

May 12, 2023

Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, N.E., Room 1A
Washington, D.C. 20426

Re: *PJM Interconnection, L.L.C.*, Docket No. ER23-____-000
Black Start Service Revisions to Enhance Fuel Assurance

Dear Ms. Bose:

PJM Interconnection, L.L.C. (“PJM”), pursuant to section 205 of the Federal Power Act (“FPA”), 16 U.S.C. § 824d, hereby submits revisions to the PJM Open Access Transmission Tariff (“Tariff”), Schedule 6A, to mitigate the adverse impacts of Black Start Units¹ potentially being unavailable during a restoration event due to fuel unavailability. This proposal provides qualification procedures, testing, performance requirements, and compensation for Fuel Assured Black Start Units. The proposed Tariff revisions were endorsed by acclamation by the PJM Members Committee (“MC”), following endorsement of these changes by the PJM Markets and Reliability Committee (“MRC”) on an affirmative sector vote of 4.714 in favor (equivalent to a 94.28 percent affirmative vote).²

PJM proposes an effective date for these Tariff revisions of July 11, 2023, which is sixty days after today’s date. PJM asks the Federal Energy Regulatory Commission

¹ All capitalized terms that are not otherwise defined herein have the definitions stated in the Tariff.

² Both committees also endorsed related and implementing changes to PJM’s manuals on Black Start Service, including that the restoration plan will include a minimum of one Fuel Assured Black Start Unit in each Transmission Owner (“TO”) Zone, with any additional such units in a TO Zone justified on a reliability basis, as discussed below.

(“Commission” or “FERC”) issue a final order accepting these Tariff revisions no later than that requested effective date, to permit PJM’s use of these fuel assurance enhancements in selecting Black Start Units through the Black Start Request for Proposal (“RFP”) process this summer.

I. INTRODUCTION

PJM’s Black Start Service Tariff does not currently require any particular level of fuel assurance among Black Start Units. This is a significant omission, which this filing corrects, following extensive PJM expert staff analyses, sustained and collaborative stakeholder engagement, and consultation and active sharing of analysis results on this issue with staff of state utility commissions in the PJM Region and staff of the Organization of PJM States, Inc.

PJM’s analyses found that the fuel supplies for a substantial number of current Black Start Units in the PJM Region may not be fuel assured, and susceptible to interruptions outside the control of the unit owner in certain conditions. PJM also found that the region’s Black Start Units that are fuel assured are unevenly distributed. PJM’s corresponding analyses found that a failure of fuel supply by PJM Region Black Start Units that are not fuel assured could substantially increase the length of time it would take to restore the PJM Region Bulk Electric System (“BES”) following the type of severe and widespread outage that would trigger the need for black start generation.

To address this concern, PJM proposes to revise the Tariff to:

- Establish a new category of black start resources: Fuel Assured Black Start Units;
- Set the minimum criteria for a variety of resource types to qualify as Fuel Assured Black Start Units;

- Establish, for resources selected as Fuel Assured Black Start Units, minimum commitment periods, performance requirements, and testing requirements; and
- Establish compensation for Fuel Assured Black Start Units that:
 - Applies and adapts the three compensation options already established for Black Start Units, giving resource owners a choice in how they commit to, and recover their costs for, providing a Fuel Assured Black Start Unit; and
 - Incentivizes resources to take on the added distinct risks of revenue loss from failing to meet the new performance and testing requirements that are specific to Fuel Assured Black Start Units so as to ensure that PJM can continue to receive multiple bids for units willing to provide Black Start Service.

II. BACKGROUND

A. The Purpose of Black Start Generation

Black start generation is a prudent planning solution to an extreme, but readily conceivable, challenge: how can the BES be restored to service when so much of that system is down that generators cannot rely on that system as a means of re-starting themselves and then re-energizing the grid? The solution, in simple terms, is to ensure that there is generation—in key locations—that can start *without* any assistance from the rest of the BES. Once started, those generators can energize select transmission facilities connecting to the next most critical generators that need to be brought online, commencing the cycle of establishing and extending the areas of the grid that are in service, with load and generation in balance, and then carefully bringing together, i.e., synchronizing, those separate “islands” until the grid is fully restored.

The implications of this type of outage are profound: if so much of the integrated BES (including parts of the interconnected grid in neighboring regions) is out of service that generators in the PJM Region cannot rely on that system to restart, then there could

easily be tens of millions of customers (if not more) without power.³ An outage so severe and widespread that it needs black start generation, therefore, is by definition a low probability⁴ but very high impact event.

Given the importance of black start generation in such a scenario, the North American Electric Reliability Corporation (“NERC”) has adopted a reliability standard devoted to system restoration from black start resources, which NERC defines in part as generators “which ha[ve] the ability to be started without support from the System or [are] designed to remain energized without connection to the remainder of the System.”⁵ The adopted reliability standard contains extensive requirements, measures, and compliance rules, the purpose of which is to “[e]nsure plans, Facilities, and personnel are prepared to enable System restoration from Black Start Resources to ensure reliability is maintained during restoration and priority is placed on restoring the Interconnection.”⁶

For its part, the Commission has recognized “the essential nature of Black Start Service;”⁷ held that it is “critical to maintaining grid reliability;”⁸ and “important for

³ Affidavit of Michael E. Bryson on Behalf of PJM Interconnection, L.L.C. (Attachment A) ¶ 11 (“Bryson Aff.”).

⁴ PJM notes that it has never had to call on Black Start Units for system restoration, not even during the Northeast blackout of 2003, as there has always been sufficient accessible generation and transmission available to restore service to the parts of the bulk electric system in the PJM Region that lost service. Bryson Aff. ¶ 11.

⁵ *Glossary of Terms Used in NERC Reliability Standards*, North American Electric Reliability Council, 5 (Aug. 1, 2017), <https://www.energy.gov/sites/prod/files/2017/09/f36/NERC%20Glossary.pdf>.

⁶ EOP-005 – *System Restoration from Blackstart Resources*, North American Electric Reliability Council, A.3 (Jan. 24, 2018), <https://www.nerc.com/pa/Stand/Reliability%20Standards/EOP-005-3.pdf>.

⁷ *PJM Interconnection, L.L.C.*, 176 FERC ¶ 61,080, at PP 40-41 (2021).

⁸ *PJM Interconnection, L.L.C.*, 138 FERC ¶ 61,020, at P 50 (2012).

restarting the system after a failure;”⁹ and found a regional power pool “rightly concerned with incenting generators to provide critical black start service.”¹⁰ Underscoring the importance of prudent planning for these extreme scenarios, the Commission directed its expert staff to work with the NERC staff (and the staff of NERC’s Regional Entities) to prepare two reports assessing entities’ plans for restoration and recovery of the bulk power system following a widespread outage, including a particular assessment of the availability of black start resources.¹¹

Consistent with the importance of black start generation to maintaining grid reliability, PJM has had Black Start Service in its Tariff since 2002.¹² The Commission found the proposed new Schedule 6A, which “provides the terms and conditions under which generators will be compensated for providing Black Start Service to PJM and customers will be assessed for such costs” to be in the public interest “because it helps ensure reliability in the event of a system-wide blackout.”¹³

B. The System Restoration Process

In the type of broad and severe outage that requires black start generation, there is no generation within an electrical path available to restore the PJM grid. Black Start Units

⁹ *Ameren Corp.*, 108 FERC ¶ 61,094, at P 78 (2004).

¹⁰ *New England Power Pool*, 102 FERC ¶ 61,176, at P 23 (2003).

¹¹ See *Report on the FERC-NERC-Regional Entity Joint Review of Restoration and Recovery Plans*, Federal Energy Regulatory Commission Staff and North American Electric Reliability Corporation (Jan. 29, 2016), <https://www.ferc.gov/sites/default/files/2020-04/01-29-16-FERC-NERC-Report.pdf>; *Report on the FERC-NERC-Regional Entity Joint Review of Restoration and Recovery Plans; Recommended Study: Blackstart Resource Availability (BRAv)*, Federal Energy Regulatory Commission Staff and North American Electric Reliability Corporation (May 2, 2018), <https://www.ferc.gov/sites/default/files/2020-04/bsr-report.pdf>.

¹² See *PJM Interconnection, L.L.C.*, 101 FERC ¶ 61,192 (2002).

¹³ *Id.* at P 1.

therefore must be called upon to help “jump start” the system and allow service to be restored to other generation. That generation would then be brought on line consistent with PJM’s restoration plan, in a manner which can keep the system in balance while pockets of generation are connected back to each other so as to restore the grid operating as an integrated pathway throughout the PJM footprint.¹⁴

At a high level, the system restoration process involves (i) assessing the system; (ii) starting Black Start Units; (iii) building cranking paths¹⁵ to critical loads;¹⁶ (iv) restoring critical loads and forming “islands” of restored service; (v) synchronizing islands; (vi) connecting to neighbors; and (vii) returning to normal operations.¹⁷ As can be seen, Black Start Units are the first units to start, and they then provide the foundation upon which the grid is restored.

¹⁴ See Affidavit of Daniel Bennett on Behalf of PJM Interconnection, L.L.C. (Attachment B) ¶¶ 18-19 (“Bennett Aff.”).

¹⁵ “Cranking path” refers to the transmission pathway from a Black Start Unit to the critical load that needs to be brought online. Bennett Aff. ¶ 19.

¹⁶ “Critical load” refers to station service and start up power requirements for non-black start generators in strategic locations that can help restore service to pockets of load that can then be connected together to restore the entire system. Critical load generators are not the Black Start Units themselves; rather, they are the first generating units that the Black Start Units help bring on line by energizing transmission facilities along a cranking path to the critical load. Critical load may also include nuclear plants (to ensure safe shutdown) and electric powered natural gas compressor stations (to help transport fuel to generating units that need to be brought back online) “Critical load” is distinct from “priority load,” which refers to retail load locations (such as hospitals and military facilities) on the distribution system which have restoration priority through TO restoration plans. Bennett Aff. ¶ 18 & Figure 4.

¹⁷ Bennett Aff. ¶¶ 18-19.

C. The Tariff Does Not Currently Require Fuel Assurance for Black Start Resources

The Tariff currently includes a formula for calculating Black Start Units' Fuel Storage Costs¹⁸ but does not require any level of fuel assurance among the region's committed Black Start Units, or define what constitutes fuel assurance. PJM's implementing manuals add some details on this topic. Specifically, Manual 36 provides for Black Start Units to maintain fuel that enables 16 hours of runtime.¹⁹ Manual 14D also addresses this issue, by assigning a higher weight to proposals for fuel assured black start resources in the black start procurement process, as one aspect of the evaluation of technical, operational, and cost factors considered in the procurement process.²⁰ In particular, the Manual 14D evaluation criteria give a higher weighting (relative to proposals for black start resources that are less fuel secure) to black start RFP proposals that have dual fuel capability, secure onsite fuel storage (for any fuel type), or primary firm transportation contracts (for natural gas units).²¹

This filing corrects that Tariff omission. As explained in detail below, *see infra* Section III.B, PJM's analyses in the past two years found that nearly half of PJM's Black Start Units do not meet a reasonable minimum standard for fuel assurance, that the distribution of Black Start Units in the PJM Region that are more fuel assured is uneven,

¹⁸ See Tariff, Schedule 6A, section 18.

¹⁹ See System Operations Division, *PJM Manual 36: System Restoration*, PJM Interconnection, L.L.C., 69 (Dec. 27, 2022), <https://www.pjm.com/-/media/documents/manuals/m36.ashx> ("Manual 36"). The relevant TO's restoration plan can allow for a shorter runtime than 16 hours, *id.*, but none currently allow that shorter time. See Bennett Aff. ¶ 13.

²⁰ See Operations Planning Division, *PJM Manual 14D: Generator Operational Requirements*, PJM Interconnection, L.L.C., 87 (Dec. 21, 2022), <https://www.pjm.com/-/media/documents/manuals/m14d.ashx>.

²¹ *Id.*

and that lack of fuel assurance poses a risk of substantially increased restoration times, which could prolong the period that loads in the PJM Region are without power after a widespread BES outage.

III. PJM's PROPOSED REVISIONS TO TARIFF, SCHEDULE 6A ARE JUST AND REASONABLE

A. Overview

By this filing, PJM proposes to revise the Tariff to:

- Establish a new category of black start resources: Fuel Assured Black Start Units;
- Set the minimum criteria for a variety of resource types to qualify as Fuel Assured Black Start Units;
- Establish, for resources selected as Fuel Assured Black Start Units, minimum commitment periods, performance requirements, and testing requirements; and
- Establish compensation for Fuel Assured Black Start Units that:
 - Applies and adapts the three compensation options already established for Black Start Units, giving resource owners a choice in how they commit to, and recover their costs for, providing a Fuel Assured Black Start Unit; and
 - Incentivizes resources which are selected as Fuel Assured Black Start Units to take on the added, distinct risks of revenue loss from failing to meet the new performance and testing requirements that are specific to fuel assurance so as to assure that PJM continues to receive bids from multiple units willing to provide Black Start Service.

PJM notes that the sole focus of this filing is to add provisions on fuel assurance to Tariff, Schedule 6A, Black Start Service; the vast majority of that schedule is otherwise unchanged by this filing. In particular, this filing makes no changes to the current effective Tariff provisions on the charges to customers for, or allocation of the costs of, Black Start

Service,²² or to the current effective Tariff provisions addressing the black start reliability backstop process.²³

B. Failure of a Black Start Unit's Fuel Supply Can Materially Lengthen the System Restoration Timeline, and Extend the Time When Large Numbers of Consumers in the PJM Region Are Without Power; It Is Reasonable to Establish Additional Requirements and Incentives to Mitigate that Risk

As noted above, starting black start resources is one of the very first steps following a careful initial system assessment. If one of the generators designated as a Black Start Unit is *not* available due to fuel supply unavailability, that challenge can require more time-consuming workarounds with corresponding delays in system restoration.²⁴ Fuel supply unavailability could take the form of a discrete natural gas pipeline failure, or an equipment failure at a natural gas pipeline compressor station controlling gas pressure on the pipeline, or, a cybersecurity incident on a natural gas pipeline system. Fuel supply availability could be a very real concern during the type of severe and widespread disruption to the BES that triggers a need for black start generation.²⁵ Fuel transportation and delivery networks would be directly harmed to the extent they rely on electric power (as in the case of gas pipeline compressor stations powered by electricity), and at a minimum could be severely stressed by increased demands for energy supply alternatives to electricity.²⁶ To better assess this concern, PJM in the last three years analyzed: (i) the extent to which its current Black Start Units met reasonable minimum criteria for fuel assurance; and (ii) the extent

²² See Tariff, Schedule 6A, sections 25-27.

²³ See Tariff, Schedule 6A, section 6A.

²⁴ Bryson Aff. ¶ 13; Bennett Aff. ¶ 19.

²⁵ Bryson Aff. ¶ 13.

²⁶ Bryson Aff. ¶ 13.

to which loss of fuel supply at non-Fuel Assured Black Start Units could adversely affect the system restoration process following an event that triggers a need for black start generation.

1. *Prevalence and Distribution of Fuel Assurance Among PJM Region Black Start Units.*

PJM analyzed its current Black Start Units in 2021 and categorized them as fuel assured or not fuel assured. PJM categorized units as fuel assured if they can operate using fuel that is stored on site, or if they are connected²⁷ to more than one interstate gas pipeline.²⁸ PJM categorized units as *not* fuel assured if they relied solely on natural gas but had only one interstate gas pipeline connection, if they received their gas from a local distribution company connection (in light of potential restrictions during extreme cold weather), or if they have fuel storage on site, but require natural gas for start-up ignition.²⁹ Using these categories, PJM found that 56 percent of its Black Start Units were fuel assured—and 44 percent were not.³⁰ If considered by MWs, rather than unit count, 43 percent of the total MWs of currently committed Black Start Units are fuel assured, while 57 percent are not.”³¹

²⁷ While the criteria discussed here focus on physical connections to gas supply sources, PJM will review fuel transportation contract information in the RFP process, and on an ongoing basis for resources that become Fuel Assured Black Start Units.

²⁸ Bennett Aff. ¶ 7 & Figure 1.

²⁹ Bennett Aff. ¶ 7 & Figure 1.

³⁰ Bennett Aff. ¶ 8 & Figure 2. For purposes of these percentages, hydroelectric resources were categorized as not fuel assured. As explained by Mr. Bennett, hydroelectric resources “provide considerable value as Black Start Units, but are not automatically categorized as fuel assured.” Bennett Aff. ¶ 7 n.3. As he notes, “PJM’s proposal in this proceeding, including the related manual changes, provides a method for hydroelectric resources to qualify as Fuel-Assured Black Start Units.” *Id.*

³¹ Bennett Aff. ¶ 8 & Figure 2.

PJM’s analysis also found that the currently committed Black Start Units that *are* fuel assured are unevenly distributed in the PJM Region.³² As explained below, this filing will help PJM satisfy an objective of including one Fuel Assured Black Start Unit in each TO Zone.

This filing also helps address a legitimate need for additional diversity in the types of resources³³ that can qualify as a Black Start Unit by establishing Fuel Assured Black Start Unit qualification rules for intermittent³⁴ resources and hybrid resources, creating opportunities for wind, solar, run-of-river, and battery storage resources to compete to help meet the PJM Region’s needs for Fuel Assured Black Start Units.

2. *Adverse Impacts of Black Start Unit Fuel Supply Unavailability on System Restoration Time.*

As noted above, when they are needed during a widespread outage, Black Start Units are brought online without outside power from the system. Once a Black Start Unit is running, it can be used to help bring up “critical load” generation—which is well situated to start the process of establishing generation and load “islands.” This process relies on developing cranking paths from the Black Start Unit to the critical load, but also may entail other steps, such as bringing on load blocks and other generation, as needed to stabilize the cranking path and the island.³⁵ Throughout this process, system frequencies and voltages

³² Bennett Aff. ¶ 9 & Figure 3.

³³ The majority of current Black Start Units are gas-fired plants.

³⁴ PJM notes that it is not using for this filing or the accompanying Tariff, Schedule 6A revisions the Tariff-defined term “Intermittent Resources” since that term is defined to include only Capacity Resources, and Black Start Units are not limited to Capacity Resources.

³⁵ Bennett Aff. ¶ 19.

need to be controlled to avoid tripping facilities back off-line or damaging equipment.³⁶ If restored generation is tripped, then the island formed by that generation and its associated load will be back off-line, and the restoration process will have to start over.³⁷

To conduct its analyses of restoration time impacts, PJM considered “primary” cranking paths and “alternate” cranking paths.³⁸ A primary path is typically the path with the shorter electrical distance from the Black Start Unit to the critical load.³⁹ By contrast, an alternate path would typically require additional generation or load to control voltages—additional steps, which increases restoration time.⁴⁰ Alternate paths also typically may have increased charging and higher line voltages,⁴¹ making those paths more challenging to build and likely resulting in increased restoration time.

PJM used this primary/alternate technique to conduct two restoration time impact analyses over the course of 2019–2022, with the second analysis building on the first. In the first analysis, as explained by Mr. Bennett, PJM quantified the impact of non-fuel assured gas Black Start Unit unavailability by “assessing on a per-unit basis the additional complexity of restoration steps between primary and alternate cranking paths from Black Start Units to Critical Load.”⁴² This additional complexity, “in the form of substation

³⁶ Bennett Aff. ¶ 19.

³⁷ Bennett Aff. ¶ 19.

³⁸ Bennett Aff. ¶ 22.

³⁹ Bennett Aff. ¶ 22.

⁴⁰ Bennett Aff. ¶ 22.

⁴¹ Bennett Aff. ¶ 20.

⁴² Bennett Aff. ¶ 23.

switching, transmission line segments, generators, line charging, and load pick-up, [was] then correlated . . . to an increased time to serve Critical Load.”⁴³ Alternate cranking paths and estimated times to energize buses and lines were provided by TOs;⁴⁴ steady state/dynamic studies were then used to validate the alternate cranking paths.⁴⁵ PJM then used those incremental restoration time estimates to quantify the differences between the primary and alternate cranking paths in terms of hours of delay.⁴⁶

In that first analysis, PJM found that:

- Black Start Unit to Critical Load path analysis in a sampling of Zones consistently showed that the required use of alternate cranking paths resulted in increased restoration complexity, and additional restoration time;⁴⁷
- The *average* incremental time increase per cranking path ranged from approximately five hours to 11 hours across the Zones sampled;⁴⁸ and
- About 30 percent of sampled Zones showed incremental increases to restoration times of between 15 and 40 hours.⁴⁹

The clear inference from this first analysis was that if extended to all TO Zones with non-fuel assured Black Start Units, the added time for Black Start Units to serve initial Critical Loads could be significant; and that such delayed initial restoration of Critical Load would

⁴³ Bennett Aff. ¶ 23.

⁴⁴ Bennett Aff. ¶ 23.

⁴⁵ Bennett Aff. ¶ 23.

⁴⁶ Bennett Aff. ¶ 23.

⁴⁷ Bennett Aff. ¶ 24.

⁴⁸ *Id.*

⁴⁹ Bennett Aff. ¶ 24.

further compound delays to the remainder of the distribution system restoration process, including restoration of high-priority loads, such as hospitals and military installations.⁵⁰

PJM's second effort at conducting a primary/alternate path analysis was even more thorough, and studied every cranking path from a non-fuel assured Black Start Unit in every TO Zone that has a non-fuel assured Black Start Unit. Performing this analysis at a Zonal level quantitatively evaluated the restoration delay impact that could be associated with a black start scenario of conducting a Zonal bottom-up restoration when non-fuel assured Black Start Units are unavailable.⁵¹

As Mr. Bennett explains, this analysis looked at multiple restoration scenarios in which non-fuel assured Black Start Units are unavailable, requiring reliance on the next best Black Start Unit to crank that Critical Load.⁵² PJM based its timing estimates for each path on the complexity of each path, accounting for such factors as the number of transformers, lines, load blocks, and additional generation along the cranking path.⁵³ As Mr. Bennett notes, although each Black Start Unit site can only crank one Critical Load at a time, it is possible for separate restoration "islands" to be built in parallel. Consequently, the overall Zonal restoration time is equal to the slowest time to restore an island in that Zone.⁵⁴

⁵⁰ *Id.*

⁵¹ Bennett Aff. ¶ 29.

⁵² Bennett Aff. ¶ 26.

⁵³ *Id.*

⁵⁴ *Id.*

As Mr. Bennett also notes, when a non-fuel assured Black Start Unit is lost to a restoration effort, alternate Black Start Unit sites must crank that lost Black Start Unit's Critical Loads *in addition to* the loads the alternate Black Start Unit sites would normally crank.⁵⁵ The incremental restoration time increase therefore is the *additional* time required to restore a Zone due to the loss of one or more non-fuel assured Black Start Unit sites *above and beyond* the theoretical Zonal restoration time with *all sites* available.⁵⁶ Accordingly, for each scenario PJM determined an incremental restoration time increase based on this additional restoration complexity.⁵⁷

As Mr. Bennett shows, this analysis found a wide range of incremental restoration time increases from the unavailability of a non-fuel assured Black Start Units. In particular, while for most units (i.e., 55 percent), their unavailability added zero to 10 hours of incremental restoration time, the remaining non-fuel assured Black Start Units, if they were unavailable, would each add far more time to the process of recovering from a black start event: 25 percent of the units would require an added 10-20 hours; 10 percent would add 20-30 hours; and 10 percent would add over 30 hours. To be clear, *each* of these estimates of additional time to recover from a widespread black-out is for the unavailability of just *one* of the non-fuel assured Black Start Units. Figure 1 below, copied from Mr. Bennett's affidavit,⁵⁸ shows these results graphically.

⁵⁵ Bennett Aff. ¶ 27.

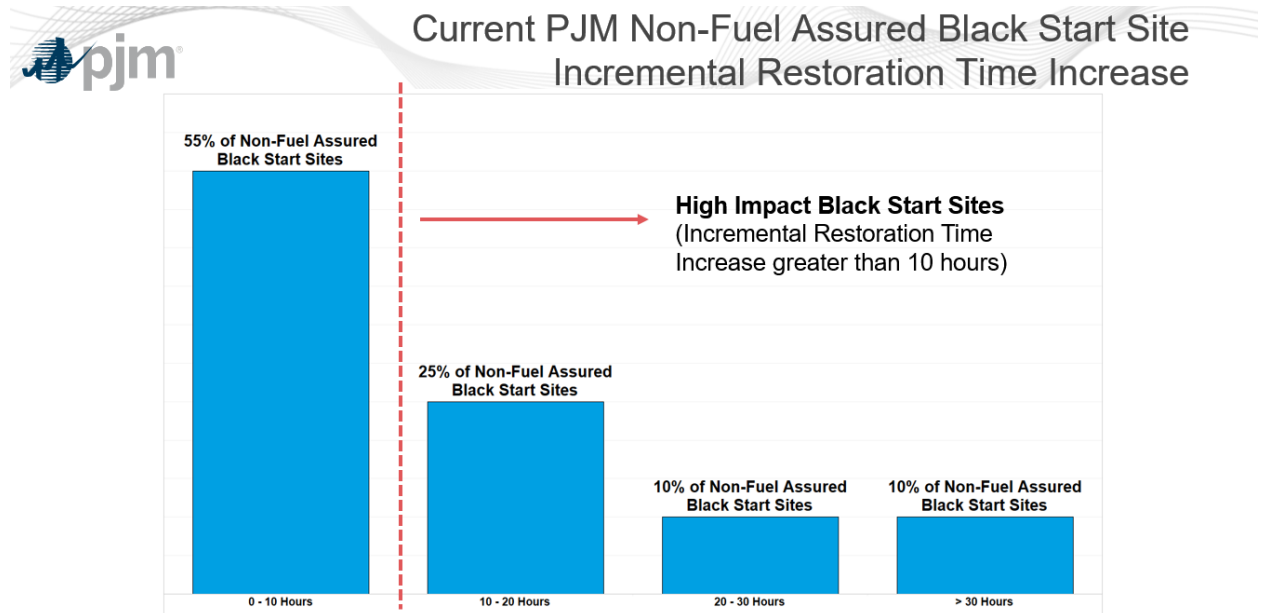
⁵⁶ *Id.*

⁵⁷ *Id.*

⁵⁸ Bennett Aff. ¶ 31, Figure 5.

Figure 1

Estimated Incremental Restoration Time Increases from Unavailability of Non-Fuel Assured Black Start Units, Grouped by Categories of Time Increases



As indicated in Figure 1, PJM is categorizing as High Impact Black Start Sites non-fuel assured Black Start Units sites that, if unavailable due to fuel unavailability, would result in a greater than 10-hour increase in restoration time, as High Impact Black Start Sites. The ten-hour criterion is a matter of judgment, and was vetted with stakeholders. As Mr. Bennett explains, “[t]he PJM stakeholder consensus was that the 10-hour threshold assumption reflected a reasonable incremental delay to restoration time, beyond which the societal impacts of an extended blackout would likely be more severe.”⁵⁹ He emphasizes that “the scenario under consideration is a PJM Region-wide, or even Interconnection-wide

⁵⁹ Bennett Aff. ¶ 30.

power outage, and in that context, delaying the restoration for more than 10 hours does imply significantly adverse societal impacts.”⁶⁰

Combining this analysis with PJM’s finding that about half of the current total MWs of Black Start Units are not fuel assured provides a reliability based quantitative foundation to identification and mitigation of the places within the PJM Region that are most vulnerable to system restoration problems if a non-fuel assured Black Start Unit is without its fuel supply at a time when that unit is most needed.

This analysis lends support, for example, to PJM’s plan (reflected in the MC-endorsed PJM Manual changes) to require one Fuel Assured Black Start Unit per Zone, supplemented by additional Fuel Assured Black Start Units only where needed to address High Impact Black Start Sites. PJM’s specific analysis described above, resulted in identification of eight High Impact Black Start Sites in five Zones, which sites PJM will seek to mitigate in its forthcoming Black Start RFP process.⁶¹

C. PJM Is Reasonably Codifying in the Tariff the 16-Hour Runtime Now Found in the Manuals, and Appropriately Specifying Exactly What that Requires for Different Types of Resources and Fuel-supply Arrangements

1. Sixteen Hours of On-Site Fuel Provides the Required Assurance.

PJM is using the capability to provide a 16-hour runtime, without reliance on grid-supplied power, as the distinguishing minimum requirement for a Fuel Assured Black Start Unit. The proposed 16-hour minimum runtime is reasonable, because it helps ensure that a Black Start Unit can serve its essential purpose of getting the restoration process started.

⁶⁰ Bennett Aff. ¶ 30.

⁶¹ Bennett Aff. ¶ 31.

And in recognition of that, Tariff, Schedule 6A has long included a 16-hour runtime assumption in its formula for determining Fuel Storage Costs for Black Start Units.⁶²

First, a 16-hour runtime helps ensure a Black Start Unit can do what it is intended to do—start critical loads as an essential early part of the process of restoring the system in a black start scenario. As Mr. Bennett explains, “Black Start Units are expected to crank critical loads which include generators with hot start times of four hours or less;”⁶³ and “Black Start Units must be capable of multiple starts.”⁶⁴ Multiple start capability allows the Black Start Unit to start multiple critical load generators that each have a four-hour start time, and to address the possibility that islands formed in the early steps of the restoration process may “trip off-line due to swinging frequency and load,”⁶⁵ requiring those critical loads to be started again. Because “[f]uel assured resources capable of 16 hours of full load operation can provide up to four or more starts of critical loads during a restoration process,” a 16-hour minimum run time capability “reasonably provides sufficient time for the restoration process to be successful.”⁶⁶

Second, the Tariff has long reflected this sixteen-hour convention. The overarching formula for Black Start Units’ annual revenue requirements has long had a component for Fuel Storage Costs.⁶⁷ The subsidiary formula for Fuel Storage Costs includes an element

⁶² Tariff, Schedule 6A, section 18.

⁶³ Bennett Aff. ¶ 13.

⁶⁴ *Id.*

⁶⁵ *Id.*

⁶⁶ Bennett Aff. ¶ 13; *see also* Bryson Aff. ¶ 16.

⁶⁷ Tariff, Schedule 6A, section 18.

for number of Run Hours, and the Tariff prescribes that “Run Hours shall be at least 16 hours or as defined by the Transmission Owner restoration plan, whichever is less.”⁶⁸ Mr. Bennett notes that “[w]hile the Tariff language allows for less than 16 hours if specified in the TO’s restoration plan, no current restoration plan in PJM allows a Black Start resource to store less than 16 hours of fuel.”⁶⁹

Third, focusing on this functional aspect of Black Start Service, i.e., sixteen hours of full load operation, advances a resource-neutral approach to defining Fuel Assured Black Start Units, and thus opens the door to sponsors of various resource types to develop proposals now and in the future that can meet that objective technical standard. Adopting a uniform technical standard does not mean that all resource types must be equally capable of meeting it. To the contrary, “[t]he law provides no basis to claim the Commission cannot approve uniform performance requirements simply because those requirements will be easier to satisfy for some generators than for others.”⁷⁰ Focusing on the technical performance requirement encourages innovation and competition.

2. *Independent Connections to Two Interstate Pipelines, or a Direct Connection to a Gas Gathering System, Provide the Required Assurance.*

PJM proposes that a natural-gas-fueled generator, for which on-site fuel storage is not feasible, will qualify as fuel assured if it has independent connections to two interstate pipelines, or if it has a direct connection to a gas gathering system.

⁶⁸ *Id.*

⁶⁹ Bennett Aff. ¶ 13.

⁷⁰ *Advanced Energy Mgmt. All. v. FERC*, 860 F.3d 656, 670 (D.C. Cir. 2017).

A single pipeline connection, standing alone, does not provide the level of assurance needed for a Black Start Unit's vital role of getting the restoration process started. The pipeline itself could be prone to service challenges, or conflicting high priority demands, during this type of event. One way to provide fuel assurance in such circumstances is through redundancy; two independent pipeline connections meet that need.

Direct connection to a natural gas gathering system "ahead of any interstate pipeline"⁷¹ also provides the higher level of fuel assurance that the Black Start Unit's responsibilities demand, by avoiding or reducing the risk of pipeline-ordered curtailments.

3. *Requiring Intermittent Resources and Hybrid Resources to be Capable of Providing 16 Hours of Full Load Operation with 90% Confidence Provides the Required Assurance in a Manner that Is Comparable to Non-Intermittent Resources.*

Intermittent and hybrid resources can add significant value to a restoration plan by increasing fuel diversity among the resources that are committed as Black Start Units. In addition, they also could provide price competitive options to thermal black start resources for PJM in future black start and fuel assurance RFPs. Facilitating their participation, in a fully reliable manner, as Fuel Assured Black Start Units was a significant sub-topic during the stakeholder process that led to this filing.

