Westinghouse

Westinghouse Electric Company
Nuclear Fuel
Columbia Fuel Fabrication Facility
5801 Bluff Road
Hopkins, South Carolina 29061
USA

SCDHEC
Christopher Hardee
Bureau of Air Quality
2600 Bull Street
Columbia, SC 29201

Direct tel: 803.647.1920
Direct fax: 803.695.3964
e-mail: joynerdp@westinghouse.com

Your ref:
Our ref: LTR-RAC-22-39

July 19, 2022

Subject: Air Emissions Evaluation
Legacy WCMT Drum Processing
Westinghouse Electric Company, LLC
Permit No. 1900-0050-R1

Received
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Mr. Hardee-

Please find attached for your records an independent air emissions evaluation completed by GEL Engineering for the processing of up to 522 legacy drums of wet combustible material ("WCM") containing tetrachloroethylene ("WCMT"). Specifically, GEL examined if legacy WCMT processing would be subject to or exempt from air construction permitting based on regulations and guidance issued by the South Carolina Department of Health and Environmental Control (DHEC) Bureau of Air Quality (BAQ).

Based on the GEL review (enclosed), emissions from WCMT drum processing are de minimis and exempt from air construction permitting and air dispersion modeling. Westinghouse requests the Department's concurrence with these conclusions regarding the air emissions evaluation.

Please contact Diana Joyner at 803.497.7062 or joynerdp@westinghouse.com with any questions regarding this notification.

Respectfully,

Diana P. Joyner
Principal Environmental Engineer
Westinghouse Electric Company, CFFF
803.497.7062 (m)

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cc: J. Ferguson, CFFF EH&S Manager
N. Parr, CFFF Environmental Manager
J. McLure, P.E., GEL Principal Engineer
A. Goode, SCDHEC Engineering Associate, Sandhills Section
ENOVIA Records

Enc.: *GEL Air Emissions Evaltuion for Legacy WCMT Drum Processing (July 18, 2022)*

GEL | Engineering LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
2040 Savage Road Charleston, SC 29407
P 843.769.7378 F 843.769.7397

www.gel.com

July 18, 2022

Ms. Diana P. Joyner
Principal Environmental Engineer
Westinghouse Electric Company LLC
5801 Bluff Road
Hopkins, South Carolina 29061

Received
JUL 21 2022
Bureau of Air Quality

Re: Air Emissions Evaluation for Legacy WCMT Drum Processing
Westinghouse Electric Company LLC
Hopkins, South Carolina

Dear Diana:

As requested by Westinghouse Electric Company LLC ("Westinghouse"), GEL Engineering, LLC ("GEL") has completed an evaluation of air emissions from the proposed processing of up to 522 legacy drums of wet combustible material ("WCM") containing tetrachloroethylene ("WCMT"). Specifically, GEL examined if legacy WCMT processing would be subject to or exempt from air construction permitting based on regulations and guidance issued by the South Carolina Department of Health and Environmental Control (DHEC) Bureau of Air Quality (BAQ).

Based on our review, GEL concludes that emissions from WCMT drum processing are de minimis and exempt from air construction permitting and air dispersion modeling. An in-depth discussion of our analysis and conclusions is included below.

Background

The information in the following sections (Background, Proof of Concept, and Full-Scale Process) is summarized from correspondence between Westinghouse and the United States Environmental Protection Agency ("EPA") regarding processing the legacy WCMT drums.

The Solvent Extraction I ("SOLX I") process at Westinghouse produces clean uranyl nitrate ("UN") that is transferred to the feedstock UN bulk storage tanks. Under the former design[1], a mixture of tributylphosphate ("TBP") solvent and tetrachloroethylene was used in SOLX I. This mixture was periodically removed from the system and replaced. While not unique to the SOLX I process, WCM was generated in the SOLX I area.

