FAIR TRADING COMMISSION

Synopsis of Final Findings Report

on

The Barbados Light and Power Company (BL&P) Limited

November 18 and 19, 2019 Power Outages

Date of Issue: December 29, 2020

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LIST OF ABBREVIATIONS

BL&P	Barbados Light & Power Company Limited
Commission	Fair Trading Commission
CFCTs	Critical Fault Clearance Times
CGXX	Waste heat generator XX, where XX is 01 to 02.
DXX	Diesel generator XX, where XX is 10 to 15.
DC	Direct Current
DCS	Distributed Control System
GCMS	Gas Chromatography/Mass Spectrometry
GES 2	Guaranteed Standards of Service - Fault Repair - Distribution System
GTXX	Gas turbine XX, where XX is 01 to 06
IDB	Inter-American Development Bank
KV	Kilovolts
kWh	Kilowatt hour
MW	Megawatts
ROCOF	Rate of Change of Frequency
SX	Steam turbine X, where X is 1 to 2
SCADA	Supervisory Control and Data Acquisition
UFLS	Under Frequency Load Shedding
UPS	Uninterruptible Power Supply
URA	Utilities Regulation Act

SECTION 1 INTRODUCTION

1.1 Background

1.1.1 On November 18 and 19, 2019, island-wide power outages occurred at 7:33 hrs and 6:59 hrs, respectively, resulting in loss of the electricity service to 130,000 customers.

1.1.2 Service restoration commenced 55 minutes after the first outage occurred and this process took 15 hrs and 22 minutes in total to conclude. Restoration of service for the second outage commenced 50 minutes after it occurred and this operation took 13 hrs and 27 minutes to complete.

1.1.3 During the restoration process, the wait time for electricity service to customers was reduced through a rotation of service to feeders. However, despite the execution of this strategy, some customers were without power for more than the accepted duration of hours referenced in the Guaranteed Standards of Service, GES 2.

1.1. 4 The aggregate loss of generation from the outages was estimated at 1,291,144 kWh.

1.1.5 On November 19 and 20, 2019, the Commission received preliminary reports of the outages of November 18 and 19, 2019, respectively. These reports captured the time of the outage, status of equipment in service, the time of service restoration and the intent to investigate the faults which occurred.

1.2 Launch of investigation

1.2.1 The Commission launched its investigation into this matter with the convening of a meeting with the BL&P on November 21, 2019, to discuss pertinent issues related to the outages. The main issues raised were the impact of fuel quality on the delivery of electricity service, lack of generation reserves due to plant

maintenance, switch failure in the 69 KV substation, and action taken to restore power. A second meeting also took place on November 22, 2019.

1.2.2 In anticipation of the submission of the final outage report by the BL&P, the Commission requested the BL&P's maintenance reports for all of its generation assets by correspondence dated December 6, 2019. This report was submitted to the Commission on December 16, 2019.

1.2.3 On December 19, 2019, the Commission received correspondence from the BL&P advising that the Reports on the outages of November 18 and 19, 2019 would be submitted by December 27, 2019. The correspondence indicated that the new submission date was as a consequence of challenges in obtaining information from field devices, as well as the scheduled outage of the 69 KV substation to facilitate further investigation. The final outage reports were submitted to the Commission on December 31, 2019.

1.2.4 BL&P's final outage reports, submitted on December 31, 2019, were reviewed by the Commission and, by letter to the BL&P dated February 7, 2020, the Commission requested sworn affidavits annexing specific documents and responses to interrogatories. These documents, which were submitted to the Commission on March 6, 2020, included documentation deemed confidential and the following:

- Affidavit of Johann Greaves
- CV - Johann Greaves (JG-1)
- Affidavit of Rohan Seale
- Detailed Outage Reports (JG-2)
- Electrical and Mechanical Maintenance Records of Generation Plant (JG-3)
- Maintenance Records for Standby Generators (JG-4)
- Maintenance Records for the 24KV/69KV Substations (JG-5)

