WORKING FOR THE GREATER GRID

AAR Developments Within MISO

Cynthia Crane, Manager, MISO Regulatory Strategy

ITC A FORTIS COMPANY | FOR THE GREATER GRID

Introduction

- ITC Holdings: a brief description
- Facility ratings: establishment, types, and impact on the grid
- Ratings practices & types of ratings adjustments within MISO
- Benefits & risks of AAR programs
- Expanding use of AARs within MISO
- ITC's perspective on AAR use, pilot program considerations, & philosophy

ITC PROFILE

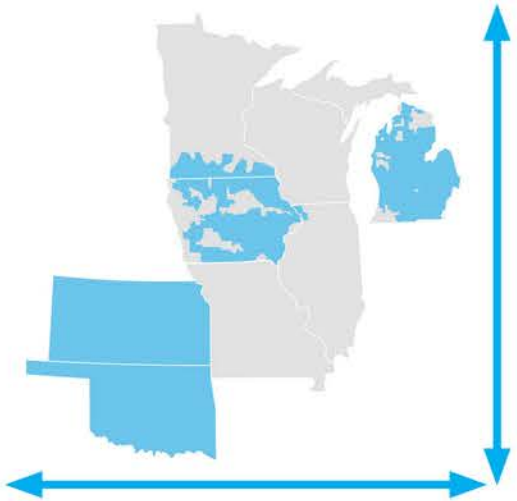
16,000 MILES
of transmission lines

660 stations and substations

ITC
A FORTIS COMPANY

90,000-SQUARE MILE
Service Territory

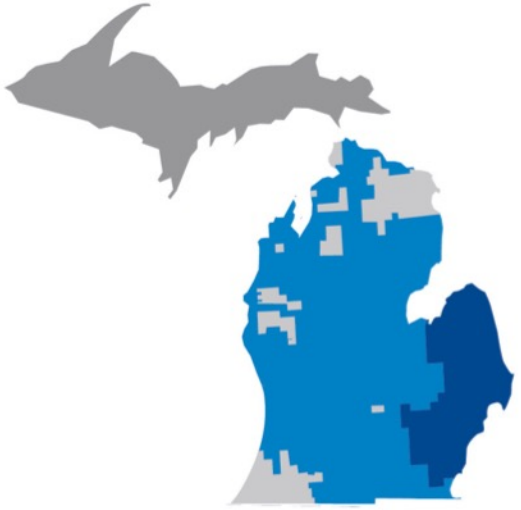
Michigan
Iowa
Minnesota
Illinois
Missouri
Kansas
Oklahoma



700+ employees, and
1,000+ skilled labor contractors

Member of **4 RTOs**

ITC SYSTEM OVERVIEW



	ITC*Transmission*	METC	ITC Midwest	ITC Great Plains	ITC Interconnection
SYSTEM PEAK LOAD	12,745MW	9,469MW	3,724MW	—	—
SERVICE AREA	Southeast Michigan	Lower Peninsula of Michigan	Portions of Iowa, Minnesota, Illinois and Missouri	Serves SPP and South Central Region	—
TOTAL TRANSMISSION MILES	~ 3,100	~ 5,600	~ 6,700	~470	.4 miles in SW Michigan
RTO MEMBERSHIP	MISO	MISO	MISO	SPP	PJM
ESTABLISHED	Assets Acquired February 28, 2003	Assets Acquired October 10, 2006	Assets Acquired December 20, 2007	Formed August 18, 2006	Formed June 1, 2016

OUR VISION

Build the **GREATER GRID** of the future that connects consumers to energy resources across North America.