The site's historic practice was to combine the mixture of TBP solvent and tetrachloroethylene from SOLX I with the TBP solvent and kerosene mixture from SOLX II. The combined mixture

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[1] In May 2020 the site implemented a new concurrent flow process that uses tributyl phosphate ("TBP") and dodecane to replace the previous counter-flow process that used TBP and tetrachloroethylene, such that tetrachloroethylene is no longer used at the site.

was periodically added in small amounts to the WCM to maximize the uranium ("U") recovery potential in any given drum, thereby enhancing recycling. Based on a sample analysis of the combined mixture, the estimated maximum amount of tetrachloroethylene that was added to each drum is 0.156 gallons (~2.11 pounds "lbs").

Historically the U has been recovered for recycling by burning the contents of the drums in order to concentrate the U in the residual ash. The incinerator burns materials at typical operational temperatures of approximately 1,400 – 1,900 degrees Fahrenheit ("°F"), leaving only an ash residue; the ash residue is recycled to recover U. Tetrachloroethylene's boiling point is 250°F. Therefore, any tetrachloroethylene present in the WCM is vaporized by the incinerator.

The 522 WCMT legacy drums are in one of two storage areas and are maintained in conformance with EPA's instructions. Based on discussions with EPA, Westinghouse engineers in consultation with GEL developed a conceptual process to remove the residual tetrachloroethylene from the WCMT drums before recovering the U via the incinerator. What follows is a summary of the proof of concept tests and a description of the full scale process approved by EPA.

Proof of Concept

To provide a proof of concept, Westinghouse retained GEL to develop and conduct a series of bench scale tests to replicate techniques that potentially could be used to remove tetrachloroethylene from the WCMT drums to achieve concentrations of tetrachloroethylene below the 500 parts per million ("ppm") regulatory ceiling in 40 CFR 266.100(d)(2)(i) whilst preserving the heat value below the 5,000 British thermal units per pound ("Btu/lb") ceiling in 40 CFR 266.100(d)(2)(ii).

For the tetrachloroethylene portion of the test, Westinghouse provided GEL with specifications identifying the highest concentration of tetrachloroethylene that would potentially be present in the WCMT. GEL then prepared a solution of tetrachloroethylene, TBP, and kerosene to replicate the fluid added to the drums of WCM. In this manner, GEL could perform tests at its laboratory using a solution that conservatively reflected the actual solution added to the drums except for the U content.

The initial bench scale tests were conducted from late September through early December 2020. During this period test plans were developed, equipment and materials were gathered (including samples of virgin materials such as mop pieces and rags that would be present in the WCM), the tests were conducted, and the post-test processed materials were analyzed by GEL for tetrachloroethylene.

Six bench scale tests were conducted under the following conditions:

- Ambient
- Ambient with sparge and suction

- Heated to 95°F
- High vacuum with sparge
- High vacuum with sparge and heated to 95°F
- Heated to 95°F with sparge

The duration of the tests varied from 9 days (ambient) down to 2 days (high vacuum with sparge). Resulting tetrachloroethylene concentrations ranged from 3.05 ppm to 134 ppm, all well below the 500 ppm regulatory ceiling in 40 CFR 266.100(d)(2)(i).

The bench scale tests validated the overall proof of concept for the removal of tetrachloroethylene. Specifically, the tests indicated that a combination of sparging the containers while drawing a vacuum greatly reduced the time necessary to remove the tetrachloroethylene. In driving off the tetrachloroethylene, however, Westinghouse calculated the heating value of the WCM drums would increase above the regulatory threshold based on the assumption that the majority of the water content would also be evaporated in the process. Therefore, Westinghouse in consultation with EPA, modified the design concept to condense and return the non-organic portion of the condensate from the effluent gas to the WCM drums.

The modified design is based on the premise that the organic and aqueous phases of the condensed effluent gas will readily separate if collected. GEL confirmed the premise in a series of laboratory trials where the estimated concentrations of the chemicals expected to be evaporated and condensed from the WCM drums were mixed and evaluated. These mixture experiments showed that the organic chemicals readily phase separate from the aqueous solution. With the organic mixture being hydrophobic and less dense than water as a result of the prevalence of kerosene in the organic phase, it phase separated above the aqueous phase.

Next, GEL further evaluated the separated aqueous phase to confirm the tetrachloroethylene remained in the organic phase. The results confirmed that the remaining tetrachloroethylene in the aqueous phase was well below the 500 ppm regulatory ceiling and in fact was less than the technically accepted solubility limit of tetrachloroethylene in water, which is 150 ppm. Based on the findings of the proof of concept tests, no further treatment of the aqueous phase is required prior to returning it to the WCM drums.

