Methodology and Assumptions

1.1 Overview

This section describes the methods and techniques that we used to develop assumptions, analyze our transmission network and share results for the 2015 10-Year Assessment. Economic, regional, and asset management planning processes are covered on the ATC website, www.atc10yearplan.com.

As part of the network assessment, ATC conducted power flow analyses to identify problems or constraints on the transmission system and evaluated the merits of potential reinforcements to address the system limitations that were identified. ATC meets with stakeholders to discuss assumptions and results. ATC's network planning process is summarized in Figure1.

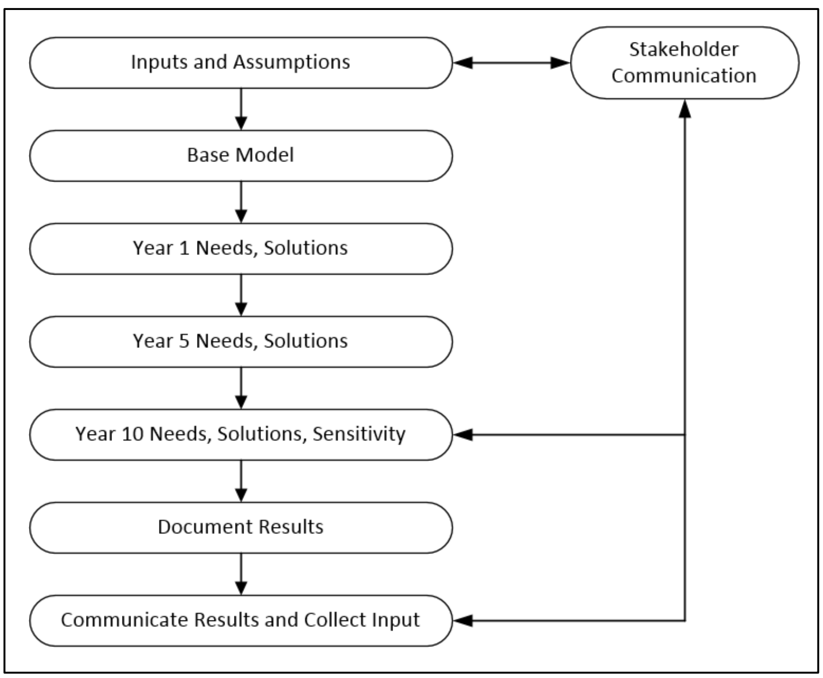

Figure 1: 10-Year Assessment Process

Stakeholder Engagement Process

ATC has developed a stakeholder engagement process that we use to engage stakeholders in developing our Assessment and solutions. More discussion of the process can be found on the stakeholder engagement process page of the www.atc10yearplan.com website.

Analysis Introduction

Included in this section is a discussion of the years ATC identified to model to satisfy both the near-term (1 – 5 year horizon) and long-term (5 year and beyond horizon) NERC standards for assessing the transmission system. Also included in this section is discussion on how ATC built each of the models used in this Assessment. Discussion items include topics such as load forecasting; which reinforcements and new generation to include in models; which system load levels, import levels and system bias scenarios to evaluate.

During the network assessment of our transmission system, we performed simulations on a variety of models as discussed below in this section. ATC not only uses these models to identify where constraints or system limitations may exist, but we also used these models in testing the robustness of potential system reinforcements. Per ATC's Transmission System Planning Criteria, constraints or system limitations were identified for NERC Category P0 type system conditions.

For NERC Category P1 through P7 contingencies, system limitations or constraints are identified using slightly different criterion. For these types of system contingency conditions, system limitations are identified according to ATC Transmission System Planning Criteria.

The system performance analysis conducted in this Assessment included steady state power flow analyses, stability simulations, multiple outage impacts as well as economic evaluations, generator interconnection impacts, and transmission-distribution interconnection impacts.

1.2 Network Assessment Methodology

American Transmission Company's 2015 10-Year Assessment provides current results of planning activities and analyses of the ATC transmission facilities. These activities and analyses identify needs for network transmission system enhancement and potential projects responsive to those needs.

Since 2001, we have engaged in open and collaborative efforts to share information and solicit input on our plans. We believe that in making our planning efforts transparent and available to the public, the proposals for needed facilities can be more readily understood and accepted by communities that stand to benefit from them. In recent years the federal government has taken additional steps to ensure that transmission-owning utilities have produced and shared planning information with the public and local stakeholders. The Attachment FF-ATCLLC in the MISO tariff's Attachment FF describes ATC's open planning processes.

