

Integrity Assessment of Essential Service Water System of Ulchin unit 1&2

Sun-ki Lee, a Sang-kook Lee, a Il-suk Jeong, a Taek-ho Song, a Jong-ju Kwon, a Seong-yul Hong, Jin-hwan Lee, b
 a Korea Electric Power Research Institute (KEPRI), b KHNP Co.,
sunlee@kepri.re.kr

1. Introduction

Because of circulating water filtration system(CFI) and essential service water system(SEC) of Ulchin unit 1&2 were designed by commonness water intake structure, circulating water filtration system is managed by quality grade Q class. In this study, circulating water filtration system (CFI) examined revision possibility from present quality grade Q class to R class. It is proving that the operation of essential service water system (SEC) is always available regardless CFI conditions.

2. Pressure Drop at the Drum Screen

2.1 Drum Screen Design Condition

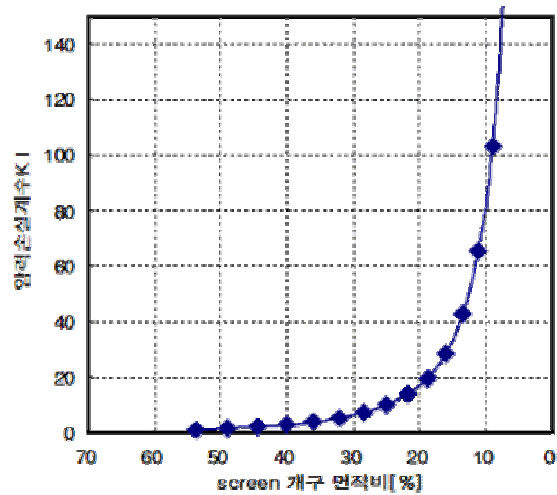
Drum screen was designed cylindrical of diameter 11.9m, length 7.5m (drum screen capacity (volume) is 834m³). Screen's lattice mesh is quadrangle of 3mm x 3mm, and rotating speed is 1.67 rpm (low speed) or 6.68 rpm (high speed). Time that coolant supply of SEC is available in state that seawater supply does not exist entirely to drum screen is about 7 minutes.

2.2 Pressure Drop at the Drum Screen

If breakdown occurs to drum screen (rotating motor or wash water line system inoperable), pressure loss is grown by alien substance sticking of screen surface. Pressure loss of screen calculates using empirical formula of Idelchik (2).

Fig.1 show that the drum screen pressure drop increase according to flow area decrease by alien substance sticking occurred. X axis is screen flow area ratio, and y axis is pressure loss coefficient. According to flow area decreases to alien substance sticking to screen surface, pressure drop increases. Pressure drop coefficient is 0.85(1.3 cm for head) in design condition

(flow area ratio is 54%). Also, when flow area ratio 27%, head loss is 7.2cm(table 1).



<Fig. 1> Relationship between screen flow area ratio and pressure loss

<Table 1> Screen flow area ratio and pressure loss

Flow area ratio (%)	Pressure drop (cm)	Flow area ratio (%)	Pressure drop (cm)	Flow area ratio (%)	Pressure drop (cm)
54 Design condition	1.3	25	9.9	7	169.7
49	1.7	22	13.7	5	299.1
44	2.2	19	19.5	4	570.1
40	3.0	16	28.3	3	1211.0
36	3.9	13	42.0	2	3053.0
32	5.3	11	64.3	1	9802.0
28	7.2	9	102.1		

3. SEC Operation Analysis

3-1 In the case of marine organism inflow

Ulchin unit 1&2 were designed the circulating water filtration system (CFI) and the essential service water system (SEC) by commonness water tank and CFI's driving (moving and stop) is decided by drum screen pressure difference. Drum screen's pressure difference is 50cm which CFI's driving is decided.

In table 1, when pressure loss is 50cm, screen flow area ratio is about 12%. That is, when is less screen's flow area ratio 12%, CFI is stopped and SEC is driven. SEC is safe in flow rate more than 3% of drum screen design capacity (32.0m³/sec). On the other hand, there is relation that flow area ratio decrease by sticking is direct with flow velocity and flow rate. Now, inflow velocity to screen is 0.4 m/sec in case of CFI and SEC are driving at the same time. SEC individual velocity of flow is 0.0125 m/sec (1.25 cm/sec). Reynolds number (Reynolds Number, Re) about velocity of flow 0.0125 m/sec is about 14. In case of Re number is less than 50, pressure drop were not occur [1, 2]. That is, in the case of SEC individual operation, because screen pressure drop were not occur, alien substance is not attached to screen.

3-2 One drum inoperable and one component on the other drum inoperable condition

Accident kind of FSAR(Final Safety Analysis Report) was described about 4 cases.

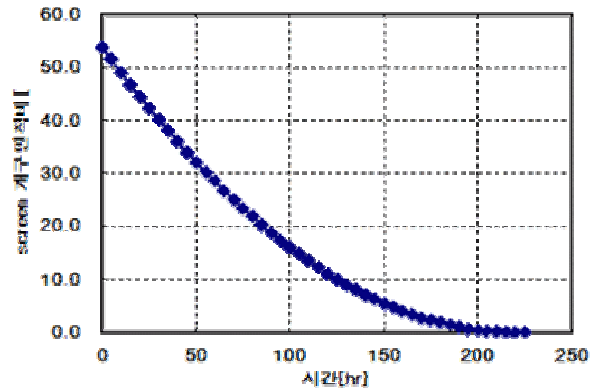
In this paper, examine about the serious accident (one drum inoperable and one component on the other drum inoperable).

In this case (screen rotating motor inoperable condition), thin floating matter and alien substance of cooling seawater attach to screen lattice and cause pressure loss. Alien substance increases the quantity according to passage of time and pressure loss is also increased.

Fig.2 shows that results of the screen flow area ratio decrease according to increase time when alien substance sticking appears by screen diameter increase on 0.01mm per hour. From the Fig. 2, time that reach to

flow area ratio about 5% which is SEC's driving possibility limit is about 150 hours.

In this case (CFI and SEC are driven at the same time), if CFI stop at 50cm pressure loss according to screen flow area ratio decrease, SEC integrity is always wholesome.



< Fig. 2> Relationship between time and screen flow area

4. Conclusion

In this study, Circulating Water Filtration System (CFI) examined revision possibility from present quality grade Q class to R class. It is proving that the Essential Service Water System (SEC) operation is always available regardless CFI conditions.

Estimation result, under the one drum inoperable and one component on the other drum inoperable condition, SEC appeared that integrity is secured for minimum 150 hours. Also SEC operation is available in case mass marine organism attaches to drum screen.

Reference

- [1] Wieghardt, K. E. G., Aeronaut. Q, (1953), pp186.
- [2] I.E. Idelchik and Erwin Fried, Flow Resistance, Taylor & Francis, 1989