March 29, 2001

Mr. Valeri Tolstykh
Regulatory Activities Unit
Safety Assessment Section
Division of Nuclear Installation Safety
International Atomic Energy Agency
Wagramer Strasse 5
P.O. Box 100, A-1400
Vienna, Austria

Dear Mr. Tolstykh:

Enclosed are the following IRS reports:

- Potential Loss of Redundant Safety- Related Equipment Because of the Lack of High-Energy Line Break Barriers (NRC Information Notice 2000-20).

- Detached Check Valve Disc Not Detected by Use of Acoustic and Magnetic Nonintrusive Test Techniques (NRC Information Notice 2000-21).

Each report is being submitted in the following two media: (1) a hard copy of the input file for the AIRS database; and (2) a 3.5-inch HD diskette containing the input file for the AIRS database in Microsoft Word 6.0 format.

If you have any questions regarding these reports, please call Eric J. Benner of my staff. He can be reached at 1 301 415 1171.

Sincerely,

***/RA/***
Ledyard B. Marsh, Chief
Events Assessment, Generic Communications and
Non-Power Reactors Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Enclosures: as stated

cc w/enclosures 1 and 2:
Mr. Lennart Carlsson
Nuclear Safety Division
Nuclear Energy Agency
Organization for Economic
Cooperation and Development
Le Seine Saint Germain
12, Boulevard des Iles
92130, Issy-les-Moulineaux, France

Mr. Valeri Tolstykh
Regulatory Activities Unit
Safety Assessment Section
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| IRS NO. | EVENT DATE | DATE RECEIVED |
|---|---|---|
| | 2000/12/11 | |

## EVENT TITLE

Potential Loss of Redundant Safety- Related Equipment Because of the Lack of High-Energy Line Break Barriers (NRC Information Notice 2000-20)

| COUNTRY | PLANT AND UNIT | REACTOR TYPE |
|---|---|---|
| USA | Generic | (BWR or PWR) |

| INITIAL STATUS | RATED POWER (MWe NET) |
|---|---|
| N/A | N/A |

| DESIGNER | 1st COMMERCIAL OPERATION |
|---|---|
| (WEST, GE, CE, B&W) | N/A |

## ABSTRACT

This IRS report discusses the discovery of several high-energy line break (HELB) concerns about redundant safety-related equipment at D. C. Cook Nuclear Plant, Units 1 and 2. As a result of the numerous safety issues identified at Cook 1 and 2 since August 1997, the NRC analyzed the risk significance of Cook issues using the Accident Sequence Precursor (ASP) program methodology. Of the 141 issues analyzed, four were found to be accident sequence precursors since their conditional core damage frequencies were greater than $1.0\times10^{-6}$/year. Two of these four issues involved postulated HELB scenarios that may lead to failure of redundant safety-related systems.

Potential Loss of Redundant Safety- Related Equipment Because of the Lack of High-Energy Line Break Barriers (NRC Information Notice 2000-20)

**Please refer to the dictionary of codes corresponding to each of the sections below and to the coding guidelines manual.**

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| | | | | |
|---|---|---|---|---|
| **1.** | **Reporting Categories:** | **1.4** | | |
| **2.** | **Plant Status Prior to the Event:** | **2.0** | | |
| **3.** | **Failed/Affected Systems:** | **3.BB** | **3.CA** | **3.EB** |
| **4.** | **Failed/Affected Components:** | **4.0** | | |
| **5.** | **Cause of the Event:** | **5.7.1** | | |
| | | | | |
| **6.** | **Effects on Operation:** | **6.0** | | |
| **7.** | **Characteristics of the Incident:** | **7.0** | | |
| **8.** | **Nature of Failure or Error:** | **8.4** | | |
| **9.** | **Nature of Recovery Actions:** | **9.0** | | |

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

December 11, 2000

NRC INFORMATION NOTICE 2000-20: POTENTIAL LOSS OF REDUNDANT SAFETY-RELATED EQUIPMENT BECAUSE OF THE LACK OF HIGH-ENERGY LINE BREAK BARRIERS