Consistent with this, PJM proposes that if the Fuel Assured Black Start Unit is an intermittent resource or hybrid resource, then its Black Start Unit Capacity will be "the monthly 90% confidence MW value calculated by [PJM]."⁷² Per the proposed Tariff

⁷¹ Bennett Aff. ¶ 16.

⁷² Tariff, Schedule 6A, section 18.

revisions, “[t]he 90% confidence MW value is calculated using Black Start Unit historical data to determine the hourly MW value the resource can provide each day in each month for 16 hours;” and “[t]he hourly MW value is then iterated until the confidence level of the unit providing the MW value on a monthly basis for 16 hours is 90%.”⁷³

In other words, PJM will only rely on an intermittent hybrid Fuel Assured Black Start Unit to provide the MW level of capacity that, based on the unit’s historic operations, the unit is 90 percent certain to be able to sustain for 16 hours. This approach is reasonable. PJM adopted the proposed 90 percent value because it corresponds with the historic Equivalent Availability Factor (“EAF”) for combustion turbine (“CT”) generators in the PJM Region. The EAF is the proportion of hours in a year when a unit is available to generate at full capacity.⁷⁴ That value has been approximately 90 percent in recent years for combustion turbine generators in PJM.⁷⁵ The average CT in PJM will operate at its full capacity only 90 percent of the hours during a year, or—more to the point—there is a 90 percent likelihood during each year that the average combustion turbine will operate at its full capacity. Applying that same principle here, PJM derives the “Black Start Unit Capacity” of an intermittent resource or hybrid resource unit by finding (based on historic operation) the output that the unit is 90 percent likely to sustain for 16 hours.

⁷³ *Id.*

⁷⁴ Affidavit of Thomas Hauske on Behalf of PJM Interconnection, L.L.C. (Attachment C) ¶ 15 (“Hauske Aff.”).

⁷⁵ Hauske Aff. ¶ 15; *see also State of the Market Report for PJM*, Monitoring Analytics, LLC, 346 (Mar. 9, 2023), https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2022/2022-som-pjm-vol2.pdf (for the five most recent calendar years, for example, the EAF for combustion turbines has been 90.7 percent (2018), 89.7 percent (2019), 90.4 percent (2020), 88.5 percent (2021), and 88.4 percent (2022)).

As Mr. Thomas Hauske explains, this approach “is reasonable for customers of Black Start Service, by ensuring that intermittent, run-of-river, and hybrid resources that are Fuel Assured Black Start Units can provide the product needed for reliability—sustained operation for 16 hours without reliance on external energy sources—at a MW output that has the same high level of certainty as the CT plants that play a major role in Black Start Service.”⁷⁶ The approach also is fair to intermittent and hybrid resources, he explains, “because it treats them similarly to CT units, which are compensated at their installed capacity level even though, statistically, CTs may not be capable of that level at times.”⁷⁷ In effect, this approach asks what help these types of resources *can* provide that fulfills the very specific role of Fuel Assured Black Start Units, and allows them to compete to provide that service. As Mr. Bryson emphasizes, “[s]o long as such resources can meet the fundamental, technical product requirement . . . it is consistent with prudent reliability planning, and with the long-term view inherent in planning for black start events, to take advantage of opportunities for assistance from this growing share of the PJM resource base.”⁷⁸

D. PJM Is Reasonably Revising the Black Start Revenue Requirement Rules to Accommodate and Incent Fuel Assured Black Start Units

Tariff, Schedule 6A, section 18 sets forth the formulas for calculating a generator’s annual Black Start Service revenue requirements. Today’s Tariff establishes three different means of recovering the fixed-cost share of the Black Start Unit’s revenue requirement,

⁷⁶ Hauske Aff. ¶ 15.

⁷⁷ Hauske Aff. ¶ 15.

⁷⁸ Bryson Aff. ¶ 17.

i.e., (i) the Base Formula Rate; (ii) the Capital Cost Recovery Rate; and (iii) the Capital Cost Recovery Rate – NERC-CIP Specific Recovery. This filing will focus on the Base Formula Rate and the Capital Recovery Rate changes. The Capital Cost Recovery Rate - NERC-CIP Specific Recovery Rate is a special form of the Base Formula Rate that also allows capital cost recovery for newly imposed regulatory NERC-CIP modifications for existing Black Start units. This rate is rarely used and there are no units currently recovering costs under this rate. However, the changes discussed below for the Base Formula rate also apply to the Capital Cost Recovery Rate – NERC-CIP Specific Recovery.

Black Start Units for which the owner has elected to forego recovery of new or additional Black Start Capital Costs (or where they have fully recovered such costs) use the Base Formula Rate for their Fixed Black Start Service Costs. The current Tariff Base Formula Rate for such units is the product of the Net Cost of New Entry (“Net CONE”),⁷⁹ the Black Start Unit Capacity, and a cost allocation factor known as “X.”

The existing Capital Cost Recovery Rate provides for recovery of the capital costs for the incremental equipment solely necessary to enable a unit to provide Black Start Service (i.e., the “Incremental Black Start Capital Costs”) in addition to whatever other product or services such unit may provide.⁸⁰ The Capital Cost Recovery Rate adds to the rate the Commission has otherwise approved for that unit⁸¹ an amount calculated as the

⁷⁹ See Tariff, Attachment DD, section 5.10 (prescribing the standards and procedures for determination of Net CONE).

⁸⁰ A separate version of the Capital Cost Recovery Rate provides for recovery of the capital costs for the incremental equipment solely necessary to enable a Black Start Unit to maintain compliance with mandatory Critical Infrastructure Protection Reliability Standards.

⁸¹ Tariff, Schedule 6A, section 18. Existing section 18 already defines “FERC-approved rate” as “the Black Start Unit’s current FERC-approved recovery of costs to provide Black Start Service, if applicable.” *Id.*

product of the Incremental Black Start Capital Costs times a Capital Recovery Factor (“CRF”).

Regardless of which method is used for the unit’s fixed costs, under the existing Tariff the unit’s total Black Start Service revenue requirement⁸² is multiplied by 1 plus an incentive factor “Z” which currently can be either 0.00 for Black Start Units electing to recover their costs under the Capital Recovery Rate or 0.10 for Black Start Units using the Base Formula Rate.

PJM now proposes to revise Tariff, Schedule 6A, section 18 to add provisions for Fuel Assured Black Start Units, as discussed in the following subsections of this transmittal.

1. *The Black Start Unit Capacity in the Base Formula Rate Properly Tracks the 16-Hour Runtime Requirement for Fuel Assured Black Start Units.*

A Black Start Unit using the Base Formula Rate⁸³ requires a value for its Black Start Unit Capacity.⁸⁴ The current Tariff sets that value as the installed capacity for any

⁸² The Tariff establishes the Black Start Service annual revenue requirement formula as:

$$\{(\text{Fixed BSSC}) + (\text{Variable BSSC}) + (\text{Training Costs}) + (\text{Fuel Storage Costs})\} * (1 + Z)$$

⁸³ The Tariff defines the Base Formula Rate as:

Base Formula Rate:

$$\text{Net CONE} * \text{Black Start Unit Capacity} * X$$

⁸⁴ See Tariff, Schedule 6A, section 18.

Black Start Unit that is a Generation Capacity Resource.⁸⁵ PJM is revising this provision to conform to the change, *see supra* Section IV.C.3, to set the Black Start Service commitment of Fuel Assured Black Start Units that are intermittent or hybrid resources at the MW level they can sustain, with 90 percent statistical confidence, for 16 hours. Since those resources are committing to provide Black Start Service at that level, they are appropriately compensated for that level. PJM is also revising section 18 to make clear that non-intermittent Fuel Assured Black Start Units that are Generation Capacity Resources will continue (as they currently do) to use their installed capacity as their Black Start Unit Capacity.⁸⁶

2. *The “X” Cost Allocation Factor Is Reasonably Set at 0.02 for All Fuel Assured Black Start Units.*

The Base Formula Rate also requires a value for “X,” which is the default allocation factor (absent documentation of the actual costs of providing Black Start Service) intended to reflect the minimum percentage of Net CONE costs that would be associated with providing Black Start Service. The Tariff currently states that “X,” the Black Start Service allocation factor (which was previously accepted by the Commission), is 0.02 for CT units and 0.01 for hydro units.

PJM proposes here to add to the Tariff definition⁸⁷ of “X” that all Fuel Assured Black Start Units using the Base Formula Rate should have the same default minimum cost

⁸⁵ See Tariff, Schedule 6A, section 18. If the Black Start Unit is an Energy Resource, its Black Start Unit Capacity is the MW value awarded by PJM to that resource through PJM’s RFP process.

⁸⁶ *Id.* Likewise, if a Fuel Assured Black Start Unit is non-intermittent and is an Energy Resource, its Black Start Unit Capacity will continue to be the MW PJM value awarded that unit through the RFP process.

⁸⁷ Tariff, Schedule 6A, section 18.

allocation factor, i.e., 0.02. Using a common minimum cost allocation factor for all Fuel Assured Black Start Units is just and reasonable because PJM is proposing a common standard for the fuel assurance all Fuel Assured Black Start Units are expected to provide. As Mr. Hauske explains, “since PJM is calculating the 16 hour Black Start MW capability for Fuel Assured units that do not store fuel on site, all Fuel Assured Black Start Units are providing similar service.”⁸⁸ Accordingly, “PJM proposes to treat all Fuel Assured Black Start Units using the Base Formula Rate the same, with the same 0.02 allocation factor regardless of resource type.”⁸⁹

3. *The “Z” Incentive Factor Is Reasonably Set at 0.20 for Fuel Assured Black Start Units that Are on the Base Formula Rate.*

The Black Start Service Revenue Requirement⁹⁰ sets the overall compensation due a provider of Black Start Service. The Base Formula Rate and the Capital Cost Recovery Rate⁹¹ are two alternative methods of calculating the “Fixed Black Start Service Costs” which is one component of that revenue requirement. The existing Black Start Service revenue requirement also includes another component—a multiplier equal to 1 plus a decimal factor identified by the term “Z.” If Z is set at zero, the resulting multiplier is simply 1, which means it has no effect on the revenue requirement. The current effective

⁸⁸ Hauske Aff. ¶ 17.

⁸⁹ Hauske Aff. ¶ 17.

⁹⁰ See *supra* note 82 (Tariff formula for this annual revenue requirement).

⁹¹ The Tariff prescribes the Capital Cost Recovery Rate formula as:

Capital Cost Recovery Rate

(FERC-approved rate) + (Incremental Black Start Capital Costs * CRF)

Tariff, Schedule 6A, section 18 establishes that Z is 0.10 for Black Start Units using the Base Formula Rate, and zero for Black Start Units that use the Capital Cost Recovery Rate. In other words, unit owners have a choice: they can opt for a Capital Cost Recovery Rate and increase their fixed cost recovery by those documented incremental black-start related capital costs, or they can opt for the Base Formula Rate, and receive a modest incentive multiplier to their fixed cost component.

By this filing, PJM is proposing to increase the Z factor for all Fuel Assured Black Start Units that use the Base Formula Rate from 0.10 to 0.20.

The resulting multiplier of 1.20 is reasonable because it provides an incentive for unit owners to take on the added risks of committing their resources as Fuel Assured Black Start Units, and because the cost of that added incentive is modest relative to the benefit of providing greater assurance that a black start restoration event will proceed successfully. As to the risks, Mr. Hauske explains if a resource becomes a Fuel Assured Black Start Unit, it takes on an added risk of forfeiting *all* of its Black Start Service revenues for a given period if the resource fails the added testing or performance requirements that are specific to fuel assurance.⁹² The resource could lose those revenues even if it satisfied the remaining Black Start Service testing and performance requirements. Importantly, nothing requires a unit owner to offer its resource as a Fuel Assured Black Start Unit—doing so is entirely voluntary.⁹³ While the risk of revenue loss is a reasonable means to help ensure that unit owners honor their fuel assurance commitments, that risk can deter some unit owners from offering fuel assurance. The increased Z factor, by increasing the revenue

⁹² Hauske Aff. ¶ 7.

⁹³ Hauske Aff. ¶ 20.

requirement available from offering as a Fuel Assured Black Start Unit, can help offset the deterrent posed by added risks of losing Black Start Service revenues. This loss-of-revenue risk is not borne by any Black Start Units which choose not to take on the additional requirement of fuel assurance, because the revenue forfeiture for failure to maintain the required fuel on site only applies to Full Assured Black Start Units.⁹⁴

In particular, the higher Z factor's 10 percent increase in annual revenue requirements is comparable to the revenue *loss* a unit owner faces if it forfeits one month of revenue—which is about 8 percent of annual revenues—if, for example, it does not continuously maintain on site the fuel and other consumables it needs to ensure a 16-hour runtime.⁹⁵

This incentive is not needed, however, for Fuel Assured Black Start Units that are on the Capital Recovery Rate. As Mr. Hauske explains, “[u]nits that need capital dollars to provide Black Start Service or fuel assurance have an incentive from the 12 percent existing authorized rate of return on their invested capital dollars” which is built into the CRF.⁹⁶ Mr. Hauske notes that the CRF’s 12 percent rate of return seems to provide a sufficient incentive given that “PJM has received multiple responses in past RFPs from generation owners that need to recover capital cost to provide Black Start Service.”⁹⁷ Since the same 12 percent will apply to both Incremental Black Start Capital Costs and Fuel Assurance Capital Costs, it is reasonable to expect that 12 percent rate of return will provide

⁹⁴ See Tariff, Schedule 6A, section 14.

⁹⁵ Hauske Aff. ¶ 24.

⁹⁶ Hauske Aff. ¶ 22.

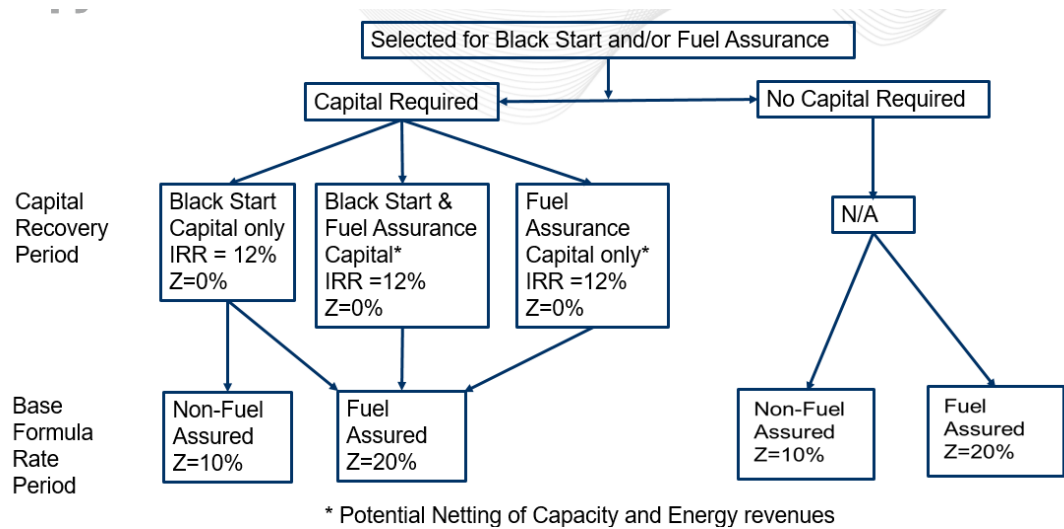
⁹⁷ Hauske Aff. ¶ 22.

sufficient incentive to unit owners with resources on the Capital Recovery Rate to become fuel assured without also offering those unit owners a 10 percent increase in the Z factor incentive.⁹⁸

By contrast, “[i]t is reasonable to be concerned . . . that existing units that do not require capital dollars might not accept the additional risks of being a Fuel Assured Black Start Unit” without an increase in the Z factor incentive.⁹⁹

To reinforce this point, Mr. Hauske prepared and presented in his affidavit the following graphic comparing the incentives available under the Base Formula Rate and the Capital Recovery Rate for unit owners in different scenarios (i.e., whether their resources are fuel assured, or not fuel assured, and whether they are under the Base Formula Rate or the Capital Recovery Rate).

Figure 2



⁹⁸ Hauske Aff. ¶ 22.

⁹⁹ Hauske Aff. ¶ 22.

Mr. Hauske also shows that the increase (from 10 percent to 20 percent) in the Z factor for Fuel Assured Black Start Units that are not on the Capital Recovery Rate is very well tailored to mitigating the risk of revenue loss that Fuel Assured Black Start Units face if they fail to store the required level of fuel on-site. Specifically, he shows that the dollar amount of the average revenue increase for Fuel Assured Black Start Units attributable to the increased Z Factor is the same as the dollar amount of the one month of Black Start Service revenue that a Fuel Assured Black Start Unit will forfeit if it fails to meet its on-site fuel storage requirement.¹⁰⁰

Mr. Hauske also explains how the Z factor increase for Fuel Assured Black Start Units that are not on the Capital Recovery Rate “also indirectly incents units *on the Capital Recovery Rates* that are *already* fuel assured.”¹⁰¹ As he notes, “[a]ll Black Start Units on the Capital Recovery Rate transition to the Base Formula Rate when they complete their capital recovery period.”¹⁰² Therefore, if a unit is on a Capital Recovery Rate at the time of an RFP, “they must weigh the risk of not offering to be fuel assured while on the Capital Recovery Rate and forgoing the future incentive factor increase when the unit transitions to the Base Formula Rate.”¹⁰³

Mr. Hauske prepared and presented in his affidavit¹⁰⁴ the graphic shown as Figure 3 below to better illustrate this consideration. In short, the higher Z factor gives an incentive

¹⁰⁰ Hauske Aff. ¶ 24.

¹⁰¹ Hauske Aff. ¶ 26 (emphasis added).

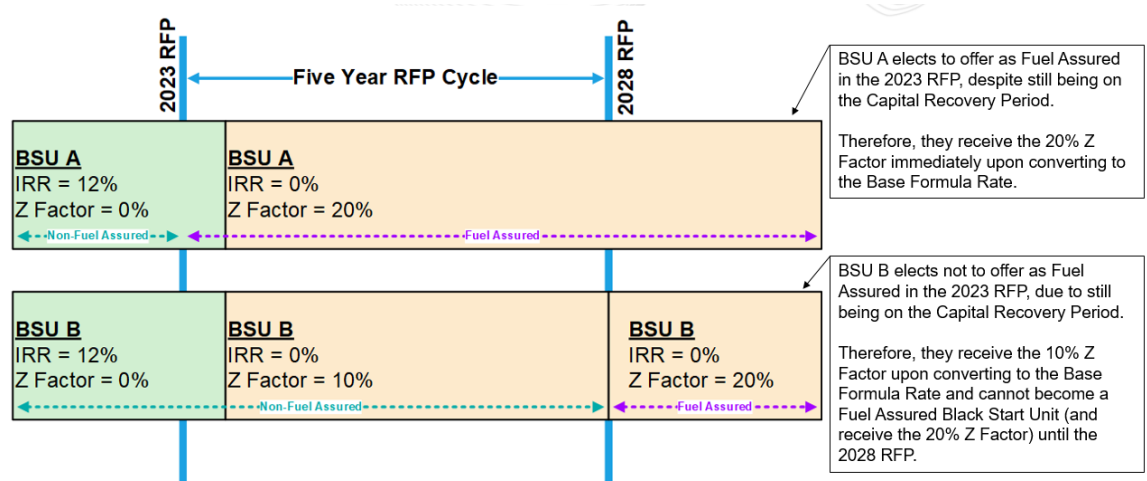
¹⁰² Hauske Aff. ¶ 26.

¹⁰³ Hauske Aff. ¶ 26.

¹⁰⁴ Hauske Aff. ¶ 26.

to a unit owner that already has a Black Start Unit on a Capital Recovery Rate to offer that resource as fuel-assured so that it will automatically receive the benefit of the higher Z factor as soon as it comes to the end of its capital cost recovery period during the ensuing five-year RFP cycle.

Figure 3



Notably, in the context of the overall costs of providing Black Start Service, the costs of providing this incentive are relatively small, and the estimated benefits of avoiding the broader economic costs of delaying a restoration of electric service following a wide-ranging black-out, outweigh the cost of the incentive in the most common scenarios.

To assess the relative cost of the 20 percent Z factor, it helps to recall that the package endorsed for this filing included PJM Manual changes elaborating on restoration plan implementation details. Specifically, pursuant to PJM’s Schedule 6A responsibility to “develop[] a coordinated and efficient system restoration plan that identifies all of the

locations where Black Start Units are needed,”¹⁰⁵ the PJM Manuals will now require one Fuel Assured Black Start Unit per TO Zone, *with additional such units only as PJM determines are necessary through a reliability analysis.*¹⁰⁶

Importantly, *PJM* decides where in the PJM Region (and how many) Fuel Assured Black Start Units are needed. The Z factor incentive is not designed to produce more Fuel Assured Black Start Units than the region needs. Rather, it is intended to help ensure that PJM has sufficient offers into the RFP process that PJM is able to select good options for meeting the Fuel Assured Black Start Unit requirement in every location that it is needed.

The very broad stakeholder support for these Tariff revisions indicates this is a cost PJM loads are willing to accept, to help mitigate the potential risk of adverse impacts on system restoration time from unavailability of Black Start Units that are not fuel assured.

In short, there is substantial evidence that the added costs to provide greater fuel assurance in the black start recovery arrangements are just and reasonable.

4. *The Fuel Assurance Capital Cost Provisions Reasonably Track the Previously Accepted Incremental Black Start Capital Cost Provisions.*

As an alternative to the Base Formula Rate, Schedule 6A, section 18, permits unit owners that incur additional capital costs to provide Black Start Service a means to recover those costs, using the Capital Cost Recovery Rate. PJM is revising section 18 to define a class of additional capital costs needed to provide fuel assurance, i.e., Fuel Assurance Capital Costs. PJM proposes to add a distinct term to expressly acknowledge “the new or

¹⁰⁵ Tariff, Schedule 6A, section 4.

¹⁰⁶ System Operations Division, *PJM Manual 36: System Restoration*, PJM Interconnection, L.L.C., 69-70 (June 15, 2022), <https://www.pjm.com/-/media/committees-groups/committees/mc/2022/20221116/consent-agenda-d---9-manual-36-revisions---redline.ashx>.

additional capital costs documented by the owner for the installation of equipment necessary for the unit to meet the fuel assurance criteria specified in the PJM manuals.”¹⁰⁷ However, PJM is patterning this new term very closely on the “Incremental Black Start Capital Costs” that the current effective Tariff recognizes for “the new or additional capital costs documented by the owner or accepted by the Commission for the incremental equipment solely necessary to enable a unit to provide Black Start Service.” As with the “Incremental Black Start Capital Costs,” the “Fuel Assurance Capital Costs” are multiplied by a CRF in the Capital Cost Recovery Rate. And as with the “Incremental Black Start Capital Costs,” the “Fuel Assurance Capital Costs” shall not include “any capital costs that the [unit owner] is recovering for that unit pursuant to a FERC-approved recovery rate.”¹⁰⁸

These parallel provisions that track what the Commission has already accepted for a very similar type of black-start-related capital costs are equally just and reasonable. Only units which voluntarily take on the risk of lost revenue that comes with the status of being a Fuel Assured Black Start Unit are eligible for this Fuel Assurance Capital Costs rate option.

5. *The Cost Recovery Periods for Fuel Assurance Capital Costs, Including 10 Years for Units that Are 16 Years or Older, Are Reasonable.*

The CRF in the Capital Cost Recovery Rate uses a recovery period determined by the age of the unit; the older the unit, the shorter the recovery period. The current Tariff’s shortest recovery period is five years, which is used for units older than 16 years.¹⁰⁹ While

¹⁰⁷ Tariff, Schedule 6A, section 18.

¹⁰⁸ See Tariff, Schedule 6A, section 18.

¹⁰⁹ Tariff, Schedule 6A, section 18.

that recovery period will remain five years for Incremental Black Start Capital Costs on older units, it will be lengthened to 10 years for Fuel Assurance Capital Costs associated with units that are older than 16 years. All other CRF recovery periods in Schedule 6A will remain the same.

The “increase of the capital recovery period to 10 years for this unit age was a compromise put forth in the stakeholder process to lessen the financial impact on Black Start Service customers (largely network transmission service loads) from fuel assurance conversions.”¹¹⁰ Lengthening the recovery period for these older units from five years to ten years significantly reduces the share of the costs that is recovered each year, thus moderating the annual rate impact on customers. That rate moderation could be particularly beneficial in these circumstances. The capital costs a resource must incur to become fuel assured could easily be comparable to the level of capital costs a resource must incur just to become a Black Start Unit—without fuel assurance.¹¹¹ Moreover, nothing prevents a resource from recovering both Incremental Black Start Capital Costs and Fuel Assurance Capital Costs at the same time, and if a resource older than 16 years incurred capital costs for both types of plant modifications then, absent an adjustment to the recovery periods, it would be recovering both sets of capital costs from customers in only five years.¹¹² Increasing, for those older plants, the recovery period from five years

¹¹⁰ Hauske Aff. ¶ 10.

¹¹¹ Hauske Aff. ¶ 10.

¹¹² Hauske Aff. ¶ 10.

to 10 years for Fuel Assurance Capital Costs will help mitigate these potential rate impacts.¹¹³

6. *Credits for Fuel Assurance Capital Costs Reasonably Recognize Energy Market Revenues Resulting from the Resource Being Committed as a Consequence of Using the Subject Fuel, and Reasonably Recognize Capacity Market Revenues Resulting from Fuel Assurance Capital Costs that Increased the Unit's Installed Capacity Rating.*

Under Tariff, Schedule 6A, section 22, Black Start Unit owners receive monthly credits reflecting their Black Start Service revenue requirements. For a Fuel Assured Black Start Unit owner receiving Fuel Assurance Capital Costs, however, those credits should be reduced to reflect other revenues paid to the owner that are specifically attributable to the same capital costs. This issue is particular to Fuel Assurance Capital Costs, because in both the scenarios described below, customers are paying for costs that yield the owner new revenue streams, making it reasonable to take those revenues into account when establishing what customers should pay for the capital costs that produced those revenues.

Specifically, PJM is adding section 22A to Schedule 6A to establish these reductions in the credits, in two scenarios. First, a unit owner may earn revenues from the unit being committed in the energy market to run on the fuel that Fuel Assurance Capital Costs enabled the unit to use. Recognizing those energy market revenues that the Fuel Assurance Capital Costs helped make possible appropriately reduces the share of those costs that Black Start Service customers must bear.

Second, Fuel Assurance Capital Costs could, in some circumstances, increase the Installed Capacity Rating of a Generation Capacity Resource, enabling the unit owner to

¹¹³ Hauske Aff. ¶ 10.

receive increased capacity market revenues from that increase in Installed Capacity. It is just and reasonable to take account of these other revenues that are generated by the Fuel Assurance Capital Costs when paying the unit owner for incurring those costs.

E. PJM Is Reasonably Requiring that Black Start Unit Commitment Periods Track the Associated Cost Recovery Period and, Where Appropriate, the Remaining Life of the Subject Equipment

Under Tariff, Schedule 6A, section 4, no Black Start Unit is eligible to recover the costs of providing Black Start Service unless it agrees to provide such service for a term of commitment established under Schedule 6A. Current section 5, setting the commitment period for unit owners that elect to forego recovery of new or additional capital costs, is already drafted in such a way that it can reasonably apply to resources whether or not they are fuel assured.

Existing section 6, however, speaks only in terms of unit owners that have elected to recover Black Start Capital Costs, and thus on its face would not seem to apply to unit owners that have elected to recover Fuel Assurance Capital Costs. PJM proposes to fill that need with a new section 6(iii). Proposed section 6(iii) very closely tracks the previously approved and current section 6(ii), which sets the recovery period for a unit owner with Black Start Capital Cost based on the age of the unit and the remaining life of the black start equipment.

F. PJM Is Modifying the Tariff to Make Clear that Fuel Assured Black Start Units Must Meet the Technical and Implementing Fuel Assurance Performance Requirements in the PJM Manuals

Black Start Units must meet the performance requirements set forth in Tariff, Schedule 6A, sections 7-9, as well as additional technical performance requirements specified in PJM Manual 12, section 4.5.10. Fuel Assured Black Start Units, all of which

are Black Start Units, must meet all of these Tariff and Manual performance requirements. But the performance requirement details currently in the Manuals do not address fuel assurance; PJM, with the endorsement of the relevant stakeholder committees, has added such details to Manual 12. Some of these Manual provisions¹¹⁴ mirror (or help implement) the provisions PJM has proposed for the Tariff, concerning testing requirements and potential losses of revenue, related to fuel assurance, which are discussed in Section IV.G of this transmittal. Other Manual provisions¹¹⁵ establish such implementing or technical requirements as providing verification of fuel and energy to PJM, including through telemetry, and providing details of their emissions permit limitations, and making efforts to obtain permit modifications or waivers to accommodate operations during a restoration situation.

PJM accordingly proposes to revise the Tariff, Schedule 6A, section 7(d) to make clear that Fuel Assured Black Start Units must meet these fuel assurance implementation rules and details in the PJM Manuals.

G. PJM Is Reasonably Requiring Fuel Assured Black Start Units that Are Dual Fuel to Conduct an Annual Test on Both Fuels, and Is Reasonably Proposing to Deny Black Start Revenues for any Month the Unit Owner Fails to Store Fuel on Site

PJM has annual testing requirements for all Black Start Units to verify that they can be started and operated without being connected to the Transmission System. PJM is revising Tariff, Schedule 6A, section 12, which establishes these testing requirements, to

¹¹⁴ See Dispatch, *PJM Manual 12: Balancing Operations*, PJM Interconnection, L.L.C., § 4.6.10 (June 1, 2022), <https://www.pjm.com/-/media/committees-groups/committees/mc/2022/20221116/consent-agenda-d---3-manual-12-revisions---redline.ashx> (first, third, and fourth bullet points).

¹¹⁵ See *id.*, (second and fifth bullet points).

make clear that a Fuel Assured Black Start Unit that relies on dual fuel capability must conduct an annual test on both fuels. Because such a unit depends on both fuels to satisfy its fuel assurance requirement, it follows that it should have to demonstrate that it can operate on both fuels. PJM's revision eliminates any ambiguity on that point.

Under current Tariff, Schedule 6A, section 14, a Black Start Unit that does not have a successful annual test on record with PJM within the previous 13 months will not qualify to receive Black Start Service revenues. PJM is adding to that section an additional rule on revenue forfeiture tailored to Fuel Assured Black Start Units that rely on on-site fuel. Specifically, such a unit will not qualify to receive any Black Start Service revenues in any month when it fails in that month to store the fuel and non-fuel consumables that are needed to meet its fuel assurance run-hour requirements. This provision is needed to help ensure that the Fuel Assured Black Start Unit will always be in a position to meet its black start obligations (which could be called upon at any time, due to events whose severity may not be foreseeable), given that meeting those obligations depends on having on site all that it needs to meet the 16-hour run-time requirement.

IV. STAKEHOLDER PROCESS

The PJM MRC endorsed a Problem Statement and Issue Charge on this issue on July 26, 2018, assigning the issue to both the Operating Committee ("OC") and the Market Implementation Committee ("MIC"). The OC and MIC met jointly in special session on this issue 13 times from January 2019 through March 2020, and moved the effort forward with work on the level of fuel assurance, fuel assurance solutions by primary fuel type, testing and verification requirements, compensation mechanisms, and implementation plans. In March 2020, the committees decided the committee work on the issue could be

paused, pending further analysis work by PJM. PJM conducted substantial additional analysis (discussed in more detail in Section III.B of this transmittal) and reported the results to the MIC and OC early in 2022.

During 2022, the OC and MIC met 10 more times in special session on this issue and developed design component details and solution packages,¹¹⁶ with associated proposed Tariff changes, culminating in the PJM MC-endorsement, by acclamation (with no objections)¹¹⁷ at the MC's November 16, 2022 meeting, of the Tariff provisions¹¹⁸ proposed in this filing. The package endorsed by the MC also included revisions to the PJM Manuals to implement details of the rule changes adopted in the Tariff.¹¹⁹

V. EFFECTIVE DATE

PJM requests an effective date of July 11, 2023, i.e., sixty days after this filing date, for these Tariff revisions. PJM asks that the Commission issue a final order accepting these

¹¹⁶ The Independent Market Monitor for the PJM Region developed an alternative solution package, which the stakeholders did not advance to the MC.

