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SUPPORTING DOCUMENT

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7. Abstract

Waste Management is currently planning to demonstrate mobilization of radioactive waste sludges in Tank 101-AZ beginning in October 1991. The retrieval system being designed will utilize mixer pumps that generate high-velocity, high-volume submerged liquid jets to mobilize settled solids. There is concern that these jets may also generate radioactive aerosols, some of which may be carried into the tank ventilation system. The purpose of this study is to determine if the current AY/AZ ventilation system or the proposed ventilation system upgrade (Project W-030) will provide adequate deentrainment of liquid and solid aerosols during mixer pump operations, or if the radioactive aerosols will overload the HEPA filters.

[The document is being released to the files at this time because, due to an oversight during reassignment of personnel, it had not been previously released. The information is worthwhile for the record and needs to be in the files.]

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CONTENTS

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EVALUATION OF AY/AZ TANK FARM VENTILATION SYSTEM DURING AGING WASTE RETRIEVAL OPERATIONS

1.0 SUMMARY

Waste Management is currently planning to demonstrate mobilization of radioactive waste sludges in Tank 101-AZ beginning October 1991. The retrieval system being designed will utilize mixer pumps that generate high-velocity submerged water jets to mobilize settled solids. There is concern that these jets may also generate radioactive aerosols, some of which may be carried into the tank ventilation system.

There currently is insufficient data to quantify the amount of aerosol generation during tank waste retrieval operations. The reason for this is that aerosol studies conducted by Pacific Northwest Laboratories (PNL) were inconclusive, and scaling problems prevented accurate extrapolations from being made. However, aerosol generation is not expected to be a severe problem during full-scale retrieval operations because:

1) The existing cooling system is adequate to handle the additional heat generated from the mixer pumps so that significant vapor rates are not expected to carry aerosols beyond the condensers.

2) Aerosol testing conducted during Tank 102-AP mixer pump testing did not indicate a significant increase in aerosols. Although it must be noted that the testing is not directly applicable to waste retrieval operations (because of the difference in number and size of mixer pumps used), qualitative information from this testing suggests aerosols will not significantly increase during retrieval operations.

3) Development tests indicate that the upgraded ventilation system (Project W-030) will adequately control aerosol generation during full-scale retrieval. This upgrade will be in place for full-scale retrieval operations when we would expect aerosol generation to be at its highest levels as tank liquid levels are reduced.

During the Waste Retrieval System Process Test, the existing ventilation system will be monitored closely to determine if aerosols change significantly and cause a problem, requiring frequent filter change-outs. If aerosols do become a problem, either the retrieval system will be operated differently (by lowering jet velocities to reduce aerosols) or a supplemental (portable) ventilation system will be used during full-scale retrieval operations.

If this issue has to be resolved before the Waste Retrieval System Process Test, then additional aerosol testing is required to verify scaling relationships and validate results already obtained.

This study only deals with retrieval from aging waste tanks. This issue should be reexamined for retrieval of waste from non-aging waste tanks, since those tanks have ventilation systems which may be less effective for aerosol removal.

2.0 INTRODUCTION

Waste Management is currently planning to demonstrate mobilization of radioactive waste sludges in Tank 101-AZ beginning October 1991. After the demonstration (The Waste Retrieval System Process Test), neutralized current acid waste (NCAW) will be retrieved from Tank 101-AZ beginning October 1993, and will be transferred to B Plant for pretreatment operations. The retrieval system being designed to accomplish these tasks will mobilize, suspend, and transfer NCAW, which is 5 to 20 volume percent solids. The major components of this retrieval system include mixer pumps and a transfer pump. The mixer pumps being designed will utilize high-velocity submerged water jets to mobilize settled solids. There is a possibility that these jets may also generate radioactive aerosols, some of which may be carried into the tank ventilation system.

3.0 PURPOSE AND NEED

The purpose of this study is to determine if the current AY/AZ ventilation system or the proposed ventilation system upgrade (Project W-030) will provide adequate deentrainment of liquid and solid aerosols during mixer pump operations, or if the radioactive aerosols will overload the high efficiency particulate air (HEPA) filters.

