USEC
A Global Energy Company

September 29, 2003
GDP 03-0060

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Paducah Gaseous Diffusion Plant (PGDP)
Portsmouth Gaseous Diffusion Plant (PORTS)
Docket Nos 70-7001/70-7002, Certificate Nos. GDP-1 and GDP-2
Response to NRC Bulletin 2003-03

The United States Enrichment Corporation (USEC) hereby submits the 30-day response to NRC Bulletin 2003-03, Potentially Defective 1-Inch Valves for Uranium Hexafluoride Cylinders (See the Reference).

Bulletin 2003-03 provides specific NRC requested actions for addressees to fulfill. As noted in Enclosure 2, USEC is proposing alternative courses of action for NRC requested actions B.1, B.2, C and D.2. The safety bases for the acceptability of these proposed alternative courses of action are provided in Enclosure 2. USEC requests NRC review and notification of the acceptability of these alternate courses of action.

USEC believes that its current population of cylinder valves manufactured by Hunt Valve are operable and continue to perform their intended safety functions. The basis for this belief includes a long history of satisfactory performance of these valves in actual use, observations of performance-based work in progress at Hunt Valve performed by USEC during the period these valves were manufactured, and comprehensive tests performed on a statistical sampling of Hunt valves that provided assurance of satisfactory safety performance. USEC is unaware of the NRC's specific basis for the uncertainty concerning whether these valves meet all ANSI N14.1 requirements and what specific requirements may not be met.

The NRC Bulletin did not identify any specific performance-based issue associated with Hunt valves. The issues raised by NRC correspondence appear to be programmatic weaknesses in the supplier's QA program which may have the potential for affecting the safety performance of the valves. However, these weaknesses have not manifested themselves in actual equipment deficiencies experienced at the gaseous diffusion plants and USEC is not aware of any specific issues elsewhere in the nuclear fuels industry in spite of heavy usage of these valves over a period of many years. Consequently, USEC

NMSS30

believes that this issue is of relatively low safety significance and can be dealt with appropriately using a graded approach.

This USEC response explicitly addresses only cylinders that are owned by USEC. USEC processes cylinders owned by other companies, including heating these cylinders for sampling and feeding, filling cylinders at withdrawal and transfer stations, and storing these cylinders in cylinder storage yards. The cylinders owned by other companies that are processed by USEC are subject to the same operating procedures during these operations at USEC sites as the cylinders owned by USEC. USEC will adhere to whatever agreement is reached between the NRC and other cylinder owners with respect to the acceptability or unacceptability of Hunt valves for these cylinders, and the length of the transition period for phasing out Hunt valves.

Should you have any questions regarding this matter, please contact Mark Smith at (301) 564-3244.

Sincerely,

S. A. Toelle

Steven A. Toelle
Director, Nuclear Regulatory Affairs

Reference: NRC Bulleting 2003-03, Potentially Defective 1-Inch Valves for Uranium Hexafluoride Cylinders, dated August 29, 2003.

Enclosures:
1. Oath and Affirmation
2. Response to NRC Bulletin 2003-03

cc: M. Virgilio, NRC HQ
J. Caldwell, NRC Region III
L. Reyes, NRC Region II
G. Janosko, NRC HQ
B. Bartlett, NRC Resident Inspector, PGDP
D. Martin, NRC Project Manager, PGDP
M. Raddatz, NRC Project Manager, PORTS
R. DeVault (DOE)

Enclosure 1
GDP 03-0060

Oath and Affirmation

OATH AND AFFIRMATION

I, Steven A. Toelle, swear and affirm that I am the Director, Nuclear Regulatory Affairs, of the United States Enrichment Corporation (USEC), that I am authorized by USEC to sign and file with the Nuclear Regulatory Commission this response to NRC Bulletin 2003-03, Potentially Defective 1-Inch Valves for Uranium Hexafluoride Cylinders, that I am familiar with the contents thereof, and that the statements made and matters set forth therein are true and correct to the best of my knowledge, information, and belief.

S. A. Toelle

Steven A. Toelle

On this 29th day of September, 2003, the individual signing above personally appeared before me, is known by me to be the person whose name is subscribed to within the instrument, and acknowledged that he executed the same for the purposes therein contained.

In witness, hereof I hereunto set my hand and official seal.

Janet M Boothe

Ja'net M. Boothe, Notary Public
State of Maryland, Howard County
My commission expires June 01, 2007

Enclosure 2
GDP 03-0060

Response to NRC Bulletin 2003-03

RESPONSE TO NRC BULLETIN 2003-03

NRC Requested Action A

Addressees are requested to review their inventory, and determine whether 1-inch valves manufactured by Hunt are in their possession. If Action Addressees are not in possession of such valves, then no further action is requested, beyond submitting a written response to that effect, as described below. However, if Action Addressees are in possession of, or in the future will receive such valves, then the actions described below in B, C, D, and E are requested.

USEC Response – Requested Action A

USEC does have 1-inch cylinder valves manufactured by Hunt Valve in its inventory. USEC possesses in excess of nine hundred (900) 1-inch Hunt cylinder valves that are subject to this NRC Bulletin (The Bulletin) in stores that are not installed in a UF_6 cylinder. USEC also possesses thousands of these valves that are installed in UF_6 cylinders in the field. This includes cylinders containing depleted, normal or enriched UF_6 stored in cylinder yards, cylinders used to withdraw UF_6 and then transfer to customer owned cylinders, cylinders owned by USEC that are used to transport UF_6 to fuel fabricators, cylinders containing only heel quantities of UF_6, new or newly washed cylinders and others.

