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Feasibility Study for Installation of Isolation Valves on Condensate System at Ulchin unit 1&2

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1. Introduction

Because there are no isolation valves in condensate system of Ulchin unit 1&2, circulating water pump was shutdown for the condenser repair. When circulating water pump was shutdown, power plant output decreased about 45%. These output decreasing can minimize by establishing isolation valves.

In this paper, evaluated effect to flow conditions change of condensate system, structural integrity of system, condenser pressure of in case of establish isolation valves to condensate system.

2. System flow condition

Fig. 1 shows circulating water system of Ulchin unit 1&2. Circulating water pumps are operating to 30.9 m3/s flow rates. Flows are divided 3 pipe line. Flow rates of each piping is 10.3m3/s, and 0.35m3/s of this passes to the second device cooling system and remainder 9.95m3/s is flowed in condenser.

Pressure loss coefficient of isolation valve (Butterfly Valve) is appeared to equation (1).

$$\zeta = \left(\frac{1.4}{1 - \sin\theta / \sin\theta_0} - 1 \right)^2 \quad (1)$$

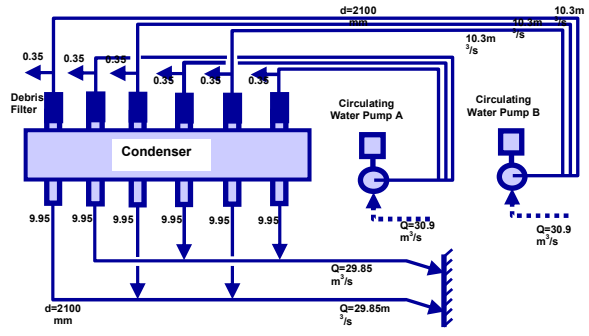

Fig. 1 Circulating water system of Ulchin unit 1&2

Pressure loss of condensate system is 0.126m by establish isolation valves (valve fully open condition) and flow rate decrease of circulating water pump is 0.1m3/s. On the other hand, flow of circulating water pump decreases to 30.25m3/s in case of fully closed condition isolation valve in one piping among 3 piping (Fig 2 and Fig. 3).

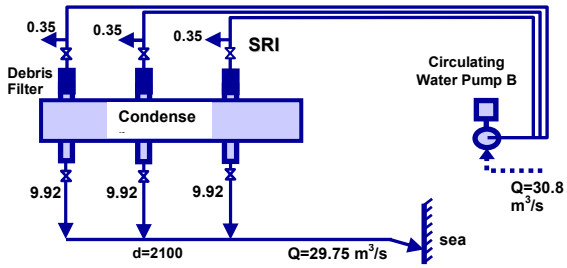

Fig. 2 Circulating water system (valve fully open condition)

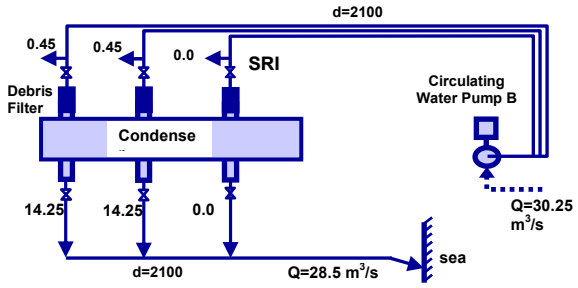

Fig. 3 Circulating water system (valve fully closed condition)

3. Estimation of condenser pressure

Table 1 show that condenser pressure estimation results to inlet flow rate changes. Case 1 is the valve fully open condition and case 2 is the valve fully closed conditions. In the case 1, condenser pressure by valve establishment increases to 4.99Kpa but there is no thermal output change. Also heat load has not changed.

On the other hand, in the case 2, to satisfy condenser reference pressure 4.98Kpa, heat load should reduces about 5 - 10%.

Table 1 Results of condenser pressure estimation

Thermal Section	Base Case	Case 1	Case 2-3%	Case 2-5%	Case 2-10%
Heat Load (Q) [MW]	1785.83	1785.83	1732.26	1696.54	1607.25
Total Abs press [kPa, in Hg]	4.98	4.99	5.13	5.06	4.89
	1.47	1.47	1.51	1.49	1.44
Steam Temp [deg C]	32.82	32.85	33.34	33.10	32.50
TR (Temp Rise) [deg C]	7.30	7.33	7.26	7.11	6.74
Cooling Water Temp [deg C]	21.7	21.7	21.7		
CW Flow Rate [m^3/hr]	214920	214200	209700		
CW Velocity inside tubes [m/s]	2054	2053	2.98		
HEI " U " uncorrected [W/m^2-K]	4368.0	4361.6	4676.7		
No. of tubes [ea]	91926	91926	76605		
Surface Area [m^2]	65924	65924	54937		

4. Structure integrity

Table 2 show that analysis results of structure integrity of condensate system (frequency mode, allowable pressure, stress in flange).

Natural frequencies (1st mode) are 44.2 Hz and 59.5 Hz at the condenser inlet and outlet piping. This value exceeds 33 Hz that is system cutoff frequency. Also allowable external pressure, stress in flange, design load etc. satisfy terms desired of ASME Coded, section II, Part D.

Table 2 Results of structure integrity

	Model	Mode	Frequency
Mode Analysis	Inlet	1	44.2
		2	44.2
		3	137.3
		4	169.3
		5	169.3
		6	479.6
	Outlet	1	59.5
		2	59.5
		3	167.1
		4	182.0
		5	182.0
		6	591.6
		Calculation	Allowable
Allowable External Pressure	Piping	8.28E5[Pa]	> 9.99E4[Pa]
Flange Stress	Flange	8.68E7[Pa]	< 8.76E7[Pa]
Design Pressure(1)	Inlet Piping	5.33E6[Pa]	< 8.76E7[Pa]
	Outlet Piping	5.33E6[Pa]	< 8.76E7[Pa]
Design Pressure(2)	Inlet Piping	1.33E7[Pa]	< 1.00E8[Pa]
	Outlet Piping	1.33E7[Pa]	< 1.00E8[Pa]

5. Conclusion

In this paper, evaluated effect to flow conditions change of condensate system, structural integrity of system, condenser pressure of in case of establish isolation valves to condensate system. Results are

(1) Flow rates decrease 0.3% at valve full open condition and 4.5% at valve fully closed condition.

(2) In valve full open condition, heat load has not changes.

(3) There is no effect to structure integrity

REFERENCES

[1] Circulating Water Line, KNU12 M03FC301