Static Security Assessment of Power System

VISHAL V. MEHTRE[1], TUSHAR D. SAWLE[2]

[1, 2] *Department of Electrical Engineering, Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune, India*

Abstract- Security testing, based on what decisions should be made about the design, control and operation of a power system, is a challenging challenge for resource engineers and network designers, especially in high-power systems. Many methods have been suggested and used for this purpose, and a variety of indicators have been suggested to address the stable security of electrical networks. Large-scale data sets on a continuous scale increase the capacity of systems that require advanced knowledge in data analytics. In this review paper, numerical strategies and methods basedon the machine are reviewed as the two main categories of static safety assessments in power systems based on the main features of the standard safety classification such as the type of separator, static safety indicator, and selection of features and output methods. This paper can be used as a useful reference for assessing the stable security of energy systems.

I. INTRODUCTION

Power system security can be defined as staying secure without adverse effects on any predetermined list of trusted interruptions or emergencies. Safety Assessment (SA) is an analysis performed to determine if, and to what extent, the energy system is reasonably safe from major disruptions to its operations.In other words a security system security test is a process of determining whether a power system is in safe or unprotected (unsafe) state, a safe state means that the load is satisfied and no violations will occur under current operating conditions and in the event of unforeseen conditions (i.e. or generators).

A warning (or emergency) situation means thatsome limitations have been violated and / or the need for the load cannot be met and corrective action must be taken to restore the electrical system to a safe condition. Figure 1 shows the different operating conditions of the power system, which are classified as safe and unsafe. Energy security assessments can be divided into determining and probable categories. While previous studies have determined safety precautions, for example, operating limits for buses, lines, and transformers after shutdown of equipment such as line, production unit or transformer, potential safety assessments assess the likelihood of an emergency and evaluatepower system safety at a set confidence level.

II. POWER SYSTEM SECURITY ASSESSMENT CATEGORIZATION

The security of the power system is assessed to determine whether the network is reasonably safe in the conditions that may arise during its operation.10 Thus this analysis includes the evaluation of statistical security measures (SSS) and energy security genes in its current state. status or specific upcoming operational areas.10 Assessing the security of the power system can be divided into two main categories, namely, static and flexible safety studies. The first is investigating the response of a stable power system in the event of an emergency. The overvoltage / undervoltage status of buses and the overcrowding of lines and transformers are assessed in the SSA. In the event of an emergency, if the electrical power of all buses is not in the predefined range and there is no line exposed to overload, it means that the network is static secure; nor is it otherwise protected. In a dynamic security test, the entire system varies before an emergency, immediately after an emergency, in the short term, and the stability of the system is investigated. Powerful safety tests include temporary protection of the rotation angle and the safety of small signals. In this study, static security measures are presented and categorized.

Power system safety testing methods can be categorized according to the class dividers, feature selection and output methods used to assess the security status of the power system.11, 12 These features can speed up or reduce test security and may improve. or weaken accuracy. References in the SSA area can also be categorized according to the power system use, in which emergencies, the relationship between random data production, the type of input data, and how their measurement and different safety indicators are considered. These factors affect the understanding of the proposed methods.

III. STATIC SECURITYASSESMENT

One of the key features of the power system protection is static safety. Strong security is defined as the system's ability to access a state within a specified security zone following an emergency. The most common method of security testing problem is to perform a robust security analysis followed by a robust security analysis. Standing safety analysis assesses the background stability of the system ignoring temporary behavior and any other time- dependent variability due to changes in load production conditions. On the other hand a powerful security analysis examines the time-dependent change from a pre-existing condition to a dependent state. Most Energy Management Systems only perform statistical safety analyzes and that is why this paper focuses on static safety assessments.

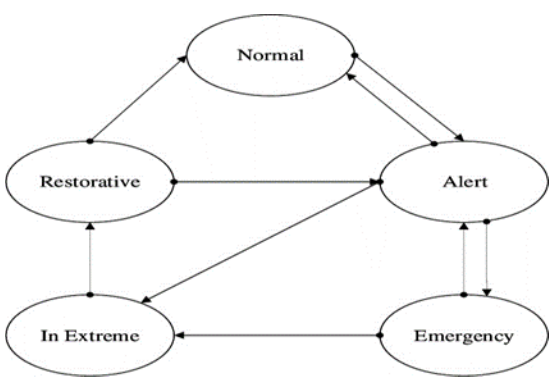

Figure 1 Operating states of power system

IV. POWER SYSTEM OPERATING STATES

- Normal situation: In this case, all system variables are within the normal range except for the overloaded equipment. The system is protected from both ‘equilibrium’ (total 7th generation system eqauls total system load) and ‘inequality’ (bus voltage and resource currents within limits) are satisfied. In this case, a single emergency cannot compromise the security of the system and cannot create any variables that violate the limit. The systemhas enough spinning space.

