3.0 Transmission Studies

3.1 Introduction

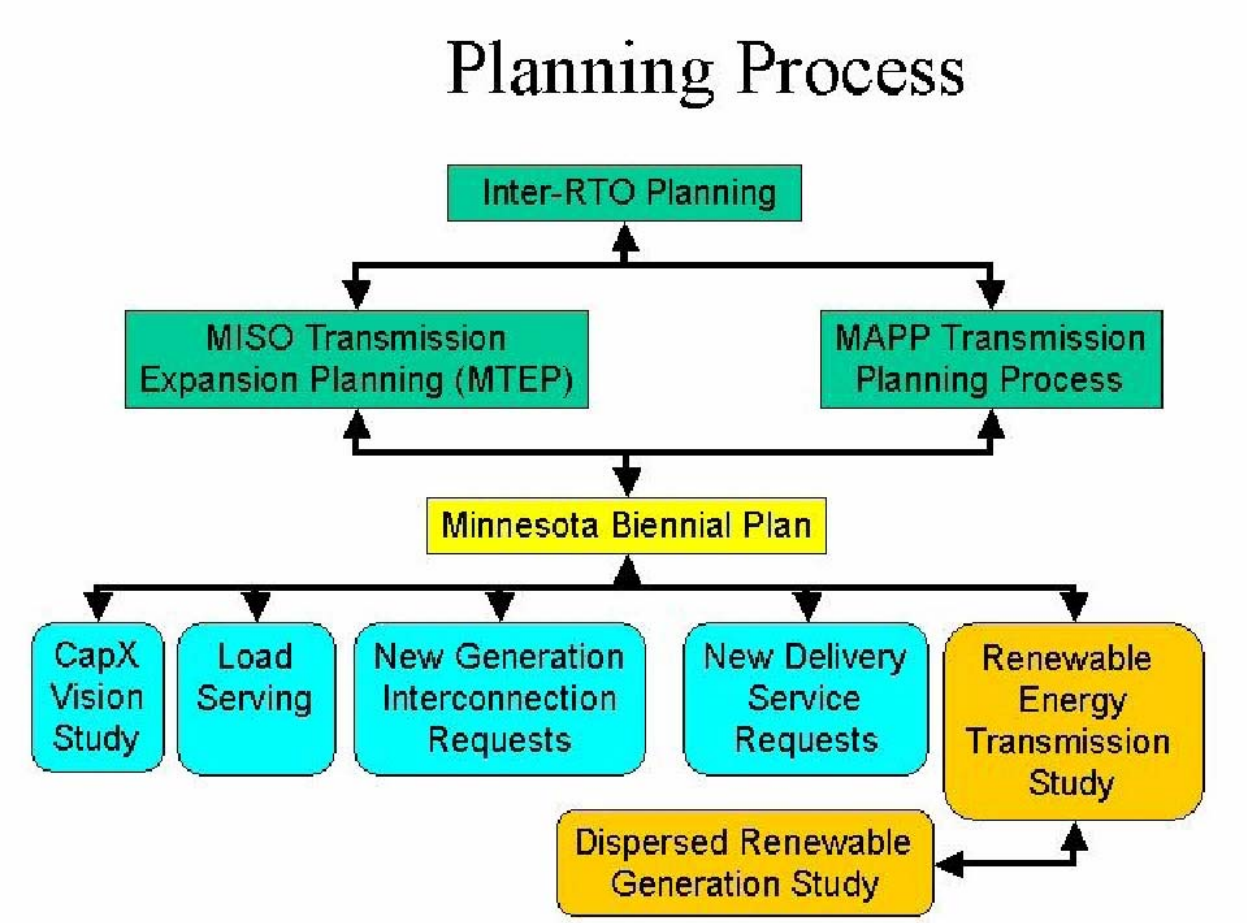
The Legislature directed the utilities to include in this Report a description of the analyses that have been undertaken and the results that have been found. The Legislature provided that the utilities must study and develop plans for the transmission network enhancements necessary to support the Renewable Energy Standards and milestones. As part of the planning process, the utilities must incorporate and build upon the work that has been done previously. The utilities were specifically directed to collaborate with regional transmission organizations like the Midwest Independent Transmission System Operator (MISO).

This Section of the Report is intended to identify certain studies that have been completed and describe studies that are ongoing. However, before setting forth a list of studies and providing a brief explanation of each one, it is helpful to describe in some detail the transmission planning process itself. The utilities have on other occasions provided an overview of transmission planning, in the 2005 Biennial Transmission Projects Report and again in the 2007 Report, but it is important to provide some additional perspective of the process from the standpoint of planning to convey huge amounts of renewable energy to consumers, while maintaining overall system reliability.