As previously submitted to EPA, the heating value of a typical drum was below the 5,000 Btu/lb threshold when moisture levels were retained. With this final design, Westinghouse is able to maintain the moisture level whilst removing the tetrachloroethylene from each WCM drum. In doing so, each WCM drum satisfies the regulatory elements to negate a solid waste designation and therefore it can be recycled for uranium recovery.

Full Scale Process

The WCM drums are segregated in two storage areas at the site. Batches will be selected to optimize the vacuum drying process efficiency in accordance with the facility's established nuclear criticality safety controls.

Operators will initially screen each drum to determine whether the drums currently satisfy the conditions in 40 CFR 266.100 (d)(2)(i) and (ii). The screening will entail inserting a Draeger tube tetrachloroethylene analyzer or similar device into the drum headspace. Based on modeling data prepared by Century 3, Inc., a headspace concentration less than or equal to 7 ppm tetrachloroethylene equates to a concentration in the liquid phase of 450 ppm or less of tetrachloroethylene. Further, the prior heating content analysis shared with EPA demonstrates that when the tetrachloroethylene is less than 450 ppm, the corresponding heat value is less than 5,000 Btu/lb.

Each drum then with an initial reading of 7 ppm tetrachloroethylene or less will be deemed not to be a solid waste in accordance with 40 CFR 261.4(a)(23), and the operators will subsequently remove the hazardous waste label from the subject drum before staging it for uranium recovery. Drums for which the headspace concentrations exceed 7 ppm tetrachloroethylene will be staged for treatment in the vacuum dryer process (See Figure 1).

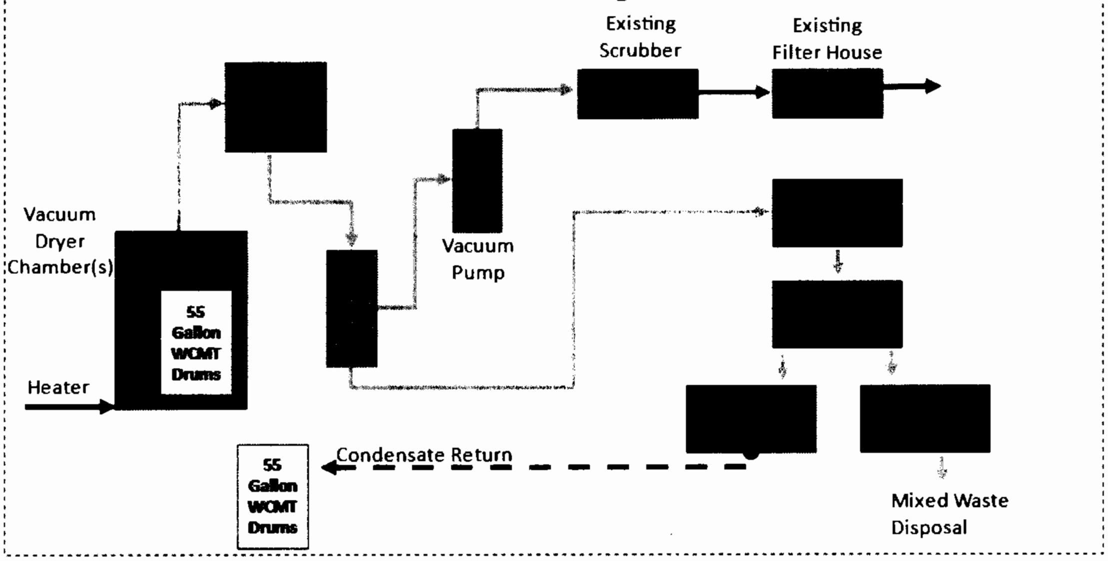
The treatment of the drums in the vacuum dryer will be performed in batches that align with normal weekly work shifts. During a treatment cycle, up to 4 drums will be loaded at a time into the vacuum dryer and the lids will be removed. While operating, the vacuum chamber will reduce the pressure to less than 10 millimeters of mercury ("mmHg") to vaporize the tetrachloroethylene within each drum. Heat (from a non-combustion source) will be applied to the drums to overcome the heat of vaporization (90°F). Effluent gas from the chamber will pass through a cold trap, then to a vacuum pump and on to a condenser. Upon cycle completion, the drums will be removed from the chamber, sealed with a lid with a closed bung, and allowed to equilibrate.

