REGULATED INDUSTRIES COMMISSION

Quality of Service Standards Scheme for Electricity Generating Entities in Trinidad and Tobago

Annual Performance Report Oct 2021- Dec 2022

April 2024

Information Document

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DEFINITIONS

1. **Nameplate capacity**: is the maximum rated output of a generator, or other electric power production equipment under specific conditions designated by the manufacturer and is commonly expressed in megawatts (MW) and is usually indicated on a nameplate physically attached to the machine.
2. **Watt-hour (Wh):** is the electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour.
3. **Heat rate:** is a measure of the thermal efficiency of a power plant/electrical generating unit that converts fuel into heat and then into electricity. It is the amount of heat energy used to produce an output of one kilowatt-hour (kWh) of electricity. The lower the heat rate, the better the efficiency of the plant/machine.
4. **Capacity factor:** is the ratio of the actual kilowatt-hours of electricity produced in a given period, to the maximum possible for a power plant, if the plant is running full time at rated power. It is influenced by plant utilisation, operational and maintenance efficiency, and type of load support provided by the power unit (whether peak or non-peak), and it may reflect excess capacity relative to load requirements.
5. **Availability factor:** is the amount of time that a power plant/generating unit is able to produce electricity over a specified period, divided by the amount of time in the period. Note that the capacity factor for a given period can never exceed the availability factor for that period. The difference arises when the plant is run at less than full capacity, in which case the capacity factor is less than the availability factor. The value of the availability factor indicates the degree to which the plant is operating reliably.
6. **Equivalent availability factor (EAF):** is the amount of time that a power plant/generating unit is able to produce electricity over a specified period, divided by the amount of time in the period accounting for any outages and equipment or seasonal deratings. EAF measures the effectiveness and overall reliability of energy production facilities.
7. **Equivalent unplanned outage factor (EUOF):** is the fraction of a given operating period in which a generating unit is not available due to forced and maintenance outages and forced and maintenance deratings. This metric is a measure of the unit's unavailability over the specified period.
8. **Equivalent forced outage factor (EFOF)**: is the fraction of a given period in which a generating unit is not available due to forced outages and forced deratings. This metric is a measure of the probability that a unit will not meet its demanded generation requirements.
9. **Base load generating machine**: The base load is the minimum level of demand on an electrical grid over a span of time and the machines that supply the base load are

traditionally operated at maximum output with little adjustment to the output level. They are typically the most efficient of the available generating machines. They are generally shut down, or the output is reduced only to perform maintenance or repair or due to grid constraints.

10. **Load-following generating machine**: A load-following generating machine is adjusted to match the fluctuations in the demand for electricity throughout the day and is typically less efficient than the machine used to supply base load.
11. **Peaking power generating machine**: Peaking power plants are generally run only when there is a high demand, known as the peak demand, for electricity and are typically the least efficient of the available machines but are capable of being started rapidly when needed.

EXECUTIVE SUMMARY

The RIC is the economic regulator of the electricity, water and wastewater sectors in Trinidad and Tobago. In accordance with this mandate, the RIC developed the *"Quality of Service Standards (QSS) Scheme for Electricity Generating Entities in Trinidad and Tobago"* to establish a framework to monitor the services[1] of the regulated service providers in the electricity generating sector. The QSS Scheme for Electricity Generating Entities in Trinidad and Tobago became effective in July 2021.

There are four (4) electricity generating entities in Trinidad and Tobago: T&TEC, which owns and operates the electricity generating plant on the island of Tobago, and three independent power producers (IPPs) located in Trinidad: Power Generation Company of Trinidad and Tobago Limited (PowerGen), Contour Global Trinity Power Limited (CGTPL) and Trinidad Generation Unlimited (TGU). TGU is not listed in the First Schedule of the RIC Act and, therefore, is not a regulated electricity generating entity under the RIC Act and has no obligation to report under the QSS Scheme for Electricity Generating Entities in Trinidad and Tobago (2021).

The three (3) regulated generating entities own and operate the following four (4) power stations:

- PowerGen – Pt. Lisas Power Station located in Couva, Trinidad and
  Penal Power Station located in Penal, Trinidad.
- CGTPL – Power Station located in Couva, Trinidad.
- T&TEC – Cove Power Station located in Friendship, Tobago.

This is the first report on the performance of the power stations of the regulated generating entities with respect to the "*QSS Scheme for Electricity Generating Entities in Trinidad and Tobago (2021).*" This report is based on the quarterly reports submitted by the regulated generating entities to the RIC. The report covers the period from October 1, 2021 to December 31, 2022, and focuses on performance with respect to the operational data and performance indicators established under the QSS Scheme.

[1] Services in this context refer to the supply of electricity by the regulated generating entities to T&TEC for transmission and distribution to T&TEC's customer base.

The reported parameters pertaining to operational data are nameplate capacity, number of generating machines and electrical energy generated.

Nameplate Capacity and number of generating machines: The data provided by the regulated electricity generating entities is as follows:

- PowerGen 1,029MW (Total)
  - Pt. Lisas Power Station - 795MW. Eleven generating machines operating in simple cycle.[2]
  - Penal Power Station - 234MW. Five generating machines, two operating in simple cycle and three in combined cycle.[3]
- CGTPL Power Station - 225MW. Three generating machines operating in simple cycle.
- T&TEC Cove Power Station - 84MW. Five generating machines operating in simple cycle.

PowerGen's combined nameplate capacity is the largest of the three regulated generating entities, followed by CGTPL and T&TEC.