¹¹⁷ See Members Committee, *Minutes*, PJM Interconnection, L.L.C., (Nov. 16, 2022), <https://www.pjm.com/-/media/committees-groups/committees/mc/2022/20221221/consent-agenda-a---draft-mc-minutes-11162022.ashx>. The proposed Tariff and manual revisions were previously endorsed by the MRC at its October 24, 2022 meeting, with an affirmative sector vote of 4.714 in favor.

¹¹⁸ See *Schedule 6A Black Start Service*, PJM Interconnection, L.L.C. (Nov. 9, 2022), <https://www.pjm.com/-/media/committees-groups/committees/mc/2022/20221116/consent-agenda-d---11-tariff-schedule-6a-revisions---redline.ashx>.

¹¹⁹ See Dispatch, *PJM Manual 12: Balancing Operations*, PJM Interconnection, L.L.C., (Nov. 9, 2022), <https://www.pjm.com/-/media/committees-groups/committees/mc/2022/20221116/consent-agenda-d---3-manual-12-revisions---redline.ashx>; Dispatch, *PJM Manual 14:D: Generator Operational Requirements*, PJM Interconnection, L.L.C., (last visited Apr. 13, 2023), <https://www.pjm.com/-/media/committees-groups/committees/mc/2022/20221116/consent-agenda-d---5-manual-14-d-revisions---redline.ashx>; Market Settlements Development Department, *PJM Manual 27: Open Access Transmission Tariff Accounting*, PJM Interconnection, L.L.C., (Aug. 31, 2020), <https://www.pjm.com/-/media/committees-groups/committees/mc/2022/20221116/consent-agenda-d---7-manual-27-revisions---redline>; System Operations Division, *PJM Manual 36: System Restoration*, PJM Interconnection, L.L.C., (June 15, 2022), <https://www.pjm.com/-/media/committees-groups/committees/mc/2022/20221116/consent-agenda-d---9-manual-36-revisions---redline.ashx>.

Tariff revisions no later than that requested effective date, to permit PJM's use of these fuel assurance enhancements in selecting Black Start Units through the RFP process this summer.

VI. CORRESPONDENCE

The following individuals are designated for inclusion on the official service list in this proceeding and for receipt of any communications regarding this filing:¹²⁰

Craig Glazer
Vice President–Federal Government Policy
PJM Interconnection, L.L.C.
1200 G Street, N.W., Suite 600
Washington, D.C. 20005
(202) 423-4743 (phone)
craig.glazer@pjm.com

Paul M. Flynn
Wendy Warren
Uju Okasi
Wright & Talisman, P.C.
1200 G Street, N.W., Suite 600
Washington, D.C. 20005-3898
(202) 393-1200 (phone)
flynn@wrightlaw.com
warren@wrightlaw.com
okasi@wrightlaw.com

Steven R. Pincus
Managing Counsel, Sr. Director
PJM Interconnection, L.L.C.
2750 Monroe Boulevard
Audubon, PA 19403
(610) 666-4370 (phone)
steven.pincus@pjm.com

VII. DOCUMENTS ENCLOSED

This filing consists of the following:

1. This transmittal letter;
2. Affidavit of Michael E. Bryson on Behalf of PJM Interconnection, L.L.C. (Attachment A);
3. Affidavit of Daniel Bennett on Behalf of PJM Interconnection, L.L.C. (Attachment B);

¹²⁰ To the extent necessary, PJM requests waiver of Rule 203(b)(3) of the Commission's Rules of Practice and Procedure, 18 C.F.R. § 385.203(b)(3), to permit all persons listed to be placed on the official service list for this proceeding.

4. Affidavit of Thomas Hauske on Behalf of PJM Interconnection, L.L.C. (Attachment C); and
5. Revisions to the Tariff in redlined (Attachment D) and clean (Attachments E and F)¹²¹ formats, and in electronic tariff filing format as required by Order No. 714.¹²²

VIII. SERVICE

PJM has served a copy of this filing on all PJM Members and on all state utility regulatory commissions in the PJM Region by posting this filing electronically. In accordance with the Commission's regulations,¹²³ PJM will post a copy of this filing to the FERC filings section of its internet site, located at the following link: <https://www.pjm.com/library/filing-order> with a specific link to the newly filed document, and will send an email on the same date as this filing to all PJM Members and all state utility regulatory commissions in the PJM Region¹²⁴ alerting them that this filing has been made by PJM and is available by following such link. PJM also serves the parties listed on the Commission's official service list for this docket. If the document is not immediately available by using the referenced link, the document will be available through

¹²¹ Due to overlapping filings, PJM submits a clean version of Tariff, Schedule 6A to merge previously accepted language on one version effective January 29, 2022 (two instances of revising "May" to "April" in section 18). PJM's prior Black Start proceeding in Docket No. ER21-1635-000 was filed on April 7, 2021, with subsequent filing obligations. During this time, on November 29, 2021, PJM filed a Governing Document Enhancement & Clarification Subcommittee filing to make minor clean-up changes in Docket No. ER22-486-000, which did not include pending Black Start language. The filing in Docket No. ER22-486-000, was accepted effective January 29, 2022, *PJM Interconnection, L.L.C.*, Letter Order, Tariff Revisions to Correct and Clarify Provisions, Docket Nos. ER22-486-000, -002 (June 22, 2022), while Black Start and its progeny were all accepted effective on June 6, 2021. *PJM Interconnection, L.L.C.*, 176 FERC ¶ 61,080, *order on compliance*, 177 FERC ¶ 61,202 (2021), *order on compliance*, Letter Order, Docket No. ER21-1635-004 (Apr. 26, 2022).

¹²² *Electronic Tariff Filings*, Order No. 714, 124 FERC ¶ 61,270 (2008), *final rule*, Order No. 714-A, 147 FERC ¶ 61,115 (2014).

¹²³ See 18 C.F.R. §§ 35.2(e), 385.2010(f)(3).

¹²⁴ PJM already maintains, updates, and regularly uses email lists for all PJM Members and affected state commissions.

the referenced link within 24 hours of the filing. Also, a copy of this filing will be available on FERC's eLibrary website located at the following link: <http://www.ferc.gov/docs-filing/elibrary.asp> in accordance with the Commission's regulations and Order No. 714.

IX. CONCLUSION

For the reasons set forth herein, PJM requests that the Commission accept the proposed Tariff revisions contained and described in this filing effective July 11, 2023.

Respectfully submitted,

/s/ Paul M. Flynn

Paul M. Flynn
Wendy Warren
Uju Okasi
Wright & Talisman, P.C.
1200 G Street, N.W., Suite 600
Washington, D.C. 20005-3898
(202) 393-1200 (phone)
flynn@wrightlaw.com
warren@wrightlaw.com
okasi@wrightlaw.com

**Attorneys for
PJM Interconnection, L.L.C.**

Craig Glazer
Vice President–Federal Government Policy
PJM Interconnection, L.L.C.
1200 G Street, N.W., Suite 600
Washington, D.C. 20005
(202) 423-4743 (phone)
craig.glazer@pjm.com

Steven R. Pincus
Managing Counsel, Sr. Director
PJM Interconnection, L.L.C.
2750 Monroe Boulevard
Audubon, PA 19403
(610) 666-4370 (phone)
steven.pincus@pjm.com

Attachment A

Affidavit of Michael E. Bryson
on Behalf of PJM Interconnection, L.L.C.

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

PJM Interconnection, L.L.C.

)
)
)

Docket No. ER23-____-000

**AFFIDAVIT OF MICHAEL E. BRYSON
ON BEHALF OF PJM INTERCONNECTION, L.L.C.**

1. My name is Michael E. Bryson. My business address is 2750 Monroe Blvd., Audubon, Pennsylvania, 19403. I currently serve as the Senior Vice President of Operations for PJM Interconnection, L.L.C. (“PJM”). I am submitting this affidavit on behalf of PJM in support of the proposed revisions to the PJM Open Access Transmission Tariff (“Tariff”) being filed today in the captioned proceeding.

2. I earned a Bachelor of Science in general engineering from the United States Military Academy at West Point, New York, focusing on computer science and electrical engineering, and have a Master of Business Administration from Saint Joseph’s University in Philadelphia. I earned a graduate certificate in power engineering from the Worcester Polytechnic Institute.

3. Prior to my current position, at PJM I have held the positions of executive director of System Operations, general manager of Dispatch Operations, and manager of the Transmission Department for the System Operations Division. I am a member of the Independent System Operator and Regional Transmission Organization (“RTO”) Operating Committee. I also serve on the board of PJM Technologies, Inc., and PJM Repository Information Services, Inc. Also, I previously served on the board of directors of the ReliabilityFirst Corporation as well as the Consortium for Electric Reliability Technology Solutions.

4. As part of my work for PJM, I am responsible for PJM’s Operations Division, overseeing the 24-hours per day, 7-days per week transmission operations for real-time systems. These operations include scheduling, transmission dispatch, generation dispatch, reliability coordination, training, and all engineering analysis required to run the system and support the critical energy management systems.

5. The purpose of this affidavit is to support the Tariff revisions PJM proposes for Black Start Service¹ by: (i) explaining the critical importance of Black Start Service to PJM’s reliable operation of the PJM transmission system; (ii) describing the need for prompt Federal Energy Regulatory Commission (“Commission”) acceptance of the

¹ PJM Tariff, Schedule 6A. All capitalized terms that are not otherwise defined herein shall have the same meaning as they are given in the Tariff, Amended and Restated Operating Agreement of PJM Interconnection, L.L.C., or the Reliability Assurance Agreement Among Load Serving Entities in the PJM Region.

proposed Black Start Tariff revisions to establish fuel assurance business rules, (iii) explaining the benefits that fuel assurance provides to reliability; and (iv) describing how PJM's package is a balanced approach providing an enhancement to reliability while also containing the cost of the service to ratepayers.

The Critical Importance of Black Start Service

6. Transmission system blackouts or power system disturbances are most likely to occur as the result of loss of generating equipment or transmission facilities, or as the result of unexpected load changes. These disturbances could be, or could develop into, a magnitude sufficient to affect the reliable operation of the PJM transmission system.

7. PJM is responsible for taking actions that are necessary to maintain the operational integrity of the PJM transmission system. This responsibility includes coordinating and monitoring restoration of all or parts of the Bulk Electric System ("BES") in the PJM footprint, as necessary. As part of this responsibility, PJM must develop and implement a reliable "black start" capability plan. This plan includes consideration of fuel sources for Black Start power for generating units, available cranking ability, available transmission paths, communication adequacy, operating instructions and procedures for synchronizing areas of the system that have become separated, and procedures for simulating, testing and verifying the Black Start plan's resources and procedures.

8. PJM's policy is to maintain, at all times, the integrity of the PJM transmission system and the Eastern Interconnection, and to prevent any unplanned separation of the PJM Transmission Owners' systems. PJM's system restoration plan identifies all of the locations where Black Start Units are needed. PJM Manual 14D² sets forth the criteria and process for selecting or identifying the Black Start Units necessary to commit to providing Black Start Service at the identified locations.

9. A Black Start Unit is a generating unit that has equipment enabling it to start without an outside electrical supply, or a generating unit with a high operating factor and the demonstrated ability to automatically remain operating, at reduced levels, when disconnected from the grid. Development of a new Black Start Unit, including converting an existing generating unit into a Black Start Unit, typically requires capital expenditures in the range of \$10 million to \$30 million. A typical upgrade would involve installing diesel generators, controls that allow the units to start without a source of power from the transmission system, and controls that allow the unit operators to close a unit's output breaker to a dead (de-energized) bus. Necessary additional controls also would allow the units to control voltage and frequency during a restoration event. Existing Black Start Units may also need additional capital investment to comply with North American Electric Reliability Corporation ("NERC") standards and for refurbishment, replacement, or upgrade of outdated black start equipment and controls.

² See Operations Planning Division, *PJM Manual 14D: Generator Operational Requirements*, PJM Interconnection, L.L.C., § 10 (Dec. 21, 2022), <https://www.pjm.com/-/media/documents/manuals/m14d.ashx>.

10. The NERC Reliability Standard for System Restoration from Black Start Resources (EOP-005-3)³ was established to ensure plans, facilities, and personnel are prepared to enable system restoration from black start resources to ensure reliability is maintained during restoration and priority is placed on restoring the transmission system. This standard, which applies to transmission operators such as PJM, transmission owners, and generator operators, generally has a Violation Severity Level of Severe across all requirements. The high Severity Level is a testament to the critical nature of system restoration and Black Start Service to the reliability of the BES.

11. An important implication of this type of outage is that if so much of the integrated BES (including parts of the interconnected grid in neighboring regions) is out of service that generators in the PJM Region cannot rely on that system to restart, then there could easily be tens of millions of customers (if not more) without power. An outage so severe and widespread that it needs black start generation, therefore, is by definition a low probability but very high impact event. For context on that low probability, I should note that PJM has never had to call on Black Start Units for system restoration, not even during the Northeast blackout of 2003, as there has always been sufficient accessible generation and transmission available to restore service to the parts of the BES in the PJM Region that lost service.

12. System restoration and black start may be one of the most important missions of PJM and its members. It's a very complicated process, we train and run simulations for the restoration plans, and while the probability of needing to start a black start resource to start the system is very low, the potential impact is high and it is critical that PJM is able to execute the restoration plans if necessary to maintain reliability.

13. Since starting black start resources is one of the very first steps following a careful initial system assessment, if one of the generators designated as a Black Start Unit is *not* available for any reason, including fuel supply availability, that challenge can require more time-consuming workarounds with corresponding delays in system restoration. Fuel supply availability could be a very real concern during the type of severe and widespread disruption to the BES that triggers a need for black start generation. Fuel transportation and delivery networks would be directly harmed to the extent they rely on electric power (as in the case of gas pipeline compressor stations powered by electricity), and at a minimum could be severely stressed by increased demands for energy supply alternatives to electricity.

14. To better address this concern, PJM conducted studies, more fully described in the accompanying affidavit of PJM lead generation engineer Mr. Daniel Bennett, assessing: (i) the extent to which its current Black Start Units met reasonable minimum criteria for fuel assurance; and (ii) the extent to which loss of fuel supply at non-fuel assured

³ See EOP-005-3 – *System Restoration from Blackstart Resources*, North American Electric Reliability Council (Jan. 24, 2018), <https://www.nerc.com/pa/Stand/Reliability%20Standards/EOP-005-3.pdf>.

Black Start Units could adversely affect the system restoration process following an event that triggers a need for black start generation.

15. As Mr. Bennett explains, these assessments found that 44 percent of PJM current Black Start Units do not meet a reasonable minimum standard of fuel assurance, and that a failure of fuel supply by PJM Region Black Start Units that are not fuel assured could substantially increase the length of time it would take to restore the PJM Region BES following the type of severe and widespread outage that would trigger the need for black start generation.

16. To address these concerns, PJM initiated a stakeholder process to develop fuel assurance business rules to mitigate the impact of non-fuel assured black start resources being unavailable during a restoration event due to fuel not being available; this scenario being a combination blackout with the loss of a natural gas pipeline. As a result, PJM is adding new provisions to its Tariff and the PJM Manuals to establish a new category of Black Start Units that will be known as Fuel Assured Black Start Units. A defining characteristic of these units is the ability to provide sustained output without outside assistance for a minimum of 16 hours. Sixteen hours is a fuel supply consideration that PJM has long had in the PJM Manuals in the black start Request for Proposal (“RFP”) process. A minimum of 16 hours is needed to ensure that a Black Start Unit can serve its essential purpose of getting the restoration process started. Sixteen hours ensures a single Fuel Assured Black Start Unit could restore multiple critical loads, or multiple starts if the system restoration process is interrupted, given that each one of those critical loads could take several hours to bring back in service.

17. Importantly, PJM is establishing through these Tariff changes an opportunity for intermittent (i.e., wind, solar, and run-of-river hydroelectric) resources, and hybrid resources (i.e., intermittent resources paired with storage) to serve as fuel assured black start resources. So long as such resources can meet the fundamental, technical product requirement of providing, with a high degree of certainty, a sustained output level for 16 hours without outside assistance, it is consistent with prudent reliability planning, and with the long-term view inherent in planning for black start events, to take advantage of opportunities for assistance from this growing share of the PJM resource base. PJM consultant Mr. Thomas Hauske explains in more detail how PJM is ensuring that intermittent and hybrid resources can meet this standard.

18. Meeting these reliability needs, however, must always be balanced against the goal of reasonably containing the cost of obtaining Black Start Service. As part of this balance, PJM seeks to meet its system restoration goals with an enhanced level of reliability by establishing fuel assurance provisions with a balanced cost recovery mechanism that provides appropriate incentive and penalty provisions, as discussed in more detail by Mr. Hauske.

19. While there will always be some level of uncertainty during a restoration event, the enhanced level of reliability resulting from this proposal will help to mitigate the impact of non-fuel assured black start resources being unavailable during a restoration event due to fuel not being available. Fundamentally, that enhancement to reliability

equates to reducing the need for more time-consuming workarounds with corresponding delays in system restoration time, some with the potential to be severe.

20. PJM's plan is to incorporate these new fuel assurance business rules in the next RTO-wide black start RFP process, which will be commencing in the second quarter of 2023. This black start RFP process is for new black start resources to be available in 2025, and aligns with PJM's compliance obligations under NERC Standard EOP-005 to perform black start studies every five years.

21. This completes my affidavit.

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

PJM Interconnection, L.L.C.	)	
	)	Docket No. ER23-____-000
	)	

VERIFICATION

I, Michael E. Bryson, state, under penalty of perjury, that I am the Michael E. Bryson referred to in the foregoing document entitled “Affidavit of Michael E. Bryson on behalf of PJM Interconnection, L.L.C.” that I have read the same and am familiar with the contents thereof, and that the facts set forth therein are true and correct to the best of my knowledge, information, and belief.

Mike Bryson

Michael E. Bryson
Senior Vice President of Operations
PJM Interconnection, L.L.C.

Dated: May 11, 2023

Attachment B

Affidavit of Daniel Bennett
on Behalf of PJM Interconnection, L.L.C.

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

PJM Interconnection, L.L.C.

)
)
)

Docket No. ER23-____-000

**AFFIDAVIT OF DANIEL BENNETT
ON BEHALF OF PJM INTERCONNECTION, L.L.C.**

I. QUALIFICATIONS

1. My name is Daniel Bennett. My business address is 2750 Monroe Blvd., Audubon, Pennsylvania, 19403. I currently serve as Lead Engineer, Generation Department, for PJM Interconnection, L.L.C. (“PJM”). I have worked as an engineer in the Generation Department for PJM for almost six years. I am submitting this affidavit on behalf of PJM in support of the proposed PJM Open Access Transmission (“Tariff”) revisions being filed today by PJM in the captioned proceeding.

2. My responsibilities include the review and analysis of generating resources’ availability and outage scheduling, the PJM Black Start selection process, and forward-looking reliability scenario analysis.

3. I joined PJM in 2017. Prior to joining PJM, I worked at PSEG Fossil from 2008 to 2017, first as a Generation Engineer and then as a System Engineer. As a System Engineer, I supervised engineering development, construction, and performance acceptance testing of several new peaking facilities and major plant upgrades for existing steam, combined cycle, and peaking plants, including the conversion of an existing peaking unit to become a Black Start Unit.¹ I also supported performance testing, troubleshooting,

¹ Capitalized terms that I use, but do not define, in this affidavit have the meaning provided by PJM’s Open Access Transmission Tariff (“Tariff”).

and maintenance of PSEG Fossil's existing steam, combined cycle and peaking plants in New Jersey, New York, Connecticut, and Texas. I was responsible for updating black start test procedures and overseeing the tests at PSEG Fossil's black start sites. I also supervised the planning, labor, and testing for the restoration of the converted peaking units' stations in the aftermath of Superstorm Sandy.

4. I have a Bachelor of Science degree in Electrical Engineering from Lehigh University.

II. PURPOSE AND OVERVIEW OF AFFIDAVIT

5. The purpose of my affidavit is to support the Tariff revisions PJM proposes for Black Start Service by (i) defining the criteria used at a Zonal level and a unit level to set fuel assurance levels within PJM; (ii) explaining the impacts on restoration in a black-start scenario created by the loss of a non-fuel assured Black Start Unit; (iii) describing the analysis methodology used to calculate the incremental restoration time impact; and (iv) identifying changes to the existing Black Start procurement process to meet the defined criteria.

III. DISCUSSION

6. For background, the PJM stakeholder group was initiated because there are currently no minimum fuel assurance requirements for Black Start Units in PJM business rules. PJM currently assigns a higher weight to fuel assured black start proposals submitted in response to PJM's Request for Proposals ("RFPs") in the black start procurement process. The stakeholder process objective was to develop Black Start Service fuel assurance business rules, at both a resource level and a Zonal level, to mitigate the impact

of non-fuel assured black start resources being unavailable during a restoration event due to fuel not being available.²

7. PJM analyzed its current Black Start Units in 2021 and categorized them as fuel assured or not fuel assured. Figure 1 shows the categories used to differentiate between the types of Black Start Units.³

Figure 1
Fuel Assurance Categories

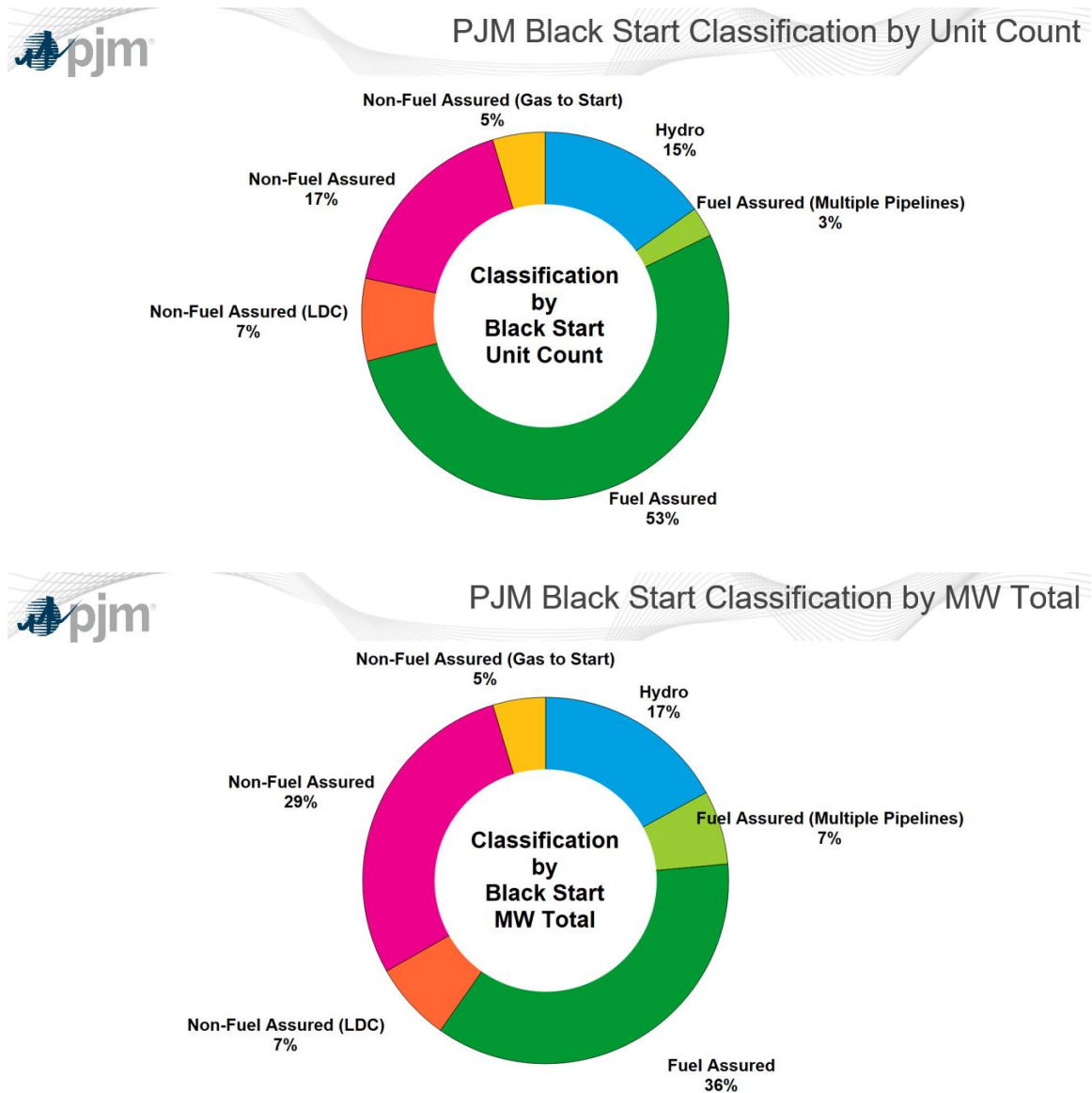
Classification	Description
Fuel Assured (FA)	Black Start sites that can operate using fuel that is stored on site, this includes oil units and dual fuel units with the capability to start without requiring gas
Fuel Assured (Multiple Pipelines)	Gas only Black Start sites that are connected to more than one interstate natural gas pipeline
Non-Fuel Assured (NFA)	Gas only Black Start sites with one interstate pipeline connection
Non-Fuel Assured (LDC)	Gas only Black Start sites that receive their gas supply via a LDC connection
Non-Fuel Assured (Gas to Start)	Black Start sites that have fuel storage on site but require natural gas for startup ignition
Hydro	Black Start sites that rely on natural river flow to generate electricity or store an inventory of water in an elevated reservoir

8. Using these fuel assurance related categories, PJM determined the breakdown of black start fuel assurance among the PJM Region's current Black Start Units on both a unit count basis and a megawatt ("MW") basis, as shown in Figure 2.

² The scenario contemplated was loss of a natural gas pipeline in conjunction with a black-start event.

³ Hydroelectric resources can and do provide considerable value as Black Start Units, but are not automatically categorized as fuel assured. PJM's proposal in this proceeding, including the related manual changes, provides a method for hydroelectric resources to qualify as Fuel Assured Black Start Units.

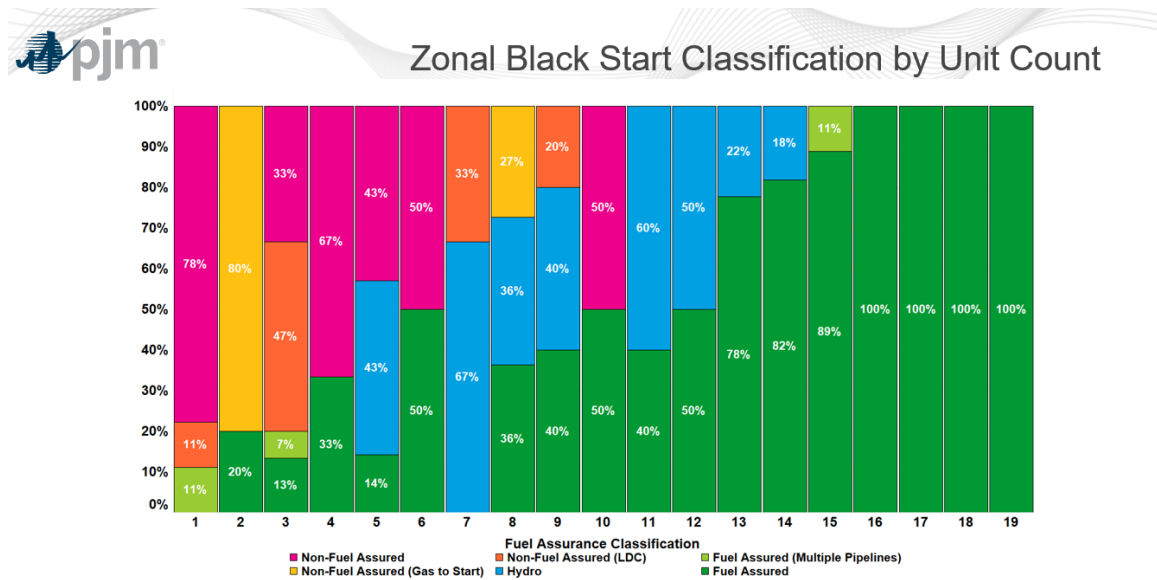
Figure 2
Classification of Black Start Units and MWs by Fuel Assurance Status



9. PJM’s analysis also found that the currently committed Black Start Units that are fuel assured are unevenly distributed among the Transmission Owner (“TO”) Zones⁴ in the PJM Region, as shown in Figure 3.

⁴ The Zones are not identified, so as not to reveal Critical Energy Infrastructure Information.

Figure 3
Fuel Assurance Classification of Current Black Start Units by Zone



10. Given the identified level of non-fuel assured resources, and the uneven distribution of fuel assured resources among Zones, the proposed Tariff changes and associated Manual changes resulting from the PJM stakeholder process are intended to address the objective of defining fuel assurance for black start at a resource level and also to establish a Zonal minimum fuel assurance level to be applied consistently across all PJM Zones.

11. At a resource level, the proposed revised Tariff defines a Fuel Assured Black Start Unit as:

[A] Black Start Unit that is capable of starting without an outside electrical supply and running 16 hours or more at full load and either stores at least 16 hours of fuel on site, can operate independently on 2 or more interstate pipelines, is directly connected to a natural gas gathering system or is an intermittent or hybrid resource that has been evaluated by the Transmission Provider to be capable of providing 16 hours of full load operation with 90% confidence and meets any other requirements specified in the PJM manuals.⁵

⁵ Proposed Tariff, Schedule 6A.

12. Under the adopted approach, Fuel Assured Black Start Units can be thermal, hydro, energy storage, intermittent, hybrid, or distributed energy/demand resources with on-site generator resources, if they can meet PJM's Black Start Service requirements in the Tariff and manuals.

13. Under PJM's existing Tariff, Schedule 6A, section 18, Black Start resources are compensated under Fuel Storage Cost for fuel storage of "at least 16 hours or as defined by the Transmission Owner restoration plan, whichever is less." The PJM proposal uses the existing Tariff's compensation for 16 hours of full load operation as the standard requirement for a resource to be identified as a Fuel Assured Black Start Unit. While the Tariff language allows for less than 16 hours if specified in the TO's restoration plan, no current restoration plan in PJM allows a Black Start resource to store less than 16 hours of fuel. PJM has determined that a Black Start resource capable of 16 hours of full load operation provides sufficient assurance that the restoration process can be completed successfully. During a restoration event, Black Start Units are expected to crank critical loads which include generators with hot start times of -four hours or less. It is possible during the restoration process that restoration islands which could consist of either a Black Start resource and its critical load or multiple Black Start resources and critical loads could trip off-line due to swinging frequency and load. Black Start Units must be capable of multiple starts to address this possibility. Fuel assured resources capable of 16 hours of full load operation can provide up to four or more starts of critical loads during a restoration process. The 16-hour requirement therefore reasonably provides sufficient time for the restoration process to be successful.

14. The proposal endorsed by the PJM stakeholders adopts a cost-effective approach to providing fuel assurance in the PJM Zones, by establishing a baseline level of fuel assurance in each Zone, and providing for additional Fuel Assured Black Start Units in a Zone when determined necessary by a reliability analysis. The proposed baseline requirement, reflected in revised PJM Manual 36, is a minimum of one Fuel Assured Black Start Unit in each Zone or (if the Zone does not have a Fuel Assured Black Start Unit) two non-fuel assured Black Start Units connected to different gas pipelines. The reliability analysis, which I discuss in more detail below, identifies scenarios where the loss of a non-fuel assured Black Start Unit can result in a more severe impact to restoration time in a Zone, thus warranting the addition of a Fuel Assured Black Start Unit to help avoid those significantly increased restoration times during recovery from a black start event.

15. This tailored, reliability-based approach is much more cost-effective than simply requiring some standard number of additional Fuel Assured Black Start Units in every Zone. For reference, PJM estimated in 2020 that requiring all Black Start Units in all Zones to be Fuel Assured Black Start Units would cost an additional \$156 million each year. That estimate is more than double the regional transmission organization (“RTO”) Black Start Annual Revenue Requirement in 2021 of approximately \$68 million each year.

