

Using Department of Energy (DOE) Order 435.1 To Find a Cost Effective Waste Management Option. – 12241

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ABSTRACT

The Depleted Uranium Hexafluoride Project in Portsmouth Ohio was faced with an interesting dilemma. During hot functional testing in August 2010, an upset condition caused gaseous depleted uranium hexafluoride ($U F_6$) to come in contact with the hydrofluoric acid (HF) vapor stream. Although the resulting uranium contamination found in the condensed aqueous hydrofluoric acid was very low, it exceeded the Department of Energy (DOE) authorized release limit. After evaluating several commercial options for treatment and disposal using the guidelines found in DOE Order 435.1, Waste Control Specialists LLC was selected for the treatment of the waste, with EnergySolutions' Clive facility selected for disposal of the treated residues. The waste was safely transported from Piketon, Ohio to Andrews, Texas, where it was treated to meet the land Disposal Restrictions (LDR), and was disposed in EnergySolutions operational mixed waste cell.

BACKGROUND

The Depleted Uranium Hexafluoride Conversion Project provides for the design, construction and operation of two facilities, one at Portsmouth, Ohio and one at Paducah, Kentucky to convert approximately 700 million kilograms of depleted uranium hexafluoride stored at the two sites into a more stable chemical form suitable for beneficial reuse or disposal.

Depleted uranium hexafluoride was generated during the past active operation of the gaseous diffusion enrichment plants at Portsmouth and Paducah Sites. The Portsmouth depleted uranium hexafluoride inventory is expected to be processed in approximately 18 years and Paducah's larger inventory within 25 years.

The US congress mandated that two conversion facilities be built for converting the depleted uranium hexafluoride inventory into depleted uranium oxide and other conversion products (P.L. 107-206). The conversion facilities would convert depleted uranium hexafluoride into a stable chemical form for beneficial use/reuse and/or disposal. The off-gas from the conversion process would yield aqueous hydrofluoric acid, which would be processed and marketed. To support

the conversion operations, the emptied depleted uranium hexafluoride cylinders would be stored, handled, and processed for reuse as uranium oxide disposal containers to the extent practicable. In August 2002, DOE awarded a contract to Uranium Disposition Services, LLC for design, construction and initial operation of the two facilities.

Figure 1 represents a graphic illustration of the depleted uranium conversion process.

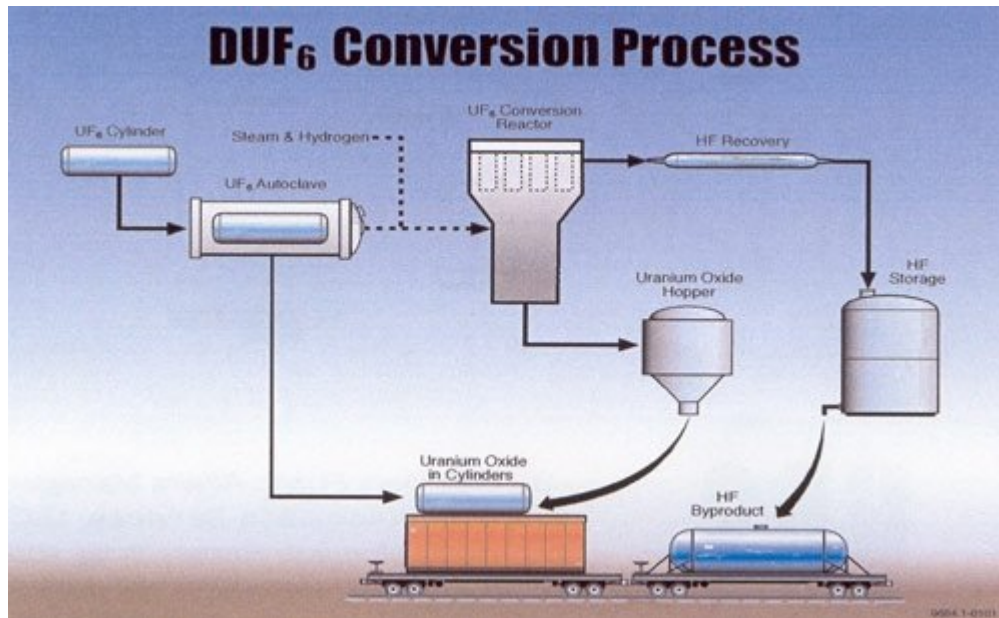


Figure 1. Graphic Illustration of Depleted Uranium Hexafluoride Conversion Process