- Certificates of Analysis for fuel oil samples for 2018-2019 (JG-7)
- Maintenance Records for Generation Plant Control Systems for 2018-2019 (JG-8)
- Responses to Interrogatories 7, 8 and 10 (JG-9)
- Records for the Testing and Troubleshooting of Relay Protection Systems 2018-2019 (RS-1)
- Contingency Planning Portfolio (RS-2)
- Responses to Interrogatories 1 to 6, 9 and 10 (RS-3)

1.2.5 The Commission issued its Preliminary Findings Report on the 'outages' to the BL&P on June 19, 2020 and requested comments on the said report by July 6, 2020. In response to this request, the BL&P submitted by the proposed date the following documents to the Commission for perusal:

- Commentary on Preliminary Findings Report
- Affidavit of Johann Greaves
- Supplemental Outages Report – Exhibit (JG 11)
- Affidavit of Rohan Seale
- Affidavit of Rodney Dottin

1.2.6 The Supplemental Outages Report also annexed three (3) appendices:

- Appendix A - GCMS Acid Extraction Tests
- Appendix B - Contingency Planning Portfolio
- Appendix C
  - Inspection and Test Record RA Transformer Differential Relay;
  - PVR and Test par client 2010;
  - SDCEM SR2002 Maintenance Manual Extract;
  - SP7S2 Original Test Results;
  - Test Reports for SP7S1, SP7S5, SP7S7, SP7S8, SP7S12, SP7S13; and

- Primary Injection Testing of RADHA Transformer and Bus Differential Scheme.

1.2.7 The Commission requested, by letter dated August 24, 2020, and the BL&P submitted under cover of letter dated September 3, 2020, documentation deemed confidential, and the following:

- Affidavit of Johan Greaves
- Affidavit of Rohan Seale
- Affidavit of Rodney Dottin
- Exhibit JG 12
  - Total Cost of Energy not Served;
  - Load, outage duration and restoration times per feeders; and
  - Amended SCADA report for November 19, 2019.
- Exhibit "RD1" Responses to Interrogatories
  - Total Estimated Cost of Outage Claims; and
  - Confirmation of Investigation of all Damage Claims.

1.2.8 This report represents a summary of the Commission's Final Findings Report which was submitted to the BL&P on November 18, 2020. It is based on the investigation conducted into the matter. The investigation included the review of the November 18 and 19, 2019 Outage Reports, the aforementioned documents submitted by the BL&P, a copy of the Inter-American Development Bank (IDB) Outage Report dated December 2019[1] and the Commission's own research. It assesses the nature of the outages, causes and proposed mitigation measures to be taken and completed. This assessment seeks to determine whether the BL&P breached the Utilities Regulation Act, CAP.282 (URA), the Standards of Service or

[1]Technical Report of the Inter-American Development Bank following the electricity outage events of November 2019.

any other legislation or standard which the Commission is empowered to administer.

SECTION 2 LEGISLATIVE FRAMEWORK

2.1 Commission's power to investigate

2.1.1 The Commission has the legal authority to investigate the outages by virtue of the provisions of Section 4(6) of the *Fair Trading Commission Act*, CAP. 326B.
This section states as follows:

> '*The Commission may, on its own initiative or on the request of any person, carry out any investigation that it considers necessary or desirable in connection with matters falling within the provisions of this Act, the Utilities Regulation Act and any laws relating to consumer protection and fair competition which the Commission has jurisdiction to administer*.'

