Orange & Rockland

LONG-RANGE TRANSMISSION PLAN 2022-2031

Transmission and Substation Engineering Department
October 29, 2021

LONG-RANGE TRANSMISSION PLAN 2022-2031

Prepared by:

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Roleto Mangonon, Principal Engineer
Transmission and Substation
Engineering Department

Date Issued: October 29, 2021

Next Review: October, 2023

TABLE OF CONTENTS

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Long Range Transmission Plan (“Plan”) of Orange and Rockland Utilities, Inc. (“Orange and Rockland”) is focused on achieving the objective of reliably serving forecasted loads over a 10-year planning horizon under certain conservative assumptions. The Plan both meets this objective and adheres to Orange and Rockland’s Transmission Planning Criteria (Appendix A). Although the assumptions were based on the approved 2022-2031 Orange and Rockland Capital Budget, the Plan may change over time in order to adapt to changing future conditions which include: variations in load forecast and load distribution, evolving new generation development projects, merchant transmission projects, demand side management programs, evolution in the regulatory and/or power market rules, and advancements in transmission technology.

The Plan models system conditions on the three divisions of Orange and Rockland, namely, Eastern Division (Rockland County and North Bergen County, New Jersey), Central Division (Orange County and portions of Passaic County, New Jersey) and Western Division (Orange County, Sullivan County and Pike County, Pennsylvania). First contingency conditions were tested on the three divisions and identified thermal and voltage limit violations as well as the corresponding MW deficit. The Plan also identified solutions to mitigate these violations and recommended projects to eliminate the deficiencies in the Orange and Rockland transmission system. The recommended capital projects include the following:

1. Increasing the capacity of existing transmission components by:
   a. Re-conductor of existing transmission line with higher ampacity conductor or the use of high temperature low sag (HTLS) conductor;
   b. Installation of parallel transmission transformer;
   c. System modification of existing transmission facilities (i.e. termination of longer transmission lines on adjacent stations to create parallel transmission paths);
2. Upgrade of existing facility to higher voltage;
3. Installation of transmission capacitor banks at various transmission substations as well as distribution substations; or,
4. Combinations of the above.

I. OVERVIEW

This document lays out Orange and Rockland Utilities' plan for the transmission system over a 10-year planning horizon[1]. Recognizing future uncertainties, the Plan should be viewed as a robust yet flexible framework or roadmap for direction rather than a well-defined series of projects to be implemented on a set schedule. Decisions on the implementation of specific projects are made based on reliability needs which are affected by numerous factors, including the economy, customer usage behavior, demand side management efforts and developer projects. Although the assumptions were based on the approved 2022-2031 Orange and Rockland Capital Budget, the Plan may change over time in order to adapt to future conditions and assumptions.

A. Factors Affecting the Long-Range Transmission Plan

The following are the various factors that will affect the Plan:

i. Changes in reliability requirements;
ii. Changes in econometric load forecasts;
iii. Impact of demand side management programs (DSM);
iv. Impacts from the State's Energy Efficiency Portfolio Standard (EEPS) and Renewable Portfolio Standard (RPS) programs[2];
v. Other state and national policy programs such as the Regional Greenhouse Gas Initiative (RGGI),
vi. New merchant generation and transmission;
vii. Decisions under the New York Independent System Operator's (NYISO's) Comprehensive Reliability Planning Process (CRPP)and FERC Order 890;
viii. NYPSC's Reforming the Energy Initiative (REV) Initiative; and
ix. Potential new legislation on the interconnection-wide planning process.

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[1] The posting and discussion of this document satisfies the requirements of Order 890 for openness and transparency in local transmission planning. The document itself constitutes the Local Transmission Plan (LTP) referred to in the NYISO tariff.

[2] The Governor has announced his desire for the State to meet a stretch goal named the "45 x 15" objective.

The studies that support the Plan reflect current assumptions regarding these factors. Conversely, the Plan needs to be updated periodically to capture, among other issues, updated assumptions.

B. Orange and Rockland Transmission Planning Criteria

System expansion and the incorporation of new facilities must follow the established and published Orange and Rockland Transmission Planning Criteria[3]. The criteria document describes Orange and Rockland's transmission planning criteria for assessing the adequacy of its transmission system to withstand design contingency conditions while providing reliable supply to all its customers throughout the planning horizon. The document includes a description of the Company's transmission system design principles, performance criteria as well as thermal and voltage assessments. The Planning Criteria document is publicly available and posted on the Orange and Rockland website.[4]

All system expansions, whether by Orange and Rockland or by other parties, must be made in accordance and in compliance with NERC Standards, NPCC Criteria, NYSRC rules and NYISO procedures. As a member of the Northeast Power Coordinating Council (NPCC) in New York and ReliabilityFirst Corporation (RFC) in New Jersey, Orange and Rockland's planning process adheres to NPCC and RFC criteria.