Addressees

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

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the discovery of several high-energy line break (HELB) concerns about redundant safety-related equipment at D. C. Cook Nuclear Plant, Units 1 and 2. A failure of redundant safety-related equipment may result in risk-significant configurations. It is expected that the recipients will review the information for applicability to their facilities and consider corrective actions, as appropriate. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Background

As a result of the numerous safety issues identified at Cook 1 and 2 since August 1997, the NRC analyzed the risk significance of Cook issues using the Accident Sequence Precursor (ASP) program methodology. Of the 141 issues analyzed, four were found to be accident sequence precursors since their conditional core damage frequencies were greater than $1.0\times10^{-6}$/year. Two of these four issues involved postulated HELB scenarios that may lead to failure of redundant safety-related systems (see Licensee Event Reports (LERs) 316/98-005 and 315/99-026 for details).

Within these two issues there are three scenarios that are described below:

- A break in a Unit 2 main steam line or main feedwater line could degrade the ability of the component cooling water (CCW) pumps of both units to perform their function. All five CCW pumps for Cook 1 & 2 are in the same room. The pumps are not qualified for the harsh environment of a HELB. Therefore, all of the pumps may fail on exposure to the high humidity and high temperatures caused by a main steam line or a main feedwater line break in the pipe chase adjoining the room.

ML003760571

- A break in the high-pressure feedwater heaters or associated piping near the door to the switchgear room could degrade the ability of both trains of 600V safety-related buses. The door between the switchgear room and the turbine building is normally open and may not close in the event of a HELB. Both trains of 600V safety-related buses are in the switchgear room and the buses are not qualified for a harsh environment. Therefore, both trains of safety-related 600V buses may fail on exposure to the high humidity and high temperatures of a HELB.

- A HELB in the turbine building could degrade the ability of all three auxiliary feedwater (AFW) pumps. The door to the turbine-driven AFW pump is normally open and may not close in the event of a HELB. The two motor-driven AFW pumps are in rooms whose ventilation intake is from the turbine building. AFW pumps are not qualified for a harsh environment. Therefore, all AFW pumps may fail on exposure to the high humidity and high temperatures of a HELB in the turbine building.

Discussion

Conditions conducive to a risk-significant configuration:

Four conditions must coexist to produce a risk-significant configuration like that at Cook. These four conditions are (1) lack of a HELB barrier between the redundant trains of a system that is needed to mitigate accidents, (2) the lack of environmental qualification for the redundant components of trains located in the same area, (3) the presence of high-energy piping in adjacent areas, and (4) the lack of a HELB barrier between adjacent piping and the redundant safety system trains.

Relationship of the risk-significant configuration to regulatory guidance:

Section 3.6.1 of the Standard Review Plan (SRP) and NRR Plant Systems Branch Technical Position SPLB 3-1 (formerly APCSB 3-1) provide regulatory guidance on the plant design for protection against postulated piping failures outside containment. When SPLB 3-1 is used as a guide to meet the requirements of the General Design Criterion 4 of 10 CFR Part 50, Appendix A, the method used to conform with that regulatory guidance depends upon when the construction permit applications were tendered and the operating licenses issued. Section B.4 of SPLB 3-1 provides details on the dependence of its applicability to the dates on which construction permits were tendered or operating licenses were issued.

