

Pre-Decisional Not For Public Disclosure

**Draft Bulletin**  
**UF<sub>6</sub> Cylinder Valves**

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I. Background

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## II. Fuel Cycle Use (show UF<sub>6</sub> Flow Path slide, pictures and valve)

### A. Conversion

Honeywell chemically converts natural uranium in the form of U<sub>3</sub>O<sub>8</sub> to UF<sub>6</sub>. The UF<sub>6</sub> is shipped as a solid in a Mark 48Y 14 ton cylinder to PGDP for enrichment. The transportation is covered under a general license (10 CFR Part 71) which invokes the DOT regulations (49 CFR 173.420), which in turn invoke compliance to ANSI N14.1.

### B. Gaseous Diffusion (Enrichment)

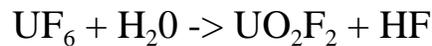
PGDP receives the 14 ton cylinder with solid UF<sub>6</sub> and vaporizes it in an autoclave; an ASME pressure vessel. The processed UF<sub>6</sub> goes to two streams: tails and product. The tails contains about 0.3% U-235 and is downloaded and stored in MK-48G cylinders on-site. There are about 50-70,000 cylinders in the DOE complex. The product line is downloaded into M-30B 2.5 ton cylinders for shipment to the low enriched commercial fuel fabrication facilities in an overpack. The overpack has an NRC Certificate of Compliance, issued by SFPO, that invokes compliance to N14.1. Empty Mk-48Ys are returned to Honeywell for refill. International shipments also occur.

### C. Low Enriched Fuel Fabrication

The three low enriched facilities are Framatome-Richland, Global Nuclear (Wilmington N.C.) and Westinghouse (Columbia). Each handles up to 5% U-235. The solid UF<sub>6</sub> is vaporized in autoclaves. The licensees receive Mk-30B cylinders from PGDP and foreign sources.

### III. UF<sub>6</sub> Characteristics

- A. At ambient temperatures and pressure - solid.
- B. When exposed to air, it reacts with the moisture as follows:



The HF is extremely hazardous!

- C. Cylinders are filled with hot liquid UF<sub>6</sub> which is allowed to cool to ambient temperature for 5 days before shipment. During the cooling-off period, the cylinder volume of UF<sub>6</sub> shrinks from about 95% full to 60% full and the internal pressure drops to about 2-3 psia.
- D. Only the Mk-30B cylinders with ~5% U-235 present a potential criticality problem if there is enough water inleakage.
- E. If a cool, solid cylinder is ruptured or develops some sort of leak, the reaction products tend to “self-seal.”
- F. Only the rupture of a liquid cylinder presents the possibility of a wide dispersal of uranium. Therefore, all licensee’s are required to minimize movement for the 5-day cool-down period before off-site shipment is permitted.

#### IV. Valve Life Cycle

##### A. ANSI N14.1

USEC has procured valves from a “qualified” vendor as safety-related components manufactured under an NQA-1 program to N14.1 specifications. The specs include material composition, tensile strength, hardness, and seat leakage (400 psi with no leakage). All cylinders not full are re-hydro tested every 5 years. The cylinder valves are replaced at that time and are part of the cylinder hydro (valve to cylinder connection - not the internal valve seat).

##### B. Initial Use

1. 400 psig hydrostatic
2. Cylinder at <5psia
3. Liquid T ~ 160-180°F
4. Liquid fill limit is 95%
5. 5-day cooldown to ambient T to solidify.
6. Solid UF<sub>6</sub> fills only ~60% of cylinder volume @ ~ 3 psia

##### C. Process Conditions (USEC Op Eval, Rv. 2)

1. Pigtail connection and pressure test (5 psia and 40 psig).
2. Valve flow and cold pressure check

##### D. 5-Year re-hydro & valve change-out (ANSI N14.1)

## V. USEC Certification Requirements

### A. Safety Grade

1. SAR identifies UF<sub>6</sub> cylinders and valves as safety grade
2. Purchase orders invoke Part 21, NQA-1, N14.1 and other USEC specific requirements (packing nut NDT, valve stem hardness).
3. Approved safety component vendor list - USEC QA audits

### B. Commercial Dedication Process

1. General process outlined by SAR.

### C. DOT and NRC Transportation Regulations

1. Requires meeting Standard N14.1
2. Do not recognize commercial grade dedication based on a sampling scheme.

## VI. Transportation Requirements

- A. Natural UF<sub>6</sub> shipped in Mk-48s are under DOT regulations per Part 71 general license. DOT regulations directly invoke N14.1. (DOT 49 CFR 173.420)
- B. Enriched UF<sub>6</sub> is shipped in overpacks covered by NRC issued Certificates of Compliance. The CoCs directly invoke N14.1.

## VII. Event History

- A. Cracked packing nuts and material testing and traceability (Information Notices 97-24, 02-31)
- B. Valve leakage test results (Information Notice 2002-31, Supplement 1)

## VIII. NRC Inspection Findings (99902011-2001-201, August 20-23, 2001)

- A. NQA-1 program ineffective
- B. USEC audits of approved vendor did not identify Hunt QA deficiencies.
  - 1. LINE REDACTED
  - 2. A July 2001 USEC audit found major weaknesses (Insp. Report, page 10) [after initial NRC questions following OI investigation initiation.]

## IX. USEC Testing Program

- A. About 1250 valves in stock - sampling program for 95 x 95 confidence level
  - 1. LINE REDACTED
  - 2. LINE REDACTED
- B. Hardness testing, tensile strength and material composition - no problems
- C. Valve seat leakage at 400 psig - 1 failed and 1 has been referred to the ANSI Committee for interpretation. Impacts the 95 x 95 confidence level approach.
- D. USEC expanded sample size for leak testing and found 14 failures from one vendor lot.
  - 1. Vendor lots are arbitrary and not limited to any single production run, material heats, etc.
  - 2. Information indicates that other lots may have been handled the same way by the vendor (e.g., not pressure tested prior to shipment).
  - 3. Leakage rates were about several bubbles every several seconds, some starting at about 200 psig.
  - 4. Several valve stems from failed valves were disassembled, buffed or polished, reinstalled and successfully tested.

## X. Operability Evaluations

### A. USEC

1. Operability evaluation, page 7, found Hunt valves to no longer be non-conforming because a sample met N14.1 via 95 x 95% confidence interval.
2. USEC Summary Report, page 1, found no conclusive evidence that Hunt deviated from USEC equipment specs or N14.1.

B. FCSS - adequate safety for interim onsite use.

C. SFPO - transportation safety for packages (Mk-30B)

## XI. Draft Bulletin Actions