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

March 28, 1997

NRC INFORMATION NOTICE 97-14: ASSESSMENT OF SPENT FUEL POOL COOLING

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 results of an assessment performed by the Office for Analysis and Evaluation of Operational Data (AEOD) on operating experience involving spent fuel pool (SFP) cooling and inventory control. The AEOD assessment is detailed in NUREG-1275, Volume 12, "Assessment of Spent Fuel Cooling," February 1997. 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 are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

NRC's Executive Director for Operations directed AEOD to independently assess the likelihood and consequences of an extended loss of SFP cooling or inventory. The assessment focused on the collection and analysis of operating experience involving SFP cooling and inventory control and comprised of six major tasks:

(1) Develop generic configurations delineating SFP cooling and inventory control equipment for a boiling-water reactor (BWR) and a pressurized-water reactor (PWR).

(2) Review and assess more than 12 years of operating experience for domestic and foreign reactors.

(3) Visit six sites to gain an understanding of the physical configurations, practices, and operating procedures for the licensees' SFPs.

(4) Review applicable SFP regulations and the NRC Standard Review Plan (NUREG-0800) for the acceptance criteria and the applicable regulatory guides.

(5) Perform independent assessments of electrical systems, instrumentation, heat loads, and radiation levels associated with the SFP.

(6) Estimate near-boiling frequencies utilizing probabilistic techniques.

The findings and conclusions of the AEOD assessment are summarized below.

- The loss of SFP coolant inventory in excess of 1 foot has occurred 10 times over the last 12 years at a rate of about once every 100 reactor-years. Loss of SFP cooling with a temperature increase in excess of 11 °C [20 °F] has occurred 4 times in the last 12 years at a rate of approximately 3 times every 1000 reactor-years. The consequences of these actual events have not been severe; however, some events resulted in loss of several feet of SFP coolant level and have continued for more than 24 hours. The primary cause of these events has been human error, most prevalently, valve mispositionings. These errors are discussed in greater detail in NUREG-1275, Volume 12.

- The relative risk due to loss of spent fuel pool cooling is low in comparison with the risk of events not involving SFPs. The review determined that the likelihood and consequences of SFP loss-of-cooling events are highly dependent on human performance (e.g., valve manipulations, crane manipulations, spent fuel handling equipment manipulations) and individual plant design features.

- The efforts by utilities to reduce outage durations have resulted in full core off-loads early in outages. This increased fuel pool heat load reduces the time available to recover from a loss-of-SFP-cooling should such an event occur early in the outage.

On a plant specific basis the following observations are provided:

- Failures of reactor cavity seals or gate seals or ineffective antisiphon devices could potentially cause loss of SFP coolant inventory, which could potentially result in uncovering the fuel or endangering makeup capability.

- Ineffective configuration control was the most frequent cause of SFP loss-of-inventory events and loss-of-cooling events.

- At multi-unit sites with common pools, there is the potential for SFP boiling conditions to affect safe-shutdown equipment for the operating unit, particularly during full core off-loads.

- Improved procedures and training which recognize the time frames over which SFP events can proceed, the heat load and possibility of loss of inventory, could enhance control room operator response to loss-of-inventory and loss-of-cooling SFP events.

- Insufficient control room instrumentation and non-safety-related power supplies to SFP instrumentation may hinder operator response to SFP events.

