NTTG 2012-13 Study Plan

Background

The Northern Tier Transmission Group was formed in 2007 as an outgrowth of earlier sub-regional transmission coordination efforts and as an extension of the transmission planning and stakeholder participation processes of Transmission Providers in the Northern Tier footprint (or service region).

Transmission Providers – a term defined by the Federal Energy Regulatory Commission – are mandated by FERC's Order 890 to conduct a transparent and open planning process at the local, sub-regional and regional levels, and to provide for timely and meaningful participation by stakeholders in development of transmission plans. These local planning processes are described in Attachments K to the participating Transmission Providers' Open Access Transmission Tariffs. These attachments also describe the Transmission Providers' participation in sub-regional planning via Northern Tier.

The framework of the sub-regional planning process is defined in the Northern Tier Transmission Group's Planning Committee Charter. The charter establishes the Planning Committee with the responsibility *"for coordinating transmission planning within the NTTG footprint, coordination with other sub-regional planning groups and the WECC planning committees."*

As part of the sub-regional planning process established by the Planning Committee Charter, this study plan is developed and reviewed with stakeholders to provide an agreed framework for conducting the planning study.

Introduction

The Northern Tier Transmission Group's biennial planning cycle provides an eight-quarter framework for the creation of a ten-year bulk transmission expansion plan that provides strategic transmission options and specific alternative plans for reinforcing the transmission system. From the charter:

> **Quarter 2**: Study plan development and assumptions – The identification of the loads, resources, transmission requests, desired flows, constraints, etc. to be included and monitored during the study period. The methodology, criteria, assumptions, databases, and identification of the analysis tools will be established and posted for comment and direction by stakeholders and Planning Committee members.

The planning process begins with the identification of transmission customer needs as identified by transmission providers. These needs include native loads and resources forecasted by Balancing Authorities and network transmission customers, as well as service needs (including receipt and delivery points) of point-to-point transmission customers.

The objective of the transmission study effort is to perform a conceptual study that determines, given a limited number of load and resource scenarios, what general transmission improvements are required to provide a feasible system operation at times of transmission stress ten years in the future. This study plan provides additional detail to the planning committee charter's framework, describing the data, assumptions, methods and processes that will be used.

The study begins by developing a "null case" from a new TEPPC 2022 economic dispatch case. NTTG Planning decided to use this case and extract a heavy summer export hour from the production cost database. The case starts from the TEPPC 2022 economic dispatch case, with incremental resources designed to balance loads in year 2022. In developing the null case, it is necessary to back out the common case transmission (CCTA) projects (see Appendix A). This is done in order to demonstrate any transmission deficiencies that occur within the Northern Tier footprint due to the forecasted load growth over the next ten years if no additional transmission is built.

Several core load and resource base cases will be also be developed using data from the TEPPC 2022 production cost model for various stressed hours (see Study Methodology below). The CCTA transmission facilities that are likely to be in service in the next ten years will be included in these cases. These core cases may then be augmented by resource expansion scenarios. These will be based on recommendations from the NTTG Planning Committee

All "core cases" will then be tested, using a commitment and dispatch program, against the load and resource scenarios under different operating conditions across the year 2022 to determine where problems may exist. For the most problematic hours, the load and resource states will be exported to a power flow program, where simple (generic) transmission modifications will be made to ascertain what types of improvements produce a reliable network at least cost.

The most effective of these modifications (those that solve the most problems at the least cost) will again be tested (in the commitment and dispatch program) against the load and resource scenarios across the year to determine when the most congested conditions occur. The loads and resources on those hours will then be exported back to the power flow program and used to study the initial transmission network augmented by specific proposed transmission projects that most resemble the effective generic additions. This analysis will be a full contingency study to assure a reliable system in 2022

Study Plan

Objectives of the Study

From the Northern Tier Transmission Group's Planning Committee Charter:

