71-6553

USEC
A Global Energy Company

August 1, 2008
GDP 08-0022

Mr. Michael F. Weber
Director, Office of Nuclear Material Safety and Safeguards
Attention: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Paducah Gaseous Diffusion Plant (PGDP)
Docket No. 70-7001, Certificate No. GDP-1
Request to Change Certificate of Compliance for the Paducah Tiger Overpack

Dear Mr. Weber:

In response to a request from the Department of Energy (DOE), the United States Enrichment Corporation (USEC) hereby submits a request for amendment to the Certificate of Compliance (CoC) No. 6553 for the Paducah Tiger Overpack (PTO). This amendment request is required to allow USEC to perform work for the DOE involving interests of the US government. Specifically, the amendment requests that USEC be allowed to ship low enriched UF_6 feed material from PGDP to Portsmouth Gaseous Diffusion Plant (PORTS) in the existing 48A cylinders. This legacy material from DOE operations currently is out of specification for feed material and cannot be used in the enrichment part of the fuel cycle. Transfer of this material to 30B cylinders at PGDP's sole transfer station is not feasible due to the ^{99}Tc contamination levels. Use of this transfer station would jeopardize USEC's ability to produce in specification product during future transfer operations. The cylinders are approximately 50 years old and have been stored full for approximately 30 years. There is no existing or planned facility capable of treating this material to remove the contaminants and allow for use in the fuel cycle except at PORTS (for ^{99}Tc removal) and PGDP for slow feed into the operating GDP. Once at PORTS, the material will be processed for technetium reduction and repackaged in Department of Transportation compliant 2.5-ton cylinders for shipment to PGDP, and used there for feed into the enrichment process. This material also contains a ^{236}U concentration greater than the limit for unirradiated uranium defined in 10 CFR 71.4. It is estimated that the material has an overall intrinsic value of approximately $120 million. If these cylinders are not shipped to PORTS prior to expiration of the PTO CoC, the opportunity to realize this significant value to the government will be lost. Additionally, an apparent historical typographical error in the certificate will be corrected ensuring the overpack tie-down bolt size of 2.5-inches is consistent with the PTO SAR. We request expedited review of this submittal because the PTO Certificate expires on October 1, 2008 and we expect that the shipment process will take up to six weeks.

Enclosure 1 provides a detailed description and justification of the proposed changes. Enclosure 2 is a copy of the revised PTO Safety Analysis Report (SAR) pages associated with this request for Nuclear Regulatory Commission (NRC) approval.

This proposed change is needed because the current CoC Condition 8 specifically prohibits the shipment of UF_6 contained in cylinders designated as 48A in the PTO. The PTO was originally certified for shipment of low enriched UF_6 in 48A and 48X cylinders. However, the 48A cylinders were constructed of A285 steel which has documented issues with brittle fracture at low temperatures. The CoC was changed to prohibit the transport of these cylinders since normal shipping conditions could result in temperatures that were below the brittle fracture transition temperature. USEC analyses have determined that allowing one-time shipment of the subject 26 cylinders (48A cylinders) of UF_6 during the months of August and September, will ensure that there is no adverse impact on the public health and safety in that the temperatures experienced by the cylinder during shipment over this time would maintain the cylinder steel above the brittle fracture transition temperature.

Because of the expiration of the PTO CoC on October 1, 2008, and the 6 weeks needed to complete the cylinder shipments, USEC requests NRC approval of this CoC change by August 19, 2008 to support interests of DOE. The amendment should become effective upon issuance.

Should you have any questions related to this submittal, please contact me at (301) 564-3250. There are no new commitments contained in this submittal.

Sincerely,

V. J. Mendez for

Steven A. Toelle
Director, Regulatory Affairs

Enclosures:
1. United States Enrichment Corporation (USEC), Detailed Description and Justification of the Changes to Certificate of Compliance for Radioactive Material Packages, USA/6553/AF, Paducah Tiger Overpack.
2. United States Enrichment Corporation (USEC) Certificate Amendment Request, Paducah Gaseous Diffusion Plant, Letter 08-0022, Removal/Insertion Instructions.

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United States Enrichment Corporation (USEC)
Detailed Description of Changes to
KY-665, "Safety Analysis Report on the 'Paducah Tiger' Protective Overpack for 10-Ton Cylinders of Uranium Hexafluoride," Revision 1

Description of Change

This change is proposed to support a request by the Department of Energy (DOE) for USEC to ship twenty-six 48A cylinders. The 48A cylinders were restricted from use in the Paducah Tiger Overpack (PTO) because the material from which they were fabricated with (A285 steel) was susceptible to brittle fracture at temperatures above ambient temperature during winter months. In addition, these cylinders do not have: 1) certified volume, 2) code stamp, 3) cylinder valve/plug bosses (couplings), or 4) nameplates with cylinder data. Prior to approximately 1995, these cylinders were shipped in the PTO. Therefore, USEC has determined that a change to the PTO Safety Analysis Report (SAR) is needed. Specifically, a change is proposed to PTO SAR, Revision 1, Section 1.0, "General Information." The proposed changes address the shipment of 48A cylinders provided they are verified to meet the intent of the requirements of ANSI N14.1 immediately prior to shipment.

