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Optimization of Main Feedwater Pump Speed Program for Kori Units 3 & 4 and Ygn Units 1 & 2 Power Uprate

Duk Joo Yoon, Jae Yong Lee, Hwang Yong Jun
Korea Electric Power Research Institute, Yuseong-gu, Daejeon, 305-380, djyoon@kepri.re.kr

1. Introduction

The difference pressure(DP) of main feedwater pump speed program affects the feedwater control valve position and control system. The DP should be evaluated to cover the increased feedwater flow for the 4.5% power uprate program of Kori Units 3 & 4 and Ygn Units 1 & 2. After the power uprate, since the required flow of feedwater flow is increased from 7.92 kg/sec to 8.28, the difference pressure(DP) of main feedwater pump speed program should be increased.

Therefore, some analyses were performed in case of a loss of a feedwater pump to determine the optimal feedwater control valve position and difference pressure(DP) of main feedwater(MFW) pump speed program after the 10% turbine runback.

These analyses were performed using advanced continuous simulation language(ACSL), which was also used for the 4.5 % uprate program. [1,2,3].

2. Operating Status

2.1 Kori Units 3&4 operating status

Operating parameters of Kori Units 3&4 are 13.3 kg/㎠ DP, 4350 rpm and 77% valve position in maximum value, as shown in table 1. Maximum value of the MFW pump speed goes up 4850 rpm after a loss of a MFW pump. Runout point of the pump in Kori Units 3&4 is 5230 rpm.

Table 1. Operating Data of Kori Units 3&4 at Normal Power before Power Uprate

Train	MFW Pump Speed (rpm)	Control Valve Position (%)	DP of Speed Program (kg/㎠)
A	4230	75~77	13.3
B	4350	67~70	
C	4290	74~76	

Table 2. Operating Data of Kori Units 3&4 in case of one MFW pump loss before Power Uprate

Train	MFW Pump Speed (rpm)		DP of Speed Program (kg/㎠)	
	Before one pump loss	After one pump loss	Before one pump loss	After one pump loss
A	4230	4800	13.3	13.3
B	4350	4850		
C	4290	0		

2.2 Ygn Units 1&2 Operating Status

Operating parameters of Ygn Units 1&2 are 14.8 DP, 4600 rpm and 67% valve position in maximum value, as shown in Table 3. Maximum value of the MFW pump speed goes up 5120 rpm after a loss of one MFW pump. Runout point of the pump in Ygn Units 1&2 is 5380 rpm. We recognized that the speed and DP of MFW pump speed program had difference between Kori Units 3&4 and Ygn Units 1&2.

This paper analyzed how these differences of operating parameters between Kori 3&4 and Ygn 1&2 affect steam generator level control after a loss of one MFW pump.

Table 3. Operating Data of Ygn Units 1&2 at Normal Power before Power Uprate

Train	MFW Pump Speed (rpm)	Control Valve Position (%)	DP of Speed Program (kg/㎠)
A	4600	64	14.8
B	4600	67	
C	4560	66	

Table 4. Operating Data of Ygn Units 1&2 in case of one MFW pump loss before Power Uprate

Train	MFW Pump Speed (rpm)		DP of Speed Program (kg/㎠)	
	Before one pump loss	After one pump loss	Before one pump loss	After one pump loss
A	4600	5120	14.8	14.8
B	4600	0		
C	4560	5020		

3. Analysis Results

Sensitivity analysis for various DPs of MFW pump speed program was performed in transients for loss of one MFW pump at full power. As shown in Figures 1 through 4, the larger DP of speed program provides more smooth transients for operating parameter such as RCS temperature, steam generator level, feedwater flow and valve position. These results can draw a deduction from a fact that the larger DP of speed program can provide larger flow when large FW flow is needed after one MFW pump loss. However, speed of MFW pump becomes higher value when the DP of speed program has larger value resulting in decreased operating margin, as shown in Figure 5. We recommend that the DP of Kori Units 3&4 be increased from 13.3 to 14.8 in order to obtain smooth transients in one MFW pump loss like the case of Ygn Units 1&2 after 4.5% power uprate. Kori Units 3&4 can accept results of 5150

rpm in case of the 14.8 DP of speed program in Figure 5 since runout point is 5230 rpm.