Generic Letter 87-11, issued on June 11, 1987, transmitted Revision 2 of the Mechanical Engineering Branch (MEB) Technical Position MEB 3-1. This revision provided additional guidance on locations where pipe breaks should be postulated. Revision 2 of MEB 3-1 allows the elimination of pipe-whip restraints, jet-impingement shields (placed to mitigate the effects of arbitrary intermediate ruptures), and other related changes. However, the revision does not relieve licensees from the need to conform to the guidance relating to HELB effects on essential systems and components. Essential systems and components are systems and components required to shut down the reactor and mitigate the consequences of a postulated piping failure, without offsite power. Even though application of Revision 2 of the MEB 3-1 pipe break criteria may not require postulating breaks near areas that house the redundant equipment and installing pipe restraints, licensees are expected to comply with their licensing basis and regulatory commitments for postulating a crack at the location most damaging to the

essential structures and systems. For example, the Giambusso letter of 1972 (NUREG-0800, Standard Review Plan 3.16.1, Appendix B, Rev. 2, October 1999) specifies that where pipes carrying high-energy fluids are routed near structures and systems necessary for safe shutdown of the plant, supplemental protection of those structures and systems shall be provided to cope with the environmental effects (including the effects of jet-impingement) of a single postulated open crack at the location most damaging to those essential structures and systems.

NUREG-1728, "Assessment of Risk Significance Associated With Issues Identified at D. C. Cook Nuclear Power Plant," Volumes 1 & 2 were published in October 2000. This report documents the results of an analysis of the risk significance at D. C. Cook Nuclear Power Plant, Units 1 & 2 since August 1997. This NUREG may be accessed electronically at the NRC's Public Electronic Reading Room at www.nrc.gov/NRC/ADAMS/index.html.

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, the appropriate regional office, or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

**/RA/**

Ledyard B. Marsh, Chief
Events Assessment, Generic Communications
and Non-Power Reactors Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

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# . . . . INCIDENT REPORTING SYSTEM

**IRS NO.** | **EVENT DATE** | **DATE RECEIVED**
2001/12/15

## EVENT TITLE

Detached Check Valve Disc Not Detected by Use of Acoustic and Magnetic Nonintrusive Test Techniques (NRC Information Notice 2000-21)

**COUNTRY**
USA

**PLANT AND UNIT**
Generic

**REACTOR TYPE**
(BWR or PWR)

**INITIAL STATUS**
N/A

**RATED POWER (MWe NET)**
N/A

**DESIGNER**
(WEST, GE, CE, B&W)

**1st COMMERCIAL OPERATION**
N/A

## ABSTRACT

This IRS report discusses the potential that nonintrusive testing (NIT) of check valves may not provide accurate results if the NIT method was not qualified and if baseline performance was not established when the valve was known to be operating acceptably. During an inservice test of high-pressure safety injection pump P-66A at the Palisades Plant on June 21, 2000, the pump failed to achieve its hydraulic reference values. The probable cause of this condition was that piston check valve CK-ES3340 in the P-66A recirculation line was stuck in mid-position.

Detached Check Valve Disc Not Detected by Use of Acoustic and Magnetic Nonintrusive Test Techniques (NRC Information Notice 2000-21)

**Please refer to the dictionary of codes corresponding to each of the sections below and to the coding guidelines manual.**

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| | | | | |
|---|---|---|---|---|
| **1.** | **Reporting Categories:** | **1.4** | | |
| **2.** | **Plant Status Prior to the Event:** | **2.0** | | |
| **3.** | **Failed/Affected Systems:** | **3.BG** | | |
| **4.** | **Failed/Affected Components:** | **4.2.3** | | |
| **5.** | **Cause of the Event:** | **5.1.1.9** | **5.4.8** | |
| | | | | |
| **6.** | **Effects on Operation:** | **6.0** | | |
| **7.** | **Characteristics of the Incident:** | **7.0** | | |
| **8.** | **Nature of Failure or Error:** | **8.2** | | |
| **9.** | **Nature of Recovery Actions:** | **9.0** | | |

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D. C. 20555-0001

December 15, 2000

NRC INFORMATION NOTICE 2000-21: DETACHED CHECK VALVE DISC NOT DETECTED BY USE OF ACOUSTIC AND MAGNETIC NONINTRUSIVE TEST TECHNIQUES

Addressees

All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the potential that nonintrusive testing (NIT) of check valves may not provide accurate results if the NIT method was not qualified and if baseline performance was not established when the valve was known to be operating acceptably. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

During an inservice test of high-pressure safety injection pump P-66A at the Palisades Plant on June 21, 2000, the pump failed to achieve its hydraulic reference values. The probable cause of this condition was that piston check valve CK-ES3340 in the P-66A recirculation line was stuck in mid-position. A simplified system diagram of the Palisades safety injection system is included as Attachment 2.