The following changes are proposed to the subject Certificate of Compliance (CoC) for one time use of the PTO for transport of Model 48A cylinders from Paducah Gaseous Diffusion Plant (PGDP) to the Portsmouth Gaseous Diffusion Plant (PORTS) and correction of the PTO tie-down bolt diameter discrepancy. Changes from the existing text are denoted by strikeouts for deletions and underlining for additions.

Modify Condition 5 of the Certificate of Conformance 6553 as follows:

5. (a) Packaging

(1) Model No.: Paducah Tiger

(2) Description

A protective overpack which provides impact and thermal resistance for the Model No. 48X <u>and 48A</u> 10-ton cylinder. The <u>48X</u> cylinder is welded steel, and is 48 inches in diameter, 121 inches long, and has a 5/8-inch thick wall. The cylinder has a 108.9 ft^3 volume, and is rated at 200 psig service pressure. <u>The 48A 10-ton cylinder is described in Condition 8 below.</u> The protective overpack has overall dimensions of approximately 153 inches by 76 inches by 76 inches. The overpack consists of two parts, a body and a lid, which are clamped and secured by four, 1-3/8-inch ratchet type binders, and eight, 1-3/4-inch guide pins, fitted with 3/4-inch high strength latch pins. The closed, assembled overpack consists of an outer 1/8-inch steel backed on both long sides, top and bottom by two, 10-gauge stainless steel breakaway plates. The valve end is protected by a 3/8-inch stainless steel breakaway plate and a 2-inch thick aluminum stiffening plate. A centrally located 3/16-inch steel shell, 60 inches in diameter x 128 inches long is separated from the outer shell by fire retardant polyurethane foam. The cylinder is held in the overpack by rubber shock isolators. Four mild steel brackets are provided on the body for lifting. Four, ~~2~~ <u>2-1/2</u>-inch bolts are used in conjunction with the ISO corner fittings for tie-down. The maximum gross weight of the package is 40,000 pounds.

Modify Condition 8 of the Certificate of Conformance 6553 as follows:

8. One-time use of Model No. 48A cylinders is ~~not~~ authorized as follows:

(a) 48A cylinders with the following cylinder identification numbers may be shipped one time only from the Paducah Gaseous Diffusion Plant near Paducah, Kentucky to the Portsmouth Gaseous Diffusion Plant near Piketon, Ohio prior to the expiration date of this certificate as identified in certificate condition 14 below.

000098, 000322, 000338, 000493, 000511, 000518, 000553, 000581, 000582, 000677, 000728, 000742, 000747, 000749, 000837, 000842, 000883, 003074, 003077, 003102, 003104, 003155, 003161, 003261, 003265, 003351

(b) These 48A cylinders, made of A285 steel, shall be transported only when a determination has been made by the shipper that, the temperature of the cylinder surface at the time of delivery to the carrier is at or above 50 °F.

(c) Each Model No. 48A cylinder must be designed, fabricated, inspected, tested and marked in accordance with Section VIII of the ASME code. ANSI N14.1 considers the 48A cylinder as currently in service and is acceptable for continued use provided they are inspected, tested, and maintained in accordance with the intent of the standard and requirements stated in ANSI N14.1 Table 1. The following ensures compliance with the intent of ANSI N14.1.

i. The subject cylinders do not have the complete nameplate data permanently affixed to the cylinder. The associated purchasing records for these cylinders have been verified to be available for each cylinder and contain the necessary data.
ii. The subject cylinders are not ASME code or National Board stamped; however, historical data indicates that all the subject cylinders were manufactured to the ASME Code requirements at the time of manufacture.
iii. The subject cylinders do not have a tare weight stamped on their nameplate. Tare weight is available for each 48A cylinder listed in 8.(a).
iv. The cylinders do not have a water capacity stamped on the nameplate. Therefore, each cylinder will be measured and the volumetric capacity calculated to ensure the volume of solid UF_6 does not exceed 61 percent of the calculated volume.

(d) These 48A cylinders contain a ^{236}U concentration greater than the limit for unirradiated uranium defined in 10 CFR 71.4. The subject cylinders will be transported as U (enriched to 20% or less) as identified in Table A-1 of 10 CFR 71, Appendix A.

(e) Each shipment shall be an exclusive use shipment as defined by 49 CFR 173.403.

The PTO SAR, Section 1.0, will be revised to add the following text. The entire revised page is shown in Enclosure 2, page 1-1.

