

Improving the Reliability of LDP through the Divergence of Power Supply for LDP

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1. Introduction

The operating system which is improved of user interface has been developed in Shin-kori 3,4 Main Control Room(MCR), since I&C equipment had been digitalized by comparison with analog MCR.

The representative operating systems are Large Display Panel (LDP), Operator Workstation (OWS), Computerized Procedure System (CPS). The LDP provides the information which is plant essential safety function, plant operating mode, the state of major operating variable and the important alarm to operator continuously. In case of malfunction and switchover fail of the inverter, it is possible to occur the power loss of LDP. The power of LDP and operator console workstation had been supplied by only 2 non-safety Power Line1/Power Line2 (P.L1/P.L2). So if P.L2 is failed, three operator consoles can't be operated following fig.2. Three operator consoles can't be operated among the 5 operator consoles in MCR, in that case heat output have to be decreased under fifty percentage(50%) within 4hours.[1] Although the power of inverter has high reliability, there are 21 failure cases of the inverter power loss since 1991. So it is necessary to improve the power of LDP.

This study shows the development measure through the divergence of the power of LDP. It is possible to prevent the power coastdown of the plant when the main power Circuit Breaker(CB) is tripped.

2. Status and Problem

2.1 Present condition of power supply for LDP

LDP and operator consoles are supplied by Non-Safety Uninterruptable Power Supply (UPS). (Charger →Inverter)

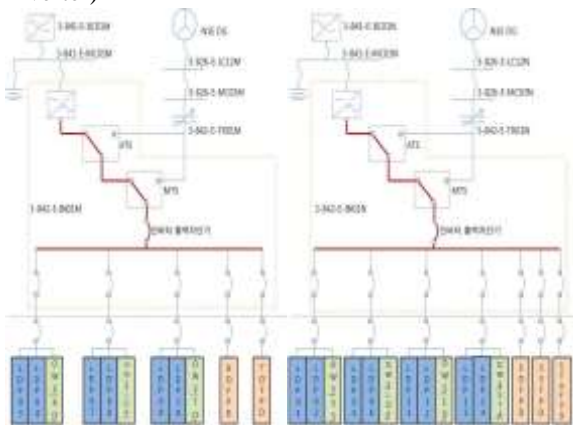


Fig.1. Configuration of power supply for LDP

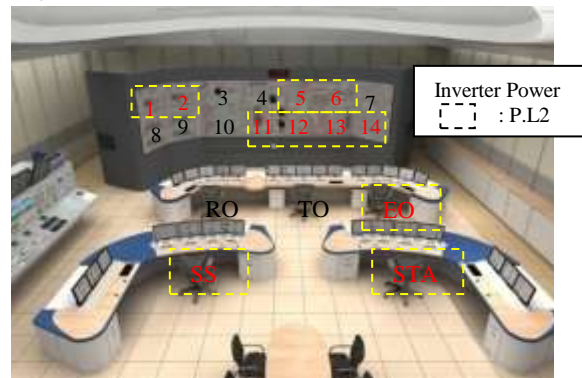


Fig.2. LDP arrangement

The dotted lines are supplied from the P.L2 and the others are supplied from the P.L1 in reference with Fig.2. In case of malfunction of the P.L2, three operator consoles are failed according to Table1. In that case if it can't be back to normal state before 4hours, the power coastdown will be occurred following SKN unit 3&4 technical specification 3.3.15.[1]

Table1 Status of LDP load

Section	OP Console	LDP OWS	LDP Screen
P.L1	RO/TO	RO/LDP/TO	3,4,7,8,9,10
P.L2	EO/STA/SS	EO/STA/LDP/SS	1,2,5,6,11,12,13,14

2.2 Status of design and construction for LDP power supply[2]

2.2.1 Reliability of power supply for LDP and operator console in MCR

The VBSS(Vital Bus Power Supply System) which supplies a power to LDP and operator consoles in MCR has a sufficient reliability for power supply. And it is also maintained without stopping the power supply during the overhaul of plant.

2.2.2 Analysis of the power supply reliability for VBSS

To the following effect, it has equipped with the multiple alternative power for improving the reliability of power supply at present.