> The planning group will biennially prepare a long-term (10 year) bulk transmission expansion plan, while taking into consideration up to a twenty year planning horizon. The plan will provide strategic transmission options (economic and reliability projects) and specific alternative plans for reinforcing the transmission system. The plan is also intended to help coordinate the integration of new generation into the system and to reduce transmission congestion. The work is intended to be completed primarily by the transmission owners in the footprint utilities with input from all interested stakeholders.
>
> Specifically, the comprehensive transmission plan and/or planning process will:
>
> 1. Identify transmission needs of transmission customers (e.g., point-to-point, network, and retail native load), as they are identified and provided to the transmission provider. The transmission provider shall consolidate this information for their respective system to include in the sub-regional planning process.
>   a. Native load needs will be incorporated by input from the various integrated resource planning (IRP) processes where they exist. Network transmission customers will be asked to submit information on their projected loads and resources on a comparable basis (e.g., planning horizon and format). The intent will be to plan for all end-use loads on a comparable basis.
>   b. Each transmission provider's existing point-to-point customers will be asked to submit any projections they have of a need for service over the planning horizon and at what receipt and delivery points.
> 2. Identify transmission congestion that is an impediment to the efficient operation of electricity markets. Congestion on the existing and planned system will be reviewed and evaluated. In addition, the impacts on congestion of potential new generation facilities or new transmission projects will be considered. This will include production simulation studies on a sub-regional and regional level, and historical use analysis as provided by the Northern Tier Use Committee and TEPPC subcommittees.
> 3. Work with TEPPC to include the needs of other sub-regions and support WECC transmission planning.

The objective of the 2012-2013 Northern Tier transmission study effort is to perform a Conceptual Study that examines a limited number of forecasted and assumed load and resource portfolios, to determine where transmission improvements are needed and which of the sub-region's set of proposed transmission additions (if any) are required to provide a feasible system operation at forecasted stress times, ten years in the future.

Investigative or screening analyses will be performed in the second half of 2012 to assess what types of transmission modifications will be needed within the Northern Tier footprint to adequately serve forecasted loads under alternative resource scenarios. A draft transmission plan report will be prepared in early 2013 that will describe the shortcomings of the current grid in serving 2022 needs and the types of improvements that overcome them.

The first half of 2013 will then be used to process the economic studies and determine cost allocations. The second half of the 2013 will be spent in preparing and reviewing the planning report.

Confidentiality

The studies to be undertaken in developing the transmission plan will employ and report on data that have, in part, been classified by their providers as Critical Energy Infrastructure Information, Confidential Transmission Information, or Proprietary Market Information. Care will be taken to protect such data from unauthorized disclosure.

Any document or file containing confidential information will be marked with its type(s) of confidential contents.

An effort will be made to maximize declassified communication by avoiding the inclusion of small amounts of classified data and by, where practical, separating documents into classified and unclassified portions (such as an unclassified report with some classified attachments).

Stakeholders may have access to classified information in accordance with tariffs and regulatory filings delimiting such access and establishing the required non-disclosure agreements.

General Schedule and Deliverables

The broad timing of the transmission plan development process and the work products to be delivered are presented in the NTTG Planning Committee Charter:

Quarters 3 and 4: Draft plan analysis – The modeling of the system loads, resources, improvements, etc. to be considered. Technical screening studies using power flow analysis will be used to evaluate preliminary feasibility of and reliability of the system. Addition or modification of transmission elements considering past economic studies, and to meet performance and study criteria established in the study plan will be identified, resulting in a draft transmission plan for public and stakeholder comment.

Quarter 5: Draft study results – Stakeholder review and comment on the draft plan. Any stakeholder may submit comments, additional information about new or changed circumstances relating to loads, resources, transmission projects or alternative solutions to be evaluated as part of the preparation of the draft transmission plan, or submit identified changes to the data provided in Quarter 1….

Collection of economic study requests for consideration and determination of possible congestion and modification to the draft plan….

Quarter 6: Economic studies and cost allocations.

Quarter 7: Final plan report

Quarter 8: Final plan approved by NTTG Steering Committee

Methodology

1. Time Frame
    a. 10 years in the future

    From the NTTG Planning Committee Charter: *The planning group will biennially prepare a long-term (10 year) bulk transmission expansion plan, while taking into consideration up to a twenty year planning horizon.*

    Proper analysis of the Northern Tier transmission system requires data and models that describe the entirety of the Western Interconnection due to the significant transmission ties between sub-regions and the substantial energy trading markets that span the interconnection. Consequently, Northern Tier bases its work on the data collection and validation work of the WECC and its committees.

