

Investigation Report

Block Island Transmission Cable Outage on November 18, 2022

EC-2022-39



STATE OF RHODE ISLAND DIVISION OF PUBLIC UTILITIES & CARRIERS

**Engineering Section
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Warwick, Rhode Island 02888
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May 16, 2023

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Executive Summary

This report is prepared from a cumulation of reports provided by Rhode Island Energy (“RIE”) and Block Island Utility District d/b/a Block Island Power Company (“BIPCo”), which were submitted by the companies as directed by the Division of Public Utilities and Carriers (“Division”) under Engineering reference number 2022-39 (“EC-2022-39”) regarding the “Block Island Transmission Cable Outage on November 18, 2022”. This cable is commonly referred to as the Block Island Transmission System (“BITS”), or the Block Island subsea 34.5kV 165T1 cable (“cable”).¹ The BITS is a 34.5kV AC bi-directional submarine transmission cable, and is the only electric connection between the mainland and Block Island, which is situated twelve (12) miles off the southern coast of Rhode Island. It is also the only connection to the United States’ first and largest offshore wind farm.² The cable has had a recent history of outages and the Division investigated to ensure there is not a systematic problem with the cable. The reliability of the cable is more important than ever, as a result of the passage of the Act on Climate.³ A cable outage requires BIPCo to run its backup diesel generators that produce higher carbon emissions than the power supplied from the mainland and prevents the renewable power from the offshore wind farm from being transmitted to the mainland.

On Friday, November 18, 2022, at approximately 14:14 hours, the Block Island subsea 34.5kV 165T1 cable lost power. There were no reported injuries related to this event. The evidence indicates that the location of the cause of the outage occurred on an exposed bare wire overhead section of the transmission system maintained by RIE, near the RIE substation located on the property of BIPCo. The evidence also suggests the outage is likely to have been caused by a transient fault on the system (animal or object such as a tree branch causing an arc). BIPCo was able to use its onsite backup diesel generators to restore power to all customers in a matter of minutes. The cable outage, however, lasted 22 hours and 38 minutes. BIPCo was able to transition from generator back to cable power without its customers experiencing a second outage.

Incident Summary

On Friday, November 18, 2022, at approximately 14:14 hours,⁴ the Block Island subsea 34.5kV 165T1 cable lost power.⁵ The cable, which is responsible for supplying electricity to Block Island and transmitting electricity from the offshore wind farm to the mainland, was initially installed in 2016. For clarification, there are two subsea cables discussed in this report. The first is the 160T1 cable that is between Block Island and the offshore wind farm. The second is the 165T1 cable that lost power in this incident; it is a subsea cable between the mainland and Block Island, which is owned and operated by RIE. Both cables arrive on Block Island below grade (i.e., are buried), then transition from underground to overhead utility poles once on BIPCo’s property, before continuing

¹ “BITS” and the 165T1 Cable (“cable”) are synonymous. Depending on the context of the report, both are used to describe the Block Island Transmission Cable.

² Block Island Wind Farm is located approximately 3.8 mi off the coast of Block Island. The five-turbine, 30 MW project was developed by Deepwater Wind in 2015 and was operational in December 2016. On October 8, 2018, Orsted agreed to purchase Deepwater Wind, however these offshore wind turbines are still commonly referred to as Deepwater Wind.

³ On April 14, 2021, Governor Dan McKee signed into law the 2021 Act on Climate (RIGL §42-6.2).

⁴ Times shown are using a 24-hour clock. Thus, for example, “14:14 hours” equates to “2:14 p.m.”

⁵ The Division was notified of the outage from RIE at 16:00 hours on November 18, 2022, pursuant to the Division’s *Standards for Electric Utility Rules*.

alongside Beach Avenue Access Road to the point of substation interconnection. Once aerial, these cables use the same type of pole configuration (crossarms). The 160T1 cable is located above the 165T1 cable on the utility poles (as seen in Figures 1, 2, 5, and 6).

On November 18, 2022, the weather on Block Island was cloudy with a high of 43°F and a low of 32°F (maximum wind speed was 23 mph⁶ -- i.e., this was not a windstorm induced event). RIE stated that *"the duration of this event was from Friday, November 18, 2022, at 2:15 pm (loss of power to BIPCo and DWW off-shore wind farm)⁷ to Saturday, November 19, 2022, at 12:53 pm (BIPCo transferred from generation back to Rhode Island Energy's feed). The outage lasted (22 hours and 38 minutes after the start of the outage)."*

The cable tripped offline due to the 165T1 circuit breaker (located at RIE's Dillon Corner Substation in Narragansett) locking out, resulting in transfer trips being sent to the feeder breaker inside the Block Island substation (located on Block Island). The result was a system-wide outage affecting all BIPCo customers (approximately 2,000 accounts, of which many are seasonal). The outage also disrupted all power flows from the offshore wind farm. BIPCo took immediate action and, through the use of its stationary onsite backup diesel generators,⁸ was able to restore power to all affected customers in approximately ten (10) minutes (details in Appendix).

The location of the cause of the outage appears to have been along a 760-foot span of the aerial section of the BITS that is owned and maintained by RIE but is situated on the property of BIPCo.

In an attempt to locate the cause of the outage, RIE's report stated that its:

Overhead ("OH") Lines department performed a visual inspection of the 165T1 overhead circuit from Riser Pole 2, Beach Avenue Access Road, Block Island, Rhode Island to the Block Island Substation, Block Island, Rhode Island, and did not identify any visible damage. Burn marks were noticed on the wood pole, crossarm, and fiberglass guy strain insulator adjacent to the B-Phase, 35 kV dead-end polymer insulator on the 160T1 overhead circuit located above the 165T1 circuit at Pole 5, Beach Access Road, Block Island, Rhode Island. Initially, consideration was given that the insulator failed because of salt contamination and caused the event. In response, insulators on Poles 5 and 6 were replaced with porcelain type insulation. The B-Phase insulator was later tested for insulation performance and the results did not suggest any signs of deterioration. Upon further review, burn marks were attributed to a previous outage affecting the 160T1 supply to DWW's offshore wind farm.