The NPCC Criteria documents are designated as Type "A" and describe the minimum criteria applicable to NPCC members functioning as part of the coordinated interconnected network. Given their importance, the Criteria documents require the approval of two thirds of the NPCC membership. NPCC Guideline documents designated as Type "B" serve as the guide through which implementation of the criteria and acceptable system performance is achieved.

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[3] Appendix A contains Orange and Rockland's Transmission Design Standards.
[4] http://www.oru.com/documents/tariffsandregulatorydocuments/federal/TransmissionPlanningGuidelines.pdf

As a member of the New York State Reliability Council (NYSRC), Orange and Rockland must also adhere to the "NYSRC Reliability Rules for Planning and Operating the New York State Power System". NYSRC reliability rules may

be more specific or stringent than NERC Standards and NPCC Criteria. Given the importance of NYSRC reliability rules, adoption or modification requires an affirmative vote of at least 9 out of the 13 members of NYSRC's Executive Committee.

C. Relationship with FERC Order 890 and Order 2003

FERC Order 890 "*Preventing Undue Discrimination and Preference in Transmission Service*" requires reliability and economic processes for new transmission. In New York, the reliability planning process is the first step of the Comprehensive System Planning Process under the NYISO Open Access Transmission Tariff (OATT), which places primary emphasis on implementing new market-based merchant resources to meet a reliability need if there is a system capacity Loss of Load Expectation (LOLE) greater than 0.1 over a 10-year period. The Comprehensive Reliability Plan issued by the NYISO then identifies regulated backstop solutions to be developed by the appropriate Transmission Owners (TOs) that would be triggered by the NYISO if the market does produce a merchant solution in a timely manner.

Further, Order 890 contains certain principles to achieve the non- discriminatory, open and transparent goals of the planning process that must be followed by both the NYISO and the local Transmission Owners. The posting of this document and its discussion with interested parties are intended to satisfy these requirements. The NYISO sets a schedule[5] for meeting these requirements in advance of the Load and Capacity Data Report (Gold Book) used at the start of next Reliability Needs Assessment (RNA) cycle.

FERC Order 2003 "*Standardization of Generator Interconnection Agreements and Procedures"* established rules and procedures that govern large generation

[5] For 2011 the NYISO has announced a schedule that requires local TOs to post their local plans in September and make presentations to interested parties in October.

interconnections. In New York, parts of Order 2003 are addressed by tariff provisions in the NYISO OATT, Attachment X. Merchant generation can follow a defined process to interconnect at the location of its choice, and the TO's Long- Range Transmission Plan must take this into account. Further, TOs are required to meet load for a given year[6] with generic generation placed at feasible locations. Recently the NYISO has adopted a deliverability requirement, embedded in Attachments X of the NYISO OATT, in addition to the prior minimum interconnection standard. As a result of the application of this tariff, new generation may require changes and additions to the transmission system that must be also be reflected in all studies performed.

Since there are many reasons that may affect decisions on future generation, DSM and transmission, it is necessary to make reasonable assumptions on such changes in the development of the Plan. However, in all circumstances, the driver for the local Long-Range Transmission Term is maintaining reliability.

D. Objectives

Orange and Rockland delivers electricity to approximately 290,000 electric customers in the southeastern portion of New York State, northern New Jersey, and northeastern Pennsylvania**.** The O & R territory is divided into three major divisions namely, Eastern Division (Rockland county and northern Bergen County, New Jersey), Central (eastern Orange county and portions of Passaic County, New Jersey) and Western Division (western Orange County, portions of Sullivan County and Pike County, Pennsylvania). Its major ties with the 345 kV bulk electric system includes six (6) 400 MVA 345/138 kV step down transformer and one (1) 400 MVA 345/138 kV step down transformer bank in New Jersey.

In-area generation resources include several small generating plants (< 20 MW total) located in the eastern and western divisions of Orange and Rockland.

[6] Attachment S of the NYISO OATT includes the concept of Class Year in which Generator Owners can place themselves so that the reliability of the system can be studied with the collective presence of all generators in the Class Year.

Therefore, the main objective of the Long-Range Transmission Plan is to maintain reliability on the 138 kV and 69 kV Orange and Rockland's transmission system during normal and emergency operating conditions.

Orange and Rockland has developed a set of objectives for the development of its Long-Range Transmission Plan in accordance with all applicable reliability criteria. The ability of the transmission system to perform in accordance with the Transmission Planning Criteria is periodically assessed as new load forecast information becomes available. This assessment can result in recommendations for specific upgrades, as discussed in more detail in Chapter 5 of this Plan.