The Paducah Tiger overpack was originally designed, tested, and utilized to transport slightly enriched UF_6 cylinders from the Paducah plant to the Portsmouth plant. These cylinders were then fed to the Portsmouth plant for further enrichment. These cylinders were 48-inch thick walled cylinders made from ASTM A285 steel and manufactured to meet ASME Section VIII code requirements. Originally, these cylinders were designated as 48-inch Type P or 48A cylinders. 48A cylinders were used in the initial testing (fire, drop, etc.) done for initial approval and certification of the Paducah Tiger overpack. When ANSI N14.1 was initially released in 1971, it contained a new designation for 48-inch thick wall cylinders, the 48X. ANSI N14.1 also required these cylinders to be constructed using ASTM A516 steel. The change from ASTM A285 to A516 was done primarily to address the brittle fracture toughness limitations of ASTM A285 at low temperatures. The Paducah Tiger overpack continued to be used to transport 48A and 48X cylinders until about 1995. At this point, the transport of 48A and 48X cylinders made with ASTM A285 steel was prohibited due to the brittle fracture toughness issues. The transport of 48-inch cylinders manufactured with ASTM A285 steel was allowed at least once after they were prohibited, but temperature limitations were imposed.

The 48A cylinders, when handled and shipped above the brittle fracture transition temperature, are functionally equivalent to the 48X cylinders that are specifically described for shipment in the PTO in this SAR. NRC has approved an amendment to the CoC that allows the one-time shipment of twenty-six 48A cylinders containing low enriched UF_6 when the mean temperature is above the brittle fracture transition temperature. As such, anywhere this SAR describes the 48X cylinder operations and controls, these would also apply to the 48A cylinder shipments allowed by NRC in the CoC amendment. In addition, the safety envelope described is fully applicable to the 48A cylinders specified in the approved CoC amendment.

Reason for Change

The change is required to allow USEC to ship low enriched UF_6 feed in 48A cylinders at the request of DOE. In addition, these cylinders do not have: 1) certified volume, 2) code stamp, 3) cylinder valve/plug bosses (couplings), or 4) nameplates with cylinder data. Prior to approximately 1995, these cylinders were shipped in the PTO. This is legacy material from DOE operations currently out of specification for feed material and cannot be used in the enrichment part of the fuel cycle. The inventory of this material is of significant value. The 48A cylinders are equivalent to 48X cylinders that can be shipped in a PTO. The proposed change will allow USEC to ship these cylinders to the Portsmouth facility, where they will be emptied, treated to remove contaminants, and shipped back to Paducah in compliant 2.5-ton cylinders.

Justification for Change

The current CoC for PTO specifically prohibits the shipment of 48A cylinders. DOE has requested USEC ship twenty-five 48A cylinders from PGDP to PORTS. USEC has one 48A cylinder that also needs to be shipped from PGDP to PORTS. The contents of all the cylinders require processing at PORTS to reduce contaminant (^{99}Tc) levels prior to feeding the cylinders at PGDP. Therefore, these cylinders need to be shipped in the PTO. These cylinders are currently prohibited from being shipped in the PTO due to brittle fracture concerns with the ASTM A285 steel used in fabrication. In addition, these cylinders do not have: 1) certified volume, 2) code stamp, 3) cylinder valve/plug bosses (couplings), or 4) nameplates with cylinder data. Prior to approximately 1995, the 48A cylinders were shipped in the PTO.

These cylinders were fabricated before ANSI N14.1 required cylinders to have a certified volume. Cylinders have been shipped in the PTO in the past without a certified volume. Calculations based on actual dimensions and the amounts of UF_6 in the cylinder were used in the past to determine that the cylinders met minimum volume and ullage requirements. The cylinders were not required to be code stamped. The cylinders were built to standards (engineering drawings, fabrication requirements, inspections, etc.) in place at the time. The purchase specifications and fabrication drawing required the cylinders to be fabricated in accordance with ASME code. All of these cylinders have the threads cut directly in the heads for the cylinder valve and plugs rather than welded in bosses/couplings. The 48A cylinder heads were made from 3/4 inch material instead of 5/8 inch in the current 48X cylinders. The thread length in the 48A cylinder head is identical to the thread length in a 48X cylinder boss (coupling). None of the 48A cylinders have nameplates with detailed cylinder data. Therefore, it will be demonstrated that: 1) the 48A cylinders should meet minimum volume and ullage requirements, which will be verified prior to shipping, 2) the 48A cylinders have equivalent historical data available to demonstrate the cylinders are code compliant, 3) the 48A cylinders have direct threads in the heads for the valve/plugs that are equivalent to the boss (coupling) used in the 48X cylinders, 4) and the 48A cylinders do not require the nameplate data required for 48X cylinders.

A review of available literature was conducted on the impact strength and the ductile-to-brittle transition temperature for A285 steel utilized in the fabrication of legacy large UF_6 cylinders. The ductile-to-brittle transition temperature for A285 is below 50°F for all 48 inch cylinders fabricated from A285 steel. Below this temperature, the impact strength of the A285 steel decreases.

Daily mean average temperatures were determined to be above 50°F during the months of May, June, July, August, September, and October for typical transit routes between PGDP and PORTS. The PTO Nuclear Regulatory Commission (NRC) CoC expires on October 1, 2008. Therefore, the only window for potential transport exists for the months of August and September 2008.

