FORM APF-05D-001-01, REV. 00

CALCULATION COVER SHEET

MECHANICAL

CALC NO. GK-474

DCP/CCP NO. N/A

CALCULATION STATUS DESIGNATION: ☐ PRELIMINARY ☐ COMMITTED ☒ FINAL ☐ SUPERSEDED ☐ VOIDED

CLASSIFICATION: ☒ SAFETY-RELATED ☐ SPECIAL-SCOPE ☐ NONSAFETY-RELATED

COMPUTER CODE/VERSION: N/A

CALCULATION SUBJECT: Contol Room Pressurization System Filtration Unit Heater Output

DESCRIPTION/REVISION SUMMARY:

Revision 1 of this calculation is issued to incorporate a Technical Specification change. The KW output of the heater is reduced from 15 KW to 5 KW output by DCP 05760.

REV.	ORIG/DATE	VERF/DATE	APP/DATE	REL
001	James J. Gore 3/21/96	Anthony Bieger 3-25-96	[illegible] 3-25-96	DC23 3-27-96

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PURPOSE:

The purpose of this calculation is to demonstrate the minimum and maximum allowable control room pressurization system filtration unit (FGK02A/B) heater capacity.

REFERENCES:

1. WCGS Technical Specification 3/4 7.6
2. ANSI N-509-76
3. Calculation XX-E-006, "Wolf Creek Degraded Voltage Calculation"

INPUTS:

1. The heater must reduce the entering air relative humidity from 100% to 70%.
2. Summer design inlet air temperature = 97°F DB
3. The off-coil temperature must be limited to 225°F to meet criteria from ANSI N-509.
4. The pressurization fan will deliver 750 CFM +/- 10%.
5. The normal electrical bus voltage is 460 volts. The minimum degraded voltage at the heater is 432 volts from Ref. 3.

ASSUMPTIONS:

1. The maximum voltage will be assumed to be 10% above the normal value (460 x 1.1 = 506 volts).
2. At the winter outdoor air conditions the air has extremely low moisture content. The amount of heat input required to lower the relative humidity from 100% to 70% in winter is insignificant when compared to the summer time conditions. The summer time design conditions is the controlling case.

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ANALYSIS:

I. Maximum Allowable Heater KW:

CFM = 750 - (750 x 0.1) = 675 CFM
T_{INLET} = 97°F DB
$T_{OFF-COIL}$ = 225°F DB
V = 506 volts
Q = 5 KW +/- 1 KW

Maximum heater output at 506 volts (assuming max. output at 460 volts is 6 KW).

$(V_2/V_1)^2 (KW_1) = (KW_2)$

$(506/460)^2 (6) = (7.26\ KW)$

Heater output resulting if air flow is minimum and off-coil temperature is limited to 225°F DB.

$Q = (1.08)(CFM)(\Delta T)$

$Q = (1.08)(675)(225 - 97)$

Q = 93,312 BTU/HR x (1 W) / (3.4129 BTU/HR) = 27,341 W = 27.341 KW

Therefore, an off-coil temperature of 225°F DB would never be achieved with a 5 KW +/- 1 KW heater rating. Wolf Creek is in compliance with this ANSI N-509 requirement.

II. Minimum Heater KW Requirements:

A. Based on minimum degraded voltage of 432 volts and minimum heater output of 4 KW.

The minimum heater output available:

$(V_2/V_1)^2 (KW_1) = (KW_2)$

V_2= 432 volts (Ref. 3)

KW_1 = 5 KW -1 KW = 4 KW

$(432/460)^2 (4) = (3.53\ kW)$

Therefore the minimum possible heater output is 3.53 KW.

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B. The minimum required heater output to reduce 97 deg. F (DB) inlet air from 100% to 70% RH:

$Q = (1.08)\ (CFM)\ (\Delta T)$

Where,

$CFM = 750 + (750 \times 0.1) = 825$ CFM
$T_{INLET} = 97°F$ DB
$T_{OFF\text{-}COIL} = 109°F$ DB (From psychometric chart: this is the resulting DB temperature)
$1.08 = C_p \times \rho$ (air)

$Q = (1.08)\ (825)\ (109 - 97) = 10{,}692$ Btu/Hr
x (1 W) / (3.4129 BTU/HR) = 3,132.82 W = 3.13 KW

From part A above a minimum of 3.53 KW is available from the heater. This is greater than the 3.13 KW required.