1. Objective 1: Transmission System Assessment

Planning for the Orange and Rockland transmission system includes the detailed evaluation of 138 kV and 69 kV transmission facilities over a 10- year period. As distribution load forecasts are considered, it is possible that projections indicate that one or more reliability criteria would not be met at some date in the future. In such cases, remedial actions are developed and planned to assure the system continues to comply with reliability criteria. There are a number of possible actions that can address transmission system reliability criteria deficiencies:

1. Additional transmission lines on the existing right-of-way (ROW) or new ROW;
2. Increasing the capacity of existing transmission components by:
   a. Re-conductor of existing transmission line with higher ampacity conductor or the use of high temperature low sag (HTLS) conductor;
   b. Installation of parallel transmission transformer.
   c. System modification of existing transmission facilities (i.e. termination of longer transmission lines on adjacent stations to create parallel transmission paths);
3. Upgrade of existing facility to higher voltage;

4. Installation of transmission capacitor banks in various transmission as well as distribution stations; and/or,
5. Combinations of the above.

Analysis is performed on a case-by-case basis to determine the most cost-effective remedial action. All are designed to bring the Transmission system into compliance with reliability criteria.

2. Objective 2: Interconnection of New Generation Resources

Reliability criteria can be met in some cases by the interconnection of new generation resources within the system or by interconnections to new or existing generation resources outside the system. New generation resources are not only a source of additional real power but are also a source of reactive power, all of which help bring the system into compliance with reliability criteria. Resources closer to load will provide greater reactive support than those further away. Other considerations include the provision of black start capabilities by units directly on the Orange and Rockland system as well as well as the provision of dual fuel capability, both of which contribute to maintaining reliability. At some point, the interconnection of new generation resources is needed to meet reliability and supply requirements.

II. LONG-RANGE TRANSMISSION PLAN ANALYSIS TOOLS AND METHODOLOGIES

Orange and Rockland's transmission system is assessed using a variety of system modeling and simulation tools to measure the transmission system's capabilities against design criteria. This is done for present and planned configurations at present and future load levels, respectively. The simulations are validated using real-time measurements made under normal and contingency conditions whenever possible. Assessments are made in the following areas, using standardized software packages to study the system's performance:

- Thermal;
- Voltage;
- Short Circuit;
- Under-frequency Load Shedding;
- Extreme Contingencies; and,
- Equipment Replacements Due to Age or Condition.

A. Thermal

Load flow studies are the primary method used by Transmission Planning to assess the performance of the transmission system under normal and contingency conditions. The software used for these studies is provided by Power Technologies International, a division of Siemens AG, and is referred to as PSS/E, the acronym for Power System Simulator / Engineering. This is the leading software package for bulk transmission system load flow studies.

The load flow levels established by the studies are measured against the thermal ratings of transmission facilities. Transmission equipment including lines and transformer banks are assigned with thermal ratings for normal operation, long-time emergency operation (LTE), and short-time emergency operation (STE).

Load flow studies are conducted to simulate normal operation under peak forecast loads. No transmission facilities should exceed their normal ratings at this operating condition. During single contingency conditions, no facilities should exceed their normal ratings. Also following the various contingency conditions defined in the New York State Reliability Council (NYSRC) and the Northeast Power Coordinating

Council (NPCC) rules, the Orange and Rockland transmission system must exhibit the capability to be returned to operation within normal thermal limits following the worst case single contingency within the time frame specified in the rules.

FERC Form 715

While load flow studies are conducted year-round by Transmission Planning for a wide variety of analyses, including planned expansions and real-time contingencies, overall system-wide assessments are required once a year to support the NYISO's requirement to file FERC Form 715, the Annual Transmission Planning and Evaluation Report. This is a comprehensive effort that includes updating the system model in terms of configuration and impedances, and adjusting the transmission system for optimum power flows. FERC 715 filing is done for the 5^{th} year (Summer Peak, Winter peak and Light Load), and 10^{th} year (Summer peak Only), as well as the operating system task force(OSTF) base cases are added for the starting year (Summer and Winter Peak). The future cases incorporate all planned changes such as additions, expansions, and retirements according to the scheduled timelines for these changes. Load flow base cases developed for the FERC 715 filing are used for annual reviews of Installed Reserve Margin (IRM), a NYSRC requirement. Load flow base cases developed for the FERC 715 filing are also used in the NYISO's Comprehensive Reliability Planning Process (CRPP) which is conducted annually looking out over a ten-year horizon, one year at a time. The first task in the CRPP is to conduct a Reliability Needs Assessment (RNA). If a reliability need or needs are identified in any or all of the ten years studied, a Comprehensive Reliability Plan (CRP) must be formulated to meet that need or those needs.

B. Voltage

Voltages throughout the transmission system are checked using the same load flow studies that are used to make the thermal assessments described in the section above. The focus, however, shifts from the delivery of real power, measured in MW, to voltage support and control provided by reactive power, measured in MVAR[7].

C. Short Circuit

Short circuit studies are conducted using the ASPEN program. These are done to assess:

1. The ability of circuit breakers on the transmission system to interrupt fault currents; and

2. The ability of all equipment on the transmission system, including but not limited to circuit breakers, bus work, disconnect switches, and structural supports to withstand the mechanical forces associated with fault currents. Momentary forces generated within the first one-half cycle following the inception of a fault typically present the highest mechanical stresses.

