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1400 Opus Place
Downers Grove, Illinois 60515

November 5, 1991

Dr. Thomas E. Murley
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTN: Document Control Desk

Subject: Quad Cities Station Units 1 and 2
Supplemental Information Relating to
Application for Amendment to Appendix A,
Technical Specifications DPR-29 and DPR-30,
NRC Docket Nos. 50-254 and 50-265

Reference: (1) J.L. Schrage to T.E. Murley letter dated September 24, 1991.

(2) Conference call on October 3, 1991 between J.L. Schrage (CECo) and L.N. Olshan/S. Flanders (NRR).

(3) J.L. Schrage to T.E. Murley letter dated October 11, 1991.

(4) Conference call on October 18, 1991 between J.L. Schrage (CECo) and L.N. Olshan/S. Flanders (NRR).

Dear Dr. Murley:

In the October 3, 1991 teleconference (Reference (2)), members of your staff requested supporting information pertaining to an application for an amendment to Quad Cities Station's Technical Specifications (Reference (1)). The proposed amendment establishes a differential temperature criteria for the Control Room Emergency Filtration (CREF) System heater based upon system flow. The requested information was provided in Reference (3). This letter provides additional information to members of your staff which was discussed during the October 18, 1991 teleconference (Reference (4)). The requested information is listed below, and described in the Enclosure.

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1. A clarification of the power required to meet the design basis versus the power required to meet the Technical Specification surveillance requirement.

2. A description of the heater sizing calculation.

If there are any comments or questions on this information please direct them to John L. Schrage at 708-515-7283.

Respectfully,

John L. Schrage
Nuclear Licensing Administrator

Attachment

cc: L.N. Olshan - Project Manager, Quad Cities
T.E. Taylor - Senior Resident Inspector, Quad Cities

ENCLOSURE

CLARIFICATION OF POWER REQUIREMENTS

The design basis of the Control Room Emergency Filtration (CREF) System heater is to ensure that the relative humidity (RH) of the air at the inlet to the charcoal adsorbers is less than 70% at the most limiting climatic condition of 95°F wet-bulb (95°F with 100% humidity). At this inlet condition, 8.14 KW of heater power is required to reduce the relative humidity to less than 70%. At this power and inlet condition, the Δ T will be 12°F.

If the inlet conditions are at the lower bound (wet bulb temperature of -10°F), the heater must deliver approximately 5.3 KW in order to reduce the relative humidity to less than 70%. However, at this inlet condition and heater power, the Δ T will only be approximately 7.9°F. Therefore, in order to meet the Technical Specification Δ T requirement of 15°F at an inlet wet-bulb temperature of -10°F, the heater must deliver approximately 10.1 KW of power.

HEATER SIZING CALCULATION

Purpose

The purpose of this calculation is to determine the power required to heat air in order to lower the RH from 100% to below 70% as it passes through the Quad Cities Control Room Air Filter Unit under the following initial conditions:

Initial Temp (°F)	Final Temp (°F)	Initial RH (%)	Flow (SCFM)
-10	-3.5	100	2200
-10	-2.1	100	1800
60	70.5	100	2200
60	72.8	100	1800
95	107.0	100	2200
95	109.7	100	1800

Method

Using Reference 1, the specific volume and enthalpy of the air at the initial conditions will be determined. Assuming a temperature rise with no addition of moisture, the final enthalpy will be determined. From the difference in enthalpies and using the given flow rates, the power required to accomplish the heating of the air will then be determined.

References

1. "ASHRAE Handbook, 1989 Fundamentals," American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

Assumptions

1. All of the heat from the heating element shall be assumed to be transferred by conduction and convection to the flowing air. Radiation to the ductwork or other losses of heat not to the air will not be considered.

2. Since no mass in the form of air or water is being added to the flowing air, the temperature change will be at a constant moisture content and therefore the humidity ratio at the initial temperature will be equal to the humidity ratio at the final temperature.

Calculations

Determine specific volume, enthalpy and humidity ratio for initial temperatures at saturation conditions from Ref. 1, Table 1, Pgs. 6.2-6.4.

t Temp (°F)	Ws Humidity Ratio (lbw/lba)	Vs Volume (ft^3/lb dry air)	hs Enthalpy (Btu/lb dry air)
-10	0.0004606	11.335	-1.915
60	0.011087	13.329	26.467
95	0.036757	14.804	63.343

The enthalpy at the final conditions (h) will be determined from the following formulae:

$h = ha + Whg$ Ref. 1, Formula 27, Pg 6.13

$hg = 1061 + 0.444t$ (Btu/lb) Ref. 1, Formula 29, Pg 6.13

The enthalpy of dry air (ha) from Ref. 1, Table 1, Pgs. 6.2-6.4 and hg calculated using the above formula will be tabulated below for the final temperatures:

t Temp (°F)	Ha Enthalpy (Btu/lb dry air)	Hg Enthalpy (Btu/lb)
-3.5	-0.841	1059.45
-2.1	-0.504	1060.07
70.5	16.94	1092.30
72.8	17.49	1093.32
107.0	25.714	1108.51
109.7	26.364	1109.71

The enthalpies at the final conditions are as follows:

@-3.5°F

h = ha + W(hg) (Btu/lb)

h = -0.841 Btu/lb dry air

+ 0.0004608(1059.45 Btu/lb)

h = -0.353 Btu/lb dry air

@-2.1°F

h = ha + W(hg) (Btu/lb)

h = -0.50 Btu/lb dry air

+ 0.0004608(1060.07 Btu/lb)

h = -0.016 Btu/lb dry air

@70.5°F

h = ha + W(hg) (Btu/lb)

h = 16.94 Btu/lb dry air

+ 0.011087(1092.30 Btu/lb)

h = 29.05 Btu/lb dry air

@72.8°F

h = ha + W(hg) (Btu/lb)

h = 17.49 Btu/lb dry air

+ 0.011087 (1093.32 Btu/lb)

h = 29.61 Btu/lb dry air

@107.0°F

h = ha + W(hg) (Btu/lb)

h = 25.714 Btu/lb dry air

= 0.036757(1108.51 Btu/lb)

h = ha + W(hg) (Btu/lh)

@109.7°F

h = ha + W(hg) (Btu/lb)

= 26.364 Btu/lb dry air

+ 0.036757(1109.71 Btu/lb)

h = 67.15 Btu/lb dry air

The initial and final enthalpies are tabulated below:

t Initial Temp (°F)	h Initial Enthalpy (Btu/lb dry air)	t Final Temp (°F)	h Final Enthalpy (Btu/lb dry air)
-10	-1.915	-3.5	-0.353
-10	-1.915	-2.1	-0.016
60	26.467	70.5	29.05
60	26.467	72.8	29.61
95	63.343	107.0	66.46
95	63.343	109.7	67.15

The power required to effect the above temperature rise will be calculated using the flowrates, specifc volumes and enthalpy differences:

@2200 SCFM

-10°F - -3.5°F

$$Q = \frac{(2200\ ft^3/min)\ (-0.353 - (-1.915))\ (Btu/lb\ dry\ air)}{(11.335\ ft^3/lb\ dry\ air)\ (1\ Btu/min)/(0.01758\ Kw)}$$

Q = 5.33 Kw

@1800 SCFM

-10°F - -2.1°F

$$Q = \frac{(1800\ ft^3/min)\ (-0.016 - (-1.915))\ (Btu/lb\ dry\ air)}{(11.335\ ft^3/lb\ dry\ air)\ (1\ Btu/min)/(0.01758\ Kw)}$$

Q = 5.30 Kw

@2200 SCFM

60°F - 70.5°F

$$Q = \frac{(2200\ ft^3/min)\ (29.05 - 26.467)\ (Btu/lb\ dry\ air)}{(13.329\ ft^3/lb\ dry\ air)\ (1\ Btu/min)/(0.01758\ Kw)}$$

Q = 7.50 Kw

@1800 SCFM

60°F - 72.8°F

$$Q = \frac{(1800\ ft^3/min)\ (29.61 - 26.467)\ (Btu/lb\ dry\ air)}{(13.329\ ft^3/lb\ dry\ air)\ (1\ Btu/min)/(0.01758\ Kw)}$$

Q = 7.46 Kw

@2200 SCFM

95°F - 107.0°F

$$Q = \frac{(2200\ ft^3/min)\ (66.46 - 63.343)\ (Btu/lb\ dry\ air)}{(14.804\ ft^3/lb\ dry\ air)\ (1\ Btu/min)/(0.01758\ Kw)}$$

Q = 8.14 Kw

@1800 SCFM

95°F - 109.7°F

$$Q = \frac{(1800\ ft^3/min)\ (67.15 - 63.343)\ (Btu/lb\ dry\ air)}{(14.804\ ft^3/lb\ dry\ air)\ (1\ Btu/min)/(0.01758\ Kw)}$$

Q = 8.14 Kw

Summary of Results

Initial Temp (°F)	Final Temp (°F)	Initial RH (%)	Flow (SCFM))	Power (KW)
-10	-3.5	100	2200	5.33
-10	-2.1	100	1800	5.30
60	70.5	100	2200	7.50
60	72.8	100	1800	7.46
95	107.0	100	2200	8.14
95	109.7	100	1800	8.14