⁶ Source: Weather Underground website.

⁷ RIE mentions DWW for Deepwater Wind.

⁸ These are the same generators used previously, on a full-time basis, to supply all the electricity to Block Island prior to the BITS installation. These generators now serve as backup generation in emergency events, or planned BITS maintenance outages.

RIE was unable to find the exact cause of the 165T1 circuit breaker lockout but opined that it could most likely be attributed to a transient fault⁹ (which resulted in a sustained outage because the protective equipment does not have a reclosing feature since it protects both the underground and overhead portion of cable) on the overhead system. RIE explained that *“This is not an unusual event. Transient faults can occur on an overhead electric distribution system where the cause is not definitive. Typical examples of transient faults include lightning strikes or an arc caused by an animal or tree branch that then falls clear.”*

Per RIE, *“The following pictures are of the new porcelain suspension insulators installed at Pole 5 and Pole 6 Beach Avenue Access Road, Block Island, Rhode Island.”*

(This space is intentionally left blank).

⁹ A fault is an irregularity of current that occurs on the distribution system and results in an outage. Transient faults, which are temporary faults, are the most common type of faults and typically occur on overhead lines. Transient faults can be caused by events such as an animal or tree branch making contact with an overhead line.

Below: Figure 1 pole 5 Beach Avenue Access Road



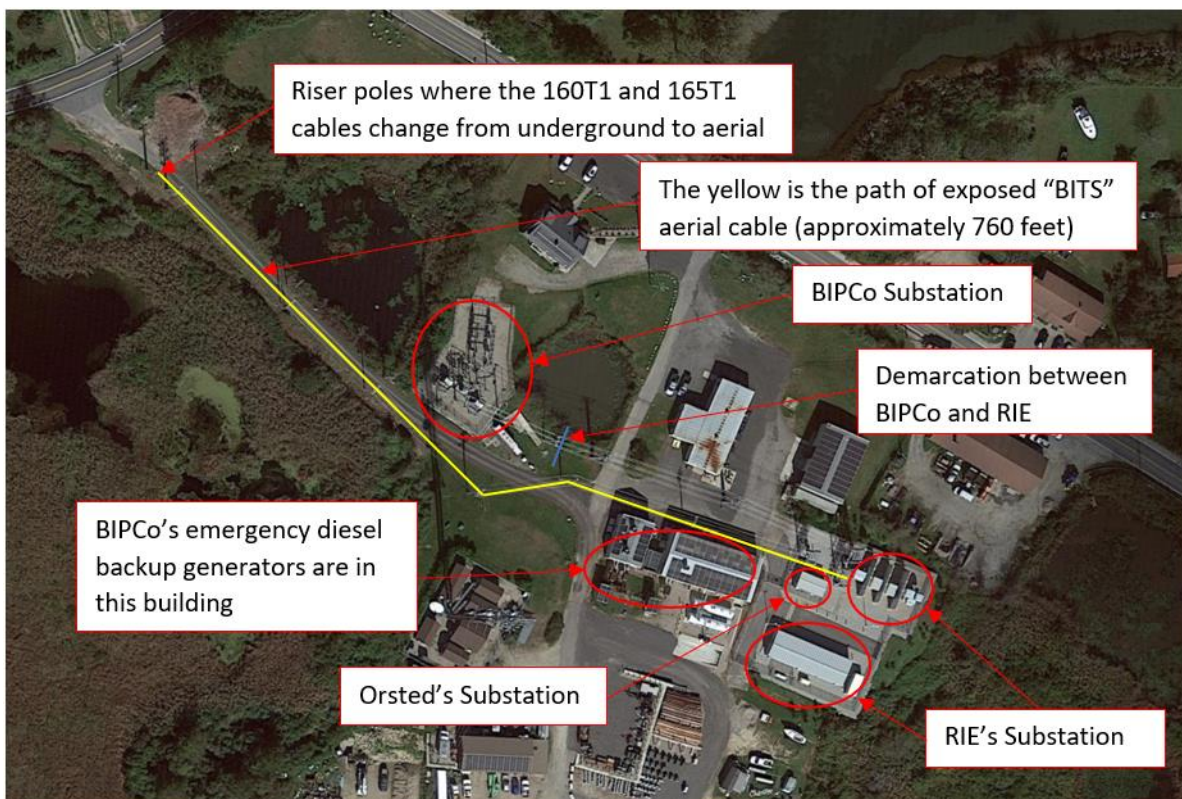
Below: Figure 2 pole 6 Beach Avenue Access Road



Below: Figure 3 shows where pole 5 and pole 6 are located adjacent to Beach Avenue Access Road, within the BIPCo property located on Block Island. Map Source is Google Maps.