How Transmission Owners Establish Facility Ratings

- NERC FAC-008-3: Requires each Transmission Owner (TO) to have a documented Facility Rating Methodology (FRM) that includes equipment ratings that are consistent with one or more of the following:
  - Ratings provided by equipment manufacturers or obtained from equipment manufacturer specifications such as nameplate ratings.
  - One or more industry standards developed through an open process such as Institute of Electrical and Electronics Engineers (IEEE) or International Council on Large Electric Systems (CIGRE).
  - Practices verified by testing, performance history, or engineering analysis.
- Each TO must specify the underlying parameters, design criteria, and methods used to determine ratings.
- Each TO considers information relevant to their service territory which could include ambient temperatures during summer and winter seasons, average wind speeds, solar irradiance, latitude, and elevation above sea level.
- Facility Ratings are established when equipment is initially installed and reviewed when system modifications occur

Types of Facility Ratings: short definitions

- Static Ratings: reflect ratings under a set of ambient conditions and do not change throughout any period of time (hour, day, or year).
  - For overhead conductors, ratings typically determined using IEEE Standard 738, “Standard for Calculating the Current-Temperature Relationship of Bare Overhead Conductors”.
  - Substation equipment often utilizes static ratings based on the manufacturer’s equipment nameplate rating which reflects worst-case or least-regrets assumptions.
- Seasonal Ratings: use a different set of ambient weather conditions for specific seasons or timeframes throughout the year.
- Ambient Adjusted Ratings (AARs) – Change more frequently (e.g. daily, hourly, etc.) and in most cases, actual ambient air temperatures are used to change the parameters used to calculate ratings for all of the equipment that comprise a facility. Sources of temperature data include public sources, private services, or actual readings in the specific facility corridor.
- Dynamic Line Ratings (DLRs) – Typically involve field-installed devices to measure tension or strain in the phase conductors, cameras to observe height of the conductor at a specified site, weather instruments to measure temperature, wind speed/direction, and solar radiation. This data is telemetered to a central location for calculation of the real-time capability of the facility.

Impact of Facility Ratings on the Grid

- MISO commits and dispatches resources in a least-cost manner to match load using equipment ratings to determine the available transmission capacity.
- If when committing or dispatching resources based on least cost, MISO determines a transmission system component will be operated above its rating, it will select a different and potentially more expensive resource in order to meet safety and system reliability standards.
- When this occurs, the events and any increased costs due to this suboptimal commitment and dispatch of resources is known as congestion.
- Congestion costs can be substantial depending upon the resources involved, duration, amount, and frequency of occurrence.
- Historic and traditional solutions to alleviating congestion include expanding, upgrading, or rebuilding the electric transmission infrastructure.
- In concept, the real-time capability of a piece of equipment may be different than its seasonal rating depending on the weather conditions the piece of equipment is experiencing at a specific point in time. Alternatives such as AARs can provide real-time congestion relief if the facility rating can be temperature adjusted.

Facility Ratings Practices in MISO

- Prevailing practice in MISO for the majority of TOs is to provide summer and winter seasonal ratings
- A TO may use static ratings for some facilities and seasonal for others due to the type of equipment. For some TOs, station equipment (transformers, breakers, and switches) are static while conductors and buses change with the season.
- Actual ratings vary across TOs due to differences in geographical location, legacy equipment, methodology choices, risk assessment, and other factors.
- A number of TOs already use some type of AAR program.
- Within the MISO TOs, discussion has focused on use of AARs, not DLRs due to:
  - Equipment and/or information requirements
  - Possible FRM modifications
  - Required changes for EMS and other operations databases and protocols
  - Overall cost of implementation
- AARs represent a sensible starting point with the simplest change before introducing greater complexity as a means of providing significant reductions in congestion.

Three Types of Real-Time Ratings Adjustments in MISO

- Automated AAR Program: Several TOs have pre-calculated the ratings for a set of facilities based upon specific temperature and possibly wind conditions and have a method in place to obtain the temperature (and possibly wind) data. A communication protocol is in place that "pushes" on a routine basis the updated ratings and/or temperature information to MISO.
- On Demand AAR Program: Other TOs which have pre-calculated the ratings for a set of facilities based upon specific temperature and possibly wind conditions and have a method in place to obtain the temperature (and possibly wind) data. The TO provides the adjusted ratings or temperatures, if they have provided MISO with a table in advance, in response to a specific MISO request.
- Manual Optimization Technique: MISO initiates an ad-hoc process by requesting the TO to evaluate possibly changing a rating on a specific facility. The TO obtains the necessary data, performs the analysis and provides the results to MISO.