NRC Requested Action B

For 1-inch Hunt valves that are not yet installed on cylinders, Action Addressees are requested to:

1. Replace such valves with equivalent valves that comply with existing NRC regulations, NRC licenses and certificates, and DOT regulations; or

2. Identify such valves, and, prior to installation of a Hunt valve on a cylinder, determine that it complies with existing NRC regulations, NRC licenses and certificates, and DOT regulations. This determination should not reference nor rely on QA documentation provided by Hunt. Action Addressees are expected to demonstrate, through their QA programs, that their valves meet NRC and DOT requirements. The determination should include:

    a. A testing program to demonstrate that each valve to be placed in service meets the pressure test requirements specified in Section 6.15.8 of the ANSI N14.1 Standard;

    b. A demonstration, to provide added assurance of valve quality, that the material specifications, certification requirements, and dimensional requirements specified in Sections 6.15.2, 6.15.3, and 6.15.4 of the ANSI N14.1 Standard, respectively, have been met. This can be accomplished through statistical sampling; and

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

c. A demonstration that the remaining requirements specified in Section 6.15 of the ANSI N14.1 Standard has been met. This demonstration may include, but not necessarily be limited to, receipt and inspection records, and visual inspections of the valves.

USEC Response – Requested Action B

B.1. Following NRC's notification of USEC on October 18, 2002 of NRC's concerns with the Quality Assurance program at the Hunt Valve Company, USEC removed the Hunt Valve Company from its Approved Suppliers List. Alternative suppliers of 1-inch cylinder valves that comply with ANSI N14.1 (the Standard) were identified and valves from these suppliers are currently being used, e.g. as customer furnished items for newly fabricated cylinders and washed cylinders, and during in-service cylinder valve replacements. Although this action was taken, USEC believes that, following a satisfactory seat leakage test in accordance with ANSI N14.1, Hunt 1-inch cylinder valves that are currently in USEC stores can be installed and used on cylinders that will be filled with depleted UF_6 and then placed in storage.

B.2. Subsequent to the date noted in B.1 above, USEC agreed with NRC to develop a plan[1] to perform independent testing of Hunt cylinder valves to demonstrate acceptability of the valves without reliance on information supplied by Hunt Valve by verifying certain valve critical characteristics. The critical characteristics for acceptance that were selected for this testing were the valve body and seat leakage tests described in Section 6.15.8 of the Standard, and material composition testing to confirm the materials supplied for the packing nut and valve stem meet Section 6.15.2 of the Standard and hardness testing of these subcomponents as required by the USEC procurement specification. USEC letter GDP 02-0118 later revised the pressure-testing portion of this plan[2].

B.2.a. Prior to installing a new Hunt valve on a cylinder, USEC will require each cylinder valve to be seat leakage tested in accordance with the USEC methodology (Footnote 2) for implementing the seat leakage test outlined in Section 6.15.8 of the Standard. This seat leakage test of each valve, along with the sampling already conducted for valve body integrity and valve materials, and the in-service testing conducted as described under the response to paragraph C below is sufficient to demonstrate the adequacy of the Hunt valve for use in on-site storage and processing of UF_6 cylinders. The basis for the adequacy of the USEC test method follows:

---

[1] USEC letter from J. Morris Brown to Martin J. Virgilio (NRC), " Action Plan Summary – Evaluation of NRC Concerns with Hunt Valve Cylinder Valves," dated November 18, 2002, Serial No. GDP 02-0106. (ADAMS electronic database accession number ML023360049)

[2] USEC letter from J. Morris Brown to Martin J. Virgilio (NRC), " Hunt Valve Action Plan Revised Commitment – Develop Pass/Fail Test Criteria Task HV 0030 Regarding Pressure/Leak Test Criteria," dated December 13, 2002, Serial No. GDP 02-0118.

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

As part of the USEC independent test program plan described in the letter noted in Footnote 1, the sample population of 129 valves (selected from the 1200 valves in stores at the time) experienced only a single seat leakage test failure. Any doubt that this single failure might raise about the ability of other Hunt valves to pass a similar test would be alleviated by the fact that, prior to installation in a cylinder, all valves will receive a seat leakage test in accordance with the USEC methodology for implementing the ANSI standard's requirements. Any valves that do not pass this test will be rejected for UF_6 service.

The pressure-testing program presented in the correspondence noted in Footnotes 1 and 2 is consistent with the requirements of ANSI N14.1, Section 6.15.8. The NRC inspectors witnessing the USEC pressure testing questioned the fidelity of the USEC test methods to the ANSI requirements, in particular the validity of retesting a valve that initially failed the testing. These questions were resolved in a response to USEC's interpretation request from the ANSI N14.1 Subcommittee where the Subcommittee concurred with the USEC interpretation of the test methods. There were 129 valves in the sample population pressure tested in accordance with the process described in ANSI N14.1. Of those, two initially exhibited excessive seat leakage. One was subsequently retested and passed the test. The interpretation request submitted to the ANSI N14.1 Subcommittee asking whether such a retest was appropriate, and whether the valve could be accepted after passing the retest, was unanimously approved by the ANSI Subcommittee and therefore the retested valve was acceptable.

The pressure-testing program resulted in one seat leakage test failure and no valve body pressure test failures. This exceeded the 95/95 confidence level acceptance criteria for the sample size.

In order to determine the root cause of the seat leakage failure, USEC conducted a considerable battery of additional tests. USEC eventually pressure tested an additional 91 Hunt valves. These valves were from the only valve lot that exhibited any leakage failures in the original sample of 129 valves. The original sample contained valves from each valve lot represented in the USEC Hunt Valve inventory. Many of these tests were designed to create a condition where seat leakage would be measurable in order to see what factors caused the one test failure. During a few of these tests, excessive seat leakage was experienced and this led to the discovery of the cause of the original sample test failure. These cases of excessive seat leakage are not considered to be ANSI N14.1 seat leakage test failures because the testing process did not follow the ANSI N14.1 standard. In fact, these tests deviated from that standard by design to vary individual parameters to discover the cause of the original seat leakage failure.