    While a ten-year plan here would look at 2021 and 2022, the time required to develop the WECC base cases leads Northern Tier to look at the 2022 time frame used in the current TEPPC study series.

    b. One-hour focus

    NTTG studies will examine the adequacy of the Western Interconnection using techniques consistent with established planning methods, focused on anticipated times of system stress. System stress will be analyzed using integrated one-hour loads and resources. To find periods of stress, which may arise from times of peak load or reduced resource availability, or simply from large geographical disparities in loads and resources, a chronological security-constrained generator commitment and dispatch model will be run across the 8,760 hours of 2022 to find specific hours when energy flow from resources to loads is most constrained[1].

[1] Summary slides of the TEPPC 2022 data analysis for determining five one-hour stressed conditions is included in Appendix B. Slide 1 shows the dates and hours where data will be extracted to create the five core cases.

2. System Conditions to Study

   Northern Tier Transmission Group studies will, as noted above, go beyond traditional focus on snapshots of winter and summer peaks to examine all hours of the year for situations where available resources and forecasted loads across the Western Interconnection cause highest stress on the transmission system in the Northern Tier footprint. Five different core cases will be studied based on the TEPPC data analysis (see footnote below). These are: 1) peak coincident NTTG summer load; 2) peak coincident NTTG winter load; 3) maximum coincident NTTG net export; 4) minimum coincident NTTG export; and 5) maximum COI plus PDCI southbound flow.

3. Bases Cases Selected

   To perform its studies, Northern Tier will rely on the region-wide data collection and model development work of TEPPC's Technical Advisory Subcommittee. Their extensive efforts to acquire, review and agree on the many datasets needed in these studies not only saves considerable work by Northern Tier, but provides a widely-accepted and well-vetted starting point. TEPPC in turn relies on the load and resource and transmission network modeling of WECC's Planning Coordination Committee. Both of these groups (TEPPC and PCC) develop reference base cases used for subsequent WECC studies and for the use of WECC members in their own work. A flow chart showing the NTTG study case process is in Appendix C.

   a. <u>Developing the System Model:</u>

      Following the NTTG 2010-11 planning cycle, the NTTG decided not to repeat the process for creating the Null case by starting with a near-term WECC base case. In the previous cycle it was found that escalating the NTTG loads forward 10 years without additional network resources, lead to an unstable network. Instead, NTTG Planning decided to use the core case with one hour heavy summer export from the production cost database and back out the common case transmission (CCTA) projects. The core case starts from the TEPPC 2022 economic dispatch case, with incremental resources designed to balance loads in year 2022.

   b. For security-constrained economic commitment and dispatch modeling, TEPPC has developed a production-cost case, labeled 2022 PC0, to underlie the series of cases they will be analyzing during the summer of 2012. This case is itself based on the TEPPC 2020

power flow base case, with transmission modified to reflect known or highly likely future changes. These transmission upgrades make up the Common Case Transmission Assumptions (CCTA)[2]. This TEPPC case will also be a starting point for the Northern Tier "null" case, where adjustments will be made to incorporate sub-regional data submitted during the Q1 request, and to remove the added transmission facilities that make up the CCTA. Studies performed with the null case will demonstrate whether the existing network is adequate to handle the load growth over the next ten years.

4. Times of Stress and Congestion Metrics

   In order to determine times of stress, the results of simulating the Western Interconnection across the hours of 2022 for alternative load and resource scenarios will be examined heuristically and a consensus judgment made with regard to which hours will be further studied. To aid the assessment, the following data and statistics will be extracted from the simulation runs:

   a. Flows on WECC-defined transmission paths and selected transmission branches within or connecting directly with the Northern Tier footprint;
   b. Number of hours during 2022 that flows on monitored paths and branches exceed 75%, 90% and 99% of their ratings;
   c. Gigawatt-hours of unserved load or unusable generation resulting from inadequate transmission;
   d. Differences in locational marginal prices between WECC market hubs.