3.2 Transmission Planning

Developing a transmission system to accommodate renewable energy to meet the Minnesota Renewable Energy milestones is an evolving process. While some might believe that one single planning study might be sufficient to determine what is needed, the task is far more complex than that. It is unrealistic to expect that utilities, or regional transmission organizations, or any one planning body, could design a single study to determine what transmission might be required to transmit a certain amount of renewable energy to Minnesota customers. The problem is magnified by a whole lot of factors, and particularly troublesome is the fact that the location of the generating sources is unknown and certain energy needs are fifteen or more years away.

Compliance with renewable energy goals is not the only kind of planning that utilities must engage in. In the 2005 Biennial Report, the utilities described a number of purposes served by transmission planning – load growth, interconnection requests, delivery service, maintenance and reliability, along with achieving state and regional goals. The schematic on the following page illustrates the types of studies that are conducted and helps to display the organizational hierarchy.



The load serving, interconnection requests, and delivery service studies shown on the line above are the kind of studies that are usually done to address specific, known situations or problems. Many of the inadequacies reported in the Biennial Report are load serving issues, where load growth has stressed the existing system, or interconnection requests, where a new identified generating facility is proposed that must be connected to the grid. Delivery service studies are conducted to determine the transmission upgrades required to move generation to the load.

The Renewable Energy Study category in the schematic above is intended to include the kind of studies that are required here, ones to determine transmission enhancements required to comply with renewable energy milestones. The Distributed Renewable Generation Study, shown as a subset of RES studies, reflects another legislative goal to promote construction of smaller renewable energy sources in the 10 to 40 MW range. A separate study is being conducted by the Department of Commerce, to determine the impacts of injecting a certain number of megawatts of these smaller dispersed generation sources into the system. The utilities are participating actively in the conduct of this study. *See* Minnesota Laws 2007, chapter 136, article 4. § 17.

Vision studies are studies that look at long-range needs and goals. The characteristics of a Vision study include:

- High level, 50,000 foot view
- Develops a blue print for the future
- Generally a 10 – 25 year time horizon
- Involves broad assumptions

Contrasted with Vision studies is what can be called Mid-Term studies. These studies have the following characteristics:

- Mid-level review, 25,000 foot view
- Generally a 7 – 15 year time horizon
- More certainty in assumptions

Finally, to complete the spectrum, there are Specific studies. While load serving studies and interconnection studies may actually fit into this category, Specific studies for more general purposes reflect the following characteristics:

- Shorter term look, 5,000 foot view
- Generally 1 – 10 year look
- Most certainty in assumptions
- Needs clearly identified

The planning activities of the utilities are generally reported to the public and to the regulators through the Biennial Report, with the greatest specificity focused on the more near-term problems and inadequacies. The Biennial Report is due every odd-numbered year on November 1, and the 2007 Report is actually Part I of this document.

All of the planning activities of the Minnesota utilities are coordinated through the Midwest Independent System Operator (MISO). MISO's planning activities can be categorized into two types: Transmission Access Planning and Expansion Planning.

Transmission Access Planning. Interconnection and Delivery Service studies are part of MISO's Transmission Access Planning. These studies are conducted as a result of a formal request to MISO for a generation interconnection or transmission service and are part of MISO's open access transmission tariff. MISO administers and coordinates the study process and the utilities participate in ad hoc study groups. At any given time, there are many requests for interconnection pending and multiple transmission studies ongoing. By way of example, MISO has over 14,000 MW of interconnection requests pending in the Buffalo Ridge area.

Expansion Planning. The other type of study conducted by MISO is Expansion Planning. MISO engages in annual regional transmission planning and prepares an Expansion Plan. As explained in the MTEP-07 report, MISO has three purposes in mind for conducting expansion planning.

> The Midwest ISO Transmission Expansion Plan (MTEP) has three primary objectives. One objective is to perform a reliability assessment of the Midwest ISO integrated transmission system. A second objective is to review Transmission Owning members' transmission plans and make sure that appropriate projects are reviewed and recommended to Midwest ISO Board of Directors for Approval. The third objective is to develop transmission upgrades to improve market performance. MTEP 2007 (MTEP 07) is an incremental reliability study that addresses the first two objectives. The third objective is presently under analysis as part of MTEP 2008 study. This section describes how the MTEP study meets these objectives.