- Warning status: If the security level of a system falls below a specified limit, the systemthen goes into a state of alert and is called a ‘security’. System variables are still within limits. This condition may be caused by a single emergency, a significant increase in system load or adverse weather conditions. Preventative measures taken to restore generation or eliminate disruption can help restore the system to normal. If these recovery steps fail, the system remains in a state ofalert. The occurrence of an emergency with an already alert system, may result inovercrowding and the system may be in an emergency. If the disturbance is severe, the system may enter a dangerous state directly from the alert state.

- Emergency: When prevention controls fail or in the event of a major disruption, the system goes into emergency. Switching to this mode is possible from normal mode or alert mode. Inthis case the balance between generation and burden is still maintained (equality issues are still satisfied) and the system remains in synchronism. Failure of these components causes system breakdown. Emergency control actions such as termination of the faulty section, reorganization of the stimulus control line, rapid calibration, and load reduction should be taken. It is very urgent that the system is restored to normal or alert for these actions.

- Emergency: If emergency control actions fail when the system is in an emergency, the system enters a state of emergency. The system begins to disintegrate into sections or islands. Overloaded generators start crashing leading to cascade disconnection and possible 'shutdown'. Control actions, such as shutting down the loading and operation of the controlled system are taken to save a large part of the system from widespread shutdown.

- Recovery mode: The recovery mode represents the state in which control action is taken to restart the damaged generators and restore the connection. System changes may be in normal or alert mode depending on system conditions. The sequence of events leading up to the system transition from normal to extreme may take from a few seconds to a few minutes. Control actions can be initiated from the central power control center either by operators or by default.

V. STATIC SECURITY ASSESSMENT TECHNIQUE

Energy security system testing methods can be categorized according to the class dividers, the selection of features and output methods used to assess the security status of the energy system. These features can speed up or slow down the security test and may improve or weaken the accuracy. References to the SSA area are standard

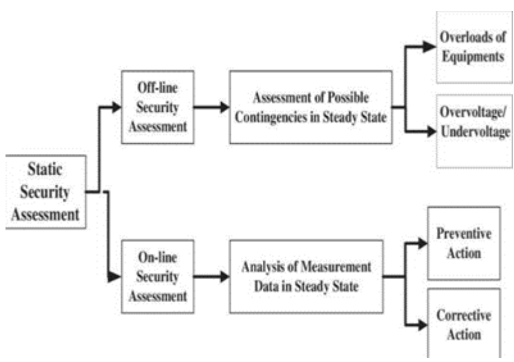

Figure 2 Categorization of security assessment problems

and is divided into perceptions of the use of the power system, in which emergencies, the relationship between random data production, the type of input data, and their measurement method and the different safety indicators are considered. These factors affect the understanding of the proposed methods. In general practice safety checks are obtained by modeling by analyzing the network and resolving the number of loads repeatedly over the prescribed years, one thing at a time. Theseanalytical methods are usually time-consumingand therefore not always suitable for real-time applications. And these methods suffer from the problem of misalignment and / or false alarm. Misalignment occurs when an emergency situation is described as critical.

With the latest advances in information processing and learning methods, ANN-based security assessment methods are an effective alternative.