2.2 Provision of safe, adequate, efficient and reasonable service to the public

2.2.1 By virtue of Section 3(3) of the URA, the Commission has regulatory oversight of the service provided to customers by the BL&P.
This section states:

> "*(3) The Commission shall …*
> *(a) protect the interests of consumers by ensuring that service providers supply to the public service that is safe, adequate, efficient and reasonable; and*

2.2.2 Section 20 of the URA also imposes a duty on the part of the BL&P, as a service provider, to maintain its property and equipment in such a way as to enable it to provide service of a certain standard to consumers. This section states:

> "*Every service provider*
> *(a) shall maintain its property and equipment in such condition as to enable it to provide service to the public which is safe, adequate, efficient and reasonable; and*

(b) shall make such repairs, changes, alterations, substitutions, extensions and improvements to such service as shall be necessary to ensure the provision of service to the public that is safe, adequate, efficient and reasonable."

2.3 Standards of Service

2.3.1 BL&P is also bound to observe and apply the Standards of Service established for it by the Commission. In exercise of its powers under Section 3(1)(d) of the URA, on September 29, 2017, the Commission issued Standards of Service for the BL&P in an Order numbered NO. FTC/ORDSOSB/2017-02 ('Order'). In accordance with its provisions, this Order took effect from January 1, 2018 and continues to be in effect until December 31, 2020 or until such time as a new Standards of Service Decision is issued. The Order provides, *inter alia,* as follows:

'*The Barbados Light & Power shall comply with the prescribed Standards of Service and Reliability Performance Targets set out at Table 1, Table 2 and Table 3 of the Schedule attached hereto and the exemptions set out in the Standards of Service Decision 2018–2020'*

2.3.2 The Order established, *inter alia*, the following amended Standard GES 2:

GES 2 (Amended)
Fault Repair - Distribution System
This refers to the time it takes to restore supply after fault on the distribution system (multiple customers).
Within eight (8) hours of receipt of complaint.
$45.00 (D) $90.00 (GS) $215.00 (SVP/LP)
For each additional eight (8) hours prorated on an hourly basis
Customer Initiated Claim required

2.3.3 The Order also established the following reliability performance targets:

SAIDI (Hours per year per customer) 3.68

SAIFI (Outages per year per customer) 5.84
CAIDI (Hours per year per customer) 0.63
ASAI (Percentage System Availability per year) 99.958

2.3.4 Breach of GES2 or of any of the Commission's Standards of Service renders BL&P liable to criminal and civil penalties under the URA. In accordance with Section 21 of the URA, BL&P would be liable, in the event of breach, to pay compensation to affected consumers in accordance with the Order. Section 21 of the URA provides:

> '*Where a service provider fails to meet prescribed standards of service, the service provider shall make to any person who is affected by the failure such compensation as may be determined by the Commission*.'

2.3.5 BL&P could also be liable for payment of penalties set by the Commission in accordance with Section 38 of the URA, which provides as follows:

> '*The Commission may make … (c) orders with respect to*
> *(i) imposing penalties for non-compliance with prescribed standards of service; and*
> *(ii) prescribing amounts to be paid to the person referred to in section 21 for failure to provide a utility service in accordance with the standards of service set by the Commission*.'

2.3.6 The Commission therefore sought to investigate, in connection with the outages:

(i) whether the BL&P had breached the provisions of Section 20 of the URA or any other legislation administered by the Commission and

(ii) whether the BL&P had breached GES 2 or any of the Standards of Service established by the Commission in the Order.

2.3.7 The occurrence of sustained power outages on November 18 and 19, 2019, severely inconvenienced the normal economic potential of businesses and denied end-users the benefit of use of service. The confluence of these events has drawn attention to the availability, reliability and resilience of BL&P's power system[2].

2.3.8 As a consequence of the sustained outages, the Commission has investigated the origin of these events to determine whether the BL&P is liable for breaches under the URA and to identify the requisite recommendations to mitigate against future interruption of service of a similar nature.

[2] A power system is a real-time energy delivery system. It consists of all generating, transmission and distribution infrastructure required to provide the energy to end-users.

SECTION 3 NOVEMBER 18, 2019 POWER OUTAGE

3.1 Nature of fault

3.1.1 The outage on November 18, 2019, resulted from the failure of SP7S2, a high voltage switch at the BL&P's Spring Garden 69 KV Substation. This event disconnected transmission service provided by the two (2) lines from this station and the Central Substation.[3] Moisture deteriorated switch (SP7S2) insulation while it was not in use, thereby resulting in the fault event.

