

TASK CLOSE OUT DOCUMENT

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Task Scope VERIFICATION OF NAT. CIRC. SHRINKAGE

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To: M. Levenson  
S. Levy  
E. Zebroski

Task No. 26e

Date Complete 4/26/79

Reason felt task is complete:

ROUGH ANALYSIS COMPLETED TO VERIFY THAT LOOP VOLUME  
SHRINKAGE IS APPROXIMATELY 2400 gallons.

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Members of Committee

J. HENK  
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Signed  
Committee Leader

4/24/79  
TASK 26e VERIFY LOOP SHRINKAGE UPON SUCCESSFUL NAT. CIRC.

CURRENT STM TEMP  $225^\circ$ , PRESSURE = 18.9 psi,  $u_g = 21.17 \frac{\text{ft}^3}{\text{lb}}$

$$\text{Power} = 5(\text{pump}) + 2\frac{1}{2}(\text{DCA, Hr}) = 7\frac{1}{2} \text{ MW}$$

FLOW RATE NOW =  $K \times 7.5 \frac{\text{lb}}{\text{SEC}}$  .. FLOW RATE LATER =  $K \times 2.5 \frac{\text{lb}}{\text{SEC}}$

IF THE FLOW IS LIMITED BY SUBSONIC PRESSURE DROP,

$$\text{LIMITING } \Delta P = K_2 \frac{1}{2} \rho V^2 = K_2 \frac{1}{2} u_g W^2 = K_3 u_g W^2$$

$$(K_3 u_g W^2)_1 = (K_3 u_g W^2)_2$$

$$u_{g1} K_1 (7.5)^2 = u_{g2} K_2 (2.5)^2$$

$$u_{g2} = u_{g1} \left( \frac{7.5}{2.5} \right)^2 = \cancel{21.17} = 9 u_{g1}$$

$$u_{g2} = (9)(21.17) \approx 189 \frac{\text{ft}^3}{\text{lb}}$$

THIS CORRESPONDS TO  $T_{\text{SAT}} = \underline{123^\circ\text{F}}$ , 1.89 psi

THUS, WHEN THE PUMPS ARE TRIPPED, THE SINK TEMP WILL DROP TO  $\sim 123^\circ$ , IF THE LIMITING FACTOR IS SUBSONIC  $\Delta P$ .

IF THE FLOW IS LIMITED BY SONIC VELOCITY, THE STM GEN PRESSURE IS PROPORTIONAL TO FLOW RATE, & THUS POWER. SINCE POWER IS DOWN BY A FACTOR OF THREE, PRESSURE DROPS FROM 18.9 psia TO 6.3 psi....  $T_{\text{SAT}}$  IS  $172^\circ\text{F}$ .

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THEREFORE, THE ESTIMATE OF 155°F BEING USED IS OK

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WHAT IS VOLUME SHRINKAGE OF 11,500 cu ft From 225°F  
TO 185°F

$$\text{MASS} = \rho_1 V_1 = \rho_2 V_2$$

$$V_2 = \frac{\rho_1}{\rho_2} V_1 = \frac{N_{g2}}{N_{g1}} V_1 = \frac{0.016535}{0.1681} (11500)$$

$$\Delta V = 11500 - 11310 = 190 \text{ cu ft} = 1410 \text{ gal} \quad \text{---}$$

~~THIS IS 60% OF THE ESTIMATE TO GO~~

THE ESTIMATE BEING USED BY GPU IS 2400 gallons, WHICH  
IS CONSERVATIVE COMPARED TO THE 1400 CALCULATED HERE.

Edmund  
4/26/79