16. In order of preference, the methods to meet the Zonal minimum black start fuel assurance criteria are:

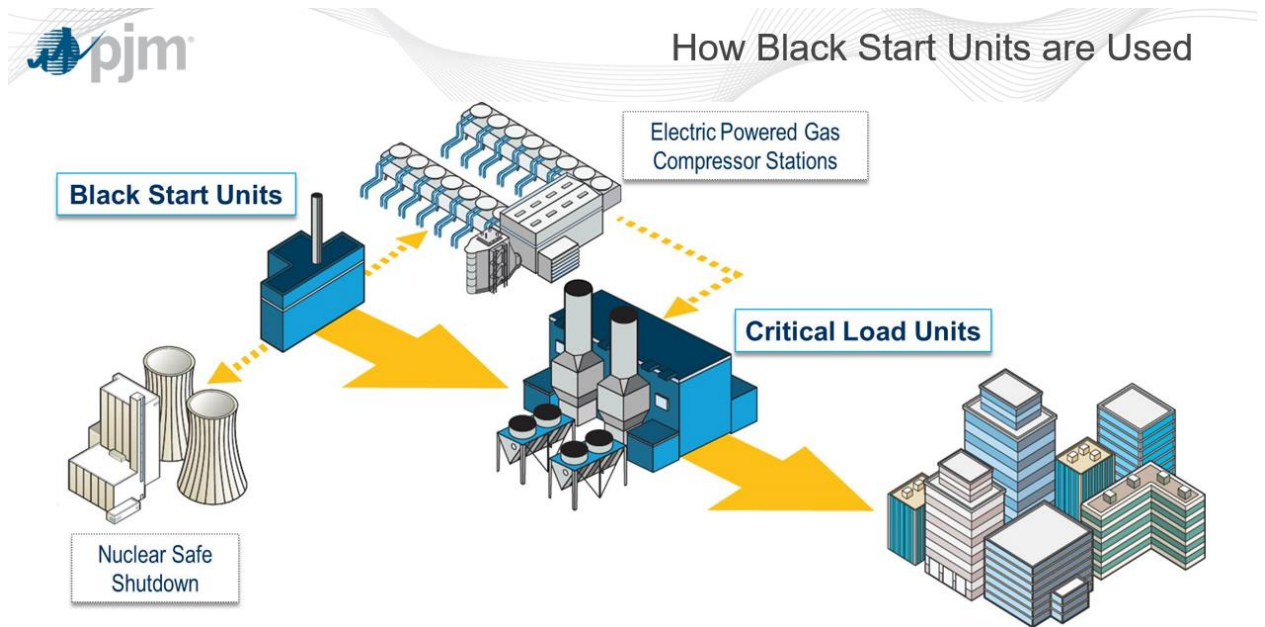
- A. Fuel Assured Black Start Unit(s) with on-site fuel storage;
- B. Fuel Assured Black Start Units(s) capable of operating independently on two or more interstate natural gas pipeline connections;
- C. Fuel Assured Black Start Units(s) directly connected to a natural-gas gathering system ahead of any interstate pipeline;

- D. Hydro Fuel Assured Black Start Units(s) that meet the criteria identified in PJM Manual 12, section 4.6;
- E. Non-hydro intermittent or hybrid Fuel Assured Black Start Unit(s) that meet the criteria identified in PJM Manual 12, section 4.6; and
- F. A minimum of two gas-only Black Start Units allocated to a TO Zone that are connected to two separate interstate natural-gas pipelines.

17. While the minimum criteria of one Fuel Assured Black Start Unit per Zone is intended to ensure a consistent baseline level of fuel assurance, PJM's analysis also indicated that there are scenarios where the loss of a non-fuel assured Black Start Unit can result in a more severe impact to restoration time in a Zone. PJM therefore developed a reliability based criteria to identify the cases that PJM calls High Impact Black Start Sites.

18. To understand this reliability analysis, it helps to first review certain basics of the system restoration process basics. Black Start Units are resources that can start without any external power sources and are then used to start the grid back up after a black out, by providing power to what we define as Critical Load. PJM defines Critical Loads in three forms, including safe shutdown power to nuclear units, power to electrically powered natural gas pipeline compressor stations, and generators called critical load units that can start within four hours of receiving cranking power from a Black Start Unit. Figure 4 illustrates this.

Figure 4
How Black Start Units Start the Restoration Process



Importantly, the rest of the restoration process at the distribution system level does not continue until after Critical Load units are running. Consequently, any delay in getting power to Critical Load units further compounds and delays the downstream distribution system restoration process.

19. As I noted, Black Start Units are brought online without outside power from the system. After the start-up of Black Start Units, cranking paths from Black Start Units to Critical Load are energized. In addition to monitoring reactive capabilities of online generators and non-generator reactive devices such as reactors and static VAR compensators, additional steps, such as picking up blocks of load or bringing online other generation, are taken as needed to support the building of the cranking paths, voltage control, load pick-up, frequency, and reserves. These system stabilizing steps are critical for controlling system voltages and system frequency, and to avoid tripping or damaging

equipment. This is important because tripping the restoration island results in having to start the restoration process over again.

20. During the PJM stakeholder process, PJM performed two sets of assessments for the incremental increase in restoration time (e.g., longer than what it would typically take to provide power to initial critical loads), to simulate the scenario where existing non-fuel assured Black Start Units are not available during a restoration event due to fuel unavailability.

21. PJM's initial analysis focused on a sampling of Zones and looked at potential system restoration impacts of existing non-fuel assured Black Start Units being unavailable to serve Critical Load, in an effort to quantify a resulting incremental delay in restoration time to serve Critical Load. The principle underlying this analysis is that a typical incremental delay or range of delays for a sampling of Zones could be indicative of increased restoration times in other impacted Zones. To be clear, this incremental delay reflects only the additional time, beyond a theoretical restoration time, to provide cranking power to initial Critical Loads, and not the total restoration time.

22. The analysis was based on a sampling of four Zones with non-fuel assured Black Start Unit sites and a different range of Zone sizes. For this analysis, PJM differentiated between primary paths and alternate paths in the restoration process, as follows:

Primary Path:

- Cranking path from a primary Black Start Unit to the Critical Load;
- Typically the shortest electrical path (least amount of line charging) from Black Start Unit to the Critical Load; and
- Shortest electrical path may not have the least number of substations or lines.

Alternate Path:

- Cranking path from an alternate Black Start Unit to the Critical Load;
- Typically requires additional generation or load to control voltages which increases restoration times; and
- Typically has increased line charging and higher line voltages, making them more challenging to build.

23. The impact of non-fuel assured Black Start Unit unavailability was quantified by assessing on a per-unit basis the additional complexity of restoration steps between primary and alternate cranking paths from Black Start Units to Critical Load in the form of substation switching, transmission line segments, generators, line charging, and load pick-up, and then correlated that additional complexity to an increased time to serve Critical Load. Alternate cranking paths and estimated times to energize buses and lines were provided by TOs. Steady state/dynamic studies were performed to validate the alternate cranking paths. The result was a range of projected incremental changes in restoration times based on the additional restoration complexity of using an alternate cranking path because the primary cranking path became infeasible due to loss of a non-fuel assured Black Start Unit.

24. The resulting analysis indicated the following:

- Black Start Unit to Critical Load path analysis in a sampling of Zones consistently showed that the required use of alternate cranking paths resulted in increased restoration complexity, and additional restoration time.
- The *average* incremental time increase per cranking path ranged from approximately five hours to 11 hours across the Zones sampled.
- However, about 30 percent of sampled Zones showed incremental increases to restoration times of between 15 and 40 hours.

- Applied to cranking paths across Zones with non-fuel assured Black Start Units, these time ranges could be significant for Black Start Units to serve initial Critical Loads.
 - This delayed initial restoration of Critical Load would further compound delays to the remainder of the distribution system restoration process beyond the initial critical loads, including restoration of high priority loads, such as hospitals and military installations.

25. In order to perform a more thorough analysis of the impact of Black Start Unit sites being unavailable for restoration efforts, and to better inform stakeholder decisions in the PJM stakeholder process, PJM performed more detailed studies at a Zonal level for every cranking path. In this expanded analysis, PJM used the same conceptual approach developed in the initial analysis, studying every cranking path from a non-fuel assured Black Start Unit in every Zone with non-fuel assured Black Start Units. In order to simulate a more realistic and not overly conservative scenario for the expanded analysis, the time range used in the initial analysis was consolidated and just the low time estimate (i.e., the value that provided the lower of two estimated restoration time increases) was used.

26. Similar in concept to the initial analysis, PJM looked at all Critical Loads in each Zone that rely on non-fuel assured Black Start Units to be restored. The analysis looked at multiple restoration scenarios where the various non-fuel assured Black Start Units are unavailable. When a Black Start Site was unavailable, PJM identified the next best Black Start Unit to crank that Critical Load. Timing for each path was based on the complexity of each path and accounted for the number of transformers, lines, load blocks, and (potentially) additional generation along the cranking path. While each Black Start Unit site can only crank one Critical Load at a time, it is possible for separate restoration

“islands” to be built in parallel because they are independent of each other. The overall Zonal restoration time was then equal to the slowest time to restore an island in that Zone.

27. To account for the loss of a non-fuel assured Black Start Unit in a restoration, alternate Black Start Unit sites must crank those Critical Loads in addition to what those alternate sites would normally crank. The incremental restoration time increase is the *additional* time required to restore a Zone due to the loss of one or more non-fuel assured Black Start Unit sites above and beyond the theoretical Zonal restoration time with all Black Start Unit sites available. For each scenario PJM determined an incremental restoration time increase (over and above a theoretical restoration time) based on this additional restoration complexity.

28. During this analysis process, PJM worked with a Member TO and with the Electric Power Research Institute (“EPRI”) to perform an independent assessment of the analysis methodology. This engagement included the Member TO performing similar evaluations with the support of EPRI, and using the EPRI System Restoration Navigator tool to study the cranking paths within that TO’s Zone, and found very similar results to those PJM found. This TO/EPRI study confirmed that despite slight differences from variations in cranking paths used, PJM’s incremental system restoration time estimating approach is reasonable.

29. For the expanded assessment, PJM performed this level of analysis for all Zones with non-fuel assured Black Start Units and all Black Start Unit site availability scenarios within those Zones. Performing this analysis at a Zonal level as opposed to looking at individual cranking paths independently (as was done in PJM’s initial analysis, described above) provided a much more complete assessment of the possible delays to restoration efforts. The analysis quantitatively evaluated the impact of performing a Zonal

bottom-up restoration with non-fuel assured Black Start Units unavailable. It is important to note that the scenarios studied were based on the idea of a single contingency (i.e., N-1 analysis) affecting the black start availability within that Zone (N-1); as additional simultaneous contingencies are studied (i.e., N-1-1 analysis), the incremental restoration time increase would go up dramatically.

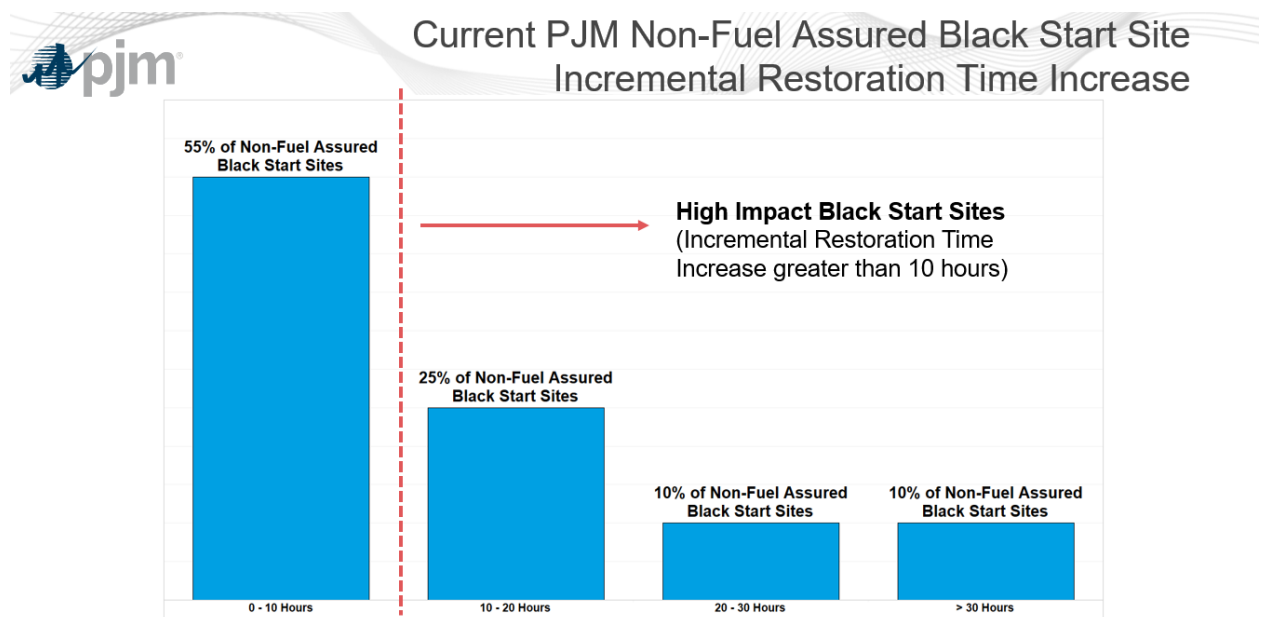
30. As PJM summarized the TO Zonal analysis results, a trend emerged that led PJM to recommend applying this incremental restoration time analysis to the task of identifying more extreme cases of extended restoration time; PJM refers to these as High Impact Black Start Sites. A majority of the alternate cranking paths studied in the scenario of non-fuel assured Black Start Units being unavailable due to fuel unavailability showed an incremental increase in restoration time of ten hours or less; those paths averaged 3.4 additional hours. There were several cases however where the increase in restoration time was significantly higher, and PJM identified these as High Impact Black Start Sites. A High Impact Black Start Site is a Black Start Site which, when unavailable during a restoration scenario due to fuel unavailability, results in an incremental restoration time increase of 10 hours or more. This 10-hour criterion is a PJM suggestion and not tied directly to any standards or requirements. The concept was vetted with stakeholders and member feedback was solicited regarding if this threshold should be adjusted based on factors like technical limitations at transmission substations and critical loads. The PJM stakeholder consensus was that the 10-hour threshold assumption reflected a reasonable incremental delay to restoration time, beyond which the societal impacts of an extended blackout would likely be more severe. Bear in mind that the scenario under consideration is a PJM Region-wide, or even Interconnection-wide power outage, and in that context,

delaying the restoration for 10 hours or more does imply significantly adverse societal impacts.

31. PJM and the PJM Members used this quantitative reliability analysis to define any Black Start Unit site with an incremental restoration time increase of 10 hours or more as a High Impact Black Start Site. PJM's analysis resulted in identification of eight High Impact Black Start Sites in five Zones, with several having incremental increases in restoration times significantly higher than 10 hours. The results of this High Impact Black Start Site analysis are shown in Figure 5.

Figure 5

Estimated Incremental Restoration Time Increases from Unavailability of Non-Fuel Assured Black Start Units, Grouped by Categories of Time Increases

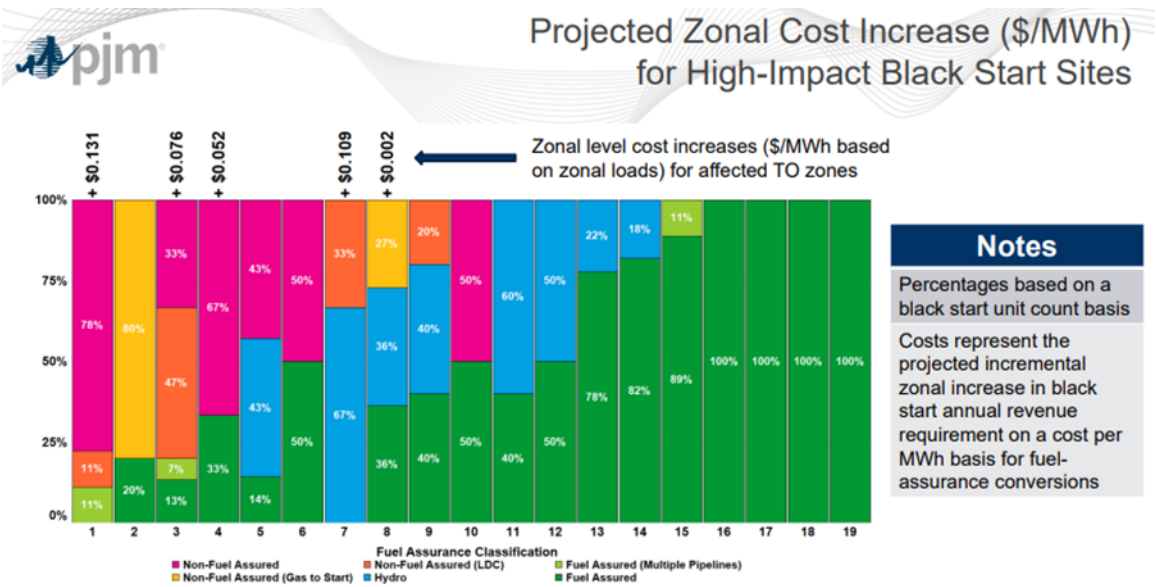


These High Impact Black Start Sites would need to be mitigated through the PJM Black Start RFP process, either by the conversion of the site to meet the fuel assurance criteria or by procuring other Black Start Units. To provide a broadly indicative estimate of the added cost of an approach that limits additional Fuel Assured Black Start Units to these High

Impact Black Start Sites, PJM estimated the fuel assurance conversion costs, on a \$/MWh basis, for each of the five affected Zones. PJM based these estimates on experience with fuel conversion costs obtained through the responses to prior Black Start RFPs, scaled to the unit sizes needed at the affected Zones. The results of PJM’s estimates of added costs are shown in Figure 6.

Figure 6

Estimated Zonal Cost Increases to Provide
Fuel Assured Black Start Units at High-Impact Black Start Sites



32. PJM also incorporated significant input and recommendations from PJM stakeholders on enhancements to black start testing and verification requirements and performance standards, designed to ensure adherence to these fuel assurance business rules. Being a Fuel Assured Black Start Unit carries with it an enhanced level of responsibilities with a potential reliability impact to restoration, and the additional testing and verification requirements are intended to enforce PJM’s expectation that the Fuel Assured Black Start Units will be available in the event of a restoration event.

33. Requiring Fuel Assured Black Start Units with dual fuel capability to conduct an annual test on both fuels will hold Fuel Assured Black Start Units accountable to demonstrate their availability on both fuels, since PJM is relying on the unit's ability to run on both fuels in order to provide the requisite fuel assured capability. Similarly, PJM is proposing to revise the Tariff to provide that Fuel Assured Black Start Units that rely on on-site fuel will not qualify to receive any Black Start Service revenues in any month when it fails in that month to store the fuel and non-fuel consumables that are needed to meet its fuel assurance run-hour requirements. Since PJM will be relying on these new units to be available during a restoration event, withholding Black Start revenues in any month a Fuel Assured Black Start Unit that obtained that status through its reliance on on-site fuel fails to store the fuel and non-fuel consumables needed to meet its fuel assurance run-hour requirements helps ensure that the plant maintains on-site all that it needs to meet the 16-hour runtime requirement. This approach provides a balanced penalty risk to ensure that sufficient inventories are maintained.

34. PJM has incorporated the new fuel assurance business rules in the PJM Black Start Generation Procurement process outlined in PJM Manual 14D, section 10. These business rules highlight the PJM process for issuing a PJM RTO-wide Black Start RFP for black start every five years to align with PJM's compliance obligations under North American Electric Reliability Corporation Standard EOP-005 to perform black start studies every five years. PJM will be including the fuel assurance enhancements in the next PJM RTO-wide Black Start RFP process, which will be commencing by Q2 2023 (this RFP process is for new Black Start Units to be available by 2025). The new fuel assurance business rules will apply to future PJM RTO-wide Black Start RFP processes as well as Incremental Black Start RFP processes. Both the Zonal minimum black start fuel

assurance criteria and the reliability criteria (incremental restoration time increase of 10 hours or more) will be factors prominently included in the technical feasibility portion of PJM's RFP proposal evaluation process.

35. This concludes my affidavit.

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

PJM Interconnection, L.L.C.

)
)
)

Docket No. ER23-____-000

VERIFICATION

I, Daniel Bennett, state, under penalty of perjury, that I am the Daniel Bennett referred to in the foregoing document entitled “Affidavit of Daniel Bennett on behalf of PJM Interconnection, L.L.C.” that I have read the same and am familiar with the contents thereof, and that the facts set forth therein are true and correct to the best of my knowledge, information, and belief.

Daniel Bennett

Daniel Bennett
Lead Engineer,
Generation Department
PJM Interconnection, L.L.C.

Dated: May 11, 2023

Attachment C

Affidavit of Thomas Hauske
on Behalf of PJM Interconnection, L.L.C.

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

PJM Interconnection, L.L.C.

)
)
)

Docket No. ER23-____-000

**AFFIDAVIT OF THOMAS HAUSKE
ON BEHALF OF PJM INTERCONNECTION, L.L.C.**

I. QUALIFICATIONS

1. My name is Thomas Hauske. My business address is 2750 Monroe Blvd., Audubon, Pennsylvania, 19403. I currently serve in a consulting role to PJM Interconnection, L.L.C. (“PJM”) as Senior Consultant, Performance Compliance. Prior to this consultant role, I served as Principal Engineer, Performance Compliance, for PJM for 12 years. I am submitting this affidavit on behalf of PJM in support of the proposed PJM Open Access Transmission Tariff (“Tariff”) revisions being filed today by PJM in the captioned proceeding.

2. My responsibilities include the review and approval of generating resources’ maintenance adders for cost-based offers, Fuel Cost Policies, and unit-specific operating parameter adjustment requests. Also, I am a subject matter expert for PJM’s cost development guidelines for cost-based offers, combined cycle (“CC”) modeling and black start program.

3. I joined PJM in 2010. Prior to joining PJM, I worked at Conectiv Energy from 2000 to 2010, first as a Project Engineer, then as a Senior Engineer, and finally as Manager of Technology Services. As Manager of Technology Services, I supervised the Performance Group, System Engineers, Operator Training, and the engineering budget analysts. As a Senior Engineer and Project Engineer, I supported the engineering

development and performance acceptance testing of several new CC and peaking facilities. I also supported performance testing, troubleshooting, and maintenance of Conectiv Energy's existing steam, CC, and peaking plants. Prior to my employment at Conectiv Energy, I worked as a Performance Engineer for Sithe New England Holdings, LLC from 1998 to 2000 and as an Engineer and Senior Engineer for Boston Edison Company from 1985 to 1998. In these positions, I provided engineering support for maintenance and operations of Boston Edison's nuclear, fossil steam, and peaking plants.

4. I have a Bachelor of Science degree in Mechanical Engineering from Drexel University and Master of Science degree in Mechanical Engineering from Northeastern University. I am a registered Professional Engineer in the State of Pennsylvania, and since 2009 have been a member of the Delaware Governor's Council on Boiler Safety.

II. PURPOSE AND OVERVIEW OF AFFIDAVIT

5. The purpose of my affidavit is to support PJM's filing, which defines requirements for Fuel Assured Black Start Units.¹ In particular, PJM's proposal provides cost recovery mechanisms for Fuel Assured Black Start Units, which are explained in this affidavit.

¹ Capitalized terms that I use, but do not define, in this affidavit have the meaning provided by PJM's Open Access Transmission Tariff ("Tariff").

III. DISCUSSION

6. PJM's Tariff, Schedule 6A currently allows Black Start Unit owners to recover Fixed Black Start Service Cost (capital), Variable Black Start Service Cost (variable Operations & Maintenance ("O&M") including North American Electric Reliability Corporation Reliability Standard costs), Training Cost, Fuel Storage Cost, and an incentive where applicable associated with providing Black Start Service. This is expressed formulaically in the Tariff as:

$$\{(Fixed\ BSSC) + (Variable\ BSSC) + (Training\ Costs) + (Fuel\ Storage\ Costs)\} * (1 + Z)$$

Black Start Unit costs are reviewed by the PJM Independent Market Monitor ("IMM") and PJM when the unit initially enters Black Start Service and on an annual basis thereafter. Black Start credits are paid to unit owners on a monthly basis and can be forfeited if the Black Start Unit fails to meet black start testing requirements in Schedule 6A and the PJM Manuals. Black Start Unit monthly credits are summed by assigned Transmission Owner ("TO") Zone and charged to network service customers and point-to-point service reservations.

7. Fuel Assured Black Start Units can have costs above and beyond those currently allowed under Schedule 6A. Additional capital and O&M costs may be required for a unit to provide fuel assurance when, for example, a gas-fired unit is converted to dual fuel operation. Fuel Assured Black Start Units also can face more risk associated with the forfeiture of monthly revenues, since they can lose both black start and fuel assurance revenues for failing to meet PJM's fuel assurance requirements, even if they satisfy other black start performance and testing requirements. As I explain in more detail below, the

PJM fuel assurance proposal is a compromise proposal that allows Black Start Unit owners to recover costs associated with providing fuel assurance, addresses the increased risk to the unit owner associated with providing fuel assurance, and provides protection for TO Zone customers procuring the service.

8. Existing Schedule 6A allows units providing Black Start Service to recover the capital cost needed to convert the unit to be Black Start capable, using a Capital Cost Recovery Rate, determined formulaically as:

Capital Cost Recovery Rate

$$(\text{FERC-approved rate}) + (\text{Incremental Black Start Capital Costs} * \text{CRF})$$

9. Under the current Tariff, these incremental capital costs of becoming Black Start capable (which must be documented, as I discuss below) would typically be the cost of installing diesel engines and electrical bus work. The formula's Capital Recovery Factor ("CRF") component is determined using a specified rate of return, federal tax rates, average state tax rates, debt interest rates, and a recovery period determined by the age of the unit. PJM recalculates the CRF annually.

10. Under PJM's proposed Tariff changes in this proceeding, units will now also be able to recover the incremental capital costs needed to become fuel assured ("Fuel Assurance Capital Costs"), such as installing dual fuel capability. Fuel Assured Black Start Units will recover their Fuel Assurance Capital Costs in the same way units recover their incremental capital costs of converting to become Black Start capable, i.e., their documented additional capital costs are multiplied by a CRF. The CRF used for Fuel Assurance Capital Costs will be the same as that used for Incremental Black Start Capital Costs, with one adjustment. As I noted above, the CRF uses a recovery period determined

by the age of the unit; the older the unit, the shorter the recovery period. The shortest recovery period currently is five years, and it is used for units older than 16 years. While that recovery period will remain five years for Incremental Black Start Capital Costs on older units, it will be lengthened to ten years for Fuel Assurance Capital Costs associated with units that are older than 16 years. The increase of the capital recovery period to ten years for this unit age range was a compromise put forth in the stakeholder process to lessen the financial impact on Black Start Service customers (largely network transmission service loads) from fuel assurance conversions. Costs to become fuel assured can be comparable to the costs to become a Black Start Unit in the first place. For example, the costs for adding oil operation to a gas-only resource can include combustion turbine (“CT”) modifications, construction of fuels storage and pumping facilities, installation of a new or larger Selective Catalytic Reduction unit, and obtaining air permit modification, all of which together can be similar to the cost of installing diesel engines to become Black Start capable. In addition, some Black Start Units could recover both Incremental Black Start Capital Costs and Fuel Assurance Capital Costs at the same time. The increased recovery period for Fuel Assurance Capital Cost recovery will spread these costs over a longer period for some units. An additional protection included in the proposal for fuel assurance customers is that the existing Schedule 6A lifetime commitment for units recovering Black Start Service capital cost will also apply to units recovering Fuel Assurance Capital Costs. This reduces the potential for customers having to pay for new fuel assurance unit conversions because the previous converted unit left Black Start Service after its capital recovery period was completed.

11. Black Start Units recovering Incremental Black Start Capital Costs under Schedule 6A must submit cost documentation to the PJM IMM and PJM for review and

approval prior to recovering those costs through Black Start Service revenues. Under PJM's present proposal, Black Start Units seeking to recover Fuel Assurance Capital Cost likewise will need to submit cost documentation to the PJM IMM and PJM for review and approval prior to those costs being included in any Black Start revenues. This ensures that all Fuel Assurance Capital Costs have been reviewed and justified prior to being charged to load customers.

12. Similar to Black Start Units that do not need to incur incremental capital costs to provide Black Start Service, some units (e.g., a liquid-fuel unit which already stores fuel onsite) will be able to become fuel assured without expending additional capital costs. Like Black Start Units that are not incurring incremental capital costs, the Fixed Black Start Service Costs for Fuel Assured Black Start Units that do not need to incur additional capital costs will be determined using Schedule 6A's Base Formula Rate, which provides as follows.

Base Formula Rate:

$$\text{Net CONE} * \text{Black Start Unit Capacity} * X$$

13. The Base Formula rate is therefore the current Delivery Year's Net Cost of New Entry ("Net CONE") multiplied by the unit's Black Start capability multiplied by the Black Start Service Allocation Factor X. Black Start capability is typically the Installed Capacity ("ICAP") of the unit. The Tariff's current Black Start Service allocation factor is 0.02 for CT units and 0.01 for Hydro units.

14. PJM proposes in this proceeding to set the Black Start Service Allocation Factor at 0.02 for all Fuel Assured Black Start Units, and to set the Black Start Unit Capacity for intermittent, hybrid, and run-of-river hydroelectric resources that are Fuel

Assured Black Start Units in a way that is comparable to the unit capacity determination for units that store 16 hours of fuel on site.

15. As to the Black Start Unit Capacity, PJM considers a resource that stores on-site fuel that enables 16 hours of runtime to be a Fuel Assured Black Start Unit. The Tariff uses the megawatts (“MWs”) of installed capacity of such a unit to set that unit’s Base Formula Rate. The Tariff uses that MW level even though such resources in practice may not be capable of providing output at that installed capacity level all the time due to outages. The fleet of CT plants in the PJM Region, for example, have an Equivalent Availability Factor (“EAF”), which takes account of planned, maintenance, and unforced outages, of approximately 90 percent.² Stated another way, CT plants are statistically expected to be able to provide energy at their installed capacity level about 90 percent—not 100 percent—of the time, on average, over a year. Given these facts, a reasonable way to calculate the Black Start Unit Capacity for intermittent, run-of-river hydro, and hybrid resources would be to ask what MW output level is such a resource 90 percent likely to sustain for 16 hours. The 16-hour runtime ensures the resource meets the minimum standard expected of a Fuel assured Black Start Unit. And the 90 percent certainty factor recognizes that PJM compensates, e.g., CT units for Black Start Service at their installed capacity level even though, statistically, a CT unit will be capable of providing its installed capacity MW level 90 percent of the time, on average, over a year. PJM proposes, therefore, to base Black Start Unit Capacity for Fuel Assured Black Start Units that are intermittent, run-of-river hydro, or hybrid resources on the MW level that historic data for

² See *State of the Market Report for PJM*, Monitoring Analytics, LLC, 346 (Mar. 9, 2023), https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2022/2022-som-pjm-vol2.pdf.

the resource shows the resource can, with 90 percent certainty, sustain for 16 hours on a monthly basis. This approach is reasonable for customers of Black Start Service, by ensuring that intermittent, run-of-river hydro, and hybrid resources that are Fuel Assured Black Start Units can provide the product needed for reliability—sustained operation for sixteen hours without reliance on external energy sources—at a MW output that has the same high level of certainty as the CT plants that play a major role in Black Start Service. And it is fair to intermittent, run-of-river hydro, and hybrid resources because it treats them similarly to CT units, which are compensated at their installed capacity level even though, statistically, CTs may not be capable of that level at times. Using the 90 percent EAF of the CT fleet as the certainty level for the intermittent, run-of-river hydro, and hybrid resources provides a reasonable objective basis for that comparability.

16. PJM's Black Start Fuel Assurance proposal thus recognizes that other unit types like intermittent, run-of-river, and hybrid resources may also be able to provide fuel assurance in Black Start Service. PJM rigorously bases the contribution these resource can make to fuel-assured Black Start Service on their demonstrated historic ability to sustain output without external support for the required minimum of 16 hours, with a high level of certainty. It is important in the current environment of changes in the PJM Region generation fleet to provide the ability for different types of units to be able to provide flexibility to PJM in selecting units to provide fuel assurance.

17. As to the allocation factor, since PJM is calculating the 16-hour Black Start MW capability for fuel assured units that do not store fuel on site, all Fuel Assured Black Start Units are providing similar service. Therefore, PJM proposes to treat all Fuel Assured Black Start Units using the Base Formula Rate the same, with the same 0.02 allocation factor regardless of resource type.