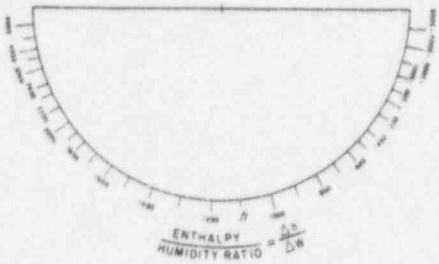
Conclusion:

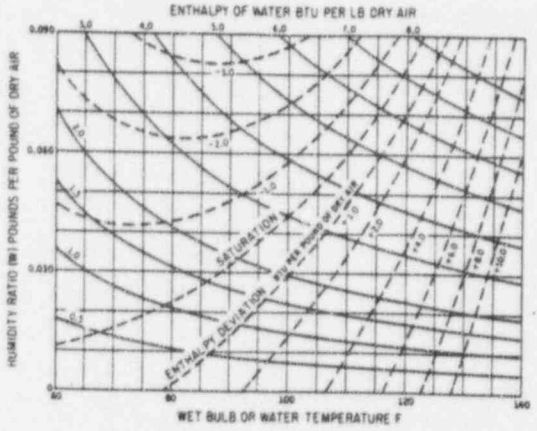
A rating of 5 KW +/- 1 KW is adequate to reduce inlet air to 70% RH as required by ANSI N509.

ASHRAE PSYCHROMETRIC CHART NO. 3

HIGH TEMPERATURE

BAROMETRIC PRESSURE 29.921 INCHES OF MERCURY





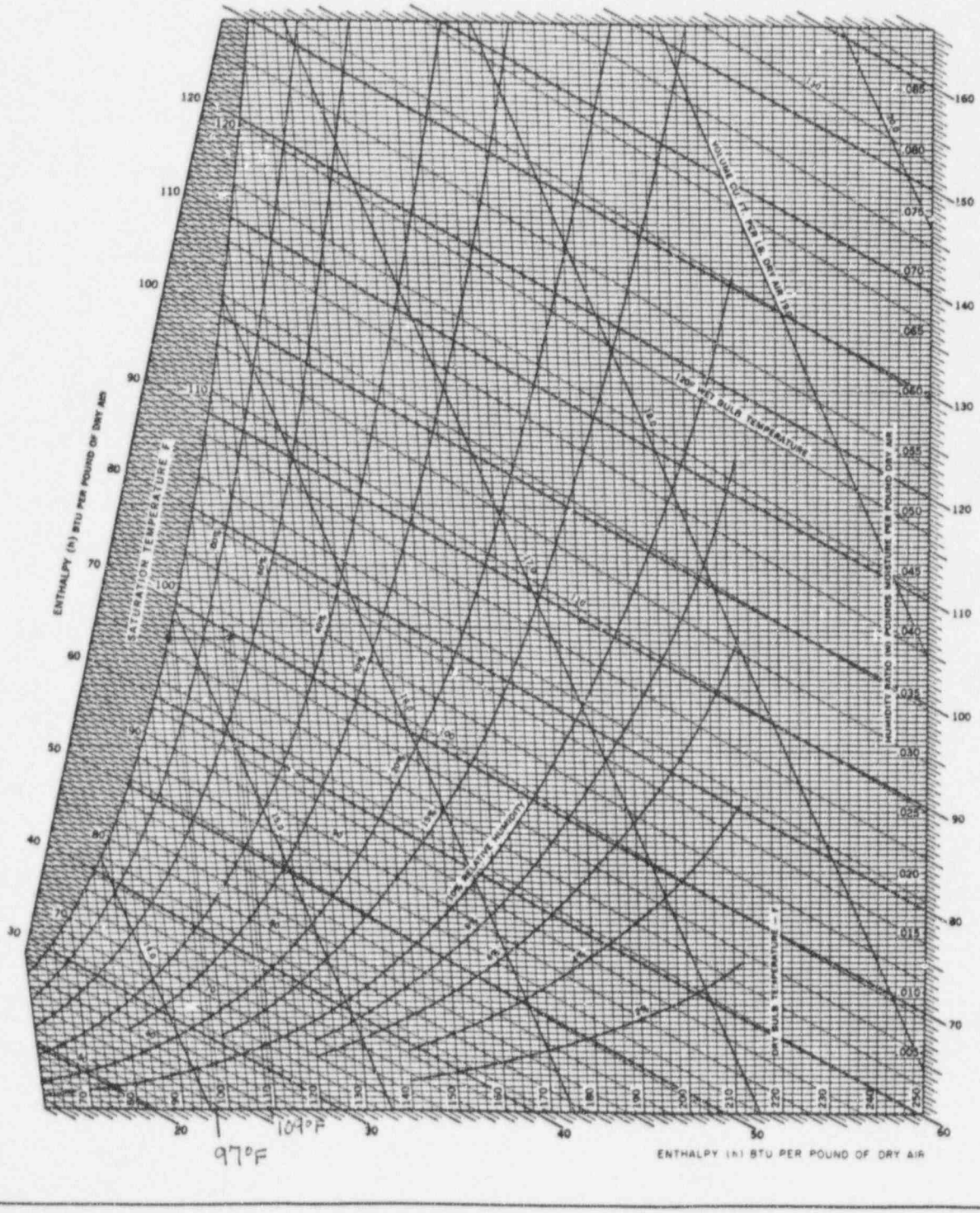


Plate III. Psychrometric chart for high temperatures. (Reprinted by permission of ASHRAE)