UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, D.C. 20555

November 6, 1990

# NRC INFORMATION NOTICE NO. 90-70: PUMP EXPLOSIONS INVOLVING AMMONIUM NITRATE

## Addressees:

All uranium fuel fabrication and conversion facilities.

## Purpose:

This Information Notice is being issued to inform uranium fuel fabrication and conversion facilities of an explosion potential associated with the pumping of solutions containing ammonium nitrate. There also could be this risk in the pumping of other solutions in which the chemical characteristics of the solute are similar to those of ammonium nitrate (described below). It is suggested that recipients review the information here and consider actions, if appropriate, to preclude possible pump explosion potential. However, suggestions contained in this Information Notice do not constitute U.S. Nuclear Regulatory Commission (NRC) requirements; therefore, no specific action or written response is required.

## Description of Circumstances:

On December 7, 1988, at a fuel fabrication facility, an incident occurred in which a pump servicing a uranyl nitrate system exploded; on April 29, 1990, at another fuel fabrication facility, a pump associated with an ammonium diurinate (ADU) system exploded. The following was common to both incidents:

1. The pumps were left on for a lengthy period of time (e.g., 40 hours), without the solutions containing ammonium nitrate being able to leave the pumps. Thus, these "dead-headed" pumps, over a period of time, boiled off the majority of the water in the solution thereby concentrating the amount of ammonium nitrate, and a rapid thermal decomposition resulted. Investigations of these incidents have determined that dryness is not a necessary condition for ammonium nitrate to explode. A concentrated solution, together with activation energy provided by the overheated pump, may be sufficient.

2. The explosive substance was determined to be ammonium nitrate.

The "dead-heading" of the pumps was caused in one case by a closed valve, and in the other case, by the clogging of a flow-restricting orifice with accumulated solids. The explosions have been formally characterized as a "rapid thermal decomposition," i.e., no ignition or detonation occurred. The pump housings were blown apart with sufficient force to break the bolts that held them

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together. In one case, the suction half of the pump became a projectile, struck a steel pipe, bent it 15 degrees, and then skidded for another 16 feet before coming to rest. In the other case, an individual who was in the affected area received a minor laceration requiring first aid. An analysis of the individual's exposure determined that no significant exposure resulted.

Discussion:

The events described in this Information Notice emphasize the need for uranium processing facilities to identify potentially explosive compounds and mixtures, be aware of where they are located or where they can accumulate or form, and take preventive measures to preclude the conditions that could cause an explosion to occur.

For the incidents just discussed, some of the corrective actions taken or considered consisted of the following:

- Use of temperature sensor shut-off devices with pumps.
- Implementation of strong administrative control (i.e., independent verification sign-off), regarding correct valve positions.
- Evaluation of other systems in the plant for similar problems, i.e., presence of, or potential for, formation of ammonium nitrate, together with activation energy sources.
- Use of "dead-man" switches in automatic or semi-automatic operations, instead of normal manual switches, to prevent personnel from overriding pump operations.
- Use of a water rinse between operations involving nitric acid and ammonium hydroxide, to preclude the formation of ammonium nitrate.
- Evaluation of vent and scrubber systems, since various materials pass through them.
- Interlocking pumps with tank-level indicators to shut pumps off at a low level, in order to prevent a concentrating condition.
- Removal of unnecessary discharge valves to prevent "dead-heading."
- Implementation of a valve tagging system.

No specific action or written response is required by this Information Notice. If you have any questions, please contact the technical contacts listed below or the Regional Administrator of the appropriate regional office.

Glenn L. Sjoblom for
Richard E. Cunningham, Director
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Technical Contacts: Edward McAlpine, Region II
(404) 331-5547

George H. Bidinger, NMSS
(301) 492-0683

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

# LIST OF RECENTLY ISSUED NMSS INFORMATION NOTICES

| Information Notice No. | Subject | Date of Issuance | Issued to: |
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| 90-38, Supp. 1 | License and Fee Requirements for Processing Financial Assurance Submittals for Decommissioning | 11/6/90 | All fuel facility and materials licensees. |
| 90-67 | Potential Security Equipment Weaknesses | 10/29/90 | All holders of OLs or CPs for nuclear power reactors and Category 1 fuel facilities. |
| 90-63 | Management Attention to the Establishment and Maintenance of a Nuclear Criticality Safety Program | 10/03/90 | All fuel cycle licensees possessing more than critical mass quantities of special nuclear materi |
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| 90-59 | Errors in the use of Radioactive Iodine-131 | 09/17/90 | All medical licensees |
| 90-58 | Improper Handling of Ophthalmic Strontium-90 Beta Radiation Applicators | 09/11/90 | All Nuclear Regulatory Commission (NRC) medical |
| 90-56 | Inadvertent Shipment of a Radioactive Source in a Container Thought to be Empty | 09/04/90 | All U.S. Nuclear Regulatory Commission (NRC) licensees |
| 90-50 | Minimization of Methane Gas in Plant Systems and Radwaste Shipping Containers | 08/08/90 | All holders of operating licenses or construction permits for nuclear power reactors |
| 90-44 | Dose-Rate Instruments Underresponding to the True Radiation Fields | 06/29/90 | All NRC licensees |
| 90-38 | Requirements for Processing Financial Assurance Submittals for Decommissioning | 05/29/90 | All fuel facility and materials licensees |

OL = Operating License
CP = Construction Permit

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| 90-38, Supp. 1 | License and Fee Requirements for Processing Financial Assurance Submittals for Decommissioning | 11/6/90 | All fuel facility and materials licensees. |
| 89-30, Supp. 1 | High Temperature Environments At Nuclear Power Plants | 11/1/90 | All holders of OLs or CPs for nuclear power reactors. |
| 90-69 | Adequacy of Emergency and Essential Lighting | 10/31/90 | All holders of OLs or CPs for nuclear power reactors. |
| 90-68 | Stress Corrosion Cracking of Reactor Coolant Pump Bolts | 10/30/90 | All holders of OLs or CPs for pressurized water reactors (PWRs). |
| 90-67 | Potential Security Equipment Weaknesses | 10/29/90 | All holders of OLs or CPs for nuclear power reactors and Category I fuel facilities. |
| 90-66 | Incomplete Draining and Drying of Shipping Casks | 10/25/90 | All holders of OLs for nuclear power reactors and all registered users of NRC approved waste shipping packages. |
| 88-63, Supp. 1 | High Radiation Hazards From Irradiated Incore Detectors and Cables | 10/5/90 | All holders of OLs or CPs for nuclear power reactors. |
| 90-65 | Recent Orifice Plate Problems | 10/5/90 | All holders of OLs or CPs for nuclear power reactors. |

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Richard E. Cunningham, Director
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Office of Nuclear Material Safety
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Technical Contacts: Edward McAlpine, Region II
(404) 331-5547

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