Electric Power System Protection of PEFP

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1. Introduction

Proton Engineering Frontier Project (PEFP) has been developing a 100 MeV proton linear accelerator. Also, PEFP has been designing the Proton Accelerator Research Center in Gyeong ju.

When faults occur in power systems, impact of outages should be minimized and the faulted facilities should be restored as soon as possible. This requires that an operator in the control center should find the reason and the location of the faults by analyzing the alarm information of protective relays or circuit breakers.

In this paper, we described electrical protection logic for electric power system fault diagnosis of PEFP.

2. Protective Relay Coordination of Electric Power System in PEFP

When a fault occurs on a power system such as buses, lines, transformers, etc., appropriate circuit breakers are tripped by corresponding protective relays operation to remove any faulted section promptly. Table 1 describes protective relays for each electric power system equipment fault of PEFP.

Table 1. Protective relay vs. equipment in power system

Protective Relay	Equipment
87 (Differential Relay)	154kV T/L
50/51 (Overcurent Relay)	
87 (Differential Relay)	154kV Switchgear
27 (Undervoltage Relay)	
87A (Differential Relay)	154kV/3.3kV Transformer
450/451 (Overcurrent Relay)	
451N (Neutral Ground overcurrent relay on Transformer primary)	
151N (Neutral Ground overcurrent relay on Transformer secondary)	
63X (Pressure Relay)	
27 (Undervoltage Relay)	3.3kV Switchgear
47 (Phase Sequence Voltage)	
25 (Synchronism Check)	
51 (overcurrent relay)	
51N (Ground Overcurrent Relay)	
51 (Phase Overcurrent Relay)	3.3kV Feeder
51N (Phase Overcurrent Relay)	
51G (Ground Fault)	

3. Electrical Protection Logic for the Electric Power System of PEFP

3.1 154kV Substation Facilities

154kV substation facilities to be protected, monitored and controlled are 154kV incoming line, 170V gas insulated switchgear (GIS), transformer. Under normal and abnormal operation, the control and monitoring of the electrical system for the proton accelerator facilities are remotely controlled and monitored by video display unit (VDU) of operating console in Utility Building, which are described in Table 2.

Table 2 Remote Monitoring/control point of 154kV Substation

Electrical Facilities	Remote Control Point	Remote Monitoring Point
154kV GIS	Circuit Breaker Disconnecting Switches Earthing Switch	154kV GIS operating Status Transformer operating status
3.3kV SWGR	Incoming breaker 480/220V L/C TR feeder breakers	3.3kV SWGR 480V L/C 480V MCC 220V L/C 125V DC 120V Vital AC

Fig. 1 describes electrical protection logic for the 154kV substation facilities.

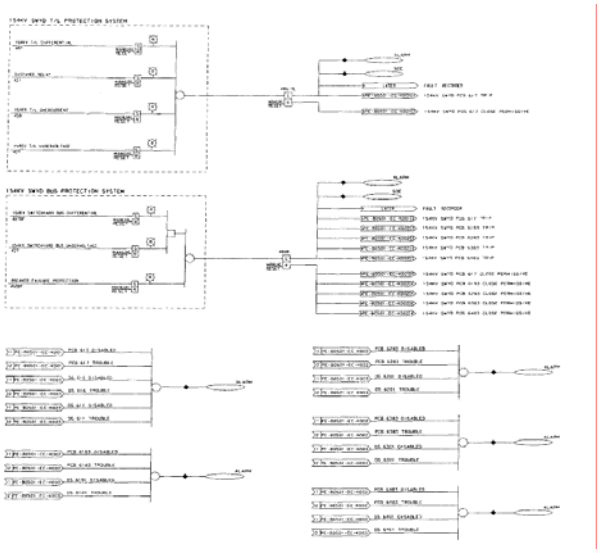

Fig. 1 Electrical Protection Logic for the 154kV Substation Facilities

3.2 Power Distribution System

Power Distributin System consists of 3.3kV switchgear system, 480V & 220V load center system, 480V motor control centers (MCC).

3.2.1 3.3kV Switchgear System

3.3kV switchgear system consists of RF power supply system (A system) and conventional facilities (B system), which is described in Fig. 2.