If excessive HEPA filter change-outs are required during retrieval of NCAW, then alternative or supplemental ventilation systems will have to be designed and installed before double-shell tank (DST) retrieval begins. Design bases, cost estimates, and schedules would then be needed to plan this work and to integrate it into the current retrieval effort.

4.0 DISCUSSION

4.1 DESCRIPTION OF CURRENT AZ TANK FARM VENTILATION SYSTEM

The AZ Tank Farm has a Primary Tank Ventilation System (702-A Building) and a separate Annulus Ventilation System that services both Tanks 101-AZ and 102-AZ. These tanks are currently used for storing aging waste (NCAW).

The main components of the Primary Tank Ventilation System include two deentrainers buried in caissons, three surface condensers in the 241-A-401 Building, a steam-powered air heater, and twelve HEPA filters in the 702-A Building (Blackman, 1988). In addition to the two AZ tanks, this primary system also ventilates the interior of the two AY tanks, 101-AY and 102-AY. This ventilation system was designed to remove a maximum heat load of 20,000,000 BTU/hr from the four tanks, and has successfully controlled aerosols generated during operation of the tanks' air lift circulators (ALCs). (Note: ALC's have been operated in only two of the four tanks at one time.)

The annulus ventilation system serves mainly for leak detection, and is not used for tank waste heat or aerosol removal.

Chemical and radiological analysis of HEPA filters taken from the 702-A ventilation system indicate most material that accumulates on the filters are soluble species of the waste (Jansky, 1985). The major radionuclides present on the filters are cesium and ruthenium, which are present in NCAW supernate. The only non-radioactive specie that was present above detectable levels was sodium. Sodium is primarily found in the supernate. This data indicates that only dissolved solids reach the HEPA filters during ALC operation, and undissolved solids in the waste fall out before the filter system.

4.2 DESCRIPTION OF PROJECT W-030 VENTILATION UPGRADE

There are current plans to upgrade the 702-A Ventilation System. The upgrades will improve the safety and reliability of the ventilation and cooling system and the waste agitation system in the 241-AY and 241-AZ Tank Farms. This will extend the useful life of the system, eliminate cooling water discharges to the soil column, minimize the risks of single point critical component failure, and provide seismic and tornado hardening of the critical systems.

The design base heat load for this upgraded system will be 10,000,000 BTU/hour (Kaiser Engineers Hanford, 1989). This design load is based on a waste heat loading of 1,000,000 BTU/hr and a heat load from simultaneous operation of twelve 300 horsepower (hp) mixer pumps. The system will also be capable of handling heat removal and aerosol generation during air lift circulators (ALCs) operation.

4.3 PNL LABORATORY-SCALE AEROSOL GENERATION STUDIES

Testing was performed by PNL in FY 1988 to estimate the magnitude of aerosol concentrations that would be produced during double-shell tank (DST) waste retrieval operations. The objective of this work was to provide an estimate of the aerosol concentrations that would be produced, and to determine if the current AY/AZ ventilation system is capable of removing the generated aerosols without overloading the HEPA filter system (Whyatt and Andersen, 1988).

Testing was performed using a one-twelfth scale DST pilot testing facility at PNL. Aerosol concentrations were measured using several types of waste simulants that exhibited ranges of solution concentration, viscosity, surface tension, and insoluble solids concentration. These parameters were tested to determine sensitivity of the results to these variables.

This testing attempted to simulate aerosol generation conditions applicable to the AY/AZ ventilation system during retrieval. Aerosol concentrations were reported in micrograms of solid aerosols per cubic meter (ug/m^3) of air. Experimental aerosol concentrations for submerged liquid jets ranged between 2,400 and 17,500 ug/m^3. Based on this data, radionuclide loading and filter change out frequency can be estimated (Eberle, 1988). However, the accuracy of these estimations are unknown because:

1. There were uncertainties in scaling of the mixer pump flow rates, and the experimental values cannot be directly applied to full-scale operation.

2. The test equipment did not include a condenser and a mist eliminator representative of tank farm equipment.

The experimental values obtained in the test cannot be directly applied to full scale operation. The results of these experiments were also characterized by wide variability and lack of reproducibility between replicate runs that made firm conclusions difficult to reach.