Discussion

The AEOD assessment found large variations in the designs and capabilities of SFPs and related systems at individual nuclear plants. The AEOD assessment identified that the frequency of loss-of-inventory events was relatively high compared to loss-of-cooling events, and prompt off-loads will lead to reduced time to boil if cooling is lost. A loss of SFP inventory in combination with higher heat loads reduces the time to respond to SFP events. Thus, the emphasis of the findings were on instrumentation to quickly alert the operators and effective procedures and training to facilitate prompt operator response. The operating experience review determined that loss-of-SFP-cooling events are infrequent and the consequences of actual events have been small. The risk assessment indicates that the SFP events are not a dominant contributor to overall plant risk. However, human error initiators and operator actions required to mitigate an error are subject to large uncertainties, and there are large variations in design vulnerabilities among plants. In summary the following areas need emphasis:

(1) Procedures and training to detect and respond to SFP loss-of-inventory and loss-of-cooling events, including those caused by loss of offsite power are needed and should address configuration controls that can prevent and/or mitigate such events. They should be consistent with the time frames over which SFP events can proceed at the specific plant, recognizing the plant-specific heat load and the possibility of loss of inventory because of cavity seal or gate failures.

(2) Reliable instrumentation is necessary to monitor SFP temperature and level and SFP area radiation, including periods following a loss of offsite power, in order to detect SFP loss-of-inventory events and loss-of-cooling events in a timely manner.

(3) Testing, maintenance, and configuration control of plant features such as reactor cavity seals, gate seals, or antisiphon devices need to be examined for those plants where failures could potentially cause loss of SFP coolant inventory sufficient to endanger makeup capability or result in fuel uncovery.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Jose G. Ibarra, AEOD
(301) 415-6345
E-mail: jgi@nrc.gov

Stephen Koenick, NRR
(301) 415-2841
E-mail: ssk2@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
97-13	Deficient Conditions Associated with Protective Coatings at Nuclear Power Plants	03/24/97	All holders of OLs or CPs for nuclear power reactors
97-12	Potential Armature Binding in General Electric Type HGA Relays	03/24/97	All holders of OLs or CPs for nuclear power reactors
92-27, Supp. 1	Thermally Induced Accelerated Aging and Failure of ITE/ Gould A.C. Relays Used in Safety-Related Applications	03/21/97	All holders of OLs or CPs for nuclear power reactors
97-11	Cement Erosion from Containment Subfoundations at Nuclear Power Plants	03/21/97	All holders of OLs or CPs for nuclear power reactors
97-10	Liner Plate Corrosion in Concrete Containments	03/13/97	All holders of OLs or CPs for power reactors
97-09	Inadequate Main Steam Safety Valve (MSSV) Setpoints and Performance Issues Associated with Long MSSV Inlet Piping	03/12/97	All holders of OLs or CPs for nuclear power reactors

OL = Operating License
CP = Construction Permit

Discussion

The AEOD assessment found large variations in the designs and capabilities of SFPs and related systems at individual nuclear plants. The AEOD assessment identified that the frequency of loss-of-inventory events was relatively high compared to loss-of-cooling events, and prompt off-loads will lead to reduced time to boil if cooling is lost. A loss of SFP inventory in combination with higher heat loads reduces the time to respond to SFP events. Thus, the emphasis of the findings were on instrumentation to quickly alert the operators and effective procedures and training to facilitate prompt operator response. The operating experience review determined that loss-of-SFP-cooling events are infrequent and the consequences of actual events have been small. The risk assessment indicates that the SFP events are not a dominant contributor to overall plant risk. However, human error initiators and operator actions required to mitigate an error are subject to large uncertainties, and there are large variations in design vulnerabilities among plants. In summary the following areas need emphasis:

(1) Procedures and training to detect and respond to SFP loss-of-inventory and loss-of-cooling events, including those caused by loss of offsite power are needed and should address configuration controls that can prevent and/or mitigate such events. They should be consistent with the time frames over which SFP events can proceed at the specific plant, recognizing the plant-specific heat load and the possibility of loss of inventory because of cavity seal or gate failures.

(2) Reliable instrumentation is necessary to monitor SFP temperature and level and SFP area radiation, including periods following a loss of offsite power, in order to detect SFP loss-of-inventory events and loss-of-cooling events in a timely manner.

