

SYSTEM PERFORMANCE UNDER NORMAL CONDITION (STATIC SECURITY)

Introduction

The power system shall be controlled to ensure that the system shall remain stable especially when the system is in steady state normal condition is the most important factor to the system control operation division (SCOD) because the quality and reliability of the system shall affect the risk of the customer from the overloading transmission equipment problem. The performance standard shall be established and implemented by including a normal condition (N-0) and a single contingency condition (N-1) of the generator or transmission system.

Definition

- Steady State is the system that the measurement index such as Voltage Amplitude and Phase Angle, power frequency variation, the quantity of the power flow is stable or in mathematic called the system is not vary in the time of the state variable or $dX/dt = 0$
- Normal Condition or N-0 is the system that operates without any tripped transmission equipment or power plant.
- A single contingency condition or N-1 is the loss of any power system element that has only one of the transmission equipment or power plant tripped but not include the Bus bar and Radial Line

Propose

- To establish and implement the performance standard for every countries before implementing the Interconnected System
- To prepare the system by planning the development and maintenance of the system according to the performance standard.
- To control and manage the capacity and transmission in a normal condition (N-0) and a single contingency condition (N-1) to meet the performance standard.
- To protect the effect to the customer from the interconnection
- To analyze and estimate the system performance, develop the reliability system and have the response of the system meet the performance standard of a normal condition (N-0) and a single contingency condition (N-1) by
 - Keep the voltage and frequency within the performance standard.

- No damage to the equipment.
- Power Plant can operate by follow the contract.

Requirement

- The control centers shall manage the operation in a normal condition (N-0) and a single contingency condition (N-1) by forecasting the load demand and planning the contingency plan for all the situation for example

- Bottlenecks The Bottlenecks in the system have to be pointed out to provide the technical constraints limiting power exchanges from implementing the equipment that is not related to the performance of the system as follow.

Normal condition (N-0) the system shall not has the Bottlenecks because

- No Restrictions of the Transmission Capacity
- The transmission equipment shall be designed and implemented for maximum capacity operation.

Single contingency condition (N-1)

- The Bottlenecks shall be set according to the Contingency condition

- Operational Network Reserve The Operational Reserve in the system has to be defined for each period of time for informing trend of the system performance and preparing for an unexpected event such as

- Operating Reserve
- Reactive Power Reserve
- Voltage Profile that suitable for the system
- Line Load in the limitation
- Stability Margin

- Monitoring and Observation

- Shall monitor the outage, report and analyze when the outage occur to define the solution.

- Shall monitor the exchanging of the power between the interconnection according to the plan both MW and MVAR by reserving the capacity for the emergency event.

Standard

■ Normal Condition (N-0)

The control centers shall have plans and control the system with no outage, no limitation to the quantity of the power in the contract and controllable of the power quality as follow

- Bus Voltage Level

Operating voltage range of 0.93 to 1.07 per unit or the deviation +/- 7%

- Frequency Deviation

The equipment shall be designed for 50 Hz as nominal frequency of the electric power system and shall be operated under normal operating conditions within 49.8 Hz to 50.2 Hz or the deviation +/- 0.2 Hz

- Harmonic Distortion

Maximum values accepted are:

- 400-500 kV: Total Harmonic Distortion of 1.5% with no individual harmonic greater than 1%
- 220-230 kV: Total Harmonic Distortion of 2% with no individual harmonic greater than 1.5%
- 110-115-132 kV: Total Harmonic Distortion of 2% with no individual harmonic greater of 1.5%

- Transmission equipment

Transmission Line

Operate within 100% of the limitation

Power Transformer

Operate within 100% of the limitation

■ Single contingency condition (N-1)

The control centers shall control the system with no outage, no cascade Tripping and no limitation to the quantity of the power in the contract and controllable of the power quality as follow

- Bus Voltage Level

Operating voltage range of 0.90 to 1.10 per unit or the deviation +/- 10%

- Frequency Deviation

The equipment shall be operated under a single contingency condition within 49.2 Hz to 50.8 Hz or the deviation +/- 0.8 Hz

- Transmission equipment

1) Transmission Line

- All Aluminum conductors (AAC)

Operate with less than 100% of the limitation

Note. To protect the permanent physical damage of transmission line.

- Aluminum Conductors Alloy Reinforced (ACSR)

Operate with less than 120% of the limitation in 30 minutes with no damage to the equipment.

Note. This type of transmission line has aluminum wires concentrically which can be restored

2) Power Transformer

Operate with less than 150% of the limitation in 30 minutes

Note. The transformer shall not be operated at 200% to protect the transformer from the damage. The overloading of the transformer will effect the insulation and lifetime of the transformer.

Procedure

- The department that responsible for a Capacity and transmission have to prepare the system by preparing the planning as following

- System Analysis planning in short term (Yearly)
- System Analysis planning in medium term (1 -5 years)
- System Analysis planning in long term (over 5 years)

The System Analysis planning have to concern about every project such as Maintenance plan for the transmission system project, developing the power plant plan

- In case that the system cannot response by the standard will have a contingency plan that provides the plan and time for correcting.

- Provide the Power System Study Report the Generation Development Plan and Transmission Development Plan that related to the System Performance of the connection in the Power Grid. The report will contain

- Load Flow Analysis
- Steady-State Stability Analysis
- Reliability Analysis

Measure

- Preparing the database for the historical indices as the standard
- Preparing the operating report by present the statistical analysis of the system from the Descriptive Statistics, for example
 - Mean, Standard Deviation or Hypothesis Testing etc.
 - Histogram
- In case that having an interconnection between the systems will record the Tripping of interconnecting lines event that's not in the agreement or not in the interconnection objective.