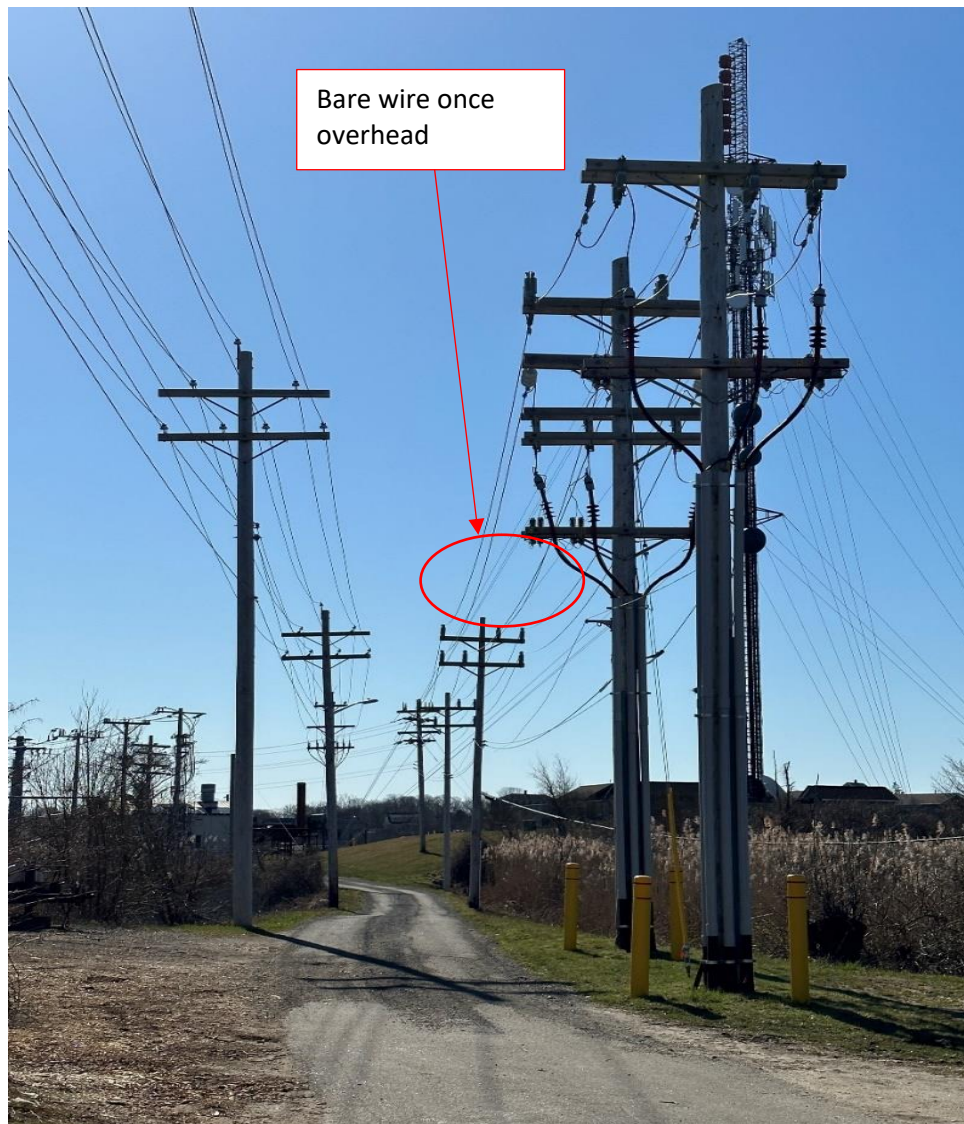
Below: Figure 4 shows an aerial view of the BIPCo Power Station and equipment. Map Source is Google Maps.



Below: Figure 5 shows where the BITS transitions from underground to overhead



Below: Figure 6, is similar to Figure 5, showing the transition from underground to overhead (poles on the right side), but also shows the overhead going down Beach Access Road to the substations.¹⁰



In hopes of mitigating future outages, RIE decided to take some additional precautions:

Although not the cause of this event, due to the location and exposure to coastal conditions, the Company replaced 18 35kV polymer insulators with porcelain type devices, which have smoother surfaces and allow rain to wash off accumulated salt and other contaminants more readily. Rhode Island Energy is further investigating

¹⁰ **Onsite Visit:** On March 20, 2023, Robert Bailey, P.E., the Division’s Associate Public Utilities Administrator for Engineering and Pipeline Safety, and Joseph Shilling, E.I.T., a Division Public Utilities Engineering Specialist II, traveled to Block Island and met with Jeffery M. Wright, President of BIPCo, to look at the power grid. It was verified that the aerial section of the BITS is bare wire and vulnerable to outages.

the use of higher voltage class insulators, which have more surface area and increase the distance from the energized conductor to ground, thus making them less prone to animal contact, tracking and flash over due to accumulated salt and other contaminants. Additionally, the Company is planning to install Smart Navigator LM HV DFCI directional faulted circuit indicators with smart controllers on the 160T1 and 165T1 overhead sections on Block Island. The Smart Navigator LM HV DFCI will communicate fault data to Rhode Island Energy's Energy Management System ("EMS") and fault information can then be used to help improve fault locating, response times, and restoration efforts. Finally, the Company is investigating the installation of Schweitzer SEL-T401L relays on the Block Island Transmission System ("BITS"). These relays utilize travelling wave technology to provide fault location accuracy within 200 feet.

See Appendix A for a detailed breakdown of how RIE restored electric service.

Lessons Learned

BIPCo stated that it was able to move from generator power to the subsea transmission cable without interrupting service to customers.

Rhode Island Energy explained that the following are lessons learned from this event:

- *Best practice for Rhode Island Energy Operations personnel to continue to work closely with Community and Customer Relations, including key account managers, during emergency response efforts.*
- *Annual refresher training on BITS Emergency Response and O&M Manual helps facilitate safe and efficient emergency response efforts. The latest training was held on Wednesday, February 1, 2023, at Rhode Island Energy's facility located at 280 Melrose Street in Providence, Rhode Island.*
- *Expand the BITS Emergency Response and O&M Manual to include a written response plan based on season, time of day, and weather conditions.*
- *There are space and scheduling limitations associated with use of the Block Island Ferry. The Company is evaluating other alternatives to get Rhode Island Energy personnel, trucks, and equipment to Block Island for emergency outage events.*
- *Consider utilizing BIPCo equipment for emergency outage events. This would require an evaluation of vehicle performance records, vehicle inspection reports, and condition of vehicles. Rhode Island Energy crews would need to receive training required for safe operation of BIPCo vehicles, including bucket rescue.*
- *Consider utilizing BIPCo contractor for restoration support on Block Island. This would require the contractor to complete the proper training and testing to be listed on the appropriate Clearance and Control list.*