18. Black Start units can also recover costs under Schedule 6A's Capital Cost Recovery Rate – NERC-CIP Specific Recovery determined formulaically as:

Capital Cost Recovery Rate – NERC-CIP Specific Recovery

$$\frac{(\text{Net Cone} * \text{Black Start NERC-CIP Unit Capacity} * X) + (\text{Incremental Black Start NERC-CIP Capital Costs} * \text{CRF})}{\text{Black Start Unit Capacity}}$$

19. The Capital Cost Recovery Rate - NERC-CIP Specific Recovery Rate is a special form of the Base Formula Rate that also allows capital cost recovery for newly imposed regulatory NERC-CIP modifications for existing Black Start units. This rate is rarely used and there are no units currently recovering costs under this rate. However, the changes discussed above for the Base Formula Rate's Black Start Unit Capacity and the Allocation Factor X would also apply to Fuel Assured Black Start Units recovering costs under the Capital Cost Recovery Rate – NERC-CIP Specific Recovery.

20. Black Start Service in the PJM Region is a voluntary service. Units must offer into a Black Start Service Request for Proposal ("RFP") and be accepted by PJM in order to enter the service. Under the PJM proposal, offering fuel assurance will also be voluntary. Existing Black Start Units that are fuel assured, existing Black Start Units that are not fuel assured, new units that are not currently providing Black Start Service but are fuel assured, and new units that are currently not providing Black Start Service that are not fuel assured, can all submit proposals to become a Fuel Assured Black Start Unit in a PJM Black Start Service RFP.

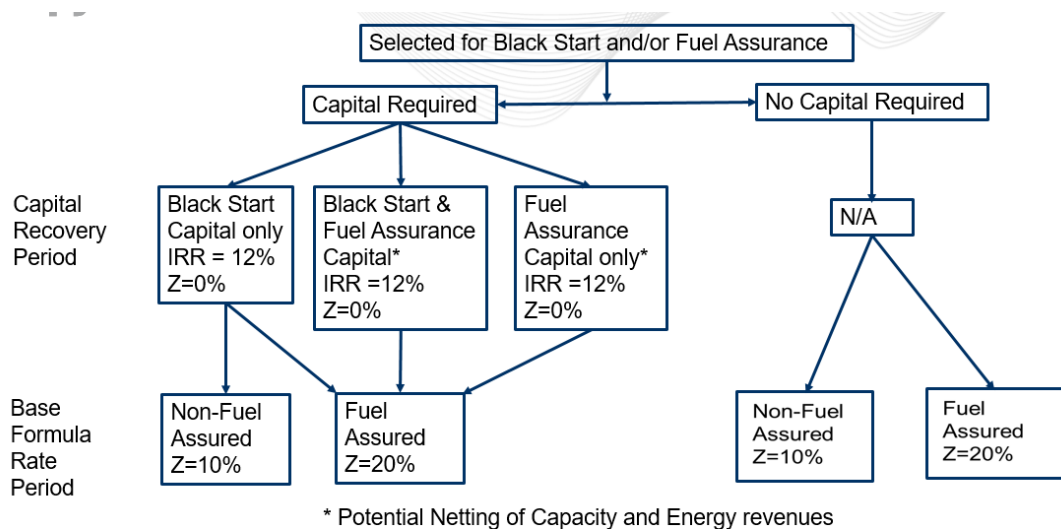
21. Black Start Units are compensated for providing Black Start Service via an annual revenue requirement paid monthly. Any Black Start Unit which does not maintain a successful Black Start test on file with PJM in the preceding 13 months will forfeit its monthly Black Start Service revenues from the time of the first unsuccessful test until such

time as the unit complete a successful test. Fuel Assured Black Start Units are subject to the same requirement, but they also have an additional risk related to fuel assurance. Specifically, any fuel assured unit that stores fuel onsite will not qualify to receive Black Start Service revenues in any month it does not maintain on-site 16-hours of fuel or of any other consumable required for operation.

22. Since Black Start Service and fuel assurance are voluntary, an incentive must be provided for unit owners to offer the service and accept the risks for providing those services. Units that need capital dollars to provide Black Start Service or fuel assurance have an incentive from the 12 percent existing authorized rate of return on their invested capital dollars that is built into the calculation of the CRFs. Considering that PJM has received multiple responses in past RFPs from generation owners that need to recover capital cost to provide Black Start Service it seems reasonable to expect that the 12 percent rate of return built into the Black Start Service CRFs will also provide an incentive for generation owners that need capital dollars to become fuel assured to offer into future RFPs. It is reasonable to be concerned, however, that existing units that do not require capital dollars might not accept the additional risks of being a Fuel Assured Black Start Unit and therefore might not offer into future RFPs as fuel assured. Recognizing this need for incentives, Black Start Units on the Base Formula Rate have their total annual revenue requirement increased under the current Tariff by an incentive factor of 10 percent to encourage units to provide the service. By contrast, the incentive factor for units recovering capital costs is zero percent, since there is a rate of return—providing sufficient incentive—already built into the CRFs. Existing Black Start Units on the Base Formula Rate therefore do not have an incentive to take on the additional risk of lost revenues from failing to meet fuel assurance criteria. To correct this, the PJM proposal provides an

incentive for existing Black Start Units that are on the Base Formula Rate and are already capable of meeting fuel assurance requirements to offer to become fuel assured by increasing the incentive factor for fuel assured resources to 20 percent.

23. The chart below illustrates the differing need for incentives among Black Start Service providers, highlighting the rate of return and incentive factor for the different categories of Black Start and Fuel Assured Black Start Units on the capital recovery or Base Formula Rates.



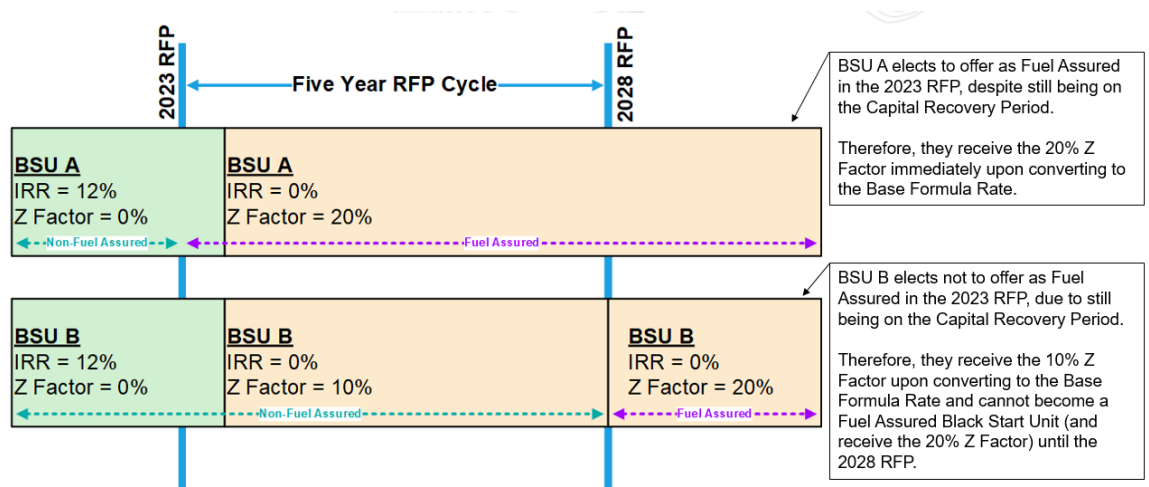
24. The 10 percent increase in the revenue for a fuel assured resource over a non-fuel assured resource is approximately the same value as one month of lost revenue, as illustrated below.

A	Total 2022 Black Start revenues for the current 68 Units on Base Formula Rate (BFR) that potentially could offer in as Fuel Assured	\$4,795,133
B	Estimated increase in 2022 revenues with a Z Factor of 20%	\$435,921
C	Total 2022 Black Start revenues with increased Z Factor (A+B)	\$5,231,054
D	Average revenue increase per unit (B/68)	\$6,411/year

E	Average Fueled Assured Unit on BFR annual revenue (C/68)	\$76,927
F	Average one Month Revenue (E/12)	\$6,411
G	Average revenue increase = One month loss of revenues	D = F

25. Consequently, the increased Z factor for Fuel Assured Black Start Units on the Base Formula Rate is well-tailored as an incentive to plant owners to become fuel-assured and take on the associated risk of revenue forfeiture if they do not store sufficient fuel on site.

26. The incentive factor increase for Fuel Assured Black Start Units that are not on the Capital Recovery Rate also indirectly incents units on the Capital Recovery Rates that are already fuel assured. All Black Start Units on the Capital Recovery Rate transition to the Base Formula Rate when they complete their capital recovery period. A unit must offer into an RFP and be selected by PJM to provide fuel assurance. If a unit is on a Capital Recovery Rate at the time of the upcoming 2023 RTO-wide RFP, they must weigh the risk of not offering to be fuel assured while on the Capital Recovery Rate and forgoing the future incentive factor increase when the unit transitions to the Base Formula Rate, as I illustrate below.



27. As part of the PJM proposal, a generation owner could offer a fuel-assured proposal in the RFP which includes the capital dollars to convert a single fuel resource into a dual fueled resource which stores fuel onsite. If that RFP proposal is selected by PJM, the generator owner would be able to recover the capital conversion cost with a rate of return as part of its annual Black Start revenues. The new fuel-assured dual-fuel unit now has the ability to operate during periods when the original fuel is unavailable. To address this issue and provide the appropriate credits to the customers paying for the conversion, the PJM proposal nets energy revenue when operating on the conversion fuel from the monthly Black Start revenues during the capital recovery period. One additional concern during development of the PJM proposal was the potential of adding oil-fired operation to a gas-fired CT for fuel assurance that results in an increase in the unit's installed capacity. If fuel assurance conversion results in an ICAP increase for the unit, the additional capacity revenues received by the unit for the increase ICAP will also be netted from the monthly Black Start revenues during the capital recovery period.

28. The PJM proposal also maintains the existing protection for customers already in place for the Black Start revenue process. Any new capital expended to make a unit fuel assured must still be reviewed by PJM IMM as specified in Schedule 6A for Black Start capital recoveries. In addition the IMM will review all fuel assurance costs on an annual basis as part of the Black Start Annual revenue review which takes place every May.

29. Currently Black Start annual revenue requirements/charges are allocated on a monthly basis to point-to-point reservations and Zonal load on a MW basis. The Black Start Unit revenue requirements minus the portion allocated to point-to-point reservations for all Black Start Units allocated to a Zone are charged to the load in that Zone. The PJM

proposal follows the same methodology as used for existing Black Start unit revenues charges. Any fuel-assured revenues will be included in the existing Black Start Unit's annual revenue requirement and allocated to point-to-point reservations and zonal load on a MW basis. Only the revenue requirements for the Fuel Assured Black Start Units assigned to a Zone minus the portion allocated to point-to-point reservations will be charged to the load in that zone. This ensures the only the customers benefiting from the service will be charged.

IV. SUMMARY AND CONCLUSION

30. This filing is intended to define a new type of Black Start resource which is fuel assured and capable of operating for 16 hours at full load during a restoration event. The PJM proposal that was approved as a compromise proposal during the stakeholder process defines fuel assurance criteria and cost recovery mechanisms. This affidavit explains and supports the cost recovery mechanisms that are included in the proposal. In general, the PJM proposal provides a way for Black Start Units which volunteer to become fuel assured to recover their cost and address the additional risk they face from providing the service. The proposal also addresses the fuel assurance costs charged to customers by extending the minimum fuel assurance capital recovery period to 10 years and provides for customers to recover some of the fuel assurance costs if a converted generator receives additional energy or capacity revenues as a result of the conversion.

31. This concludes my affidavit.

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

PJM Interconnection, L.L.C.	)))	Docket No. ER23-____-000
------------------------------------	-------------	---------------------------------

VERIFICATION

I, Thomas Hauske, state, under penalty of perjury, that I am the Thomas Hauske referred to in the foregoing document entitled “Affidavit of Thomas Hauske on behalf of PJM Interconnection, L.L.C.” that I have read the same and am familiar with the contents thereof, and that the facts set forth therein are true and correct to the best of my knowledge, information, and belief.

Thomas Hauske
Thomas Hauske
Senior Consultant, Performance
Compliance
PJM Interconnection, L.L.C.

Dated: May 11, 2023

Attachment D

Revisions to the PJM Open Access Transmission Tariff

(Marked/Redline Format)
Effective July 11, 2023

SCHEDULE 6A

Black Start Service

References to section numbers in this Schedule 6A refer to sections of this Schedule 6A, unless otherwise specified.

To ensure the reliable restoration following a shut down of the PJM transmission system, Black Start Service is necessary to facilitate the goal of complete system restoration. Black Start Service enables the Transmission Provider to designate specific generators called Black Start Units whose location and capabilities are required to re-energize the transmission system following a system-wide blackout. The Transmission Provider shall administer the provision of Black Start Service. PJMSettlement shall be the Counterparty to the purchases and sales of Black Start Service.

TRANSMISSION CUSTOMERS

1. All Transmission Customers and Network Customers must obtain Black Start Service through the Transmission Provider, with PJMSettlement as the Counterparty, pursuant to this Schedule 6A.

PROVISION OF BLACK START SERVICE

2. A Black Start Unit is a generating unit that has equipment enabling it to start without an outside electrical supply or a generating unit with a high operating factor (subject to Transmission Provider concurrence) with the demonstrated ability to automatically remain operating, at reduced levels, when disconnected from the grid. A Black Start Unit shall be considered capable of providing Black Start Service only when it meets the criteria set forth in the PJM manuals. The expected life of the Black Start Unit shall take into consideration expectations regarding both the enabling equipment and the generation unit itself.

A Fuel Assured Black Start Unit is a Black Start Unit that is capable of starting without an outside electrical supply and running 16 hours or more at full load and either stores at least 16 hours of fuel on site, can operate independently on 2 or more interstate pipelines, is directly connected to a natural gas gathering system or is an intermittent or hybrid resource that has been evaluated by the Transmission Provider to be capable of providing 16 hours of full load operation with 90% confidence and meets any other requirements specified in the PJM manuals. Unless otherwise specified as only applicable to Fuel Assured Black Start Units, all terms and conditions set forth in this Tariff, Schedule 6A applicable to Black Start Units shall be deemed to include Fuel Assured Black Start Units.

3. A Black Start Plant is a generating plant that includes one or more Black Start Units. A generating plant with Black Start Units electrically separated at different voltage levels will be considered multiple Black Start Plants.

4. The Transmission Provider is responsible for developing a coordinated and efficient system restoration plan that identifies all of the locations where Black Start Units are needed. The PJM Manuals shall set forth the criteria and process for selecting or identifying the Black

Start Units necessary to commit to providing Black Start Service at the identified locations. No Black Start Unit shall be eligible to recover the costs of providing Black Start Service in the PJM Region unless it agrees to provide such service for a term of commitment established under section 5, 6, or 6A below.

5. Owners of Black Start Units selected to provide Black Start Service in accordance with Schedule 6A, section 4 and electing to forego any recovery of new or additional Black Start Capital Costs shall commit to provide Black Start Service from such Black Start Units for an initial term of no less than two years and authorize the Transmission Provider to resell Black Start Service from its Black Start Units. The term commitment shall continue to extend until the Black Start Unit owner or the Transmission Provider provides written, one-year advance notice of its intention to terminate the commitment or the commitment is involuntarily terminated pursuant to section 15 of this Schedule 6A. Black Start Units that are selected to provide Black Start Service after June 6, 2021, pursuant to Schedule 6A, section 6 that subsequently transition from the Capital Cost Recovery Rate to the Base Formula Rate shall have a lifetime commitment and can only terminate for the reason specified in Schedule 6A, section 6(ii).

6. (i) Owners of Black Start Units selected to provide Black Start Service prior to June 6, 2021, in accordance with section 4 of this Schedule 6A and electing to recover new or additional Black Start Capital Costs shall commit to provide Black Start Service from such Black Start Units for a term based upon the age of the Black Start Unit or the longest expected life of the Incremental Black Start Capital Cost, as set forth in the applicable CRF Table in section 18 of this Schedule 6A. For those Black Start Units that elect to recover new or additional Black Start Capital Costs in addition to a prior, FERC-approved cost recovery rate, the applicable commitment period shall be the longer of the FERC-approved recovery period or the applicable term of commitment as set forth in the CRF Table in section 18 of this Schedule 6A. The Transmission Provider may terminate the commitment with one year advance notice of its intention to the Black Start Unit owner, but the Black Start Unit owner shall be eligible to recover any amount of unrecovered Fixed Black Start Service Costs over a period not to exceed five years. A Black Start Unit owner may terminate the provision of Black Start Service with one year advance notice and consent of the Transmission Provider (or its commitment period may be involuntarily terminated pursuant to the section 15 below). Such Black Start Unit shall forego any otherwise existing entitlement to future revenues collected pursuant to this Schedule 6A and fully refund any amount of the Black Start Capital Costs recovered under a FERC-approved rate (recovered on an accelerated basis pursuant to the provisions of section 17(i) of this Schedule 6A) in excess of the amount that would have been recovered pursuant to section 18 of this Schedule 6A during the same period. At the conclusion of the term of commitment established under this section 6 of this Schedule 6A, a Black Start Unit shall commence a new term of commitment under either section 5 or 6 of this Schedule 6A, as applicable.

(ii) Owners of Black Start Units selected to provide Black Start Service after June 6, 2021, in accordance with Schedule 6A, section 4 and electing to recover new or additional Black Start Capital Costs shall commit to provide Black Start Service from such Black Start Units for an initial capital recovery period based upon the age of the Black Start Unit plus the remaining life of the Black Start equipment. For those Black Start Units that elect to recover new or additional Black Start Capital Costs in addition to a prior, FERC-approved cost recovery rate, the

applicable commitment period shall be the longer of the FERC-approved recovery period or the initial capital recovery period based upon the age of the Black Start Unit plus the remaining life of the Black Start equipment.

(iii) Black Start Units selected to be Fuel Assured Black Start Units in accordance with Schedule 6A, section 4 and electing to recover new or additional Fuel Assurance Capital Costs or new and additional Fuel Assurance Costs and Black Start Capital Costs shall commit to provide Black Start Service from such Black Start Units for an initial capital recovery period based upon the age of the Black Start Unit plus the remaining life of the Black Start equipment. For those Fuel Assured Black Start Units that elect to recover new or additional Black Start Capital Costs in addition to a prior, FERC-approved cost recovery rate, the applicable commitment period shall be the longer of the FERC-approved recovery period or the initial capital recovery period based upon the age of the Black Start Unit plus the remaining life of the Black Start equipment. For those Fuel Assured Black Start Units that elect to recover new or additional Fuel Assurance Capital Costs, the applicable capital recovery period shall be the fuel assurance capital recovery period based upon the age of the Fuel Assured Black Start Unit .

The Transmission Provider may terminate the commitment with one year advance notice of its intention to the Black Start Unit owner, but the Black Start Unit owner shall be eligible to recover any amount of unrecovered Fixed Black Start Service Costs including any amount of unrecovered Fuel Assurance Capital Costs over a period not to exceed five years. A Black Start Unit owner may terminate the provision of Black Start Service with one year advance notice and consent of the Transmission Provider (or its commitment period may be involuntarily terminated pursuant to the section 15 below), provided the Black Start Unit's owner demonstrates to the satisfaction of the Transmission Provider at least one of the following reasons for such termination apply:

- a. Black Start Unit retirement or deactivation with at least one year's notice;
- b. Expiration of a state, federal, or other governmental agency permit(s) required for Black Start Service with at least one year's notice; or
- c. Additional capital is required by the Black Start Unit owner to maintain Black Start Service capability (in which case, the Black Start Unit will apply for Black Start Service selection in accordance with the procedures set forth in Manual 12 and only continue to provide Black Start Service if selected for Black Start Service by the Transmission Provider).

Such Black Start Unit shall forego any otherwise existing entitlement to future revenues collected pursuant to this Schedule 6A and fully refund any amount of the Black Start Capital Costs and/or Fuel Assurance Capital Costs recovered under a FERC-approved rate (recovered on an accelerated basis pursuant to the provisions of section 17(i) of this Schedule 6A) in excess of the amount that would have been recovered pursuant to Schedule 6A, section 18 during the same period.

6A. Black Start Units which are owned or contracted for by a Transmission Owner to provide Black Start Service as a result of the black start reliability backstop process defined in the PJM Manuals, shall be subject to cost recovery through such Transmission Owner's annual revenue requirement under such Transmission Owner's Tariff, Attachment H, as filed with, and accepted by, FERC under Section 205 of the Federal Power Act and in accordance with Tariff, Part I, section 9, or through such other cost recovery mechanism, provided that such cost recovery mechanism is filed with and accepted by FERC. The relevant Transmission Owner shall commit to provide, or effectuate the provision of, Black Start Service from such a Black Start Unit for the FERC-approved cost recovery period. The Transmission Provider may terminate the commitment with one year advance notice of its intention to the Transmission Owner. Provision of Black Start Service from a Black Start Unit obtained through the black start reliability backstop process defined in the PJM Manuals shall be subject to sections 7 through 13 of this Schedule 6A. The Revenue Requirements, Credits, and Charges provisions contained in sections 16 through 27 of this Schedule 6A, shall not apply to Black Start Units obtained as a result of the black start reliability backstop process defined in the PJM Manuals.

6B. In the event that a Black Start Unit fails to fulfill its commitment established under section 5 to provide Black Start Service, receipt of any Black Start Service revenues associated with the non-performing Black Start Unit shall cease and, for the period of the unit's non-performance, the Black Start Unit owner shall forfeit the Black Start Service revenues associated with the non-performing Black Start Unit that it received or would have received had the Black Start Unit performed, not to exceed revenues for a maximum of one year.

In the event that a Black Start Unit fails to fulfill its commitment established under section 6 above, such unit shall forego any otherwise existing entitlement to future revenues collected pursuant to this Schedule 6A and fully refund any amount of the Black Start Capital Costs recovered under a FERC-approved rate (recovered on an accelerated basis pursuant to the provisions of section 17(i) of this Schedule 6A) in excess of the amount that would have been recovered pursuant to section 18 of this Schedule 6A during the same period, but such unit remains eligible to establish a new commitment under section 5 or 6 of this Schedule 6A. Provided, however, Black Start Units that are selected to provide Black Start Service after June 6, 2021, pursuant to Schedule 6A, section 6 that subsequently transition from the Capital Cost Recovery Rate to the Base Formula Rate shall have a lifetime commitment and can only terminate for a reason specified in Schedule 6A, section 6(ii).

Performance Standards and Outage Restrictions

7. In addition to the performance capabilities set forth in the PJM Manuals, Black Start Units must have the capabilities listed below. These capabilities must be demonstrated in accordance with the criteria set forth in the PJM manuals and will remain in effect for the duration of the commitment to provide Black Start Service.

- a. A Black Start Unit must be able to close its output circuit breaker to a dead (de-energized) bus within the time specified in the PJM Manuals.

- b. A Black Start Unit must be capable of maintaining frequency and voltage under varying load.
- c. A Black Start Unit must be able to maintain rated output for a period of time identified by each Transmission Owner's system restoration requirements, in conjunction with the Transmission Provider.

d. A Fuel Assured Black Start Unit must meet the fuel assurance requirements as specified in the PJM Manuals.

8. Each owner of Black Start Units or Black Start Plants must maintain procedures for the start-up of the Black Start Units.

9. If a Black Start Unit is a generating unit with a high operating factor (subject to Transmission Provider concurrence) with the ability to automatically remain operating at reduced levels when disconnected from the grid, this ability must be demonstrated in accordance with the criteria set forth in the PJM manuals.

10. No more than one Black Start Unit at a Black Start Plant may be subject to a Generator Planned Outage or Generator Maintenance Outage at any one time without written approval of the Transmission Provider and the Transmission Owner in the Zone receiving Black Start Service from the Black Start Plant. This restriction excludes outages on common plant equipment that may make all units unavailable. A Black Start Unit not selected for providing Black Start Service in accordance with this Schedule 6A, section 4 and the PJM Manuals may be substituted for a Black Start Unit that is subject to a Generator Planned Outage to permit a concurrent planned outage of another critical Black Start Unit at the same Black Start Plant. The Black Start Unit used as a substitute shall not receive compensation for additional capital expenditures to qualify for Black Start Service, will not increase the current Black Start Unit capital recovery commitment period, must be connected at the same voltage level and cranking path, must be similar age as the current Black Start Unit, must provide equivalent Black Start Unit Capacity, and must have had a valid annual test within the previous 13 months. Black Start Unit substitutions may be permitted for reasons other than Generator Planned Outages if requested by the Black Start Unit owner and if approved by the Transmission Provider; provided, however, all requests for Black Start Unit substitutions must be supported by documentation and information demonstrating operational or technical reasons for the substitution satisfactory to the Transmission Provider and may only occur once within a 12-month period.

11. Concurrent planned outages at multiple Black Start Plants within a zone may be restricted based on Transmission Owner requirements for Black Start Service availability. Such restrictions must be predefined and approved by Transmission Provider in accordance with the PJM manuals.

Testing

12. To verify that they can be started and operated without being connected to the Transmission System, Black Start Units shall be tested annually in accordance with the Tariff

and the PJM Manuals. Fuel Assured Black Start Units that are dual fuel must conduct an annual test on both fuels. The Black Start Unit owner shall determine the time of the annual test.

13. Compensation under this Schedule 6A for energy output delivered to the Transmission System during the annual test shall be provided for the Black Start Unit's minimum run time at the higher of the unit's cost-capped offer or real-time Locational Marginal Price plus start-up and no-load costs for up to two start attempts, if necessary. For Black Start Units that are generating units with a high operating factor (subject to Transmission Provider's concurrence) with the ability to automatically remain operating at reduced levels when disconnected from the grid, an opportunity cost will be provided to compensate the unit for lost revenues during testing.

14. All Black Start Units must have a successful annual test on record with the Transmission Provider within the preceding 13 months. A Black Start Unit receiving revenues under Section 5 or Section 6 above that does not have a successful annual test on record with the Transmission Provider within the preceding 13 months will not qualify to receive Black Start Service revenues. A Fuel Assured Black Start Unit that stores fuel on-site and fails in any month to store the fuel and non-fuel consumables needed to meet its fuel assurance run hour requirements except for allowable conditions specified in the PJM Manuals, and except when the Fuel Assured Black Start Unit can also operate independently on 2 or more interstate pipelines, does not qualify to receive Black Start revenues in that month.

15. If a Black Start Unit fails the annual test, the unit may be re-tested within a ten-day period without financial penalty. If the Black Start Unit does not successfully re-test within that ten-day period, monthly Black Start Service revenues under this Schedule 6A will be forfeited by that unit from the time of the first unsuccessful test until such time as the unit passes an annual test. If the Black Start Unit owner does not make the necessary repairs to enable the Black Start Unit to pass the annual test within 90 days of the due date for the annual test pursuant to section 14 above, the Black Start Unit will immediately cease to qualify as a Black Start Unit and, if applicable, will have failed to fulfill its commitment pursuant to section 5 or section 6 above, whichever is applicable, of this Schedule 6A and will be subject to the additional forfeiture of revenues set forth in section 6B of this Schedule 6A. The 90 day period may be extended up to 1 year by the Transmission Provider in accordance with the PJM Manuals. If the 90 day period is extended, the Black Start Unit owner will continue to forfeit all revenues starting in the month of the first failed test until the Black Start Unit has demonstrated to the Transmission Provider that a successful test has been completed.

Revenue Requirements

16. A Black Start Unit Owner's annual Black Start Service revenue requirement shall be the sum of the annual Black Start Service revenue requirements for each generator that is designated as providing Black Start Service and has provided the Transmission Provider with a calculation of its annual Black Start Service revenue requirements. A separate line item shall appear on the participants' Transmission Provider bill for Black Start Service charges and credits.

17. Black Start Service revenue requirements for each Black Start Unit shall be based, at the election of the owner, on either (i) a FERC-approved rate for the recovery of the cost of

providing such service for the entire duration of the commitment term set forth in either section 5 or 6 of this Schedule 6A, as applicable, or (ii) the formula rates set forth in section 18 of this Schedule 6A for the commitment term set forth in section 5 or 6 of this Schedule 6A as applicable. Each generator's Black Start Service revenue requirements shall be an annual calculation.

17A. Annual Review for all Black Start Units

Requests for Black Start Service revenue requirements and for changes to the Black Start Service revenue requirements must be submitted to the Market Monitoring Unit for review and analysis, with supporting data and documentation, pursuant to Tariff, Attachment M–Appendix, section III and the PJM Manuals, with a copy to the Office of the Interconnection, by no later than May 3 of each year. The Market Monitoring Unit and the Black Start Unit owner shall attempt to come to agreement on the level of each component included in the Black Start Service revenue requirements by no later than May 14 of each year. By no later than May 21 of each year, the Black Start Unit owner shall notify the Office of the Interconnection and the Market Monitoring Unit in writing whether it agrees or disagrees with the Market Monitoring Unit's determination of the level of each component included in the Black Start Service revenue requirements. The Black Start Unit owner may also submit Black Start Service revenue requirements that it chooses to the Office of the Interconnection by no later than May 21 of each year, provided that (i) it has participated in good faith with the process described in this section and in Tariff, Attachment M–Appendix, section III (ii) the Black Start Service revenue requirements are no higher than the level defined in any agreement reached by the Black Start Unit owner and the Market Monitoring Unit that resulted from the foregoing process, and (iii) the Black Start Service revenue requirements are accepted by the Office of the Interconnection subject to the criteria set forth in the Tariff and PJM Manuals.

The Office of the Interconnection shall determine whether to accept the values submitted by the Black Start Unit owner subject to the requirements of the Tariff and the PJM Manuals by no later than May 27. If the Office of the Interconnection does not accept the values submitted by the Black Start Unit owner in such case, the Black Start Unit owner may file its proposed values with the Commission for approval. Pursuant to Tariff, Attachment M–Appendix, section III, if the Office of the Interconnection accepts the Black Start Service revenue requirements submitted by the Black Start Unit owner in such case, the Market Monitoring Unit may petition the Commission for an order that would require the Black Start Unit owner to utilize the values determined by the Market Monitoring Unit or the Office of the Interconnection or such other values as determined by the Commission. The annual calculation of Black Start Service revenue requirements shall become effective on June 1 of each year, except that no change to a Black Start Service revenue requirement shall become effective until the existing revenue requirement has been effective for at least twelve months. Notwithstanding the foregoing, the deadlines set forth in this section 17 shall not apply to a Black Start Unit owner's election to select a new method of recovery for its Fixed BSSC.

17B. Initial Review for New Black Start Units or existing Black Starts Units that require Fuel Assured Capital Cost

Requests for new Black Start Service revenue requirements and/or Fuel Assured Capital Costs must be submitted to the Market Monitoring Unit for review and analysis, with supporting data and documentation, pursuant to Tariff, Attachment M–Appendix, section III and the PJM Manuals, with a copy to the Office of the Interconnection, by no later than 90 days after entering Black Start Service or qualifying to be a Fuel Assured Black Start Unit. The Market Monitoring Unit and the Black Start Unit owner shall attempt to come to agreement on the level of each component included in the Black Start Service revenue requirements by no later than 90 days after the Black Start Unit owner’s submittal of final black start capital costs (if applicable), variable black start costs, and fuel storage cost documentation. By no later than 90 days of the Black Start Unit owner’s submittal of final black start cost documentation, the Market Monitoring Unit shall calculate the new Black Start Unit’s annual revenue requirement and submit it to the Office of the Interconnection and the Black Start Unit owner. If more than three Black Start Unit owners submit documentation within a 90-day period, the Market Monitoring Unit shall complete the review of the first three submittals within 90 days and the next set of three within the following three months and so on until all are complete. The Black Start Unit owner shall notify the Office of the Interconnection and the Market Monitoring Unit in writing if it disagrees with the Market Monitoring Unit’s determination of the level of any component included in the Black Start Service revenue requirements within 7 days after the Market Monitoring Unit’s submittal of the annual revenue requirement to the Office of the Interconnection. The Black Start Unit owner shall also submit Black Start Service revenue requirements that it proposes to the Office of the Interconnection provided that (i) it has participated in good faith with the process described in this section and in Tariff, Attachment M–Appendix, section III; (ii) the Black Start Service revenue requirements are no higher than the level defined in any agreement reached by the Black Start Unit owner and the Market Monitoring Unit that resulted from the foregoing process; and (iii) the Black Start Service revenue requirements are accepted by the Office of the Interconnection subject to the criteria set forth in the Tariff and PJM Manuals.