MTEP-07 at page 21.

The MTEP-05 report was described briefly in the 2005 Biennial Report, and MTEP-06 and 07 are referenced in the 2007 Biennial Report. MSIO is presently conducting additional studies in anticipation of the preparation of MTEP-08 next year.

Finally, as the schematic shows, MISO also coordinates with its counterparts in other areas of the country. This coordination is not done haphazardly, but rather in a deliberate fashion to ensure that the entire country has a transmission system that is reliable and efficient and delivers energy at a reasonable cost. Minnesota is part of the Eastern Interconnection. The Eastern Interconnection is a huge transmission grid that encompasses essentially the entire Unites States east of the Rocky Mountains, excluding Texas but including parts of Canada. Other Regional Transmission Organizations include the Southwest Power Pool, the PJM Interconnection, and the ISO New England. MISO has the largest geographic area of any of the nine U.S. and Canadian ISO organizations.

With this general understanding of transmission planning, we turn to a brief discussion of several studies that have been completed or are underway.

3.3 Completed Studies

3.3.1 Southwest Minnesota Exploratory Study

This study was conducted by MISO. The purpose was to examine transmission options to transfer large blocks of wind power from the southwestern Minnesota/northwestern Iowa area to markets in Minnesota, Iowa, and Wisconsin.

This study was discussed in the MTEP-06 Report. This study was also described in the 2005 Biennial Report.

3.3.2 Buffalo Ridge Incremental Generation Outlet Transmission Study (BRIGO)

The BRIGO (Buffalo Ridge Incremental Generation Outlet) Study was performed in recognition of the fact that continued generation development on the Buffalo Ridge would ultimately require

addition of major transmission facilities to enable reliable and efficient transport of power to the load centers in the eastern portion of the state. The purpose of the BRIGO Study was intended to identify some smaller-scale improvements that could be implemented while those larger-scale plans were developed. The goal was to find a few targeted projects that would enable more efficient use of the existing transmission infrastructure. The study was made public in June 2005 and the goal at the time was to have the proposals in service in the 2009 time frame.

For purposes of this study, the 825 MW facilities were assumed to be in service, as were the Big Stone II and Mankato Energy Center generators. The incremental generation outlet potential of each alternative was determined by scaling up generation and documenting the overloads that occurred. The study's final recommendations were to add three 115 kV lines, a new 345/115 kV transformer, and capacitors at three substations. It is projected that, with these new facilities in service, generation capacity on the Buffalo Ridge will increase to approximately 1,150 MW (an increase of 350 MW from pre-BRIGO levels). More information about the BRIGO projects can be found on the PUC website under PUC Docket No. CN-06-154.

3.3.3 Southwest Minnesota → Twin Cities 345 kV EHV Development Study

In May 2005, the CapX 2020 Vision Study was published and identified a need for a new 345 kV transmission line from southwestern Minnesota to the south side of the Twin Cities. In order to fully define the scope of this potential project, the study commonly referred to as the "EHV Study" was begun. Published in November 2005, this study was designed to build off the generation outlet capacity increases identified in the BRIGO Study.

The centerpiece of this proposal is a 345 kV transmission line from Brookings County Substation in South Dakota to a new Hampton Corner Substation west of Prairie Island in the Twin Cities area. There are also three proposed intermediate substations. Several smaller projects are also proposed to alleviate overloads and low voltage conditions on the underlying system. All totaled, the plan includes three new 345 kV substations (Hazel, Helena, and Hampton Corner), the main 345 kV line, two new 115 kV lines, several new transformers, and various line rebuilds to alleviate overloads caused by locating so much wind generation in the region.

A Certificate of Need has been filed with the Minnesota PUC for this project and the anticipated in-service date is 2014. The PUC Docket Number is CN-06-1115.

3.3.4 Red River Valley Load Serving Study (Transmission Improvement Planning Study (TIPS)

This study was completed in 2005. It looked at future load growth in northwestern Minnesota and North Dakota. The study showed that improvements are necessary. The need for improvements in this area is being tracked through Tracking Number 2003-NW-N4 in the Biennial Report. An Update of the TIPS study was completed in early 2007.

3.3.5 Northwest Exploratory Study

The Northwest Exploratory Study is a study conducted by MISO. It examined the best methods of increasing transmission capability to transmit 2000 MW of wind and coal generation in North Dakota and South Dakota to the Twin Cities market. This was a high level study to determine the performance of the system as new transmission facilities where added in support of this new generation. Only transmission impacts on 100 kV and above facilities were investigated. The Northwest Exploratory Study was discussed in the MTEP-05 Report.

