

SYSTEM PERFORMANCE UNDER SINGLE CONTINGENCY (DYNAMIC SECURITY)

Introduction

In Dynamic State, Controlling the power system to ensure that the system shall remain stable is the most important factor to the system control operation division (SCOD). SCOD shall operate and control the system to operate without any system outage, overloading the power equipment and no violation in power purchasing agreement under a single contingency (N-1).

Definition

- **Dynamic State** is a system that the measurement index such as Voltage Amplitude, Phase Angle, system frequency or the quantity of the power flow is still is changing with the time domain unstable.

- **Voltage Instability** is a condition that results in grid voltages that are below the level where voltage control equipment can return them to the normal level. In many cases, the problem is compounded by excessive reactive power loss leading to blackout or brownout.

- **Maximum Fault clearing time** is the times that start from the system Fault occurs until the breaker fully opened to clear fault.

- **Rotor Angle Stability** is the system stability that makes each of power plants still operate and synchronize among the others under a contingency or large disturbance.

- **Interconnected System Stability** is the system stability among each connected system

- **Cascading Outages** is the outage causing from the protection system continue tripping the transmission line or equipment in continuous that finally lead to the blackout or brownout

Propose

The loss of any single power system element N-1 from generating set, compensating installation or any transmission facilities shall not jeopardize the security of operation of the power system. As a result of limits being reached or exceeded for current, voltage, stability, etc., and accordingly shall not cause interruptions of supply.

Requirement

- **Maximum Fault clearing time of the breaker**

After a fault, the Grid shall remain stable for the following duration

Nominal Voltage	Maximum Clearing Time
500 kV	4 cycles (80 milliseconds)
230 kV	5 cycles (100 milliseconds)
115 kV	7 cycles (140 milliseconds)

- **Maximum Short Circuit Current of the breaker**

The facilities and devices connected to networks are designed to operate according to given current limits. Therefore, the power system is to be operated within construction limits. Sound operation requires that, at any node on the power system, short-circuit currents do not exceed the capacity of devices installed on that node.

Nominal Voltage	Maximum Clearing Time
500 kV	50 kA
230 kV	40 kA
115 kV	30 kA

- **Rotor Angle Stability**

Not allowed any Rotor Angle Instability for a single contingency (N-1)

- **Interconnected System Stability**

Not allowed any Interconnected System Instability for a single contingency (N-1)

- **Cascading Outages**

Not allowed any cascade Tripping from the protection system for a single contingency (N-1)

- **Load Shedding**

Not allowed load shedding after single contingency and the 1st step of U/F Relay being 49.0 Hz

Standard

- **System stability in dynamic state**

The transmission network remains stable when after a contingency (tripping of a single generating unit or transmission element) or a short-circuit on a transmission element, the frequency and the voltage level stay within the limits defined above. Moreover the power

oscillations, which appear after the event, are damped, none of the generating units have lost the synchronism and no cascade tripping occurs.

Voltage Stability

Maintaining appropriate voltage control resources in the national networks to ensure voltage stability in the sub-stations that are connected to the Inter-connectors and which are necessary in controlling the Scheduled Flows preventing the system blackout or brownout

Criteria

- Keeping the Recovery Voltage over 0.8 per unit in the first second after Fault cleared
- The voltage range in steady state for Dynamic Must not less than 0.7 per unit

■ Frequency Control

- The equipment shall be designed for 50 Hz as nominal frequency of the electric system, allowing control within the boundary set by +/-0.2 Hz under normal conditions and toleration of transitory frequency variations of at least +3/-2 Hz.

- The nominal frequency of the system and all equipment shall be 50 Hz and shall be controlled within the limits of +/- 0.2 Hz under normal conditions. Electrical equipment should withstand frequency transients of at least +3/-2 Hz.

- The power plant shall operate under the control of a governor control system unless otherwise specified by the permission from SCOD. The frequency dead bands applied to the operation of governor control system shall not exceed +/- 0.05 Hz or SCOD can setup the new value if needed.

- SCOD shall provide the Primary Reserve and Secondary Reserve in adequate for a single Contingency N-1.

- The maximum permissible dynamic frequency deviation from the nominal frequency shall not exceed +/- 0.8 Hz for support the following

- a shortfall in generation capacity equal to or less than the reference incident
- Dead Band of the power plant

The frequency shall be restored to the normal conditions within 15 minutes after the outage.

Procedure

■ The Planning Authority and Transmission Planner shall study and inform the system by proposing the report 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.

■ Providing the Power System Study Report the Generation Development Plant and Transmission Development Plan that related to the System Performance of the connection in the Power Grid. The report shall include

- Short Circuit Analysis
- Transient Stability Analysis
- Electromagnetic Transient Analysis

Measure

The Planning Authority and Transmission Planner shall have a valid assessment and evidence it reported documentation by

■ 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.