The Office of the Interconnection shall determine whether to accept the values submitted by the Black Start Unit owner subject to the requirements of the Tariff and the PJM Manuals by no later than 30 days after its receipt of the Black Start Unit owner’s written notice of a disagreement. If the Office of the Interconnection does not accept the values submitted by the Black Start Unit owner in such case, the Black Start Unit owner may file its proposed values with the Commission for approval. Pursuant to Tariff, Attachment M–Appendix, section III, if the Office of the Interconnection accepts the Black Start Service revenue requirements submitted by the Black Start Unit owner in such case, the Market Monitoring Unit may petition the Commission for an order that would require the Black Start Unit owner to utilize the values determined by the Market Monitoring Unit or the Office of the Interconnection or such other values as determined by the Commission. The annual calculation of Black Start Service revenue requirements shall become effective the day the unit enters Black Start Service or becomes fuel assured.

18. The formula for calculating a generator’s annual Black Start Service revenue requirement is:

$$\{(Fixed\ BSSC) + (Variable\ BSSC) + (Training\ Costs) + (Fuel\ Storage\ Costs)\} * (1 + Z)$$

For units that have the demonstrated ability to operate at reduced levels when automatically disconnected from the grid, the formula is revised to:

$$(\text{Training Costs}) * (1 + Z)$$

Where:

Fixed BSSC

Black Start Units with a commitment established under section 5 of this Schedule 6A shall calculate Fixed BSSC or “Fixed Black Start Service Costs” in accordance with the following Base Formula Rate:

Base Formula Rate:

$$\text{Net CONE} * \text{Black Start Unit Capacity} * X$$

Where:

“Net CONE” is the then current installed capacity (“ICAP”) net Cost of New Entry (expressed in \$/MW year) for the CONE Area where the Black Start Unit is located.

“Black Start Unit Capacity” is either: (i) the Black Start Unit’s installed capacity, expressed in MW, for those Black Start Units which are not Fuel Assured Black Start Units that are Generation Capacity Resources; ~~or~~ (ii) the awarded MWs in the Transmission Provider’s request for proposal process under the PJM Manuals, for those Black Start Units, which are not Fuel Assured Black Start Units, that are Energy Resources; or (iii) the Fuel Assured Black Start Unit’s installed capacity for fuel assured non-intermittent Capacity Resources; or (iv) the monthly 90% confidence MW value calculated by the Transmission Provider for fuel assured intermittent or hybrid Capacity Resources. The 90% confidence MW value is calculated using Black Start Unit historical data to determine the hourly MW value the resource can provide each day in each month for 16 hours. The hourly MW value is then iterated until the confidence level of the unit providing the MW value on a monthly basis for 16 hours is 90%.

“X” is the Black Start Service allocation factor unless a higher or lower value is supported by the documentation of the actual costs of providing Black Start Service. For such units qualifying as Black Start Units on the basis of demonstrated ability to operate at reduced levels when automatically disconnected from the grid, X shall be zero. For non-fuel assured Black Start Units with a commitment established under section 5 of this Schedule 6A, X shall be .01 for Hydro units, .02 for CT units. For fuel assured Black Start Units with a

commitment established under section 5 of this Schedule 6A, X shall be .02 for all units.

Black Start Units with a commitment established under section 6 above shall calculate Fixed BSSC or “Fixed Black Start Service Costs” in accordance with one of the following formulas, as applicable:

Capital Cost Recovery Rate – NERC-CIP Specific Recovery

$$(\text{Net Cone} * \text{Black Start NERC-CIP Unit Capacity} * X) + (\text{Incremental Black Start NERC-CIP Capital Costs} * \text{CRF}) + \text{(Fuel Assurance Capital Costs} * \text{CRF)}$$

Where:

“Net Cone” is the then current installed capacity (“ICAP”) net Cost of New Entry (expressed in \$/MW year) for the CONE area where the Black Start Unit is located.

“Black Start NERC-CIP Unit Capacity” is the Black Start Unit’s installed capacity, expressed in MW, but, for purposes of this calculation, capped at 100 MW for Hydro units, or 50 MW for CT units.

“Incremental Black Start NERC-CIP Capital Cost” are those capital costs documented by the owner or accepted by the Commission for the incremental equipment solely necessary to enable a Black Start Unit to maintain compliance with mandatory Critical Infrastructure Protection Reliability Standards (as approved by the Commission and administered by the applicable Electric Reliability Organization).

“Fuel Assurance Capital Costs” are the new or additional capital costs documented by the owner for the installation of equipment necessary for the unit to meet the fuel assurance criteria specified in the PJM manuals.

“CRF” or “Capital Recovery Factor” is equal to the levelized CRF as set forth in the applicable CRF table posted on the PJM website in accordance with Tariff, Schedule 6A, section 18 and Manual 15.

A Black Start Unit may elect to terminate forward cost recovery under this Capital Cost Recovery Rate – NERC-CIP Specific Recovery at any time and seek cost recovery under the Capital Cost Recovery Rate, pursuant to the terms and conditions set forth below.

Capital Cost Recovery Rate

$$(\text{FERC-approved rate}) + (\text{Incremental Black Start Capital Costs} * \text{CRF}) + \text{(Fuel Assurance Capital Costs} * \text{CRF)}$$

Where:

“FERC-approved rate” is the Black Start Unit’s current FERC-approved recovery of costs to provide Black Start Service, if applicable. To the extent that a Black Start Unit owner is currently recovering black start costs pursuant to a FERC-approved rate, that cost recovery will be included as a formulaic component for calculating the Black Start Unit’s annual revenue requirement pursuant to this section 18. However, under no circumstances will PJM or the Black Start Unit owner restructure or modify that existing FERC-approved rate without FERC approval.

“Incremental Black Start Capital Costs” are the new or additional capital costs documented by the owner or accepted by the Commission for the incremental equipment solely necessary to enable a unit to provide Black Start Service in addition to whatever other product or services such unit may provide. Such costs shall include those incurred by a Black Start Unit owner in order to meet NERC Reliability Standards that apply to Black Start Units solely on the basis of the provision of Black Start Service by such unit. However, Incremental Black Start Capital Costs shall not include any capital costs that the Black Start Unit owner is recovering for that unit pursuant to a FERC-approved recovery rate.

“Fuel Assurance Capital Costs” are the new or additional capital costs documented by the owner for the installation of equipment necessary for the unit to meet the fuel assurance criteria specified in the PJM manuals. However, Fuel Assurance Capital Costs shall not include any capital costs that the Fuel Assured Black Start Unit owner is recovering for that unit pursuant to a FERC-approved recovery rate.

The Capital Recovery Factor (“CRF”) is equal to the Levelized CRF based on the age of the Black Start Unit, which is modified to provide Black Start Service.

The CRF applicable to Black Start Capital Costs of Black Start Units selected for Black Start Service prior to June 6, 2021, shall continue to be determined in accordance with the following 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

The CRF applicable to Black Start Capital Costs and/or for Fuel Assurance Capital Costs, of Black Start Units selected for Black Start Service after June 6, 2021, shall be updated annually on March 1 for (i) federal income tax rates as utilized by the U.S. Internal Revenue Service in effect at the time of the annual CRF update; (ii) average state tax rate; and (iii) debt interest rates and shall be posted on the PJM website by March 31 each year

as shown in the table below. Interested parties shall have until April 15 of each year to contest PJM's calculation of the annual CRF value before it becomes effective on June 1 of each year.

PJM determines annual CRF inputs	March 1
PJM posts annual CRF	March 31
Deadline for contesting annual CRF	April 15
Annual revenue requirement calculation	May 3 through May 27
Annual revenue requirement with CRF in effect	June 1

The CRF values shall be calculated for a recovery period based on the age of the Black Start Unit using the equation below:

$$CRF = \frac{r(1+r)^N \left[1 - \frac{sB}{\sqrt{1+r}} - s(1-B)\sqrt{1+r} \sum_{j=1}^L \frac{m_j}{(1+r)^j} \right]}{(1-s)\sqrt{1+r}[(1+r)^N - 1]} \dots$$

Where:

Formula Symbol	Description
r	After Tax Weighted Average Cost of Capital (ATWACC), which equals (equity percentage)(cost of equity) + (debt percentage)(debt interest rate)(1 – effective tax rate)
s	Effective Tax Rate, which equals (1 – state tax rate)(federal tax rate) + state tax rate
B	Bonus depreciation percent in effect at the Black Start Unit in-service date
N	Cost recovery period based on the age of the unit in years, as established in the Age of Unit/Applicable Recovery Period table below
L	The lesser of N or 16 years
M_j	Modified Accelerated Cost Recovery System (MACRS) depreciation

The following assumptions are used in the calculation:

The current federal tax and depreciation rates are as established by U.S. Internal Revenue Service;

The state tax rate is an average of the income tax rates for all the states in the PJM Region;

The capital investment necessary to make a unit qualify for Black Start Service is made up of 50 percent equity;

The capital investment necessary to make a unit qualify for Black Start Service is made up of 50 percent debt;

The debt interest rate is based on the most recent Net CONE quadrennial review after-tax weighted average cost of capital (ATWACC) and shall be updated as follows:

The debt interest rate will be updated during the Net CONE quadrennial review; and

If the 2-year change in the Moody Utility Index for bonds rated Baa1 is more than 200 basis points, this change will be added to the interest rate used in the most recent Net CONE quadrennial review and will be used as the current year's debt interest rate.

The debt term is equal to the applicable recovery period specified in the Age of Unit/Applicable Recovery Period table below; and

The cost of equity shall be equal to an after tax internal rate of return on equity of 12%.

Any changes to the debt and equity percentages and after tax internal rate of return on equity components stated above shall be included in revisions to this section 18.

Age of the Unit (years)	<u>Incremental Black Start Capital Costs</u> Applicable Recovery Period (years)	<u>Fuel Assurance Capital Costs Recovery Period</u> (years)
1-5	20	<u>20</u>
6-10	15	<u>15</u>
11-15	10	<u>10</u>
16+	5	<u>10</u>

In those circumstances where a Black Start Unit owner has elected to recover Incremental Black Start Capital Costs and/or Fuel assurance Capital Costs, in addition to a FERC-approved recovery rate, its applicable term of commitment shall be the greater of: (i) the FERC-approved recovery period, or; (ii) the applicable term of commitment as set forth in the Age of Unit/Applicable Recovery Period table above.

After a Black Start Unit has recovered its allowable Incremental Black Start Capital Costs, ~~or~~ Incremental Black Start NERC-CIP Capital Costs, and/or Fuel assurance Capital Costs as provided by the applicable Capital Cost Recovery Rate, and has satisfied its applicable commitment period required under section 6 of this Schedule 6A, the Black Start Unit shall be

committed to providing black start in accordance with section 5 of this Schedule 6A and calculate its Fixed BSSC in accordance with the Base Formula Rate.

Variable BSSC

All Black Start Units shall calculate Variable BSSC or “Variable Black Start Service Costs” in accordance with the following formula:

$$\text{Black Start Unit O\&M} * Y$$

Where:

“Black Start Unit O&M” are the operations and maintenance costs attributable to supporting Black Start Service and must equal the annual variable O&M outlined in the PJM Cost Development Guidelines set forth in the PJM Manuals. Such costs shall include those incurred by a Black Start Owner in order to meet NERC Reliability Standards that apply to the Black Start Unit solely on the basis of the provision of Black Start Service by unit.

“Y” is 0.01, unless a higher or lower value is supported by the documentation of costs. If a value of Y is submitted for this cost, a (1-Y) factor must be applied to the Black Start Unit’s O&M costs on the unit’s cost-based energy schedule, calculated based on the Cost Development Guidelines in the PJM Manuals.

For units qualifying as Black Start Units on the basis of a demonstrated ability to operate at reduced levels when automatically disconnected from the grid, there are no variable costs associated with providing Black Start Service and the value for Variable BSSC shall be zero.

Black Start Units with the demonstrated ability to automatically remain operating, at reduced levels, when disconnected from the grid may receive NERC compliance costs associated with providing Black Start Service in addition to the formula above, if approved in accordance with the procedures in section 17 of this Schedule 6A.

Training Costs:

All Black Start Units shall calculate Training Costs in accordance with the following formula:

$$50 \text{ staff hours/year/plant} * 75/\text{hour}$$

Fuel Storage Costs:

Black Start Units that store liquefied or compressed natural gas, propane, or oil on site shall calculate Fuel Storage Costs in accordance with the following formula:

$$\{ \text{MTSL} + [(\# \text{ Run Hours}) * (\text{Fuel Burn Rate})] \} *$$

$$(12 \text{ Month Forward Strip} + \text{Basis}) * (\text{Bond Rate})$$

Where:

Run Hours are the actual number of hours a Transmission Provider requires a Black Start Unit to run. Run Hours shall be at least 16 hours or as defined by the Transmission Owner restoration plan, whichever is less.

“Fuel Burn Rate” is actual fuel burn rate for the Black Start Unit.

“12-Month Forward Strip” is the average of forward prices for the fuel burned in the Black Start Unit traded the first Business Day on or following April 1.

“Basis” is the transportation costs from the location referenced in the forward price data to the Black Start Unit plus any variable taxes.

“Bond rate” is the value determined with reference to the Moody's Utility Index for bonds rated Baa1 reported the first Business Day on or following April 1.

“MTSL” is the “minimum tank suction level” and shall apply to oil fired Black Start Units’ storage tanks that have an unusable volume of oil. In the case where a Black Start Unit shares a common fuel tank, the Black Start Unit will be eligible for recovery of the Black Start Energy Tank Ratio of the MTSL in its fuel storage calculation.

$$\text{Black Start Energy Tank Ratio} = \{(\text{Fuel Burn Rate} * \text{Minimum Run Hours}) / (\text{Tank Capacity} - \text{MTSL})\}$$

The MTSL fuel storage calculation shall be as follows:

$$\{(\text{Black Start Energy Tank Ratio} * \text{MTSL}) + [(\text{\#Run Hours}) * (\text{Fuel Burn Rate})]\} * (12 \text{ Month Forward Strip} + \text{Basis}) * (\text{Bond Rate})$$

For units qualifying as Black Start Units on the basis of a demonstrated ability to operate at reduced levels when automatically disconnected from the grid, there are no associated fuel storage costs and the value for FSC shall be zero.

Z

Z shall be an incentive factor solely for Black Start Units with a commitment established under section 5 above and shall be ten percent for non-fuel assured Black Start Units and twenty percent for Fuel Assured Black Start Units. For those Black Start Units that elect to recover new or additional Black Start or Fuel Assurance Capital Costs under section 6 above, the incentive factor, Z, shall be equal to zero.

Every five years, PJM shall review the formula and its costs components set forth in this section 18, and report on the results of that review to stakeholders.

19. Transmission Provider or its agent shall have the right to independently audit the accounts and records of each Black Start Unit that is receiving payments for providing Black Start Service.

20. PJM shall notify its Members when a Black Start Unit seeks to recover new or additional Black Start NERC-CIP Capital Costs under section 18 of this Schedule 6A no later than thirty (30) days prior to the effective date of the recovery. At the written request of a PJM Member, made simultaneously to the Market Monitoring Unit and PJM, with notice to the Black Start Unit owner, the Market Monitoring Unit shall make available to the affected PJM Member for inspection at the offices of the Market Monitoring Unit, all data supporting the requested new or additional NERC-CIP specific Capital Costs. The Black Start Unit owner may elect to attend this review. In all cases, the supporting data is to be held confidential and may not be distributed.

21. The Market Monitoring Unit shall include a Black Start Service summary in its annual State of the Market report which will set forth a descriptive summary of the new or additional Black Start NERC-CIP Capital Costs requested by Black Start Units, and include a list of the types of capital costs requested and the overall cost of such capital improvements on an aggregate basis such that no data is attributable to an individual Black Start Unit.

Credits

22. For existing Black Start Units, monthly credits are provided to Black Start Unit owners that submit to the Transmission Provider their annual revenue requirements established pursuant to section 17A of this Schedule 6A. The generator's monthly credit is equal to 1/12 of its annual Black Start Service revenue requirement for eligible critical Black Start Units. For new Black Start Unit owners, monthly credits will be held by the Office of the Interconnection in a non-interest bearing account until the Office of the Interconnection, or the Commission as applicable, accepts the owner's annual revenue requirement pursuant to section 17B of this Schedule 6A. New Black Start Unit owners will begin to receive monthly credits, including any monthly credits held by the Office of the Interconnection back to the date the unit enters Black Start Service and any required estimated annual revenue requirement true up after the Office of the Interconnection, or the Commission as applicable, accepts the new Black Start Unit owner's annual revenue requirement.

22A. For Fuel Assured Black Start Units that are recovering Fuel Assurance Capital Costs, pursuant to section 17B of this Schedule 6A, shall have its monthly credits reduced, but not less than zero, by the positive net value of the Day-ahead Energy Market and Real-time Energy Market revenues from being committed using the fuel assurance fuel as further described in the PJM manuals minus the cost of running on that fuel. The Black Start Unit's monthly credits shall not be increased. For Fuel Assured Black Start Units that are recovering Fuel Assurance Capital Cost and the Fuel Assurance Capital Costs increased the Installed Capacity Rating (ICAP) of the unit, monthly credits shall be reduced, but not less than zero, by the monthly capacity revenues for the increased ICAP. Monthly credits will only be reduced during the Fuel Assurance Capital Cost recovery period.

23. Revenue requirements for jointly owned Black Start Units will be allocated to the owners based on ownership percentage.

24. Transmission Provider shall not compensate generators for Black Start Service unless they meet the Transmission Provider criteria for Black Start Service and the criteria for Black Start Service in the Applicable Standards and provide Transmission Provider with all necessary data in accordance with this Schedule 6A and the PJM manuals.

Charges

25. Zonal rates will be based on Black Start Service capability or share of generation units designated by the Transmission Provider and allocated to network service customers and point-to-point reservations. Zonal rates will include estimated annual revenue requirements for new Black Start Units from the date the units enter Black Start Service to last day of the month preceding the Office of the Interconnection's acceptance of the unit's annual revenue requirement. The estimated annual revenue requirement will be based on the Black Start Unit owner's best estimate at the time the unit enters Black Start Service. Any estimated annual revenue requirement true up will be included in the monthly bill after the Office of the Interconnection accepts the new Black Start unit's annual revenue requirement.

26. Revenue requirements for Black Start Units designated by the Transmission Provider as critical (regardless of zonal location) will be allocated to the receiving Transmission Owner's zone. Black Start Units that are shared and designated to serve multiple zones will have their annual revenues allocated by Transmission Owner designated critical load percentage.

27. Purchasers of Black Start Service shall be charged for such service in accordance with the following formulae.

Monthly Charge for a purchaser receiving Network Integration Transmission Service or Point-to-Point Transmission Service to serve Non-Zone Load = Allocation Factor * Total Generation Owner Monthly Black Start Service Revenue Requirement

Monthly Charge for a purchaser receiving Network Integration Transmission Service or Point-to-Point Transmission Service to serve Zone Load = Allocation Factor * Zonal Generation Owner Monthly Black Start Service Revenue Requirement * Adjustment Factor

Where:

Purchaser serving Non-Zone Load is a Network Customer serving Non-Zone Network Load or a Transmission Customer where the Point of Delivery is at the boundary of the PJM Region.

Zonal Generation Owner Monthly Black Start Service Revenue Requirement is the sum of the monthly share of Black Start Service revenue requirements for each generator nominated by the Transmission Owners in that zone.

Total Generation Owner Monthly Black Start Service Revenue Requirement is the sum of the Zonal Generation Owner Monthly Black Start Service Revenue Requirements for all Zones in the PJM Region.

Allocation Factor is the monthly transmission use of each Network Customer or Transmission Customer per Zone or Non-Zone, as applicable, on a megawatt basis divided by the total transmission use in the Zone or in the PJM Region, as applicable, on a megawatt basis.

For Network Customers, monthly transmission use on a megawatt basis is the sum of a Network Customer's daily values of DCPZ or DCPNZ (as those terms are defined in Tariff, Part I, section 34.1) as applicable, for all days of the month.

For Transmission Customers, monthly transmission use on a megawatt basis is the sum of the Transmission Customer's hourly amounts of Reserved Capacity for each day of the month (not curtailed by PJM) divided by the number of hours in the day.

Adjustment Factor is determined as the sum of the total monthly transmission use in the PJM Region on a megawatt basis, exclusive of such use by Network Customers and Transmission Customers serving Non-Zone Load, divided by the total monthly transmission use in the PJM Region on a megawatt basis.

In the event that a single customer is serving load in more than one Zone, or serving Non-Zone Load as well as load in one or more Zones, or is both a Network Customer and a Transmission Customer, the Monthly Charge for such a customer shall be the sum of the Monthly Charges determined by applying the appropriate formulae set forth in this Schedule 6A.

Attachment E

Revisions to the PJM Open Access Transmission Tariff

(Clean Format)
Effective January 29, 2022

SCHEDULE 6A

Black Start Service

References to section numbers in this Schedule 6A refer to sections of this Schedule 6A, unless otherwise specified.

To ensure the reliable restoration following a shut down of the PJM transmission system, Black Start Service is necessary to facilitate the goal of complete system restoration. Black Start Service enables the Transmission Provider to designate specific generators called Black Start Units whose location and capabilities are required to re-energize the transmission system following a system-wide blackout. The Transmission Provider shall administer the provision of Black Start Service. PJMSettlement shall be the Counterparty to the purchases and sales of Black Start Service.

TRANSMISSION CUSTOMERS

1. All Transmission Customers and Network Customers must obtain Black Start Service through the Transmission Provider, with PJMSettlement as the Counterparty, pursuant to this Schedule 6A.

PROVISION OF BLACK START SERVICE

2. A Black Start Unit is a generating unit that has equipment enabling it to start without an outside electrical supply or a generating unit with a high operating factor (subject to Transmission Provider concurrence) with the demonstrated ability to automatically remain operating, at reduced levels, when disconnected from the grid. A Black Start Unit shall be considered capable of providing Black Start Service only when it meets the criteria set forth in the PJM manuals. The expected life of the Black Start Unit shall take into consideration expectations regarding both the enabling equipment and the generation unit itself.

3. A Black Start Plant is a generating plant that includes one or more Black Start Units. A generating plant with Black Start Units electrically separated at different voltage levels will be considered multiple Black Start Plants.

4. The Transmission Provider is responsible for developing a coordinated and efficient system restoration plan that identifies all of the locations where Black Start Units are needed. The PJM Manuals shall set forth the criteria and process for selecting or identifying the Black Start Units necessary to commit to providing Black Start Service at the identified locations. No Black Start Unit shall be eligible to recover the costs of providing Black Start Service in the PJM Region unless it agrees to provide such service for a term of commitment established under section 5, 6, or 6A below.

5. Owners of Black Start Units selected to provide Black Start Service in accordance with Schedule 6A, section 4 and electing to forego any recovery of new or additional Black Start Capital Costs shall commit to provide Black Start Service from such Black Start Units for an initial term of no less than two years and authorize the Transmission Provider to resell Black Start Service from its Black Start Units. The term commitment shall continue to extend until the

Black Start Unit owner or the Transmission Provider provides written, one-year advance notice of its intention to terminate the commitment or the commitment is involuntarily terminated pursuant to section 15 of this Schedule 6A. Black Start Units that are selected to provide Black Start Service after June 6, 2021, pursuant to Schedule 6A, section 6 that subsequently transition from the Capital Cost Recovery Rate to the Base Formula Rate shall have a lifetime commitment and can only terminate for the reason specified in Schedule 6A, section 6(ii).

6. (i) Owners of Black Start Units selected to provide Black Start Service prior to June 6, 2021, in accordance with section 4 of this Schedule 6A and electing to recover new or additional Black Start Capital Costs shall commit to provide Black Start Service from such Black Start Units for a term based upon the age of the Black Start Unit or the longest expected life of the Incremental Black Start Capital Cost, as set forth in the applicable CRF Table in section 18 of this Schedule 6A. For those Black Start Units that elect to recover new or additional Black Start Capital Costs in addition to a prior, FERC-approved cost recovery rate, the applicable commitment period shall be the longer of the FERC-approved recovery period or the applicable term of commitment as set forth in the CRF Table in section 18 of this Schedule 6A. The Transmission Provider may terminate the commitment with one year advance notice of its intention to the Black Start Unit owner, but the Black Start Unit owner shall be eligible to recover any amount of unrecovered Fixed Black Start Service Costs over a period not to exceed five years. A Black Start Unit owner may terminate the provision of Black Start Service with one year advance notice and consent of the Transmission Provider (or its commitment period may be involuntarily terminated pursuant to the section 15 below). Such Black Start Unit shall forego any otherwise existing entitlement to future revenues collected pursuant to this Schedule 6A and fully refund any amount of the Black Start Capital Costs recovered under a FERC-approved rate (recovered on an accelerated basis pursuant to the provisions of section 17(i) of this Schedule 6A) in excess of the amount that would have been recovered pursuant to section 18 of this Schedule 6A during the same period. At the conclusion of the term of commitment established under this section 6 of this Schedule 6A, a Black Start Unit shall commence a new term of commitment under either section 5 or 6 of this Schedule 6A, as applicable.

(ii) Owners of Black Start Units selected to provide Black Start Service after June 6, 2021, in accordance with Schedule 6A, section 4 and electing to recover new or additional Black Start Capital Costs shall commit to provide Black Start Service from such Black Start Units for an initial capital recovery period based upon the age of the Black Start Unit plus the remaining life of the Black Start equipment. For those Black Start Units that elect to recover new or additional Black Start Capital Costs in addition to a prior, FERC-approved cost recovery rate, the applicable commitment period shall be the longer of the FERC-approved recovery period or the initial capital recovery period based upon the age of the Black Start Unit plus the remaining life of the Black Start equipment.

The Transmission Provider may terminate the commitment with one year advance notice of its intention to the Black Start Unit owner, but the Black Start Unit owner shall be eligible to recover any amount of unrecovered Fixed Black Start Service Costs over a period not to exceed five years. A Black Start Unit owner may terminate the provision of Black Start Service with one year advance notice and consent of the Transmission Provider (or its commitment period may be involuntarily terminated pursuant to the section 15 below), provided the Black Start

Unit's owner demonstrates to the satisfaction of the Transmission Provider at least one of the following reasons for such termination apply:

- a. Black Start Unit retirement or deactivation with at least one year's notice;
- b. Expiration of a state, federal, or other governmental agency permit(s) required for Black Start Service with at least one year's notice; or
- c. Additional capital is required by the Black Start Unit owner to maintain Black Start Service capability (in which case, the Black Start Unit will apply for Black Start Service selection in accordance with the procedures set forth in Manual 12 and only continue to provide Black Start Service if selected for Black Start Service by the Transmission Provider).

Such Black Start Unit shall forego any otherwise existing entitlement to future revenues collected pursuant to this Schedule 6A and fully refund any amount of the Black Start Capital Costs recovered under a FERC-approved rate (recovered on an accelerated basis pursuant to the provisions of section 17(i) of this Schedule 6A) in excess of the amount that would have been recovered pursuant to Schedule 6A, section 18 during the same period.

6A. Black Start Units which are owned or contracted for by a Transmission Owner to provide Black Start Service as a result of the black start reliability backstop process defined in the PJM Manuals, shall be subject to cost recovery through such Transmission Owner's annual revenue requirement under such Transmission Owner's Tariff, Attachment H, as filed with, and accepted by, FERC under Section 205 of the Federal Power Act and in accordance with Tariff, Part I, section 9, or through such other cost recovery mechanism, provided that such cost recovery mechanism is filed with and accepted by FERC. The relevant Transmission Owner shall commit to provide, or effectuate the provision of, Black Start Service from such a Black Start Unit for the FERC-approved cost recovery period. The Transmission Provider may terminate the commitment with one year advance notice of its intention to the Transmission Owner. Provision of Black Start Service from a Black Start Unit obtained through the black start reliability backstop process defined in the PJM Manuals shall be subject to sections 7 through 13 of this Schedule 6A. The Revenue Requirements, Credits, and Charges provisions contained in sections 16 through 27 of this Schedule 6A, shall not apply to Black Start Units obtained as a result of the black start reliability backstop process defined in the PJM Manuals.

6B. In the event that a Black Start Unit fails to fulfill its commitment established under section 5 to provide Black Start Service, receipt of any Black Start Service revenues associated with the non-performing Black Start Unit shall cease and, for the period of the unit's non-performance, the Black Start Unit owner shall forfeit the Black Start Service revenues associated with the non-performing Black Start Unit that it received or would have received had the Black Start Unit performed, not to exceed revenues for a maximum of one year.

In the event that a Black Start Unit fails to fulfill its commitment established under section 6 above, such unit shall forego any otherwise existing entitlement to future revenues collected pursuant to this Schedule 6A and fully refund any amount of the Black Start Capital Costs

recovered under a FERC-approved rate (recovered on an accelerated basis pursuant to the provisions of section 17(i) of this Schedule 6A) in excess of the amount that would have been recovered pursuant to section 18 of this Schedule 6A during the same period, but such unit remains eligible to establish a new commitment under section 5 or 6 of this Schedule 6A. Provided, however, Black Start Units that are selected to provide Black Start Service after June 6, 2021, pursuant to Schedule 6A, section 6 that subsequently transition from the Capital Cost Recovery Rate to the Base Formula Rate shall have a lifetime commitment and can only terminate for a reason specified in Schedule 6A, section 6(ii).

Performance Standards and Outage Restrictions

7. In addition to the performance capabilities set forth in the PJM Manuals, Black Start Units must have the capabilities listed below. These capabilities must be demonstrated in accordance with the criteria set forth in the PJM manuals and will remain in effect for the duration of the commitment to provide Black Start Service.

- a. A Black Start Unit must be able to close its output circuit breaker to a dead (de-energized) bus within the time specified in the PJM Manuals.
- b. A Black Start Unit must be capable of maintaining frequency and voltage under varying load.
- c. A Black Start Unit must be able to maintain rated output for a period of time identified by each Transmission Owner's system restoration requirements, in conjunction with the Transmission Provider.

8. Each owner of Black Start Units or Black Start Plants must maintain procedures for the start-up of the Black Start Units.

9. If a Black Start Unit is a generating unit with a high operating factor (subject to Transmission Provider concurrence) with the ability to automatically remain operating at reduced levels when disconnected from the grid, this ability must be demonstrated in accordance with the criteria set forth in the PJM manuals.

10. No more than one Black Start Unit at a Black Start Plant may be subject to a Generator Planned Outage or Generator Maintenance Outage at any one time without written approval of the Transmission Provider and the Transmission Owner in the Zone receiving Black Start Service from the Black Start Plant. This restriction excludes outages on common plant equipment that may make all units unavailable. A Black Start Unit not selected for providing Black Start Service in accordance with this Schedule 6A, section 4 and the PJM Manuals may be substituted for a Black Start Unit that is subject to a Generator Planned Outage to permit a concurrent planned outage of another critical Black Start Unit at the same Black Start Plant. The Black Start Unit used as a substitute shall not receive compensation for additional capital expenditures to qualify for Black Start Service, will not increase the current Black Start Unit capital recovery commitment period, must be connected at the same voltage level and cranking path, must be similar age as the current Black Start Unit, must provide equivalent Black Start

Unit Capacity, and must have had a valid annual test within the previous 13 months. Black Start Unit substitutions may be permitted for reasons other than Generator Planned Outages if requested by the Black Start Unit owner and if approved by the Transmission Provider; provided, however, all requests for Black Start Unit substitutions must be supported by documentation and information demonstrating operational or technical reasons for the substitution satisfactory to the Transmission Provider and may only occur once within a 12-month period.

11. Concurrent planned outages at multiple Black Start Plants within a zone may be restricted based on Transmission Owner requirements for Black Start Service availability. Such restrictions must be predefined and approved by Transmission Provider in accordance with the PJM manuals.

Testing

12. To verify that they can be started and operated without being connected to the Transmission System, Black Start Units shall be tested annually in accordance with the Tariff and the PJM Manuals. The Black Start Unit owner shall determine the time of the annual test.

13. Compensation under this Schedule 6A for energy output delivered to the Transmission System during the annual test shall be provided for the Black Start Unit's minimum run time at the higher of the unit's cost-capped offer or real-time Locational Marginal Price plus start-up and no-load costs for up to two start attempts, if necessary. For Black Start Units that are generating units with a high operating factor (subject to Transmission Provider's concurrence) with the ability to automatically remain operating at reduced levels when disconnected from the grid, an opportunity cost will be provided to compensate the unit for lost revenues during testing.

14. All Black Start Units must have a successful annual test on record with the Transmission Provider within the preceding 13 months. A Black Start Unit receiving revenues under Section 5 or Section 6 above that does not have a successful annual test on record with the Transmission Provider within the preceding 13 months will not qualify to receive Black Start Service revenues.

