ECONOMIC DISPATCH

OF

ELECTRIC GENERATION CAPACITY

A REPORT TO CONGRESS AND THE STATES
PURSUANT TO SECTIONS 1234 AND 1832
OF THE
ENERGY POLICY ACT OF 2005

United States Department of Energy

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Sections 1234 and 1832 of the Energy Policy Act of 2005 (EPAct)[1] direct the U.S. Department of Energy (the Department, or DOE) to:

1) Study the procedures currently used by electric utilities to perform economic dispatch;
2) Identify possible revisions to those procedures to improve the ability of non-utility generation resources to offer their output for sale for the purpose of inclusion in economic dispatch; and
3) Study the potential benefits to residential, commercial and industrial electricity consumers nationally and in each State if economic dispatch procedures were revised to improve the ability of non-utility generation resources to offer their output for inclusion in economic dispatch.

EPAct defines "economic dispatch" to mean "the operation of generation facilities to produce energy at the lowest cost to reliably serve consumers, recognizing any operational limits of generation and transmission facilities." [EPAct 2005, Sec. 1234 (b)] On November 7, 2005, the Department submitted a report to Congress in fulfillment of this requirement, *The Value of Economic Dispatch*.[2] The Act also requires the Secretary of Energy to submit a yearly report to Congress and the States "on the results of the study conducted under subsection (a), including recommendations to Congress and the States for any suggested legislative or regulatory changes." [EPAct 2005, Sec. 1234 (c)]

This report responds to the latter requirement, as the first annual study following up on the initial economic dispatch report to Congress and the States. It concludes that while the value of economic dispatch to promote reliability and efficiency of generation resources remains unchanged, national or state policy with respect to economic dispatch has changed very little since November 7, 2005. Accordingly, it does not appear that the practice of economic dispatch has undergone significant change.

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[1] The two sections have identical language. Hereafter in this report, citations will be to section 1234.

[2] This report, issued by the Department of Energy on November 7, 2005, can be found at http://www.oe.energy.gov/epa_sec1234.htm .

Review of the Department of Energy's 2005 Economic Dispatch Report

Security-constrained economic dispatch is an area-wide optimization process designed to meet electricity demand at the lowest cost, given the operational and reliability limitations of the area's generation fleet and transmission system. DOE's 2005 report found that security-constrained economic dispatch benefits electricity consumers by systematically increasing the use of the most efficient generation units (and demand-side resources, where available). This can lead to:

> … better fuel utilization, lower fuel usage, and reduced air emissions than would result from using less efficient generation. As the geographic and electrical scope integrated under unified economic dispatch increases, additional cost savings result from pooled operating reserves, which allow an area to meet loads reliably using less total generation capacity than would be needed otherwise. Economic dispatch requires operators to pay close attention to system conditions and to maintain secure grid operation, thus increasing operational reliability without increasing costs. Economic dispatch methods are also flexible enough to incorporate policy goals such as promoting fuel diversity or respecting demand as well as supply resources. Over the long term, economic dispatch can encourage new investment in generation as well as in transmission expansion and upgrades that enhance both reliability and cost savings.[3]

The initial report found that there have been many studies of the savings from various aspects of economic dispatch, but the studies do not provide consistent estimates of the benefits and effectiveness of economic dispatch. Compiling the results of an extensive survey of the electric industry's use of economic dispatch, the report found that all of the regional grid operators (Regional Transmission Operators and Independent System Operators), and the utilities in the third of the nation outside grid operator footprints use economic dispatch to manage and dispatch their generation units. At the same time, although regional grid operators and utilities observe the basic principles of security-constrained economic dispatch, the details of dispatch execution and the constraints placed around dispatch operations vary widely. The report concluded that there is room to improve economic dispatch practices to reduce the total cost of electricity and increase grid reliability. It did not attempt, however, to estimate the magnitude of such potential improvements.

Review of the FERC-State Economic Dispatch Joint Board Recommendations and Outcomes

Section 1298 of EPAct directed the Federal Energy Regulatory Commission (FERC) to convene regional joint boards with state regulators to:

> … consider issues relevant to what constitutes "security constrained economic dispatch" and how such a mode of operating an electric energy system affects or

[3] *Ibid.* at 3-4.