The Palisades inservice testing (IST) program designated check valve CK-ES3340 as having safety functions in both the open and closed positions. Upon discovery of this valve stuck in mid-position, the licensee designated swing check valve CK-ES3332 to provide the safety function to close, previously performed by CK-ES3340, in addition to its originally-designated safety function to open. The open safety function of CK-ES 3332 had been tested previously under the IST program by verifying that the valve passed the maximum accident condition flow. NIT had been performed in 1997, and the licensee concluded then that the acoustic monitoring data provided indications of valve closure. The valve had never been disassembled for internal inspection.

On June 21, 2000, Palisades performed NIT, using acoustic and magnetic monitoring techniques, to verify the closure capability of check valve CK-ES3332 as a substitute for the closure function performed by CK-ES3340. The licensee concluded that the acoustic test data provided closure indications of the check valve disc impacting its seat and also provided open

indications of the disc impacting the backstop. The analysis of magnetic test data also indicated that the valve disc had moved to the open position. However, because of changes that were made to the Palisades NIT data collection software between 1997 and 2000, the licensee could not trend the data between these tests. No additional testing or examination was performed on June 21, 2000.

On September 5, 2000, the licensee radiographed valve CK-ES3332 to obtain more actual data. Radiography revealed that the valve disc and connected swing arm had separated from the hinge pin and were resting on the bottom of the valve. Opening the check valve to perform an internal inspection confirmed the radiography and revealed that the swing arm and disc were intact. There was no indication of service wear on the hinge pin. A subsequent licensee event report (LER, Reference 1), attributed this condition to improper assembly of the valve during the plant's construction. In addition, the LER stated that "the actual condition of CK-ES3332 was not ascertained in June 2000, during acoustic testing, because the results obtained from the acoustic testing corresponded with generically expected open and closed indications."

NRC and Industry Guidance on Check Valve NonIntrusive Testing

In accordance with the Code (References 2, 3 and 4), a check valve that is required by 10 CFR 50.55a to be included in the IST program must be exercised to the positions in which it performs its safety functions. Attachment 1 to NRC Generic Letter 89-04 (Reference 5), details 11 separate NRC Staff Positions on potential generic deficiencies related to IST programs and procedures. Position 1, "Full Flow Testing of Check Valves", states that a check valve's full stroke to the open position may be verified by passing the maximum required accident-condition flow through the valve. Position 1 also provides guidance on qualifying other techniques (e.g., establishing a baseline when the valve is known to be in good working order and specifying adequate acceptance criteria). For backflow testing of check valves, Position 3 states that check valve closure may be verified by visual observation, by an electrical signal initiated by a position-indicating device, by observation of appropriate pressure indication in the system, by leak testing, or by other positive means.

Section 4.1.2 of NUREG-1482 (Reference 6) provides guidance on exercising check valves with flow and on using NIT. It states that nonintrusive techniques may be used to verify the capability of check valves to open, close, and fully stroke in accordance with quality assurance program requirements. These techniques are considered "other positive means" in accordance with requirements for testing the check valve obturator movement (References 7, 8, and 9).

Information on qualification of NIT is given in the summary of NRC public workshops on the revision of Inspection Procedure 73756 (Reference 10). In response to a question about expectations for qualification of an NIT method, the NRC stated that a "qualified" NIT method is a technique that has been successfully and reliably demonstrated for the examination method and for the specific valve application.