5. Contingencies to be Run

   In performing screening studies, the ability of power flow programs to automatically test contingencies will be exercised, using contingency lists provided by Northern Tier's member Transmission Providers. These lists will include significant single outages of transmission elements or generators. Any violations will be noted in assessing the adequacy of tested transmission improvements, but detailed analysis and corrective actions will not be pursued.

[2] The CCTA is a list of likely future transmission projects put together by the WECC sub-regional coordination group (SCG). The CCTA report is in the appendix.

In the detailed power flow analyses to be performed in the fifth quarter, contingency studies will be reviewed by representatives of each Transmission Provider to ascertain which observed criteria violations are credible and what corrective actions would be taken to produce an accepted study.

Criteria

The viability of power flow studies will be determined in accordance with WECC and NERC criteria.

The primary metric for power flow success is service of all demand in the Northern Tier Transmission Group footprint and export of a substantial portion of sub-regional surplus generation.

Assumptions

1. The study will incorporate the loads, resources and transmission submitted in the Quarter 1 (Q1) data request, with details provided as requested to assigned engineers in order to perform required analyses. Comparing this information with what was supplied in 2010 will help in determining what has changed in the two-year period and what studies should be performed in the current cycle.

2. Loads

   A set of loads was provided in response to the Q1 data request, consisting of forecasted area loads for Balancing Authority Areas internal to the Northern Tier footprint. These loads are generally those in the participating load serving entities' official load forecasts (such as those in integrated resource plans) and are similar to those provided to the Load and Resource Subcommittee of the WECC Planning Coordination Committee. Loads will be expanded, where necessary, from forecasted peaks and averages to hourly loads for use in the security-constrained economic commitment and dispatch programs. Table 1 below shows a load comparison from data submitted during Q1 of 2012 compared with loads that were in the 2010HS case used in the last NTTG planning cycle. PacifiCorp was the only one to submit any DSM numbers in both requests. The amount of incremental DSM in the ten-year forecast this cycle is 125 MW compared to 299 MW that was submitted last cycle.

Table 1 - Load Comparison Chart		10yr Summer Load Data submitted in Q1 2012	10yr Summer Load in 2010 NTTG base case	Difference
Avista		2249	1908	341
Basin Electric		476	481	-5
Black Hills		465	462	3
Idaho Power		4383	3116	1267
Northwestern		1680	1698	-18
PacifiCorp East		9842	8500	1342
PacifiCorp West		3795	3573	222
Portland General		4119	3791	328

3480 NET DIFF

3. Resources

Resources provided in response to the Q1 data request are incremental to existing resources within the Northern Tier footprint and are summarized in Table 2a (2010 submittal) and Table 2b (2012 submittal). Resource data comes from integrated resource plans, interconnection queues, resource developers, and transmission providers who provide indications of expected resource additions.

Table 2a: Resource Additions Identified in Q1 Data 2010 Submittals

Q1 RESOURCE DATA SUMMARY

Resources added by 2020 (MW Capacity)

From 2010 Q1 Data Response

Submitter	*Natural Gas*	*Wind*	*Geo-thermal*	*Hydro-Electric*	*Coal*	*Market*	*TOTAL*
Basin Electric	*0*	*0*	*0*	*0*	*385*	*0*	*385*
Grasslands Renewable Energy	0	0	0	350	0	0	*350*
Idaho Power	300	150	40	49	0	425	*964*
NWMT	890	2195	0	50	290	0	*3425*
PacifiCorp	1574	1156	0	39	0	1870	*4639*
PCW	0	3000	0	0	0	0	*3000*
PGE	450	700	0	0	0	0	*1150*
Transwest Express	325	2900	0	0	0	0	*3225*
Transcanada Chinook/Zephyr	0	3000	0	0	0	0	*3000*
TOTAL	*3539*	*13101*	*40*	*488*	*675*	*2295*	*20138*

Table2b: Resource Additions Identified in Q1 Data 2012 Submittals

Q1 RESOURCE DATA SUMMARY

Resources added by 2021 (MW Capacity)

From 2012 Q1 Data Response

Submitter	*Natural Gas*	*Wind*	*Solar*	*Biomass*	*Oil*	*Geo-thermal*	*Hydro-Electric*	*Coal*	*Market*	*TOTAL*
Avista		*100*								*100*
Black Hills (IRP)	55									*55*
Idaho Power	300	201	20	43		52	49		470	*1135*
NWMT	46	709					23			*778*
PacifiCorp	1627	1240	17	92	47	65	10	20	961	*4079*
PCW		3000								*3000*
PGE	650	1301								*1951*
TOTAL	*2678*	*6551*	*37*	*135*	*47*	*117*	*82*	*20*	*1431*	*11098*

Resource information provided in data submittals also includes information regarding proposed resource locations, but is not detailed here to protect confidentiality or because specific locations, beyond state names, has yet to be provided.