3.1.2 As a consequence, a three (3) phase fault initiated on the transformer SPT10 bus[4] but its protection system failed to clear the fault.[5] This fault was cleared within 376 milliseconds by Bus Bar B Zone 2[6] protection[7].

3.2 Misoperation of protection system

3.2.1 The BL&P admitted that the Transformer SPT10 Bus differential protection system did not operate as designed to clear the fault caused by switch SP7S2. Investigation of this inaction revealed that a high resistance path in the protection and control circuitry of the differential relay impacted its operability[8].

3.2.2 Subsequent to this fault occurrence, GT04 and GT05 tripped on loss of excitation[9] while at 8.5 MW and 19.3 MW, respectively, and all other thermal units (D10, D14, D15, GT03 and GT06) tripped afterwards. In total, an estimated 790,023 kWh[10] was lost owing to collapse of the system after 18.02 seconds of occurrence of the fault.[11]

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[3] Exhibit "JG-2"–The BL&P, Report on the Island Wide Outage of November 18 2019, page 1.
[4]Ibid, page 6, paragraph 1.
[5]Ibid, page 8, paragraph 1.
[6]Zones define the boundaries of system protection.
[7]The BL&P, Report on Island Wide Outage of November 18 2019, page 8, paragraph 1.
[8]Ibid, page 12, paragraph 1.
[9]This refers to when a synchronised generator ceases to maintain this function.
[10]Ibid, page 3, paragraph 1.
[11]Ibid, Table 1.

3.3 Generation status prior to outage

3.3.1 The aggregate load demanded at the time was 113.5 MW. This load provision comprised 56.1 MW of power produced by three (3) Low Speed Diesels and one (1) waste heat turbine; 54.1 MW from four (4) gas turbines; and 3.3 MW from the solar generating plant. At the time of the outage, 44.0 MW of thermal plant[12] was under planned maintenance, while another 44.0 MW of thermal plant[13] was forced out of service by unplanned maintenance events. In total, 88 MW of thermal plant was inoperable prior to the fault.

3.4 Restoration activities

3.4.1 The operation of gas turbine GT01 initiated the black starting process 53 minutes after fault occurrence. This resulted in the first feeder (Temple Yard) being closed at 08:28 hrs.[14] During this time, some generating units experienced operational challenges. Despite this, the restoration process concluded with the closure of the Fontabelle #1 Ex Temple Yard feeder at 22:55 hrs.

3.4.2 The BL&P's restoration of service to customers according to Exhibit JG 12[15] confirms that this was executed in three (3) phases. For the first and second phase, 35.71% and 6.66% of the feeders, respectively, which served customers showed an outage duration for those feeders in excess of the eight (8) hours.

[12]The 44 MW comprises units S2 (20 MW), GT02 (13 MW) and D11 (11 MW). See The BL&P, Report on Island Wide Outage of November 18 2019, Table 2, page 4, and Table 4, page 16.
[13] Ibid, The 44 MW comprises units S1 (20 MW), D12 (11 MW), D13 (11.5 MW) and CG01 (1.5 MW).
[14]Ibid, page 5, paragraph 1.
[15]The BL&P, Affidavit of Johann Greaves - Computation of the percentages of outage duration times is based on the BL&P's submission, Exhibit JG 12.

3.5 Restoration impediments

3.5.1 Unit GT04 could not be immediately utilised for black-starting after it tripped[16,17]due to failed communication between Seawell and Spring Garden load centres.

3.5.2 GT05 and GT06, which have an aggregate load of 40 MW, became inoperable for 10 hours after the UPS supply, which powered their control systems, became depleted. The standby generator, which provides power to the auxiliaries for these units, was undergoing maintenance at the time.

