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1,2		QA - LR Hall	[signature] TZA	12/22/94	B4-08						
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7. Abstract

Position Paper to develop and document a position on the selection of the heat removal capability that the MWTF Tank Ventilation Systems will be designed to remove.

8. RELEASE STAMP

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B.D. Groth
June 10, 1993

POSITION PAPER ON PROJECT W-236A
TANK HEAT LOADING

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POSITION PAPER ON PROJECT W-236A TANK HEAT LOADING

The purpose of this paper is to provide Project W-236A, Multi-function Waste Tank Facility, (MWTF) Project File documentation on the selection of the heat removal capability that MWTF Tank Ventilation Systems will be designed to remove. This information is necessary for designing a heat removal system to prevent the thermal limits of the tank structure from being exceeded. It is important to note that this paper is not for defining the tank mixer pump requirements, but is to be only used for defining and defending the normal heat generation rate that the ventilation system and other heat removal systems will be designed to remove.

There are three main heat loads in the tanks of which two can be controlled to a certain extent through operational considerations. These two are mixing pump heat and heat of chemical addition. The third heat source is radionuclide content which can only be controlled by what wastes are pumped to the tank and whether it is diluted prior to pumping. Other heat loads such as transfer pumps were considered to be negligible. In addition, chemical addition is considered a transient situation that is rarely performed and will be treated as such.

MIXING PUMP HEAT LOAD

The requirement for the mixer pumps in Project W-236A is to maintain a near uniform suspension solids in the tanks at all times. This is different than the mixing pump requirements for the retrieval projects (e.g. projects W-151 and W-211) where the pumps are also required to mobilize high shear strength sludge in the tank. This accounts for the large discrepancies in power required for such mixing pumps.

The mixing requirement for Project W-236A is for mixing pumps to be installed in the tank and be capable of keeping the solids mixed to 90% homogeneity (ref. 1). The tank waste physical properties are given in Table 1 of reference 1. Preliminary scale model testing on simulated waste performed by T.R. Beaver and S. Chang indicates that an 80 HP mixing pump will be able to keep the solid contents of the tank in suspension (ref. 2). However, due to concerns over the ability to accurately scale up the results of the scale model testing, as well as the wide range of tank waste characteristics it was deemed prudent to include a design margin and consider a 150 HP pump. Since this might not be enough power to resuspend the solids if the pump failed and had to be changed out, it was decided that two 150 HP pumps would be installed for redundancy to prevent settling out of solids. In normal operations, only one pump would be operating at a time. The mixing pumps are to be equipped with variable speed drives so the speed may be reduced for operational considerations such as partially filled tanks, full mixing not required, the thermo-physical properties of the waste not requiring as much power, etc.

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If for some reason both pumps were to fail and the waste was allowed to settle this is not a safety concern. The ability to mix the waste is an operational concern based on retreivability of the waste. The project understands that if a high enough shear strength waste settles in the tank, it may be necessary to add more pumps to resuspend the waste. The project considers this an unlikely event, but has included a minimum of four 42" risers in each tank for the addition of mixing pumps if necessary. Since the time required to resuspend the settled solids is relatively short with this large amount of mixing (approximately 7 days), the heat removal system of the tank will not be designed for this scenario. The tank waste can be allowed to heat up during this time as long as the tank thermal limits are not exceeded.

Since two 150 HP pumps will most likely be installed and there may be special circumstances such as increased mixing, resuspending partial settled solids, and resuspension after some long term power failure, etc. it is prudent to design the heat removal system to remove the heat potentially generated from both pumps. This also provides the project with a greater design margin in the event further refinement of the mixing pump requirements indicates a larger pump is needed. Two 150 HP (mechanical) pumps would generate 763,200 BTU/hr.

RADIOLYTIC HEAT LOAD

The worst case radiolytic heat load in any current waste tanks on site is 250,000 BTU/hr (101-AZ waste decayed to October, 1997) (ref. 3). This radiolytic heat load is considered to be conservative as concentration of any wastes is not to be performed and then returned to Project W-236A tanks.

CHEMICAL ADDITION HEAT LOAD

The heat load due to chemical addition is difficult to define without determining the processes that need to take place. Chemical addition is also a transient situation that can be dealt with by slowing the mixer pump speed for a period of time, or allowing the tank waste to heat up slightly. Typically the only reactions that would generate substantial quantities of heat would be neutralization reactions. There currently exists no reason to reduce the pH of the waste by the addition of acid.

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CONCLUSIONS

To provide a design margin for operational considerations and for design of the heat removal system, a factor of 20% was added to the total heat from the mixing pumps and radiolytic heat generation. The total heat load for each MWTF tank to be designed to remove is 1.25 M BTU/hr based on this information. In addition, the structural limits on the tank are based upon temperature and not the heat generation rate. Therefore, if the temperature of the waste is less than the structural limits, additional heat can be generated for short periods of time increasing the temperature of the waste.

A reasonable lower bound for the heat capacity of the waste based on information in reference 4 and chemical handbooks is 32.6 BTU/ft^3 -°F. In a one million gallon tank, this corresponds to 4.36M BTU per one °F increase in temperature. This provides the operator with considerable flexibility in planning of processes for the tank. The use of variable speed drives on the mixing pumps further allows the operator to fine tune the amount of mixing required for various tank wastes to minimize the heat generated by the pumps. Many of the tanks will contain less than the 30% solids the MWTF tanks are designed to handle.

It should also be noted that the 1.25M BTU/hr is extremely conservative in light of the fact that over 90% of the existing tanks have radiolytic heat generation rates less than 40,000 BTU/hr and that an 80 HP pump predicted to be adequate will add 200,000 BTU/hr. This adds up to only 240,000 BTU/hr for the majority of the tank contents.

BG
6/29/93

One other concern that warrants mentioning is the effect particle size distribution would have on the power needed to keep the tank contents in suspension. The CaOH used as a waste simulant has a particle size distribution that matches the majority of tank wastes with the exception of a small percent of large particles (>100 microns) that are present in the tank wastes but not in the simulant. This will be remedied in future simulant testing by "spiking" the CaOH with particles up to 1000 microns. There is a potential that this will increase the power requirements needed. However, the project feels that the risk of proceeding with the preliminary design based on the 1.25 MBTU/hr is prudent and if further testing indicates a greater heatload, then affected portions of the design will be rebaselined.

Note - The redlined section was added on the June 29, 1993 revision. All signees before this date were informed of the change and are in agreement.

POSITION PAPER ON PROJECT W-236A
TANK HEAT LOADING

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