In the late 1980's and early 1990's, the Nuclear Industry Check Valve Group conducted an experimental research and testing program to evaluate the available NIT technologies to determine their acceptability and reliability for use in check valve testing (Reference 11). The group obtained baseline information on check valves and concluded that, with baseline information available, the NIT methods investigated could detect a missing disc. Their report also indicates that having a complete operational history of the valve will improve accuracy of the data evaluation.

Discussion

In accordance with the guidance in Reference 6, the NRC considers NIT acceptable for inservice testing of check valves provided that the method used is qualified. Qualification includes establishing a performance baseline when the check valve is in good operating condition. A check valve's performance can then be assessed against this baseline. In order to meet the check valve obturator testing requirements, the NIT technique must be repeatable. Both the NRC and industry have provided guidance on the use of NIT, as referenced above.

The only means to determine if an NIT technique will provide accurate and repeatable results for a specific check valve is to qualify the technique prior to its use. The qualification process may reveal that certain NIT techniques give inconclusive results for a particular application. For example, other plant noise sources may affect the sound pattern of the disc striking the valve backstop or seat, which may affect the results of the acoustic monitoring test. Such issues are typically addressed in the NIT qualification process and are documented for future reference.

In the case of Palisades, check valve CK-ES3332 had not been verified to be in good operating condition prior to the use of NIT. When NIT was performed on June 21, 2000, the technique had not been properly qualified. The individuals who examined the results of the test concluded incorrectly, based on their experience, that the valve was moving properly to its open and closed positions. Had the NIT method been qualified for valve CK-ES3332, the initial examination should have identified the valve's improper assembly.

Generic Implications

If NIT techniques used to verify the opening or closing capability of safety-related check valves are not properly qualified and a baseline established for each individual valve when the valve is known to be operating acceptably, potentially inadequate valve performance may be undetectable in the analysis of NIT results.

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 Office of Nuclear Reactor Regulation (NRC) project manager.

***/RA/***
Ledyard B. Marsh, Chief
Events Assessment, Generic Communications
and Non-Power Reactors Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Technical contact: J. Colaccino, NRR
301-415-2753
E-mail: jxc1@nrc.gov

Attachments:
1. List of References
2. Palisades Safety Injection System Simplified Diagram

References

4. LER 50-225/00-04, “Discovery of Inoperable Check Valve Results in Plant Shutdown,” October 4, 2000. (Accession No. 9810270327)

5. American Society of Mechanical Engineers (ASME) Code, 1986 Edition, Section XI, Subsection IWV, “Inservice Testing of Valves in Nuclear Power Plants,” paragraph IWV-3522.

6. ASME/American National Standards Institute (ANSI), Operations and Maintenance Standard (OM), Part 10, “Inservice Testing of Valves in Light-Water Reactor Power Plants,” 1988 Addenda, paragraph 4.3.2.2(a).

7. ASME OM Code 1996 Addenda, Subsection ISTC, paragraph 4.5.4(a)(1). NUREG-1482, “Guidelines for Inservice Testing at Nuclear Power Plants,” April 1995.