   The NYISO conducts semi-annual updates of its short circuit base case models, one each for the summer and winter seasons. Significant data for these studies include system configuration, i.e., network topology, impedances of all connected equipment, and circuit breaker interrupting ratings.

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[7] Voltages must remain within a prescribed range of 0.95 to 1.05 per unit through all contingencies studied under the NYSRC rules.

D. Under-frequency Load Shedding

Under-frequency relays are installed at various locations throughout the system to provide protection against widespread system disturbances. The Under-frequency Load Shedding Program (UFLS) is updated each year for the NYISO and PJM control areas.

1. Circuit Weight

A circuit weight is calculated annually for each circuit based on the priority of the customers that are located on the circuit. For example,

(a) A circuit contains a hospital (150), a nursing home (25) and a prison (2) would have a circuit weight of 177.

(b) An artificial weight is given for the two circuits that feed the O & R SVOC building.

The available circuits with under-frequency relays are then prioritized by circuit weight. Excluding circuits with high priority customers, such as hospitals and malls, the UF relays are then turned on for the higher-weighted circuits until the cumulative load for these circuits reaches the requirement for each level. The under-frequency relays for the remaining circuits are turned off.

2. Under-frequency relays:

i. The **Northeast Power Coordinating Council (NPCC)** requirements are for two frequency settings based on the previous year's peak. The first setting requires 10% of the previous year's peak plus 25% of the curtailables and co-generation used during the previous year's peak to be shed at 59.3 hertz. The second setting requires 15% of the previous year's peak to be shed at 58.8 hertz.

ii. The **Reliability-First Corporation (RFC)** requirements are for three frequency settings based on forecasted peak. The first setting requires 10% of the year's forecasted peak to be shed at 59.3hertz. The second setting requires 10% of the year's forecasted peak to be shed at 58.9 hertz. The third setting requires 10% of the year's forecasted peak to be shed at 58.5 hertz.

E. Extreme Contingencies

Extreme contingency scenarios that stress the transmission system beyond its design criteria are assessed in accordance with NPCC Document B-4, "Guidelines for NPCC Area Transmission Reviews". Document B-4 states that extreme contingency assessment, similar to stability assessment, is to be part of the Comprehensive Review conducted once every five years in each of the NPCC areas. The NYISO conducts the Comprehensive Review for the New York Control Area. Beyond this requirement, Orange and Rockland also periodically conducts extreme contingency assessments for its own transmission system. The intent is to gauge the extent of customer and overall system impact that could be incurred under selected worst case scenarios involving multiple contingencies, and to identify potential mitigating actions that could be taken to minimize the adverse impact. The results of the extreme contingency tests are published in Orange and Rockland's annual Transmission System Summer Peak Operating Study ("Summer Study"). These results are for information purposes only, therefore, no corrective measures are identified to mitigate these extreme contingency cases.

E. Equipment Replacements Due to Age or Obsolescence

The age of major equipment in the system such as transformers, breakers and switchgears are also taken into account. The recommended number of years in service for equipment prior to change out is about 50 years.

III. BASE CASES MAJOR ASSUMPTIONS

The analysis presented in this document is performed on a yearly cycle and takes close to eighteen months to carry out and review. The studies are based on assumptions that were published in Orange and Rockland's annual Summer Study.

Long-Range Transmission Plan Assumptions[8]

Study Year	System Peak Assumptions
2022	Orange and Rockland Projected System Peak = **1595 MW**
2026	Orange and Rockland Projected System Peak = **1614 MW**
2031	Orange and Rockland projected System Peak = **1626 MW**

Study Year	In-Area Generation Resources Assumptions
2022	No new generation in service
2026	New generation in-service
2031	New generation in-service

Study Year	Demand Side Management (DSM) Assumptions
2022	90 MW (Initial reduction)
2026	135 MW (Cumulative reduction)
2031	142 MW (Final cumulative reduction)

Study Year	Capital Projects Assumptions
2022	Capital projects identified in the Budget are in service prior to summer of 2022.
2026	Capital projects identified in the Budget will be in service prior to summer of 2025.
2031	Capital projects identified in the Budget will be in service prior to summer of 2031.

[8] These assumptions supplement or replace the comparable assumptions in the FERC 715 Annual transmission Planning and Evaluation Report filed by the NYISO in April, 2011.

VI. DEVELOPMENT OF THE LONG-RANGE TRANSMISSION PLAN

This chapter presents the requirements, procedures, and scheduling that will be necessary for the development of the Long-Range Transmission Plan. The process is designed to be completed in 18 months from beginning to end.

The process timeline is now designed to dovetail with the scheduling requirements of FERC Order 890, which requires a local transmission plan to be posted for public review in the September timeframe in sufficient time for meaningful review and comments prior to the inputs that need to be provided for the NYISO's Comprehensive System Planning Process (CSPP).

