Application of GridWise™ Interoperability Framework to Demand Response

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Introduction

In almost a decade since the advent of Energy deregulation in the U.S., Energy markets in this country have witnessed market failures, and thus far non-market mechanisms have repeatedly been used for damage control. In some cases, such as the events following the market melt-down in California in 2000, heavy handed regulation proved to be necessary to stop detrimental market bleeding. Lack of Demand Response has been identified as one of the most significant contributing factors to such events. Without Demand Response mechanisms, Energy demand is sluggish and is no match for the agility of supply. Without Demand Response the combination of demand and transmission system conditions can enable the suppliers to maneuver supply output to extract exorbitant prices, threaten the operational reliability of the power system, or both. This explains why Demand Response has become a central issue in recent market design and regulatory policy forums.

This short position paper provides a brief classification of demand response approaches for further discussion in the context of the Interoperability Framework. The Framework Draft paper already mentions and provides examples of Demand Response. The intent of this position paper is to further expand the scope of Demand Response in this context.

Classification of Demand Response

Demand Response may be broadly classifieds into two main areas involving the ability of demand to change output in response to prices while respecting electricity usage priorities, or the ability of the Transmission System Operator to surgically curtail demand at specific locations to avoid cascading outages while respecting contractual arrangement and priorities. The former is referred to as price-based Demand Response and the latter as reliability-based Demand Response. Other forms of Demand Response are also possible whereby the Transmission System Operator may prescribe specific usage patterns that enable reliable and economic system operation. These are explained briefly below.

Real-Time Price-Based Demand Response

This approach involves enabling the energy consumer to reduce consumption in response to real-time price signals. It requires systems and infrastructure to convey the real-time prices to automatic local controls that would in turn control the ON/OFF operation of individual appliances to change consumption. The Interoperability Framework includes examples of this approach. Form an organizational and business interoperability point of view Demand Response Aggregators may set up hierarchical Demand Response systems whereby they achieve collective price reduction for a number of their clients while using the diversity of their usage patterns.

Use of distributed generation could supplement price based demand response. The Interoperability Framework would provide the mix of manual and automated operational control of distributed generation in this context.

Reliability-Based Demand Response

In this approach consumers will be given the choice to sign up for a preferred rate in return for their agreement to be curtailed in case of supply shortage conditions. Here the Interoperability Framework would provide the smarts to surgically curtail demand that has signed up for such programs at most effective locations while distributing curtailments over time and space. Again a hierarchical control system with dynamic curtailment priority based on memory as to cumulative curtailments of individual consumers would be in order.

Usage Profile-Based Demand Response

The Transmission System Operator may prescribe a preferred usage pattern for individual consumers or group of consumers, with a view to their historical usage pattern and operational economic and reliability needs. If the consumer manages its consumption within a band of the specified temporal consumption profile it gets a preferred rate; otherwise, it would pay a penalty. The Interoperability Framework would provide the automatic means at the disposal of the consumers to control their usage pattern to their economic benefit while achieving overall system economic efficiency and operational reliability. Once again aggregators could find the opportunity to set up an intermediate control level between the System Operator and the individual consumers and the Interoperability Framework would provide the needed framework to realize this model.

Next Steps

We would like to discuss the above classification at the April 11-12, 2007 meeting to explore needed additions to the Draft Framework to enable it to cover the three classes briefly discussed above.
We would be happy to provide further clarification detail at the meeting to help the discussion.