SSINS No.: 6835
IN 85-87

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

November 18, 1985

IE INFORMATION NOTICE NO. 85-87: HAZARDS OF INERTING ATMOSPHERES

Addressees:

All nuclear power reactor facilities holding an operating license (OL) or a construction permit (CP) and fuel facilities.

Purpose:

This information notice is provided to alert licensees to events that have occurred at nuclear power plants where personnel were exposed to oxygen-deficient atmospheres immediately dangerous to life or health (IDLH). This notice focuses on personnel safety issues that are largely outside the scope of NRC's nuclear safety requirements. However, the information should be helpful to licensees in their efforts to maintain safe working conditions for their employees.

It is expected that recipients will review this information for applicability to their facilities and consider actions, if appropriate, to preclude similar problems at their facilities. However, suggestions contained in this notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

A brief description of the events is provided in Attachment 1. In each event, workers were physically affected and required prompt medical attention. The severity of physical effects of inert-gas exposure ranged from disturbed respiration to loss of consciousness. In one event, two deaths resulted from exposure in an IDLH area.

Discussion:

While not toxic themselves, inert gases such as nitrogen, argon, and carbon dioxide can displace normal air and thereby create oxygen-deficient IDLH areas. Argon and carbon dioxide have specific gravities relative to air of 1.5 and 1.4, respectively, and thus can present hazards even in open-topped areas. Even after good faith efforts to purge and ventilate areas known to be inerted, a "de-inerted" area can present personnel hazards. Pockets of inerting gas can linger in low-lying areas of the affected spaces. In areas where oxygen is in the 8-12% range, unconsciousness can occur rapidly and without warning.

Unprotected exposure to an atmosphere containing less than 6% oxygen by volume (at sea level) causes incapacitation after only a few breaths, convulsive movements, and death in a few minutes.

Title 29, Code of Federal Regulations, Part 1910.134, provides certain regulatory requirements for worker protection against respiratory hazards. These Occupational Safety and Health Administration (OSHA) regulations include (among other things) requirements for "appropriate surveillance of work area conditions," written procedures for the proper use of respirators in dangerous areas, and special provisions for communication and rescue from hazardous working areas. However, in three of the four events discussed, unprotected workers unknowingly entered existing oxygen-deficient IDLH areas. In all but the Hope Creek event, an effective workplace surveillance program (including periodic air quality sampling and hazard area controls/posting) could have identified hazardous areas and possibly prevented worker entry into IDLH areas. Along with the workplace surveillance program for hazards identification, procedures establishing entry and work requirements can form the basis of an effective non-radiological hazards control program.

Several information documents are available that could be useful to licensees trying to improve their worker safety programs. NUREG/CR-3551, "Safety Implications Associated with In-Plant Pressurized Gas Storage and Distribution Systems in Nuclear Power Plants" (May 1985), provides a detailed, thorough technical review and offers a broad perspective for many aspects of using compressed gases. The NUREG discusses many elements important to plant safety that relate directly to a non-radiological hazards control program and personnel respiratory protection, including (1) physical properties and hazards of gases, (2) failure modes of gas systems, (3) incidents, and (4) potential hazards. IE Information Notice 81-26, Part 4, "Personnel Entry Into Inerted Containment" (August 1981), is another useful reference which discusses a non-emergency entry into a fully inerted BWR containment at power. The notice discusses the entry hazards, provides guidance, and lists other pertinent references. The Institute for Nuclear Power Operations' Good Practice "Safe Work Procedure for Enclosed Volumes" (OA-101, Rev. October 1983) provides procedural guidance for safely entering and working in potentially IDLH confined spaces. Other related correspondence includes: IE Circular 80-03, "Protection From Toxic Gases" (March 1980), and IE Information Notice 83-62, "Failure of Redundant Toxic Gas Detectors Positioned at Control Room Ventilation Air Intakes" (September 1983). These two issuances focus primarily on maintaining adequate protection of control rooms against toxic gas threats.