A. General Description of the Contingency Evaluation Process

Orange and Rockland is required by NERC, NPCC and NYSRC rules to maintain its transmission system so that the worst contingency during the highest load period will not result in equipment loading that exceeds the designated emergency rating of that equipment and also will not result in the loss of any customer service. The system operator should initiate criteria corrective action within four (4) hours that will not result to equipment loading that does not exceed the designated normal rating of that equipment[9].

A single contingency, designated "N-1," is defined as a single loss of any individual piece of equipment along with associated infrastructure that would be lost as a result of the loss of that equipment. Generally, this may be the loss of a single transmission line, the failure of a circuit breaker, switch, or outage of a single circuit in a transmission tower, or relay operations causing the outage of a single transmission line and/or the outage of station.

[9] See Orange and Rockland's Transmission Design Standards (Appendix A).

B. Long-Range Transmission Plan Process Milestones and Schedule

For every 18-month cycle, the Long-Range Transmission Plan process begins after the issuance of the NYISO's Gold Book describing the summer conditions for the year prior to the first study year of this Plan:

1. Summer peak load period for year 1 of the study;
2. Summer peak load for year 5 of the study; and
3. Summer peak load for year 10 of the study.

The NYISO, with input from the TOs on changes to their transmission system and on their load forecast develops a summer model for the entire New York system. This provides the model for areas outside the Orange and Rockland system for the studies reported in the Plan. To define the internal portions of the model, the first step is to take the independent peaks for each Distribution Substation in the three (3) divisions which are available after the summer and perform a spreadsheet tabulation evaluation to identify possible deficiencies as an early signal of potential problem areas. In the fourth quarter, after the coincident load forecast for each area station is available, the load flow base cases for the three timeframes of the study are developed. Starting in the first quarter of the study year load flow analysis for the whole transmission system using the three timeframes is conducted. Short circuit analysis is also performed in areas where there have been significant model or generation changes. The second quarter of the study year is devoted to the evaluation of the results of these analyses and the development and verification of potential solutions. Finally during the summer period the Plan is thoroughly reviewed and the report is drafted.

Special note should be taken that the model for the first year of evaluation (2022 for the current Plan) contains the NYISO's forecasted loads for the summer of the previous year (2021) for the non-Orange and Rockland portions and the summer forecasted loads for the first year of the study (2022) for the Orange and Rockland system. This is necessary for the timely completion of the analysis because the NYISO forecasted loads for the first year of evaluation are not ready until just prior to the summer of that year.

These steps are described in detail below:

1. **Orange and Rockland Model to NYISO for years 0, 5 and 10**
(2021, 2026 and 2031)

Orange and Rockland works collaboratively with the NYISO to build an accurate representation of the Orange and Rockland transmission system and its load as a component of the NYISO load model;

2. **NYISO Model to Orange and Rockland for Years 0, 5 and 10**
(2021, 2026 and 2031)

The NYISO collects all of the component models of each contributing Transmission Owner and generation entity within the state and surrounding areas, and combines them into a single model which is then distributed to all utilities. Generators that are in the NYISO interconnection process for future establishment are not included in the model unless they meet certain NYISO criteria, including being under construction;

3. **Obtain Independent Peaks by Station for Years 1, 5 and** 10
(2022, 2026 and 2031)

Orange and Rockland's Distribution Engineering Department determines the distribution substation load forecasts after the summer of each year, based on the most current summer load information for each substation. The independent peaks of each of the distribution substations will be available by the start of the fourth quarter;

4. **Evaluation of individual substation peaks for Years 1, 5 and 10** (2022, 2026 and 2031)

The individual substation peaks combined with a diversity factor in order to provide a rough estimate of the MW margin or deficiency of a particular substation. These results are generally optimistic by design;

5. **Obtain weather normalized Peaks for Years 1, 5 and 10** (2022, 2026 and 2031)

Following the determination of the independent peaks for each substation, the weather normalized peaks to be used in the load model are determined in the fourth quarter. This data will be incorporated into the Orange and Rockland portion of the NYISO load flow models;

6. **Define the Orange and Rockland Portion of the Models for Years 1, 5 and 10** (2022, 2026 and 2031)

Each Orange and Rockland distribution station is updated with the latest load data including any major block loads, transfer of significant loads to adjacent stations, creation of new adjacent substations that will provide load relief or load back-up for an existing station and any load retirements;

7. **Load Flow Studies for the three divisions using the 3 Snapshot Years**

During the first quarter of year 1 of the study, the load models are evaluated for each of the 3 years in question. A list of N-1 contingency conditions are modeled and tested;

8. **Problems Identified**

Thermal overloads and voltage violations may require pre- contingency adjustments to the system (such as pre-loading transmission lines, or reactive compensation, etc.) in order to resolve post-contingency violations.