The information in this report provides further foundation for continued public discussions on the transmission planning process; identified transmission needs and limitations;

possible resolutions to those needs; and coordination with other public infrastructure planning processes.

Computer simulation model years for the 2015 network Assessment analyses were selected in order to meet NERC requirements for a 1-5 year horizon and beyond the 5 year horizon. The years 2016 and 2020 were selected to meet the 1-5 year horizon. The year 2025 was selected to meet the beyond 5 year horizon. A range of system conditions and study years were developed and analyzed for the 2015 Assessment. Steady state peak load models for all three years were created. In order to address uncertainty in reactive power capability and preserve some margin for the ATC area, an additional model was created for each year. For each of the additional models the maximum and minimum reactive power capability was reduced by 10 percent for appropriate generators within the ATC footprint. These models were used for both intact system and contingency analyses.

The needs identified were determined by identifying facilities whose normal or emergency limits are exceeded. The criteria we used to determine what these limits are provided in the ATC Transmission System Planning Criteria.

This assessment was developed in a chronological fashion. Planned transmission additions expected to be in service by June 2015 were included in the 2016 model, as listed in the Table PF-1. Projects that have completed the analysis and are either under construction, have filed an application to construct, or are in the process of preparing an application were included in the 2020 and 2025 models as appropriate based on projected in service dates (See Tables PF-2 and PF-3).

1.2.1 Load Forecast

Steady state summer peak models were built using our customers load forecasts (50/50 projections) as a starting point, meaning that there is a 50 percent chance that the load level will either fall below or exceed the customer projection. In 2014, customer load forecasts were gathered for all ATC customers through at least the year 2024 (in most cases through the year 2030). The forecasts were compared to historic data and previous load forecasts to ensure validity and consistency. As a final step, the final forecast information was forwarded back to individual customers to ensure their concurrence. Once consensus was achieved, the data was incorporated into our models.

Certain ATC customers did not provide an 11^{th}-year load forecast for the year 2025. To obtain a forecast for 2025, certain customer-provided forecasts were extended by growing their load by using a 3-year linear growth rate calculated over the last three years of the forecasts provided by the customer. Load power factors were held at their levels at the last year forecast. Non-scalable loads were also held at their load levels at the last year forecast using this methodology.

A similar methodology was utilized to obtain a projection for 2030. Customer-provided forecasts were extended by growing their load by using a 3-year linear growth rate calculated over the last three years of the forecasts provided by the customer. Load power factors were held at their levels at the last year forecast. Non-scalable loads were once again held at their load levels at the last year forecast.

ATC summer peak total load projections (MW)

Year	Load (MW)	Study period compounded growth rate
2015	13,203	Not applicable
2016	13,345	Not applicable
2020	13,727	0.78% (2015-2020)
2025	14,130	0.58% (2020-2025)
2030	14,531	0.56% (2025-2030)
Overall		0.64% (2015-2030)

It should be noted that, we worked with the distribution companies as much as possible to confirm forecast variations from past trends.

1.2.2 Model Building

1.2.2.a Assumptions Common to all Models

The following assumptions are common to all models studied in the 10-Year Assessment. Any exceptions are listed within the respective assumption section.

- New Generation
- Generation Retirements
- Cutoff Dates for Model Modifications
- Generation Project Schedule
- Generation Outside of the System
- Generation Dispatch
- Line and Equipment ratings
- Project Criteria

1.2.2.a.1 New Generation

There have been generation projects proposed within the ATC service territory. Many of these proposed projects have interconnection studies completed and a few have had transmission service facility studies completed. Some have proceeded to or through the licensing phase and one or more are under construction. However, there are also proposed generation projects that have dropped out of the generation queue (refer to Appendix A, Generation Interconnections), adding uncertainty to the transmission planning process. To address this planning uncertainty, we have adopted a criterion for purposes of this and prior Assessments, to establish which proposed generation projects would be included in the 2015 Assessment models.

In the 2015 10-Year Assessment, the criterion was broken into two time frames, years 1 through 5 and 6+ years.

1. For years 1 through 5, only those generators with FERC approved interconnection agreements will be included in the planning models.
2. Beginning with year 6 and continuing into the future, generators are only required to have a Facility Study completed in order to be included in the 10-Year Assessment models.

