Waste Processing Air Cleaning

J. R. Kriskovich
Lockheed Martin Hanford Corp.

Date Published
July 1998

To Be Presented at
DOE/NRC Nuclear Air Cleaning Conference

Minneapolis, Minnesota
August 3-6, 1998

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

FLUOR DANIEL HANFORD, INC.

P.O. Box 1000
Richland, Washington

Hanford Management and Integration Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

INFORMATION CLEARANCE FORM

A. Information Category

- ☐ Abstract
- ☐ Summary
- ☐ Visual Aid
- ☒ Full Paper
- ☐ Other ______
- ☐ Journal Article
- ☐ Internet
- ☐ Software
- ☐ Report

B. Document Number HNF-3104-FP

C. Title Waste Processing Air Cleaning

D. Internet Address

E. Required Information

1. Is document potentially Classified? ◉ No ○ Yes (MANDATORY)

   7/23/98
   Manager's Signature Required

   If Yes ______ ○ No ○ Yes Classified
   ADC Signature Required

2. Internal Review Required? ○ No ◉ Yes
   If Yes, Document Signatures Below

   Counsel ______

   Program ______

3. References in the Information are Applied Technology ◉ No ○ Yes
   Export Controlled Information ◉ No ○ Yes

4. Does Information Contain the Following: (MANDATORY)
   a. New or Novel (Patentable) Subject Matter? ◉ No ○ Yes
      If "Yes", Disclosure No.: ______
   b. Information Received in Confidence, Such as Proprietary and/or Inventions?
      ◉ No ○ Yes If "Yes", Affix Appropriate Legends/Notices.
   c. Copyrights? ◉ No ○ Yes If "Yes", Attach Permission.
   d. Trademarks? ◉ No ○ Yes If "Yes", Identify in Document.

5. Is Information requiring submission to OSTI? ○ No ◉ Yes
   If Yes UC- 510 and B&R- EW3120071

6. Release Level? ◉ Public ○ Limited

7. Charge Code N21AE HJ230200

F. Complete for a Journal Article

1. Title of Journal

G. Complete for a Presentation

1. Title for Conference or Meeting DOE/NRC Nuclear Air Cleaning Conference
2. Group Sponsoring DOE/NRC
3. Date of Conference 8/3-6/98
4. City/State Minneapolis, MN
5. Will Information be Published in Proceedings? ○ No ◉ Yes
6. Will Material be Handed Out? ○ No ◉ Yes

H. Author/Requestor

Jim Kriskovich [signature]
(Print and Sign)

Responsible Manager

SH Rifaey [signature] 7/23/98
(Print and Sign)

I. Reviewers

Reviewers	Yes	Print	Signature	Public Y/N (If N, complete J)
General Counsel	☒	S.D. Brumley by Kara Broz	7/27/98	(Y) / N
Office of External Affairs	☒	per telecon waiver Kara Broz	7/23/98	(Y) / N
DOE-RL	☒	Walid Abdul W. ABDUL	7/27/98	(Y) / N
Other	☐			Y / N
Other	☐			Y / N

J. If Information Includes Sensitive Information and is not to be released to the Public indicate category below.

- ☐ Applied Technology
- ☐ Personal/Private
- ☐ Proprietary
- ☐ Business-Sensitive
- ☐ Predecisional
- ☐ UCNI
- ☐ Protected CRADA
- ☐ Export Controlled
- ☐ Procurement-Sensitive
- ☐ Patentable
- ☐ Other (Specify) ______

Information Clearance Approval

APPROVED FOR RELEASE
OFFICIAL DOCUMENT
KMB
Date 7/27/98

K. If Additional Comments, Please Attach Separate Sheet

A-6001-401 (02/98)

WASTE PROCESSING AIR CLEANING

James R. Kriskovich
Lockheed Martin Hanford Corporation
Richland, Washington

ABSTRACT

Waste processing and preparing waste to support waste processing relies heavily on ventilation. Ventilation is used at the Hanford Site on the waste storage tanks to provide confinement, cooling, and removal of flammable gases.

I. INTRODUCTION

The Hanford Site is a 1,424-km^2 (550-mi^2) Department of Energy Environmental clean-up site. The site originally was constructed in the early 1940's and continued operation throughout the cold war. The Hanford Site's mission was to produce nuclear materials for the war effort. In the process, millions of liters of liquid waste products were generated. The highly radioactive wastes were pumped into underground tanks. These tanks were to be used as temporary storage; however, the waste remains. Currently, a total of 177 underground waste storage tanks in the Tank Farms exist on the Hanford Site. They consist of 149 single-shell tanks (SSTs) and 28 double-shell tanks (DSTs), ranging in size from 208,000 L (55,000 gal) to 4,390,000 L (1,160,000 gal) on the Hanford Site.

As the cold war ended, the Hanford Site's mission changed from producing nuclear material to environmental restoration. The center of this effort includes the waste stored in the 177 waste tanks. To ensure the safety of facility workers and the off-site population, the waste in the tanks is continuously monitored. This includes monitoring the liquid level, temperature, pressure, flammable gas concentration, and flammable gas release to ensure these parameters remain within prescribed limits. To help maintain the waste (and the tanks) within these limits, some of the tanks are actively or force ventilated.

Because the waste tanks exhibit different characteristics, differing ventilation needs are required. For example, flammable gas is present in the waste and vapor space of the tanks. The flammable gas is a result of radiolysis, which is the decomposition of water due to gamma rays (*Glasstone and Sesonske* 1967). The concentration of flammable gas is different for each tank, and controls are in place to assure the concentration does not exceed 25% of the Lower Flammability Limit (LFL). As a result, different ventilation systems are relied on to dilute the critical mixture of flammable gas. By diluting the critical mixture, this reduces and eliminates the possibility of a deflagration within the tank vapor space. In fact, no waste tank vapor space exceeds 1% of the LFL.