After the equilibrium time has passed each drum will be tested using a Draeger-type tube to confirm removal of the tetrachloroethylene. Drums with a headspace tetrachloroethylene concentration greater than 7 ppm will be staged for further treatment within the same batch. Drums with headspace concentrations less than or equal to 7 ppm will be segregated until the remaining drums in the batch have been treated.

Upon completion of the batch, the condensate will be allowed to phase separate. When the phase separation is complete the aqueous portion will be returned to the batch of drums in equal portions and the non-aqueous phase will be collected and managed as a hazardous waste. Once the aqueous portion is returned to the drums, their hazardous waste labels will be removed, and the drums will be staged for uranium recovery.

Figure 1

Treatment Design



Calculating Potential VOC and Tetrachloroethylene Losses to the Atmosphere

Alpha-coded calculations for potential VOC and tetrachloroethylene losses to the atmosphere across the legacy WCMT drum processing system are provided in Table 1 (attached). The calculations are based on the following conservative assumptions:

- For the purposes of worst-case emission calculations, it is assumed that all 522 legacy WCMT drums (Column A of Table 1) will require vacuum drying. As described in the sections above, it is expected that some of the drums will meet screening criteria and will not require vacuum drying.
- For the purposes of this air emissions evaluation, it is assumed that the vacuum drying process will be operated 24 hours per day, seven days per week, and that all 522 drums (Column C) are processed in one month (31 days, Column B). These assumptions provide a worst-case emissions scenario for the air regulatory evaluation. In reality, vacuum drying is an intermittent batch process and will only be operated during first-shift and part of second-shift on weekdays. Accounting for the actual processing cycle time, downtime between batches, requirements for nuclear criticality safety, and maintenance activities, Westinghouse currently expects processing the entire population of legacy WCMT drums to take up to 12 months.

- Based on calculations prepared by Westinghouse process engineers, a typical WCMT drum with added solvent mixture contains 8.92 lbs of kerosene, 2.46 lbs of TBP, and 2.11 lbs of tetrachloroethylene. Therefore, the VOC weight in a typical WCM drum is 8.92 + 2.46 + 2.11 = 13.49 lbs (Column D).
- As noted above, a typical WCMT drum contains 2.11 lbs of tetrachloroethylene (Column E).
- It is conservatively assumed that all VOC and tetrachloroethylene content will be removed from the WCMT drums during vacuum processing. In reality, bench scale testing indicates there will be residual VOCs and tetrachloroethylene in the WCMT drums following successful processing in the vacuum system.
- The research and bench scale testing conducted by GEL indicates that the chiller and condenser will convert >95 percent of the water and organic vapors driven from the WCM drums back to liquid phase. Therefore, it is assumed that VOC and tetrachloroethylene losses to the atmosphere across the drum processing system are 5 percent (Column F).
- The existing scrubber and existing filter house shown on Figure 1 above are existing inherent radiological controls (ID No. S2A and S2B). For the purposes of these calculations, it is assumed that the inherent radiological controls have 0 percent control (no reduction) on VOC and tetrachloroethylene losses from the drum processing system.
- Based on the above conservative assumptions, during the temporary operating life of the legacy WCMT drum processing system, annual VOC losses to the atmosphere are calculated at 0.18 tons/yr (Column G). Annual tetrachloroethylene losses to the atmosphere are calculated at 0.03 tons/yr (Column H).
- Based on the above conservative assumptions, tetrachloroethylene losses to the atmosphere are calculated at 1.78 lbs/day (Column I). VOC losses to the atmosphere are calculated at 352.09 lbs/month (Column J).