- *There are significant Bureau of Ocean Energy Management/environmental requirements associated with repair of the submarine cable.*
- *Distance to Fault Relays (“DTF”) located at Dillon’s Corner Substation No. 165 and Block Island Substation No. 160 provided inaccurate information regarding the location of the fault. DTF relays are typically not extremely accurate for fault location, because they use static system conditions entered by the user to plot the distance to the fault and not actual dynamic values. Also, they are generally not as reliable for fault locating on mixed construction systems, such as BITS which is comprised of land cable, submarine cable, and overhead construction.*

Cost of Restoration

This outage created expenses for both RIE and BIPCo, and lost revenues for Orsted, the owner of the offshore wind turbines. RIE explained that *“there are no specific costs to repair the damage because the exact cause affecting the 165T1 circuit could not be determined. Approximate cost of 165T1 cable testing: \$25,000. Approximate cost to review substation and overhead equipment: \$5,000, approximate cost of Block Island insulator replacements: \$15,000.”* BIPCo did not provide an exact cost, however, its diesel generators used 2,492 gallons of fuel during this outage. This was estimated to be about \$9,000 based on BIPCo’s accounting treatment of the fuel inventory. It is unknown how much this outage cost Orsted; however, during the period of the outage, the turbines could not transmit electricity into the regional wholesale energy markets.

The incident also brought into question how often training occurs for an event like this. RIE explained that its:

OH and UG¹¹ Lines personnel routinely perform switching, grounding, installation of conductors/cables, and splicing on both “Blue-Sky” days and during emergency response. Substation and Operations personnel routinely install and test substation equipment. Rhode Island Energy personnel also attend Annual Expert Training which includes how to respond to events both safely and professionally.

Rhode Island Energy has also held emergency response training for its underground transmission systems including the BITS. The most recent training for the BITS on February 1, 2023, included a review of emergency response and the BITS O&M manual.

BIPCo explained that *“transitioning off/on the submarine cable is a routine event for them. It is something that we train regularly for and perform full function testing of all systems at least once every twelve months.”*

RIE and BIPCO were both asked to share any other information that they believed to be important to the Division’s understanding of the situation, its probability of recurrence, and appropriate next steps aimed at avoiding a recurrence of this type of failure in the future:

¹¹ OH refers to Overhead and UG refers to Underground

RIE response:

- *The Company originally requested that electric facilities continue underground on BIPCo property to reduce exposure and improve reliability. BIPCo concluded that the risks associated with proximity to wetlands and crossing of the Company and BIPCo underground duct banks were elevated and proceeded to recommend that the section remain overhead.*
- *Typically, transient faults are cleared without a sustained outage, but because the zone of protection of the 165TI encompasses both underground and overhead construction, the protection scheme does not utilize reclosing of the circuit breakers to prevent further extensive damage to cable in the event of an underground fault.*

BIPCo's response:

- *RI Energy's response to these events was exceptionally better than National Grid's historical response. It is important to note that during all of these outages the communications between myself and their operations team, their senior leadership team, and their CEO were timely, reassuring, and in the spirit of cooperation. Additionally, RI Energy allowed our crews to work together with theirs. Historically, National Grid never allowed our crews to assist in the way that RI Energy worked with us. As a result, this cable outage was less than 24 hours long. Based on our past experiences this would've been a three to four-day cable outage with National Grid calling the shots. We worked together every step of the way, they listened to our input, they heard our concerns regarding fuel use, and we worked as if we were one company.*

Division Conclusion & Recommendations

The Division acknowledges that the exact cause of this outage could not be determined. However, the Division specifically notes that RIE's report did indicate that there was a burn mark from a prior outage located on the exposed cable going to the offshore wind turbines, in close proximity – a few feet – from the general area of the exposed bare wires. The evidence suggests that the instant transient fault may have occurred in this location.

This outage cost the utilities in excess of \$54,000. The cost to RIE to repair the outage was approximately \$45,000. BIPCo incurred a cost of approximately \$9,000 for 2,492 gallons of diesel fuel for the backup generators. Finally, Orsted's wind farm was unable to deliver any power during the line outage and thus lost an unknown amount of power generation revenue.¹²

The Division recommends that the exposed bare wire aerial section of the BITS facilities on Block Island be monitored for future outages. While moving these wires underground was discussed in the reports from both utility companies, doing so would require crossing the existing wetlands

¹² More importantly, RI and the region cannot realize the maximum clean energy benefits from wind generation when the BITS cable is out.

(which poses potential environmental issues) and would have to avoid existing underground BIPCo cables in the area, two factors that pose significant technical and practical challenges. Undergrounding facilities would also pose significant undetermined costs that would have to be assessed in the context of reliability studies weighed against cost/benefit outcomes.

The Division acknowledges that RIE changed the polymer insulators with porcelain insulators and is planning to install directional faulted circuit indicators on the overhead section on Block Island, while also investigating the installation of Schweitzer relays on BITS. The Division requested that RIE also consider the recommendations below. RIE has already reviewed the Division's recommendations, and its responses are indicated below.¹³

1. Consider installing fault locators at multiple locations on the BITS. These fault locators offer load reading capability and the ability to communicate with SEL relays for enhanced protective coordination. These fault locators can communicate in a manner to allow the breaker/relay to have either a non-reclose feature or reclose feature depending on whether the fault is detected on the cable or is on the overhead portion of the system. These options could potentially reduce outage time.

RIE Response: Rhode Island Energy is investigating installation of Smart Navigator directional faulted circuit indicators ("DFCI") with smart controllers on the 160T1 and 165T1 overhead sections of the BITS on Block Island. Directional fault indicators installed on either end of the overhead ("OH") section would provide a visual indication of whether a fault occurred within the OH section. The Smart Navigator DFCI can also be set up to communicate fault data directly to Rhode Island Energy's Energy Management System ("EMS"). The OH sections on Block Island would still need to be patrolled to confirm the fault was located on the OH, prior to re-energizing either the cable from Dillon's Corner Substation to Block Island Substation or the cable from Block Island Substation to Deepwater Wind's ("DWW") offshore wind turbines. Additionally, Rhode Island Energy is investigating the installation of advanced devices on the BITS which may utilize travelling wave or similar technology that may improve fault location accuracy.