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

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Attachments:
1. Event Summaries
2. List of Recently Issued IE Information Notices

Event Summaries

Hope Creek — Event Date: September 1985

An inadvertent initiation of the carbon dioxide fire suppression system (FSS) caused the release of approximately 10 tons of cardox (liquid carbon dioxide under pressure) into one of the four diesel generator fuel oil storage tank rooms. The affected room pressurized and carbon dioxide leaked into adjacent areas where several workers were overcome. Twenty-three people were transported to nearby hospitals with one individual listed in serious condition upon arrival (condition later improved to "guarded"). The plant was evacuated, and search and rescue teams reported some difficulty in accounting for all construction personnel during the search to ensure all persons had been evacuated.

The cause of the 10 ton continuous discharge (system designed for 2-ton "burst" release of CO_2) is still under review, but believed to be caused by a fault in the FSS control system initiated by moisture electrically shorting FFS control circuitry. The licensee and OSHA are investigating the incident.

Rancho Seco — Event Date: August 1985

With the plant in a cold, shutdown condition, a nitrogen inerting blanket was placed on a moisture separator reheater. The nitrogen leaked past several shut valves into the main condenser. A non-licensed operator, while walking down the condensate system, stopped near the open condenser manway. The operator passed out because of an apparent local IDLH area created by nitrogen escaping the condenser. Prompt and effective rescue/first aid was provided by an accompanying assistant, and the operator was transported to the hospital. No permanent injury resulted from the incident. As a result of a licensee review of the lessons learned from the event, the licensee has improved its hazards controls program for using inerting gases by increasing atmosphere sampling, providing appropriate hazard postings to alert workers, and analyzing the potential effect on associated systems (e.g., potential leak paths).

D.C. Cook Nuclear Plant — Event Date: September 1976

Two workers were killed in a recirculation pit (sump) by asphyxiation from argon inerting gas used to support welding on stainless steel piping. After the welding was completed, the argon purge was not secured and gas leakage from the faulty argon purge-pipe connection filled the pit. When a workman entered the pit to remove the purge connection, he was overcome by the inerted atmosphere. He and one of two fellow workers attempting rescue were killed. A licensee safety review of the incident revealed several work practice deficiencies including:

1. Local ventilation for the pit was available, but not used before entry.

2. Although the equipment was available, oxygen air sampling was not performed.

3. "Buddy system" for the first entry into a confined space was not employed.

Other Events

Other instances of problems have occurred during the past few years, many of which are not reported formally to the NRC. In a typical example, a health physics (HP) technician was overcome by an oxygen-deficient atmosphere in a steam generator (SG). The secondary-side of SGs are often nitrogen inerted to minimize oxygen uptake during non-operational modes. In this case, the wrong SG was purged of its inerting atmosphere, and an HP technician (when entering the still-inerted SG) was overcome. Another HP technician on the scene promptly pulled the asphyxiated technician from the IDLH area. No lasting injuries from the event were noted.

Attachment 2
IN 85-87
November 18, 1985

LIST OF RECENTLY ISSUED
IE INFORMATION NOTICES

Information Notice No.	Subject	Date of Issue	Issued to
85-86	Lightning Strikes At Nuclear Power Generating Stations	11/5/85	All power reactor facilities holding an OL or CP
85-85	Systems Interaction Event Resulting In Reactor System Safety Relief Valve Opening Following A Fire-Protection Deluge System Malfunction	10/31/85	All power reactor facilities holding an OL or CP
85-84	Inadequate Inservice Testing Of Main Steam Isolation Valves	10/30/85	All power reactor facilities holding an OL or CP
85-83	Potential Failures Of General Electric PK-2 Test Blocks	10/30/85	All power reactor facilities holding an OL or CP
85-82	Diesel Generator Differential Protection Relay Not Seismically Qualified	10/18/85	All power reactor facilities holding an OL or CP
85-81	Problems Resulting In Erroneously High Reading With Panasonic 800 Series Thermoluminescent Dosimeters	10/17/85	All power reactor facilities holding an OL or CP and certain material and fuel cycle licensees
85-80	Timely Declaration Of An Emergency Class Implementation Of An Emergency Plan, And Emergency Notifications	10/15/85	All power reactor facilities holding an OL or CP
85-17 Sup. 1	Possible Sticking Of ASCO Solenoid Valves	10/1/85	All power reactor facilities holding an OL or CP

OL = Operating License
CP = Construction Permit