> enhances the reliability and affordability of service to customers in the region concerned and to make recommendations to the Commission regarding such issues.[4]

On September 30, 2005, FERC issued an order convening joint boards in each of four designated regions (Northeast, PJM-MISO, South and West). The boards met over a period of several months and submitted regional reports to FERC, which compiled those reports with additional commentary in a submittal to Congress on July 31, 2006.[5]

The analysis and conclusions about economic dispatch varied significantly across the four regions. However, no joint board recommended any material changes to the way that economic dispatch is conducted within its region. FERC's report summarizes:

> … Regions where centralized dispatch predominates (PJM-MISO, Northeast) did not propose changing the basic dispatch or pricing mechanisms, and regions where individual utility dispatch predominates (South, West) did not propose new initiatives for greater centralization of the dispatch. In regions with existing RTOs, there were a number of recommendations for specific improvements within the existing centralized dispatch framework, but no new proposals for fundamental changes in the way the RTOs operate the dispatch. In regions where individual utility dispatch predominates, the boards were open to voluntary changes to aspects of the existing dispatch, or continued industry pursuit of regional dispatch on a voluntary basis, as long as these initiatives could be demonstrated to provide benefits to customers and gain appropriate state and federal approvals. However, these boards did not call for any specific initiatives and opposed any form of mandated modification.[6]

Since the FERC joint board report contains an excellent summary of the joint boards' concerns and conclusions, the present report addresses only the specific, affirmative recommendations offered by the various joint boards:

- The Northeast Joint Board recommended broadening the application of economic dispatch through greater coordination between the NYISO and ISO-NE, consideration of possible coordination with other areas, meetings with stakeholders on such coordination, examination of the possibility of coordination with other areas, and preparation of a report by NYISO and ISO-NE to FERC describing their seams elimination plans. That report had not been filed when this report was written.

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[4] EPAct, Section 1298.

[5] Federal Energy Regulatory Commission, "Security Constrained Economic Dispatch: Definition, Practices, Issues and Recommendations – A Report to Congress Regarding the Recommendations of Regional Joint Boards For the Study of Economic Dispatch Pursuant to Section 223 of the Federal Power Act as Added by Section 1298 of the Energy Policy Act of 2005," July 31, 2006, at http://www.ferc.gov/industries/electric/indus-act/joint-boards/final-cong-rpt.pdf .

[6] *Ibid.* at 10.

- The PJM-MISO Joint Board recommended examining the cost and feasibility of consolidating MISO and PJM economic dispatch and expanding further to include areas not currently under RTO-managed dispatch, subject to cost-effectiveness and applicable state laws. They also recommended continued improvements to the seams coordination between the two RTOs. This work is ongoing.
- The Western Joint Board recommended the conduct of studies to determine the potential of better dispatch coordination across larger sections of the region, particularly to improve the dispatch of renewables and to coordinate import and export scheduling.
- The Northeast Joint Board recommended that the RTOs improve data transparency by making bid data available more quickly to market participants.
- The PJM-MISO Joint Board asserted the need for continued RTO independence and objectivity in the conduct of economic dispatch.
- The PJM-MISO Joint Board recommended continued attention by the RTOs and state regulators to enable greater demand response participation in economic dispatch. PJM now allows demand response resources to bid into its real-time energy markets.
- Similarly, the Western Joint Board recommended broadening the definition of security-constrained economic dispatch to include policies such as demand response that affect dispatch beyond purely economic and security considerations.
- The PJM-MISO Joint Board recommended that the RTOs establish a clear benchmark to assess the effectiveness of economic dispatch at achieving reliability and cost-effectiveness objectives.
- The Western Joint Board recommended against conducting a more detailed study of utility economic dispatch methods (as suggested in the Department's 2005 report), on the grounds that such a review was not likely to add value.
- The Southern and Western Joint Boards considered the DOE recommendation concerning the standardization of non-utility generator-to-buyer contract terms, and concluded that this was worth pursuing on the condition that the results maintain flexibility and be applied regionally rather than nationally. However, no organization or agency has pursued this recommendation.
- The Northeast Joint Board recommended that FERC request the ISO-RTO Council to identify best practices for future improvements in economic dispatch tools. However, to date FERC has not issued a request of this nature.

Other Activities and Issues Related to Economic Dispatch

FERC Reform of Open Access Transmission Tariff

The Commission recently issued Order 890, in which it revised its *pro forma* Open Access Transmission Tariff, under which transmission operators offer transmission service for all bulk power sellers and buyers.[7] A common theme within FERC's reform effort, supported by many

[7] FERC Order No. 890, "Preventing Undue Discrimination and Preference in Transmission Service," February 16, 2007, RM05-17-000 and RM05-25-000.

comments in response to FERC's Notice of Inquiry on OATT reform,[8] was that greater transparency in grid conditions, operations, and planning would enable many transmission customers – producers and purchasers – to participate more effectively in the wholesale electric market.