- ① It is supplied with power from inverter of VBSS provided from battery charger.

- ② Although the battery charger is failed, it can be supplied with power from inverter of VBSS by being supplied from battery.
- ③ Even if the inverter is failed, it can be supplied with power by being switchovered automatically to Regulating Main Transformer(XFMR).
- ④ In case of the fail of battery charger/Regulating XFMR(LC12M or LC12N), it can be provided with the power from VBSS continuously by putting into tie circuit breaker of low voltage CB automatically.
- ⑤ If the battery charger/Regulating XFMR (LC12M or LC12N) is failed, it is supplied with the power from VBSS by being supported from Emergency Diesel Generator(N-1E DG).

2.3 Analysis of the status of inverter malfunction for other plants.

The status of power loss malfunction (since 1991)

- Hanbit#4 120VAC blackout had been occurred, because of the inverter malfunction('13.3) etc, 21counts.
- Type of malfunction : 10 counts of power loss, 4 counts of automatic power switchover, 3 counts of manual malfunction recovery, 3 counts of the others.
- The reason of malfunction : manufacture defect, surge inflow, aged deterioration, a defect of design etc.

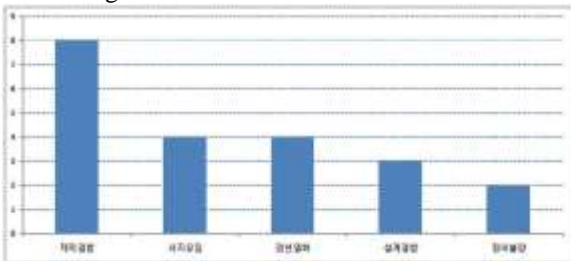


Fig.3. The reason of inverter malfunction

It is certain that the reliability of inverter power is high. But, one of the LDP power is failed, it caused power loss of 3 operator consoles. Because the LDP power had been supplied from only two inverters. Therefore, it is complemented by adding the other power lines.

3. Development Measure

3.1 Change Issues

The LDP power line has been decided to add the inverter power for improving the reliability and preventing the power coastdown. So, it is applied to use the spare cables(IN02M(P.L3), IN02N(P.L4)) for power dualization of the inverter. It is suggested that the existing cables have been splitted by using the terminal box in the inverter room. Finally, LDP power line has been dualized, so that it can be improved.

After adding the power of LDP, the power supply of load has been dispersed as Table2.[3]

Table2 Change Issue of LDP power

Section	Load	Power Supply (VBSS)	
		Before	After
OP Console	PM01-5,6 (RO)	P.L1	Not changed
	PM02-2,3 (TO)	P.L1	P.L3
	PM02-8,9 (EO)	P.L2	Not changed
	PM03-7,8 (SS)	P.L2	P.L4
	PM04-2,3 (STA)	P.L2	Not changed
LDP	PM06-1 (SS OWS)	P.L2	P.L4
	PM06-2 (RO OWS)	P.L1	Not changed
	PM06-3 (LDP OWS)	P.L1	Not changed
	PM06-3 (LDP OWS)	P.L2	Not changed
	PM06-4 (TO OWS)	P.L1	P.L3
	PM06-4 (EO OWS)	P.L2	Not changed
	PM06-5 (STA OWS)	P.L2	Not changed

The existing power of LDP has been received from only two inverters referred for Table1. But, now the LDP power lines have been provided with 4 inverters. So if one of the power of LDP is failed, only 1 or 2 operator consoles will be shutdown. Therefore it is not necessary to decrease the heat output under fifty percentage(50%) within 4hours.

4. Conclusion

This study mentioned the divergence of power for LDP as method of power loss caused by unreliability of inverter. Ultimately, LDP power line has been added, and then it is more improved on the safety of LDP operation than before. So Shin-Kori 3,4 can enhance the reliability and economic, safety of plant.

REFERENCES

- [1] SKN unit 3&4 Technical Specification Rev.1
- [2] SKN unit 3&4 SFR(9-757-E-0023) Review Report, KEPSCO E&C, 2013
- [3] Request for design change of the divergence of load power for LDP and operator consoles in SKN unit 3&4, SFR No.9-757-E-0478.