The cause of the seat leakage failure was damage to the seat caused by shavings from the valve body "plowing" across the seating surface. The shavings were apparently a result of thread machining/deburring practices resulting in aluminum bronze filings being generated from the valve body threaded area as the valve is operated. As a result of this root cause evaluation, USEC revised the procurement specification for 1-inch cylinder valves to require enhanced polishing/deburring of the valve stem.

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

B.2.b As part of the USEC independent test program plan described in the letter noted in Footnotes 1 and 2, USEC also conducted valve body pressure testing of 129 valves chosen randomly from the approximately 1200 valves in stores. All of the valves tested passed the valve body pressure testing. Also as part of this testing, USEC conducted material testing of the 1-inch cylinder valve suspect[3] packing nut heat codes and the suspect valve stem heat codes from the sample valve population obtained for the test program. The conclusions of the materials testing revealed no conclusive evidence that the suspect packing nuts or valve stem heat codes did not meet the ANSI requirements. The results of this testing were summarized in a test report provided to NRC via e-mail on April 1, 2003. This report may be found in NRC's ADAMS electronic database at the accession number ML031480846. Dimensional requirements of ANSI N14.1, Section 6.15.4 are addressed below under the response to B.2.c.

B.2.c Additional requirements in ANSI N14.1, Section 6.15 for valve dimensions, cleanliness, and tinning have not been a matter of contention in any NRC correspondence related to Hunt Valve. USEC has not experienced an adverse trend of Hunt valves not meeting any of these ANSI N14.1 requirements or any reason to believe that these requirements were not met for the valves in USEC stores. Any deficiencies in these characteristics that are serious enough to affect the safety function of the cylinder valve would be self revealing during the valve installation process or during the in-service tests described elsewhere in this response. Therefore, these characteristics were not chosen as critical characteristics for acceptance of these valves and no further testing for these characteristics is proposed before installing these valves in UF_6 cylinders that will be filled with depleted UF_6 and then placed in storage.

NRC Requested Action C

For Hunt l-inch valves already installed on cylinders containing depleted UF_6 that are not transported offsite or subjected to further processing, Action Addressees are requested to develop a safety justification for planned continued use of the Hunt valves on these cylinders.

USEC Response – Requested Action C

USEC believes that this paragraph should apply to all cylinders that will not be shipped off site, i.e. those containing depleted UF_6, cylinders containing only a heel quantity of UF_6, and those that will be subjected to further processing while on site. The basis for this belief is the following: Because these cylinders will not be shipped off site, USEC has full control over all operating practices that will be used for such cylinders regardless of whether they contain depleted, enriched, or normal UF_6. These practices include several in-service tests that provide reasonable assurance that the valves will be capable of performing their intended safety function under design conditions.

[3] The sample population contained ten of the eleven suspect packing nut heat codes and one of the two suspect valve stem heat codes that were identified by NRC in Information Notice (IN) 2002-31, including Supplement 1.

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

The safety basis for continued use of Hunt valves for on site storage and processing is contained in the discussion below. The discussion first addresses some general information applicable to any cylinder used only on site. Then additional information is provided for cylinders only containing depleted UF_6 and those subject to further processing.

General Safety Basis Information

The safety function of large cylinders containing UF_6 (including the valve and plug) is to provide primary system integrity to minimize the potential for releasing UF_6 to the atmosphere. Cylinders utilized to contain UF_6 are designed, built, and tested to ANSI N14.1, and used as prescribed in the GDP SARs. This ensures safe containment of UF_6 throughout the enrichment process, including transport, sampling, feeding, filling and storage of cylinders containing enriched, normal and depleted UF_6. Cylinders (including the valve and plug) are particularly relied upon to prevent a release of liquid UF_6; a release from a cylinder containing solid UF_6 would be small and would impact only the immediate area. In addition, cylinders (including valve and plug) are relied upon in nuclear criticality safety analyses to prevent the introduction of water from the environment into a cylinder containing enriched uranium; however, this is not a concern for cylinders containing depleted or normal enrichment uranium.

The SARs for the GDPs identify a number of potential accident scenarios involving the release of UF_6 from cylinders from a variety of initiating events. The SAR analysis for the release from a cylinder containing solid UF_6 is that only workers in the immediate area of the release would be impacted and that evacuation of the area (see and flee) could be readily accomplished in a manner that would prevent significant exposure to personnel. The primary safety concern is the loss of containment on cylinders containing liquid UF_6. In this regard, three basic types of scenarios are examined in the SAR. The first is loss of containment of a cylinder containing liquid UF_6, from a variety of initiating events, while the cylinder is contained in an autoclave. In these cases, the safety features of the autoclave and the associated operating requirements provide adequate protection to workers and the public from such an event. A second type of event is the rupture of a line (pigtail) connecting a cylinder being filled to the process source of liquid UF_6. For these postulated accidents, reliance is placed on the pigtail design and on safety isolation valves at PORTS or the cylinder valve closer at PGDP to prevent a release that would exceed evaluation guidelines to the public or the workers. The third type of postulated event is the loss of integrity of a cylinder containing liquid UF_6 outside of an autoclave due to a variety of initiating events that mechanically damage the cylinder. This postulated event has an unacceptable consequence to the public and workers and the frequency is maintained at acceptable levels by a combination of design features (cylinders and cylinder handling equipment) and operational requirements. In the events discussed above, the bounding source terms and associated consequences are orders of magnitude larger than the postulated release from the valve leakage seen by USEC in the recent Hunt valve test program. The tests that showed leakage were at pressures well above the highest operating pressures and were described as a few small bubbles per second with the air test. This would translate to a source term of a few grams per minute and would be a release that would present no impact outside the immediate area. In addition, plant experience with cylinder valve leaks of this type confirm that

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

releases of only a few grams are likely. Thus, any valve leakage of the type experienced in the USEC testing would be within the SAR safety basis and would have no impacts on personnel outside the immediate area or on the public.