These 48A cylinders contain a ^{236}U concentration greater than the limit for unirradiated uranium defined in 10 CFR 71.4. However, the subject cylinders will be transported as U (enriched to 20% or less) as identified in Table A-1 of 10 CFR 71 Appendix A.

The following provides additional detail regarding these issues.

Brittle Fracture

As delineated above, all large (30-inch and 48-inch) UF_6 cylinders were initially fabricated using A285 low carbon steel. In 1971, with the release of the new standard ANSI N14.1, the material used to fabricate large UF_6 cylinders was changed to A516 steel in addition to required impact testing to demonstrate impact fracture toughness of the welded material. Regardless, cylinders fabricated from A285 steel can still provide the same reliability as cylinders fabricated from A516 steel assuming certain restrictions are put in place. To better understand and develop adequate restrictions, a discussion of brittle fracture and impact toughness will be presented.

Brittle fracture was identified as a significant issue during World War II, when welded Liberty ships and T-2 tankers failed under less severe conditions than expected. A research program was initiated to find the cause of the ship failures and to recommend potential solutions. In addition, the research included developing a better understanding of the mechanisms of brittle fracture in mild low carbon steel. It was discovered that three factors contribute to a brittle fracture type of failure. They are:

- a triaxial state of stress,
- a low temperature, and
- a high strain rate or rapid rate of loading.

All three of these factors do not have to be present at the same time to produce brittle fracture. A triaxial state of stress, such as exists at a notch (or defect), and low temperature are responsible for most service brittle fracture failures. Brittle fracture failures are accentuated when the material is loaded at a high rate, as during impact loading. During transport of UF_6 cylinders inside the PTO, the only factor that can be economically controlled is the temperature of the PTO, cylinder and its contents. Temperature was previously used as a condition of use for 48X cylinders fabricated from A285 for a brief period by the DOE CoC for the PTO.

As discussed above, since the brittle fracture failures are accentuated when the material is subjected to a high rate of loading, many types of impact tests have been used to determine the susceptibility of materials to brittle behavior. Steels that have identical properties when tested in tension or torsion at low strain rates can show pronounced differences in their tendency for brittle fracture when tested in a notched-impact test. This is true for A285 and A516 steel.

The principal test now used is the Charpy V-Notch test as described in the ASTM A370 standard. The advantage of this testing method is that it is a relatively simple test that utilizes a relatively inexpensive, small test specimen. Tests can be readily carried out over a range of usually subambient temperatures. From this testing, the temperature at which the material transitions from ductile-to-brittle failure takes place. The results of this testing have been published for most common steels for pressure vessels in ASTM A20; for A285 and A516 steel, the transition temperature is 50°F and -60°F respectively.

Transition temperatures in the 20° to 45°F range have been found for 1950's vintage A285 steel. To ensure conservatism, the minimum transition temperature for all large cylinders fabricated from A285 will be assumed to be less than 50°F. As long as all transport of the A285 cylinders utilizing the PTO is at temperatures 50°F or above, then brittle facture will not be an issue.

The temperature of the cylinders will be a function of the average temperature the cylinders experience prior to shipment and during the transport in the PTO. If the cylinders' surface temperature is verified to be at or above 50°F prior to shipment and the temperatures during transit are at or above a mean daily average of 50°F, then the cylinders will always be above the transition temperature during shipment and when they arrive at the destination. A search of the National Oceanic and Atmospheric Administration's National Climatic Data Center (NCDC) website found a series of climate maps with the mean daily average temperature by month for the lower 48 states. Only the months of May, June, July, August, September, and October have historical mean daily averages above 50°F for likely transit routes between PGDP and PORTS. Figures 1, 2, and 3 below were obtained from the NCDC website for the months of July, August, and September.

