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SURFACE TEMPERATURES IN THE ORR TANK NEAR THE POOLSIDE FACILITY

By

E. S. Bettis and F. T. Binford

It has been shown⁽¹⁾ that the surface temperature to be expected in the reactor tank wall in the vicinity of the poolside facility can, under present design conditions exceed the saturation temperature of the surrounding water. Sanders⁽²⁾ has computed the heat generation terms in this region.

If S_o is taken to be the heat generation rate in BTU/ft³ hr, h to be the heat transfer coefficient in BTU/ft² hr °F and L the half thickness of the plate then the maximum surface temperature will not exceed the water temperature by more than

$$\Delta T = \frac{S_o L}{h}$$

The maximum heat generation rate given by Sanders⁽²⁾ is 2.5 watts/gram or 6.5×10^5 BTU/ft³ hr. Taking $h = 200$ BTU/ft² hr °F and $L = 0.073$ feet we have

$$\Delta T = 237^\circ\text{F}$$

which is clearly much higher than can be permitted.

The maximum heat generation rate allowable is that rate which will result in a surface ΔT not exceeding 100°F. Thus

$$S_o = \frac{100 h}{L} = 2.8 \times 10^5 \text{ BTU/ft}^3 \text{ hr.}$$

or $S_o = 1.07$ watts/gram in that portion which is not internally cooled.

Using the method outlined by Sanders⁽²⁾ it can be shown that the interposition of $1/4$ " of lead thermal shielding between the aluminum wall and the reactor will result in the reduction of the maximum heat generation rate in that portion of the wall which is not internally cooled from 2.5 watts per gram to approximately 0.9 watts per gram so that the possibility of boiling is effectively negated. The attached sketch shows the heat production in watts per gram for points of interest with the lead shield in place. These values will not allow the water to reach boiling temperatures.

The heat generation rates in the lead shield will not exceed 1.53 watts per gram in the region of interest.

Heat generation rates of up to 7.5 watts per gram can be tolerated in the lead provided the shielding is so arranged as to provide overall heat transfer coefficients of at least $200 \text{ BTU/ft}^2 \text{ hr } ^\circ\text{F}$ on both surfaces.

The lead shielding is to be placed parallel to and spaced $1/4$ " from the vertical faces which are adjacent to the sides of the flat pool face of the reactor as shown in Figure 1. These slabs are canned in $1/8$ " aluminum, the overall dimensions of the canned slab being $1/2$ " thick, 5" wide and 30" long. The slab weight is carried by resting on the flat horizontal ledge of the reactor tank across the bottom of the pool face. A small lug on the bottom of the front and back edge of each slab raises it approximately $1/4$ " to allow circulation of water underneath the slab.

Tapped holes in the reactor tank vertical risers provide means for inserting screws through ears in the slab to hold it in position. Details of the slab and its mounting are shown on drawing D-16867.

In addition to providing this thermal shielding for the maximum temperature points in the reactor tank, the thickness of the $3/4$ " ion chamber support gusset plates as shown on section E-E, Dwg. D-19607, has been reduced to $3/8$ " in order to prevent excessive temperature rise in these plates. The $3/8$ " plates have been checked and found to provide adequate strength for the duty required of them.

With the change of the thickness of these plates and the provision of the thermal shields described herein, the temperature of the entire reactor tank now appears to be satisfactory.

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- (1) Binford, F. T., ORNL CF-55-10-19, "Temperature Distribution in ORR Housing.
 - (2) Sanders, J. P., ORNL CF-55-7-134, "Energy Absorption Rate and Temperature Distribution in the Reactor Tank and Experimental Facilities".