



## TIP 256: EPRI P40.019: Strategic and Flexible Transmission 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 2013 which developed a flexibility assessment framework, proposed use appropriate metrics, and quantified the ability of traditional resource types to provide flexibility. The project will continue in 2014 to develop implementable processes, with a focus on integrating resource and transmission in long-term flexibility assessment tools and planning algorithms which consider new flexible resources, such as distributed generation, demand response and energy storage, in resource expansion. Tools will be provided to allow system planners to consider the flexibility needs of the system. Through case studies of funding member's systems, the framework developed is expected to be demonstrated to show the use of both simple and detailed metrics, as well as tools developed over the course of the project.

This project is due to be completed in 2015. 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. In 2013, the project has sought to define 5 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. The impacts of variability and uncertainty on resource adequacy were also examined in 2013. Some initial work on the assessment of the impact of transmission and demand side resources on flexibility was also carried out, and the impact of flexibility requirements on resource adequacy examined.

The 2014 work will continue to integrate the process of assessing power system flexibility in a single multi-level tool, including screening and detailed flexibility metrics. This tool will equip planners with the means to include a complete flexibility assessment aspect to the system planning process. Case studies to demonstrate the tool will be carried out, particularly related to the Northwest region. The impact of transmission on the provision of flexibility will also be assessed and included in the flexibility screening and assessment tool if appropriate. Similarly, energy limited resource such as hydro power and demand response will be considered. A fourth level will be added to the tool which considers these aspects.

### Why It Matters

This project is expected to provide numerous benefits to the development of the power system. In particular, it should allow 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 will 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 to 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 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.

## Goals and Objectives

The overall objective of this project is 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 produced to assist in the technology transfer process. The System Flexibility and Assessment Screening 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; 2014 work will add this consideration. The framework developed in 2011-2013 using value-based probabilistic planning can be used to balance reliability worth and economic worth of a transmission system plan. The overall goal of this project is to examine how flexibility requirements can be included in a planning framework.

## Deliverables

- System Flexibility Assessment Tool: The System Flexibility Assessment Tool will be used to apply the multi-level framework for assessing flexibility needs, resources and adequacy developed in the project. This tool will extend the System Flexibility Screening Tool by adding additional levels of detail. These additional levels of detail require more detailed information and produce results including Expected System Flexibility Deficiency and Insufficient Ramp Resource Expectation. The screening analysis previously performed will also be improved with demand response and storage added to the tool.
- Flexibility in transmission and resource planning: This technical update will describe the work done in the project in 2014. This includes consideration of how flexibility metrics will be impacted by transmission systems, how resource planning and resource adequacy can include flexibility metrics and description of existing and new operational processes needed to ensure flexibility in power system operation. Case studies of one or more systems will illustrate the methods developed here.

**Project Start Date:** January 1, 2014

**Project End Date:** December 31, 2014

## For More Information Contact:

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BPA FY2014 Membership: \$58,603