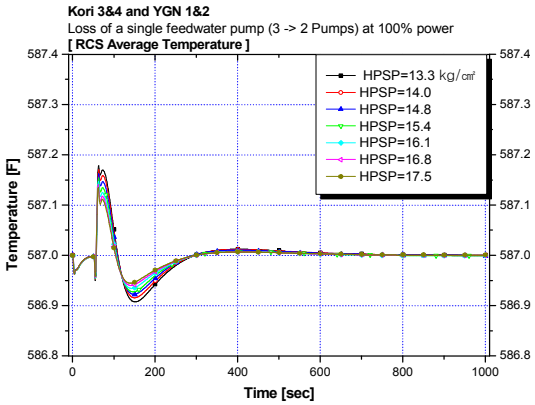

Figure 1. RCS Temperature in the Transient of One MFW Pump Loss

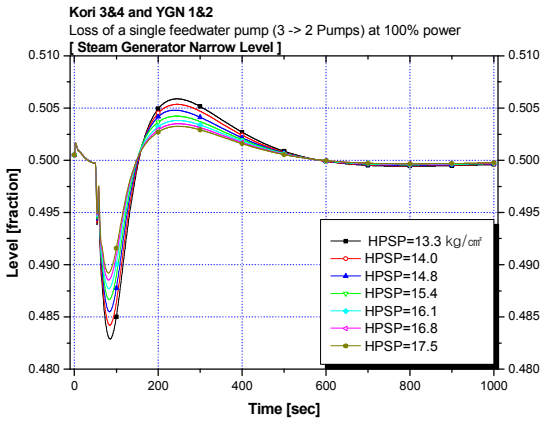

Figure 2. SG Level in the Transient of One MFW Pump Loss

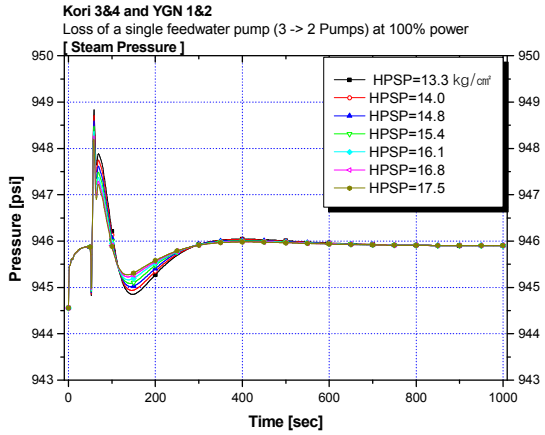

Figure 3. SG pressure in the Transient of one MFW Pump Loss

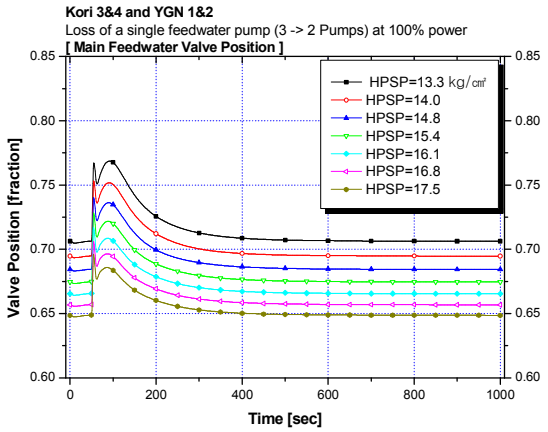

Figure 4. Valve Position in the Transient of one MFW Pump Loss

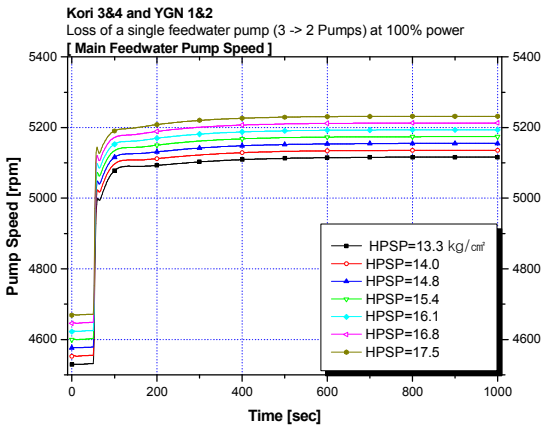

Figure 5. Pump Speed in the Transient of one MFW Pump Loss

4. Conclusions

In this paper, the optimal DP of MFW pump speed program was determined after 4.5% power uprate, in order to obtain smooth transients in case of one feedwater pump loss.

REFERENCES

[1] L.E. Engelhart & G. E. Campbell, Setpoint Study of Kori Units 3&4, Westinghouse Co., WCAP-10348, 1983.

[2] The Aegis Technologies Group Inc., ACSL Xtreme User's Manual, U.S.A, 2001.

1. [3] Duk Joo Yoon and Yong Soo Kim at al, Optimization for Setpoints of SG Water Level Control Systems in Power-uprated YGN 1&2 and Kori 3&4, Journal of Nuclear Science and Technology, Vol. 42, No. 12, pp. 1067-1076, December 2005.