



Black Start Education

Black Start Unit Testing, Substitution, Termination Rules, and Capital Recovery Factor (CRF)

Becky Davis

PJM Performance Compliance
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A blue circular graphic with a white border containing the text "Black Start Unit".

Black Start Unit

A single generator 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.

A dark blue circular graphic with a white border containing the text "Black Start Plant".

Black Start Plant

A plant that includes a unit that can black start. A Black Start Plant with Black Start Units at different voltage levels (electrically separated) will be considered multiple Black Start Plants.

PJM, in collaboration with the Transmission Owners, identify the generating units that are critical for system restoration.

- Transmission Owners develop and review the restoration plan annually.

Black Start Units Listed in TO Restoration Plans

Black Start Units								
Unit Name	Unit Type	ICAP	Emergency Minimum (Unit Min Stable Load)	Prim.Fuel	Sec. Fuel	Hot Start Time (Hours)	Cold Start Time (Hours)	Ramp Rate (MWs/Minute)

- Black Start Units receiving compensation under Schedule 6A have agreed that the unit should be designated as black start.

Every generating unit that is providing black start capability shall be tested to verify that it can be started and operated without being connected to the PJM power system.

- Scheduled at the discretion of the generator owner; however, prescheduled with PJM prior to testing.
- Completed and submitted black start test report for all testing performed (pass or fail, and requested 14 days following test).
- A successful test is required, on a 13-month rolling basis, for the Black Start Unit to continue receiving black start compensation under Schedule 6A.

Identify all Black Start Units for annual testing.

Black Start Testing Requirements

- Start when requested from “blackout” state
- Close to a dead bus within 3 hours
- Operate at reduced levels when disconnected from the grid
- Maintain frequency and voltage under varying load

SECTION 2 : TEST PERFORMANCE

TEST PERFORMED ON DATE

BLACK START TEST BEGINS TIME

Please notify PJM Dispatch on the day of the actual test, prior to test start.

TIME OF OUTPUT BREAKER CLOSE TIME

The generating unit must have the ability to close the output breaker to a dead bus within 180 minutes.

THE BLACK START TEST DISPLAYED THE ABILITY TO ...	ACTUAL EQUIPMENT TEST SUCCESS	SIMULATED EQUIPMENT TEST SUCCESS	ITEM NOT TESTED	TESTING FAILED
... START WITHOUT POWER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... CLOSE INTO A DE-ENERGIZED BUS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... OPERATE AT REDUCED LEVELS WHEN DISCONNECTED FROM THE GRID	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... MAINTAIN FREQUENCY UNDER VARYING LOAD (FOR A PERIOD OF AT LEAST THIRTY MINUTES)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... MAINTAIN VOLTAGE UNDER VARYING LOAD (FOR A PERIOD OF AT LEAST THIRTY MINUTES)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... MAINTAIN BLACKSTART RATED OUTPUT FOR DURATION MATCHING LCC RESTORATION REQ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please check the appropriate box above for each testing item.

BLACK START TEST ENDED TIME

TEST SUPERVISED BY NAME

Schedule 6A Black Start Service – Section 10

10. No more than one Black Start Unit at a Black Start Plant may be subject to planned maintenance at any one time. This restriction excludes outages on common plant equipment that may make all units unavailable. A Black Start Unit not currently designated as critical and on the same voltage level may be substituted for a Black Start Unit that is subject to a planned outage to permit a concurrent planned outage of another critical Black Start Unit at the Black Start Plant to begin. The Black Start Unit used as a substitute must have had a valid annual test within the previous 12 months.

Provide additional clarification and guidance for Black Start Unit substitution.

Initial commitment of at least two years from black start service implementation date.

May terminate with one year's advanced notice if:

- **Black Start Unit owner initiated termination**

Forego any existing entitlement to revenues collected under Schedule 6A (refund FERC-approved rates)

- **PJM initiated termination**

Black Start Unit owner eligible to recover any amount of unrecovered fixed black start service costs over a period < 5 years

Additional termination rules to address potential delays for units without a black start test on file for an extended period.

Black Start Units may recover new or additional black start capital costs for a term based on the age of the Black Start Unit.

Capital Recovery Factor (CRF) Table

Age of Black Start Unit	Term of Black Start Commitment	Levelized CRF
1 to 5	20	0.125
6 to 10	15	0.146
11 to 15	10	0.198
16+	5	0.363

Capital recovery factor (CRF) based on a levelized pro forma for a 100 MW combustion turbine for \$1 M.

Capital Recovery Factor Components

9%
State
tax rate

50%
Equity
and
50%
Debt

12%
Internal
rate of
return
on
equity

Federal tax rate

36%
Current

~21%
Proposed

Current federal corporate tax rate 21%

Income tax rate

41%
Current

~28%
Proposed

Based on current federal corporate and state tax rates

Interest Rate

7%
Current

~3.5%
Proposed

Based on current bond rate

New/Revised Tax Laws

Bonus depreciation

Appendix

References:

- [PJM OATT Schedule 6A Black Start Service](#)
- [PJM M-12 Balancing Operation; Section 4](#)
- [PJM M-10 Pre-Scheduling Operations; Section 2](#)
- [PJM M-14D Generation Operational Requirements; Section 10](#)
- [PJM M-27 Open Access Transmission Tariff Accounting; S-7](#)
- [PJM M-36 System Restoration; Sections 6 & 8](#)

Black Start Testing Form:

<https://www.pjm.com/-/media/markets-ops/ancillary/black-start-test-report-forms.ashx?la=en>