Thermal overloads and voltage violations that cannot be corrected will be identified according to the year of appearance, extent of violation, growth of the problem over time, and potential of remediation through scheduled or anticipated infrastructure improvements;

9. **Solutions Proposed and Evaluated**

For all thermal overloads and voltage violations that cannot be corrected using actions permissible within the transmission planning criteria, the impact of various system enhancements are evaluated according to their feasibility, timely establishment, extent of impact, and cost, and the one that most optimally satisfies the reliability, economic and operational requirements of the Transmission System is selected;

10. **Report and Presentation**

The results of the analysis performed for each division are included in the annual Long-Range Transmission Plan; and

11. **FERC Order 890 Presentations and Responses**

In accordance with the requirements set forth in FERC Order 890, the Plan is posted and presented to interested parties. The intent is to provide information on the local transmission plan early in the planning cycle so as to provide a meaningful opportunity for comments.

C. Design Criteria Requirements

1. Thermal Overloads and Voltage Violations

Thermal overloads occur when the complex power, or MVA, on a transmission path exceed the normal rating of that path. These overloads can be caused by excessive real power flow, reactive power flow, or a combination of both. Voltage violations occur when bus voltages exceed their limits either above or below their nominal ratings.

For Overhead lines and inter-utility ties, Orange and Rockland transmission planning design criteria for every “loss of transmission path” contingency is evaluated such that:

a. Immediately following the contingency and prior to any criteria corrective action, the flow on any path does not exceed the Long Term Emergency rating of that path; and

b. Following criteria corrective action (steady state), the flow on the path may not exceed the normal rating of that path.

2. Short-Circuit Violations

Short-Circuit Violations occur when a 3-phase fault, 2-phase fault or single line to ground fault create a short-circuit flow on a transmission path which exceeds the appropriate short-circuit rating of any of the breakers that are necessary for the isolation of that transmission path.

D. Methods for Deficit Resolution through System Enhancements

When criteria corrective actions are deemed insufficient or inappropriate for resolving post-contingency problems, strategies for the resolution of deficits through system enhancements are identified. Various solutions are modeled and evaluated for every problem, based on extent of impact, reliability improvement, scheduling, and cost. The following solution concepts are considered:

1. Load Transfers

Distribution Substation load transfers that reduce load within a specific area may be sufficient to reduce or eliminate deficits found in a certain area.

Advantages:	Economical, fast, may support other organizational goals.
Disadvantages:	May limit future growth in other areas, may interfere with other organizational goals.

2. Upgrades to Infrastructure

Enhancements to transmission lines, circuit breakers, transformers, or bus works can increase the ability to import power into an area. Upgrades will include but not limited to re-conductoring with higher ampacity conductor or with a high temp low sag (HTLS) conductor, replacement of equipment, installation of parallel equipment such as lines and transformers, conversion to higher voltage class, among others.

Advantages: Permanent improvement in capacity, more economical than building new infrastructure.

Disadvantages: May require significant outage time, more expensive than load transfers.

3. New Generation or Upgrades (REV SCREENING)

The timely establishment of new generation or the upgrade of existing generation can have a major impact on reducing transmission system deficits. Generally, anticipated generation is not considered unless construction has begun. Orange and Rockland closely monitors the status of all generation projects in the NYISO queue that can have an impact within the Orange and Rockland service territory.

Advantages: Permanent improvement in capacity.

Disadvantages: Merchant generation not under the control of Orange and Rockland, long period from concept to operation; May need short-circuit mitigation.

4. New or Reconfiguration of Transmission Lines

New transmission lines increase the ability to import power into an area by providing an alternative path for support following a contingency. Sometimes, it can be sufficient to reconfigure a line to improve reliability, either by relocating a termination point to another station, or by relocating the termination point within a station. Consideration must be taken for any increase in short-circuit magnitudes.

Advantages: Permanent improvement in capacity, reliability.

Disadvantages: Cost, long lead times, may need short-circuit mitigation.

5. New Transmission Switching Stations with New or Reconfigured Transmission Lines

Transmission switching stations can be established according to the need for load relief in support of area stations that have reached their capacity. In most cases, these new transmission stations will also provide new transmission line connections or pathways that improve capacity and deliverability.

Advantages: Permanent improvement in capacity.

Disadvantages: Expensive, long lead time.

6. Transmission Station Configuration Upgrades

Transmission stations can be reconfigured or expanded to provide reliability improvements. Isolated bus configurations can be effectively upgraded to ring bus or breaker-and-a-half configurations. Consideration must be taken for any increase in short-circuit magnitudes.

Advantages: Permanent improvement in capacity, reliability, cost.

Disadvantages: Cost, long lead times, may need short-circuit mitigation

7. Reactive Power Compensation (Capacitors and/or Reactors)

The need for reactive power compensation varies according to the structure and function of various transmission and sub- transmission components. Overhead transmission lines need to carry a large volume of power, and may be limited by low voltage constraints. The most efficient and economical support for deliverability is the installation of shunt capacitor banks to inject reactive power into the transmission path and maintain high voltage along the transmission corridor.

Advantages: Permanent improvement in compensation, lower cost, short lead time.

