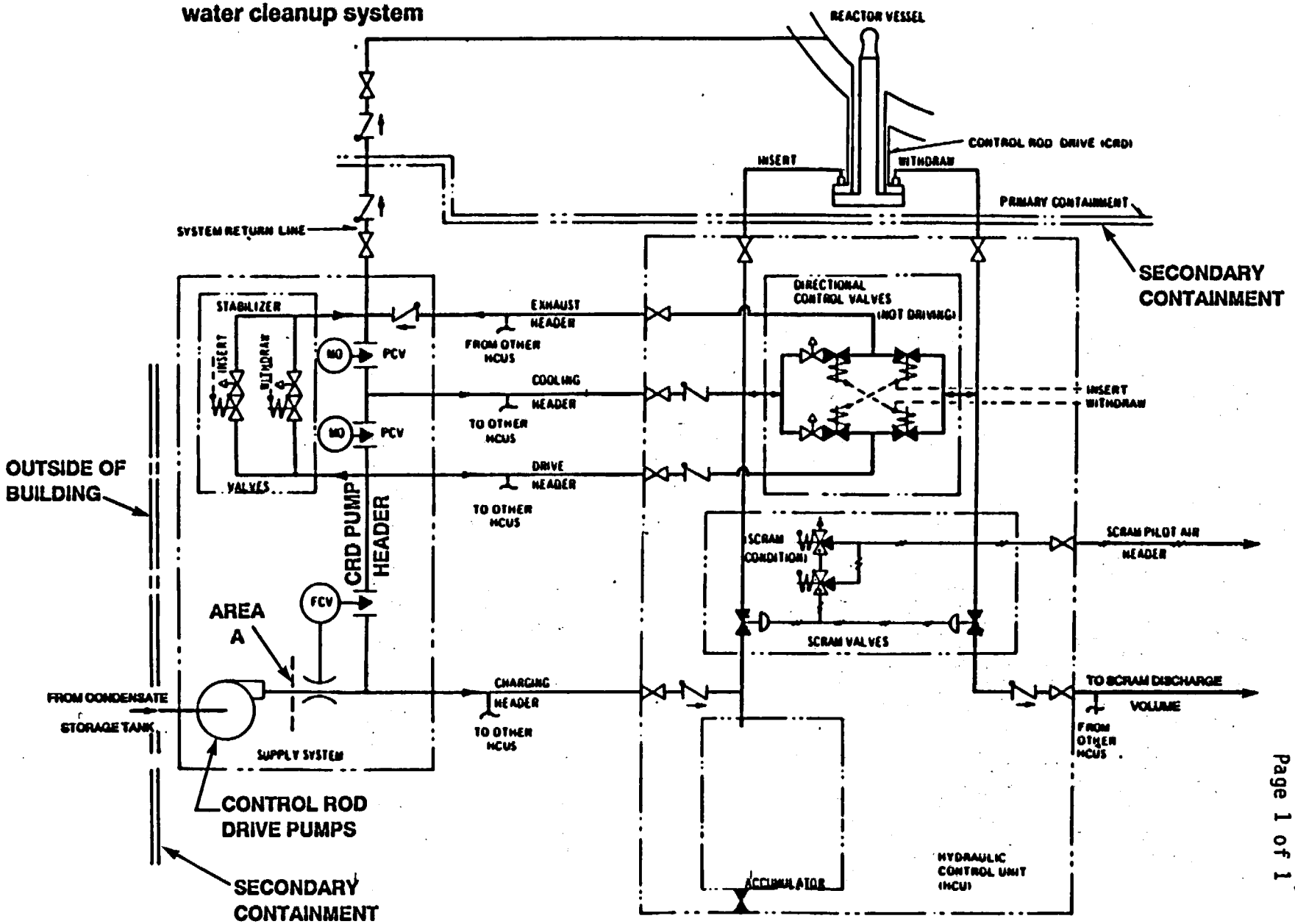

Figure 1. BWR CONTROL ROD DRIVE SYSTEM

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
90-77	Inadvertent Removal of Fuel Assemblies from the Reactor Core	12/12/90	All holders of OLs or CPs for pressurized-water reactors (PWRS).
88-23, Supp. 3	Potential for Gas Binding of High-Pressure Safety Injection Pumps During A Loss-Of-Coolant Accident	12/10/90	All holders of OLs or CPs for pressurized-water reactors (PWRs).
90-76	Failure Of Turbine Overspeed Trip Mechanism Because Of Inadequate Spring Tension	12/7/90	All holders of OLs or CPs for nuclear power reactors.
90-75	Denial Of Access To Current Low-Level Radioactive Waste Disposal Facilities	12/5/90	All Michigan holders of NRC licenses.
90-74	Information on Precursors To Severe Accidents	12/4/90	All holders of OLs or CPs for nuclear power reactors.
90-73	Corrosion Of Valve-To-Torque Tube Keys In Spray Pond Cross Connect Valves	11/29/90	All holders of OLs or CPs for nuclear power reactors.
90-72	Testing of Parallel Disc Gate Valves In Europe	11/28/90	All holders of OLs or CPs for nuclear power reactors.
90-71	Effective Use of Radiation Safety Committees to Exercise Control Over Medical Use Programs	11/6/90	All NRC licensees authorized to use by-product material for medical purposes.
90-70	Pump Explosions Involving Ammonium Nitrate	11/6/90	All uranium fuel fabrication and conversion facilities.
90-38, Supp. 1	License and Fee Requirements for Processing Financial Assurance Submittals for Decommissioning	11/6/90	All fuel facility and materials licensees.