1.2.2.a.2 Generation Retirements

On occasion, generators connected to the ATC transmission system are retired or mothballed. As a result, we developed criteria to determine when generators should no longer be included in our 10-Year Assessment models. If the generator has a completed MISO Attachment Y study, the generator will be disconnected in the appropriate load flow study models. In addition, ATC sent an annual letter to each generation owner. Generating companies were asked to identify generator retirements or mothballing that should be included in ATC's planning horizon. Generators identified as such by the customer will be modeled off line in the relevant models.

There are generators that have been publicly announced as likely candidates for retirement. However, using the disconnection criteria above, in the 2015 10-Year Assessment models we assumed the following generators were to be out of service (ATC cannot comment on whether these units have completed MISO Attachment Y studies).

ATC assumed the following generators were to be out of service

Plant Name	Zone	Installed capacity	Assumed out of service
Edgewater #3	4	57 MW	57 MW
Nelson Dewey #1	3	107 MW	107 MW
Nelson Dewey #2	3	104 MW	104 MW
Weston #1	1	51.4 MW	51.4 MW
Pulliam #5	4	47.4 MW	47.4 MW
Pulliam #6	4	70.6 MW	70.6 MW
Presque Isle #5*	2	55 MW	55 MW
Presque Isle #6*	2	55 MW	55 MW
Presque Isle #7*	2	78 MW	78 MW
Presque Isle #8*	2	78 MW	78 MW
Presque Isle #9*	2	78 MW	78 MW
White Pine #1*	2	18.2 MW	18.2 MW
White Pine #2*	2	18.2 MW	18.2 MW
White Pine #3*	2	18.2 MW	18.2 MW

Net decrease before 2015		0 MW	0 MW
Net decrease after 2015 in project deficient models		437.4 MW	437.4 MW
Net decrease after 2015 in all project models		836 MW	836 MW

*Only retired in 2025 all project models

1.2.2.a.3 Cutoff Dates for Model Modifications

For model building purposes, we assumed cutoff dates for generation changes to be included in models. In order to include the latest data in the models, cutoff dates correspond to the dates the models were built.

- 2016 models – January 15, 2015
- 2020 models – January 15, 2015
- 2025 project deficient models – January 15, 2015
- 2025 all project models – March 31, 2015

It was assumed that if the generator was available as of the cutoff date, it was available for dispatch in that grouping of models except for the units noted above.

1.2.2.a.4 Generation Projects Schedule

To maintain the schedule needed to complete this Assessment, the models were developed during late 2014 and early 2015. Only those generation projects that qualified to be included in our planning models, as of the various cutoff dates, were included in the Assessment models. For generation projects not in service by June 2015, the criterion above resulted in the following proposed generation projects being included in the applicable power flow models.

Proposed generation projects being included in the applicable power flow models

Plant Name	Zone	Installed capacity increase	Dispatched increase	Assumed in-service
Garden wind farm	2	13.4 MW	13.4 MW	Oct 2015
Glacier Hills wind farm	3	17.4 MW	0 MW	Dec 2014
Twin Falls Hydro	2	3.7 MW	0.5 MW	June 2016
Net increase by Dec 2015		13.4 MW		
Net increase 2016-2030		21.1 MW		

**wind farm Installed capacity lists is 20% of total installed capacity*

A more comprehensive discussion of proposed generation is provided on the Generation Interconnections page of the 10-Year Assessment website**.**

1.2.2.a.5 Generation Outside of the System
The model for the system external to ATC was taken from the most appropriate model included in the MMWG 2014 Series models. The external system interchange was adjusted from the 2014 MMWG Series models to match the latest ATC members' firm interchange.

1.2.2.a.6 Generation Dispatch
Balancing Authority area generation was dispatched based on economic dispatch for that Balancing Authority with the exception of the Light Load models.

1.2.2.a.7 Line and Equipment Ratings
We revised line and equipment ratings based on updates to our Substation Equipment and Line Database (SELD).

1.2.2.a.8 Project Criteria
The steady state models built for the 2015 10-Year Assessment include revised system topology based on projects that were placed in service in the model year, or were anticipated to be placed in service by June 15 of that year. Refer to Tables PF-1 through PF-3 for projects that were included in the analyses.