While many of the subjects covered by Order 890 do not address economic dispatch directly, the order will affect the ways that generation resources (including independent power producers) are treated under economic dispatch, whether conducted by a vertically integrated utility or an independent grid operator. The principal changes required by the order include:

- A requirement that public utilities work through the North American Electric Reliability Corporation (NERC) to develop consistent methodologies for calculating Available Transfer Capability (ATC) and to publish those methodologies. Calculating and publishing ATC is one of the "most critical functions under the *pro forma* OATT because it determines whether transmission customers can access alternative power supplies," the Commission said.[9]
- Each transmission provider's planning process must meet nine specified planning principles: coordination, openness, transparency, information exchange, comparability, dispute resolution, regional coordination, economic planning studies, and cost allocation.
- The rule reforms the pricing of energy and generator imbalances to require charges to be related to the cost of correcting the imbalance, to encourage efficient scheduling behavior and to exempt intermittent generators, such as wind power producers, from higher imbalance charges in recognition of the special circumstances presented by such resources.
- The Commission adopted a conditional firm component to long-term point-to-point transmission service addressing situations in which firm service can be provided for most, but not all, hours of the requested time period. The rule also reforms the existing requirements for redispatch service to ensure that the requirements are of greater use to transmission customers and more consistent with reliable planning and operation of an area's system.

Load forecasting

As noted in the Department's November 2005 Economic Dispatch Report, improving the quality and accuracy of load forecasting would improve the reliability and cost-minimization outcomes of economic dispatch. This is because most of the units available to meet load in real time were identified and scheduled the day before, based upon the day-ahead load forecast used in the security-constrained unit commitment process. While the cost of over-estimating load (in which case the load prediction is notably lower than actual) is relatively low and primarily financial (because money and fuel was expended to make a generator available although it was not fully

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[8] Federal Energy Regulatory Commission, "Preventing Undue Discrimination and Preference in Transmission Services," Notice of Inquiry, September 16, 2005, and comments, found at http://www.ferc.gov/industries/electric/indus-act/oatt-reform.asp .

[9] Federal Energy Regulatory Commission, news release regarding Order 890, February 15, 2007.

utilized), significantly under-estimating load can compromise reliability and cause sharp short-term increases in real-time wholesale market prices.

The importance of accurate load forecasting was demonstrated recently by the heat wave that occurred across most of the nation in July, 2006, the second hottest July on record in the United States. Due to the combination of the heat wave and a strong economy, total energy production in July 2006 was 4.3 percent higher than that in July 2005.[10] The California ISO, for example, reported that energy demand experienced within its control area on July 21 and 22 broke all previous records, demonstrating "tremendous growth in the demand for electricity – the amount of growth [not] forecasted to appear [until] five years from now."[11] Further, demand in California continued to rise on following days and was prevented from exceeding the area's production capacity only through the combination of aggressive customer conservation efforts and the loss of hundreds of distribution transformers which failed in the heat, removing significant additional load from the grid. A similar but less protracted disruption in electric service occurred in Texas on April 17-18, 2006.[12] Although long-term load forecasting is subject to many uncertainties, improvements in near-term load forecasting could lead to greater cost savings as well as improved reliability.

Private Sector Initiatives

The largest geographic and electric systems integrated under security-constrained economic dispatch are operated by RTOs and ISOs. Those grid operators have made specific changes to their economic dispatch efforts, including coordination of market operations, congestion management and redispatch between PJM and MISO, and co-optimization of resource prices across multiple markets by ISO-New England.

Commercial software vendors continue to work to improve the quality and scope of the tools used for security-constrained unit commitment and security-constrained economic dispatch. Because RTOs manage significantly greater resource fleets than traditional utilities – for instance, PJM handles over 150 gigawatts of resources spanning 30,000 "buses,"[13] while traditional utilities might dispatch across 5,000 buses – the scope of dispatch calculations has raised new computational challenges. At the same time, software developers are developing new algorithms to solve large-scale security-constrained unit commitment (SCUC) and security-constrained economic dispatch (SCED) problems, using new techniques such as temporal coupling and mixed integer programming to improve modeling of specific resource types and

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[10] Energy Information Administration," Monthly Flash Estimates of Electric Power Data", September 19, 2006, Data for July 2006.

[11] California ISO, "Conservation Works! More Conservation Needed as Peak Demand Skyrockets to Critical Peak Monday," July 23, 2006.

[12] See http://www.nbc5i.com/news/8794207/detail.html?rss=dfw&psp=news and other local news sources.

[13] The term "bus" is used in the electricity industry to refer to a node in an electrical transmission network where one or more elements are connected together.

optimize multiple complex power flows simultaneously.[14] Demands from the software vendors' most challenging customers -- large grid operators such as the NYISO, ISO-NE and PJM -- are driving and supporting such vendor initiatives.

Conclusions

Other than some responses to the FERC-State Joint Board studies, few significant changes were made in 2006 in the policies and practices for economic dispatch in the United States electric grid. More significant changes are likely to result, however, from the industry's implementation of FERC's Order 890. Although the order was issued in mid-February 2007, the rulemaking process was initiated in September 2005, and full implementation of the order will take many months.

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[14] E-mail from Avnaesh Jayantilal, Director Market Management Systems, Areva T&D, Redmond WA, October 13, 2006.