As noted above in the discussion of USEC experience with Hunt valves, USEC is confident that the Hunt valves installed on cylinders containing UF_6 are capable of performing their intended safety function under all design conditions. Since 1990, USEC has utilized cylinders equipped with over 25,000 Hunt valves for processing, storage and transport of UF_6. During this time period, USEC has not experienced adverse trends in the performance of these valves. As noted above, the testing performed by USEC in response to information provided by NRC did not identify information that would cause us to conclude that the Hunt valves in use would not meet the performance requirements relied upon for safety. The Hunt valves, with the design as specified in the ANSI N14.1 standard, have a large margin of safety in providing the containment boundary. The valve body and seat are tested at 400 psig with air; this pressure is approximately four times greater than the highest pressure that would be experienced during normal operating and potential accident conditions. The valve body has ultimate strength many times higher than the test pressures. The part of the valves with the lowest margin relative to leakage is the packing and the valve seat. Upon installation of valves into all new or newly washed cylinders, the ANSI standard requires a check for leaks with air using a "bubble test" at 100 psig to verify that the valve is leak tight. The cylinders are then pumped down to a vacuum and provided to USEC. For valves installed in cylinders containing UF_6, leak checks with air at a lower pressure or vacuum tests are performed to ensure the valve is leak tight.

It should be noted that changing out valves in cylinders full of UF_6 entails some minor additional risk including some additional low level radiation exposure compared to leaving the Hunt valves installed until they would be changed out in accordance with normal operations. A requirement to change out the valves within 12 months would require additional valve changes to thousands of cylinders with additional low level radiation exposure to many persons. In addition, because cylinder valve changes are an evolution performed by operators and maintenance personnel, dramatically increasing the occurrences of this operation inherently increases the potential for human error. This includes errors associated with the valve change-out itself, where the existing cylinder valve is removed and the new valve is installed in rapid succession with an initial vacuum in the cylinder to prevent any UF_6 release. The additional handling of full cylinders would involve some low added risk of cylinder breach due to the additional handling evolutions. Although both of these operations are designed to keep the risk of a UF_6 release caused by human error extremely low, increasing the number of times that valve change outs are performed by orders of magnitude would necessarily increase the potential for such a release. In comparison, the potential risk in allowing the Hunt valves to be used until they would be changed out as a normal operational requirement appears to be extremely low, particularly for the specific populations of valves discussed in this safety basis information.

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

Valves Installed On Cylinders Containing Depleted Uranium That Are Not Transported Offsite

In addition to the design and testing requirements associated with the procurement of UF_6 cylinders and valves, operating procedures require a number of pressure and vacuum checks for the leak tightness of the cylinder, valve and UF_6 connections prior to a number of processing evolutions. Prior to the acceptance of a cylinder for processing, a pressure check is done to confirm that the cylinder is holding a vacuum. A cylinder with a pressure above established limits is rejected and the cause determined. If the cause were to be a leaking valve, the valve would be changed and leak tightness established prior to accepting the cylinder for processing. Before a cylinder is filled, the presence of a cylinder vacuum is established and the connector of the cylinder to the process (pigtail) is checked with the cylinder valve closed for leak tightness under vacuum and positive pressure representative of the UF_6 process pressure. These checks verify that the cylinder valve is performing its intended safety function. When the UF_6 flow is introduced, the valve and other connections are carefully monitored for signs of leakage and the flow is secured if any leakage is noted. At the completion of cylinder filling, the UF_6 supply is valved off, the cylinder valve is closed and the pigtail is evacuated. Prior to disconnection of the pigtail, vacuum checks are performed to verify that the cylinder valve is leak tight (and that the shutoff valve from the UF_6 supply source is leak tight). These checks performed for the filling of every cylinder provide added assurance that the cylinder valve will perform its safety function. The cylinder is then moved by crane to a cooling location for a period of 5 days or more. Any small valve leakage would be detected during that time as the cylinder cools and internal pressure drops from 40-50 psia to subatmospheric. The cylinder is then moved to the storage location.

As a result of the above operational requirements, the experience with Hunt valves, the robustness of the design and testing, and the additional independent testing performed by USEC on Hunt valves in stores, there is reasonable assurance of the ability of Hunt valves to perform their safety function for the cylinders in storage with depleted uranium. If a valve were to leak through the seat during the storage period, there would be minimal safety impact. During cylinder storage periods, seat valve leakage would not result in a path to atmosphere unless the valve packing and/or valve port cap also leaked. Any initial leakage would be from the atmosphere into the cylinder with a gradual pressure increase. This inleakage would continue until the cylinder pressure reached that of the atmosphere, or more likely, until the formation of uranyl fluoride at the small leakage site plugged the tiny opening. Due to the reaction of UF_6 with moisture contained in atmospheric air, a small amount of HF would be formed (<100 grams HF) during pressure equalization. If the leakage site had not plugged by this time (experience has shown that holes 1" diameter or less plug and seal), the only leakage from the cylinder would be by gradual diffusion of gas into and out of the cylinder based on changes in barometric pressure and molecular diffusion. Both of these are very slow release mechanisms and produce very small release rates. Such leakage would not be discernible except during the inspections of depleted cylinders that are required every four years per the Depleted Uranium Management Plan requirements of the NRC Certificate of Compliance. Based on the above, there is no safety concern from the use of Hunt valves for long term storage of depleted uranium cylinders.