3.5.3 Similarly, units D14 and D15 with a compliment load of 44 MW could not be accessed immediately, since their control system UPS failed, and these systems had to be reloaded prior to the use of these units[18].

3.5.4 During the restoration process, units D14, D15 and GT06 experienced fuel system related issues. GT06 was forced out of service for that day, while the issue with D14 recurred through the restoration phase. Unit D15 was forced offline due to a stuck fuel pump and was subsequently returned to service 5 hours and 7 minutes after the issue arose.[19]

3.6 BL&P's proposed mitigation activities

3.6.1 On page 19 of the November 18, 2019 Outage Report, the BL&P lists a number of corrective measures which are completed or to be implemented. The following provides the current status of these activities:

3.6.2 List of completed activities:

- Leakage test on critical paper insulated switches in Spring Garden and Central 69 KV substations;

[16]The BL&P, Report on Island Wide Outage of November 18 2019, page 3, Table 1.
[17]Ibid, page 12-13, paragraph 4 (2).
[18]Ibid, page 13.
[19]Ibid, page 5, Table 3. According to Table 1, page 3, this unit was at 20 MW when it tripped.

- Injection test to verify the credible functioning of the protection scheme for SPT10 Transformer Bus and Bus B;
- Restoration of UPS support for communication link between Seawell and Spring Garden; and
- Maintenance for GT05 and GT06 Emergency Generator.

3.6.3 List of completed first Quarter 2020 activities:

- Verification of coordination of protection systems between the 69 KV line at Central and the transformer Bus at Spring Garden;
- Investigation of the need for redundant protection at SPT10 as reinforcement to single failure contingency of the transformer bus protection;
- Investigation of GT05 and GT06 control system UPS and replacement of batteries;
- Replacement of UPS batteries for D14 and D15 control system. One set of batteries was replaced prior to the fault. Redundant battery support was procured for replacement.

3.6.4 List of activities for second Quarter of 2020, which are ongoing:

- Verification of operation of loss of excitation protection coordinates with generation equipment parameters and system conditions through stability studies (progress impacted by Covid-19 pandemic); and
- Conduct stability studies to determine system inertia and Critical Fault Clearance Times (CFCTs)[20], to enhance system protection and frequency control tools.[21]

3.6.5 List of activities for third & fourth Quarter of 2020, respectively, to be completed:

[20]The time taken for a disturbance to be applied without the power system losing stability. Faults should be cleared within this time, which is usually less than 150 milliseconds.
[21]The BL&P, Supplemental November 18 and 19, 2019 Power Outage Report, page 11.

- Use of stability studies to investigate and replace protection incorporating impedance relays for loss of excitation for GT04, GT05 and GT06; and
- Replacement of paper-based insulated switches with polymer insulation switches to mitigate against future faults at critical locations. The switches have been procured.[22]

[22]The BL&P indicated that six (6) switches were replaced, while others are being procured. See Tracked Preliminary Findings Report, comment A12, page 19.

SECTION 4 NOVEMBER 19, 2019 POWER OUTAGE

4.1 Nature of fault

4.1.1 At 6:22 hrs, a low voltage direct current (DC) alarm occurred on GT01 while it was carrying 12 MW. The unit subsequently tripped offline at 6:59 hrs owing to the said alarm, which was being investigated prior to the trip.[23] Investigation of the alarm by the BL&P revealed that the lubrication pump and fuel pump for the unit were operational from the previous day's outage and, as a result, the DC supply became depleted. The trip event led to an island-wide power outage and as a result, the total unserved energy was estimated at 501,121 kWh[24].

4.2 Generation status prior to outage

4.2.1 The composite load commitment from units online was 110.6 MW[25]. Three (3) diesel units and a waste heat generator, four (4) gas turbines, a solar plant and the battery energy storage were used to meet consumption demanded from the BL&P, while seven (7) main generation units and a waste-heat system were out of service for maintenance or due to operational issues. The load compliment for these offline thermal units at the time was 122 MW[26]. In total, 44 MW of thermal units were offline due to planned maintenance, while an additional 78 MW was forced out, resulting in unplanned maintenance.