1.2.2.b Steady State Power Flow Models

1.2.2.b.1 Normal (Category P0) Conditions
The load flow models for the 10-Year Assessment are built to include established (pre-contingency) operating procedures to assess system performance under the normal (P0) conditions as required in the TPL-001-4 Reliability Standard. The relevant operating procedures are generally standing operating procedures that apply for the planning horizon. These procedures include, but are not limited to, normal open points and switched capacitor banks. Normal open points are assumed to remain normally open in the base cases. Changes in the status of normally open points are provided by the system planners that participate in the decision to change the status of a normally open point. Switched non-mobile capacitor banks are assumed to be available for use by the system operators, except in the case of planned outages. This availability is represented by modeling these capacitor banks in the discrete adjustment voltage regulating mode. Mobile capacitor banks are modeled in the base case when there is a known date and location in the planning horizon during which the mobile capacitor bank is planned to be in service.

1.2.2.b.2 Planned Maintenance and Construction Outages
The load flow models for the 10-Year Assessment are built to include maintenance and construction outages that are planned to occur in planning horizon. These outages are

typically conditions that are expected to last for a period of six months or more. The modeled outages are provided by the system planners that participate in the decision to schedule the maintenance or construction outage.

1.2.2.b.3 Protection Systems
All existing and planned protection systems, including any backup or redundant systems that would be applicable to a given contingency were simulated in the studies and analyses. In the steady state simulations, we simulated event based contingencies that reflect all of the elements that would be removed by the existing or planned protection system. Dynamic studies, in particular, simulate protection system operating times, associated breaker clearing times, and backup device tripping functionality.

1.2.2.b.4 Control Devices

All existing and planned control devices that would be applicable to a given contingency were simulated in the studies and analyses. These control devices include transformer automatic tap changers, capacitor bank automatic controls, SVC and the back-to-back HVDC (VSC) power flow controller.

1.2.2.b.5 Project Deficient Models
The load flow models built for the 10-Year Assessment are for system analyses in the Assessment. Some projects were purposely left out of these models in order to verify system problems and determine which problems worsen over time. We have taken the approach of evaluating subsequent summer peak seasons in each of our annual Assessments to determine the immediacy of needs identified, hence providing a means of prioritization.

The 2016, 2020, and 2025 steady state project deficient summer peak models were developed to evaluate needs, verify Assessment findings of the previous years, and confirm that previously identified needs will increase over time. The 2025 project deficient models reflect years sufficiently forward in time to determine the need for and assess the performance of larger-scale projects (345 kV lines, for example) that could be expected to be in service in that timeframe.

1.2.2.b.6 All Project Models
After the initial analyses portion of the 10-Year Assessment was completed, “All Project” models were built. The “All Project” models were built with all planned and proposed projects included as well as the majority of the provisional projects. These models are more indicative of the expected system configurations for the three study years. The “All Project” models are more appropriate for internal studies performed by ATC planners throughout the year and for regional models. As part of the 10-Year Assessment, the zone planners perform contingency analyses on each of the “All Project” models. These analyses will

verify whether all of the planned, proposed and provisional projects will resolve issues revealed in the 10-Year Assessment process and will not introduce any new limitations.

1.2.2.b.7 Load, Dispatch and Interchange Profiles

1.2.2.b.7.a Load Range Models

1.2.2.b.7.a.1 Summer Peak (2016, 2020, and 2025)

- We utilized interconnection point load forecasts provided by various distribution companies in 2014 for both real and reactive power components of load. Please refer to the Section 4.2.1, Load Forecast, for further details.
- Only firm interchange was included in the analyses.
- Mackinac VSC set to the 20 MW north to south operating point.

1.2.2.b.7.a.2 Summer Peak 90% QMax/Qmin (2016, 2020, and 2025)

- We utilized interconnection point load forecasts provided by various distribution companies in 2014 for both real and reactive power components of load. Please refer to the Section 4.2.1, Load Forecast, for further details.
- Only firm interchange was included in our analyses.
- Mackinac VSC set tothe 20 MW north to south operating point.
- Special additions: Generator QMax/Qmin reduced to 90%.

1.2.2.b.7.a.3 Shoulder Models (2020 and 2025)

- We utilized interconnection point load forecasts provided by various distribution companies in 2014. Please refer to the Section 4.2.1, Load Forecast, for further details.
- Scalable loads in Zone 2, northern Zone 4, and the remainder of the ATC system were reduced such that when non-scalable loads were reset to the LDC provided shoulder load levels, the overall Zone 2 load was modeled at 90% of summer peak, northern Zone 4 was modeled at 80% of summer peak, and the remainder of the ATC system load level was modeled at 70% of summer peak. These load levels were chosen for the shoulder models based on historical data because they are the load levels where maintenance may occur. However, it is recognized that loads at individual points will vary under real-time shoulder conditions.
- The external system interchange was adjusted from the 2014 MMWG Series 2020 and 2025 summer interchange, respectively, to match latest ATC members' firm interchange.
- Mackinac VSC set to the 20 MW north to south operating point.
- Special additions: Generator QMax/Qmin reduced to 90%.

