Doc No. 70-0036

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

AUG 21 1990

MEMORANDUM FOR: Bruce S. Mallett, Chief, Nuclear Materials Safety Branch

THRU: Donald J. Sreniawski, Director of Projects for Fuel Facilities and Contaminated Sites 8/21/90

FROM: James W. Doman, Nuclear Process Engineer, Fuel Cycle Safety Irradiated Fuel Section, NMSS

SUBJECT: INVESTIGATION OF DEFECTIVE URANIUM HEXAFLUORIDE (UF_6) CYLINDER VALVE INCIDENT AT COMBUSTION ENGINEERING, INC. (CE) (HEMATITE) FACILITY

Reference: Letter dated May 18, 1990, H. E. Eskridge, Manager, Nuclear Licensing, Safety and Accountability, CE

Inspection Report No. 70-0036/9002 (CE-Hematite facility) Conducted on April 23-27, 1990

This memo is written to document the findings leading to resolution of a Part 21 notification from CE concerning a defective UF_6 cylinder valve. Reporting and processing of this incident was done in accordance with a Draft Policy and Guidance Procedure (dated 8/3/90), for Handling 10 CFR Part 21 Reports.

History of Event

On April 17, 1990, an unplanned release of UF_6 (3.8% uranium-235) occurred through a cylinder valve. At the time of the release, the cylinder was located in the vaporizer in preparation of introducing UF_6 to reaction vessel R-1 for conversion to uranium oxide (UO_2). After the leak had subsided and the cylinder cooled, the valve was replaced with a new one without incident. The defective valve was disassembled, cleaned and found to have two problems: (1) the stem seat was scoured, and (2) the packing gland retainer nut was cracked over 80% of its circumference (see Figure 1). The width of the crack was measured to be 1/8 of an inch. This cylinder was the last one processed in a group of nine received from a General Electric fuel facility. No problems were encountered in handling the other eight cylinders.

The licensee allowed the cylinder to cool for 2½ days with the vaporizer closed before attempting to decontaminate the outside surface of the cylinder valve, the vaporizer, and the cylinder valve. Analysis of the wash solution generated during this decontamination indicated a recovery of 4.6 Kgs U of material. The amount of material lost, as determined by weights of the cylinder before and after this incident was 4.3 Kgs U. The material balance is well within the limit of error of the UF_6 cylinder scale, indicating that no significant loss occurred.

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A complete description of this event and the radiological analysis performed by the licensee is contained in the letter to B. S. Mallett, USNRC, Region III, dated May 18, 1990 from H. E. Eskridge, CE-Hematite.

Part 21 Considerations

10 CFR Part 21 requires licensees to report defects which may present a substantial safety hazard. This particular valve failure was reported to the NRC, and the event discussed during a special team inspection at CE-Hematite on April 23-27, 1990. At that time, the licensee was not clear if specific reporting was required and, if so, exactly how it was accomplished. The recent Draft Policy and Guidance Directive for Handling 10 CFR Part 21 Reports (dated August 3, 1990) delineates the steps required for reporting and was utilized for this incident (although after the fact).

There are several factors that make this incident reportable under Part 21 and the following discussion covers three of them:

1. The faulty valve packing nut problem has been identified by the NRC for some time based upon dialogue with various licensees and in particular with the Department of Energy (DOE).

   In November 1989, NRC Information Notice No. 89-78, "Failure of Packing Nuts on One-Inch Uranium Hexafluoride Cylinder Valves," was issued to address precisely the problem encountered at the CE-Hematite facility. The cause of the cracking problem had been identified to be the combined result of the following:

   a. Excessive stresses placed on the nut by cold flow and thermal expansion of the teflon packaging rings, resulting from retightening of the nut and repeated heating of the valve;

   b. Mechanical and structural characteristics of the packing nut material are incompatible with these stresses; and

   c. The presence of uranium hexafluoride, hydrofluoric acid, and nascent hydrogen facilitates cracking.

   Photographs taken of the failed valve at CE-Hematite were examined at NRC Headquarters and the type of failure was found to be the same as addressed in Information Notice No. 89-78.

2. The committee for reviewing ANSI Standard 14.1 (1987), "Uranium Hexafluoride - Packaging and Transport," was aware of the nut cracking problem and has addressed it in a draft revision (dated for issue in 1990). NRC Headquarters is represented on this committee.

   Specific changes that are proposed for the revised standard include the allowance of other materials for packing nut fabrication and special

stress relieving measures after fabrication. Refer to section 6.14.2(2) for 3/4" valves and 6.15.2(2) for 1" valves in ANSI Standard 14.1.