Disadvantages: Shunt devices are subject to fluctuation as a function of voltage. Capacitor banks or reactors must be evaluated for contribution to transients during switching.

8. Installation of Power Flow Control Devices (Phase Angle Regulators, Variable Frequency Transformers)

Phase angle regulators (PAR's) and Variable Frequency Transformers

(VFT’s) may be installed in the system to control the real power flow on a transmission path needs to be regulated.

Advantages: Permanent improvement in reliability.

Disadvantages: Cost, long lead time, relatively large equipment.

9. Short Circuit Remediation

As generators are added to the system and as new transmission ties create more connections between stations, the overall level of short- circuit current magnitudes will increase. To reduce short-circuit currents higher impedance devices such as series reactors or phase angle regulators can be added to the system.

Advantages: Allows for more interconnections between stations, more economical than other alternatives such as DC back-to-back links.

Disadvantages: Absorb reactive power, reduces voltages.

10. Non-Wires Alternatives (NWAs)

Permanent DSM, Energy Efficiency, battery storage and other non-traditional wire solutions can delay or replace the costly implementation of alternative infrastructure improvements.

V. TRANSMISSION SYSTEM ASSESSMENT

The following table lists the three divisions within the Orange and Rockland Transmission system. This is followed by individual tables for each division containing the results of first contingency (N-1) analysis together with pre- and post project assessments as well as short circuit evaluations.

	DIVISIONS	AREA COVERED
1	**EASTERN**	- Rockland County - North Bergen County (New Jersey)
2	**CENTRAL**	- Portions of Orange County - Portions of Passaic County (New Jersey)
3	**WESTERN**	- Portions of Orange County - Portions of Sullivan County

LOCAL PLANS AND ASSESSMENT

Each division will have the following proposed projects and with their corresponding proposed in-service dates:

1. Major transmission local plans and their respective assessments;
2. Short circuit assessment;
3. Proposed transmission capacitor bank installations; and,
4. Proposed equipment replacements due to age.

A. Eastern Division Local Plans and Assessment

GEOGRAPHIC COVERAGE	Rockland County North Bergen County
DESIGN	First Contingency

MAJOR LOCAL TRANSMISSION PLANS						
PROJECT DESCRIPTION	**IN-SERVICE DATE**		**PLANNING CRITERIA**	**WORST CONTINGENCY**	**AFFECTED FACILITIES**	**PROPOSED SOLUTION**
	2019 Plan	**2021 Plan**				
Lovett 345 kV Station (formerly North Rockland 345Kv Station)[1]	June 2018	**May 2021**	N-1 Thermal Rating Violation	Loss of Line 67 and Line 68	Line 60 above STE. Line 652 Above STE.	Install 400 MVA 345/138 kV Bank
LINE 705 New UG[1]	Dec 2022	**Dec 2023**	N-1 Thermal Rating Violation	Loss of Line 561	Line 702 above LTE.	Install parallel Line 702 UG Cable.
LINE 47/Closter Re-configuration[1]						Completed
Ramapo Bank 1300 Upgrade[2]						Completed
Ramapo Bank 2300 Upgrade[2]						Completed
Line 51 Upgrade[1]	Dec 2022	**Dec 2022**	N-1 Thermal Rating Criteria	Loss of Bank 258	Line 51 Above Normal Rating	Re-conductor Line 51

[1]Reliability Projects

[2]Replacement Projects Due to Equipment Condition

ASSESSMENT (Lovett 345 KV Station)				
SUMMER YEAR	**N-1 CONDITIONS**	**AFFECTED**	**MW DEFICIT**	**REMARKS**
2022	Loss of Line 67 & Line	Line 60 & Line 652	380 MW	Pre-upgrade
2023	Loss of Line 67 & Line	None	None	Year of installation
2026	Loss of Line 67 & Line	None	None	Post-installation of
2031	Loss of Line 67 & Line	None	None	Post-installation of

ASSESSMENT (Line 705 New UG)				
SUMMER YEAR	**N-1 CONDITIONS**	**AFFECTED**	**MW DEFICIT**	**REMARKS**
2021	Loss of Line 561	Line 702 and Line 652	10 MW	Pre-Upgrade
2022	Loss of Line 561	Line 702 and Line 652	20 MW	Pre-Upgrade
2023	Loss of Line 561	None	-	Post Upgrade
2026	Loss of Line 561	None	-	Post Upgrade
2031	Loss of Line 561	None	-	Post Upgrade

ASSESSMENT (LINE 51)				
SUMMER YEAR	**N-1 CONDITIONS**	**AFFECTED**	**MW DEFICIT**	**REMARKS**
2022	Loss of Bank 258	Line 51	16 MW	Pre-Upgrade
2023	Loss of Bank 258	Line 51	18 MW	Post Upgrade
2026	Loss of Bank 258	None	None	Post Upgrade
2031	Loss of Bank 258	None	-	Post Upgrade