Because of variability of the data and questions of the appropriate scaling factors, meaningful evaluations of the existing DST ventilation systems could not be performed. The results of these tests are included in the Appendix, but they will not be used to estimate aerosol concentrations during waste retrieval operations.

Also because of the uncertainties in this test, no qualitative comparison could be made of aerosol generation during mixer pump operation versus air lift circulator operation. The PNL report recognizes the scaling problems and recommends further testing on a different scale to verify scaling relationships. No further pilot testing is currently planned for this activity.

4.4 AEROSOL GENERATION DURING TANK 102-AP MIXER PUMP OPERATION

Aerosol Sampling was conducted by PNL in support of the performance test of the mixing pump for Tank 102-AP, the grout feed tank (Ruecker and Andersen, 1988). Sampling was conducted during several phases of the operability performance testing campaign for the mixing pump, including during emptying of the tank by a transfer pump.

The results of these tests indicated there were little differences in aerosol concentrations between mixer pump operation and normal background levels. It was concluded that the operation of the mixing pump, while submerged in the supernate, would not result in the generation of detectable levels of aerosols. However, the experimental concentrations reported are suspect because they were so low (below normal background levels). The results are questionable because during emptying of the tank, a leaking transfer pump was used. Approximately 25 gallons per minute of slurry leaked from a point near the roof of the tank to splash onto the liquid surface below. This is expected to produce additional aerosols above background.

It must also be noted that tank mixing was accomplished with only one 150 horsepower (hp) mixer pump. During tank waste retrieval operations, two to four 300 hp mixer pumps will be employed for solids mobilization. Hence, the results of this aerosol testing are not directly applicable to tank waste retrieval operations. Higher aerosol concentrations might result during retrieval, but they can't be extrapolated or inferred from the 102-AP mixer pump tests.

One issue that was not resolved by this testing was whether or not an aerosol problem will result should a liquid jet become exposed and impinge directly on a rigid surface. This is unlikely to happen during NCAW retrieval because the mixer pumps being designed are incapable of operating at a low enough liquid level to allow jet exposure. It is expected, however, that aerosol generation will increase as the liquid level in the tank decreases. But the amount of aerosols that subsequently becomes entrained in the ventilation system is unknown.

Even though no quantitative conclusions can be confidently made, a qualitative comparison can be inferred from this testing. Based on the surface activity (degree of agitation at the liquid surface) during mixer pump operation, the amount of aerosols produced is expected to be less than during ALC operation. During mixer pump operation, most of the aerosols should be generated at the liquid surface at the tank wall. And during the 102-AP test, the surface activity at the wall was not very turbulent (Reference Video). However, during ALC operation, aerosols are produced when the motive air used to induce liquid circulation escapes as bubbles from the liquid surface. Performance tests were conducted on prototype ALCs (Cook and Waters, 1955). Even at the minimum air flow rate of 50 standard cubic feet per minute (SCFM) for 22 ALCs (or 2.3 SCFM per ALC) (Bergmann, 1988), visual observations (as evidenced by photographs in Cook and Waters, 1955) indicate a higher surface turbulence than during mixer pump operation.

4.5 PILOT-SCALE DOUBLE-SHELL TANK VENTILATION SYSTEM

The new ventilation system design has been tested on a pilot scale by PNL (Brouns, Oxford, and Peterson, 1988) to aid in design verification by Kaiser Engineers Hanford (KEH). A one-tenth scale tank ventilation system was built for this testing. The test system included a refrigeration unit to remove condensable vapors, and a high efficiency mist eliminator (HEME) to remove aerosol particles. Tests were conducted to evaluate the effectiveness of the system at removing both soluble and insoluble aerosol particles. Process and design parameters varied during the tests included off-gas flow rate, water spray rate, inlet temperature, relative humidity, aerosol concentration, and aerosol specie (soluble versus insoluble). Aerosol concentrations up to 1000 particles per cubic centimeter were studied. Mean values for the decontamination factors (DFs) for the overall test system ranged from 192 to 4817.