[23] The BL&P, Report on the Island Wide Outage of November 19 2019, page 7, paragraph 2.
[24]Ibid, page 2, paragraph 3.
[25]The summation of the individual loads for the units is 111.5 MW but Table 2, page 4 shows 110.6 MW. Both values are incorrect. The errors appear to be with the load for GT05. This should be 20 MW instead of 21.5 MW. The correct total should be 110 MW.
[26]Ibid, page 4, Table 2. Thermal unit capacity (44 MW) on planned maintenance includes S2 (20 MW), D11 (11 MW), and GT02 (13 MW). Thermal unit capacity (78 MW) forced out of service were S1 (20 MW), D13 (11.5 MW), CG01 (1.5 MW) and GT06 (20 MW).

4.3 Restoration activities

4.3.1 Restoration of service was initiated with GT03, 49 minutes after the fault occurrence. The first feeder (Airport ex Seawell) was closed at 7:49 hrs and the last feeder was closed at 20:26 hrs to complete the restoration process[27]. A load rotation strategy was employed to distribute service fairly amongst consumers. According to the details provided under Exhibit JG 12, only during the first phase of the restoration process was the eight (8) hour duration exceeded for 5.56%[28] of those feeders serving customers.

4.4 Restoration impediments

4.4.1 The 20 MW capacity contribution from unit GT05 was not readily accessible for 10 hours due to a barring block which commenced after its UPS supply became depleted. Additionally, the Standby Generator which serves GT05 and GT06 experienced breaker failure and therefore could not be used to power the auxiliaries for these units. After D14 and D15 tripped, these were unavailable due to failure of their UPS supply and their DCS had to be reloaded prior to service.

4.4.2 Units D11, D13, D14 and GT06 were unavailable for service due to mechanical maintenance, while load on D15 was restricted as a consequence of fuel issues; a generator breaker fault on this unit also impacted availability; attention to these issues contributed to delays in the restoration process.[29]

4.5 Summary of mitigation measures proposed by the BL&P

4.5.1 The following is a list of proposed measures in respect of the outage. These include activities which were completed and outstanding[30].

4.5.2 List of completed activities:

[27]The BL&P, Report on the Island Wide Outage of November 19 2019, Table 4, page 9.
[28]Computation of feeder participation for the outage of November 19, 2019 was based on the BL&P's submission Exhibit JG 12.
[29]The BL&P, Report on the Island Wide Outage of November 19 2019, page 12, paragraph 1.
[30]Ibid, page 12, paragraph 2.

- Replacement of the battery bank for GT01;
- Restoration of transmission between Central and Spring Garden 69 KV Substation;
- Verification of integrity of critical paper insulated switches for 69 KV Substation;
- Lease of 12 MW of generation capacity to furnish existing reserves, while fuel issues are investigated; and
- Investigation of communication link between Seawell and Spring Garden, and replacement UPSs. Investigation of redundant UPS is ongoing.

4.5.3 List of activities completed by first Quarter of 2020:

- Review of response procedure for GT01 alarms by January 31**;**
- Determination of the cause of GT05 and GT06 backup generator breaker failure[31];
- Investigation of GT05 control system UPS and replacement as needed. UPS batteries were replaced and investigations are ongoing; and
- Replacement of D14/D15 control system UPS batteries. One replacement was completed. Redundant batteries were procured.