Resource operating parameters will also need to be acquired from developers or assigned by analysts (based on similar generators already modeled in the base TEPPC case). In addition, the TEPPC base case contains some identified future generators and some generic generators, added to balance loads and resource in 2022.

4. Transmission

A number of specific transmission projects were identified in response to the Q1 data request. To analyze the projects in quarter three, additional project details will be solicited from project sponsors for those that did not provide the detail in their initial response.

Table 3: Transmission Projects Submitted to Northern Tier

* indicates that this facility was included in the last cycle

Black Hills	230 kV	Teckla-Osage-Lange [WY]
Idaho Power Co.	500 kV	*Boardman-Hemingway [ID-OR]
	500 kV	*Gateway West (with PacifiCorp) [WY-ID]
Northwestern Energy	500 kV	*MSTI Project [MT-ID]
	500 kV	*Montana Intertie (Path 8) Upgrade [MT-WA]
	230 kV	*AMPS line (Path 18) Upgrade [MT-ID]
	230 kV	*MSTI Collector (up to 5 segments) [MT]
PacifiCorp	500 kV	*Gateway Central [ID-UT]
	500 kV	*Gateway South [WY-UT]
	500 kV	*Gateway West (with Idaho Power) [WY-ID]
	500 kV	*Hemingway-Captain Jack [ID-OR]
	230 kV	*Walla Walla-McNary [WA-OR]
Portland General	500 kV	*Cascade Crossing (Boardman-Salem) [OR]
	230 kV	Horizon-Keeler [OR]
	230 kV	Blue Lake-Gresham [OR]
	230 kV	Pearl-Sherwood [OR]

<u>Facilities from Last Cycle not submitted in current cycle:</u>

Grasslands Renewable	230 kV	Collector System [MT]
	500 kV	DC line, Colstrip to Bismarck {MT-ND]
TransCanada	500 kV	Chinook Project (AC+DC) [MT-ID-NV]
	500 kV	Zephyr Project (AC+DC) [WY-ID-NV]

5. Comparison Conclusions:

   The comparison tables show that although load growth has slowed in some areas, there is still a significant increase in load since the last ten-year forecast. However, the amount of new resources submitted is down significantly (9000 MW w/o DSM). Of this amount, 7600 MW of the reduction is wind generation, where 3000 MW was double-counted in the last cycle and 3000 MW from the TransCanada project was not submitted this cycle. Northwestern reduced their latest forecast by 2647 Mw to represent only committed projects. Another 350 MW went away with the Grasslands project. Basin's coal plant (385 MW) submitted last time is now in service.

   Since there have been some significant changes in forecasted load, resources, and transmission facilities, the work group plans to repeat the null and core case studies that were performed during the last study cycle.

Databases

The primary source of power flow model data will be the Western Electricity Coordinating Council, which makes such data available in formats familiar to those performing power flow studies in the Western Interconnection. The modifications made to the 2020 Case by the TEPPC work groups in developing their 2022 PC0 case have been obtained in a format that, when applied to the original power flow case, provide a power flow case equivalent to the network modeled within the TEPPC security-constrained economic commitment and dispatch program. Any transmission modifications made by Northern Tier will be collected and made available in the same format.

The database underlying the commitment and dispatch model is, as noted above, the dataset developed for the TEPPC 2022 PC0 case. The data is made available within a platform called PowerBase that is proprietary to the model vendor (Ventyx) that provides WECC with PROMOD, its commitment and dispatch model.

