DSATools™
Dynamic Security Assessment Software

Impact Assessment of Renewable Energy on System Security

Summary of the Technology

- **Based on DSATools™ dynamic security assessment techniques**
- **Integrated with Energy Management Systems**
- **Assessment of the impact of renewable energy sources on system security**
- **Modeling of various forms of renewable generation**
- **Compliant with NERC security criteria**
- **System security status monitoring for real-time and forcast conditions**
- **Recommendations for a secure level of renewables and for reserve requirements from conventional MW and MVAR sources**

Power generation from renewable energy has become an increasing portion of resources in many power systems. Specifically, the following new forms of renewable energy have already had high penetration, or are expected to have rapid growth, in the generation installations in many regions of world:

- Wind
- Solar
- Biomass
- Biofuel
- Geothermal
- Energy storage devices (batteries)
- Ocean and wave

Most of these renewables have unique characteristics that are very different from conventional generation. Special models and analytical techniques are required to assess their impact on system reliability and security, and to ensure an acceptable performance level. Powertech provides such technologies based on our DSATools™ software package and the dynamic security assessment approach implemented for many of our clients.

Technical Challenges

Planning and operation of a power system with high penetration of renewables are faced with a number of technical challenges.

Characteristics

- Renewables are often located in unpopulated remote regions that require long transmission.
- Outputs may be unpredictable (e.g. due to a sudden drop of wind speed).
- New generation technologies are adopted which may be non-synchronous, or even non-rotary.
- Few voltage and frequency regulation capabilities are usually available.
- The operation of renewables may be very sensitive to certain system conditions, such as low voltages.

Modeling

- Equipment from different vendors can vary widely. Standard simulation models are generally not available, so customized modeling is required.
- It is critical to include functions in the models for relay/protection, reactive compensation, etc.

Security monitoring

In addition to conventional voltage and transient stability, the following system performance indicators are required for security monitoring under credible contingency conditions in the near real-time horizon:

- Damping of electromechanical oscillations.
- Transient voltages for voltage recovery after a fault clearance.
- Transient frequencies.

The **ultimate objective** is to maximize the utilization of renewables while ensuring system security that is measured by various types of stability, feasible power transfers, MW and MVAR reserves, etc.

Powertech Solution

A real-time monitoring and assessment system built on DSATools™ technology:

Modeling

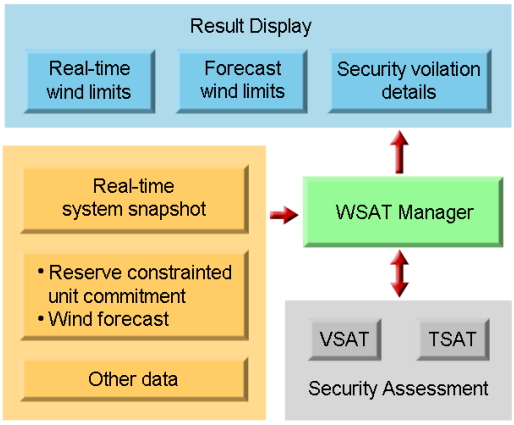
- Based on a user-defined modeling approach.
- A wide range of available models, including those for wind turbines, solar panels, batteries, etc.
- Various relay and protection models.

Security monitoring

- A full set of security criteria with customized rules.
- Monitoring of security limits with user-defined power transfers.
- Regulatory requirements such as those set by NERC can be fully met.

Application modes

- Off-line mode to evaluate planning options for various renewable integrations and related transmission system enhancement requirements.
- On-line mode to monitor system security for real-time, forecast, and short-term look-ahead conditions.



WSAT functional flowchart

An Application Example ±WSAT

An example of WSAT demonstrated here with a Wind Security Assessment Tool (WSAT) which was jointly developed by the Irish national grid company EirGrid and Powertech. WSAThas been installed and is operational at the National Control Center (NCC) of EirGrid. WSAT was deployed in response to

- Increased wind penetration in (LU*ULG·V WUDQ system. For example, wind generation was recently recorded to supply 50% of the total system load and this level is expected to grow.
- Concerns from system operators on the highest amount of intermittent wind power at any given time.

WSAT addresses these issues by ensuring satisfactory performance for real-time system at the base, N-1, and credible N-n system conditions:

- Thermal loading, steady-state voltage levels, and voltage stability. This is assessed using the VSAT tool.
- Transient stability. This is assessedusing the TSAT tool.

To determine the wind limits, the security assessment by VSAT is further extended to the following power transfers between wind and conventional generation:

- Wind increase by 250 MW: wind generation increase proportionally to wind reserve and conventional generation decrease according to specified merit order.
- Load increase by 300 MW: proportional load and generation increase.

These analyses by DSATools™ VSAT and TSAT programs are managed by the WSAT Manager module whose results are shown to controllers. Details on security violations identified are also available for further understanding of system performances. WSATand other research have indicated that grid stability can be maintained at up to 70 percent wind penetration, if certain measures are taken.

EirGrid is investigating the desirability and feasibility of a number of improvements for WSAT:

- Addition of frequency stability analysis.
- Forecast stability analysis, for example, stability assessment of the system within a time frame of 12 hours.
- Launch of WSAT in System Operators Northern Ireland (SONI) Control Centre.

The main window for NCC controllers

History result display

For more information contact

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