



Generation Interconnections

The size and location of new or expanded power plants can have significant impacts on the transmission system. These impacts can range from very positive (adding voltage support in a weak area of the system) to very negative (aggravating loading problems and/or causing generator instability). Information on the status, as of July 1, 2009, of ATC's portion of the Midwest Independent System Operator generation interconnection queue is provided in this section. There continues to be significant activity in ATC's portion of this queue, ranging from newly proposed generation projects to cancellation of previously proposed generation projects.

There are two key aspects in determining the total impacts a proposed new generator may have on the transmission system:

- impacts of interconnecting the new generator to the transmission system and
- impacts of using the transmission system to deliver power from the new generator.

Per the Midwest ISO Revised Attachment X process, A generator interconnection study is usually performed in three stages: Interconnection Feasibility Study (Application Review Phase), Interconnection System Impact Study (System Planning and Analysis and/or Definitive Planning Phase), and an Interconnection Facilities Study (Definitive Planning Phase).

The *Interconnection Feasibility Study* includes a determination of thermal overload or voltage level impacts created by the new generator. This study process is now performed by MISO approximately five to six times per calendar year and provides a qualitative screen of the affected facilities, indicating if there is ample capacity on the system to support the new interconnection. Depending on the results of the study, the request may either enter into the Definitive Planning Phase (DPP), System Planning and Analysis Phase (SPA) or Customer Not Ready Phase of the System Impact study.

The *System Impact Study* includes a determination of whether the proposed generator and other nearby generators will remain connected to the system under various disturbance situations, such as line trips and equipment failures and includes a fault duty analysis to determine whether existing system equipment can accommodate the increased short circuit fault duty caused by the new generator. Finally, the System Impact Study will identify solutions for any thermal, stability or fault duty problems.

Delivery impacts are assessed during the DPP portion of the interconnection study process using the Midwest ISO deliverability methodology, which determines whether a new generator is deliverable to the Midwest ISO Day 2 market and to what percent if not wholly deliverable. Whatever portion of the new generator that is deliverable may then be used as a Network Resource by Network Customers through the Midwest ISO's Module E Resource Adequacy procedures.

The facility study is conducted in the DPP process phase to specify and estimate the time and cost of the equipment, engineering, procurement and construction of the system upgrades identified in the earlier interconnection studies.



The results of the interconnection studies are needed to develop a comprehensive picture of the transmission facilities that will be required for a proposed generator. This is why we include in our Assessment those proposed generators for which interconnection studies have been completed.

The first portion of this section provides the status of the generation queue within our service territory. The second portion of this section describes the transmission system additions associated with various proposed generation projects for which final interconnection studies have been completed. The third portion of this section describes some of the implications associated with interconnecting generation at various locations within our service territory.

ATC Generation Queue

Since ATC's inception, sixteen new generators have gone into service and two updates to existing generators have been completed, totaling 4,293 MW. These generators are shown in Table PR-26.

Table PR-27 lists the proposed generators in the generation queue for our service territory as of July 1, 2009. This table lists each proposed generation project and summarizes them by zone and MW amount. These proposed projects also are shown by approximate location in Figure PR-9. As shown, the total capacity of proposed generators in the queue is 2,944 MW. Of that proposed capacity, 44 percent reflects new coal units; wind units reflect 47 percent; biomass reflect 3 percent; nuclear updates reflect 4 percent and the remaining 2 percent is comprised of simple cycle (natural gas) turbines (see Figure PR-10). Of this generation, 44 percent in Zone 5, 28 percent in Zone 4, 21 percent is proposed in Zone 3, 3 percent in Zone 2, and 4 percent in Zone 1.

The developer's projected in-service date listed in Table PR-27 is the last official commercial operation in-service date provided by the developer for that request. Under the Midwest ISO's former Attachment X procedures, a developer could suspend their Interconnection Agreement which could delay the project. They were not required to update their official in-service date as part of this suspension.