The differing ventilation includes both active and passive ventilation systems. An active system consists of providing a motive force to ventilate the tank (i.e., a fan), where as a passive system relies on natural changes in the vapor space of the tank (i.e., barometric pressure changes).

Ventilation is used also to remove heat that is generated because of the isotope decay. Heat removal is essential to prevent structural damage of the waste storage tank caused by high temperature. As was the case for flammable gas, the heat generation is different for each tank. Therefore, different types of systems are used to remove the heat. This includes systems with condensers and recirculation systems.

In addition, ventilation is used also to maintain confinement. Because the tanks are located outside, the possible spread of contamination exists as a result of the high level of radioactive particulate. Ventilation is used to maintain a negative pressure within the tank vapor space to prevent the escape of contamination and High Efficiency Particulate Air (HEPA) filters are used in the exhaust train to capture the particulate.

II. DISCUSSION

One waste processing activity that was completed at the Hanford Site was grouting of the waste. This was accomplished by mixing the low-level liquid waste with a cement type material. The mixture was then pumped into a large vault, 18,180,000 L (4,000,000 gal), where it cured and hardened. During the grout campaign, ventilation played an important role. When the vault was filled ventilation was used to maintain confinement by creating a negative pressure in the vault, and used to help cool the mixture because of the heat of hydration as it began to cure.

The grout ventilation system was a once-through system used to sweep air through the vapor space of the vault. The system consisted of an electric heater, two stages of HEPA filtration, a fan, stack, and stack monitoring system. This system is similar to the current systems being used to ventilate some of the waste storage tanks.

Other waste processing activities currently are being planned at the Hanford Site. This includes vitrification of the waste. Vitrification consists of mixing the tank waste with a glass-like material. This material is melted and then mixed with the waste. The mixture is then allowed to cool into a final solid glass product, creating a stable form of waste preventing the possibility of liquid leaks, and other related accident scenarios.

Although the design for the vitrification plant has not been completed, ventilation is planned to play a key role. This role would most likely include the same functions as the waste storage tanks, which is to maintain confinement, provide cooling and removal of any off-gas (possibly flammable gas) during the vitrification process.

it to the DSTs. This is referred to as stabilization. During this activity the possibility exists that flammable gas, which could be stored under the surface of the waste, could be released. To help reduce the time at risk should the gas be released, portable ventilation systems will be connected to the tank. The systems are similar to the permanently installed systems.. They consist of a glycol heater, pre-filter, two stages of HEPA filtration, fan, stack and stack sampling system.

Because of their flexibility and design, these systems can be deployed to any tank. Two types of portable systems will be used to support stabilization. One system is designed for 0.236 m^3/sec (500 cfm) and the other is designed for 0.472 m^3/sec (1000 cfm).

III. CONCLUSION

Ventilation systems play a key role in waste processing activities and the preparation of waste to support waste processing. The ventilation systems maintain confinement, cooling, and are relied on to remove flammable gas.

References

Glasstone, Samuel and Alexander Sesonske, 1967, *Nuclear Reactor Engineering*, Van Nostrand Reinhold Company, New York, New York.

Other activities at the Hanford Site that deal with tank waste include removal of the waste from the tanks. Although this is not considered waste processing, this effort is being performed to support processing. One activity planned to begin before the end of this year is the removal of waste from a single-shell tank (241-C-106) and transferred to a double-shell tank (241-AY-102). The particular method used in this case is identified as sluicing. This method relies on liquid injected through a nozzle, which breaks up the sludge and solid portion of the waste. It is then transferred to the receiver tank by the use of a pump.

During the sluicing activity the injection of the liquid will displace the air in the vapor space. The ventilation system will be used to maintain confinement. Also, a video camera is planned to be used during sluicing to monitor the operation. Because a fog will be generated during the sluicing operation, the ventilation system will be relied on to remove the fog. The ventilation system will also be used to remove any flammable gas that may be released during the sluicing operation.

The ventilation system used to support the sluicing activity is a re-circulation system. This system diverts and discharges part of the air that is drawn from the tank to atmosphere (after passing through HEPA filtration). The remaining portion is returned back to the tank.

The system is comprised of the following components: air is drawn from the tank where it passes through a condenser. Eighty percent of the air stream is then diverted through a moisture separator, a heating coil, a fan and discharged back to the tank vapor space. The remaining twenty percent of the air stream is routed through a High Efficiency Mist Eliminator (HEME), a High Efficiency Metal Filter (HEMF), a heater, two stages of HEPA filtration, a fan, and released to the atmosphere through a stack, which includes a stack sampling system.

The benefit of the recirculation system is to reduce the total emissions discharged through the stack and still provide the necessary function of cooling. The re-circulation scenario also is used to ventilate the tank where the waste will be transferred (241-AY-102). The system components are similar to that discussed above in which the air is drawn from the tank where it passes through a condenser, a moisture separator, and a fan, and approximately eighty percent of the air stream is returned back to the tank. The remaining twenty percent is routed through the main vent header through a condenser, HEME, heater, two stages of HEPA filtration, a HEGA, a fan, and discharged through the stack, which includes a stack sampling system.

As was the case above, the recirculation system provides the necessary function of cooling, confinement and gas removal for the waste without large emissions being released to the environment.

Another activity at the Hanford Site that is being performed as preparation to begin processing the waste and to help eliminate possible contamination to the ground water is to remove the moisture from the SSTs. This is performed by slowly pumping the water from the waste and transferring