To: W. L. Carter

Subject: Review of Vacuum Still, Condenser, and Sample Reservoir
(Drawing M-12173-CD-011)

A stress analysis of the vacuum still, condenser, and sample reservoir has been made by Mr. C. A. Hahs. A copy of his calculations is attached.

The operating temperature of 1800°F for this equipment is above the present scope of Section III or Section VIII of the ASME Boiler and Pressure Vessel Code. This analysis was made on the basis of meeting the intent of Section VIII of the code since Section III does not cover operating conditions in the creep range. On the basis of Section VIII, the stress which will produce 1% total creep during the operating life of the vessel was taken as the allowable stress. The data furnished by Mr. H. E. McCoy gives an allowable stress of 700 psi for a maximum operating life of 1000 hours based on this criteria. The stress which will result in rupture of the material in 1000 hours is estimated to be 1650 psi. It should be noted that, if the vessel is operated for a longer period than 1000 hours, the stress which will produce rupture is lower.

Some changes in design and method of support were transmitted verbally to you after our review of the original design. These changes have been made. After these changes, the design calculations show that the stresses are below the allowable stress of 700 psi.

No fatigue analysis of the vessel has been made, and none is required by Section VIII. However, the thermal stresses are important, and operation through a large number of thermal cycles may lead to fatigue failure. Data for a fatigue analysis is not available.

The creep-rupture and corrosion properties of INOR-8 are not sufficiently defined at 1800°F. This is discussed in detail in Mr. McCoy's letter of September 30, 1966 (copy attached). Because of the uncertainty in the data, the following recommendations are made.

1. The present vessel should be limited to a total operating life of no more than 1000 hours and to processing non-radioactive salts.

2. This vessel should be observed to determine the effects of external oxidation and internal corrosion, and the effects should be evaluated to determine whether protective measures are required.
3. The additional creep-rupture and corrosion data listed by McCoy should be obtained before vessels are designed for longer operating lives and/or processing radioactive salts.

4. If it is desired to operate this vessel after the initial 1000-hour period, it will be necessary to completely re-examine the vessel dimensionally and metallurgically and compare results with a similar examination made before operation of the vessel. Particular attention should be given to creep effects at locations of high stress and to the examination for developments of cracks or other injurious defects.

T. W. Pickel
Design Analysis
GE&G Division

Attachments

cc: M. Bender
    C. E. Bettis
    R. B. Briggs
    C. J. Claffey
    F. L. Culler
    D. E. Ferguson
    W. R. Gall
    C. A. Hahs
    R. B. Lindauer
    H. E. McCoy
    E. C. Miller
    G. W. Renfro
    G. C. Robinson
    R. W. Schneider