Technology Innovation Project

Closing Project Brief

TIP 256: EPRI P173.012: Strategic and Flexible System Planning

Context

Flexibility—the ability of a system to respond to changes in demand and variable generation (VG) output—has become more important in recent years, primarily because of the growth in variable VG, but also due to changing plant mixes in many regions. System planning will increasingly need to consider operational issues to ensure that sufficient resources exist to meet changes in net load (demand net of VG). In addition, resource and transmission planning are becoming more intertwined as the location of resources impacts system operation. By properly quantifying the needs and sources of flexibility for a system, it can be included into the planning process. In systems with high degrees of production variability and uncertainty, flexibility will be important both to meet reliability targets, in terms of responding to changes in net load, and to reduce the cost impacts of integrating large amounts of variable generation; more flexible systems should reduce the impacts of VG. The desire for additional flexibility should be balanced against the expensive nature of many flexible resources. In addition, new sources of flexibility, such as demand response, are not well understood in terms of the characteristics they offer a system.

Description

The long-term aim of the project is to develop planning processes and tools with the capability to confirm that systems are designed to facilitate long-term strategic energy objectives in the most economic and reliable manner. Existing work was carried out between 2011 and 2016 which developed a flexibility assessment framework, proposed use appropriate metrics, and quantified the ability of traditional resource types to provide flexibility, including proposing methods to consider energy limited resources such as hydro. Case studies are being carried out to verify the applicability of these metrics to different system. The project in 2017 demonstrated these metrics, with a focus on consideration of transmission constraints and energy limited resources such as hydro, energy storage and demand response, as well as adjusting the metric calculations based on case study and member feedback. A tool, named InFLEXion, was updated to allow system planners to consider the flexibility needs of the system, and the algorithms were made available to integrate with existing production costing tools. Through case studies of funding member's systems, the framework developed is expected to show the use of both simple and detailed metrics, as well as tools developed over the course of the project.

This project completed in 2017. Work completed in 2011 set out a high-level framework to develop metrics and tools related to system flexibility needs and availability. The 2012 work continued with a detailed assessment of the flexibility needs of a real-world case study system, and focused on the development of a screening tool for examining flexible resources and needs. The project has focused on two standard metrics for power system flexibility, and has developed the flexibility screening and assessment tool to increase the detail with which systems can be assessed. This has multiple levels of functionality: the first screens flexibility requirements on multiple time horizons, the second screens the resources available while the third assesses the adequacy of the system in providing flexibility when needed. 2014 through 2016 work developed the basis to consider transmission system impacts on flexibility and provided initial case studies on that and energy limited considerations. Implementation guidelines were also provided in 2016.

The 2017 work developed metrics to show how energy storage and resource adequacy interact with resource flexibility. The InFLEXion tool was updated with improved usability and functionality. The focus was on flexibility considerations with resource adequacy and energy storage. Also, the implementation guidelines were updated.

Benefits

This project provides numerous benefits to the development of the power system. In particular, it allows better planning decisions to be made to understand the requirements for flexibility and maximize the value of flexible resources on the grid. The key benefits include:

- Metrics to determine the flexibility needs and resources of a system, considering new and existing flexibility resources as well as the transmission network
- Results from case studies demonstrate the usage of the methods developed
- Identification of the proper consideration of flexibility in system resource adequacy and resource expansion by using case studies to show the value of flexibility
- A better understanding of the flexibility offered by demand response and energy storage and how this compares with other flexible resources in managing variability and uncertainty

- A flexibility screening and assessment tool for use in long-term planning and the algorithms used which enables users to incorporate flexibility assessment in a meaningful way into planning processes.

Accomplishments

The overall objective of this project was to assist system planning from both the resource side as well as the transmission side. Flexibility metrics which enable planners to consider flexibility requirements at the planning stage have been developed and will continue to be enhanced. A set of guidelines on the use of flexibility metrics will also be updated to assist in the technology transfer process. The System Flexibility and Assessment Screening (InFLEXion) Tool will allow for easier analysis of flexibility requirements and flexibility resources for systems with high levels of variable generation. Using data about the system of interest, this tool allows the user to produce metrics about system variability, flexibility of the resources on the system, and based on production simulation results (not done with the tool) or historical data, the flexibility adequacy of the system. In addition, the detailed flexibility metrics will allow for consideration of the flexibility sufficiency of a system, including how transmission impacts on the system flexibility metrics, and how different resources can improve system flexibility. In most flexibility assessments done thus far, transmission is not considered; work started in 2014 and to be complete in 2017 will allow this to be done. The overall goal of this project is to examine how flexibility requirements can be included in a planning framework.

Updated delivery of Inflexion tool with feature and interface upgrades

Deliverables

- InFLEXion 5.1: Updated delivery of the InFLEXion tool with feature and interface upgrades.
- A technical update that focuses on assessing flexibility in resource adequacy.
- Role of Storage as Flexible Resource: Technical update along with with storage program focusing on the contribution of storage towards system flexibility.
- Flexibility Assessment Guidelines: Update to the flexibility guidelines to support member implementation of the tools and methods.

Project Start Date: January 1, 2013

Project End Date: December 31, 2017

Funding

Included in BPA Membership

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Conclusions:

This project resulted in flexibility metrics, which enable power planners to consider operational flexibility requirements in planning studies. A set of guidelines on the use of flexibility metrics was developed. The System Flexibility and Assessment Screening (InFLEXion) Tool allows for easy analysis of flexibility requirements and flexibility resources for systems with high levels of variable generation. Using data about the system of interest, this tool allows the user to produce metrics about system variability and flexibility of the resources on the system and the flexibility adequacy of the system.