3. The DOE, Oak Ridge Operations Office, Safety and Health Division, is responsible for monitoring operations associated with handling and shipping of UF_6 by DOE contractors. To this extent, they have been aware of the packing nut problem and have been instrumental in providing timely information to the NRC on this problem, as well as others. The DOE, however, has no obligation to follow Part 21 reporting to the NRC, nor do they require reporting from their contractors (such as Martin Marietta). Generic problems, such as this valve packing nut problem, are more or less tracked informally through the use of "Unusual Occurrence Reports."

   Discussions with Oak Ridge Operations personnel indicate that they feel this problem has been properly addressed. The recommended specification changes in ANSI 14.1 and the recommended handling changes as outlined in Information Notice No. 89-78 should be sufficient.

Resolution of Problem

On August 6 through 10, 1990, a team of NRC personnel visited the CE-Hematite facility for the purpose of conducting a routine (augmented) inspection. During this visit, the author of this memo took time to address the following items with the licensee:

1. Reviewed Information Notice No. 89-78 with engineering personnel to be sure they understood the proper methods for torquing the packing nut. The licensee had not seen, nor were they aware of this Information Notice.

2. Reviewed the failure mechanism of the packing nut with the licensee. Further investigation of their specific failed valve was not warranted, due to similarity to other failed valves.

3. Informed licensee of proposed changes to ANSI 14.1. They were currently in the process of securing 30 new valves and will look at using the new specifications.

4. Reviewed licensee's "UF_6 Cylinder Inspection Form," Rev. 8/2/90 (attached) for statement about valve inspection upon receipt of cylinders. This was a commitment made in CE-Hematite's letter dated May 18, 1990, "Event Report - UF_6 Leak from Defective Cylinder Valve." The licensee was conducting proper inspection for damage.

5. Reviewed ORO-651, Revision 5 document, "Uranium Hexafluoride: Handling Procedures and Container Criteria" with licensee. The licensee's hook-up and leak checking procedures (OS-601.5) for UF_6 cylinders were not adequate for finding a leak prior to pressurization with UF_6 gas. More specific instructions (consistent with ORO-651) have been incorporated into their operating procedure.

6. Requested specific written notification of a Part 21 defect from the Manager, Nuclear Licensing, Safety and Accountability.

7. The "Form for Receiving Part 21 Telephone Notifications" was completed (attached) and distributed per draft directive.

Persons Contacted

Lee Duel, Manufacturing Engineer, CE
H. E. Eskridge, Manager, Nuclear Licensing, Safety and Accountability, CE
Bob Griscom, Engineering Manager, CE
Bob Dyer, Office of Safety and Health, DOE, Oak Ridge Operation
Scott Pennington, Uranium Fuel Section, NRC

Conclusion

It is the conclusion of this investigator that the licensee acted in accordance with the guidelines and regulations in 10 CFR Part 21.

Information Notice No. 89-78 states that, "although the NRC does not consider the cracked packing nut to be a major safety issue, licensees should consider actions to identify and reduce the occurrence of cracking." CE-Hematite has also acted in accordance with this notice and made appropriate procedural changes.

No further action is required on this issue at this time.

James W. Doman,
Nuclear Process Engineer
Fuel Cycle Safety Irradiated
Fuel Section

Attachments:
1. Figure 1
2. UF_6 Cylinder Inspection Form
3. Part 21 Telephone Notification Form

cc w/attachments:
C. Haughney, NMSS
G. Bidinger, NMSS
S. Soong, NMSS
S. Pennington, NMSS