The results of these tests indicate that the upgraded ventilation system will be capable of reducing aerosol concentrations in the offgas by at least two orders of magnitude before it reaches the HEPA filters. (Note: The ventilation upgrade will not be in place for the Tank 101-AZ Waste Retrieval System Process Test (October 1991).)

5.0 CONCLUSIONS & RECOMMENDATIONS

There currently is insufficient data to confidently estimate the magnitude of aerosol generation during tank waste retrieval operations. Aerosol studies conducted by PNL were inconclusive, and scaling problems prevented accurate extrapolations from being made. However, aerosol generation is not expected to be a severe problem during full-scale retrieval operations. There are several reasons for this position:

1. No significant increase in aerosols was detected during Tank 102-AP mixer pump tests, even with a leaking transfer pump that should have produced additional aerosols. It must be noted that the testing is not directly applicable to waste retrieval operations because of the difference in number and size of mixer pumps used.

2. Development tests indicate that the upgraded ventilation system (Project W-030) is expected to remove enough aerosols during retrieval so that the HEPA filters will not have to be changed out frequently. W-030 is scheduled to be completed and operational by second quarter 1994. This upgrade will not be in place at the start of retrieval of 101-AZ for the B Plant Demonstration (October 1993), but will be operational during full-scale B Plant operations and during retrieval of the other AY/AZ tanks.

3. During the Waste Retrieval System Process Test, the existing ventilation system will be monitored closely to determine if aerosols change significantly and cause a problem, requiring frequent filter change-outs. If so, alternate or supplemental ventilation systems must be in place for actual waste retrieval operations. Or the retrieval system will have to be operated in such a manner that aerosols do not become a problem. If aerosols are not a problem with the existing ventilation system, then there is not expected to be a problem during future full-scale retrieval operations when the upgraded ventilation system is in place.

If this issue has to be fully resolved before the Waste Retrieval System Process Test, then additional aerosol testing is required to verify scaling relationships and validate results already obtained. PNL recommends further pilot-scale testing as well as simulant characterization. This work is currently not scheduled.

This study only deals with retrieval from aging waste tanks. This issue should be reexamined for retrieval of waste from non-aging waste tanks, since those tanks have ventilation systems which may be less effective for aerosol removal.

6.0 REFERENCES

Stegen, L. C., 1988, Supporting Document #SD-WM-TPP-041, "Technology Program Plan for Retrieval of Solid Waste from Aging and Non-Aging Double-Shell Tanks."

Blackman, A. E., 1989, draft Supporting Document SD-WM-TI-363, "Double-Shell Primary Tank Ventilation Descriptions."

Jansky, M. T., 1985, Internal Letter #65453-85-199, "702-A Exhaust System HEPA Filter."

Kaiser Engineers Hanford, March 1989, Supporting Document #SD-W030-CDR-001 Rev. 0, "Conceptual Design Report - Project W-030, Tank Farm Ventilation Upgrade."

Whyatt, G. A., and Andersen, C. M., 1988, draft Report #PNL-7W21-88-07 Rev. 0, "Investigation of Aerosol Concentrations Resulting from Impinging Liquid Jets," Pacific Northwest Laboratory, Richland, Washington.

Eberle, C. S., 1988, Internal Memo #FRRP:Eb88-007, "Dose Rate Estimation of the AY/AZ Tank Farm 702-A Ventilation System."

Ruecker, C. M., and Andersen, C. M., 1988, Letter Report #PNL-7W21-88-06, "Aerosol Concentrations Resulting from the Operation of the Mixing Pump in Tank AP-102."

Video, 1988, "Tank 102-AP Mixer Pump Test."

Cook, M. W., and Waters, E. D., 1955, Document #HW-39432, "Operational Characteristics of Submerged Gas-Lift Circulators."

Bergmann, L. M., 1988, Operating Specifications Document #OSD-T-151-00017 Rev. C-0, "Operating Specifications in 241-AY and 241-AZ."

Brouns T. M., Oxford, R. J., and Peterson, M. E., Technical Report #PNL-7W21-88-09, "Performance Evaluation of the Pilot-Scale Double-Shell Tank Ventilation System Using Soluble and Insoluble Aerosols."