OL = Operating License
CP = Construction Permit

Combining the General Electric dose calculations for the postulated path with the leak rates measured from the hydraulic units at either Limerick or Susquehanna produces dose rates significantly in excess of the values in the Final Safety Analysis Report. Independent calculations by the NRC staff produced offsite dose values that were comparable to the General Electric results. Radiation release by this path is not possible as long as the control rod drive pumps are kept running. However, continued operation of these pumps following an accident cannot be assured, particularly if the non-seismically qualified suction piping were to fail.

This problem was resolved at Washington Nuclear Power Plant Unit 2 by the installation of two check valves in series in the common discharge pipe from the control rod drive pumps (at area A in Figure 1) to prevent backflow out of the reactor building (secondary containment). The Washington Nuclear Power Plant Unit 2 installation includes provisions for leak testing the valves and a leak rate criterion of 0.01 gpm was established for these valves.

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Original Signed by
Charles E. Rossi

Charles E. Rossi, Director
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Attachments:
1. Figure 1. BWR Control Rod Drive System
2. List of Recently Issued NRC Information Notices

			D/DOEA:NRR	*C/OGCB:DOEA:NRR
			CERossi	CHBerlinger
			12/13/90	11/09/90
*OGCB:DOEA:NRR	*SPLB:DST:NRR	*C/SPLB:DST:NRR	*D/DST:NRR	*RPB:ADM
DCKirkpatrick	CRNichols	CMcCracken	AThadani	TechEd
08/17/90	08/20/90	09/24/90	10/30/90	08/06/90

*12/11/90

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for these and other plants produced offsite dose values that were comparable to the General Electric results and that could also significantly exceed the values specified in the Final Safety Analysis Report. Radiation release by this path is not possible as long as the control rod drive pumps are kept running. However, continued operation of these pumps following an accident cannot be ensured, particularly if the non-seismically qualified suction piping were to fail.

This problem was resolved at Washington Nuclear Power Plant Unit 2 by the installation of two check valves in series in the common discharge pipe from the control rod drive pumps to prevent back flow out of the secondary containment. The Washington Nuclear Power Plant Unit 2 installation includes provisions for leak testing the valves. Washington Nuclear Power Plant Unit 2 planned to establish a leak rate criterion for these valves of 0.01 gpm.

The control rod drive system for BWR/6 plants is designed with a testable check valve and a motor-operated isolation valve, therefore this pathway is applicable to only pre-BWR/6 plants.

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Attachments:
1. Figure of Control Rod Hydraulic System
2. List of Recently Issued NRC Information Notices

Document Name: UNIDENTIFIED RELEASE PATH IN

*SEE PREVIOUS CONCURRENCES

			D/DOEA:NRR	C/OGCB:DOEA:NRR
			CERossi	CHBerlinger
			10/ /90	10/ /90
OGCB:DOEA:NRR	SPLB:DST:NRR	C/SPLB:DST:NRR	D/DST:NRR	RPB:ADM
DCKirkpatrick*	CRNichols*	CMcCracken*	AThadani	TechEd*
08/17/90	08/20/90	09/24/90	10/28 /90	08/06/90

Combining the General Electric dose calculations for the postulated path with the leak rates measured from the hydraulic units at either Limerick or Susquehanna produces dose rates significantly in excess of the values specified in the Final Safety Analysis Report. Independent calculations by the NRC staff produced offsite dose values that were comparable to the General Electric results and that could also significantly exceed the values specified in the Final Safety Analysis Report. Radiation release by this path is not possible as long as the control rod drive pumps are kept running. However, continued operation of these pumps following an accident cannot be assured, particularly if the non-seismically qualified suction piping were to fail.

This problem was resolved at Washington Nuclear Power Plant Unit 2 by the installation of two check valves in series in the common discharge pipe from the control rod drive pumps (at area A) to prevent backflow out of the reactor building secondary containment. The Washington Nuclear Power Plant Unit 2 installation includes provisions for leak testing the valves and a leak rate criterion of 0.01 gpm was established for these valves.

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Document Name: RELEASE PATH NOTICE

CHB 12/11/90

			D/DOEA:NRR	*C/OGCB:DOEA:NRR
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this path is not possible as long as the control rod drive pumps are kept running. However, continued operation of these pumps following an accident cannot be ensured, particularly if the non-seismically qualified suction piping were to fail.

This problem was resolved at Washington Nuclear Power Plant Unit 2 by the installation of two check valves in series in the common discharge pipe from the control rod drive pumps to prevent back flow out of the secondary containment. The Washington Nuclear Power Plant Unit 2 installation includes provisions for leak testing the valves. Washington Nuclear Power Plant Unit 2 planned to establish a leak rate criterion for these valves of 0.01 gpm.

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Attachments:
1. Figure of Control Rod Hydraulic System
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Document Name: UNIDENTIFIED RELEASE PATH IN

*SEE PREVIOUS CONCURRENCES

			D/DOEA:NRR	C/OGCB:DOEA:NRR
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			08/ /90	08/ /90
OGCB:DOEA:NRR	SPLB:DST:NRR	C/SPLB:DST:NRR	D/DST:NRR	*RPB:ADM
DCKirkpatrick	CRNichols	CMcCracken	AThadani	TechEd
08/17/90 DCK	08/20/90	08/24/90	08/ /90	08/06/90

9/24 P117

The Washington Nuclear power installation includes provisions for leak testing the valves. Washington Nuclear Power has established a very low leak rate criterion for these valves (.01 gpm was indicated). A partial check by the NRC staff indicates that many of the newer BWR plants already have check valves installed in the control rod drive pump discharge pipe. However, this check also showed that other BWR plants, mainly the earlier ones, did not have such check valves.

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DCKirkpatrick DCK	CRNichols	CMcCracken	AThadani	TechEd JMain
08/3 /90	08/ /90	08/ /90	08/ /90	08/6 /90