1.2.2.b.7.a.4 Minimum Load Scenario (2016 and 2020)

- ATC Load: 5,308 MW and 5,464 MW, respectively.

- 2014 forecast collection, scalable loads reduced to 33% of peak + non-conforming off-peak loads = 40% of Peak load.
- Increased power factor of loads based on historical data.
- Total ATC Generation: 5,362 MW and 5,351 MW, respectively.
- Includes all planned and proposed projects to be in-service by 6/15/2016 and 6/15/2020, respectively.
- Interchange: Firm interchange only as of 01/15/2015.
- Dispatch: ATC-wide Merit order as of 01/15/2015.
- Mackinac VSC set to the 20 MW north to south operating point.
- Special additions: Generator QMax/Qmin reduced to 90%, 2020 model includes planned and proposed ATC projects at the 345 kV level.

1.2.2.b.7.b Load Sensitivities

1.2.2.b.7.b.1 High Load Scenario (2025)

- ATC Load: 14,967 MW.
- 2014 load forecast utilized.
- Scalable loads were increased such that when non-scalable loads were reset to the LDC provided peak load levels, the overall ATC system load was modeled at a level determined by a probabilistic 90/10 forecast. For the 2015 assessment, the increase was 105.6%.
- Total ATC Generation: 14,659 MW in project deficient model and 14,302 MW in all project model.
- Includes all planned and proposed projects to be in-service by 6/15/2025.
- Interchange: Firm interchange + internal ATC member transactions + external transactions from ATC members to Commonwealth Edison and Xcel Energy were included in the analyses to cover load.
- Dispatch: Merit order by control area as of 01/15/2015.
- Mackinac VSC set to the 20 MW north to south operating point.
- Special additions: Generator QMax/Qmin reduced to 90%.

1.2.2.b.8 Model Years

Computer simulation model years for the 2015 network Assessment analyses were selected in order to meet NERC requirements for a 1-5 year horizon and beyond the 5 year horizon. The years 2016 and 2020 were selected to meet the 1-5 year horizon. The year 2025 meets the beyond 5 year horizon. The years 2016, 2020 and 2025 were chosen to coordinate with the most recently released MMWG models that were available.

The 2015, 2020, and 2025 models were developed to evaluate needs, verify findings of the 2014 Assessment, and confirm that previously identified needs will increase over time. The

2025 model reflects sufficiently forward in time to determine the need for and assess the performance of larger-scale projects (345 kV lines, for example) that could be expected to be in service in that timeframe.

1.2.2.c Dynamic Stability Assessment Models

The process for performing dynamic stability assessments includes three types of analyses: (1) the annual review of existing generator angular stability, (2) specific generator interconnection study reports, and (3) specific voltage stability assessments.

The base cases for the annual review of existing generation angular stability for this compliance monitor period is a 2020 light load model and a 2020 peak load model based off 2013 series MMWG 2019 models, modified to include the ATC project-deficient topology for all of the ATC footprint.

The base cases for specific generator interconnect study reports are described in detail in the associated study report.

The base cases for specific voltage stability assessments are described in detail within the associated study report.

1.2.2.d Short-Circuit Assessment Models

The base case model for the annual short-circuit assessment was the ATC Near-Term Planning Horizon CAPE scenario. On an annual basis, the addition of near-term planning horizon transmission modifications are modeled in CAPE and the current interrupting capability for existing ATC BES circuit breakers and circuit switchers, used to interrupt fault current, are modeled in CAPE. The current interrupting capability is compared to the expected short circuit fault current using 3-phase and line-ground short circuit fault simulations. Mitigation plans are developed where short circuit fault current sufficiently exceed the device current interrupting capability. For our studies of new interconnections, the base model is an as-built CAPE scenario. Interconnection studies modify the as-built CAPE base case to include the new interconnected facilities and any proposed transmission system modifications.