Crack 270°, 1/8" Wide Along Edge of Packing Nut

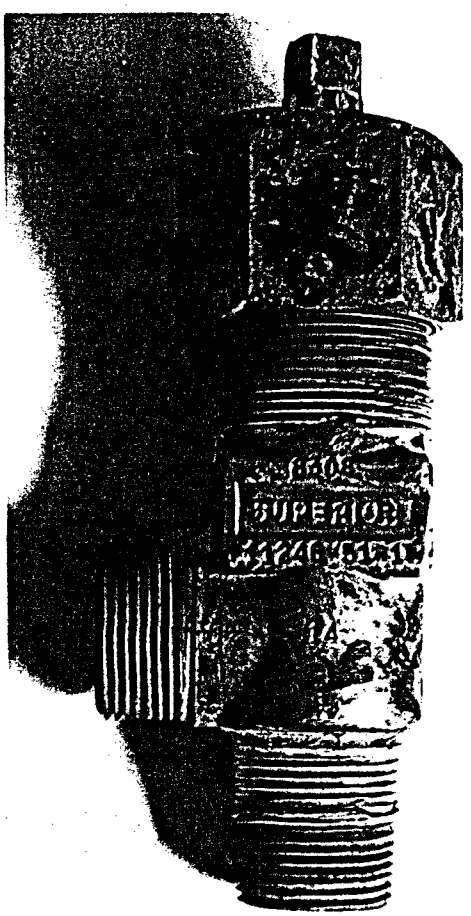

Figure 1

Cracked Packing Nut
CE-Hematite Facility

O.S. 1001.6

UF_6 CYLINDER INSPECTION FORM

Receipt/Shipment I.D. _____

1. CYLINDER INSPECTION

a. Model No. _____
b. Serial No. _____
c. Inspected for signs of leakage, cracks, excessive distortions, broken or torn skirts, or other conditions which may affect safe use.
[ ] OK [ ] REJ Comment: _____
_____
_____
d. Valve Manufacturer and Lot No. _____
Condition (cracks, stem damage) _____
NOTE: Superior Valve Lots 17-22 are rejects.
e. Check for proper marking
Name plate intact [ ] YES [ ] NO
Most recent retest date _____
Most recent tare wt. _____
(Refer to UF_6 cylinder shipping check list for stenciling required.)
Inspected by/date _____

2. CONTENTS (SHIPPING ONLY)

a. Description _____
b. Amount _____ Gms/Kgs
c. Activity _____ Ci/MC

3. HEALTH PHYSICS SURVEY: CONTENTS

Shipping Only

a. Radiation at surface _____ MR/HR (MAX)
Radiation at 1 meter _____ MR/HR (MAX)

Cylinder When Shipping - Overpack When Receiving

b. Contamination Alpha _____ dpm/100cm^2
Contamination Beta _____ dpm/100cm^2

HEALTH PHYSICS SURVEY: TRAILER

a. Radiation at surface _____ MR/HR (MAX)
Radiation at 2 meters _____ MR/HR (MAX)
b. Contamination Alpha _____ dpm/100cm^2
Contamination Beta _____ dpm/100cm^2
Surveyed by/date _____

4. DOCUMENTATION (SHIPPING ONLY)

a. Principle radionuclides _____
b. Transport group: A1 A2 Highway Controlled
c. Label used: I II III
d. Fissile class: I II III Exempt LSA
e. Shipping mode _____
Preparer/date _____

FORM FOR RECEIVING PART 21 TELEPHONE NOTIFICATIONS

DATE: 8-13-90

NAME OF PERSON RECEIVING THE CALL: _____

NAME OF INDIVIDUAL REPORTING: H.E ESKRIDGE

ADDRESS: ABB Combustion Engineering
P.O. Box 107 Highway P
Hematite, MO 63047

TELEPHONE NUMBER: (314) 937-4691

NAME OF THE FACILITY, ACTIVITY, OR COMPONENT IN VIOLATION:
1" UF_6 Cylinder Valve -- Packing Nut
Superior Valve Mfg. Co.
Serial # 11246 Lot 51-1 (Heat # 14)

NAME OF THE FIRM CONSTRUCTING THE FACILITY OR SUPPLYING THE COMPONENT WHICH IS IN VIOLATION:
Superior Valve

LOCATION OF THE FIRM: _____

TELEPHONE NUMBER OF THE FIRM: (____)_____

NATURE OF THE DEFECT OR FAILURE: _____
Failed Packing Nut

SAFETY HAZARD ASSOCIATED WITH THE DEFECT OR FAILURE: _____
Inability to close cylinder valve & release of UF_6 to environment.

DATE INFORMATION OF THE FAILURE WAS OBTAINED: April 18, 1990

IF THE VIOLATION IS A DEFECTIVE COMPONENT:

NUMBER OF ALL COMPONENTS IN USE, BEING SUPPLIED OR SUPPLIED TO MORE THAN ONE FACILITY: THOUSANDS -- TOO NUMEROUS TO COUNT

LOCATION OF ALL COMPONENTS: AT UF_6 FACILITIES, SUCH AS DOE DIFUSSION PLANTS, OXIDE CONVERSION FACILITIES, OXIDE PRODUCTION FACILITIES, AND SCRAP RECOVERY FACILITIES.

CORRECTIVE ACTION BEING TAKEN: INFORMATION NOTICE 89-78 ISSUED. PROBLEM DISCUSSED SPECIFICALLY WITH LICENSEE

WHO IS PERFORMING THE CORRECTIVE ACTION: NRC HEADQUARTERS

HOW LONG WILL THE CORRECTIVE ACTION TAKE TO COMPLETE: ON-GOING

WHAT ADVICE RELATED TO THE DEFECT OR FAILURE IS BEING GIVEN TO THE (ANY)? PURCHASERS OR LICENSES: INFORMATION NOTICE 89-78