The primary conclusion of the study is that given the large area of the potential new generation development, two 345 kV lines from Western North Dakota to the Twin Cities region are required to accommodate up to 2000 MW of new generation. If the same corridors used for those 345 kV lines are instead used to build 500 kV lines, the system does not provide any better service. Therefore, the recommendations are to develop a 345 kV line from western North Dakota to Fargo to the north side of the Twin Cities and to build a second line from western North Dakota heading south through the Ellendale region of North Dakota, through the South Dakota portion of the Buffalo Ridge, and east to the south side of the Twin Cities.

More detailed studies are needed to determine the details for converting these conceptual developments into reliable projects. This analysis would include developing the best points of interconnecting the lines into the existing transmission network, conductor size, other facilities associated with the project -- including some underlying system upgrades -- and a thorough stability analysis of the system with the new facilities.

Unless there is a definite strong bias to early development of any given generation site -- like the South Dakota portion of the Buffalo Ridge for wind generation -- the first step of the development should be the Fargo-Twin Cities line as this section provides the most flexibility for various scenarios of timing for the new generation development. The CapX 2020 utilities have determined to go forward with the line and have applied for a Certificate of Need from the Public Utilities Commission.

3.3.6 West Central Community Based Energy Development (CBED) Study

The focus of this study was to determine the impact dispersed wind generation might have on the transmission network. The base model selected was the 2009 summer peak model. This high level study focused on identifying generation locations in the western-central planning zone and compensated for the additional generation by reducing peaking generation in Minnesota and surrounding areas.

The study team developed a methodology for sizing generation at existing substations based on transformer size serving the local load and peak substation load. The study assumed that the additional wind generation would increase proportionally based on new generation size and only considered constraints on the 115 kV and above transmission network.

The study results suggested that by dispersing wind generation, the impact on the transmission ranged from $50 – 97 million depending on the level of wind penetration studied. The study did not address the impacts on the lower voltage sub-transmission where most of these projects would interconnect, nor the impact of losses on the transmission network.

This CBED study is also addressed in Section 2.6.2 of the 2007 Biennial Report.

3.3.7 Dotson Load Serving and Generation Outlet Study

This study was performed in order to optimize new transmission needs for a wind generation interconnection request in the MISO queue with other transmission load serving needs in the Dotson, New Ulm and Storden areas. A 150 MW wind generation request near Storden was modeled along with new ethanol plants at Cobden, Lamberton, and St. James. In addition, a pending, presently unmet transmission service request for the City of New Ulm load was also modeled. Other system load was modeled at 2011 and 2016 summer peak levels.

Several alternatives were developed in order to determine a common set of transmission projects that could meet all of the above needs rather than stand-alone projects that might only meet one need. This resulted in lower social and economic impacts than would have been caused by several stand-alone plans. Discussions were held with MISO staff and representatives from the wind developers as well as the transmission providers to develop the plan.

The study recommends constructing a 161 kV line from Heron Lake to Dotson to New Ulm as well as adding new 161/69 kV connections at Storden and Dotson. Other additions to upgrade existing transmission lines to accommodate the wind generation outlet were also recommended. The total cost for the preferred plan was estimated at $64.97 million.

Further discussion of this area is included in section 7.6 of the 2007 Biennial Report under Tracking Numbers 2007-SW-N1, 2007-SW-N2, and 2007-SW-N3.