The Division appreciates RIE's response and planned corrective actions.

2. Installation of a recloser on Block Island where the BITS transitions from underground to the exposed bare wire overhead section. This recloser should have a reclosing feature that quickly restores power in response to a momentary fault condition (animal, tree branch, etc.). RIE could allow BIPCo the ability to operate this recloser to allow for de-energization for expedited and safer repairs potentially by BIPCo.

RIE's Response: The overhead portion of the BITS 165T1 circuit is part of the line differential scheme between Dillon's Corner Substation and Block Island Substation (which also protects 24.3 miles of mainland, submarine, and Block Island land cable). The Line differential scheme is designed to operate in cycles to help minimize fault duration to the BITS and would operate much faster than the overcurrent protection associated with a

¹³ The Division also requested BIPCo review the report and recommendations. BIPCo had no substantive comments and indicated the report accurately describes the event and lessons learned.

recloser. Additionally, if a permanent fault occurred on the OH system, reclosing functionality would subject the 24.3 miles of cable, which includes 20 miles of submarine cable, to additional surges and fault current. A recloser installed on the OH portion of the 165T1 circuit could also potentially close into an underground fault located on the cable between the Block Island OH portion and the metal-clad switchgear located in the Block Island Substation.

The Division appreciates RIE's response, as this would appear to attempt to eliminate any added fault current to the BITS. The Division would request the company include in the January 2024 report referenced below, more detail of the line differential scheme versus a recloser scheme.

3. Install insulated wire (tree wire) on the pole jumpers on the aerial section of BITS to improve BIL (basic insulation level) and to reduce the likelihood of transient events such as animals or other objects causing a fault and outage.

RIE Response: Rhode Island Energy will as recommended investigate the installation of insulated wire for use as pole jumpers on the overhead portion of the BITS located on Block Island. Capacity considerations indicated that 795 Al 35 kV covered conductor will be required for ampacity purposes. Operations and engineering will need to perform a constructability and standards review of utilizing 795 Al 35 kV covered conductor, which will transition to existing bare construction.

Rhode Island Energy is investigating adding osprey guards to five pole line structures along the Beach Avenue Access Road in Fall 2023.

The Division appreciates RIE's response and planned corrective actions.

The Division notes that RIE and BIPCo worked together efficiently and effectively to resolve this outage. BIPCo is changing its emergency action plan (which is currently focused largely on weather events) to include long-term cable outage preparations. BIPCo was able to restore all customers in a matter of minutes by utilizing the stationary on-site diesel generators. Even though the cause of the outage was not determined precisely, it likely occurred on this aerial part of the BITS. Upgrades to RIE insulators were done in hopes of mitigating the likelihood of future outages, and fault location equipment is planned for installation that will help locate future outages within a few hundred feet. RIE is considering utilizing BIPCo's equipment (trucks, etc.) to help future operational and restoration efforts due to ferry limitations with scheduling and space limitations (not mentioned in the report, but the ferry's operation is dependent on the weather, and high winds can prevent the ferry from operating for days, which would prevent RIE from mobilizing equipment to the island.

As of the date of this report, RIE has already completed the following:

1. Replaced 18 polymer dead-end insulators on Block Island with porcelain type insulation.
2. Completed thermal/infrared imaging at the Block Island Substation and the OH structures located on Block Island, and no abnormalities were found.

3. Arrangements were made with Interstate Navigation to get equipment and personnel on the Block Island Ferry during normal business hours for emergency restoration.
4. Identified and engaged rental car and truck use for emergency events.
5. Identified and engaged air service to transport personnel and tools during emergency events.
6. Scheduled Clearance and Control training of Block Island personnel.
7. Completed thermal/infrared imaging on all underground facilities serving Block Island.
8. Completed internal emergency response refresher training for the BITS.

Finally, RIE is required to provide an update to the Division in January 2024 in the form of a report, providing the status of upgrades and improvements to the BITS, and any new or relevant information related to transmission cable outages. Once the Division has reviewed this report, it will determine if future reports are warranted.

Appendix A

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280 Melrose Street
Providence, RI 02907
Phone 401-578-2700



February 10, 2023

VIA ELECTRONIC MAIL

Robert D. Bailey, P.E.
Rhode Island Division of Public Utilities and Carriers
89 Jefferson Boulevard
Warwick, RI 02888

**RE: EC-2022-39 – Block Island Power Outage on November 18, 2022
The Narragansett Electric Company d/b/a Rhode Island Energy’s
Report Responding to the Division’s Letter Dated December 14, 2022**

Dear Mr. Bailey:

On behalf of The Narragansett Electric Company d/b/a Rhode Island Energy (“Rhode Island Energy” or the “Company”), attached is the electronic version of Rhode Island Energy’s report in response to a letter to the Company from the Division of Public Utilities and Carriers (“Division”) dated December 14, 2022, in the above-referenced matter.

The Company’s report consists of responses to the 23 questions posed by the Division in its December 14, 2022 letter regarding the Block Island Power Outage that occurred on November 18, 2022.

Thank you for your attention to this matter. If you have any questions, please contact me at 401-578-2700.

Very truly yours,

A handwritten signature in cursive script that reads "Celia B. O'Brien".

Celia B. O'Brien

Attachment

cc: John Spirito, Division
Anthony Manni, Division
Joseph Shilling, Division
David Bonenberger, Rhode Island Energy

1. What event occurred?

The 165T1 Circuit Breaker (“CB”) feeding the Block Island submarine cable locked out at Dillon’s Corner Substation and Block Island Substation. Deep Water Wind (“DWW”) tripped offline. Block Island Utility District d/b/a Block Island Power Company (“BIPCo”) tripped offline and went on generation.

