2.1 SYSTEM MODELLING

2.1.1 Electrical system configuration

The electrical system configuration for the simulation comprises of PEA’s 115kV, 33kV, 11kV, and 0.4kV systems of the petrochemical and gas separation plant in Thailand, which is interconnected to 115kV 50Hz utility supply as shown in the figure 1.

2.1.2 Generator and excitation system

The synchronous machine model - Type 1 is used for modelling of generator. The excitation system of the generator is a brushless type. The rotating rectifier excitation system, IEEE type AC2 is used to represent the excitation system.

2.1.3 Prime mover of generator

The Rolls Royce RT62 gas turbine is used as the prime mover of the 4 generators in the plant. The model of IEEE Gas Turbine (SGT) is used to represent the gas turbine block diagram.

2.1.4 Load model

The loads in the plant are composed of induction motors, synchronous motors, and static loads. The Synchronous machine model - Type 1 is used for the modeling of synchronous motor. The 11kV and 6.6kV induction motors are individually represented by a circuit model. The 380V loads are lumped for each load bus and represented as both a motor and a static load. The purpose of dynamic modeling of induction motor is to examine the dynamic behavior of motor looking at the variation of voltage, current, torque, and speed during the transient period.

2.2 SIMULATION RESULT

2.2.1 Frequency drop pattern

There are two cases of utility supply outage. Case 1 is the outage of 115kV utility supply to which 4 generators are inter-connected. Case 2 is the outage of 33kV supply, to which 2 generators are connected. The amount of frequency drop and its trend versus time have been calculated to make clear whether the frequency reaches the 48Hz, at which frequency load shedding is activated with a proper time delay.

The frequency drop pattern is as shown in the figure 1. The voltage instability can happen when the generator is over-loaded excessively after the plant power system is isolated from the utility grid. This voltage instability prevents frequency drop and results in failure of pick-up of under frequency relay which makes available under frequency load shedding. (See case 1–4 for dynamic simulation.) The prime target of “Load shedding block and timing study” is to find out that the frequency relay load shedding can be made available without voltage instability happening. If the voltage collapse happens, the frequency relay can not rescue the power system and the total plant will become black-out.
2.2.2 Dynamic simulation on load shedding

Two kinds of load shedding schemes are simulated. One is the Fast Act Load Shedding (FALS). The other is Under Frequency Load Shedding (UFLS). The signal delay time considered for FALS is 220ms. The proposed setting of under frequency relay is 48Hz and timers settings are step 1 0.2 seconds delay (UFLS-1), step 2 0.4 seconds (UFLS-2), step 3 0.6 seconds (UFLS-3), step 4 0.8 seconds (UFLS-4).

The lowest frequencies after the fast act load shedding are: respectively Case FALS-1 : 49.20Hz, Case FALS-2 : 48.53Hz, Case FALS-3 : 47.58Hz, Case FALS-4 : 46.53Hz, Case FALS-2 : 47.74Hz.

3. CONCLUSION

In this paper the dynamic simulation has been performed to calculate the frequency drop pattern versus time in the case that the generators in the petrochemical gas separation plant are isolated from the utility grid system. Two kinds of load shedding schemes, those are, the Fast Act Load Shedding (FALS) and Under Frequency Load Shedding (UFLS) are simulated and compared. The fact acting load shedding can secure the frequency of generator into an acceptable range without happening of voltage instability. However the under frequency load shedding scheme with a time delay causes the lower system frequency than the fast acting load shedding. In case of heavy overload, the under frequency load shedding can not secure the system frequency due to happening of voltage instability.

[참 고 문 헌]