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

Valves Installed On Cylinders Containing Enriched or Depleted[4] Uranium That Are Subject to Further Processing On Site

In addition to the design and testing requirements associated with the procurement of UF_6 cylinders and valves, operating procedures require a number of pressure and vacuum checks for the leak tightness of the cylinder, valve and UF_6 connections prior to a number of processing evolutions. Prior to the acceptance of a cylinder for filling, a pressure check is done to confirm that the cylinder is holding a vacuum. A cylinder with a pressure above established limits is rejected and the cause determined. If the cause were to be a leaking valve, the valve would be changed and leak tightness established prior to accepting the cylinder for processing. Before a cylinder is filled (either at a withdrawal station or at a transfer station), the presence of a cylinder vacuum is established and the connector of the cylinder to the process (pigtail) is checked with the cylinder valve closed for leak tightness under vacuum and positive pressure representative of the UF_6 process pressure. These checks verify that the cylinder valve is performing its intended safety function. When the UF_6 flow is introduced, the valve and other connections are carefully monitored for signs of leakage and the flow is secured if any leakage is noted. At the completion of cylinder filling, the UF_6 supply is valved off, the cylinder valve is closed and the pigtail is evacuated. Prior to disconnection of the pigtail, vacuum checks are performed to verify that the cylinder valve is leak tight (and that the shutoff valve from the UF_6 supply source is leak tight). These checks performed for the filling of every cylinder provide added assurance that the cylinder valve will perform its safety function. The cylinder is then moved by crane to a cooling location for a period of at least 5 days for a 48-inch diameter cylinder and 3 days for a 30-inch diameter cylinder. Any small valve leakage would be detected during that time as the cylinder cools and internal pressure drops from 40-70 psia to subatmospheric. The cylinder is then moved to a storage location. As a result of the above operational requirements, the experience with Hunt valves, the robustness of the design and testing, and the additional independent testing performed by USEC on Hunt valves in stores, there is reasonable assurance of the ability of Hunt valves to perform their safety function for the cylinders being filled and put in interim storage.

If a valve were to leak through the seat during an interim storage period, there would be minimal safety impact. During cylinder storage periods, seat valve leakage would not result in a path to atmosphere unless the valve packing and/or valve port cap also leaked. Any initial leakage would be from the atmosphere into the cylinder with a gradual pressure increase. This inleakage would continue until the cylinder pressure reached that of the atmosphere, or more likely, until the formation of uranyl fluoride at the small leakage site plugged the tiny opening. Due to the reaction of UF_6 with moisture contained in atmospheric air, a small amount of HF would be formed (<100 grams HF) during pressure equalization. The small amount of water (hydrogen) that would leak in with the atmospheric air would not result in any significant moderation of the uranium in the cylinder and most of the HF would remain in the gaseous state. If the leakage site

[4] While further processing of depleted uranium is not normally performed, some sampling of this material may be required to support DOE plans for disposition of depleted uranium. In addition, on very infrequent occasions, some transfer of depleted uranium to another cylinder may be made for a customer.

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

had not plugged by this time (experience has shown that holes 1" diameter or less plug and seal), the only leakage from the cylinder would be by gradual diffusion of gas into and out of the cylinder based on changes in barometric pressure and molecular diffusion. Both of these are very slow release mechanisms and produce very small release rates and would introduce very little additional water (hydrogen) from the atmosphere to the cylinder. Such a leakage would not be discernible except during the inspections of cylinders containing fissile material that are required every year or the inspections of cylinders containing depleted material that are required every 4 years per the requirements of the NRC Certificate of Compliance and NCS requirements. Based on the above, there is no safety concern from the use of Hunt valves for interim storage of UF_6 cylinders.

USEC utilizes a number of production cylinders (approximately 400 cylinders at PGDP) for repeated filling at withdrawal stations with subsequent heating for refeeding at the vaporizers or for material transfer to customer cylinders at the C-360 facility. In addition, a small number of cylinders with inventory of product or feed are in storage at both PGDP and PORTS awaiting processing at a future date. The Hunt valves provide adequate safety for such processing by USEC on site for the following reasons. First, the cylinders are checked for cold pressure prior to heating. If the vacuum requirements are not met, the cylinder is rejected for heating and the cause for the pressure increase is identified and corrected (e.g., if the cylinder valve were leaking, a new cylinder valve meeting all ANSI N14.1 requirements would be installed). Prior to heating, leak testing of the pigtail connections and valve are conducted at vacuum and pressure (similar to operating pressure) conditions. All heating takes place in a containment autoclave with safety features for providing containment and stopping the heating process if any significant leakage occurs. Heating is conducted with the cylinder valve open so that cylinder pressure may be monitored by installed pressure indicating devices and alarm circuits. The cylinder valve does not form part of the autoclave isolation boundary for any accident condition. Therefore, the cylinder valve seat performs no safety function during the actual process of heating the cylinder. Prior to disconnection of the pigtail connections, the cylinder valve on the cylinder in the autoclave is closed. If the parent cylinder still contains more than a heel quantity of UF_6, the UF_6 pigtail and manifold piping are evacuated and leak rated at vacuum. This verifies the leak tightness of the cylinder valve, as well as assuring that no significant UF_6 is present in the isolated section of piping. If the cylinder valve is leaking, operations procedures contain steps to safely handle the condition.

Based on the above information, USEC proposes to continue to process such cylinders equipped with Hunt valves, including being able to heat in the containment autoclaves described in the Certificate Application, for sampling and/or transfer into another cylinder and to fill such cylinders with UF_6 at the withdrawal facilities or transfer facilities for further refeed, sampling and/or transfer activities. USEC proposes to use these cylinders with the Hunt valves installed until the current hydrostatic test expires and the cylinder must be cleaned and retested. At that time, a new valve, manufactured by an alternate supplier, would be installed. The NRC Certificate requirements as implemented by the procedures described above, in conjunction with the USEC operating experience with Hunt valves and the margin inherent in the valve design, provide adequate assurance that such processing can be performed without undue risk.