The following requests have been suspended:

- G427 – 98 MW wind farm, Cypress Substation in Fond du Lac County, Wisconsin
- G546 – 100 MW wind farm, Line 6541 in Walworth County, Wisconsin
- G590 – 98 MW wind farm, Line 971K91 in Calumet County, Wisconsin

Generation interconnection requests previously in the generation queue, which have been cancelled or removed from the queue since January 31, 2008 (because the developer withdrew the request or missed contractual milestones), are summarized in Table PR-28.

Link to publicly posted generation queue:

http://oasis.midwestiso.org/documents/ATC/Cluster_8_Queue.html

Transmission associated with proposed generation interconnections

Prior to the start of the MISO Day 2 Market, transmission service for new generators was handled separately through an OASIS transmission service request(s). For generators listed below that had



studies completed prior to Day 2 start-up, system reinforcements were identified through both generator interconnection and transmission service studies.

Implications of generation development

Availability of fuel, water and transmission interconnections are among the key aspects to be considered when sighting generation.

From a transmission perspective, the ability of the transmission system to accommodate new generation is a function of stability, power flow and short circuit analyses. For certain generation technologies, harmonics and voltage fluctuations may need to be considered as well. In most instances, new generation will require certain transmission system reinforcements to interconnect and deliver the generation output. In a few specific instances, new generation can be beneficial to the transmission system, perhaps even deferring or eliminating the need for transmission reinforcements that would be necessary absent the new generation. The ability of generation to defer or eliminate the need for transmission reinforcements also can be a function of the generation location, number of generators and/or expected generator capacity factor.

In this section, a very general zone-by-zone evaluation of the likelihood of needing or deferring transmission reinforcements for various generator locations is provided. The purpose of these evaluations is to provide a very cursory indication to the generation market of the likely magnitude of the impact and the transmission reinforcements that would likely be needed by general location.

Zone 1

Within Zone 1, generation has been proposed in various locations, but most of the proposals have involved generation located in the vicinity of the 345-kV infrastructure. Based on studies that we have conducted for proposed generation interconnections and transmission service from this area to date, some transmission reinforcements are likely to be required for any significant (>100 MW) generation development. The extent and nature of the reinforcements is also a function of where the power from the generation is to be delivered.

The Rhinelander Loop located in the northern portion of Zone 1 is a potential candidate for moderate-sized (up to 150 MW, depending on location) generation development, provided generator stability can be maintained, and provided it can be located in the northern portion of the Loop. Whether this generation would be effective as a transmission-deferral mechanism depends on a number of factors. The need for additional reinforcements outside of the Loop could also be a function of where the power from the generation is to be delivered.

The transmission infrastructure in the central portion of Zone 1 includes three new 345-kV lines which make up the GCMW corridor (Gardner Park – Highway 22, Morgan – Highway 22, and Highway 22 – Werner West). These additional lines were essential for the new Weston 4 coal plant to interconnect to the ATC transmission system, bringing much needed support to the area for both stability and thermal considerations for the Weston facility. While it has not been evaluated in any G-T requests, it is possible that this new infrastructure has improved the area such that the transmission system has the potential to support additional small- to medium-size generation development depending on actual physical location of the facility.



The infrastructure in the southern portion of Zone 1 consists of five 138-kV lines and several 69-kV lines. Only smaller generation projects (typically <25 MW) could be accommodated with minimal transmission reinforcements. The existing infrastructure in this portion of Zone 1 is not suitable for significant generation development.

Zone 1 completed generation studies:

| Request | Size | Type | County, State | Status |
|---------|----------|--------------------|---------------------|--------------|
| G144 | 550 MW | Coal | Marathon County, WI | In-Service |
| G522 | 550 MW | Coal | Portage County, WI | Out of Queue |
| G523 | 550 MW | Coal | Marathon County, WI | Out of Queue |
| G588 | 55/60 MW | Combustion Turbine | Wood County, WI | In-Queue |

Zone 2

We have completed studies of five generation interconnection requests for the Zone 2 area. Even though the first four requests are no longer active in the queue, they have helped us build a base of knowledge similar to what we have in other zones relating to likely generation interconnection impacts.