EASTERN DIVISION SHORT CIRCUIT ASSESSMENT	
YEAR	**AFFECTED BREAKERS**
2022	NONE
2026	NONE
2031	NONE

EASTERN DIVISION PROPOSED TRANSMISSION CAPACITOR BANK INSTALLATIONS			
STATION	**IN–SERVICE YEAR**		**MVAR**
	2019 PLAN	**2021 PLAN**	
Little Tor	2022	**2023**	32 MVARS
West Nyack	2020	**2022**	16 MVARS

EASTERN DIVISION PROPOSED EQUIPMENT REPLACEMENTS DUE TO AGE			
STATION	2019 PLAN	**2021 PLAN**	**EQUIPMENT**
West Haverstraw	2021	**2022**	138 kV Breakers
Burns	2021	**2022**	138 kV Breakers

B. Central Division Local Plans and Assessment

GEOGRAPHIC COVERAGE	Orange County Portions of Bergen County
DESIGN	First Contingency

MAJOR LOCAL TRANSMISSION PLANS						
PROJECT DESCRIPTION	**IN-SERVICE DATE**		**PLANNING CRITERIA**	**WORST CONTINGENCY**	**AFFECTED FACILITIES**	**REMARKS**
	2019 Plan	**2021 PLAN**				
LINE 27/271 UPGRADE[3]	June 2023	**June 2026**			Line 27/271	Required project under AC Transmission
Line 26 T/L Upgrade[2]	June 2026	**June 2027**	N/A	N/A	N/A	Replace aging conductors.

[2]*Replacement Projects Due to Equipment Condition*
[3]*Reliability Projects*

ASSESSMENT (Line 27/271 Upgrade)				
SUMMER YEAR	**N-1 CONDITIONS***	**AFFECTED**	**MW DEFICIT**	**REMARKS**
2022	AC Transmission	Line 27/271	Approaches Normal	Pre-Upgrade
2023	AC Transmission	Line 27/271	Approaches Normal	Pre-Upgrade
2023	AC Transmission	Line 27/271	-	Post Upgrade
2026	AC Transmission	Line 27/271	-	Post Upgrade

CENTRAL DIVISION SHORT CIRCUIT ASSESSMENT	
YEAR	**AFFECTED BREAKERS**
2022	NON
2026	NON
2031	NON

CENTRAL DIVISION PROPOSED TRANSMISSION CAPACITOR BANK INSTALLATIONS			
STATION	**IN–SERVICE YEAR**		**MVAR**
	2019 PLAN	**2022 PLAN**	
West Warwick	2025	**2025**	32 MVARS
Woodbury	2024	**2024**	32 MVARS

CENTRAL DIVISION PROPOSED EQUIPMENT REPLACEMENTS DUE TO AGE (NONE)			
STATION	2019 Plan	2022 Plan	**EQUIPMENT**
West Point	-	**2024**	**Breakers**

5.3. Western Division Local Plans and Assessment

GEOGRAPHIC COVERAGE	Orange County Sullivan County
DESIGN	First Contingency

MAJOR LOCAL TRANSMISSION PLANS						
PROJECT DESCRIPTION	**IN-SERVICE DATE**		**PLANNING CRITERIA**	**WORST CONTINGENCY**	**AFFECTED FACILITIES**	**REMARKS**
	2019 Plan	**2022 PLAN**				
WESTERN 34.5 kV UPGRADE TO 69 KV[1]	Various stages starting on Dec 2022	**Various stages starting on Dec 2024**	N/A	N/A	N/A	Creation of 69 kV loop in the northern part of the western division for more reliability in the

[1]*Reliability Projects and Equipment Upgrade due to Condition*

ASSESSMENT (Line 6 Upgrade to 69 KV)				
SUMMER YEAR	**N-1 CONDITIONS**	**AFFECTED**	**MW DEFICIT**	**REMARKS**
2022	NONE	NONE	NONE	Pre- upgrade
2026	NONE	NONE	NONE	Pre-upgrade
2031	NONE	NONE	NONE	Post-upgrade

WESTERN DIVISION SHORT CIRCUIT ASSESSMENT	
YEAR	**AFFECTED**
2022	NONE
2026	NONE
2031	NONE

WESTERN DIVISION PROPOSED TRANSMISSION CAPACITOR BANK INSTALLATIONS			
STATION	**IN–SERVICE YEAR**		**MVAR**
	2019 PLAN	**2018 PLAN**	
Pocatello	2025	**2027**	32 MVARS
Fair Oaks	2025	**2027**	16 MVARS
Bullville	2025	**2027**	16 MVARS

WESTERN DIVISION PROPOSED EQUIPMENT REPLACEMENTS DUE TO AGE - NONE		
YEAR	**STATION**	**EQUIPMENT**

6. SUPPLEMENTAL STUDIES

There are no supplemental studies conducted by Orange and Rockland in its service territory.

APPENDIX
A

(Orange and

Rockland's

Transmission Design

Standards – Revision 11)