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

Cylinders that are subject to such further processing and are to remain on site with Hunt valves installed will be carefully controlled to ensure that such cylinders are not inadvertently shipped off site while containing more than a heel quantity of UF_6. For a specific discussion of cylinders containing a heel quantity of UF_6, see the response to NRC Requested Action D.2

NRC Requested Action D

For l-inch Hunt valves already installed on cylinders that may be transported offsite or subjected to further processing, or that contain natural or enriched UF_6, Action Addressees that process, use, store, or transport UF, are requested to:

1. Describe the standard operating procedures pertaining to the handling of UF_6, cylinders with 1-inch valves installed, and state whether they include each of the following procedures, pertaining to the processing, use, storage, or transport of such cylinders:

   a. Ensuring that, at the time of valve installation, the cylinder and valve were successfully subjected to the 100 psig (6.9×10^5 Pa) air test required in the ANSI N14.1 Standard;

   b. Ensuring that the valve is closed and not leaking prior to each shipment, while also ensuring that the valves packing nuts are tightened only in conformance with the ANSI N14.1 Standard.

   c. Ensuring that the valve is verified to be capable of maintaining a negative pressure without substantial leakage, prior to heating, filling, or emptying; and

2. Provide information on how you plan to demonstrate that, after a transition period not to exceed twelve months from the date of issuance of this bulletin, all valves installed on UF_6 cylinders (except for those subject to C above) comply with existing NRC regulations, NRC licenses and certificates, and DOT regulations. Alternatively, a plan that would result in complete replacement of all the Hunt valves already installed on cylinders, by equivalent valves that comply with existing NRC regulations, NRC licenses and certificates, and DOT regulations, over a twelve-month period, would be considered acceptable.

USEC Response – Requested Action D

D.1. The normal operations associated with cylinders containing 1-inch valves include those described below. All of the procedure actions listed by NRC bulletin paragraph D.1 are included in the site procedures governing these operations. Where one of the listed actions is noted in the discussion below, the corresponding Bulletin paragraph number is noted parenthetically.

a. Cylinder filling – Prior to the acceptance of a cylinder for filling, a pressure check is done to confirm that the cylinder is holding vacuum **(D.1.c).** Then, prior to filling the cylinder at the withdrawal stations or the transfer station, a pigtail is connected to the cylinder. This pigtail is vacuum tested to 5 psia and then leak tested with air or nitrogen to at least 40 psig. Although this test is actually designed to ensure that the pigtail connections are leak tight, the test would also detect any cylinder valve leakage that would occur at the operating pressures associated with the safety function of this valve. If cylinder valve leakage were detected, the cylinder would be rejected for filling. There is reasonable assurance that, if the valve passes this vacuum and leak test prior to commencing the filling process, it would be capable of performing its isolation function in the case of a pigtail break event during cylinder filling. After a cylinder is filled, the pigtail is purged and evacuated with a hold time established to ensure that the cylinder valve is seated tightly before disconnecting the pigtail. These in-service tests after cylinder filling provide reasonable assurance that the valve is seated properly and not leaking once the cylinder is isolated from the withdrawal or transfer station.

b. Cylinder burping – After the liquid UF_6 in a product cylinder has solidified and cooled to ambient temperature, the cylinder is normally moved to the burping station. The cylinder is connected via a pigtail to the burp station manifold. This pigtail is vacuum tested to 5 psia and then leak tested with air or nitrogen to at least 40 psig. Then the cylinder valve is then opened and the cylinder contents are lined up to a trapping system to remove coolant and other non-condensable gases that might remain in the cooled cylinder. Once the cylinder burp is completed as indicated by a very low vacuum in the cylinder, the cylinder valve is shut. Then, the pigtail is purged and evacuated with a hold time established to ensure that the cylinder valve is seated tightly before disconnecting the pigtail. These in-service tests after cylinder burping provide reasonable assurance that the valve is seated properly and not leaking once the cylinder is isolated from the burping station.

c. Cylinder heating – Prior to heating a cylinder in an autoclave, procedures require that the cylinder be checked for adequate cold pressure. Higher than expected cold pressure could be an indication of cylinder valve leakage and/or the presence of non-condensable gases within the cylinder. Adequate cold pressure within the cylinder is an indication that the cylinder valve is capable of maintaining a negative pressure without substantial leakage prior to heating the cylinder for emptying or for sampling. **(D.1.c)** Prior to heating, leak testing of the pigtail connections and valve are conducted at vacuum and pressure (similar to operating pressure) conditions. During heating of a cylinder in an autoclave, the cylinder valve is open during the heat cycle. Procedures for both the feed facilities and the transfer and sampling facility require

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

that valve clarity be demonstrated prior to the autoclave heat cycle. Valve clarity requires that the cylinder valve is open and a clear path exists between the cylinder contents and the pressure indicating device installed in the autoclave manifold. The cylinder valve also does not provide any containment isolation function during the heating evolution. Therefore, the cylinder valve seat performs no safety function during the actual heating process. For cylinders that have not been emptied as a result of heating (i.e., sampled, partially emptied or experienced an interrupted heat cycle), once the heating is complete and prior to disconnecting the autoclave pigtail, plant procedures require a process similar to that described above for cylinder filling before the pigtail can be disconnected. These checks provide assurance that the cylinder valve is seated tightly after heating is completed.