2. What was the exact cause of this event?

Based on post fault investigations, the outage was likely attributed to a transient, also known as temporary, fault on the overhead system but the exact cause affecting the 165T1 circuit could not be determined.

The Company’s¹ Overhead (“OH”) Lines department performed a visual inspection of the 165T1 overhead circuit from Riser Pole 2, Beach Avenue Access Road, Block Island, Rhode Island to the Block Island Substation, Block Island, Rhode Island and did not identify any visible damage. Burn marks were noticed on the wood pole, crossarm, and fiberglass guy strain insulator adjacent to the B-Phase, 35 kV dead-end polymer insulator on the 160T1 overhead circuit located above the 165T1 circuit at Pole 5, Beach Access Road, Block Island, Rhode Island. Initially, consideration was given that the insulator failed because of salt contamination and caused the event. In response, insulators on Poles 5 and 6 were replaced with porcelain type insulation. The B-Phase insulator was later tested for insulation performance and the results did not suggest any signs of deterioration. Upon further review, burn marks were attributed to a previous outage affecting the 160T1 supply to DWW’s off-shore wind farm.

3. Please provide pictures of the cause.

There are no pictures of the cause. Please refer to the Company’s response to Question 2, above.

4. Please provide pictures of the repairs.

There are no pictures of repairs. Please refer to the Company’s response to Question 2, above.

¹ The Narragansett Electric Company d/b/a Rhode Island Energy (“Rhode Island Energy” or the “Company”).

The following pictures are of the new porcelain suspension insulators installed at Pole 5 and Pole 6 Beach Avenue Access Road, Block Island, Rhode Island.



Figure 1 Pole 5 Beach Avenue Access Road



Figure 2 Pole 6 Beach Avenue Access Road

5. What was the exact location of the cause of this event?

The exact location of the cause affecting the 165T1 circuit could not be determined. Please refer to the Company’s response to Question 2, above.

6. What was the approximate time and date of this event?

The duration of the event was from Friday, November 18, 2022, at 2:15 pm (loss of power to BIPCo and DWW off-shore wind farm) to Saturday, November 19, 2022, at 12:53 pm (BIPCo transferred from generation back to Rhode Island Energy’s feed).

7. Were any injuries reported? If there were injuries, what were the injuries and what is the current status of the injured?

There were no injuries associated with the failure or the emergency restoration effort.

8. What were the weather conditions at the time of this event?

Weather on Block Island, Rhode Island was cloudy with a high of 43°F and a low of 32°F on Friday, November 18, 2022.

9. Was this an unusual event, or a common occurrence?

This is not an unusual event. Transient faults can occur on an overhead electric distribution system where the cause is not definitive. Typical examples of transient faults include lightning or an arc caused by an animal or tree branch that then falls clear.

10. Does Rhode Island Energy plan on changing the design/layout of any of its facilities or equipment to help mitigate these events?

Although not the cause of this event, due to the location and exposure to coastal conditions, the Company replaced 18 35kV polymer insulators with porcelain type devices, which have smoother surfaces and allow rain to wash off accumulated salt and other contaminants more readily. Rhode Island Energy is further investigating the use of higher voltage class insulators, which have more surface area and increase the distance from the energized conductor to ground, thus making them less prone to animal contact, tracking and flash over due to accumulated salt and other contaminants.

Additionally, the Company is planning to install Smart Navigator LM HV DFCI directional faulted circuit indicators with smart controllers on the 160T1 and 165T1 overhead sections on Block Island. The Smart Navigator LM HV DFCI will communicate fault data to Rhode Island Energy’s Energy Management System (“EMS”) and fault information can then be used to help improve fault locating, response times, and restoration efforts.

Finally, the Company is investigating the installation of Schweitzer SEL-T401L relays on the Block Island Transmission System (“BITS”). These relays utilize travelling wave technology to provide fault location accuracy within 200 feet.

11. Did Rhode Island Energy have all the resources available to begin making immediate repairs, or were outside resources needed?

Rhode Island Energy had resources readily available to investigate and re-energize the BITS and replace the polymer insulators.

12. Please explain how power was restored to the customers and how long it took.

- a. 11/18/2022, 14:15: 165T1 circuit breakers locked out at Dillon’s Corner Substation and Block Island Substation. This resulted in loss of power to BIPCo and DWW’s off-shore wind farm.
- b. 11/18/2022, 14:19: Rhode Island Energy’s Control Center informed BIPCo of the outage and informed them that they should go on generation when able.
- c. 11/18/2022, 14:29: BIPCo transferred to generation and fully restored power to all customers.
- d. 11/18/2022, 18:00 (approximate): Rhode Island Energy crews arrive on Block Island to begin patrol of overhead lines and commence with switching/tagging of the 165T1 circuit.
- e. 11/18/2022, 20:20: Rhode Island Energy’s Control Center granted clearance to Underground (“UG”) Lines and Substation Operations and Maintenance (“O&M”) departments to test the underground cable originating at Dillon’s Corner Substation in Narragansett, Rhode Island.
- f. 11/19/2022, 01:39: Rhode Island Energy’s UG Lines and Substation O&M departments released clearance after underground/submarine cable tested okay from Dillon’s Corner Substation, Narragansett, Rhode Island to Riser Pole 2, Beach Avenue Access Road, Block Island, Rhode Island.
- g. 11/19/2022, 01:58: Cable was re-energized from Dillon’s Corner Substation, Narragansett, Rhode Island to Riser Pole 2, Beach Avenue Access Road, Block Island, Rhode Island and allowed to remain in-service for a period of ten minutes.
- h. 11/19/2022, 02:08: Cable was de-energized from Dillon’s Corner Substation, Narragansett, Rhode Island to Riser Pole 2, Beach Avenue Access Road, Block Island, Rhode Island.
- i. 11/19/2022, 08:00 (approximate): Rhode Island Energy OH Line crews arrived on Block Island. OH Line crews performed a daytime inspection of Rhode Island Energy’s overhead poles and equipment.
- j. 11/19/2022, 09:20: Rhode Island Energy’s Control Center granted clearance to OH Lines department to replace B-Phase, 35 kV dead-end polymer insulator on adjacent 160T1 circuit given burn marks were noticed on wood pole, crossarm, and fiberglass guy strain insulator adjacent to insulator. Evidence of salt accumulation and rust was noticed on the insulator that was replaced.