4.5.4 List of second and third Quarter activities which have commenced and are outstanding, respectively:

- Conduct system stability study to determine system inertia and Critical Fault Clearance Times for additional protection enhancements and frequency control tools; and
- Supplement UFLS scheme with Rate of Change of Frequency (ROCOF) relays. This enhancement was implemented on two (2) feeders in December 2019 based on the BL&P's experience. A setting of -2.5 Hz/s with no time delay was

[31] The BL&P, Supplemental November 18 and 19, 2019 Power Outage Report, page 12. Investigation by the BL&P revealed that the breaker was in the wrong position.

used but this will be reviewed during the proposed stability studies. Additional feeders are expected to be installed during the latter part of 2020.[32]

[32]The BL&P, Report on the Island Wide Outage of November 19 2019, page 13, item 10.

SECTION 5 COMMISSION'S FINDINGS

5.1 Failure of high voltage switch

5.1.1 The Commission found that the failure of the SP7S2 switch resulted from inadequate maintenance activities, particularly given the length of time the switch was inactive prior to it being energised. The discovery of moisture build-up in the switch's insulation by the BL&P[33] suggests that the immediate operating environment within the substation contributed to this anomaly. This irregularity is well within the BL&P's control to mitigate through the praxis of requisite checks and tests.

5.2 Misoperation of protection system

5.2.1 **The Commission found that the failure of the Zone 1 differential protection on the Transformer SPT10 Bus resulted from the lack of a comprehensive maintenance regime for these devices.** The BL&P's discovery of a loose connection on one (1) of the phases of the Current Transformer (CT)[34] suggests that the frequency of assessment from secondary or primary injection tests may not have been adequate.

5.3 Generation adequacy

5.3.1 An adequate supply of power refers to the ability of the electric system to supply the aggregate electrical demand and energy requirements of customers at all times, taking into account scheduled and reasonably unscheduled outages of the power system elements.

5.3.2 The BL&P did not have sufficient plant capacity above the expected peak load that could have addressed contingencies on November 18 and 19, 2019. A total of 18.4 MW[35] and 3.1 MW, respectively, were available prior to the power outages.

[33]The BL&P, Report on the Island Wide Outage of November 18 2019, page 6, paragraph 1.
[34]Ibid.
[35]Ibid, page 16, Table 4.

Adequate plant capacity takes into account the estimated peak load, forced outage of the largest unit and the aggregate capacity of units undergoing planned maintenance. The Commission's computation of the reserve margin based on the dependable and certain capacities for generating units revealed that the 32%[36] threshold was not maintained.

5.4 Trip due to depleted DC supply

5.4.1 The Commission found that the trip of GT01 on November 19, 2019 resulted from a misdiagnosis of the alarm at the time, which should have been considered critical. The unit tripped 37 minutes after annunciation of a low voltage DC alarm. The amount of time which elapsed following initiation of the alarm supports that an incorrect assessment of the alarm was made by the BL&P personnel. Furthermore, trained personnel only detected that the DC lube oil and fuel pumps had remained in service from the previous day, after the unit tripped. One (1) of the key functions of plant personnel is to ensure the correct status of all equipment on a day to day basis; hence, equipment which is not required to operate should be readily reported and investigated.

5.5 Fuel quality verification

5.5.1 The Commission's review of copies of the Certificates of Analysis for the period 2018-2019 (RG 11), and individual fuel analysis reports which were submitted by the BL&P on July 6, 2020 under (Exhibit JG 11), Appendix A, indicates evidence of contaminated fuel, specifically in the latter reports.

5.5.2 The results (under Exhibit JG 11) were based on the Gas Chromatography/Mass Spectrometry (GCMS) Extraction Test technique and Fourier Transform Infrared Spectroscopy applied to the fuel samples. Of the total sample count, three (3) were related to 2018 and ten (10) were related to 2019. Eleven (11) of the reports concluded that a combination of foreign substances (such as phenolic compounds,

[36]The BL&P, Integrated Resource Plan 2012, March 21st, 2013, page 45-46, 50.

alcohols, aldehydes and saturated fatty acid compounds) were present in the fuel samples examined.