Figure 1. July Mean Daily Average Temperature

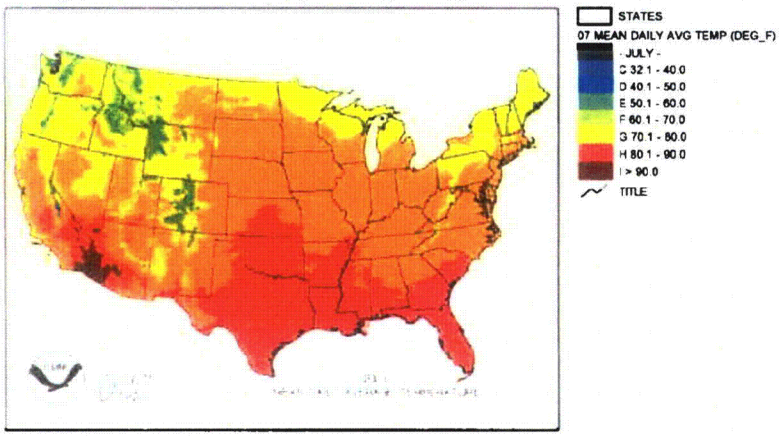


Figure 2. August Mean Daily Average Temperature

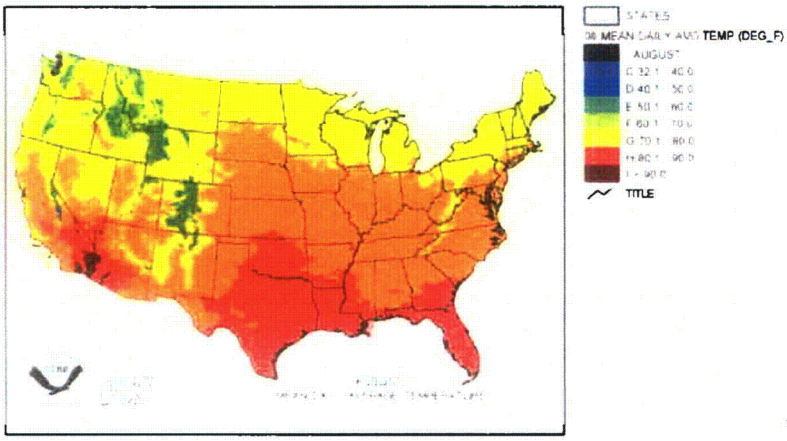
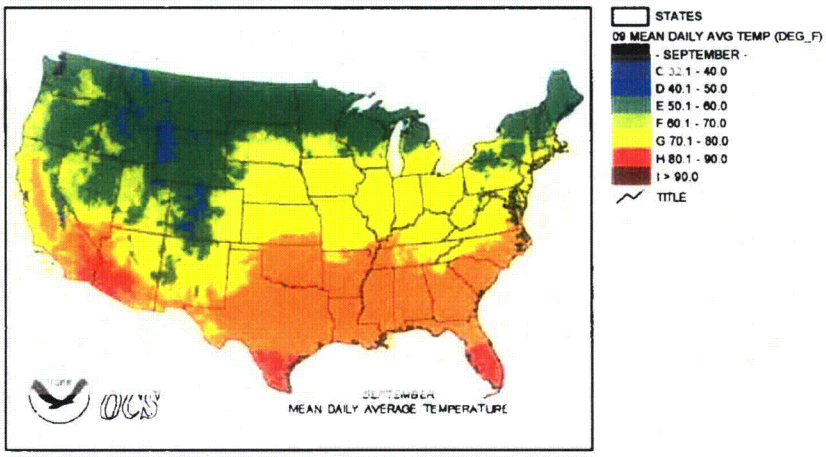


Figure 3. September Mean Daily Average Temperature



Since the mean daily average temperatures are historically above 50°F for the months of July, August, and September for typical transit routes between PGDP and PORTS, then this would be the most likely time period that the actual conditions will meet the minimum 50°F requirements.

Cylinder Certified Volume

ANSI N14.1 requires newly fabricated UF_6 cylinders to have a certified water volume stamped on the cylinder nameplate. The certified water volume provides assurance that the cylinder meets the minimum volume requirements of ANSI N14.1. For a 48A cylinder, the minimum volume is 108.9 ft^3; however, these cylinders do not have a certified volume. ANSI N14.1 requires a minimum of 5 percent ullage (free volume) for cylinders used to transport UF_6. This ullage is calculated based on the density of liquid UF_6 at 250°F. The method demonstrated in USEC-651 will be used to determine ullage.

As discussed previously, there are a total of twenty-six 48A cylinders that need to be shipped from PGDP to PORTS. As stated in ANSI N14.1, "48A cylinders are identical to 48X cylinders except that the volumes are not certified." As has been done in the past, calculations can be performed to demonstrate that the cylinders meet the requirements of minimum volume and ullage.

A calculation from direct measurements was performed for one of the twenty-six 48A cylinders and it was shown to have a volume greater than the ANSI N14.1 minimum volume of 108.9 ft^3. Calculations for the remainder of the 48A cylinders were performed using conservative dimensions from the design drawing. These calculations indicated that these unmeasured cylinders should exceed the ANSI N14.1 minimum volume of 108.9 ft^3. The known quantity of UF_6 contained in each cylinder is less than the ANSI N14.1 maximum fill limit for transportation of 21,030 pounds. The resulting ullage for all the cylinders is greater than 5 percent at 250°F. This corresponds to a volume of solid UF_6 at 68°F that is less than 61 percent as required for transportation by 49 CFR 173.420. Therefore, even though the cylinders do not have certified water volume stamped on the cylinder nameplate as required by ANSI N14.1, all cylinders should have sufficient water volume based on design drawings and direct measurement of one cylinder. Each cylinder will be measured and the volumetric capacity calculated to ensure the volume of the cylinder meets ANSI N14.1 minimum volume of 108.9 ft^3 and that the volume of the solid UF_6 does not exceed 61 percent of the calculated volume.