ATC is beginning to see substantial interest in siting wind turbine generators in the Upper Peninsula of Michigan. ATC has completed studies related to three wind farms located in Marquette, Houghton and Delta counties totaling 521 MW. One of the major challenges wind farms proposed for the Upper Peninsula will face is the limited transmission infrastructure to interconnect and deliver the energy produced by these power plants. Since the Upper Peninsula transmission grid was primarily designed to serve local load, substantial transmission upgrades are required to accommodate these proposed plants. The completion of the Northern Umbrella Plan, however, will result in a much more robust 138-kV network at Plains Substation that could potentially accommodate a reasonable amount (< 100 MW) of generation in the future at or near Plains.

It is likely that given the scarcity of 138-kV infrastructure in the Upper Peninsula there are virtually no other locations in Zone 2 that are ideal candidates for significant generation development. Generation studies have indicated substantial reinforcements are required to site large amounts of generation throughout the Upper Peninsula.

There are areas in Zone 2, such as on the western end of the Upper Peninsula, which are or will be in need of transmission reinforcements where smaller generation projects could be beneficial in terms of deferring transmission expenditures. The allowable capacity of such generation would depend on the location. However, other potential impacts (stability, fault duties) would need to be evaluated on a location-by-location basis.



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Zone 2 completed generation studies:

| Request | Size | Type | County, State | Status |
|----------|---------------|---------|----------------------|--------------|
| G567-568 | 165 or 300 MW | Coal | Delta County, MI | Out of Queue |
| G583 | 19 MW | Biomass | Ontonagon County, MI | Out of Queue |
| G750 | 201 MW | Wind | Marquette County, MI | Out of Queue |
| G799 | 120 MW | Wind | Houghton County, MI | Out of Queue |
| G937 | 29 MW* | Wind | Delta County, MI | In Queue |

** was initially studied at 200 MW*

Zone 3

In Zone 3, generation has been proposed in various locations, but over half have been in the southernmost counties. Generation could be beneficial in a few areas depending on the capacity of such generation and the exact location. Smaller-scale generation (< 100 MW) in certain locations of Zone 3 could be beneficial to improving the voltage profile in the area(s) and potentially deferring transmission reinforcements. Stability analysis would need to be conducted to ensure stable operation of such generation.

Similarly, the southeast portion of Zone 3 is heavily loaded and will require transmission reinforcements in the future to ensure reliable operation. Small-scale generation in certain locations could be beneficial to changing power flow patterns and improving the voltage profile in the area.

Zone 3 completed generation studies:

| Request | Size | Type | County, State | Status |
|---------|---------|--------------|----------------------|--------------|
| G281 | 130 MW | Wind | Green County, WI | Out of Queue |
| G282 | 99 MW | Wind | Lafayette County, WI | In Queue |
| G338 | 54 MW | Wind | Dodge County, WI | In Service |
| G366 | 80 MW | Wind | Columbia County, WI | In Queue |
| G371 | 100 MW | Wind | Columbia County, WI | Out of Queue |
| G483 | 50 MW | Wind | Green County, WI | Out of Queue |
| G506 | 100 MW | Wind | Monroe County, WI | Out of Queue |
| G527 | 280 MW | Coal | Grant County, WI | Out of Queue |
| G528 | 550 MW | Coal | Columbia County, WI | Out of Queue |
| G546 | 100 MW | Wind | Walworth County, WI | In Queue |
| G550 | 24 MW | Simple cycle | Jefferson County, WI | In Service |
| G553 | 280 MW | Coal | Columbia County, WI | Out of Queue |
| G706 | 99 MW | Wind | Columbia County, WI | In Queue |
| G724 | 99 MW | Wind | Dane County, WI | Out of Queue |
| G747 | 99 MW | Wind | Rock County, WI | Out of Queue |
| G749 | 50 MW | Wind | Lafayette County, WI | In Queue |
| G793 | 100 MW | Wind | Rock County, WI | Out of Queue |
| G901 | 600 MW | Wind | Winnebago County, IL | Out of Queue |
| G902 | 600 MW | Wind | Winnebago County, IL | Out of Queue |
| G953 | 49.5 MW | Wind | Grant County, WI | Out of Queue |