In addition, cases may be exported from the PowerBase system to a Microsoft Access database in a form labeled Portable Database Format, or PDF. This Access database may then be converted into the Access database format used by ABB's GridView model, another commitment and dispatch model used in the Western Interconnection that can also be used to simulate the cases.

All modifications made to the TEPPC PC0 case to establish the Northern Tier cases will be collected and identified, and made available for use by others (within confidentiality constraints) as PROMOD case files and GridView scenario files (these programs are described next).

Analysis Tools

Reliability analyses are conducted using power flow programs which, given a snapshot of loads and resources, determine whether the transmission grid can be operated to allow the electricity to flow reliably. Economic congestion studies are performed using security-constrained hourly chronological generator commitment and dispatch programs that find feasible and least-cost resource operations, which deliver electricity from generators to loads distributed across the same underlying transmission grid modeled in the power flow programs.

In this study cycle, the Power World power flow program will be used to develop the initial transmission network. Northern Tier will also use this program to conduct the screening analysis in quarters three and four of the biennial cycle, to determine, for each of the load and resource scenarios, what general transmission additions are needed to allow reliable system operation. To generate hourly load and resource patterns, the Ventyx PROMOD and ABB GridView programs are available to Northern Tier's technical work group and economic studies team. PROMOD is the program currently used by WECC staff and others in performing the Transmission Expansion Planning Policy Committee's analyses, while the GridView model is used by a number of entities in the Western Interconnection to perform comparable studies. GridView appears to provide some technical advantages with regard to the study process proposed for Northern Tier in this planning cycle, though they are not yet proved.

Study cases will be maintained in the Power World and GridView databases and made available to stakeholders interested in verifying, further analyzing, or extending the work done in this planning process, provided that appropriate steps are taken to maintain confidentiality.

Constraints

Path constraints (also referred to as interface limits) will be as defined in WECC's Path Rating Catalog, as modified by TEPPC in its PC0 case, and as further agreed by the Northern Tier Planning Committee. Because of the complexity of the WECC Path Rating Process, transmission projects added to the initial transmission grid that connect the same areas connected by defined paths, will not be added into those paths' definitions. Instead, their transfer limits will be set according to their thermal limits or to any announced rating being sought by the sponsor of the project.

Study Procedure

Technical Work Group

The Technical Work Group reports to the Northern Tier Planning Committee and consists of assigned engineers from planning committee members who are Transmission Providers or members who otherwise will assign transmission planning engineers to this study effort. The

TWG is responsible for collecting, reconciling and preparing data, clarifying assumptions, running simulation programs, analyzing results, identifying and testing solutions, and reporting outcomes.

Due to the technical nature and multiplicity of the computer programs used, the varying experience of participating engineers in working with the programs, and the need to work among companies with different resources, the operation of the computer programs will be done by two teams within the TWG.

The Power Flow Team will consist of engineers with access to and experience with the Power World power flow program, supported by the other members of the TWG.

The Economic Studies Team will consist of engineers with access to and experience with the two principle security-constrained hourly chronological economic commitment and dispatch programs, PROMOD and GridView; again supported by the other members of the TWG.

Data Preparation

The Technical Work Group will review and analyze the data submitted to Northern Tier in Q1, identify and obtain additional data and clarification needed to develop the studies, and prepare the data for use in the computer programs. Data and assumptions will be well-documented and reported to the Planning Committee for correction and approvals (with proper protection of confidential information) before studies are accepted.

Data needed for the Northern Tier study process include:

1. Hourly loads for 2022 for TEPPC load-areas within the Northern Tier footprint,
2. Generator details for resources submitted in response to Northern Tier's Q1 data requests, including:
    a. For thermal generation, the interconnection, cost and operating details required by PROMOD and GridView
    b. For wind generation, the capacity and location of the projects
    c. For hydroelectric projects, the location, capacity and energy (monthly or hourly), and other relevant characteristics (dependent on operating modes) for the projects
3. Transmission data, both for 'committed projects' needed to build the initial case, and for the transmission projects identified in response to Northern Tier's Q1 request for data, including

a. Definition of the project, in .aux format, including buses, branches, transformers and other devices

b. Operating information (line ratings, operation of phase shifters, flows on DC line segments, etc)

Core Case Creation

Besides the null case, a number of load and resource conditions will be developed and studied by the Technical Work Group. Five core cases have been recommended by the work group:

1. Case representing peak coincident summer loads within the NTTG bubble.
2. Case with peak coincident winter loads in within NTTG.
3. A case representing maximum coincident export conditions from the NTTG footprint.
4. A stressed case representing minimum coincident exports from the NTTG footprint.
5. A case representing maximum COI plus PDCI flows.

