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7. Abstract

Position Paper to develop and document a position on the air flow rates for the ventilation system for the waste storage tanks being designed by the Multi-Function Waste Tank Facility project.

8. RELEASE STAMP

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Position Paper

Project W236A

Multi-Function Waste Tank Facility

Tank Ventilation System Design Air Flow Rates

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Concurrence:	J. R. Nicholson, ICF KH/MWTF Consulting Engineer	5-2-94 Date
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Concurrence:	R. L. Fritz, WHC/MWTF Project Manager	5/2/94 Date

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Position Paper
Project W-236A
Multi-Function Waste Tank Facility
Tank Ventilation System Design Air Flow Rate

1.0 Purpose

The purpose of this paper is to document a project position on required ventilation system design air flow rates for the waste storage tanks currently being designed by project W-236A, the Multi-Function Waste Tank Facility (MWTF).

2.0 Background

The Title I design primary tank heat removal system consists of two systems:

1) A primary tank vapor space ventilation system
2) An annulus ventilation system

At the conclusion of Title I design, air flow rates for the primary and annulus ventilation systems were 960 scfm and 4400 scfm, respectively, per tank (ref 1). These design flow rates were capable of removing 1,250,000 Btu/hr from each tank (ref 2). However, recently completed and ongoing studies have resulted in a design change to reduce the extreme case heat load to 700,000 Btu/hr. This revision of the extreme case heat load, coupled with results of scale model evaporative testing performed by WHC Thermal Hydraulics (ref 3), allow for a reduction of the design air flow rates for both primary and annulus ventilation systems.

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3.0 Discussion

The air flow rates for both the primary and annulus ventilation systems are determined by the heat removal requirements. The revised extreme case heat removal requirements (ref 4) are listed as follows:

- Mixer Pump 382,500 Btu/hr
- Radionuclide 250,000 Btu/hr
- Contingency 67,500 Btu/hr
- Total 700,000 Btu/hr

These reduced heat loads allow for lower air flow rates through both the primary and annulus ventilation systems. Required air flow rates for the MWTF design were determined using empirical correlations (ref 5). The empirical correlations were modified using evaporation rate data obtained from tank scale model testing provided by WHC Thermal Hydraulics. The empirical correlations are incorporated into a computer code originally developed for analysis of the 241-AZ tank ventilation system (ref 5). Computer code verification of the empirical correlations will be performed as part of the Title II design effort. Preliminary analysis using modified empirical correlations specify that approximately 455 scfm of primary ventilation air flow is required to maintain the tank waste temperature at 190°F using the following inputs:

- Heat load 700,000 Btu/hr
- Design inlet air temperature 77° F
- Design relative humidity 40% RH
- Annulus air flow 1,100 scfm

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A safety factor of approximately 10% was applied to the primary air flow rate (455 scfm), as predicted by the modified empirical equations. This results in a maximum design air flow rate for the primary ventilation system of 500 scfm (an approximately 48% reduction from the Title I design air flow rate of 960 scfm). This reduction in the design heat load allows for a larger proportion of the total heat removal to be performed by the primary ventilation system (as opposed to the annulus ventilation system). With an air flow of 500 scfm, the primary ventilation system will be able to remove approximately 605,000 Btu/hr without assistance from the annulus ventilation system.

ICF KH selected a maximum design air flow rate of 1,100 scfm for the annulus ventilation system to enable the primary ventilation system air flow rate to be regulated to a maximum of 500 scfm. The annulus design air flow reduction from the Title I design rate of 4400 scfm to 1100 scfm allows for the removal of the annulus circular header, distribution piping, and the annulus supply fans, and for the downsizing of the annulus system.

Design air flow rates for the heat removal system are based on the ability to provide adequate cooling at the extreme case heat load (as defined in ref 4). Limited control of tank waste temperature at the nominal heat load (ref 4) is possible using variable air volumes in the ventilation systems.

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4.0 Conclusions and Recommendations

Based on the preceding discussion, ICF Kaiser Hanford Co. (ICF KH) concludes that the design should incorporate the following design air flow rates:

- Primary ventilation system: 500 scfm maximum
- Annulus ventilation system: 1100 scfm maximum.

In addition, the minimum air flow rates in the primary and annulus ventilation systems will be investigated during Title II design. The results of the Title II investigation will determine the range of available temperature control using variable air flows to both ventilation systems.

5.0 References

1. Title I Design Report, *Multi-Function Waste Tank Facility*, WHC-SD-W236A-RPT-002, Rev. 0, prepared by ICF Kaiser Hanford Company, February 1994.

2. Functional Design Criteria, *Multi-Function Waste Tank Facility*, WHC-SD-W236A-FDC-001, Rev. 1, prepared by Westinghouse Hanford Company, October 1993 (draft).

3. Internal Memo, B. A. Crea (WHC Thermal Hydraulics) to J. M. Light (WHC), *Design Values from the Evaporation Test*, 7E870-BAC-94-045, April 11, 1994.

4. Groth, B. D. , Position Paper, *Project W-236A Tank Heat Loading*, Rev. 1. March 30, 1994.

5. *Analysis of Tank Bump Potential During In-Tank Washing Operations Proposed for the 241-AZ Tanks*, WHC-SD-W-E-114 Rev. 0, prepared by Westinghouse Hanford Company, (date).