

PJM Manual 36:

System Restoration

Revision:

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Prepared by
System Operations Division

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Attachment A: Minimum Critical Black Start Requirement

A.1 Critical Black Start Criteria

A.1.1 Goal

PJM and its stakeholders have developed requirements for the amount and redundancy of Black Start generation based on critical load requirements. Specific black start data to include fuel resources for black start power for generating units, available cranking and transmission paths, and communication adequacy and protocol and power supplies are contained in the PJM Black start database.

A.1.2 Minimum Critical Black Start Requirement

This attachment to the *PJM Manual for System Restoration (M-36)* defines the Minimum Critical Black Start Requirement on each transmission zone (or restoration area if level 3 cross zonal coordination is utilized) to be the sum of critical cranking power load, gas infrastructure critical load and nuclear off-site station light and power load requirements, with an allowance for exceptions or additions based on unique circumstances (as per EOP-005-3 R1.2 and R1.8). Critical Load consists of the following components:

1. Cranking power to all units with a hot start time four hours or less (See Note below).
2. Off-site Nuclear Station Light and Power (to maintain safe shutdown) as defined in each plant's Nuclear Plant Interface Requirements (NPIR) document.
3. Critical Natural Gas Infrastructure (such as electric compressors).
4. Exceptions or additions to the criteria shown above will be allowed with PJM approval.
 - a. SOS-T endorsement will be sought for these exceptions and additions.
 - b. One such example could be to address coping power needs for steam units that cannot be supplied by resources other than Black Start.
 - c. Exceptions to critical cranking power are made for intermittent generation [and non-hydro energy storage resources](#) (i.e. wind, solar, [batteries](#), [flywheels](#)).
 - d. Exceptions to critical cranking power will be considered on a case by case basis for:
 - i. Complex cranking paths for minimum ICAP gain.
 - ii. Non-dispatchable units or units with very high minimum limits.

Note:

For generating stations with multiple units (0-4 hour start), consider the impact on restoration time if only enough critical load was carried to start one of the units at the station. This unit could then supply the other units at the station with auxiliary power. If doing this would increase restoration time significantly, critical load will be identified for all units at the station. Consideration will also be given to whether plant personnel can start all units at the plant in parallel given physical plant or resource constraints.

Note:

PJM will utilize the above definitions for critical load in the 5 Year Black Start Selection Process scheduled for 2018 for implementation in 2020. Following the selection of Black Start units that would best meet these critical load requirements, cranking paths will be updated in TO system restoration plans and the PJM Black Start database.

Off-site power should be restored as soon as possible to nuclear units, both units that had been operating and those that were already off-line prior to system disturbance, without regard to using these units for restoring customer load. Nuclear units that are taken off-line on a controlled shutdown can normally be restored to service between 24 and 48 hours following the controlled shutdown.

A list of critical substations that serve Gas Infrastructure critical load will be documented in the Transmission Owner's Restoration Manual.

Required Black Start = 110% (Critical Load requirement) on a locational basis

This will account for an average forced outage rate (5%) plus an allowance for additional, unexpected Critical Load (5%). It is recognized that while this requirement is generally specified on a TO zonal basis, that zones may be aggregated, as described in Section 9 (cross zonal coordination) , such that the Black Start resources may physically lie in adjacent zones.

In addition, PJM recognizes the need for some redundancy in Black Start generation. Redundancy allows for system restoration even if some Black Start resources are unavailable, potential system damage precludes use of certain Black Start resources and also allows for variance between Critical Load calculations and actual needs.

To achieve this redundancy:

- PJM will ensure a minimum of two Black Start resources are "allocated" to each transmission zone with a Critical Load requirement. Note that the Black Start resources are not required to be physically located within the zone to which they are allocated. However, each zone must be able to identify within their system restoration plan the two resources allocated to them during a system restoration. Exceptions to this "two resource rule" will be allowed with PJM and System Operation Subcommittee-Transmission (SOS-T) endorsement.

Black Start Resource Operators must maintain fuel to allow for 16 hours of run time or as defined by the Transmission Owner restoration plan, whichever is less. Generator Operators must notify PJM and Transmission Owners if a Black Start resource fuel level falls below these values.

Also, per NERC Standard EOP-005-3, R13, each Generator Operator with a Blackstart Resource shall notify its Transmission Operator of any known changes to the capabilities of that Blackstart Resource affecting the ability to meet the Transmission Operator's restoration plan within 24 hours following such change.

Additionally, off-site power should be provided to Nuclear Generation consistent with the timelines identified in the Transmission Owner's Restoration Plan or NPIR agreements.

PJM, in collaboration with the TOs, will select Black Start units to meet Critical Load requirements during the 5 year Black Start Selection process described in PJM Manual M-14D, Generator Operational Requirements. PJM will utilize the Black Start Replacement Process,

as described in PJM Manual M-14D for changes to Black Start availability or Critical Load requirements that occur within the 5 year period.

PJM, in its role as Transmission Operator (TOP), is responsible for selecting the Black Start resources for a system restoration plan. PJM would work closely with the TOs to identify these units based on:

- Critical Load requirements
- Available Black Start resources
- Minimum number of Black Start resources allocated to a zone
- Possible cross zonal coordination opportunities

PJM will utilize the start time parameters and test data to evaluate the Black Start resources and whether these resources will meet the requirements of the restoration plans. PJM may require some Black Start resources to adhere to less than a 3 hour start time given critical load restoration timing requirements. These units will be notified of this timing requirement and tested to it during annual Black Start testing. PJM recognizes that Black Start resources with three hour start times may not appropriate to meet nuclear power off-site safe-shutdown load restoration requirements. The target restoration time for off-site power to nuclear stations is 4 hours.

The TO will adjust its system restoration plan based on the Black Start units allocated to it from this selection process. The TO has the option of procuring additional Black Start resources (if not already procured by PJM), but the costs of these resources will be recovered, if necessary, outside of the PJM Open Access Transmission Tariff (OATT).

Should there be a disagreement about the location, amount or number of Black Start resources, or disagreement between the supplying TO, receiving TO or PJM about cross zonal coordination, the following process will be followed:

- The parties involved would bring the issue to the SOS-T for consultation.
- If the parties continue to disagree, the issue would be referred to the Dispute Resolution Process as detailed in Schedule 5 of the PJM Operating Agreement.
 - o General notification of initiation and result of Dispute Resolution process will be given to the Operating Committee.

Underfrequency Islanding Schemes and Load Rejection Schemes are considered an acceptable alternative to solely maintaining critical black start units, or can be utilized in conjunction with critical black start units as a means to serve critical load during restoration.