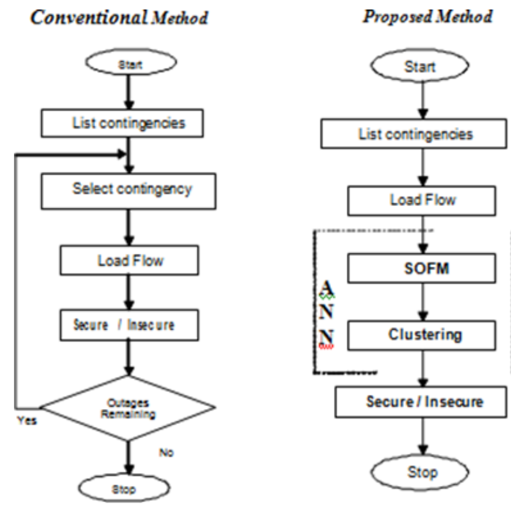

Figure 3 Comparison between Conventional and Proposed method

VI. ARTIFICIAL NEURAL NETWORK

The artificial neural network (ANN) is used to test the SSS for the energy system. ANN is based on a set of interconnected units or nodes called artificial neurons, which freely model neurons in the biological brain. Individual connections, such as synapses to brain biology, can transmit signals to other neurons. A synthetic neuron that receives a signal and then processes it and can detect the neurons connected to it. The "signal" in the connection is a real number, and the output of each neuroncounts a specific non-linear function of its total input. Links are called edges. Neurons and edges usually have a variable weight as the study progresses. The weight increases or decreases the signal strength in the connection. Neurons may have a threshold in the sense thata signal is sent only if a combined signal exceeds that limit. Normally, neurons are grouped together in layers. Different layers may make different changes to their inputs. Signals travel from the first layer (installation layer), to the last layer (the outgoing layer), perhaps after breaking the layers several times.

- Numerical methods:

The input data for the proposed contains three pieces of information. The first part of the datais the flow flow records, including specification of transmission lines, transformers, tap switches, phase switches, loads, circuit breakers, relays and type and location of generators. Dynamic dataset is thesecond component of the database, which includes a generator model such as a dynamicsystem model, controller, Power System Assistant (PSS), data loading and transfer as well as time limits and generator limits. Phase3 is emergency data, including error types, location and duration and changes that occur after errors.

It is defined as the n-dimension set of injected net buses, voltages and bus voltage angles. In the proposed definition, the protection circuit is based on load flow estimates, operating conditions, safety limits, and related emergencies. Regional limits for protection of temperature limits, electrical power, electrical safety, low signal strength, and temporary stability. These definitions are repeated.

A two-layer graphics processing unit (GPU) is developed for the SSA power system, which can analyze several emergencies at a time based on GPU capabilities. In the first layer, a low-density, low-density depletion method is applied to the GPU to accelerate computational flow calculations. Complete GPU computing capabilities help in another layer. In this layer, the same novel method uses a multi-GPU simultaneously in the SSA system, enabling the system to consider multiple emergencies simultaneously. a specialist system called CQR is used to assess the safety of the power system. The SSA is used in the form of a widespread problem i.e., flexible organizations (FORS).

The simplified form of the whole power system, with reduced order, to maintain its essential features is called the equilibrium model. The power grid with the same modeland without it is called the original and reduced network, respectively. Reduced network form in equivalent model form has the following advantages:

CONCLUSION

Power system security can be defined as staying secure without adverse effects on anypredetermined list of trusted interruptions or emergencies. The most common method of security checking problem is to perform a stable security analysis followed by a strong security analysis. Power system testing methods can be categorized according to the dividers, selecting the features and output methods used to assess the safety status. of theenergy system. These features can speed up or slow down security tests and may even improve performance. Therefore, the safety assessments of modern energy systems are very complex due to the indirect system behavior. In addition, the safety of the energy system is becoming increasingly important because power networks are pushed to work within their safety limits. Therefore, in high power systems, safety testing is a challenge forusers and designers of the power system. This study could be used as a useful reference for future activities in the SSA area, which could focus on safety assessments on the island's microgrid or battery-powered system.

REFERENCES

[1] Ebrahimi E, Sanjari MJ, Gharehpetian GB. Control of three-phase inverter-based DG system during fault condition without changing protection coordination. Int J Electr Power Energy Syst. 2014

[2] Kirschen D, Jayaweera D. Comparison ofrisk-based and deterministic security assessments. IET Gener Transm Dis. 2007; 1(4): 527- 533

[3] Alizadeh Mousavi O, Sanjari M, Cherkaoui R, Gharehpetan G. Power system segmentation using DC links to decrease the risk of cascading blackouts, Paper presented at IEEE PES Powertech, Trondheim, Norway, June 19-23, 2011

[4] Samantaray S, Kamwa I, Joos G. Ensemble decision trees for phasor measurement unit-based wide-area security assessment in the operations time frame. IET Gener Transm Dis. 2010; 4(12): 1334- 1348.

[5] Chow TT. A review on photovoltaic/thermal hybrid solar technology. Appl Energy. 2010; 87(2): 365- 379.

[6] Shahidehpour M, Tinney F, Fu Y. Impact of security on power systems operation. ProcIEEE. 2005; 93(11): 2013- 2025

[7] Peng H, Su M, Li S, Li C. Static securityrisk assessment for islanded hybrid AC/DC microgrid. IEEE Access. 2019;

[8] Venkatesh T, Jain T. Synchronized measurements-based wide-area static security assessment and classification of power systems using case based reasoning classifiers. Comput Electr Eng. 2018