Code Stamp

All of these 48A cylinders were manufactured to meet the requirements of ASME Section VIII Code for Unfired Pressure Vessels, Paragraph U-69. ANSI N14.1 did not exist when these cylinders were manufactured. ANSI N14.1 does not provide specific design, manufacture, inspection, or testing requirements for 48A cylinders. 48A cylinders are listed in ANSI N14.1, Table 1, *Standard UF_6 Cylinder Data*, as cylinders that are currently in service. ANSI N14.1 further states that cylinders listed in Table 1 that are not specifically defined in the standard are acceptable for continued use, provided they are inspected, tested, and maintained in accordance with the intent of this standard and the requirements stated in Table 1.

Even though these cylinders do not have a code stamp, there is historical data that documents that all of the cylinders were manufactured to the ASME code requirements in place at the time of manufacture. Copies of the purchase specifications for these cylinders were reviewed and verified to require specific code requirements for fabrication, welding, cleaning, testing, etc. The cylinders do have a nameplate that contains the unique cylinder identification number and other data (last hydrostatic test date and maximum recommended service temperature with pure UF_6). All the cylinders will be inspected as required by ANSI N14.1 prior to shipment. Therefore, even though the 48A cylinders above do not have an ASME or National Board code stamp on the cylinder nameplate as required by ANSI N14.1, the cylinders have been demonstrated to meet the intent of the requirements of ANSI N14.1 for similar 48X cylinders.

Cylinder Valve/Plug Boss (Coupling)

The design and fabrication of 48A cylinders did not include a boss (coupling) welded into the cylinder heads for the cylinder valve and plug. Instead, the ¾-inch thick heads were drilled and tapped and the valve and plugs were installed. The current design in ANSI N14.1 utilizes a modified 1-inch half-coupling modified with a counter bore.

The counter bore leaves ¾ inch of 1-inch NPT threads in the coupling. The coupling required by ANSI N14.1 is forged steel conforming to ASTM A105. The 48A cylinder head is fabricated from A285 plate steel and has a yield strength of 30,000 pounds per square inch (psi). The ASTM A105 has a yield strength of 36,000 psi. Both designs have sufficient strength to successfully pass the post fabrication hydrostatic test at 200 percent maximum allowable working pressure (MAWP). Engineering judgment indicates since both designs utilize ¾ inch of threads, the 48A cylinder valve and plug design meet the intent of the requirements of ANSI N14.1 for similar 48X cylinders.

Cylinder Nameplate

None of the 48A cylinders have nameplates with the data required of current 48X cylinders. These specific 48A cylinders only have the cylinder serial number, maximum operating temperature, and the last hydrostatic test date. Most of the data usually required on the nameplate has been previously addressed in specific discussions above. Though the data is not on each cylinder nameplate, this data is available for each cylinder in other documentation. Each item required on current 48X cylinder nameplates will be discussed below.

1) ASME Code and National Board Stamping – See Code Stamp discussion above.

2) MAWP 200 psig at 250°F – MAWP is specified in the purchase specification for all these cylinders.

3) MDMT -20°F at 200 psig – See Brittle Fracture discussion for details of temperature restrictions.

4) Minimum transport temp -40°F – See Brittle Fracture discussion for details of temperature restrictions.

5) Cylinder Model –The 48A cylinders were serialized per purchase specifications with specific ranges of numbers that identify them as 48A cylinders.

6) Owners name or identification symbol and serial number - The 48A cylinders were serialized per purchase specifications with specific ranges of numbers that identify them as 48A cylinders.

7) Tare weight. – The tare weight has been documented in NMC&A records and is available for each specific 48A cylinder that will be shipped.

8) Water Capacity – See Cylinder Certified Volume discussion above.

9) Maximum net weight, Pure UF_6 21,030 pounds – All 48A cylinders must meet the shipping requirements listed in ANSI N14.1 Table 1. Inventory data shows that for each cylinder the net weight is below the threshold; all cylinders will have their shipping weight verified to be in compliance with ANSI N14.1.

10) Month and year of manufacture – This information is not available. As these cylinders will not be refilled following emptying at PORTS, this data is not significant to safely shipping these 48A cylinders.

Based on the discussion of each nameplate data above, a nameplate with the current data required by ANSI N14.1 is not necessary and the information provided in this evaluation and appendices is sufficient to allow shipment of these 48A cylinders.

Shipment of Material as Unirradiated Material (Outside 10 CFR 71 Definition)

The transport of low enriched UF_6 in 48A cylinders has occurred over many years. As noted earlier, the initial transport of cylinders did not require overpacks. From 1971 until 1995, the PTO was utilized for shipment of 48A and 48X cylinders containing enriched feed (nominal 1.6 percent ^{235}U enrichment) from PGDP for further enrichment at PORTS. From 1974-2001, there were approximately 14,000 such shipments in PTOs that occurred without any incident via roadways and railways. In 2001 the PORTS enrichment cascade was shutdown and further shipments to PORTS of low enriched PGDP material was no longer needed.