8. Generic Letter 89-04, “Guidance on Developing Acceptable Inservice Testing Programs,” April 3, 1989.

9. NUREG-1482, “Guidelines for Inservice Testing at Nuclear Power Plants,” April 1995.

10. ASME Code, 1989 Edition, Section XI, Subsection IWV, paragraph IWV-3522(a).

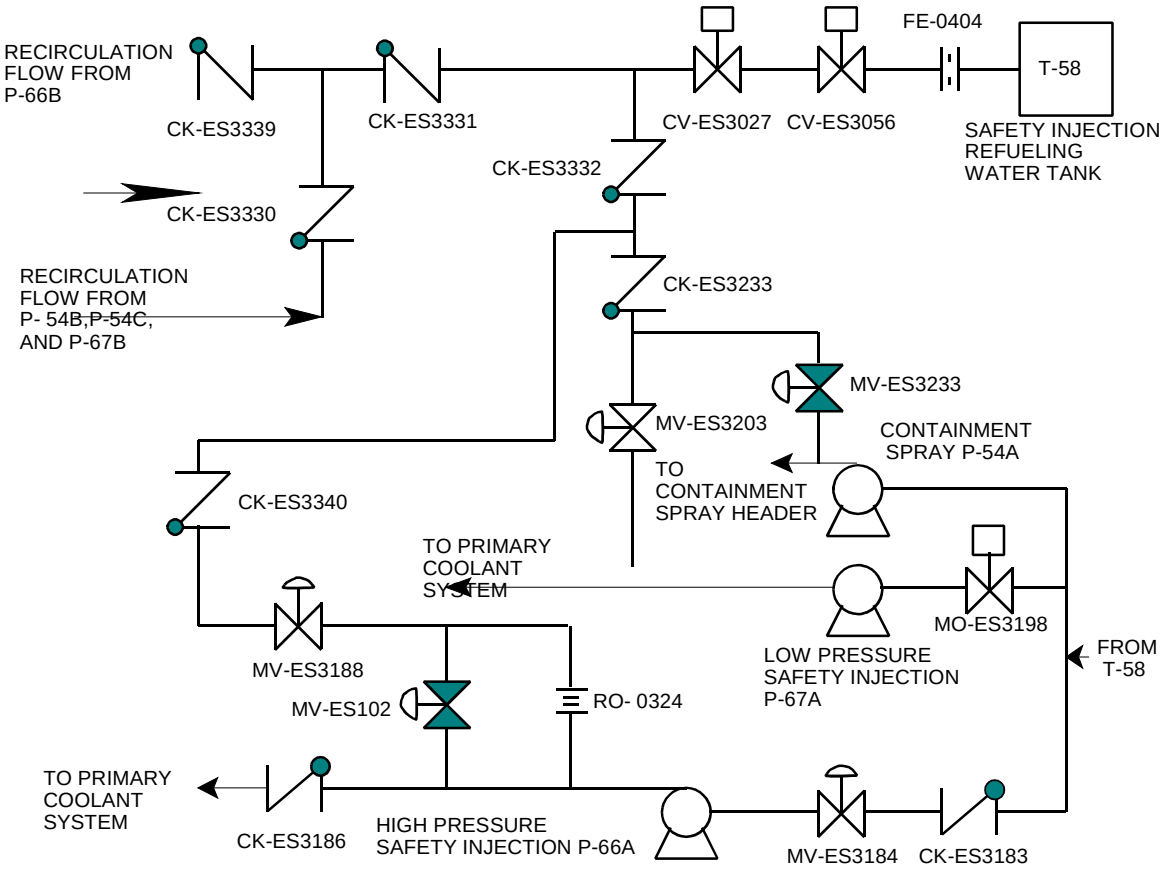
11. ASME/ANSI OM Part 10, 1988 Addenda, paragraph 4.3.2.4(a).

12. ASME OM Code, 1996 Addenda, Subsection ISTC, paragraph 4.5.4(a)(3).

13. Memorandum from Joseph Calycina (NRC) to file, “Summary of Public Workshops Held in NRC Regions on Inspection Procedure 73756, ‘Inservice Testing of Pumps and Valves,’ and Answers to Panel Questions on Inservice Testing Issues,” Question 2.3.1, July 18, 1997. (Accession No. 9810270327)

14. “Evaluation of Nonintrusive Diagnostic Technologies for Check Valves (NIC-01),” Volume 1, February 1991, transmitted by a letter dated February 20, 1992, to Francis Grubelich, NRC, from the Nuclear Industry Check Valve Group. (Accession No. 9205280219)

Palisades Safety Injection System Simplified Diagram



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ORIGINATOR: Eric Benner
SECRETARY: Violet Bowden
DATE: March 21, 2001

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| 2. | K. Gray | 03/ /01 |
| 3. | L Marsh | 03/ /01 |
| 4. | Secretary/Dispatch | 03/ /01 |

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