



Blackstart Service Business Rules

Blackstart Definition

- 1) A blackstart unit is defined as a generating unit that is able to start without an outside electrical supply or the demonstrated ability of a base load unit to remain operating, at reduced levels, when automatically disconnected from the grid.
- 2) A blackstart plant is a generating plant that includes one or more blackstart units. A blackstart plant with blackstart units electrically separated at different voltage levels will be considered multiple blackstart plants.

Critical Blackstart Unit Determination

- 3) Transmission Owners, in conjunction with PJM, are responsible for identifying the blackstart generating units that are critical for restoration of the PJM RTO system and included in each owner's System Restoration Plans. The responsibility for identification of critical blackstart units will ultimately migrate to PJM.
 - a) Enough blackstart generation will be deemed critical to facilitate the goal of a complete system restoration in 16 hours.
 - b) Sufficient redundancy of critical blackstart is desirable due to possibility of unit failure to start or transmission facility failures preventing units from serving their intended loads.
- 4) No more than three (3) blackstart units at any one blackstart plant will be considered critical and eligible for compensation under the PJM Blackstart Service unless approved as an exception.
 - a) Exceptions must be for justifiable reliability reasons for unique system conditions or configurations.
 - b) Possible exceptions would be due to plant/unit limitations or restrictions, electrical (transmission) characteristics, electrical (auxiliary/balance of plant) characteristics or control characteristics.
 - c) These exceptions will be heard on a case by case basis and must be approved by PJM and the PJM SOS-Transmission.

Blackstart Unit Planned Outage Restrictions

- 5) No more than one unit at a blackstart plant with multiple blackstart units may be on planned maintenance at any one time.
 - a) This restriction excludes outages on common plant equipment which may make all units unavailable.



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- 6) Concurrent planned outages at multiple blackstart plants within a zone may be restricted based on Transmission Owner requirements for blackstart availability.
 - a) These restrictions will be predefined, approved by PJM and incorporated into the eDART tool.

- 7) A Generation owner may substitute another blackstart unit (not currently designated as critical) at a plant (on the same voltage level) for a blackstart unit that is on a planned outage to allow a concurrent planned outage of another critical blackstart unit at a plant to begin.
 - a) This substituted unit must have a valid blackstart test within the last 13 months to be considered as an eligible substitution.

- 8) These planned outage restrictions do not apply to any planned outages in the current planned outage schedule at the time of the Blackstart Service implementation.

Minimum Blackstart Capability

- 9) Transmission Owners within MAAC will adhere to the MAAC Standards for minimum blackstart capability.

Generation Owner's Commitment

- 10) Generation Owners shall commit initially for at least two (2) years to provide blackstart service from the blackstart service implementation date.
 - a) Generation Owner and Transmission Owner each have an annual right to terminate, however the remainder of the two year commitment must be fulfilled.
 - b) All succeeding annual commitments must be at least an additional year to maintain a rolling two-year commitment.
 - c) In the event that a Black Start Unit fails to fulfill its two year rolling commitment to provide Black Start Service, the Black Start Unit owner shall forfeit the monthly Black Start Service revenues for the period of its non-performance not to exceed revenues for a maximum of one year.

- 11) Changes in blackstart revenue requirements may be made annually, but will become effective in the second year of the commitment.

- 12) If due to an event of force majeure a generation owner cannot provide blackstart service, the commitment requirements stated above shall not be binding.

- 13) A critical blackstart unit that is retiring may enter discussions with PJM to determine revenue adequacy requirements. However, PJM will not guarantee generator revenue adequacy.

- 14) Generation Owners that commit to provide blackstart service shall not have their blackstart capable designation terminated within the time of their commitment.



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- a) PJM shall provide at least a two year notice to the owner of generating units that are providing blackstart service prior to terminating that unit's designation as a critical blackstart unit.

Performance Standards

- 15) A blackstart unit must have the ability to close it's output circuit breaker to a dead bus within 90 minutes of the request from the local Transmission Owner or PJM.
 - a) This may be demonstrated by physically closing the generator breaker connected to a dead bus while the unit is running OR by a test that simulates closing the generator breaker while only the generator side of the breaker is energized.
- 16) If a unit has the ability to operate at reduced levels when automatically disconnected from the grid, this may be demonstrated by physically removing the unit from the grid while the unit is running OR by a test that simulates removing the unit from the grid.
- 17) A blackstart unit must have the capability to maintain frequency under varying load.
 - a) This may be demonstrated by picking up an isolated block of load OR by appropriate dynamic off-line testing of the governor controls
- 18) A blackstart unit must have the capability to maintain voltage under varying load.
 - a) This may be demonstrated by picking up an isolated load OR by producing both leading and lagging MVARs by varying the voltage setting while the unit is synchronized to the system OR by appropriate dynamic off-line testing of the voltage controls.
- 19) A blackstart unit must maintain rated output for 16 hours or as identified by the Transmission Owner System Restoration requirements.
 - a) It is assumed that there is an inherent reserve available for hydro and gas units and that there would be no additional fuel storage or carrying charges necessary to maintain blackstart capability. However, this capability may be less than 16 hours.

Blackstart Testing

- 20) Critical blackstart units must be tested annually.
- 21) To collect monthly blackstart revenues, a unit must have a successful blackstart test on record with PJM within the last 13 months
 - a) Within six months of the implementation of the Blackstart Service, each critical blackstart unit must have had a successful blackstart test within the previous 13 months to continue to receive blackstart revenue.