(3) Testing, maintenance, and configuration control of plant features such as reactor cavity seals, gate seals, or antisiphon devices need to be examined for those plants where failures could potentially cause loss of SFP coolant inventory sufficient to endanger makeup capability or result in fuel uncovery.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

original signed by
Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Jose G. Ibarra, AEOD
(301) 415-6345
E-mail: jgi@nrc.gov

Stephen Koenick, NRR
(301) 415-2841
E-mail: ssk2@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCE Tech Editor has reviewed & concurred on 01/09/97

[OFFICIAL RECORD COPY] DOCUMENT NAME: G:\SSK2\INSFP.D3

To receive a copy of this document, indicate in the box: "C" = Copy w/o attachment/enclosure "E" = Copy w/attachment/enclosure "N" = No copy

OFFICE	TECH CONTS*		C:PECB/DRPM*		D:DRPM					
NAME	JIBarra/SKoenick		AChaffee		TMartin					
DATE	01/13/97		03/10/97		03/27/97					

3/27/97

Discussion

The AEOD assessment found large variations in the designs and capabilities of SFPs and related systems at individual nuclear plants. The AEOD assessment identified that the frequency of loss-of-inventory events was relatively high compared to loss-of-cooling events, and prompt off-loads will lead to reduced time to boil if cooling is lost. Both of these conditions reduce the time to respond to SFP events. Thus, the emphasis of the findings were on instrumentation to quickly alert the operators and effective procedures and training to facilitate prompt operator response. The operating experience review determined that loss-of-SFP-cooling events are infrequent and the consequences of actual events have been small. The risk assessment indicates that the SFP events are not a dominant contributor to overall plant risk. However, human error initiators and operator actions required to mitigate an error are subject to large uncertainties, and there are large variations in design vulnerabilities among plants. In summary the following areas need emphasis:

(1) Procedures and training to detect and respond to SFP loss-of-inventory and loss-of-cooling events, including those caused by loss of offsite power are needed and should address configuration controls that can prevent and/or mitigate such events. They should be consistent with the time frames over which SFP events can proceed at the specific plant, recognizing the plant-specific heat load and the possibility of loss of inventory because of cavity seal or gate failures.

(2) Reliable instrumentation is necessary to monitor SFP temperature and level and SFP area radiation, including periods following a loss of offsite power, in order to detect SFP loss-of-inventory events and loss-of-cooling events in a timely manner.

(3) Testing, maintenance, and configuration control of plant features such as reactor cavity seals, gate seals, or antisiphon devices need to be examined for those plants where failures could potentially cause loss of SFP coolant inventory sufficient to uncover the fuel or endanger makeup capability.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Jose G. Ibarra, AEOD
(301) 415-6345
E-mail: jgi@nrc.gov

Stephen Koenick, NRR
(301) 415-2841
E-mail: ssk2@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCE

OFC	Tech Cont*	C:TechBranch*	C:PECB/DRPM	C:SPSB/DSSA
NAME	JIBarra/SKoenick	LMarsh	AChaffee*	MRubin
DATE	01/13/97	02/20/97	3/10/97	3/19/97

OFC	C:HHFB/DRCH	C:HICB:DRCH	D:DRPM	
NAME	CThomas	JWermiel	TMartin	
DATE	3/17/97	3/20/97	3/24/97	

[OFFICIAL RECORD COPY] DOCUMENT NAME: G:\SSK2\INSFP.D3

conditions reduce the time to respond to SFP events. Thus, the emphasis of the findings were on instrumentation to quickly alert the operators and effective procedures and training to facilitate prompt operator response. The operating experience review determined that loss-of-SFP-cooling events are infrequent and the consequences of actual events have been small. The risk assessment indicates that the SFP events are not a dominant contributor to overall plant risk. However, human error initiators and operator actions required to mitigate an error are subject to large uncertainties, and there are large variations in design vulnerabilities among plants. In summary the following areas need emphasis:

(1) Procedures and training to detect and respond to SFP loss-of-inventory and loss-of-cooling events, including those caused by loss of offsite power are needed and should address configuration controls that can prevent and/or mitigate such events. They should be consistent with the time frames over which SFP events can proceed at the specific plant, recognizing the plant-specific heat load and the possibility of loss of inventory because of cavity seal or gate failures.