Zone 3 completed generation studies (continued):

| Request | Size | Type | County, State | Status |
|---------|---------|------|---------------------|--------------|
| G954 | 49.5 MW | Wind | Grant County, WI | Out of Queue |
| H012 | 150 MW | Wind | Columbia County, WI | In Queue |
| H024 | 48 MW | Wind | Columbia County, WI | In Queue |

Zone 4

Generation has been proposed in various locations in Zone 4. Generation could be beneficial in a few areas depending on the capacity of such generation and exact location.

The northern portion of Door County is a potential candidate for small-scale (< 50 MW) generation development, provided generator stability can be maintained and it can be appropriately located. Currently, the northern portion of the county is served by a single radial 69-kV circuit, and electric service is subject to interruption for the loss of this radial circuit. The voltage profile within Door County is projected to precipitate the need for reinforcements in the future. Whether this generation would be effective as a transmission-deferral mechanism depends on a number of factors. The need for reinforcements outside of Door County could also impact where the power from the generation is to be delivered.

One area in Zone 4 that may not accommodate any additional generation without transmission reinforcements is the area around the Point Beach and Kewaunee nuclear plants, east of Lake Winnebago. In this area, existing transmission lines have little excess capacity. As the system evolves, stability margins at those plants may become a concern. Additional generation may require transmission reinforcements to meet our stability criteria.

Zone 4 completed generation studies:

| Request | Size | Type | County, State | Status |
|---------|---------|---------|------------------------|--------------|
| G240 | 54 MW | Steam | Manitowoc County, WI | In Service |
| G353-4 | 145 MW | Wind | Fond du Lac County, WI | In Service |
| G368 | 129 MW | Wind | Fond du Lac County, WI | In Service |
| G376 | 160 MW | Wind | Green County, WI | In Queue |
| G384 | 99 MW | Wind | Manitowoc County, WI | Out of Queue |
| G410 | 99 MW | Wind | Kewaunee County, WI | Out of Queue |
| G421 | 50 MW | Wind | Brown County, WI | Out of Queue |
| G427 | 98 MW | Wind | Fond du Lac County, WI | In Queue |
| G486 | 10.5 MW | Wind | Manitowoc County, WI | Out of Queue |
| G507 | 68 MW | Wind | Fond du Lac County, WI | In Service |
| G524 | 550 MW | Coal | Brown County, WI | Out of Queue |
| G590 | 98 MW | Wind | Calumet County, WI | In Queue |
| G611 | 99 MW | Wind | Calumet County, WI | In Queue |
| G773 | 150 MW | Wind | Brown County, WI | In Queue |
| G833 | 53 MW | Nuclear | Manitowoc County, WI | In Queue |
| G834 | 53 MW | Nuclear | Manitowoc County, WI | In Queue |
| G927 | 1.5 MW | Wind | Calumet County, WI | In Queue |
| G987 | 400 MW | Wind | Brown County, WI | Out of Queue |



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Zone 5

Major generation additions will be completed in Zone 5 over the next few years. The PSCW has approved two units near the existing Oak Creek Power Plant, with the first unit going into service in 2009 and the second unit in 2010.

Studies of other proposed generation projects that are no longer in the generation queue indicate that additional generation in certain areas of Zone 5 would pose stability problems. In particular, larger-scale generation interconnecting to the 345-kV network could pose stability issues.

Smaller-scale generation in certain locations in Washington and Waukesha counties potentially could be accommodated without the need for transmission reinforcements if located appropriately.

Zone 5 completed generation studies:

| Request | Size | Type | County, State | Status |
|-----------|---------|----------------|----------------------|------------|
| G051 | 1300 MW | Coal/steam | Milwaukee County, WI | In Queue |
| G093/G510 | 1200 MW | Combined cycle | Ozaukee County, WI | In Service |