from all Light Load reliability analysis are expected to be in-service prior to November 1 of the Delivery Year under study.

2.3.12 Spare Equipment Strategy Review

PJM will annually evaluate the spare equipment strategy that could result in the unavailability of major transmission equipment that has a lead time of one year or more (such as a transformer) and assess the impact of this possible unavailability on system performance using NERC category P0, P1 and P2 contingency categories identified in Table 1 of NERC TPL-001-4. This assessment will consider the conditions that the system is expected to experience during the possible unavailability of the long lead time equipment.

2.3.13 Winter Peak Reliability Analysis

The winter peak reliability analysis ensures that the Transmission System is capable of delivering the system generating capacity at winter peak. The PJM 50/50 winter peak demand level was chosen as being representative of a typical winter peak condition. The system generating capability modeling assumption for this analysis is that the generation modeled reflects generation by fuel class that historically operates during the winter peak demand level.

The starting point power flow is the same power flow case set that is used for the baseline analysis, with adjustments to the model for the winter peak demand level, winter peak load profile, winter ratings (50F rating). In coordination with individual TOs, PJM may select and apply a lower temperature degree ratings set (e.g. 32F ratings instead of 50F ratings) as appropriate. PJM will apply the alternate ratings set on an individual TO basis, interchange, and accompanying generation dispatch. The PJM portion of the model is adjusted, and the MMWG winter model is used for areas surrounding PJM. Interchange levels for the various PJM zones will reflect all yearly long term firm (LTF) transmission service, except MAAC which will reflect the historical average. Load level, interchange, and generation dispatch for non-PJM areas impacting PJM facilities are based on statistical averages for previous winter peak periods. Thus the same baseline network model and criteria apply. The flowgates ultimately used in the winter peak reliability analysis are determined by running all applicable contingencies maintained by PJM planning and monitoring all PJM market monitored facilities and all NERC BES facilities. The contingencies used for winter peak reliability analysis will include NERC TPL category P1, P2, P3, P4, P5, P6, and P7. NERC TPL Category P0, normal system conditions will also be studied. All BES facilities and all non-BES facilities in the PJM real-time congestion management control facility list are monitored. The same single contingency power flow solution techniques used in other baseline reliability tests also apply. Details of the winter peak reliability analysis procedure, including methods of creating the study dispatch, can be found in Attachment D.3. The resulting system enhancements from all Winter Peak reliability analysis are expected to be in-service prior to December 1 of the Delivery Year under study (For example, 2021 Winter Peak studies December of 2021 through February of 2022, System enhancements identified in this study are expected to be in-service prior to December 1, 2021).

2.3.14 Baseline Stability Analysis

PJM ensures generator and system stability during its interconnection studies for each new generator. In addition, PJM annually performs stability analysis for approximately one third of the existing generators on the system. Analysis is performed on the RTEP baseline
D-3.1 Winter Peak Reliability Analysis

The winter peak reliability analysis tests the ability of an electrical area to export generation resources to the remainder of PJM during winter peak conditions. The export generation is selected by using the historical mix of generation that operates at the winter peak level. This test is applied to ensure that generation capability, including renewable generation capability that typically operates at winter peak such as wind, as well as pumped hydro, are not "bottled" from a reliability perspective.

The winter peak reliability analysis, from the perspective of individual generator resources, ensures that, under winter peak system conditions, their ability to provide energy to the system has a probability of not being limited by the typical dispatch of other generation resources that operate at that demand level, including resources in neighboring systems. The Generator Deliverability Test and Common Mode Outage procedure have a similar objective at the summer peak forecast load. While deliverability under all possible system conditions is not within the purview of the RTEP, analyzing the system performance under this wide range of forecasted demand levels improves overall deliverability of generating resources. Consideration will be given to the capacity factor by fuel class during this period, as described in Table 1. This test does not guarantee that a given resource will be able to deliver energy at the winter peak condition. Rather, the purpose is to demonstrate that typical winter peak generating capabilities in any electrical area can be run simultaneously, at winter peak, and that the excess energy above demand in that electrical area can be exported to the remainder of PJM. In short, the test ensures that bottled capability conditions will not exist at winter peak, limiting the availability and usefulness of a range of resources available to system operators, including renewable resources. In actual non-emergency operating conditions, the economic dispatch serves load.

D-3.2 Winter Peak Reliability Analysis Procedure

1.0 Introduction

To maintain reliability and operational flexibility during the winter peak period, resources within a given electrical area must, in aggregate, be able to be exported to other areas of PJM. PJM utilizes a Winter Peak Reliability Analysis procedure to study the system performance during typical winter peak conditions. This document provides the procedure for Winter Peak Reliability Analysis.

2.0 Study Objectives

The goal of the PJM Winter Peak Reliability Analysis study is to determine if the aggregate of generators in a given area can be reliably transferred to the remainder of PJM during winter peak conditions. Generators requesting interconnection to PJM must pass this test in order to become a PJM capacity or energy resource.

Additionally, the PJM Winter Peak Reliability Analysis will be used to ensure thermal and voltage adequacy based on normal (applicable to system normal conditions prior to contingencies) and emergency (applicable after the occurrence of a contingency).
thermal ratings specific to the Transmission Owner facilities being examined during winter peak conditions.

3.0 General Procedures and Assumptions for Winter Peak Reliability Analysis

**Step 1: Develop Base case**

The RTEP base case is developed for a reference year 5 years in the future. All RTEP identified system upgrades and Supplemental RTEP Projects are included in the system model. PJM load is modeled at a non-diversified forecasted 50/50 winter peak load level per the latest applicable PJM load forecast and 50F degree ratings. In coordination with individual TOs, PJM may select and apply a lower temperature degree ratings set (e.g. 32F degree ratings instead of 50F ratings) as appropriate. PJM will apply the alternate ratings set on an individual TO basis. Target PJM RTO area interchange that reflects all yearly long term firm (LTF) transmission service will be maintained. Generation and Merchant Transmission projects that have proceeded at least through the execution of the Facility Study Agreement stage of the interconnection process are considered in the model along with any associated network upgrades. The starting point dispatch is developed as explained in the next step.

**Step 2: Establish initial RTEP dispatch for unit under study**

Existing PJM Resources: Place all in-service nuclear resources on-line at a generation value equal to their installed capacity. Wind units are derated in the initial dispatch to 33% of their nameplate capability. Coal units are initially derated consistent with Table 1. Queued Units in the PJM queue that have an ISA will be placed on-line consistent with Table 1. The target generation value for each Transmission Owner (TO) zone in the model is dispatched at a magnitude to meet the projected load + losses + PJM RTO interchange. In addition, for the PJM MAAC zone, the average historical interchange for the winter peak period, as calculated by PJM is calculated and applied to that zone. If necessary, generation resources in each TO zone are then uniformly de-rated until the target generation value is met.

The following applies to all queued resources in PJM and neighboring systems. Model all non-ISA queued generation offline. All ISA queued generation is modeled online. If selected by the test procedure, PJM queued resources will have the potential to be dispatched to 100%.

For queued interconnection studies, all queued resources in the study queue ahead of the unit under study are set at 0 MW but available to be turned on per the Generator Deliverability procedure and Common Mode Outage test procedure. The resource request under study is also set at 0 MW but available to be turned on. Resource requests queued after the unit under study are not modeled. The loading on each transmission line that results from this dispatch and the application of a contingency is the base loading of the facility. (See Addendum 2 for treatment of Common Mode Outage Procedures).