As noted earlier, the material in the cylinders that are the subject of this CoC amendment request is essentially the same as that shipped over the years in the PTO to PORTS. This material is PGDP product while the primary feed stock was reprocessed uranium. While the ^{99}Tc and ^{236}U concentrations are at the high end of most of the previous years shipments, the overall uranium isotope activity (including ^{234}U) is consistent with these previous shipments. The ^{234}U concentrations are within the ASTM Specification C 996, *Standard Specification for Uranium Hexafluoride Enriched to Less than 5% ^{235}U*, which applies to UF_6 not exceeding 5 percent enrichment that is intended for feed to an enrichment plant; however, it exceeds the specification for ^{99}Tc.

During the shipment of such material from PGDP to PORTS over many decades, the UF_6 was shipped as a Type A(F) material using the PTO. Prior to 2004, there was no definition for unirradiated uranium contained in 10 CFR 71; there was such a definition in 49 CFR 173, Subpart I. In 2004, a regulatory effort was accomplished to make the contents of these federal regulations consistent with each other and with IAEA requirements. As part of these changes, unirradiated uranium was defined to have a concentration of ^{236}U less than 5000 micrograms per gram of ^{235}U. If concentrations exceed the ^{236}U (or other radionuclide) concentrations, 10 CFR 71 does not utilize the A_2 value for U (enriched to 20% or less); rather, it requires a calculation for each nuclide quantity for comparison to the individual A_2 nuclide values. For large quantities of enriched uranium, the ^{234}U A_2 value would always be exceeded if calculated separately; interestingly, the ^{236}U value (which triggers the definition of unirradiated material) has an A_2 value which is unlimited. Of course, the ^{234}U remains highly diluted by the mass of ^{238}U and ^{235}U. As an example, the ^{234}U content of current enriched product shipments from PGDP, shipped as Type A(F) material, is approximately equivalent to the ^{234}U content of any of the cylinders that are subject to this amendment request for shipment in the PTO. However, the current product shipments are considered not to be irradiated and thus, are shipped using the U (enriched to 20% or less) A_2 value.

Therefore, the proposed change is to continue to allow the subject cylinders to be shipped as Type A(F) material in the PTOs. As shown above, such shipment of the low enriched uranium material with the ^{236}U and ^{234}U concentrations identified would not result in any significant risk to the public health and safety. The primary risk to the public from shipments of low enriched UF_6 in the PTO is the chemical toxicity risk of the UF_6 itself and the potential criticality risks; these risks are unchanged with respect to the material previously shipped and currently authorized for shipment in the PTO.

Conclusion

Model No. 48A cylinders are currently restricted from being shipped in the PTO due to brittle fracture concerns regarding the ASTM A285 steel from which these cylinders were manufactured. In addition, these cylinders do not have: 1) certified volume, 2) code stamp, 3) cylinder valve/plug bosses (couplings), or 4) nameplates with cylinder data. Prior to about 1995, these cylinders were shipped in the PTO.

These cylinders were fabricated before ANSI N14.1 required cylinders to have a certified volume. Cylinders have been shipped in the PTO in the past without a certified volume. Calculations based on actual dimensions and the amount of UF_6 in the cylinder were used in the past to determine that the cylinders met minimum volume and ullage requirements. The cylinders were not required to be code stamped. The cylinders were built to standards (engineering drawings, fabrication requirements, inspections, etc.) in place at the time. The purchase specifications and fabrication drawing required the cylinders to be fabricated in accordance with ASME code. All of these cylinders have the threads cut directly in the heads for the cylinder valve and plugs rather than the threads in welded

in bosses/couplings. The 48A cylinder heads were made from ¾-inch material instead of 5/8 inch in the current 48X cylinders thus, thread length is identical. None of the 48A cylinders have nameplates with detailed cylinder data. Therefore, it has been demonstrated that: 1) the 48A cylinders should meet minimum volume and ullage requirements, which will be verified prior to shipping, 2) the 48A cylinders have equivalent historical data available to demonstrate the cylinders are code compliant, 3) the 48A cylinders have direct threads in the heads for the valve/plugs that are equivalent to the boss (coupling) used in the 48X cylinders, and 4) the 48A cylinders do not require the nameplate data required for 48X cylinders.

A review of available literature was conducted on the impact strength and the ductile-to-brittle transition temperature for A285 steel utilized in the fabrication of legacy large UF_6 cylinders. The ductile-to-brittle transition temperature for A285 is below 50°F for all 48-inch cylinders fabricated from A285 steel. Below this temperature, the impact strength of the A285 steel decreases.

Daily mean average temperatures were determined to be above 50°F during the months of May, June, July, August, and September for typical transit routes between PGDP and PORTS. The PTO NRC CoC expires on October 1, 2008. Therefore, the only window for potential transport exists only for the months of August and September 2008.

These 48A cylinders contain a ^{236}U concentration greater then the limit for unirradiated uranium defined in 10 CFR 71.4. However, the subject cylinders will be transported as U (enriched to 20% or less) as identified in Table A-1 of 10 CFR 71 Appendix A.

