Design and Operation of 3-Pin FTL HVAC System

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1. Introduction

According to the increasing demand for irradiation tests to develop new fuels, the 3-Pin FTL(Fuel Test Loop for 3 pin test fuel) facility has now been under design to conduct in-core fuel performance tests at the operating conditions, which will be installed at HANARO. The HVAC system of the FTL will be dependent on that of the HANARO. The FTL has three equipments rooms, which are the room 1, room 2 and the control room. The high pressure and high temperature equipments will be installed in the room 1. The atmosphere of the room 1 shall be maintained under the designed condition. This paper describes the design of the FTL HVAC system in the room 1.

2. Heat Loads in the Room 1

2.1 Design Criteria

The normal environment and operation conditions in the room 1 are as followings :

- Temperature : 40 ~ 150 ℉ (4.4 ~ 65.5 ℃)
- Pressure : -0.25"w.g (-6.35 mmAq)
- Relative Humidity : 20 ~ 90 %RH
- Supplied Air Flow Rate : 1250CMH
- Ventilation Frequency : 6 times/hr

Supplied air conditions are as followings :

- Temperature : 25 ~ 27℃ in summer
  20 ~ 22℃ in winter
- Relative Humidity : 50+10%RH in summer
  40+5%RH in winter

2.2 Assumptions and Conditions

The calculation of the room 1 heat load has been performed under the following assumptions and conditions.

- Negligible external heat load from Main Cooling Pump because of its closed, water cooling type.
- No heat from the room wall.
- Neglect the heat from the wire and cable.
- The equipment heat loads come from the MCW(Main Cooling Water) system. The MCW system is operated at the high temperature.

2.3 Basic Equation and Calculation Method

1) Generated heat from the electric motors

$$q_{em} = (P/E_M)F_{UM}F_{LM}$$

where, q_{em} = generated heat (W)
P = motor capacity (W)
E_M = motor efficiency
F_{UM} = motor utility (under 1.0)
F_{LM} = motor load (under 1.0)

2) Motor power and heat load

$$\text{Motor power} = [W(\ell/MIN) \times S.P(MAQ)] / [60 \times 102 \times \eta]$$
$$\text{Heat load}(q_c) = GC(t_{room} - t_{inlet})$$

where, G (kg) : supplied air
C : specific heat of air (0.24 kcal/kg.℃hr)
t_{inlet} : inlet air temperature (27 ℃)
t_{room} : atmospheric room temperature

3) Calculation Method

The heat loads come from the lighting, hot pipe and equipments (pressurizer, heat exchangers, pumps and etc.). The air is supplied to the room 1 from the reactor hall and exhausted to the stack via some filters. The atmospheric room temperature is calculated from the equipments heat loads and the supplied air flow rate. This temperature is evaluated for the design criteria requirements.

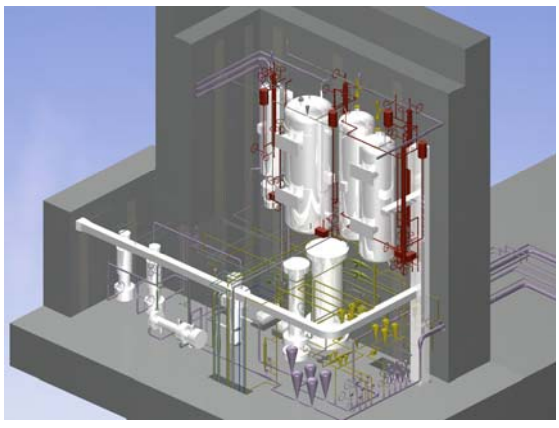

Figure 1. FTL Room 1 View and HVAC Duct.

2.4 Input Data for Calculation

The major heat loads are as followings :

1) Lighting heat load room temperature
$q_{lighting} = 2$ kW

2) Heat load from Pipe and Equipment

Pipe or Equipments	Heat Dissipation(W)
Pipe-Recirculation	142
Pipe-Spray & Surge	1,022
Main Heater Vessel	822
Total (q_{pipe})	1,986

3) Pressurizer heat loss($q_{pressurizer}$) = 824 W

2.5 Calculation Results and Considerations

1) Evaluation of room temperature
The heat load(qroom#1) of the FTL room 1 is,
qroom#1 = qlighting + qpipe + qpump + qpressurizer
= 5,300 W = 4,558 kcal/hr.
The room temperature of the FTL room 1 is,
troom = (qc/GC) + tinlet = 39.7 ℃ (for summer)
This temperature fulfills the room temperature requirement(50℃). So the external cooling facility is not needed.

2) Evaluation of ventilation flow rate
The volume of the FTL room 1 = 208 m3.
The ventilation frequency(6 times/hr) is applied to the room volume for the air flow rate.
208 m3 x 6 times/hr = 1,248 CMH.
This designed air flow rate(1,248CMH) fulfills the supplied air(1,250 CMH).

3. Conclusion

The HVAC air of the FTL room 1 is supplied from the HANARO reactor hall. The high pressure and high temperature equipments will be installed in the room 1. The atmospheric air temperature and flow rate are calculated and evaluated for the necessity of the external cooling facility. The room temperature is satisfactory for the design requirement. The supplied air is enough to remove the generated heat.

Acknowledgements

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