d. Cylinder movement and storage - During normal cylinder movement and storage, the cylinder valves remain closed. (The cylinder valve may be opened to check cylinder cold pressure or to obtain gas samples or other similar evolutions. However, procedures require that the valve be securely closed after each of these infrequent activities.) The routine tests when disconnecting a cylinder pigtail provide positive assurance that the valve seat is leak tight before a cylinder containing UF_6 is removed from the withdrawal or transfer station or autoclave and placed in a liquid cylinder cooldown yard. Immediately after disconnecting a liquid filled cylinder from the withdrawal station or transfer station or from an autoclave, the cylinder contains less than 100 psig of pressure. As the cylinder solidifies, the UF_6 occupies less volume and the internal pressure within the cylinder diminishes to the point that, once the cylinder is solidified, it is at a vacuum. Once the cylinder is fully solidified and prior to shipping such a cylinder, procedures require that the cylinder be checked to ensure that its contents remain under a substantial vacuum.[5] Checking for adequate cold pressure prior to shipping assures that the cylinder valve is shut and not leaking prior to each shipment. **(D.1.b)**

e. Cylinder washing – In order to perform the hydrostatic test required by Section 6.3.2 of ANSI N14.1, cylinders are washed to remove the UF_6 heel. The washing operation involves removal and replacement of the cylinder valve. Upon completion of the cylinder wash and hydro process, a new cylinder valve is installed and plant procedures require a 100-psig air test to ensure that the cylinder pressure boundary is intact. Similarly, procurement specifications for cylinder washing services specify that a 100 psig air test is to be performed after valve installation when cylinder washing is performed by a qualified service supplier. **(D.1.a)**

f. Procurement of new cylinders – The USEC procurement specification for new cylinders requires that each cylinder pass a 100-psig air pressure test following installation of a valve in a new cylinder. **(D.1.a)**

[5] Cylinders containing Russian material are not physically checked for a negative pressure prior to shipping. Such cylinders are shipped from PGDP based on the fact that the cylinder contained a vacuum prior to being shipped from Russia, its cylinder valve was not operated since the last cold pressure check was performed and a seal was present when the cylinder was received to verify that the cylinder valve has not been repositioned. Other cold pressure checks referred to in this response indicate a physical measurement of the vacuum present in the cylinder.

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

g. Replacement of cylinder valves – On occasion, a degraded valve is discovered in an in-use UF6 cylinder. In these cases, the valve must be replaced with a new valve while the cylinder contains UF_6. In these cases, a leak test using a lower test pressure or a vacuum test is performed on the newly installed valve in order to avoid the chemical hazard associated with pressurizing a cylinder containing UF_6 with 100 psig of air. (ANSI N14.1 only requires the 100 psig test for new or cleaned cylinders; therefore, **D.1.a** does not apply.)

h. Torquing of valve packing nuts – During many plant operations involving UF_6 cylinders, governing procedures allow the cylinder valve packing nut to be torqued to stop leakage e.g., during the air leak test performed when connecting and disconnecting pigtails. Plant procedures limit packing nut torque to a value less than or equal to the 100 psig allowed by ANSI N14.1 Section 6.3.5. **(D.1.b)**

D.2. Based on the proposed response to paragraph C above, the USEC response to this paragraph will only address cylinders that will be shipped off site. With the exception of the cylinder populations described below, within 12 months of the date of this letter, USEC will ensure all cylinders being shipped off site do not contain a valve manufactured by Hunt Valve.

Populations of USEC cylinders with the potential for being shipped off site after the 12-month transition period include the following:

- 30B cylinders used to transport downblended Russian HEU to fuel fabricators. For these cylinders USEC will ensure that all cylinders being shipped off site do not contain a valve manufactured by Hunt Valve after a 36-month transition period.
- Cylinders containing only a heel quantity of UF_6. For these cylinders, USEC proposes that the cylinders may be shipped with a Hunt valve installed for an indefinite time period, but only for the purpose of transport to a facility where the cylinder will be washed and the cylinder valve will be changed to that of an alternate supplier.

Each of these populations is addressed separately below.

30B Cylinders Used To Transport Downblended Russian HEU To Fuel Fabricators

Due to the lengthy process described below, including overseas transport and several interim storage points, the phased replacement of Hunt valves in these cylinders may take up to three years. The Russian "Megatons to Megawatts" program process contains the following major steps. A clean empty 30B cylinder is pressurized with nitrogen and shipped overseas to Russia to be filled. After a period of temporary storage, the cylinder is filled with downblended material at pre-established enrichments and then stored in Russia for several months prior to return shipment. This material is then shipped to PGDP where it is stored again until the material can be utilized to fill an order of the same enrichment level. Once assigned to a particular order, the 30B cylinder is shipped to a fuel fabricator where it is emptied. Most of these cylinders are then washed, hydrostatically tested and the cylinder valve is replaced, all at the same facility where the cylinder was emptied. (One fuel fabricator in this process does not have an authorized wash facility. Any cylinders with Hunt Valves that are shipped to this fabricator to be emptied will

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

then be shipped with a heel to an authorized wash facility for the Hunt valve to be changed.) Cylinder wash facilities have been using valves not manufactured by Hunt Valve Company after the washing of these 30B cylinders since approximately the March 2003 time period. This entire process could take up to 36 months to complete for cylinders that are currently empty and pressurized with nitrogen and awaiting shipment to Russia to commence the cycle. The safety basis for the continued shipment of these cylinders is described below.

Based on USEC experience with Hunt valves, the design and testing specified for the valves, the audits[6] and testing performed by USEC personnel and the pressure testing performed on the cleaned cylinders after the valve was installed, there is reasonable assurance that the valves will meet their required safety function. Prior to shipment to fabricators, USEC personnel verify that the cylinder valve remains shut by ensuring that the seal installed when the cylinder was filled in Russia is still intact when the cylinder is received at PGDP and that the cylinder passes visual inspection criteria. Similar checks are performed by other users of these cylinders in order to comply with ANSI N14.1 Section 5.4.[7] These actions, in addition to the fact that the cylinder valve is not allowed to be operated during the transport of the cylinder, provide assurance that the valve will fulfill its safety function both during transport and at the customer site. While operations with cylinders vary among customer sites, the basic requirements for safe handling of UF_6, including the type of safety controls employed by USEC, provide adequate safety for customers using these cylinders with Hunt valves. Additionally, the audits performed by USEC and the independent testing performed on valves in stores stock at PGDP provide additional assurance of the ability of the valves to perform their safety function. The safety analyses associated with the shipping packages show that the packages for the 30B cylinders are designed to protect the cylinders from high temperatures and pressures in the event of a fire. Analyses indicate that the bulk cylinder content temperature would remain at or below the triple point temperature and that the cylinder pressure would be near the triple point pressure of 22 psia. The maximum estimated local UF_6 temperatures are estimated to be less than 200 °F. These temperatures and pressures are within the normal operating range that Hunt valves experience in autoclave operations and thus it is likely that the valves will perform adequately as described in the safety analysis documentation. For these reasons, USEC believes that a time period of three years to phase out the Hunt valves associated with the Russian material is appropriate.