CONCLUSIONS

Based on the information presented above, VOC and tetrachloroethylene losses from legacy WCMT drum processing are de minimis and exempt from air construction permitting and air dispersion modeling. Monthly VOC losses to the atmosphere (352.09 lbs/month) are well below DHEC's criteria for exemption from air construction permitting (1,000 lbs/month uncontrolled VOCs)[2]. Daily tetrachloroethylene losses to the atmosphere (1.78 lbs/day) are well below DHEC's de minimis criteria for exemption for air dispersion modeling (40.200 lbs/day tetrachloroethylene)[3].

CLOSURE

Thank you for the opportunity to be of service. If you have any questions or require additional information, please contact me at (843) 769-7378, extension 4420 or by e-mail at jwm@gel.com.

Sincerely,

John W. McLure

John W. McLure, P.E.
Principal

Enclosures

Table 1: Emission Calculations for Legacy WCMT Drum Processing

fc: welt0018.legacywcmevaluation07182022.doc

2 DHEC BAQ Permitting Exemption List, October 23, 2020, Section 6, Item i.
https://scdhec.gov/sites/default/files/media/document/2021-02-21_%20Air%20Permitting%20Exemption%20List.pdf

3 South Carolina Modeling Guidelines for Air Quality Permits, October 2018 (Revised 4/15/2019), Table B.1.
https://scdhec.gov/sites/default/files/media/document/BAQ_SC%20Modeling%20Guidelines_10.15.18_revised%204.15.19.pdf

Table 1 - Emission Calculations for Legacy WCMT Drum Processing
Westinghouse Electric Company LLC
Hopkins, South Carolina
prepared by GEL Engineering, LLC, July 2022

Source	A Total Number of Legacy WCMT Drums	B Maximum Number of Days Per Month	C Maximum Possible Number of Legacy WCMT Drums Processed in 1 Month	D VOC Weight Typical WCMT Drum (lbs)	E Tetrachloroethylene Weight Typical WCMT Drum (lbs)	F Conservative Estimate of Losses to Atmosphere Across the Drum Processing System (%)	G Annual VOC Losses to Atmosphere (tons/yr)	H Annual Tetrachloroethylene Losses to Atmosphere (tons/yr)	I Maximum Daily Tetrachloroethylene Losses to Atmosphere (lbs/day)	J Maximum Monthly VOC Losses to Atmosphere (lbs/month)
Legacy WCMT Drum Processing	522	31	522	13.49	2.11	5	0.18	0.03	1.78	352.09
DHEC Air Construction Permitting Threshold										1,000
DHEC de Minimus criteria for Air Dispersion Modeling									40.200	

$$\boxed{A}\ \frac{\text{total \# legacy drums}}{\text{1 year max operating life}} \times \boxed{D}\ \frac{\text{lbs VOC}}{\text{typical legacy drum}} \times \boxed{\text{(F\% losses)/100\%}} \times \frac{\text{1 ton}}{\text{2000 lbs}} = \boxed{G}\ \frac{\text{tons VOC losses}}{\text{year}}$$

$$\boxed{A}\ \frac{\text{total \# legacy drums}}{\text{1 year max operating life}} \times \boxed{E}\ \frac{\text{lbs tetrachloroethylene}}{\text{typical legacy drum}} \times \boxed{\text{(F\% losses)/100\%}} \times \frac{\text{1 ton}}{\text{2000 lbs}} = \boxed{H}\ \frac{\text{tons tetrachloroethylene losses}}{\text{year}}$$

$$\boxed{C}\ \frac{\text{max \# legacy drums}}{\text{month}} \times \boxed{E}\ \frac{\text{lbs tetrachloroethylene}}{\text{typical legacy drum}} \times \boxed{\text{(F\% losses)/100\%}} \div \boxed{B}\ \frac{\text{max \# days}}{\text{month}} = \boxed{I}\ \frac{\text{lbs tetrachloroethylene losses}}{\text{day}}$$

$$\boxed{C}\ \frac{\text{max \# legacy drums}}{\text{month}} \times \boxed{D}\ \frac{\text{lbs VOC}}{\text{typical legacy drum}} \times \boxed{\text{(F\% losses)/100\%}} = \boxed{J}\ \frac{\text{lbs VOC losses}}{\text{month}}$$