Loads and resources for all areas outside the Northern Tier footprint will be as specified in the TEPPC PC0 case.

Null Case Analysis

Using the modified 2022 base case (described in the Methodology section above) with the CCTA transmission removed, an attempt will be made to produce a 2022 solved power flow case. This null case will indicate whether additional transmission facilities may be needed in the next ten years. Development and execution of the initial network case will proceed in parallel with this case to avoid delay, as it is anticipated that the null case will fail.

Initial Transmission Network

TEPPC used the TEPPC 2020 case to develop a 2022 PC0 base case, by importing the power flow base case and then replacing the "foundational transmission list" with facilities that were deemed to be committed transmission upgrades needed for native load service or to meet identified reliability needs, with a high likelihood of being in service before 2022 (see CCTA report in Appendix A). This 2022 PC0 case will be used by NTTG for developing all of the core cases.

Determining Loads & Resources at Times of System Stress

Using the GridView program with the initial transmission network properly represented, the economic studies team will analyze the five load and resource scenarios across the hours of 2022.

Congestion and cost outputs will be reviewed to identify a limited number of hours where paths were severely congested, load went unserved or economical resources could not be used. The load and generation levels on those hours will be exported as snapshots for closer analysis in the power flow programs.

Screening Studies

Beginning with the initial transmission network and the stressed-hour snapshots, the power flow team will use the Power World program to test simple *ad hoc* modifications of the transmission network, such as adding a high-voltage branch between substations, to identify generic fixes that provide substantial relief of identified stresses in as many situations and at as low a cost as might be found. A minimal set of what are judged to be the best generic fixes will be selected for further analysis. The generic fixes may be different for different load and resource scenarios, though a criterion for selecting 'best' fixes will be that they relieve stress under multiple scenarios.

Determining Times of System Stress with Generic Fixes

The transmission modifications made in the selected set of generic fixes will be reproduced in the GridView program and run against the five core cases. Program outputs will again be examined to identify a minimal number of hours on which loads and dispatched resources show the greatest stress. These load and resource configurations will be exported back to the power flow program.

Draft Transmission Plan

The choice of generic fixes and the results of the commitment and dispatch analysis will form the basis for the draft transmission plan to be reported at the end of 2012. The report will document the work done to that point, describe the rationale for selecting the generic fixes and evaluate their effectiveness in reducing congestion and otherwise improving system operation.

Together with stakeholder review and feedback, the draft plan will lead to a more focused and comprehensive evaluation to be performed in the second year of the planning cycle.

Adequacy and Reliability

During the biennial planning cycle, the potential improvements to the transmission grid in the Northern Tier footprint will be subjected to a contingency analysis, to see whether they continue to provide load service without violating voltage or current limits after critical transmission elements or appropriate pairs of elements are taken out of service.

Where practical, the generic additions of the earlier analyses will be replaced by specific transmission projects submitted for consideration in response to the Q1 data request. In the event that multiple projects provide comparable relief, an effort will be made to discern and

quantify differences in the relief provided, or to provide a qualitative assessment of the projects in the context of the scenarios considered and the level of study performed.

The fifth quarter will also provide a three-month window for stakeholders to introduce additional economic study requests or provide other data that might be of value in the planning process.

Additional Economic Congestion and Power Flow Study

Quarter six of the eight-quarter planning cycle provides a further opportunity to perform economic studies and power flow analyses to address questions that arise out of earlier analysis, or to incorporate new data or developments that might improve the transmission plan.

This quarter will also be used to develop the transmission plan final report.

Final Transmission Plan

The final transmission plan will be contained in a comprehensive report that, upon stakeholder review and comment, will be presented to the Northern Tier Steering Committee for its review and acceptance before the end of the final quarter of the 2012-13 biennial planning cycle.