---

[6] As part of the process for placement on the USEC Approved Suppliers List, USEC audited Hunt Valve and found that they met the requirements of AMSE NQA-1, 1989. Periodic surveillances of supplier performance conducted at the supplier's site during the time when actual assembly and testing of cylinder valves was being performed confirmed that the quality of valves produced by Hunt Valve met the ANSI N14.1 requirements. Even after USEC identified programmatic weaknesses in the Hunt Valve QA program, the quality of their end product remained acceptable, while the supplier executed a corrective action plan to correct the programmatic deficiencies. When USEC received information from the NRC alleging the unreliability of quality assurance information at Hunt Valve, this supplier was removed from the USEC Approved Suppliers List and no further Hunt Valves were purchased. This series of audits and surveillances conducted by trained and qualified USEC auditors provides additional assurance that the quality of the valves manufactured by Hunt Valve remained at an acceptable level in spite of programmatic weaknesses in their QA program.

[7] This section requires either that the vapor pressure of the cylinder is below one atmosphere of pressure or that the measured purity of the cylinder content is within specification. Department of Transportation regulations also require that cylinder pressure must be less than atmospheric prior to shipment.

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

Cylinders Containing Only a Heel Quantity of UF_6

Many cylinders are present at both PGDP and PORTS that would meet the ANSI N14.1 (Section 8.1.2) criteria to be considered empty, i.e. contain less than 50 lbs of UF_6 for a 10 ton or 14 ton cylinder or less than 25 lbs of material for a 2 ½ ton cylinder. These cylinders are referred to in this response as "heeled cylinders." Many of these cylinders are not intended to be utilized again for a number of technical and economic reasons. Some of these cylinders contain valves manufactured by Hunt Valve. As long as such cylinders remain on site, the Hunt valves would not be replaced unless a decision is made to return the cylinder to normal service. In this case, if the cylinder is still within its hydrostatic test date, the cylinder would already be addressed in the USEC response to paragraph C above. If the cylinder has exceeded its hydrostatic test date, it cannot be refilled unless it is washed and hydrostatically tested, at which time the Hunt valve would be replaced with a cylinder valve from an alternate supplier. Some of these cylinders may be washed on site and therefore no shipping of the cylinder would be required. However, other cylinders may need to be shipped to an off-site wash facility to be washed, tested and have a new valve installed. USEC is proposing an exception to the 12-month replacement of Hunt Valves to allow heeled cylinders to be shipped to facilities for the purpose of washing and valve replacement for an indefinite time period. Without this exception, USEC would be forced to replace the cylinder valve on such heeled cylinders strictly for the purposes of a one-time shipment to a supplier facility. At the wash facility, the newly installed valve would have to be removed again and replaced with a different valve once the wash and testing is completed. The safety basis discussion below justifies that there is minimal safety risk associated with this exception.

USEC proposes to allow shipment of cylinders that contain heel quantities of UF_6 and non-volatile uranium compounds for an indefinite time period for the purpose of transporting such a cylinder to a facility to be washed and have the cylinder valve replaced with a valve from an alternate supplier. Cold pressure checks are performed on these cylinders prior to shipment to ensure that a negative pressure exists within the cylinder. This check essentially assures that the valve is seated tightly and is not leaking prior to shipment and the valve is not allowed to be operated during the period of shipment. The amount of uranium in these cylinders is very small (<50 lb. in 48" cylinders and <25 lb. in 30" cylinders). At the maximum enrichments allowed, none of these cylinders have greater than a safe mass of U-235 and thus are intrinsically safe regardless of the amount of moderation that enters the cylinder. However, as noted above for the full cylinders, these cylinders had been processed (emptied) and maintained their pressure and vacuum integrity during the various processing checks. As a result, the cylinders can be considered to be strong, tight containers that will meet the intended safety function providing containment to keep the uranium in and the outside environment out. In the event of a leak to atmosphere during shipment, the initial leakage will be from the atmosphere into the cylinder. Since the cylinders are essentially empty, with a UF_6 vapor pressure of 1-5 psia, inleakage of atmospheric air would result in 100 grams or less of water being added to the cylinder. This would produce less than 220 grams of HF. Assuming a slow leak up to atmospheric pressure, there would be essentially no release of uranium or HF until atmospheric pressure is reached in

RESPONSE TO NRC BULLETIN 2003-03 (Cont.)

the cylinder. After reaching atmospheric pressure, the release of HF and uranium would be by the slow mechanisms of atmospheric pressure changes and molecular diffusion. Due to the very small release pathways, this would result in a very slow release that could not be discerned except in the immediate area of the cylinder. As noted earlier, any such small release pathway would likely be quickly plugged by uranyl fluoride formed at the leak site. Based on these factors, there is no apparent safety benefit to changing out a cylinder valve so that a cylinder could be shipped for cleaning with subsequent valve change out.

NRC Requested Action E

Maintain, for inspection, the documentation of the specific actions taken, and the responses to the above requests for information.

USEC Response – Requested Action E

USEC will retain evidence of the actions taken as a result of this bulletin as quality records. These records will be available on site for inspection by the NRC at any time.