(2) Reliable instrumentation is necessary to monitor SFP temperature and level and SFP area radiation, including periods following loss of offsite power, in order to detect SFP loss-of-coolant inventory and loss of cooling events in a timely manner.

(3) Testing, maintenance, and configuration control of plant features such as reactor cavity seals, gate seals, or antisiphon devices need to be examined for those plants where failures could potentially cause loss of SFP coolant inventory sufficient to uncover the fuel or endanger makeup capability.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Jose G. Ibarra, AEOD
(301) 415-6345
E-mail: jgi@nrc.gov

Stephen Koenick, NRR
(301) 415-2841
E-mail: ssk2@nrc.gov

Attachment: List of Recently Issued NRC Information Notices
*SEE PREVIOUS CONCURRENCE

OFC	Tech Cont*	C:TechBranch*	C:PECB/DRPM	D:DRPM
NAME	JIBarra/SKoenick	LMarsh	AChaffee	TMartin
DATE	01/13/97	02/20/97	/ /97 VSB 3/7/97	/ /97

[OFFICIAL RECORD COPY] DOCUMENT NAME: G:\SSK2\INSFP.D3
mkm 3/10/97

conditions reduce the time to respond to SFP events. Thus, the emphasis of the findings were on instrumentation to quickly alert the operators and effective procedures and training to facilitate prompt operator response. The operating experience review determined that loss-of-SFP-cooling events are infrequent and the consequences of actual events have been small. The risk assessment indicates that the SFP events are not a dominant contributor to overall plant risk. However, because human error initiators and operator action required to detect and correct an error are subject to large uncertainties and the large variation in design vulnerabilities, the NRC would like to highlight to the industry:

(1) The importance of procedures and training to detect and respond to SFP loss-of-inventory and loss-of-cooling events, including those caused by loss of offsite power. The procedures and training needed to address configuration controls that can prevent and/or mitigate such events. The procedures and training should be consistent with the time frames over which SFP events can proceed at the specific plant, recognizing the plant-specific heat load and the possibility of loss of inventory due to cavity seal or gate failures.

(2) The importance of having reliable instrumentation to monitor SFP temperature and level and SFP area radiation, including during periods when offsite power has been lost, in order to detect SFP loss-of-coolant inventory and loss of cooling events in a timely manner.

(3) The importance of testing, maintenance, and configuration control of plant features such as reactor cavity seals or gate seals, or antisiphon devices for those plants where failures could potentially cause loss of SFP coolant inventory sufficient to uncover the fuel or endanger makeup capability.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Jose G. Ibarra, AEOD
(301) 415-6345
E-mail: jgi@nrc.gov

Stephen Koenick, NRR
(301) 415-2841
E-mail: ssk2@nrc.gov

*SEE PREVIOUS CONCURRENCE
Attachment: List of Recently Issued NRC Information Notices

OFC	Tech Cont*	C:TechBranch*	C:PECB/DRPM	D:DRPM
NAME	JIBarra/SKoenick	LMarsh	AChaffee	TMartin
DATE	01/13/97	02/20/97	/ /97	/ /97

[OFFICIAL RECORD COPY] DOCUMENT NAME: G:\SSK2\INSFP.D3

mkm 3/6/97

conditions reduce the time to respond to SFP events. Thus, the emphasis of the findings were on instrumentation to quickly alert the operators and effective procedures and training to facilitate prompt operator response. The operating experience review determined that loss-of-SFP-cooling events are infrequent and the consequences of actual events have been small. The risk assessment indicates that the SFP events are not a dominant contributor to overall plant risk. However, because human error initiators and operator action required to detect and correct an error are subject to large uncertainties and the large variation in design vulnerabilities, the NRC would like to highlight to the industry:

(1) The importance of procedures and training to detect and respond to SFP loss-of-inventory and loss-of-cooling events, including those caused by loss of offsite power. The procedures and training needed to address configuration controls that can prevent and/or mitigate such events. The procedures and training should be consistent with the time frames over which SFP events can proceed at the specific plant, recognizing the plant-specific heat load and the possibility of loss of inventory due to cavity seal or gate failures.