Therefore, since:

(1) the data available or to be calculated in lieu of the nameplate data for the subject 48A cylinders indicates the cylinders as manufactured will meet the intent of ANSI N14.1,

(2) the 48A cylinders should meet minimum volume and ullage requirements, which will be verified prior to shipping,

(3) if shipped during the months of August and September 2008 following verification that the cylinder wall temperature meets or exceeds 50°F brittle fracture will not be an issue,

(4) the total activity of each cylinder is consistent with that of previous shipments of this type material and current shipments of Type A(F), and

(5) the cylinders are transported as U (enriched to 20% or less),

the intent of the regulations is preserved and there will be no adverse impact on the public health and safety for these 26 cylinder shipments.

United States Enrichment Corporation (USEC)
Certificate Amendment Request
Paducah Gaseous Diffusion Plant
Letter GDP 08-0022

Removal/Insertion Instructions

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REVISION LOG

Date	Change	Description
7/15/99	REV 1	Initial Issue. Complete Revision of all pages.
5/02/00	A	Revised Sections 3.5.1.1, 3.5.6, 4.2.2 and 7.1.2 to increase the amount of residual UF_6 allowed for shipment in the overpack.
7/12/00	B	Revised Sections 1.1, 1.2.1.9, and 2.1.2 to allow for the shipment of W. H. Stewart Company cylinders in the overpack.
9/18/00	C	Revised Sections 1.2.1.9, and 7.0 to allow for one round-trip shipment of cylinder PT0225 which does not have a water capacity stamped on the nameplate.
1/10/03	D	Revised Section 1.0 to delete the reference to the Portsmouth Plant and to provide more concise wording of the information contained in this Section.
8/13/04	E	Revised Sections 1.1, 1.2, 2.1.2, 2.10, 4.5, 7.4, 8.3 to address and incorporate the 2001 version of the ANSI N14.1 to allow the use of cylinders manufactured to this version. Revised Table 1.2.2; 48X Cylinder Material Specification. Deleted the text added by "Change C" above since the one time activity addressed by this change was completed.
12/22/05	F	Revised Section 2.0 to reflect Type AF package requirements in renumbered paragraph 71.19. Revised Section 4.2.1 to correct the A_2 methodology reference to 10CFR71, Appendix A, Section IV.b. Revised Section 6.1 by deleting the source reference for H/U ratio.
Proposed	G	Revised Section 1.0 to address the shipment of 48A cylinders in the PTO.

1.0 GENERAL INFORMATION

The Paducah Gaseous Diffusion Plant enriches uranium hexafluoride (UF_6) which is contained in large steel cylinders when not in process. Cylinders containing enriched material may be shipped to other facilities authorized to receive special nuclear material. The large steel cylinders used to ship the UF_6 in conjunction with the Paducah Tiger Overpack (PTO) are Model 48X 10-ton UF_6 cylinders (48X cylinders). During shipment, the PTO encases the 48X cylinder to provide thermal, puncture, and impact protection.

The Paducah Tiger overpack was originally designed, tested, and utilized to transport slightly enriched UF_6 cylinders from the Paducah plant to the Portsmouth plant. These cylinders were then fed to the Portsmouth plant for further enrichment. These cylinders were 48-inch thick walled cylinders made from ASTM A285 steel and manufactured to meet ASME Section VIII code requirements. Originally, these cylinders were designated as 48-inch Type P or 48A cylinders. 48A cylinders were used in the initial testing (fire, drop, etc.) done for initial approval and certification of the Paducah Tiger overpack. When ANSI N14.1 was initially released in 1971, it contained a new designation for 48-inch thick wall cylinders, the 48X. ANSI N14.1 also required these cylinders to be constructed using ASTM A516 steel. The change from ASTM A285 to A516 was done primarily to address the brittle fracture toughness limitations of ASTM A285 at low temperatures. The Paducah Tiger overpack continued to be used to transport 48A and 48X cylinders until about 1995. At this point, the transport of 48A and 48X cylinders made with ASTM A285 steel was prohibited due to the brittle fracture toughness issues. The transport of 48-inch cylinders manufactured with ASTM A285 steel was allowed at least once after they were prohibited, but temperature limitations were imposed.

The 48A cylinders, when handled and shipped above the brittle fracture transition temperature, are functionally equivalent to the 48X cylinders that are specifically described for shipment in the PTO in this SAR. NRC has approved an amendment to the CoC that allows the one-time shipment of twenty-six 48A cylinders containing low enriched UF_6 when the mean temperature is above the brittle fracture transition temperature. As such, anywhere this SAR describes the 48X cylinder operations and controls, these would also apply to the 48A cylinder shipments allowed by NRC in the CoC amendment. In addition, the safety envelope described is fully applicable to the 48A cylinders specified in the approved CoC amendment.

The PTO with the 48X cylinder is referred to as a package and is shipped by either truck or rail. The package is a Type AF radioactive material package with a maximum shipping weight of 40,000 pounds, which meets the requirements specified in 10 CFR 71.73. The transport index required for criticality safety purposes is 0.0.