Using operation experience from Uranium Disposition Services, LLC's partner AREVA, in Richland, WA an Authorized Limit for the aqueous hydrofluoric acid was prepared and eventually approved by DOE. The Authorized Limit was set at 0.1 becquerels/ml (3 pCi/ml). With an approved Authorized Limit, Uranium Disposition Services, LLC was able to pursue a agreement with Solvay Fluorides, LLC of Houston Texas for purchase of all hydrofluoric acid produced at both the Portsmouth and Paducah conversion facilities. (1)

The Portsmouth facility completed their Operation Readiness Review in May 2010. The next phase of the project involved a step wise approach to hot functional testing of all the plant's systems. By August, 2010 the Portsmouth facility was ready to begin testing of one of their six conversion units using uranium hexafluoride feed material. The six conversion units are designed to function in pairs, but the test plan only specified using one of the two paired units. System engineers and operations personnel were unaware that the shared nitrogen purge system could be back fed with uranium hexafluoride gas.

At some point during the introduction of the uranium hexafluoride gas, the pressure within the conversion unit overcame the nitrogen purge pressure causing uranium hexafluoride to enter the paired conversion unit that was not being tested. The uranium hexafluoride was captured by conversion unit's ventilation system that was designed to capture hydrofluoric acid gas vapors. The uranium hexafluoride eventually ended up in the hydrofluoric acid scrubber units where it was converted into uranium oxide and aqueous hydrofluoric acid. The uranium oxide contaminated the entire hydrofluoric acid scrubber system where aqueous hydrofluoric acid is initially collected before being transferred over to the hydrofluoric acid storage tanks. Before the upset condition was detected, the dissolved uranium oxide made its way to one of the hydrofluoric acid storage tanks, known as Tank 554. By the time the upset condition was identified, there was about 5000 gallons of hydrofluoric acid collected in Tank 554.

After performing analysis of the hydrofluoric acid in Tank 554, the total uranium concentration was determined to be ~0.6 becquerels/ml (15 pCi/ml). This clearly exceeded the approved authorized limit of 0.1 becquerels/ml (3 pCi/ml).

In addition to the hydrofluoric acid, the project generated approximately 11,000 liters of potassium hydroxide which was also contaminated with uranium. This waste was eventually neutralized with hydrochloric acid.

DISCUSSION OF CORRECTIVE ACTIONS

Depleted Uranium Hexafluoride project personnel immediately began to identify options for the disposition of the uranium contaminated hydrofluoric acid and neutralized potassium hydroxide. Two primary options were identified. The first option involved managing the hydrofluoric acid as a commercial product by finding ways for it to be sold to Solvay as originally intended. Several methods were considered, with the primary basis being the blending of the uranium contaminated hydrofluoric acid with other hydrofluoric acid until the uranium concentration was below 0.1 becquerels/ml (3 pCi/ml). Eventually DOE decided that this was not the preferred option.

The alternative was to manage the hydrofluoric acid along with the potassium hydroxide as wastes. The hydrofluoric acid which was intended to be a commercial chemical product, was considered off-specification resulting in the RCRA waste code of U134. The neutralized potassium hydroxide was not considered a RCRA waste. Waste management personnel with the Depleted Uranium Hexafluoride project were directed to identify facilities that could receive, treat and dispose of the uranium contaminated liquid wastes. Waste management personnel

began to evaluate several commercial options for treatment and disposal using the guidelines found in DOE Order 435.1. As the hydrofluoric acid was a mixed RCRA waste, it presented the fewest options for disposition. Three facilities were identified with the physical and permitted capabilities to manage the hydrofluoric acid. The three facilities were PermaFix's Diversified Scientific Services, Incorporated's facility in Kingston, TN, EnergySolutions' facility in Clive UT, and Waste Control Specialists LLC's facility in Andrews, TX.

Diversified Scientific Services, Inc. offered to neutralize the hydrofluoric acid and then thermally destruct the remaining solution in their industrial boiler. EnergySolutions proposed neutralizing the solution, after which it would be solidified and then disposed in the mixed waste disposal cell.

Waste Control Specialists LLC offered to provide a novel approach and service, instead of receiving the waste as mixed waste, Waste Control Specialists LLC determined the waste met Texas Exempt Waste requirements (as described in Texas Administrative Code (30 TAC 336.5(d))) and could be managed a hazardous waste.