(2) The importance of having reliable instrumentation to monitor SFP temperature and level and SFP area radiation, including during periods when offsite power has been lost, in order to detect SFP loss-of-coolant inventory and loss of cooling events in a timely manner.

(3) The importance of testing, maintenance, and configuration control of plant features such as reactor cavity seals or gate seals, or antisiphon devices for those plants where failures could potentially cause loss of SFP coolant inventory sufficient to uncover the fuel or endanger makeup capability.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Jose G. Ibarra, AEOD
(301) 415-6345
E-Mail: jgi@nrc.gov

Stephen Koenick, NRR
(301) 415-2841
E-Mail: ssk2@nrc.gov

*SEE PREVIOUS CONCURRENCE
Attachment: List of Recently Issued NRC Information Notices

OFC	Tech Cont*	C:TechBranch*	C:PECB/DRPM	D:DRPM
NAME	JIBarra/SKoenick	LMarsh	AChaffee	TMartin
DATE	01/13/97	02/20/97	/ /97	/ /97

[OFFICIAL RECORD COPY] DOCUMENT NAME: G:\SSK2\INSFP.D3

SKO 3/4

instrumentation to quickly alert the operators and effective procedures and training to facilitate prompt operator response. The operating experience review determined that loss-of-SFP-cooling events are infrequent and the consequences of actual events have been small. The risk assessment indicates that the SFP events are not a dominant contributor to overall plant risk. However, because human error initiators and operator action required to detect and correct an error are subject to large uncertainties and the large variation in design vulnerabilities, the NRC would like to highlight to the industry:

(1) The importance of procedures and training to detect and respond to SFP loss-of-inventory and loss-of-cooling events, including those caused by loss of offsite power. The procedures and training needed to address configuration controls that can prevent and/or mitigate such events. The procedures and training should be consistent with the time frames over which SFP events can proceed at the specific plant, recognizing the plant-specific heat load and the possibility of loss of inventory due to cavity seal or gate failures.

(2) The importance of having reliable instrumentation to monitor SFP temperature and level and SFP area radiation, including during periods when offsite power has been lost, in order to detect SFP loss-of-coolant inventory and loss of cooling events in a timely manner.

(3) The importance of testing, maintenance, and configuration control of plant features such as reactor cavity seals or gate seals, or antisiphon devices for those plants where failures could potentially cause loss of SFP coolant inventory sufficient to uncover the fuel or endanger makeup capability.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Jose G. Ibarra, AEOD
(301) 415-6345
E-Mail: jgi@nrc.gov

Stephen Koenick, NRR
(301) 415-2841
E-Mail: ssk2@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

OFC	Tech Cont	C:TechBranch	C:PECB/DRPM	D:DRPM
NAME			AChaffee	TMartin
DATE	/ /97	2/20/97	/ /97	/ /97

[OFFICIAL RECORD COPY] DOCUMENT NAME: G:\SSK2\INSFP.D2

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Jose G. Ibarra, AEOD
(301) 415-6345
E-Mail: jgi@nrc.gov

Stephen Koenick, NRR
(301) 415-2841
E-Mail: ssk2@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

OFC	Tech Cont	C:TechBranch	C:PECB/DRPM	D:DRPM
NAME	SSK	JER J.E.Rosenthal	AChaffee	TMartin
DATE	1/14/97	1/29/97	/97	/97

[OFFICIAL RECORD COPY] DOCUMENT NAME: G:\SSK2\INSFP.D2