1.2.3 Preliminary Needs and Solution Development

1.2.3.a Steady State Project-Deficient Needs Assessment

1.2.3.a.1 System Intact and Single Contingency Simulations

ATC performed system intact and single contingency simulations on the 2016, 2020, and 2025 models. Single contingency simulations included single element (line, transformer, generator, EHV bus breakers and switched shunt) and event-based breaker-to-breaker outages. We ran these simulations for all of the steady state models described above.

1.2.3.a.2 Comparison of Results vs. Planning Criteria
The models described above are analyzed and compared to the ATC Transmission System Planning Criteria. Limits that approach or exceed our criteria are then listed in a limitations table.

1.2.3.a.3 Reconciliation of Significant Changes to Power Flow Results
To reconcile changes in power flow results between Assessments, zone planners ran data comparisons to determine if limitations identified in prior Assessments have become more severe, less severe, or have been mitigated. Steps were taken to verify topology and other model changes to ensure that the results are consistent with all of the available information.

1.2.3.b Preliminary Solution Development

1.2.3.b.1 New Limitation
If a new limitation is found in the initial screening, the zone planner will take steps to ensure that the limitation is valid, including verification of the power flow model. If the new limitation is within the current five-year timeframe, the zone planner will then check for potential delayability, including investigation of operating guides or other mitigation measures.

Cost estimates are developed for one or more solution options that effectively address the identified limitations. After cost information has been obtained, the zone planner initiates the project development process by completing the project request to create a provisional project. Finally, the project request is processed through ATC's project approval process.

1.2.3.b.2 Repeat Limitation
If a previously identified limitation is found in our initial screening, the zone planner will re-verify that existing solution options address that limitation. If an in-service date or scope change is warranted, updated cost estimates are developed. The project request is then updated with the revised in-service date, cost, scope and/or justification. The updated project request is then resubmitted through ATC's project approval process.

1.2.3.b.3 Network Unspecified Network Project Process

Unspecified projects are defined as those projects which may shift into the 10-year timeframe. Unspecified projects can be the result of the following reasons.

- Changing load forecast.
- Changes in generation and distribution interconnection projects.

- Changes in public policy requirements.
- Additional projects that are driven by economic benefits or multiple outage impacts.

A significant amount of dollars were set aside in ATC's capital forecast in order to address Network Unspecified Projects. ATC begins to identify Network Unspecified Projects with internal discussions to determine how to best serve our customers local and regional needs. In these discussions, we collaboratively determine which potential projects are more likely to be built within the 10-year Assessment period. The cost and potential benefits of the project are discussed, vetted and approved by our executives. After consensus is reached, the ATC capital forecast is updated to include these Network Unspecified Project dollars.

1.2.3.c All Projects Assessment

After the 10-Year Assessment analysis is completed, models are built that include all planned, proposed and some provisional projects. These models are called "All Projects" models and are more indicative of the expected system configurations for 2016, 2020, and 2025 study years. These models may be appropriate for internal planning studies performed throughout the year.

As part of the 10-Year Assessment, zone planners perform a contingency analysis on each of the "All Projects" models. The contingency analysis includes systematically removing each line, generator, transformer, switched shunt and modeled EHV bus breakers individually to determine the effect on the transmission system. The analysis will verify whether all of the planned, proposed, and provisional projects will resolve issues revealed in the Assessment process.

This All Projects Assessment provides a list of reinforcements that are beginning to refine our reinforcement plan. The following are three important questions regarding this plan.

- How do the reinforcements for all the zones perform together?
- Does applying a solution in one zone create a problem that was not seen before in another zone?
- Are some zone solutions redundant when all the solutions are applied to the system?

We attempt to address the first two questions, in our 10-Year Assessment. Models for years 2016, 2020, and 2025 were built that included reinforcements reflecting our best thoughts on all of the most likely planned, proposed and provisional projects to address the identified issues. These projects are those identified in the project tables for this Assessment with specific in-service dates. First contingency analysis was performed on these new models, including selected outages on neighboring systems. This analysis showed that one new reinforcement needed to be developed. This reinforcement was simulated and shown to fix the limitation in a separate zone planner analysis. The third question is addressed during our detailed project development process.

1.2.4 Other Studies

1.2.4.a Multiple Element Outage Review and Analysis

ATC performs a comprehensive steady state evaluation of the applicable multiple element outage type planning events and extreme events in the NERC TPL-004-1 Reliability Standard. These evaluations are performed on either an annual schedule, a rolling periodic schedule, or interconnection study specific schedule. The discussion of these contingencies with "load loss allowed" is covered below.