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- i) If, after six months, the unit still does not have a valid blackstart test on record (within the previous 13 months), the initial six months of blackstart revenue will be forfeited. The unit will then not be eligible for monthly blackstart revenue until successful completion of a blackstart test.
- 22) Blackstart tests are scheduled at the discretion of the generation owner.
- 23) Compensation for energy output delivered to the system shall be provided for the unit's minimum run time at the higher of the unit's cost-capped offer or real-time LMP plus start-up and no-load costs for up to two start attempts, if necessary.
- 24) Annual tests shall include:
 - a) Starting and bringing the unit to synchronous speed without assistance from a system electrical feed
 - b) Testing of all communication circuits
 - c) Performing or simulating switching needed to connect the blackstart unit to the transmission system following a system blackout
 - d) Testing of features unique to each facility that relate to blackstart service
- 25) Testing records be forwarded to PJM Performance Compliance and the Transmission Owner and include:
 - a) Date(s) of test
 - b) Duration of test – Start of test until unit is online
 - c) Test conditions – ambient temperature, weather
 - d) Indication of whether the unit was able to start without being connected to the system
 - e) Indication of the ability to close a circuit breaker into a dead bus
 - f) Indication of the ability to control frequency within the prescribed range and voltage through the control of reactive (both over and underexcited)
 - g) Indication of the ability to remain stable and control voltages while operating isolated from the transmission grid and supplying the source's own auxiliary load.
 - h) Description of communications and control systems that are capable of allowing SCADA/EMS data and voice communications as defined in the PJM Control Center Requirements Manual
 - i) Explanation of failed test and corrective actions taken
 - j) Description of operator training
 - k) Dates of training
 - l) Copies of blackstart procedures
- 26) If a unit fails a blackstart test, the unit is given a ten day grace period within which it may re-test without financial penalty.
 - a) If the unit does not successfully pass a blackstart test within the ten day grace period immediately following a failed test, monthly blackstart revenues will be forfeited from the time of the first unsuccessful test until the unit successfully passes a blackstart test.



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Settlements

27) Each blackstart generator's revenue requirements shall reflect the generator's costs for its blackstart equipment. Each generator's revenue requirements shall be an annual calculation based on the CDTF variable O&M data (minus the 10% cost capping adder), which is supplied to PJM.

28) The formula for calculating a generator's annual blackstart revenue requirement is:

$$\{(\text{Fixed Blackstart costs}) + (\text{Variable Blackstart Costs}) + (\text{Training Costs}) + (\text{Fuel Storage \& Carrying Costs})\} * (1 + \text{Incentive Factor})$$

where:

$$\text{Fixed Blackstart costs} = \text{CDR} * 365 * \text{Unit capacity} * X$$

Where: CDR = PJM Capacity Deficiency Rate on an Installed Capacity basis

Unit Capacity = Generating Unit's installed capacity

X = Blackstart allocation factor (Hydro = 0.01, Diesel = 0.02, CT = 0.02)

$$\text{Variable Blackstart costs} = \text{Unit O\&M} * Y$$

Where: Y = 0.01 unless another value is supported by the documentation of costs

Note: If a value of Y is submitted for this cost, (1-Y) factor must be applied to the unit's O&M costs on the unit's cost-based energy schedule.

$$\text{Training Costs} = 50 \text{ staff-hours/year/plant} * \$75/\text{hour}$$

$$\text{Fuel Storage \& Carrying Costs} = (\# \text{ Run Hours}) * (\text{Fuel Burn Rate}) * (\text{12 Month Forward Strip} + \text{Basis}) * (\text{Bond Rate})$$

Where: Run Hours are actual run hours required for black start unit to run. At least 16 hours or as defined by the Transmission Owner restoration plan.

Note: If no DC pumps are available for the blackstart unit, the fuel storage and carrying costs may include a tank minimum suction level.

Fuel burn rate is actual fuel burn rate for blackstart unit

12 Month Forward Strip is the average of forward prices for the fuel burned in the blackstart unit

Basis is the transportation costs from the location referenced in the forward price data to the blackstart unit plus any variable taxes

Bond rate will be a representative annual interest rate.

$$\text{Incentive Factor} = Z = 10\%$$

Where Z is an incentive factor initially set to the above level and will be periodically reviewed by PJM

29) PJM or its agent shall have the right to independently audit the accounts and records of each generating unit that is receiving payments for providing blackstart service.



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Credits

- 30) Monthly credits are provided to generation owners who submit their annual revenue requirements based on the formula in item 28 to PJM. The owner's monthly credit is equal to 1/12 of their annual blackstart revenue requirement for eligible critical blackstart units.
- 31) Revenue requirements for join-owned blackstart units will be allocated to the owners based on ownership percentage.

Charges

- 32) Zonal rates will be based on blackstart capability within each transmission zone and allocated to network service customers and point-to-point reservations.
- 33) Charges for blackstart units nominated by a Transmission Owner as critical (regardless of zonal location) will be allocated to the nominating Transmission Owner's zone.
- 34) Monthly pool-wide blackstart revenue requirements are allocated as charges to point-to-point customers based on their monthly peak usage of the PJM transmission system.
 - a) Monthly peak usage equals the total hourly amounts of transmission capacity reserved and not curtailed by PJM divided by 24.
 - b) The remaining blackstart revenue requirements for each zone not recovered for point-to-point customers are allocated to the network customers serving load in that zone based on their monthly peak loads. Monthly peak loads equal the sum of all daily network integration transmission service peak load contributions.