Depleted Uranium Hexafluoride project personnel determined the option proposed by Waste Control Specialists LLC to be significantly less costly than all the other two options. As with any new approach, initial resistance and justification was needed to demonstrate that the approach was a viable alternative. Depleted Uranium Hexafluoride project personnel submitted the technical and economic justification to the Department of Energy (DOE) using a DOE Order 435.1 Commercial Exemption Request. The 435.1 Commercial Exemption Request was approved by the DOE project office under the newly revised rules that no longer required DOE Headquarters approval, which significantly shortened the approval process. (2)

Depleted Uranium Hexafluoride project personnel prepared and submitted waste profiles to Waste Control Specialists LLC for the hydrofluoric acid and the neutralized potassium hydroxide. With the submitted profiles in hand, Waste Control Specialists LLC submitted a notification of prospective acceptance of exempt waste to the State of Texas. Texas agreed that the exemption is authorized under Title 30, Section 336.5(c) and Title 25, Section 289.251(d)(1) of the Texas Administrative Code, which states:

Title 30, Section 336.5

(c) Waste, that is exempted from licensing requirements under Texas Health and Safety Code, §401.106(a), is exempted from the requirements of this chapter.

Title 25, Section 289.251

(d) Exemptions for source material.

(1) Any person is exempt from this section and §289.252 of this title if that person receives, possesses, uses, or transfers source material (which includes depleted uranium) in any chemical mixture, compound, solution, or alloy in which the source material is by weight less than 1/20 of 1.0% (0.05%) of the mixture, compound, solution, or alloy.

As exempt waste, the hydrofluoric acid and neutralized potassium hydroxide could be managed as exempt waste not requiring disposal in a licensed low level radioactive waste disposal facility. This would allow Waste Control Specialists LLC to receive and treat the waste within their RCRA permitted facilities and not be subjected to their radioactive materials license.

Waste Control Specialists LLC is permitted to operate a Treatment Storage and Disposal Facility (TSDF) in accordance with a RCRA permit. Under the permit Waste Control Specialists LC is authorized to treat and store RCRA wastes. Waste Control Specialists LLC also has the ability to treat, store, and dispose of hazardous waste, Polychlorinated Biphenyl (PCB) TSCA waste, and Naturally Occurring Radioactive Material (NORM). The Waste Control Specialists LLC site includes a Subtitle C landfill that currently has 4.13 million cubic meters of permitted disposal capacity.

Waste Control Specialist LLC has processing capabilities that includes the Stabilization Building with 1800 square meters of treatment and staging area, and two 65 cubic meter mixing pans for hazardous waste treatment. Figure 2 provides a layout of Waste Control Specialists LLC facilities.



Figure 2. Waste Control Specialists LLC Facility Layout

After receiving the exemption authorization from the State of Texas confirming the wastes was authorized as exempt waste for disposal, DOE personnel began to question the regulatory mechanism that would allow waste that is considered radioactive at the site of origin to be received and managed as non-radioactive in the State of Texas. After several weeks of discussion, DOE finally determined that new Authorized Limit approval would be necessary.

According to DOE Order 458.1, an Authorized Limit is a “limit on the concentration or quantity of residual radioactive material on the surfaces or within property that has been derived consistent with DOE directives including the ALARA process requirements. An authorized limit may also include conditions or measures that limit or control the disposition of property.” DOE developed the Authorized Limit approach to allow for the release of property, or waste as in this case, which has residual radioactivity, that meets designated criteria for how it may be used which depends on the dose consequence to the target population. (3)

The Depleted Uranium Hexafluoride project personnel along with DOE determined that the additional time needed to prepare and approve a new Authorized Release, would have greater impact to the project than to send the waste off as radioactive waste. As such after reevaluation of the other options, the project determined that the best alternative to exempt disposal was to

send the wastes to Waste Control Specialists LLC for treatment, and send the treated residues to the EnergySolutions' Clive, UT Low Level Radioactive Waste Disposal Facility for disposal.

The waste was safely transported from Piketon, Ohio to Andrews, Texas, where they were treated to meet the Land Disposal Restrictions (LDR) as applicable, and were packaged in B-25 boxes and transported to Clive, UT where it was disposed in EnergySolutions' LLW and mixed waste cells.

CONCLUSION

The entire effort was interesting for several reasons. The waste was generated during the last year of the first Depleted Uranium Hexafluoride contractor. The waste became additional scope for the new contractor, adding time delays and introducing new personnel into the project. The effort was also unique because it demonstrated the process mandated by DOE Order 435.1 to evaluate all options, including commercial options, could reveal solutions to waste management problems that are currently available and more cost effective, but not well known within the DOE complex.

REFERENCES

(1) Depleted Uranium Hexafluoride Project website (www.pppo.energy.gov/duf_history.html), Department of Energy, November 2011

(2) Department of Energy Manual 435.1-1, Radioactive Waste Management Manual , Administrative Change 1, June, 2011

(3) Department of Energy Order 458.1, *Radiation Protection of the Public and the Environment*, March 2011