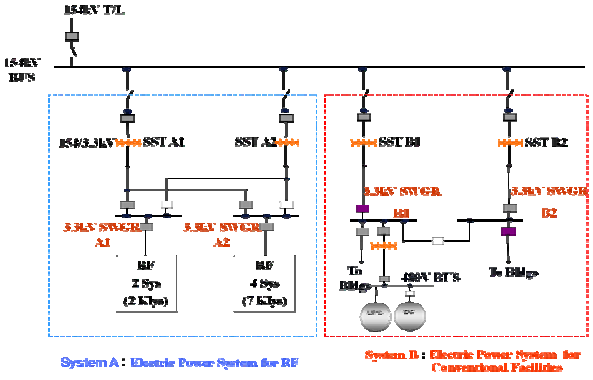

Fig. 2 3.3kV Switchgear System of PEFP

3.3kV switchgear is capable of supplying electrical power continuously to the 3.3kV load and 480V/220V load center. The incoming circuits form each transformers and the circuits connecting between switchgears are equipped with a digital protection relay, which has overcurrent protection and grounded overcurrent protection. Feeders of the 480V/220V load center are protected by overcurrent protection and instantaneous ground protection. 3.3kV motor feeders are equipped with the instantaneous ground overcurrent relay. Fig. 3 describes electrical protection logic of the 3.3kV switchgear system.

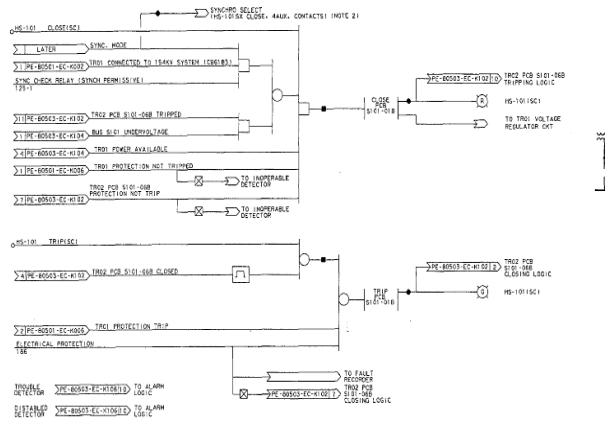

Fig. 3 Electrical Protection Logic of the 3.3kV Switchgear System

3.2.2 480V & 220V Load Center and 480V MCC

The 480V load center is powered from 3,300V-480/277V transformer and supply power to 480V related load. The 220V load center is powered from 3,300V-220V load center transformer and supply power to 220V related load. 480V motor control center (MCC) system supply power to the electrical load of the conventional facilities, such as motor, heater, lighting, receptacle, etc.

480/220V load center is equipped with ground overcurrent relay and temperature detector for alarm and cooling fan operation. 480V MCC is equipped with overcurrent relay. Fig. 4 describes the electrical protection logic of the 480V load center.

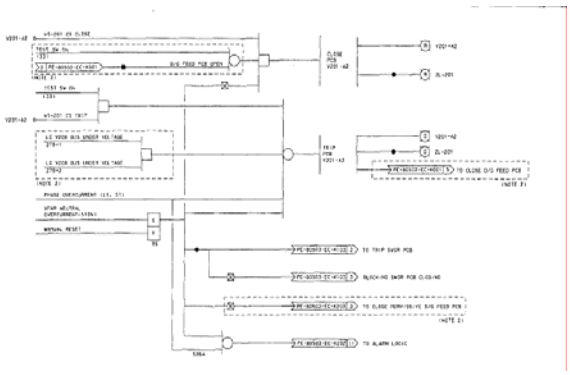

Fig. 4 Electrical Protection Logic of the 480V Load Center

4. Conclusions

In this paper, we described electrical protection logic for electric power system fault diagnosis of PEFP.

When a fault occurs on a power system, corresponding protective relays and alarms are analyzed. Based on the protective relays and alarms information of electric power system in PEFP, we designed electric protection logic for the 154kV substation, 3.3kV switchgear system, 480/220V load center and 480V MCC system.

ACKNOWLEDGEMENT

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REFERENCES

[1] H. Yang, W. Chang, and C. Huang, "On-Line Fault Diagnosis of Power Substation Using Connectionist Expert System", *IEEE Trans. on Power Systems*, vol. 10, no. 1, Feb. 1995, pp. 323-331.