5.5.3 The presence of foreign substances in the majority of these fuel samples suggests that (a) the fuel was not compliant with the ISO 8217 fuel Standard, (b) the BL&P could not have required confirmation from the supplier on a consistent basis that the fuel purchased was free from deleterious substances and (c) the BL&P was not periodically testing fuel to ensure that fuel purchased was ISO 8217 compliant. There is no restriction on the BL&P that would preclude the latter being met.

5.5.4 Based on the assessment of the individual fuel samples (Exhibit JG 11), the BL&P had been aware of fuel quality issues since 2018. Two (2) reports for the fuel sample results dated November 2018 concluded that phenolic and alcohol compounds, which were atypical to residual fuel constituents, were detected in the samples. Nine (9) of the samples in 2019 contained foreign substances as well.

5.5.5 The Commission notes that fuel is only considered compliant where the technical parameters and general requirements are met in the ISO 8217 fuel standard.

5.5.6 **Given that fossil fuel is the primary input in power production at the BL&P's plants, more rigorous measures should have been adopted early, in addition to routine testing.** Furthermore, the fuel quality issues of 2018 in Houston, Texas, as well as in Singapore, were known globally.[37]

5.5.7 **The Commission views fuel quality as an essential maintenance feature in the performance and reliability of the BL&P's power system. In this regard, closer attention must be paid to the procurement and appraisal of fuel that the BL&P acquires.**

[37]Sticking of fuel pumps, sludging, filter clogging and corroded pumps were some of the fuel quality challenges experienced by marine vessels in Houston. See International Maritime Corporation, Development of Draft Guidelines for Consistent Implementation of Regulation 14.1.3 of MARPOL, Annex VI: Technical Annex, page 2 number 1- 3.

5.6 Key power system reliability concerns

5.6.1 Assessment of the power outages of November 18 and 19, 2019 also revealed the following reliability issues: (a) repeated depletion of DC supply (UPS) to serve auxiliaries for GT05 and GT06, (b) unavailability of standby generation for these units, (c) loss of communication between Seawell and the Spring Garden generation sites and (d) repeated failure of the UPS for units D14 and D15.

SECTION 6 BREACH IN REGULATORY OBLIGATION

6.1 Breach of URA

6.1.1 Under Section 3(3)(a) of the URA, the Commission is required to ensure that the BL&P provides "safe, adequate, efficient and reasonable service". Additionally, Section 20(a) stipulates that the incumbent utility shall maintain its plant and equipment as a precondition for guaranteeing the aforementioned characteristics of this service. Section 20(b) highlights the measures to be taken by the BL&P to ensure that the requirement at (a) is met.

6.1.2 Based on the Commission's findings, the following four (4) areas constitute breaches of regulatory compliance:

I. **Insufficient operating reserves.**
II. **Inadequate testing of switchgear and protection systems.**
III. **Lack of adequate monitoring and surveillance of electrical equipment.**
IV. **Lack of verification of fuel quality on a consistent basis.**

6.1.3 Recommendations will be made to the BL&P as it relates to the aforementioned areas.

6.2 Breach of Standards of Service

6.2.1 The Commission has, by its Standards of Service 2018 Decision, prescribed the minimum level of service that the BL&P must deliver to customers on a consistent basis. Guaranteed Standards award compensation to impacted customers when a breach occurs.

6.2.2 The outages of November 18 and 19, 2019 denied multiple customers access to a sustained electricity supply beyond the target time of eight (8) hours as stipulated in the Standard GES 2 – Fault Repair – Distribution System.

6.2.3 Damage to some customers' equipment occurred and this requires compliance with the Standard GES 3 – Voltage Complaint, which stipulates that the BL&P

investigate the reported incident within twenty-four (24) hours of receipt; provide an assessment of the report within five (5) working days of receipt; and resolve the issue within thirty (30) days of the report.

The Commission notes that both outages were blackouts and meet the characteristic of a fault on the distribution system.

6.2.4 The two (2) Standards are applicable under the circumstances of the November 18 and 19, 2019 Outages and compensation is required from the BL&P where there is a breach.