- k. 11/19/2022, 11:20: Rhode Island Energy’s OH Lines department released clearance after making repairs to the overhead system.
- l. 11/19/2022, 12:23: Rhode Island Energy’s Control Center notified DWW that Rhode Island Energy was ready to energize the cable to DWW’s off-shore wind farm upon verification from DWW.
- m. 11/19/2022, 12:31: 165T1 circuit was re-energized from Dillon’s Corner Substation to Block Island Substation.
- n. 11/19/2022, 12:50: Rhode Island Energy’s Control Center notified BIPCo that it was okay to transfer from generation back to normal utility power.
- o. 11/19/2022, 12:52: Rhode Island Energy re-energized cable to DWW off-shore wind farm.
- p. 11/19/2022, 12:53: BIPCo confirmed that they were back on utility power.

13. What lessons were learned from this event?

- a. Best practice for Rhode Island Energy Operations personnel to continue to work closely with Community and Customer Relations, including key account managers, during emergency response efforts.
- b. Annual refresher training on BITS Emergency Response and O&M Manual helps facilitate safe and efficient emergency response efforts. The latest training was held on Wednesday, February 1, 2023, at Rhode Island Energy’s facility located at 280 Melrose Street in Providence, Rhode Island.
- c. Expand the BITS Emergency Response and O&M Manual to include a written response plan based on season, time of day, and weather conditions.
- d. There are space and scheduling limitations associated with use of the Block Island Ferry. The Company is evaluating other alternatives to get Rhode Island Energy personnel, trucks, and equipment to Block Island, Rhode Island for emergency outage events.
- e. Consider utilizing BIPCo equipment for emergency outage events. This would require an evaluation of vehicle performance records, vehicle inspection reports, and condition of vehicles. Rhode Island Energy crews would need to receive training required for safe operation of BIPCo vehicles, including bucket rescue.
- f. Consider utilizing BIPCo contractor for restoration support on Block Island. This would require the contractor to complete the proper training and testing to be listed on the appropriate Clearance and Control list.

- g. There are significant Bureau of Ocean Energy Management/environmental requirements associated with repair of the submarine cable.
- h. Distance to Fault Relays (“DTF”) located at Dillon’s Corner Substation No. 165 and Block Island Substation No. 160 provided inaccurate information regarding the location of the fault. DTF relays are typically not extremely accurate for fault location, because they use static system conditions entered by the user to plot the distance to the fault and not actual dynamic values. Also, they are generally not as reliable for fault locating on mixed construction systems, such as BITS which is comprised of land cable, submarine cable, and overhead construction.

14. What is the approximate cost to repair the damage?

There are no specific costs to repair the damage because the exact cause affecting the 165T1 circuit could not be determined. Please refer to the Company’s response to Question 2, above.

Approximate cost of 165T1 cable testing: \$25,000

Approximate cost to review substation and overhead equipment: \$5,000

Approximate cost of Block Island insulator replacements: \$15,000

15. Was there any equipment failure?

There was no equipment failure specific to this event because the exact cause affecting the 165T1 circuit could not be determined. Please refer to the Company’s response to Question 2, above.

16. Please provide a high-level timeline listing the repair process for this event.

Please refer to the Company’s response to Question 12, above.

17. Was the damaged equipment near the end of its life cycle?

Please refer to the Company’s response to Question 15, above.

18. What was the date and time on which the Block Island subsea cable was put back into service?

- a. 11/19/2022, 12:31: 165T1 circuit was re-energized from Dillon’s Corner Substation to Block Island Substation.
- b. 11/19/2022, 12:50: Rhode Island Energy’s Control Center notified BIPCo that it was okay to transfer from generation back to normal utility power.
- c. 11/19/2022, 12:52: Rhode Island Energy re-energized cable to DWW off-shore wind farm.
- d. 11/19/2022, 12:53: BIPCo confirmed that they were back on utility power.

19. Did this event cause any critical infrastructures to lose power? If yes, for how long?

This event caused the loss of power to BIPCo and DWW’s off-shore wind farm. Normal utility power was restored to both BIPCo and DWW’s off-shore wind farm 22 hours and 38 minutes after the start of the outage.

20. Was the outage isolated, or did it impact all of BIPCo?

The outage impacted the supply to BIPCo and DWW’s off-shore wind turbines.

21. Does Rhode Island Energy regularly train for this type of incident or similar incidents?

OH and UG Lines personnel routinely perform switching, grounding, installation of conductors/cables, and splicing on both “Blue-Sky” days and during emergency response. Substation and Operations personnel routinely install and test substation equipment. Rhode Island Energy personnel also attend Annual Expert Training which includes how to respond to events both safely and professionally.

Rhode Island Energy has also held emergency response training for its underground transmission systems including the BITS. The most recent training for the BITS on February 1, 2023, included a review of emergency response and the BITS O&M manual.

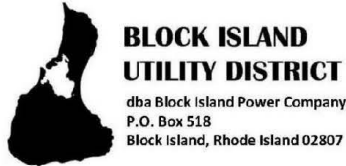
22. Did any devices fail to do their job to protect the subsea cable from tripping offline?

The protective relays appear to have operated as designed.