Economic Benefits & Risks of AARs

- AAR Ratings are intended to improve the efficiency of the MISO market and provide economic benefits by reducing congestion caused by facilities that are capable of having ratings adjustments based on temperature.
- The actual benefits depend on: total amount of congestion (duration, frequency, & volume), potential incremental rating increase, next limiting facilities, or difference in generation costs on either side of the facility causing the congestion
- Potential beneficiaries of reduced congestion include: load serving entities, generator owners, & adjoining RTOs if facilities are close to a seam
- Risks can result from: inaccurate measurement of ambient conditions or differences in ambient conditions between the monitoring point and the facility location or transmission corridor, or failure to update the AAR throughout the day if ambient conditions become more severe/limiting, or increasing the number of hours at a higher operating point which may accelerate the end of life of facilities.
- Benefits of reducing congestion must be balanced with the potential impacts on reliability, compliance, and operational efficiency in addition to the costs of implementing and maintaining an AAR program.

Expanding AAR Use Within MISO

- ITC has been working with the MISO TOs to develop a conceptual framework for the evaluation and development of AAR programs
- Principles balance responsibility & applicability, program transparency, and implementation flexibility.
- The workplan includes:
  - Facility identification: the TOs are leveraging MISO's expertise and are developing a methodology to identify the facilities most likely to provide benefits from use of AARs based on recent historical congestion.
  - Benefit evaluation: the TOs & MISO will next collaborate to develop a consistent and transparent methodology for estimating the expected benefits.
  - Cost evaluation: The evaluation of benefits will also consider the cost to implement and maintain an AAR program and other potential impacts including reliability impacts, operator workload and effectiveness, outage scheduling flexibility, and others.
- Due to their compliance obligations, each TO is solely responsible for developing its FRM. Thus, ultimately, each TO would need to develop a program to review and consider AAR implementation that reflects its unique circumstances and system.

ITC's Perspective on AARs

- An AAR program could be one of a range of tools used to solve congestion and maximize use of the existing transmission system, but is not the only one, and permanent fixes are still needed.
- Exploring the possibility of developing a pilot program that also includes considerations of reliability, compliance, and efficiency.
- Applicability is limited to real-time operations because planning has a much longer time horizon and addresses expected worst case conditions.
- Managing sources of risk, including:
  - Identifying and mitigating compliance risks, such as IEEE 738 standard which, based on our FRM, would require the adjustment of other parameters (wind & solar) beyond just temperature when implementing AAR ratings
  - Ensuring a program does not increase the risk to facilities, reliability, or safety beyond what currently exists in our ratings methodology
  - Protecting against potential after-the-fact charges of discrimination or capacity withholding from the IMM or other stakeholders

ITC Pilot Program Implementation Considerations

Applicability and development considerations would include, but not be limited to:

- Consideration of the most congested facilities, not a blanket program
- Engineering assessment of whether candidate facilities could be temperature adjusted
- Availability of temperature, and perhaps other weather, data
- Establishment of communications protocols with MISO, including resolution of any potential cybersecurity issues
- Development of required modifications to EMS, operations & ratings databases, operations protocols, and other internal system adjustments required
- Continued compliance with NERC and other industry standards
- Development of a business case that compares the congestion benefits to the costs of starting up, maintaining, and adding onto an AAR program
- Ensuring that the risk under an AAR program is no greater than under current seasonal ratings

Actual implementation would occur following this analysis and any identified systems development or modifications.

ITC AAR Philosophy

- ITC is driving to create as efficient a grid as possible.
- We are seeking measures to gain more capability out of the transmission system and have worked at this for years.
- AARs represent one tool to maximizing use of the transmission system, is most useful in specific situations, and should be balanced against other methods to reduce congestion.
- As the stewards of the transmission system, ITC must balance the security of the system with the desire to get more out of the existing system.

Questions?

ccrane@itctransco.com