3.4 Ongoing Studies

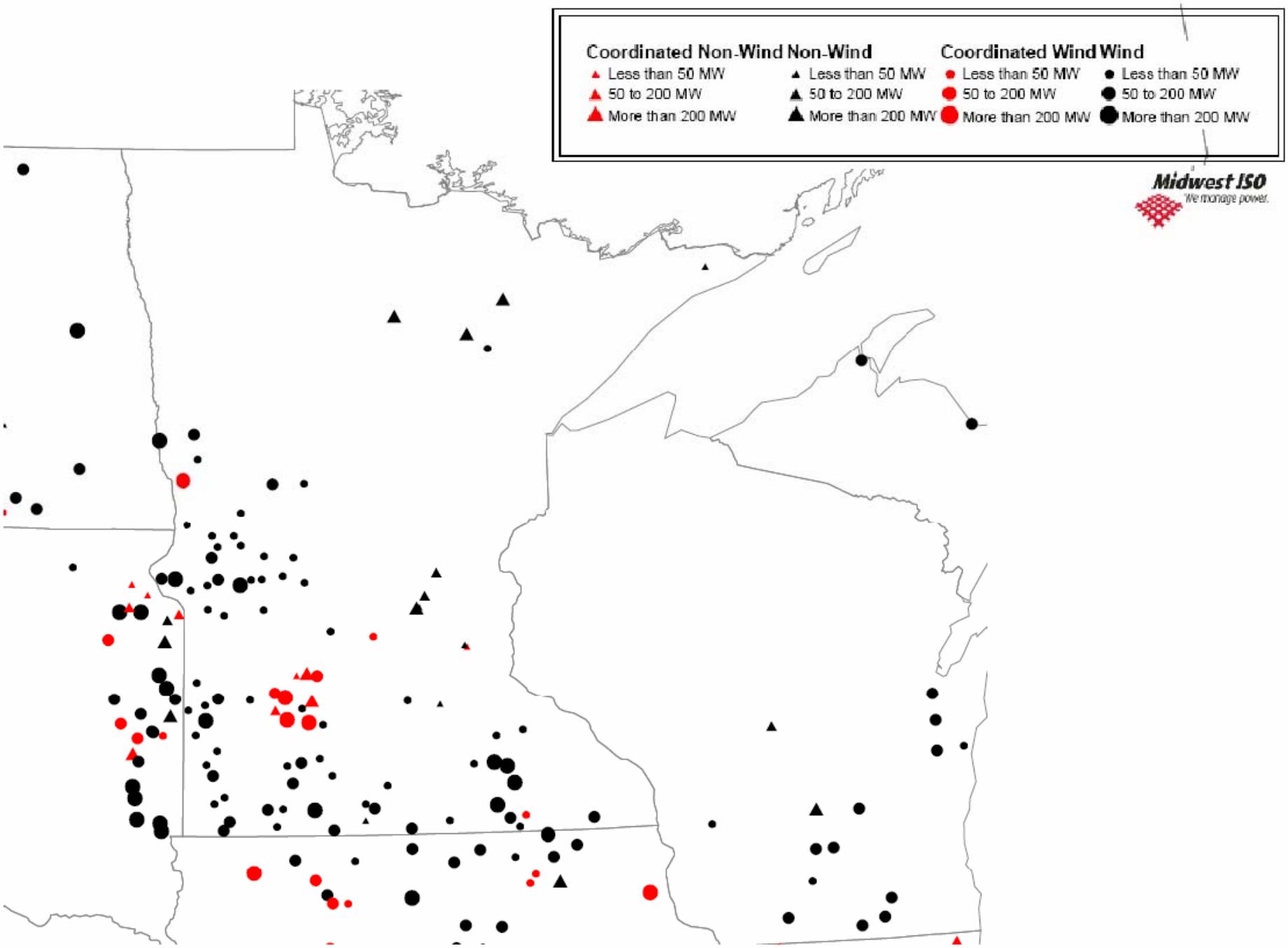
3.4.1 Regional Incremental Generation Outlet (RIGO)

Objective. In the vein of the Buffalo Ridge Incremental Generation Outlet (BRIGO) projects, RIGO aims to increase wind outlet capacity in areas outside the Buffalo Ridge that are experiencing high interest among wind developers. By specifically focusing on west-central Minnesota and southeastern Minnesota, Xcel Energy, in conjunction with the neighboring utilities, has begun a transmission planning study that is focused on single 115 kV or 161 kV line improvements. The projects being studied are of a scope that could be implemented in time to assist in accomplishing the 2012 RES milestone (in service by end of 2011).

Scope. The study group created several options for the west central and southeastern portions of Minnesota. The initial study results are showing that the southeastern options have higher outlet potential so the study group is currently focusing their efforts on these options. It is anticipated that the RIGO effort will result in a project proposal, which will be put forth for internal approval in early 2008. A Certificate of Need proceeding is anticipated and would likely begin in 2009.

3.4.2 Interconnection Studies

Part of MISO's ongoing transmission study efforts includes the generation interconnection studies performed to analyze the impacts of potential generators on the regional transmission system. The map on the following page shows the status of the MISO queue as of August 2007. The sheer number and size of generation projects attempting to interconnect to the transmission system in Minnesota, Iowa, and the Dakotas means that many of these projects will cause transmission system overloads to occur that must be addressed prior to the facilities being placed in service.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Midwest ISO
"We manage power."