15. If a Black Start Unit fails the annual test, the unit may be re-tested within a ten-day period without financial penalty. If the Black Start Unit does not successfully re-test within that ten-day period, monthly Black Start Service revenues under this Schedule 6A will be forfeited by that unit from the time of the first unsuccessful test until such time as the unit passes an annual test. If the Black Start Unit owner does not make the necessary repairs to enable the Black Start Unit to pass the annual test within 90 days of the due date for the annual test pursuant to section 14 above, the Black Start Unit will immediately cease to qualify as a Black Start Unit and, if applicable, will have failed to fulfill its commitment pursuant to section 5 or section 6 above, whichever is applicable, of this Schedule 6A and will be subject to the additional forfeiture of revenues set forth in section 6B of this Schedule 6A. The 90 day period may be extended up to 1 year by the Transmission Provider in accordance with the PJM Manuals. If the 90 day period is extended, the Black Start Unit owner will continue to forfeit all revenues starting in the month of the first failed test until the Black Start Unit has demonstrated to the Transmission Provider that a successful test has been completed.

Revenue Requirements

16. A Black Start Unit Owner's annual Black Start Service revenue requirement shall be the sum of the annual Black Start Service revenue requirements for each generator that is designated as providing Black Start Service and has provided the Transmission Provider with a calculation of its annual Black Start Service revenue requirements. A separate line item shall appear on the participants' Transmission Provider bill for Black Start Service charges and credits.

17. Black Start Service revenue requirements for each Black Start Unit shall be based, at the election of the owner, on either (i) a FERC-approved rate for the recovery of the cost of providing such service for the entire duration of the commitment term set forth in either section 5 or 6 of this Schedule 6A, as applicable, or (ii) the formula rates set forth in section 18 of this Schedule 6A for the commitment term set forth in section 5 or 6 of this Schedule 6A as applicable. Each generator's Black Start Service revenue requirements shall be an annual calculation.

17A. Annual Review for all Black Start Units

Requests for Black Start Service revenue requirements and for changes to the Black Start Service revenue requirements must be submitted to the Market Monitoring Unit for review and analysis, with supporting data and documentation, pursuant to Tariff, Attachment M–Appendix, section III and the PJM Manuals, with a copy to the Office of the Interconnection, by no later than May 3 of each year. The Market Monitoring Unit and the Black Start Unit owner shall attempt to come to agreement on the level of each component included in the Black Start Service revenue requirements by no later than May 14 of each year. By no later than May 21 of each year, the Black Start Unit owner shall notify the Office of the Interconnection and the Market Monitoring Unit in writing whether it agrees or disagrees with the Market Monitoring Unit's determination of the level of each component included in the Black Start Service revenue requirements. The Black Start Unit owner may also submit Black Start Service revenue requirements that it chooses to the Office of the Interconnection by no later than May 21 of each year, provided that (i) it has participated in good faith with the process described in this section and in Tariff, Attachment M–Appendix, section III (ii) the Black Start Service revenue requirements are no higher than the level defined in any agreement reached by the Black Start Unit owner and the Market Monitoring Unit that resulted from the foregoing process, and (iii) the Black Start Service revenue requirements are accepted by the Office of the Interconnection subject to the criteria set forth in the Tariff and PJM Manuals.

The Office of the Interconnection shall determine whether to accept the values submitted by the Black Start Unit owner subject to the requirements of the Tariff and the PJM Manuals by no later than May 27. If the Office of the Interconnection does not accept the values submitted by the Black Start Unit owner in such case, the Black Start Unit owner may file its proposed values with the Commission for approval. Pursuant to Tariff, Attachment M–Appendix, section III, if the Office of the Interconnection accepts the Black Start Service revenue requirements submitted by the Black Start Unit owner in such case, the Market Monitoring Unit may petition the Commission for an order that would require the Black Start Unit owner to utilize the values determined by the Market Monitoring Unit or the Office of the Interconnection or such other

values as determined by the Commission. The annual calculation of Black Start Service revenue requirements shall become effective on June 1 of each year, except that no change to a Black Start Service revenue requirement shall become effective until the existing revenue requirement has been effective for at least twelve months. Notwithstanding the foregoing, the deadlines set forth in this section 17 shall not apply to a Black Start Unit owner's election to select a new method of recovery for its Fixed BSSC.

17B. Initial Review for New Black Start Units

Requests for new Black Start Service revenue requirements must be submitted to the Market Monitoring Unit for review and analysis, with supporting data and documentation, pursuant to Tariff, Attachment M–Appendix, section III and the PJM Manuals, with a copy to the Office of the Interconnection, by no later than 90 days after entering Black Start Service. The Market Monitoring Unit and the Black Start Unit owner shall attempt to come to agreement on the level of each component included in the Black Start Service revenue requirements by no later than 90 days after the Black Start Unit owner's submittal of final black start capital costs (if applicable), variable black start costs, and fuel storage cost documentation. By no later than 90 days of the Black Start Unit owner's submittal of final black start cost documentation, the Market Monitoring Unit shall calculate the new Black Start Unit's annual revenue requirement and submit it to the Office of the Interconnection and the Black Start Unit owner. If more than three Black Start Unit owners submit documentation within a 90-day period, the Market Monitoring Unit shall complete the review of the first three submittals within 90 days and the next set of three within the following three months and so on until all are complete. The Black Start Unit owner shall notify the Office of the Interconnection and the Market Monitoring Unit in writing if it disagrees with the Market Monitoring Unit's determination of the level of any component included in the Black Start Service revenue requirements within 7 days after the Market Monitoring Unit's submittal of the annual revenue requirement to the Office of the Interconnection. The Black Start Unit owner shall also submit Black Start Service revenue requirements that it proposes to the Office of the Interconnection provided that (i) it has participated in good faith with the process described in this section and in Tariff, Attachment M–Appendix, section III; (ii) the Black Start Service revenue requirements are no higher than the level defined in any agreement reached by the Black Start Unit owner and the Market Monitoring Unit that resulted from the foregoing process; and (iii) the Black Start Service revenue requirements are accepted by the Office of the Interconnection subject to the criteria set forth in the Tariff and PJM Manuals.

The Office of the Interconnection shall determine whether to accept the values submitted by the Black Start Unit owner subject to the requirements of the Tariff and the PJM Manuals by no later than 30 days after its receipt of the Black Start Unit owner's written notice of a disagreement. If the Office of the Interconnection does not accept the values submitted by the Black Start Unit owner in such case, the Black Start Unit owner may file its proposed values with the Commission for approval. Pursuant to Tariff, Attachment M–Appendix, section III, if the Office of the Interconnection accepts the Black Start Service revenue requirements submitted by the Black Start Unit owner in such case, the Market Monitoring Unit may petition the Commission for an order that would require the Black Start Unit owner to utilize the values determined by the Market Monitoring Unit or the Office of the Interconnection or such other values as determined

by the Commission. The annual calculation of Black Start Service revenue requirements shall become effective the day the unit enters Black Start Service.

18. The formula for calculating a generator's annual Black Start Service revenue requirement is:

$$\{(\text{Fixed BSSC}) + (\text{Variable BSSC}) + (\text{Training Costs}) + (\text{Fuel Storage Costs})\} * (1 + Z)$$

For units that have the demonstrated ability to operate at reduced levels when automatically disconnected from the grid, the formula is revised to:

$$(\text{Training Costs}) * (1 + Z)$$

Where:

Fixed BSSC

Black Start Units with a commitment established under section 5 of this Schedule 6A shall calculate Fixed BSSC or "Fixed Black Start Service Costs" in accordance with the following Base Formula Rate:

Base Formula Rate:

$$\text{Net CONE} * \text{Black Start Unit Capacity} * X$$

Where:

"Net CONE" is the then current installed capacity ("ICAP") net Cost of New Entry (expressed in \$/MW year) for the CONE Area where the Black Start Unit is located.

"Black Start Unit Capacity" is either: (i) the Black Start Unit's installed capacity, expressed in MW, for those Black Start Units that are Generation Capacity Resources; or (ii) the awarded MWs in the Transmission Provider's request for proposal process under the PJM Manuals, for those Black Start Units that are Energy Resources.

"X" is the Black Start Service allocation factor unless a higher or lower value is supported by the documentation of the actual costs of providing Black Start Service. For such units qualifying as Black Start Units on the basis of demonstrated ability to operate at reduced levels when automatically disconnected from the grid, X shall be zero. For Black Start Units with a commitment established under section 5 of this Schedule 6A, X shall be .01 for Hydro units, .02 for CT units.

Black Start Units with a commitment established under section 6 above shall calculate Fixed BSSC or “Fixed Black Start Service Costs” in accordance with one of the following formulas, as applicable:

Capital Cost Recovery Rate – NERC-CIP Specific Recovery

$$(\text{Net Cone} * \text{Black Start NERC-CIP Unit Capacity} * X) + (\text{Incremental Black Start NERC-CIP Capital Costs} * \text{CRF})$$

Where:

“Net Cone” is the then current installed capacity (“ICAP”) net Cost of New Entry (expressed in \$/MW year) for the CONE area where the Black Start Unit is located.

“Black Start NERC-CIP Unit Capacity” is the Black Start Unit’s installed capacity, expressed in MW, but, for purposes of this calculation, capped at 100 MW for Hydro units, or 50 MW for CT units.

“Incremental Black Start NERC-CIP Capital Cost” are those capital costs documented by the owner or accepted by the Commission for the incremental equipment solely necessary to enable a Black Start Unit to maintain compliance with mandatory Critical Infrastructure Protection Reliability Standards (as approved by the Commission and administered by the applicable Electric Reliability Organization).

“CRF” or “Capital Recovery Factor” is equal to the levelized CRF as set forth in the applicable CRF table posted on the PJM website in accordance with Tariff, Schedule 6A, section 18 and Manual 15.

A Black Start Unit may elect to terminate forward cost recovery under this Capital Cost Recovery Rate – NERC-CIP Specific Recovery at any time and seek cost recovery under the Capital Cost Recovery Rate, pursuant to the terms and conditions set forth below.

Capital Cost Recovery Rate

$$(\text{FERC-approved rate}) + (\text{Incremental Black Start Capital Costs} * \text{CRF})$$

Where:

“FERC-approved rate” is the Black Start Unit’s current FERC-approved recovery of costs to provide Black Start Service, if applicable. To the extent that a Black Start Unit owner is currently recovering black start costs pursuant to a FERC-approved rate, that cost recovery will be included as a formulaic component for calculating the Black Start Unit’s annual revenue requirement pursuant to this section 18. However, under no

circumstances will PJM or the Black Start Unit owner restructure or modify that existing FERC-approved rate without FERC approval.

“Incremental Black Start Capital Costs” are the new or additional capital costs documented by the owner or accepted by the Commission for the incremental equipment solely necessary to enable a unit to provide Black Start Service in addition to whatever other product or services such unit may provide. Such costs shall include those incurred by a Black Start Unit owner in order to meet NERC Reliability Standards that apply to Black Start Units solely on the basis of the provision of Black Start Service by such unit. However, Incremental Black Start Capital Costs shall not include any capital costs that the Black Start Unit owner is recovering for that unit pursuant to a FERC-approved recovery rate.

The Capital Recovery Factor (“CRF”) is equal to the Levelized CRF based on the age of the Black Start Unit, which is modified to provide Black Start Service.

The CRF applicable to Black Start Capital Costs of Black Start Units selected for Black Start Service prior to June 6, 2021, shall continue to be determined in accordance with the following 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

The CRF applicable to Black Start Capital Costs of Black Start Units selected for Black Start Service after June 6, 2021, shall be updated annually on March 1 for (i) federal income tax rates as utilized by the U.S. Internal Revenue Service in effect at the time of the annual CRF update; (ii) average state tax rate; and (iii) debt interest rates and shall be posted on the PJM website by March 31 each year as shown in the table below.

Interested parties shall have until April 15 of each year to contest PJM’s calculation of the annual CRF value before it becomes effective on June 1 of each year.

PJM determines annual CRF inputs	March 1
PJM posts annual CRF	March 31
Deadline for contesting annual CRF	April 15
Annual revenue requirement calculation	May 3 through May 27
Annual revenue requirement with CRF in effect	June 1

The CRF values shall be calculated for a recovery period based on the age of the Black Start Unit using the equation below:

$$CRF = \frac{r(1+r)^N \left[1 - \frac{sB}{\sqrt{1+r}} - s(1-B)\sqrt{1+r} \sum_{j=1}^L \frac{m_j}{(1+r)^j} \right]}{(1-s)\sqrt{1+r}[(1+r)^N - 1]} \dots$$

Where:

Formula Symbol	Description
r	After Tax Weighted Average Cost of Capital (ATWACC), which equals (equity percentage)(cost of equity) + (debt percentage)(debt interest rate)(1 – effective tax rate)
s	Effective Tax Rate, which equals (1 – state tax rate)(federal tax rate) + state tax rate
B	Bonus depreciation percent in effect at the Black Start Unit in-service date
N	Cost recovery period based on the age of the unit in years, as established in the Age of Unit/Applicable Recovery Period table below
L	The lesser of N or 16 years
M_j	Modified Accelerated Cost Recovery System (MACRS) depreciation

The following assumptions are used in the calculation:

The current federal tax and depreciation rates are as established by U.S. Internal Revenue Service;

The state tax rate is an average of the income tax rates for all the states in the PJM Region;

The capital investment necessary to make a unit qualify for Black Start Service is made up of 50 percent equity;

The capital investment necessary to make a unit qualify for Black Start Service is made up of 50 percent debt;

The debt interest rate is based on the most recent Net CONE quadrennial review after-tax weighted average cost of capital (ATWACC) and shall be updated as follows:

The debt interest rate will be updated during the Net CONE quadrennial review; and
If the 2-year change in the Moody Utility Index for bonds rated Baa1 is more than 200 basis points, this change will be added to the interest rate used in the most recent Net CONE quadrennial review and will be used as the current year's debt interest rate.

The debt term is equal to the applicable recovery period specified in the Age of Unit/Applicable Recovery Period table below; and

The cost of equity shall be equal to an after tax internal rate of return on equity of 12%.

Any changes to the debt and equity percentages and after tax internal rate of return on equity components stated above shall be included in revisions to this section 18.

Age of the Unit (years)	Applicable Recovery Period (years)
1-5	20
6-10	15
11-15	10
16+	5

In those circumstances where a Black Start Unit owner has elected to recover Incremental Black Start Capital Costs, in addition to a FERC-approved recovery rate, its applicable term of commitment shall be the greater of: (i) the FERC-approved recovery period, or; (ii) the applicable term of commitment as set forth in the Age of Unit/Applicable Recovery Period table above.

After a Black Start Unit has recovered its allowable Incremental Black Start Capital Costs or Incremental Black Start NERC-CIP Capital Costs, as provided by the applicable Capital Cost Recovery Rate, and has satisfied its applicable commitment period required under section 6 of this Schedule 6A, the Black Start Unit shall be committed to providing black start in accordance with section 5 of this Schedule 6A and calculate its Fixed BSSC in accordance with the Base Formula Rate.

Variable BSSC

All Black Start Units shall calculate Variable BSSC or "Variable Black Start Service Costs" in accordance with the following formula:

$$\text{Black Start Unit O\&M} * Y$$

Where:

"Black Start Unit O&M" are the operations and maintenance costs attributable to supporting Black Start Service and must equal the annual variable O&M outlined in the PJM Cost Development Guidelines set forth in the PJM Manuals. Such costs shall include those incurred by a Black Start Owner in order to meet NERC Reliability

Standards that apply to the Black Start Unit solely on the basis of the provision of Black Start Service by unit.

“Y” is 0.01, unless a higher or lower value is supported by the documentation of costs. If a value of Y is submitted for this cost, a (1-Y) factor must be applied to the Black Start Unit’s O&M costs on the unit’s cost-based energy schedule, calculated based on the Cost Development Guidelines in the PJM Manuals.

For units qualifying as Black Start Units on the basis of a demonstrated ability to operate at reduced levels when automatically disconnected from the grid, there are no variable costs associated with providing Black Start Service and the value for Variable BSSC shall be zero.

Black Start Units with the demonstrated ability to automatically remain operating, at reduced levels, when disconnected from the grid may receive NERC compliance costs associated with providing Black Start Service in addition to the formula above, if approved in accordance with the procedures in section 17 of this Schedule 6A.

Training Costs:

All Black Start Units shall calculate Training Costs in accordance with the following formula:

50 staff hours/year/plant*75/hour

Fuel Storage Costs:

Black Start Units that store liquefied natural gas, propane, or oil on site shall calculate Fuel Storage Costs in accordance with the following formula:

$$\{MTSL + [(\# \text{ Run Hours}) * (\text{Fuel Burn Rate})]\} * \\ (12 \text{ Month Forward Strip} + \text{Basis}) * (\text{Bond Rate})$$

Where:

Run Hours are the actual number of hours a Transmission Provider requires a Black Start Unit to run. Run Hours shall be at least 16 hours or as defined by the Transmission Owner restoration plan, whichever is less.

“Fuel Burn Rate” is actual fuel burn rate for the Black Start Unit.

“12-Month Forward Strip” is the average of forward prices for the fuel burned in the Black Start Unit traded the first Business Day on or following April 1.

“Basis” is the transportation costs from the location referenced in the forward price data to the Black Start Unit plus any variable taxes.

“Bond rate” is the value determined with reference to the Moody's Utility Index for bonds rated Baa1 reported the first Business Day on or following April 1.

“MTSL” is the “minimum tank suction level” and shall apply to oil fired Black Start Units’ storage tanks that have an unusable volume of oil. In the case where a Black Start Unit shares a common fuel tank, the Black Start Unit will be eligible for recovery of the Black Start Energy Tank Ratio of the MTSL in its fuel storage calculation.

Black Start Energy Tank Ratio = $\{(Fuel\ Burn\ Rate * Minimum\ Run\ Hours) / (Tank\ Capacity - MTSL)\}$

The MTSL fuel storage calculation shall be as follows:

$\{(Black\ Start\ Energy\ Tank\ Ratio * MTSL) + [(Run\ Hours) * (Fuel\ Burn\ Rate)]\}$
 $* (12\ Month\ Forward\ Strip + Basis) * (Bond\ Rate)$

For units qualifying as Black Start Units on the basis of a demonstrated ability to operate at reduced levels when automatically disconnected from the grid, there are no associated fuel storage costs and the value for FSC shall be zero.

Z

Z shall be an incentive factor solely for Black Start Units with a commitment established under section 5 above and shall be ten percent. For those Black Start Units that elect to recover new or additional Black Start Capital Costs under section 6 above, the incentive factor, Z, shall be equal to zero.

Every five years, PJM shall review the formula and its costs components set forth in this section 18, and report on the results of that review to stakeholders.

19. Transmission Provider or its agent shall have the right to independently audit the accounts and records of each Black Start Unit that is receiving payments for providing Black Start Service.
20. PJM shall notify its Members when a Black Start Unit seeks to recover new or additional Black Start NERC-CIP Capital Costs under section 18 of this Schedule 6A no later than thirty (30) days prior to the effective date of the recovery. At the written request of a PJM Member, made simultaneously to the Market Monitoring Unit and PJM, with notice to the Black Start Unit owner, the Market Monitoring Unit shall make available to the affected PJM Member for inspection at the offices of the Market Monitoring Unit, all data supporting the requested new or additional NERC-CIP specific Capital Costs. The Black Start Unit owner may elect to attend this review. In all cases, the supporting data is to be held confidential and may not be distributed.
21. The Market Monitoring Unit shall include a Black Start Service summary in its annual State of the Market report which will set forth a descriptive summary of the new or additional

Black Start NERC-CIP Capital Costs requested by Black Start Units, and include a list of the types of capital costs requested and the overall cost of such capital improvements on an aggregate basis such that no data is attributable to an individual Black Start Unit.

Credits

22. For existing Black Start Units, monthly credits are provided to Black Start Unit owners that submit to the Transmission Provider their annual revenue requirements established pursuant to section 17A of this Schedule 6A. The generator's monthly credit is equal to 1/12 of its annual Black Start Service revenue requirement for eligible critical Black Start Units. For new Black Start Unit owners, monthly credits will be held by the Office of the Interconnection in a non-interest bearing account until the Office of the Interconnection, or the Commission as applicable, accepts the owner's annual revenue requirement pursuant to section 17B of this Schedule 6A. New Black Start Unit owners will begin to receive monthly credits, including any monthly credits held by the Office of the Interconnection back to the date the unit enters Black Start Service and any required estimated annual revenue requirement true up after the Office of the Interconnection, or the Commission as applicable, accepts the new Black Start Unit owner's annual revenue requirement.

23. Revenue requirements for jointly owned Black Start Units will be allocated to the owners based on ownership percentage.

24. Transmission Provider shall not compensate generators for Black Start Service unless they meet the Transmission Provider criteria for Black Start Service and the criteria for Black Start Service in the Applicable Standards and provide Transmission Provider with all necessary data in accordance with this Schedule 6A and the PJM manuals.

Charges

25. Zonal rates will be based on Black Start Service capability or share of generation units designated by the Transmission Provider and allocated to network service customers and point-to-point reservations. Zonal rates will include estimated annual revenue requirements for new Black Start Units from the date the units enter Black Start Service to last day of the month preceding the Office of the Interconnection's acceptance of the unit's annual revenue requirement. The estimated annual revenue requirement will be based on the Black Start Unit owner's best estimate at the time the unit enters Black Start Service. Any estimated annual revenue requirement true up will be included in the monthly bill after the Office of the Interconnection accepts the new Black Start unit's annual revenue requirement.

26. Revenue requirements for Black Start Units designated by the Transmission Provider as critical (regardless of zonal location) will be allocated to the receiving Transmission Owner's zone. Black Start Units that are shared and designated to serve multiple zones will have their annual revenues allocated by Transmission Owner designated critical load percentage.

27. Purchasers of Black Start Service shall be charged for such service in accordance with the following formulae.

Monthly Charge for a purchaser receiving Network Integration Transmission Service or Point-to-Point Transmission Service to serve Non-Zone Load = Allocation Factor * Total Generation Owner Monthly Black Start Service Revenue Requirement

Monthly Charge for a purchaser receiving Network Integration Transmission Service or Point-to-Point Transmission Service to serve Zone Load = Allocation Factor * Zonal Generation Owner Monthly Black Start Service Revenue Requirement * Adjustment Factor

Where:

Purchaser serving Non-Zone Load is a Network Customer serving Non-Zone Network Load or a Transmission Customer where the Point of Delivery is at the boundary of the PJM Region.

Zonal Generation Owner Monthly Black Start Service Revenue Requirement is the sum of the monthly share of Black Start Service revenue requirements for each generator nominated by the Transmission Owners in that zone.

Total Generation Owner Monthly Black Start Service Revenue Requirement is the sum of the Zonal Generation Owner Monthly Black Start Service Revenue Requirements for all Zones in the PJM Region.

Allocation Factor is the monthly transmission use of each Network Customer or Transmission Customer per Zone or Non-Zone, as applicable, on a megawatt basis divided by the total transmission use in the Zone or in the PJM Region, as applicable, on a megawatt basis.

For Network Customers, monthly transmission use on a megawatt basis is the sum of a Network Customer's daily values of DCPZ or DCPNZ (as those terms are defined in Tariff, Part I, section 34.1) as applicable, for all days of the month.

For Transmission Customers, monthly transmission use on a megawatt basis is the sum of the Transmission Customer's hourly amounts of Reserved Capacity for each day of the month (not curtailed by PJM) divided by the number of hours in the day.

Adjustment Factor is determined as the sum of the total monthly transmission use in the PJM Region on a megawatt basis, exclusive of such use by Network Customers and Transmission Customers serving Non-Zone Load, divided by the total monthly transmission use in the PJM Region on a megawatt basis.

In the event that a single customer is serving load in more than one Zone, or serving Non-Zone Load as well as load in one or more Zones, or is both a Network Customer and a Transmission Customer, the Monthly Charge for such a customer shall be the sum of the Monthly Charges determined by applying the appropriate formulae set forth in this Schedule 6A.

Attachment F

Revisions to the PJM Open Access Transmission Tariff

(Clean Format)
Effective July 11, 2023

SCHEDULE 6A

Black Start Service

References to section numbers in this Schedule 6A refer to sections of this Schedule 6A, unless otherwise specified.

To ensure the reliable restoration following a shut down of the PJM transmission system, Black Start Service is necessary to facilitate the goal of complete system restoration. Black Start Service enables the Transmission Provider to designate specific generators called Black Start Units whose location and capabilities are required to re-energize the transmission system following a system-wide blackout. The Transmission Provider shall administer the provision of Black Start Service. PJMSettlement shall be the Counterparty to the purchases and sales of Black Start Service.

TRANSMISSION CUSTOMERS

1. All Transmission Customers and Network Customers must obtain Black Start Service through the Transmission Provider, with PJMSettlement as the Counterparty, pursuant to this Schedule 6A.

PROVISION OF BLACK START SERVICE

2. A Black Start Unit is a generating unit that has equipment enabling it to start without an outside electrical supply or a generating unit with a high operating factor (subject to Transmission Provider concurrence) with the demonstrated ability to automatically remain operating, at reduced levels, when disconnected from the grid. A Black Start Unit shall be considered capable of providing Black Start Service only when it meets the criteria set forth in the PJM manuals. The expected life of the Black Start Unit shall take into consideration expectations regarding both the enabling equipment and the generation unit itself.

A Fuel Assured Black Start Unit is a Black Start Unit that is capable of starting without an outside electrical supply and running 16 hours or more at full load and either stores at least 16 hours of fuel on site, can operate independently on 2 or more interstate pipelines, is directly connected to a natural gas gathering system or is an intermittent or hybrid resource that has been evaluated by the Transmission Provider to be capable of providing 16 hours of full load operation with 90% confidence and meets any other requirements specified in the PJM manuals. Unless otherwise specified as only applicable to Fuel Assured Black Start Units, all terms and conditions set forth in this Tariff, Schedule 6A applicable to Black Start Units shall be deemed to include Fuel Assured Black Start Units.

3. A Black Start Plant is a generating plant that includes one or more Black Start Units. A generating plant with Black Start Units electrically separated at different voltage levels will be considered multiple Black Start Plants.

4. The Transmission Provider is responsible for developing a coordinated and efficient system restoration plan that identifies all of the locations where Black Start Units are needed. The PJM Manuals shall set forth the criteria and process for selecting or identifying the Black

Start Units necessary to commit to providing Black Start Service at the identified locations. No Black Start Unit shall be eligible to recover the costs of providing Black Start Service in the PJM Region unless it agrees to provide such service for a term of commitment established under section 5, 6, or 6A below.

5. Owners of Black Start Units selected to provide Black Start Service in accordance with Schedule 6A, section 4 and electing to forego any recovery of new or additional Black Start Capital Costs shall commit to provide Black Start Service from such Black Start Units for an initial term of no less than two years and authorize the Transmission Provider to resell Black Start Service from its Black Start Units. The term commitment shall continue to extend until the Black Start Unit owner or the Transmission Provider provides written, one-year advance notice of its intention to terminate the commitment or the commitment is involuntarily terminated pursuant to section 15 of this Schedule 6A. Black Start Units that are selected to provide Black Start Service after June 6, 2021, pursuant to Schedule 6A, section 6 that subsequently transition from the Capital Cost Recovery Rate to the Base Formula Rate shall have a lifetime commitment and can only terminate for the reason specified in Schedule 6A, section 6(ii).

6. (i) Owners of Black Start Units selected to provide Black Start Service prior to June 6, 2021, in accordance with section 4 of this Schedule 6A and electing to recover new or additional Black Start Capital Costs shall commit to provide Black Start Service from such Black Start Units for a term based upon the age of the Black Start Unit or the longest expected life of the Incremental Black Start Capital Cost, as set forth in the applicable CRF Table in section 18 of this Schedule 6A. For those Black Start Units that elect to recover new or additional Black Start Capital Costs in addition to a prior, FERC-approved cost recovery rate, the applicable commitment period shall be the longer of the FERC-approved recovery period or the applicable term of commitment as set forth in the CRF Table in section 18 of this Schedule 6A. The Transmission Provider may terminate the commitment with one year advance notice of its intention to the Black Start Unit owner, but the Black Start Unit owner shall be eligible to recover any amount of unrecovered Fixed Black Start Service Costs over a period not to exceed five years. A Black Start Unit owner may terminate the provision of Black Start Service with one year advance notice and consent of the Transmission Provider (or its commitment period may be involuntarily terminated pursuant to the section 15 below). Such Black Start Unit shall forego any otherwise existing entitlement to future revenues collected pursuant to this Schedule 6A and fully refund any amount of the Black Start Capital Costs recovered under a FERC-approved rate (recovered on an accelerated basis pursuant to the provisions of section 17(i) of this Schedule 6A) in excess of the amount that would have been recovered pursuant to section 18 of this Schedule 6A during the same period. At the conclusion of the term of commitment established under this section 6 of this Schedule 6A, a Black Start Unit shall commence a new term of commitment under either section 5 or 6 of this Schedule 6A, as applicable.

(ii) Owners of Black Start Units selected to provide Black Start Service after June 6, 2021, in accordance with Schedule 6A, section 4 and electing to recover new or additional Black Start Capital Costs shall commit to provide Black Start Service from such Black Start Units for an initial capital recovery period based upon the age of the Black Start Unit plus the remaining life of the Black Start equipment. For those Black Start Units that elect to recover new or additional Black Start Capital Costs in addition to a prior, FERC-approved cost recovery rate, the

applicable commitment period shall be the longer of the FERC-approved recovery period or the initial capital recovery period based upon the age of the Black Start Unit plus the remaining life of the Black Start equipment.

(iii) Black Start Units selected to be Fuel Assured Black Start Units in accordance with Schedule 6A, section 4 and electing to recover new or additional Fuel Assurance Capital Costs or new and additional Fuel Assurance Costs and Black Start Capital Costs shall commit to provide Black Start Service from such Black Start Units for an initial capital recovery period based upon the age of the Black Start Unit plus the remaining life of the Black Start equipment. For those Fuel Assured Black Start Units that elect to recover new or additional Black Start Capital Costs in addition to a prior, FERC-approved cost recovery rate, the applicable commitment period shall be the longer of the FERC-approved recovery period or the initial capital recovery period based upon the age of the Black Start Unit plus the remaining life of the Black Start equipment. For those Fuel Assured Black Start Units that elect to recover new or additional Fuel Assurance Capital Costs, the applicable capital recovery period shall be the fuel assurance capital recovery period based upon the age of the Fuel Assured Black Start Unit .

The Transmission Provider may terminate the commitment with one year advance notice of its intention to the Black Start Unit owner, but the Black Start Unit owner shall be eligible to recover any amount of unrecovered Fixed Black Start Service Costs including any amount of unrecovered Fuel Assurance Capital Costs over a period not to exceed five years. A Black Start Unit owner may terminate the provision of Black Start Service with one year advance notice and consent of the Transmission Provider (or its commitment period may be involuntarily terminated pursuant to the section 15 below), provided the Black Start Unit's owner demonstrates to the satisfaction of the Transmission Provider at least one of the following reasons for such termination apply:

- a. Black Start Unit retirement or deactivation with at least one year's notice;
- b. Expiration of a state, federal, or other governmental agency permit(s) required for Black Start Service with at least one year's notice; or
- c. Additional capital is required by the Black Start Unit owner to maintain Black Start Service capability (in which case, the Black Start Unit will apply for Black Start Service selection in accordance with the procedures set forth in Manual 12 and only continue to provide Black Start Service if selected for Black Start Service by the Transmission Provider).

Such Black Start Unit shall forego any otherwise existing entitlement to future revenues collected pursuant to this Schedule 6A and fully refund any amount of the Black Start Capital Costs and/or Fuel Assurance Capital Costs recovered under a FERC-approved rate (recovered on an accelerated basis pursuant to the provisions of section 17(i) of this Schedule 6A) in excess of the amount that would have been recovered pursuant to Schedule 6A, section 18 during the same period.