Category P2 - P7 Outages
Generally, ATC performs a comprehensive analysis of each applicable NERC Category P2 - P7 multiple element outage in the ATC system with "load loss allowed" on a three year cycle. There are presently no DC lines in the ATC system. Therefore, no P3.5, P6.4 and P7.2 contingencies are performed. The assessment of contingencies outside of the ATC system are based on MISO's annual MTEP reliability analyses.

Category E Outages
ATC performs a sufficient assessment for each applicable category of Category E extreme events analyses. The assessment of contingencies outside of the ATC system are based on MISO's annual MTEP reliability analyses.

1.2.4.b System Stability Review and Analysis

ATC generally investigates three type of system stability: steady state voltage stability, dynamic voltage stability and dynamic angular (e.g. generator) stability.

The specific system performance criteria that are used to assess each type of system stability are given in the ATC Transmission System Planning Criteria.

Steady State Voltage Stability
The steady state voltage stability analysis (e.g. P-V Curve simulation) is performed on a specific area of the ATC system when general steady state analysis indicates areas of very

low voltage or voltage collapse (non-convergent simulations) for NERC TPL-001-4 reliability standard requirement contingencies in the near or longer term planning horizons. Additionally, each dynamic study performed by ATC screens for voltage stability issues through the application of the ATC voltage recovery criteria described in the ATC Transmission System Planning Criteria. If general steady state or dynamic analyses identifies areas of weakness indicative of voltage instability, further examination of system characteristics and, possibly, more detailed analysis will be performed.

Dynamic Voltage Stability

The dynamic voltage stability analysis is performed on a specific area of the ATC system when general steady state analysis indicates areas of very low voltage or voltage collapse (non-convergent simulations) for NERC TPL-001-4 reliability standard requirement contingencies in the near or longer term planning horizons. Dynamic voltage stability analysis can reveal results where the voltage at some buses will collapse and not recover to acceptable values found by steady state analysis, which assumes that system "rides through" the dynamic recovery period.

Dynamic voltage stability analysis is assessed for any new or revised generation interconnection facilities before they are placed in service.

When dynamic analysis is performed, very large loads may be modeled with specific dynamic models and the remaining loads are modeled with using lumped dynamic load models that depend on the percentage of industrial, commercial, agricultural and residential load at each distribution load interconnection point.

Dynamic Angular (Generator) Stability

The dynamic angular stability of all major generation facilities in the ATC system is assessed on a five year rotation. Generation facilities may be assessed in less than five years, if there are significant changes to the generator exciter, the generator governor, a power system stabilizer, the generator step up transformer, or nearby system topology. In addition, dynamic angular stability is assessed for any new generation facility before it is placed in service.

Generation facilities with a total net output above 100 MW and associated transmission lines operating usually above 100 kV are normally selected for system angular stability assessment. The methodology used in assessing the major generator stations includes:

1. A review to determine that no significant system topological changes have occurred near the generator stations other than local load growth.
2. A review of the parameter values and the model types used in representing the dynamic response of units at the generator stations in system angular stability simulations to determine that no significant changes have occurred.

3. A review of the date of the last stability study conducted for each of the major generator stations to determine that the elapsed time does not exceed 5 years.

The assessments take into account applicable simulation requirements and performance requirements in the NERC TPL-001-4 reliability standards, as well as the ATC dynamic performance criteria, which cover compliance with the TPL-503-MRO-1 reliability standard requirements.

ATC observes a ½ cycle margin required for tested generator data and a 1 cycle margin required for planned generator data. These margins are observed between the Maximum Expected Clearing Time (MECT) and Critical Clearing Times (CCT) that lead to unacceptable system instability.

Small Signal Stability

Since no previous studies have found any small signal instability situations in the ATC system and the MRO recently retired its small signal stability standard, no small signal stability assessment was performed this year.

1.2.5 Documentation

1.2.5.a Writing/Approval Processes

The 10-Year Assessment is written and developed by several contributors. The following steps are performed in order to ensure cohesive, consistent information.

- Requests are made for the latest financial, demographics, asset renewal and economics information from other ATC departments.
- Drafts of text, figures and tables are compiled for peer review.
- A summary presentation of Assessment information is reviewed and approved by ATC management.

Once the information has been approved by all parties, the hard copy Summary Report is printed and distributed. The Summary Report and additional details are posted at www.atc10yearplan.com.