23. Please feel free to share any other information that you believe is important to our understanding of the situation, its probability of reoccurrence, and appropriate steps to take to better avoid this type of failure in the future.

- a. The Company requested that electric facilities continue underground on BIPCo property to reduce exposure and improve reliability. BIPCo concluded that the risks associated with proximity to wetlands and crossing of the Company and BIPCo underground duct banks were elevated and proceeded to recommend that the section remain overhead.
- b. Typically, transient faults are cleared without a sustained outage but, because the zone of protection of the 165T1 encompasses both underground and overhead construction, the protection scheme does not utilize reclosing of the circuit breakers to prevent further extensive damage to cable in the event of an underground fault.

Appendix B



DIVISION OF PUBLIC UTILITIES & CARRIERS

Engineering Section
Mr. Robert D. Bailey, P.E.
89 Jefferson Boulevard
Warwick, Rhode Island 02888
401-941-4500

January 30, 2023

Re: EC-2022-39 Block Island Power Outage on November 18, 2022

Dear Mr. Bailey:

The Block Island Utility District's responses to the Divisions' inquiry into the Block Island submarine cable outage that occurred on November 18, 2022 are included below:

1. What event occurred?
On November 18, 2022, at 14:14 the submarine cable tripped at RI Energy's Wakefield Substation, sending transfer trips to the 34.5 kV feeder breaker inside Rhode Island's Block Island substation.
2. What was the exact cause of this event?
I will defer to RI Energy to answer this question.
3. Please provide pictures of the cause.
I will defer to RI Energy to answer this question.
4. Please provide pictures of the repairs.
I will defer to RI Energy to answer this question.
5. What was the exact location of the cause of this event?
I will defer to RI Energy to answer this question.
6. What was the approximate time and date of this event?
November 18, 2022 at 14:14.
7. Were any injuries reported?
No.
8. What were the weather conditions at the time of this event?
Clear, calm, and warm.
9. Was this an unusual event, or a common occurrence?
Unusual.

10. Does BIPCO plan on changing the design / layout of any of its facilities or equipment to help mitigate these events?
No. The incident did not occur on BIPCO's system.
11. Did BIPCO have all the resources available to begin making immediate repairs or were outside resources needed?
BIPCO did not have any repairs to make. However, BIPCO crews assisted RI Energy's crews in testing the submarine cable on the evening of the trip. BIPCO also assisted RI Energy with making arrangements with Interstate Navigation to expedite getting crews and vehicles on the ferry.
12. Please explain how power was restored to the customers and how long it took.
We restored service to the island with our backup diesel generators approximately 7 minutes after the cable tripped.
13. What lessons were learned from this event?
Although this is not a common occurrence, switching from the submarine cable to generators and back is a routine exercise for our crews. The prospect of a long-term cable outage was something that we had not given much thought to up until this event. We held a "what-if" session with the employees and the board of utility commissioners to review the incident and develop action items to ensure our preparedness. BIPCO will update its emergency action plan, which is mostly geared toward weather events, to include long-term cable outage preparations. The focus of our discussions was external communications, fuel logistics, emergency line of credit to pay for fuel during times when our operating line of credit is drawn down and generator maintenance activities.
14. What is the approximate cost to repair the damage?
I will defer to RI Energy to answer this question.
15. Was there any equipment failure?
BIPCO experienced no equipment failures related to this incident. I will defer to RI Energy to answer this question as it pertains to their systems.
16. Please provide a high-level timeline listing the repair process for this event.
BIPCO ran its backup generators from November 18 at 14:24 until November 19 at 12:30 PM, the following day when the cable was restored to service, and we were able to transfer back over. There was no power interruption during this sequence. BIPCO used 2,492 gallons of fuel to generate 29,478 kWh during the period of time that the cable was out of service. I will defer to RI Energy to provide details pertaining to their activities.
17. Was the damaged equipment near the end of its life cycle?
I will defer to RI Energy to answer this question.
18. What was the date and time on which the Block Island subsea cable was put back into service?
November 19, 2022, at approximately 12:30 PM.
19. Did this event cause any critical infrastructures to lose power? If yes, for how long?

Yes, the entire island was off for approximately 7 minutes.

20. Was the outage isolated or did it impact all of BIPCO?

The entire island was off from 14:14 to 14: 24 on November 18, 2022.

21. Does BIPCO regularly train for this type of incident or similar incidents?

Transitioning off/on the submarine cable is a routine event for BIPCO. It is something that we train regularly for and perform full functional testing of all systems at least once every twelve months.

22. Did any devices fail to do their job to protect the subsea cable from tripping offline?

I will defer to RI Energy to answer this question.

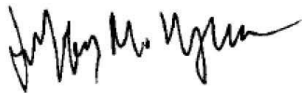
23. Please feel free to share any other information that you believe is important to our understanding of the situation, its probability of reoccurrence, and appropriate steps to take to better avoid this type of failure in the future.

We are curious to see the results of RI Energy's investigation and if the past three cable trips are related. I suspect that at least the November 18th trip and the more recent trip on January 18th. I would not be surprised to learn that the trip on August 10th is also related. We are confident that RI Energy will determine the root cause of all these trips and determine if they are related.

RI Energy's response to these events was exceptionally better than National Grid's historical response. It is important to note that during all of these outages the communications between myself and their operations team, their senior leadership team, and their CEO were timely, reassuring, and in the spirit of cooperation. Additionally, RI Energy allowed our crews to work together with theirs. Historically, National Grid never allowed our crews to assist in the way that RI Energy worked with us. As a result, this cable outage was less than 24 hours long. Based on our past experiences this would've been a three to four-day cable outage with National Grid calling the shots. We worked together every step of the way, they listened to our input, they heard our concerns regarding fuel use, and we worked as if we were one company.

Please do not hesitate to ask any follow-up or clarifying questions.

Respectfully,



Jeffery M. Wright, President
Block Island Utility District DBA
Block Island Power Company (BIPCO)