6A. Black Start Units which are owned or contracted for by a Transmission Owner to provide Black Start Service as a result of the black start reliability backstop process defined in the PJM Manuals, shall be subject to cost recovery through such Transmission Owner's annual revenue requirement under such Transmission Owner's Tariff, Attachment H, as filed with, and accepted by, FERC under Section 205 of the Federal Power Act and in accordance with Tariff, Part I, section 9, or through such other cost recovery mechanism, provided that such cost recovery mechanism is filed with and accepted by FERC. The relevant Transmission Owner shall commit to provide, or effectuate the provision of, Black Start Service from such a Black Start Unit for the FERC-approved cost recovery period. The Transmission Provider may terminate the commitment with one year advance notice of its intention to the Transmission Owner. Provision of Black Start Service from a Black Start Unit obtained through the black start reliability backstop process defined in the PJM Manuals shall be subject to sections 7 through 13 of this Schedule 6A. The Revenue Requirements, Credits, and Charges provisions contained in sections 16 through 27 of this Schedule 6A, shall not apply to Black Start Units obtained as a result of the black start reliability backstop process defined in the PJM Manuals.

6B. In the event that a Black Start Unit fails to fulfill its commitment established under section 5 to provide Black Start Service, receipt of any Black Start Service revenues associated with the non-performing Black Start Unit shall cease and, for the period of the unit's non-performance, the Black Start Unit owner shall forfeit the Black Start Service revenues associated with the non-performing Black Start Unit that it received or would have received had the Black Start Unit performed, not to exceed revenues for a maximum of one year.

In the event that a Black Start Unit fails to fulfill its commitment established under section 6 above, such unit shall forego any otherwise existing entitlement to future revenues collected pursuant to this Schedule 6A and fully refund any amount of the Black Start Capital Costs recovered under a FERC-approved rate (recovered on an accelerated basis pursuant to the provisions of section 17(i) of this Schedule 6A) in excess of the amount that would have been recovered pursuant to section 18 of this Schedule 6A during the same period, but such unit remains eligible to establish a new commitment under section 5 or 6 of this Schedule 6A. Provided, however, Black Start Units that are selected to provide Black Start Service after June 6, 2021, pursuant to Schedule 6A, section 6 that subsequently transition from the Capital Cost Recovery Rate to the Base Formula Rate shall have a lifetime commitment and can only terminate for a reason specified in Schedule 6A, section 6(ii).

Performance Standards and Outage Restrictions

7. In addition to the performance capabilities set forth in the PJM Manuals, Black Start Units must have the capabilities listed below. These capabilities must be demonstrated in accordance with the criteria set forth in the PJM manuals and will remain in effect for the duration of the commitment to provide Black Start Service.

- a. A Black Start Unit must be able to close its output circuit breaker to a dead (de-energized) bus within the time specified in the PJM Manuals.

- b. A Black Start Unit must be capable of maintaining frequency and voltage under varying load.
 - c. A Black Start Unit must be able to maintain rated output for a period of time identified by each Transmission Owner's system restoration requirements, in conjunction with the Transmission Provider.
 - d. A Fuel Assured Black Start Unit must meet the fuel assurance requirements as specified in the PJM Manuals.
8. Each owner of Black Start Units or Black Start Plants must maintain procedures for the start-up of the Black Start Units.
9. If a Black Start Unit is a generating unit with a high operating factor (subject to Transmission Provider concurrence) with the ability to automatically remain operating at reduced levels when disconnected from the grid, this ability must be demonstrated in accordance with the criteria set forth in the PJM manuals.
10. No more than one Black Start Unit at a Black Start Plant may be subject to a Generator Planned Outage or Generator Maintenance Outage at any one time without written approval of the Transmission Provider and the Transmission Owner in the Zone receiving Black Start Service from the Black Start Plant. This restriction excludes outages on common plant equipment that may make all units unavailable. A Black Start Unit not selected for providing Black Start Service in accordance with this Schedule 6A, section 4 and the PJM Manuals may be substituted for a Black Start Unit that is subject to a Generator Planned Outage to permit a concurrent planned outage of another critical Black Start Unit at the same Black Start Plant. The Black Start Unit used as a substitute shall not receive compensation for additional capital expenditures to qualify for Black Start Service, will not increase the current Black Start Unit capital recovery commitment period, must be connected at the same voltage level and cranking path, must be similar age as the current Black Start Unit, must provide equivalent Black Start Unit Capacity, and must have had a valid annual test within the previous 13 months. Black Start Unit substitutions may be permitted for reasons other than Generator Planned Outages if requested by the Black Start Unit owner and if approved by the Transmission Provider; provided, however, all requests for Black Start Unit substitutions must be supported by documentation and information demonstrating operational or technical reasons for the substitution satisfactory to the Transmission Provider and may only occur once within a 12-month period.
11. Concurrent planned outages at multiple Black Start Plants within a zone may be restricted based on Transmission Owner requirements for Black Start Service availability. Such restrictions must be predefined and approved by Transmission Provider in accordance with the PJM manuals.

Testing

12. To verify that they can be started and operated without being connected to the Transmission System, Black Start Units shall be tested annually in accordance with the Tariff

and the PJM Manuals. Fuel Assured Black Start Units that are dual fuel must conduct an annual test on both fuels. The Black Start Unit owner shall determine the time of the annual test.

13. Compensation under this Schedule 6A for energy output delivered to the Transmission System during the annual test shall be provided for the Black Start Unit's minimum run time at the higher of the unit's cost-capped offer or real-time Locational Marginal Price plus start-up and no-load costs for up to two start attempts, if necessary. For Black Start Units that are generating units with a high operating factor (subject to Transmission Provider's concurrence) with the ability to automatically remain operating at reduced levels when disconnected from the grid, an opportunity cost will be provided to compensate the unit for lost revenues during testing.

14. All Black Start Units must have a successful annual test on record with the Transmission Provider within the preceding 13 months. A Black Start Unit receiving revenues under Section 5 or Section 6 above that does not have a successful annual test on record with the Transmission Provider within the preceding 13 months will not qualify to receive Black Start Service revenues. A Fuel Assured Black Start Unit that stores fuel on-site and fails in any month to store the fuel and non-fuel consumables needed to meet its fuel assurance run hour requirements except for allowable conditions specified in the PJM Manuals, and except when the Fuel Assured Black Start Unit can also operate independently on 2 or more interstate pipelines, does not qualify to receive Black Start revenues in that month.

15. If a Black Start Unit fails the annual test, the unit may be re-tested within a ten-day period without financial penalty. If the Black Start Unit does not successfully re-test within that ten-day period, monthly Black Start Service revenues under this Schedule 6A will be forfeited by that unit from the time of the first unsuccessful test until such time as the unit passes an annual test. If the Black Start Unit owner does not make the necessary repairs to enable the Black Start Unit to pass the annual test within 90 days of the due date for the annual test pursuant to section 14 above, the Black Start Unit will immediately cease to qualify as a Black Start Unit and, if applicable, will have failed to fulfill its commitment pursuant to section 5 or section 6 above, whichever is applicable, of this Schedule 6A and will be subject to the additional forfeiture of revenues set forth in section 6B of this Schedule 6A. The 90 day period may be extended up to 1 year by the Transmission Provider in accordance with the PJM Manuals. If the 90 day period is extended, the Black Start Unit owner will continue to forfeit all revenues starting in the month of the first failed test until the Black Start Unit has demonstrated to the Transmission Provider that a successful test has been completed.

Revenue Requirements

16. A Black Start Unit Owner's annual Black Start Service revenue requirement shall be the sum of the annual Black Start Service revenue requirements for each generator that is designated as providing Black Start Service and has provided the Transmission Provider with a calculation of its annual Black Start Service revenue requirements. A separate line item shall appear on the participants' Transmission Provider bill for Black Start Service charges and credits.

17. Black Start Service revenue requirements for each Black Start Unit shall be based, at the election of the owner, on either (i) a FERC-approved rate for the recovery of the cost of

providing such service for the entire duration of the commitment term set forth in either section 5 or 6 of this Schedule 6A, as applicable, or (ii) the formula rates set forth in section 18 of this Schedule 6A for the commitment term set forth in section 5 or 6 of this Schedule 6A as applicable. Each generator's Black Start Service revenue requirements shall be an annual calculation.

17A. Annual Review for all Black Start Units

Requests for Black Start Service revenue requirements and for changes to the Black Start Service revenue requirements must be submitted to the Market Monitoring Unit for review and analysis, with supporting data and documentation, pursuant to Tariff, Attachment M–Appendix, section III and the PJM Manuals, with a copy to the Office of the Interconnection, by no later than May 3 of each year. The Market Monitoring Unit and the Black Start Unit owner shall attempt to come to agreement on the level of each component included in the Black Start Service revenue requirements by no later than May 14 of each year. By no later than May 21 of each year, the Black Start Unit owner shall notify the Office of the Interconnection and the Market Monitoring Unit in writing whether it agrees or disagrees with the Market Monitoring Unit's determination of the level of each component included in the Black Start Service revenue requirements. The Black Start Unit owner may also submit Black Start Service revenue requirements that it chooses to the Office of the Interconnection by no later than May 21 of each year, provided that (i) it has participated in good faith with the process described in this section and in Tariff, Attachment M–Appendix, section III (ii) the Black Start Service revenue requirements are no higher than the level defined in any agreement reached by the Black Start Unit owner and the Market Monitoring Unit that resulted from the foregoing process, and (iii) the Black Start Service revenue requirements are accepted by the Office of the Interconnection subject to the criteria set forth in the Tariff and PJM Manuals.

The Office of the Interconnection shall determine whether to accept the values submitted by the Black Start Unit owner subject to the requirements of the Tariff and the PJM Manuals by no later than May 27. If the Office of the Interconnection does not accept the values submitted by the Black Start Unit owner in such case, the Black Start Unit owner may file its proposed values with the Commission for approval. Pursuant to Tariff, Attachment M–Appendix, section III, if the Office of the Interconnection accepts the Black Start Service revenue requirements submitted by the Black Start Unit owner in such case, the Market Monitoring Unit may petition the Commission for an order that would require the Black Start Unit owner to utilize the values determined by the Market Monitoring Unit or the Office of the Interconnection or such other values as determined by the Commission. The annual calculation of Black Start Service revenue requirements shall become effective on June 1 of each year, except that no change to a Black Start Service revenue requirement shall become effective until the existing revenue requirement has been effective for at least twelve months. Notwithstanding the foregoing, the deadlines set forth in this section 17 shall not apply to a Black Start Unit owner's election to select a new method of recovery for its Fixed BSSC.

17B. Initial Review for New Black Start Units or existing Black Starts Units that require Fuel Assured Capital Cost

Requests for new Black Start Service revenue requirements and/or Fuel Assured Capital Costs must be submitted to the Market Monitoring Unit for review and analysis, with supporting data and documentation, pursuant to Tariff, Attachment M–Appendix, section III and the PJM Manuals, with a copy to the Office of the Interconnection, by no later than 90 days after entering Black Start Service or qualifying to be a Fuel Assured Black Start Unit. The Market Monitoring Unit and the Black Start Unit owner shall attempt to come to agreement on the level of each component included in the Black Start Service revenue requirements by no later than 90 days after the Black Start Unit owner’s submittal of final black start capital costs (if applicable), variable black start costs, and fuel storage cost documentation. By no later than 90 days of the Black Start Unit owner’s submittal of final black start cost documentation, the Market Monitoring Unit shall calculate the new Black Start Unit’s annual revenue requirement and submit it to the Office of the Interconnection and the Black Start Unit owner. If more than three Black Start Unit owners submit documentation within a 90-day period, the Market Monitoring Unit shall complete the review of the first three submittals within 90 days and the next set of three within the following three months and so on until all are complete. The Black Start Unit owner shall notify the Office of the Interconnection and the Market Monitoring Unit in writing if it disagrees with the Market Monitoring Unit’s determination of the level of any component included in the Black Start Service revenue requirements within 7 days after the Market Monitoring Unit’s submittal of the annual revenue requirement to the Office of the Interconnection. The Black Start Unit owner shall also submit Black Start Service revenue requirements that it proposes to the Office of the Interconnection provided that (i) it has participated in good faith with the process described in this section and in Tariff, Attachment M–Appendix, section III; (ii) the Black Start Service revenue requirements are no higher than the level defined in any agreement reached by the Black Start Unit owner and the Market Monitoring Unit that resulted from the foregoing process; and (iii) the Black Start Service revenue requirements are accepted by the Office of the Interconnection subject to the criteria set forth in the Tariff and PJM Manuals.

The Office of the Interconnection shall determine whether to accept the values submitted by the Black Start Unit owner subject to the requirements of the Tariff and the PJM Manuals by no later than 30 days after its receipt of the Black Start Unit owner’s written notice of a disagreement. If the Office of the Interconnection does not accept the values submitted by the Black Start Unit owner in such case, the Black Start Unit owner may file its proposed values with the Commission for approval. Pursuant to Tariff, Attachment M–Appendix, section III, if the Office of the Interconnection accepts the Black Start Service revenue requirements submitted by the Black Start Unit owner in such case, the Market Monitoring Unit may petition the Commission for an order that would require the Black Start Unit owner to utilize the values determined by the Market Monitoring Unit or the Office of the Interconnection or such other values as determined by the Commission. The annual calculation of Black Start Service revenue requirements shall become effective the day the unit enters Black Start Service or becomes fuel assured.

18. The formula for calculating a generator’s annual Black Start Service revenue requirement is:

$$\{(Fixed\ BSSC) + (Variable\ BSSC) + (Training\ Costs) + (Fuel\ Storage\ Costs)\} * (1 + Z)$$

For units that have the demonstrated ability to operate at reduced levels when automatically disconnected from the grid, the formula is revised to:

$$(\text{Training Costs}) * (1 + Z)$$

Where:

Fixed BSSC

Black Start Units with a commitment established under section 5 of this Schedule 6A shall calculate Fixed BSSC or “Fixed Black Start Service Costs” in accordance with the following Base Formula Rate:

Base Formula Rate:

$$\text{Net CONE} * \text{Black Start Unit Capacity} * X$$

Where:

“Net CONE” is the then current installed capacity (“ICAP”) net Cost of New Entry (expressed in \$/MW year) for the CONE Area where the Black Start Unit is located.

“Black Start Unit Capacity” is either: (i) the Black Start Unit’s installed capacity, expressed in MW, for those Black Start Units which are not Fuel Assured Black Start Units that are Generation Capacity Resources; (ii) the awarded MWs in the Transmission Provider’s request for proposal process under the PJM Manuals, for those Black Start Units, which are not Fuel Assured Black Start Units, that are Energy Resources; (iii) the Fuel Assured Black Start Unit’s installed capacity for fuel assured non-intermittent Capacity Resources; or (iv) the monthly 90% confidence MW value calculated by the Transmission Provider for fuel assured intermittent or hybrid Capacity Resources. The 90% confidence MW value is calculated using Black Start Unit historical data to determine the hourly MW value the resource can provide each day in each month for 16 hours. The hourly MW value is then iterated until the confidence level of the unit providing the MW value on a monthly basis for 16 hours is 90%.

“X” is the Black Start Service allocation factor unless a higher or lower value is supported by the documentation of the actual costs of providing Black Start Service. For such units qualifying as Black Start Units on the basis of demonstrated ability to operate at reduced levels when automatically disconnected from the grid, X shall be zero. For non-fuel assured Black Start Units with a commitment established under section 5 of this Schedule 6A, X shall be .01 for Hydro units, .02 for CT units. For fuel assured Black Start Units with a

commitment established under section 5 of this Schedule 6A, X shall be .02 for all units.

Black Start Units with a commitment established under section 6 above shall calculate Fixed BSSC or “Fixed Black Start Service Costs” in accordance with one of the following formulas, as applicable:

Capital Cost Recovery Rate – NERC-CIP Specific Recovery

$(\text{Net Cone} * \text{Black Start NERC-CIP Unit Capacity} * X) + (\text{Incremental Black Start NERC-CIP Capital Costs} * \text{CRF}) + (\text{Fuel Assurance Capital Costs} * \text{CRF})$

Where:

“Net Cone” is the then current installed capacity (“ICAP”) net Cost of New Entry (expressed in \$/MW year) for the CONE area where the Black Start Unit is located.

“Black Start NERC-CIP Unit Capacity” is the Black Start Unit’s installed capacity, expressed in MW, but, for purposes of this calculation, capped at 100 MW for Hydro units, or 50 MW for CT units.

“Incremental Black Start NERC-CIP Capital Cost” are those capital costs documented by the owner or accepted by the Commission for the incremental equipment solely necessary to enable a Black Start Unit to maintain compliance with mandatory Critical Infrastructure Protection Reliability Standards (as approved by the Commission and administered by the applicable Electric Reliability Organization).

“Fuel Assurance Capital Costs” are the new or additional capital costs documented by the owner for the installation of equipment necessary for the unit to meet the fuel assurance criteria specified in the PJM manuals.

“CRF” or “Capital Recovery Factor” is equal to the levelized CRF as set forth in the applicable CRF table posted on the PJM website in accordance with Tariff, Schedule 6A, section 18 and Manual 15.

A Black Start Unit may elect to terminate forward cost recovery under this Capital Cost Recovery Rate – NERC-CIP Specific Recovery at any time and seek cost recovery under the Capital Cost Recovery Rate, pursuant to the terms and conditions set forth below.

Capital Cost Recovery Rate

$(\text{FERC-approved rate}) + (\text{Incremental Black Start Capital Costs} * \text{CRF}) + (\text{Fuel Assurance Capital Costs} * \text{CRF})$

Where:

“FERC-approved rate” is the Black Start Unit’s current FERC-approved recovery of costs to provide Black Start Service, if applicable. To the extent that a Black Start Unit owner is currently recovering black start costs pursuant to a FERC-approved rate, that cost recovery will be included as a formulaic component for calculating the Black Start Unit’s annual revenue requirement pursuant to this section 18. However, under no circumstances will PJM or the Black Start Unit owner restructure or modify that existing FERC-approved rate without FERC approval.

“Incremental Black Start Capital Costs” are the new or additional capital costs documented by the owner or accepted by the Commission for the incremental equipment solely necessary to enable a unit to provide Black Start Service in addition to whatever other product or services such unit may provide. Such costs shall include those incurred by a Black Start Unit owner in order to meet NERC Reliability Standards that apply to Black Start Units solely on the basis of the provision of Black Start Service by such unit. However, Incremental Black Start Capital Costs shall not include any capital costs that the Black Start Unit owner is recovering for that unit pursuant to a FERC-approved recovery rate.

“Fuel Assurance Capital Costs” are the new or additional capital costs documented by the owner for the installation of equipment necessary for the unit to meet the fuel assurance criteria specified in the PJM manuals. However, Fuel Assurance Capital Costs shall not include any capital costs that the Fuel Assured Black Start Unit owner is recovering for that unit pursuant to a FERC-approved recovery rate.

The Capital Recovery Factor (“CRF”) is equal to the Levelized CRF based on the age of the Black Start Unit, which is modified to provide Black Start Service.

The CRF applicable to Black Start Capital Costs of Black Start Units selected for Black Start Service prior to June 6, 2021, shall continue to be determined in accordance with the following 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

The CRF applicable to Black Start Capital Costs and/or for Fuel Assurance Capital Costs, of Black Start Units selected for Black Start Service after June 6, 2021, shall be updated annually on March 1 for (i) federal income tax rates as utilized by the U.S. Internal Revenue Service in effect at the time of the annual CRF update; (ii) average state tax rate; and (iii) debt interest rates and shall be posted on the PJM website by March 31 each year

as shown in the table below. Interested parties shall have until April 15 of each year to contest PJM's calculation of the annual CRF value before it becomes effective on June 1 of each year.

PJM determines annual CRF inputs	March 1
PJM posts annual CRF	March 31
Deadline for contesting annual CRF	April 15
Annual revenue requirement calculation	May 3 through May 27
Annual revenue requirement with CRF in effect	June 1

The CRF values shall be calculated for a recovery period based on the age of the Black Start Unit using the equation below:

$$CRF = \frac{r(1+r)^N \left[1 - \frac{sB}{\sqrt{1+r}} - s(1-B)\sqrt{1+r} \sum_{j=1}^L \frac{m_j}{(1+r)^j} \right]}{(1-s)\sqrt{1+r}[(1+r)^N - 1]} \dots$$

Where:

Formula Symbol	Description
r	After Tax Weighted Average Cost of Capital (ATWACC), which equals (equity percentage)(cost of equity) + (debt percentage)(debt interest rate)(1 – effective tax rate)
s	Effective Tax Rate, which equals (1 – state tax rate)(federal tax rate) + state tax rate
B	Bonus depreciation percent in effect at the Black Start Unit in-service date
N	Cost recovery period based on the age of the unit in years, as established in the Age of Unit/Applicable Recovery Period table below
L	The lesser of N or 16 years
M_j	Modified Accelerated Cost Recovery System (MACRS) depreciation

The following assumptions are used in the calculation:

The current federal tax and depreciation rates are as established by U.S. Internal Revenue Service;

The state tax rate is an average of the income tax rates for all the states in the PJM Region;

The capital investment necessary to make a unit qualify for Black Start Service is made up of 50 percent equity;

The capital investment necessary to make a unit qualify for Black Start Service is made up of 50 percent debt;

The debt interest rate is based on the most recent Net CONE quadrennial review after-tax weighted average cost of capital (ATWACC) and shall be updated as follows:

The debt interest rate will be updated during the Net CONE quadrennial review; and

If the 2-year change in the Moody Utility Index for bonds rated Baa1 is more than 200 basis points, this change will be added to the interest rate used in the most recent Net CONE quadrennial review and will be used as the current year's debt interest rate.

The debt term is equal to the applicable recovery period specified in the Age of Unit/Applicable Recovery Period table below; and

The cost of equity shall be equal to an after tax internal rate of return on equity of 12%.

Any changes to the debt and equity percentages and after tax internal rate of return on equity components stated above shall be included in revisions to this section 18.

Age of the Unit (years)	Incremental Black Start Capital Costs Applicable Recovery Period (years)	Fuel Assurance Capital Costs Recovery Period (years)
1-5	20	20
6-10	15	15
11-15	10	10
16+	5	10

In those circumstances where a Black Start Unit owner has elected to recover Incremental Black Start Capital Costs and/or Fuel assurance Capital Costs, in addition to a FERC-approved recovery rate, its applicable term of commitment shall be the greater of: (i) the FERC-approved recovery period, or; (ii) the applicable term of commitment as set forth in the Age of Unit/Applicable Recovery Period table above.

After a Black Start Unit has recovered its allowable Incremental Black Start Capital Costs, Incremental Black Start NERC-CIP Capital Costs, and/or Fuel assurance Capital Costs as provided by the applicable Capital Cost Recovery Rate, and has satisfied its applicable commitment period required under section 6 of this Schedule 6A, the Black Start Unit shall be

committed to providing black start in accordance with section 5 of this Schedule 6A and calculate its Fixed BSSC in accordance with the Base Formula Rate.

Variable BSSC

All Black Start Units shall calculate Variable BSSC or “Variable Black Start Service Costs” in accordance with the following formula:

$$\text{Black Start Unit O\&M} * Y$$

Where:

“Black Start Unit O&M” are the operations and maintenance costs attributable to supporting Black Start Service and must equal the annual variable O&M outlined in the PJM Cost Development Guidelines set forth in the PJM Manuals. Such costs shall include those incurred by a Black Start Owner in order to meet NERC Reliability Standards that apply to the Black Start Unit solely on the basis of the provision of Black Start Service by unit.

“Y” is 0.01, unless a higher or lower value is supported by the documentation of costs. If a value of Y is submitted for this cost, a (1-Y) factor must be applied to the Black Start Unit’s O&M costs on the unit’s cost-based energy schedule, calculated based on the Cost Development Guidelines in the PJM Manuals.

For units qualifying as Black Start Units on the basis of a demonstrated ability to operate at reduced levels when automatically disconnected from the grid, there are no variable costs associated with providing Black Start Service and the value for Variable BSSC shall be zero.

Black Start Units with the demonstrated ability to automatically remain operating, at reduced levels, when disconnected from the grid may receive NERC compliance costs associated with providing Black Start Service in addition to the formula above, if approved in accordance with the procedures in section 17 of this Schedule 6A.

Training Costs:

All Black Start Units shall calculate Training Costs in accordance with the following formula:

$$50 \text{ staff hours/year/plant} * 75/\text{hour}$$

Fuel Storage Costs:

Black Start Units that store liquefied or compressed natural gas, propane, or oil on site shall calculate Fuel Storage Costs in accordance with the following formula:

$$\{ \text{MTSL} + [(\# \text{ Run Hours}) * (\text{Fuel Burn Rate})] \} *$$

$$(12 \text{ Month Forward Strip} + \text{Basis}) * (\text{Bond Rate})$$

Where:

Run Hours are the actual number of hours a Transmission Provider requires a Black Start Unit to run. Run Hours shall be at least 16 hours or as defined by the Transmission Owner restoration plan, whichever is less.

“Fuel Burn Rate” is actual fuel burn rate for the Black Start Unit.

“12-Month Forward Strip” is the average of forward prices for the fuel burned in the Black Start Unit traded the first Business Day on or following April 1.

“Basis” is the transportation costs from the location referenced in the forward price data to the Black Start Unit plus any variable taxes.

“Bond rate” is the value determined with reference to the Moody's Utility Index for bonds rated Baa1 reported the first Business Day on or following April 1.

“MTSL” is the “minimum tank suction level” and shall apply to oil fired Black Start Units’ storage tanks that have an unusable volume of oil. In the case where a Black Start Unit shares a common fuel tank, the Black Start Unit will be eligible for recovery of the Black Start Energy Tank Ratio of the MTSL in its fuel storage calculation.

$$\text{Black Start Energy Tank Ratio} = \{(\text{Fuel Burn Rate} * \text{Minimum Run Hours}) / (\text{Tank Capacity} - \text{MTSL})\}$$

The MTSL fuel storage calculation shall be as follows:

$$\{(\text{Black Start Energy Tank Ratio} * \text{MTSL}) + [(\text{\#Run Hours}) * (\text{Fuel Burn Rate})]\} * (12 \text{ Month Forward Strip} + \text{Basis}) * (\text{Bond Rate})$$

For units qualifying as Black Start Units on the basis of a demonstrated ability to operate at reduced levels when automatically disconnected from the grid, there are no associated fuel storage costs and the value for FSC shall be zero.

Z

Z shall be an incentive factor solely for Black Start Units with a commitment established under section 5 above and shall be ten percent for non-fuel assured Black Start Units and twenty percent for Fuel Assured Black Start Units. For those Black Start Units that elect to recover new or additional Black Start or Fuel Assurance Capital Costs under section 6 above, the incentive factor, Z, shall be equal to zero.

Every five years, PJM shall review the formula and its costs components set forth in this section 18, and report on the results of that review to stakeholders.

19. Transmission Provider or its agent shall have the right to independently audit the accounts and records of each Black Start Unit that is receiving payments for providing Black Start Service.

20. PJM shall notify its Members when a Black Start Unit seeks to recover new or additional Black Start NERC-CIP Capital Costs under section 18 of this Schedule 6A no later than thirty (30) days prior to the effective date of the recovery. At the written request of a PJM Member, made simultaneously to the Market Monitoring Unit and PJM, with notice to the Black Start Unit owner, the Market Monitoring Unit shall make available to the affected PJM Member for inspection at the offices of the Market Monitoring Unit, all data supporting the requested new or additional NERC-CIP specific Capital Costs. The Black Start Unit owner may elect to attend this review. In all cases, the supporting data is to be held confidential and may not be distributed.

21. The Market Monitoring Unit shall include a Black Start Service summary in its annual State of the Market report which will set forth a descriptive summary of the new or additional Black Start NERC-CIP Capital Costs requested by Black Start Units, and include a list of the types of capital costs requested and the overall cost of such capital improvements on an aggregate basis such that no data is attributable to an individual Black Start Unit.

Credits

22. For existing Black Start Units, monthly credits are provided to Black Start Unit owners that submit to the Transmission Provider their annual revenue requirements established pursuant to section 17A of this Schedule 6A. The generator's monthly credit is equal to 1/12 of its annual Black Start Service revenue requirement for eligible critical Black Start Units. For new Black Start Unit owners, monthly credits will be held by the Office of the Interconnection in a non-interest bearing account until the Office of the Interconnection, or the Commission as applicable, accepts the owner's annual revenue requirement pursuant to section 17B of this Schedule 6A. New Black Start Unit owners will begin to receive monthly credits, including any monthly credits held by the Office of the Interconnection back to the date the unit enters Black Start Service and any required estimated annual revenue requirement true up after the Office of the Interconnection, or the Commission as applicable, accepts the new Black Start Unit owner's annual revenue requirement.

22A. For Fuel Assured Black Start Units that are recovering Fuel Assurance Capital Costs, pursuant to section 17B of this Schedule 6A, shall have its monthly credits reduced, but not less than zero, by the positive net value of the Day-ahead Energy Market and Real-time Energy Market revenues from being committed using the fuel assurance fuel as further described in the PJM manuals minus the cost of running on that fuel. The Black Start Unit's monthly credits shall not be increased. For Fuel Assured Black Start Units that are recovering Fuel Assurance Capital Cost and the Fuel Assurance Capital Costs increased the Installed Capacity Rating (ICAP) of the unit, monthly credits shall be reduced, but not less than zero, by the monthly capacity revenues for the increased ICAP. Monthly credits will only be reduced during the Fuel Assurance Capital Cost recovery period.

23. Revenue requirements for jointly owned Black Start Units will be allocated to the owners based on ownership percentage.

24. Transmission Provider shall not compensate generators for Black Start Service unless they meet the Transmission Provider criteria for Black Start Service and the criteria for Black Start Service in the Applicable Standards and provide Transmission Provider with all necessary data in accordance with this Schedule 6A and the PJM manuals.

Charges

25. Zonal rates will be based on Black Start Service capability or share of generation units designated by the Transmission Provider and allocated to network service customers and point-to-point reservations. Zonal rates will include estimated annual revenue requirements for new Black Start Units from the date the units enter Black Start Service to last day of the month preceding the Office of the Interconnection's acceptance of the unit's annual revenue requirement. The estimated annual revenue requirement will be based on the Black Start Unit owner's best estimate at the time the unit enters Black Start Service. Any estimated annual revenue requirement true up will be included in the monthly bill after the Office of the Interconnection accepts the new Black Start unit's annual revenue requirement.

26. Revenue requirements for Black Start Units designated by the Transmission Provider as critical (regardless of zonal location) will be allocated to the receiving Transmission Owner's zone. Black Start Units that are shared and designated to serve multiple zones will have their annual revenues allocated by Transmission Owner designated critical load percentage.

27. Purchasers of Black Start Service shall be charged for such service in accordance with the following formulae.

Monthly Charge for a purchaser receiving Network Integration Transmission Service or Point-to-Point Transmission Service to serve Non-Zone Load = Allocation Factor * Total Generation Owner Monthly Black Start Service Revenue Requirement

Monthly Charge for a purchaser receiving Network Integration Transmission Service or Point-to-Point Transmission Service to serve Zone Load = Allocation Factor * Zonal Generation Owner Monthly Black Start Service Revenue Requirement * Adjustment Factor

Where:

Purchaser serving Non-Zone Load is a Network Customer serving Non-Zone Network Load or a Transmission Customer where the Point of Delivery is at the boundary of the PJM Region.

Zonal Generation Owner Monthly Black Start Service Revenue Requirement is the sum of the monthly share of Black Start Service revenue requirements for each generator nominated by the Transmission Owners in that zone.

Total Generation Owner Monthly Black Start Service Revenue Requirement is the sum of the Zonal Generation Owner Monthly Black Start Service Revenue Requirements for all Zones in the PJM Region.

Allocation Factor is the monthly transmission use of each Network Customer or Transmission Customer per Zone or Non-Zone, as applicable, on a megawatt basis divided by the total transmission use in the Zone or in the PJM Region, as applicable, on a megawatt basis.

For Network Customers, monthly transmission use on a megawatt basis is the sum of a Network Customer's daily values of DCPZ or DCPNZ (as those terms are defined in Tariff, Part I, section 34.1) as applicable, for all days of the month.

For Transmission Customers, monthly transmission use on a megawatt basis is the sum of the Transmission Customer's hourly amounts of Reserved Capacity for each day of the month (not curtailed by PJM) divided by the number of hours in the day.

Adjustment Factor is determined as the sum of the total monthly transmission use in the PJM Region on a megawatt basis, exclusive of such use by Network Customers and Transmission Customers serving Non-Zone Load, divided by the total monthly transmission use in the PJM Region on a megawatt basis.

In the event that a single customer is serving load in more than one Zone, or serving Non-Zone Load as well as load in one or more Zones, or is both a Network Customer and a Transmission Customer, the Monthly Charge for such a customer shall be the sum of the Monthly Charges determined by applying the appropriate formulae set forth in this Schedule 6A.