Electrical energy generated: For the period under review, the quantum of electrical energy generated at the four power stations is as follows:

- PowerGen 4,725,758 MWh (Total)
  - Pt. Lisas Power Station - 2,868,762 MWh.
  - Penal Power Station - 1,856,996 MWh.
- CGTPL Power Station - 1,392,231 MWh.
- T&TEC Cove Power Station - 497,485 MWh.

PowerGen generated the most electrical energy followed by CGTPL and T&TEC.

The reported parameters pertaining to the performance indicators are heat rate, capacity factor, availability factor, equivalent availability factor and equivalent unplanned outage factor. In developing the standards for electricity generation in 2019, the RIC chose to limit the number of

[2] A simple cycle gas plant is a type of gas power plant that generates electricity by propelling hot gas through a turbine.
[3] A combined cycle power plant uses both gas and steam turbines together to produce more electricity from the same amount of fuel than a traditional simple-cycle plant. The waste heat from the gas turbine/s is routed to the steam turbine, which generates the extra power.

indicators to specific quality of service indicators and thermal efficiency, which have a significant impact on tariffs paid by retail electricity customers.

Heat Rate: PowerGen's Penal Power Station had the lowest, and most efficient quarterly computed heat rate values of the four power stations, which can be attributed to the operation of the combined cycle plant in the power station. The generating machines in the other three power stations are either internal combustion engines or combustion gas turbines operated in simple cycle mode, which result in less efficient operations and higher heat rate computations. The next lowest quarterly computed heat rate values were for T&TEC's Cove Power Station. This was due primarily to the simple cycle operation of higher-efficiency internal combustion generating machines in this power station at full-load conditions. PowerGen's Pt. Lisas Power Station had the highest quarterly computed heat rate values, followed by CGTPL Power Station, of the four (4) power stations. All the generating machines in both of these power stations are combustion gas turbines operated in simple cycle mode.

Capacity Factor: PowerGen Pt. Lisas Power Station had the lowest values for capacity factor over the period as many of the generating machines in the plant are used for load following. The highest values for capacity factor occurred at the PowerGen Penal Power Station, where three (3) machines are used in combined cycle to supply the base load. The values for capacity factor at CGTPL Power Station where the machines are used to supply peak power, and at T&TEC Cove Power Station where the machines are reportedly used for load following, fell between the values for capacity factor reported by the other two (2) power stations.

Availability Factor: The availability of the plant at all four (4) power stations varied throughout the period. At CGTPL Power Station, the highest availability factor computed was 98.6%. T&TEC Cove Power Station's highest availability factor was 95.9%. PowerGen Penal Power Station's highest availability factor was 95.0%. PowerGen Pt. Lisas Power Station's highest availability factor was 85.2%.

The greatest margin between the overall capacity factor and the overall availability factor over the period October 1, 2021 to December 31, 2022 was at PowerGen Pt. Lisas Power Station, where two (2) machines (#13 and 14) are used for base load, eight (8) machines are used for load

following (#5, 6, 7, 8, 9, 10, 11 and 12) and one (1) machine (#3) is used for peak power. The margin between the overall capacity factor and the overall availability factor at T&TEC Cove Power Station was lower than those at the PowerGen Pt. Lisas Power Station, where all of the five (5) machines were reportedly used for load following purposes. The margin between the overall capacity factor and the overall availability factor at Contour Global Trinity Power Station was lower than those at the T&TEC Cove Power Station, where all five (5) machines were reportedly used for peak power purposes. The smallest margin between the overall capacity factor and the overall availability factor was at PowerGen Penal Power Station where three (3) machines (# 8, 9 and 10) are used for base load and two (2) machines are used for peak power.

Equivalent Availability Factor: The monthly computed equivalent availability factors at all four power stations varied between 55.4% and 100% throughout the period. At CGTPL Power Station, the highest equivalent availability factor computed was 100.0%. PowerGen Penal Power Station's highest equivalent availability factor was 97.5%. T&TEC Cove Power Station's highest equivalent availability factor was 89.9%. PowerGen Pt. Lisas Power Station's highest equivalent availability factor was 88.9%.

Equivalent Unplanned Outage Factor: The monthly computed equivalent unplanned outage factors at all four power stations varied between 0% and 33.3% throughout the period. At the CGTPL Power Station, the highest equivalent unplanned outage factor was 33.3%. T&TEC's Cove Power Station's highest equivalent unplanned outage factor was 31.7%. PowerGen's Penal Power Station's highest equivalent unplanned outage factor was 23.9%. PowerGen's Pt. Lisas Power Station's highest equivalent unplanned outage factor was 25.5%.

Equivalent Forced Outage Factor: The monthly computed equivalent forced outage factors at all four (4) power stations varied between 0% and 31.2% throughout the period. At the CGTPL Power Station, the highest equivalent forced outage factor was 4.2%. T&TEC's Cove Power Station's highest equivalent forced outage factor was 31.2%. PowerGen's Penal Power Station's highest equivalent forced outage factor was 20.6%. PowerGen's Pt. Lisas Power Station's highest equivalent forced outage factor was 16.3%.

The amount of electrical energy generated by the power stations of the regulated generating entities over the period showed some correlation to the nameplate capacity of the respective power stations. PowerGen's Pt. Lisas Power Station, with the largest nameplate capacity, generated the greatest amount of electrical energy, followed by PowerGen's Penal Power Station, CGTPL Power Station, and T&TEC's Cove Power Station, similar to the order of their nameplate capacity.

The heat rates at the four power stations varied throughout the period, with PowerGen's Penal Power Station having the lowest computed values, an indication that it was the most efficient at converting fuel to electrical energy. This was followed by T&TEC's Cove Power Station, CGTPL Power Station, and PowerGen's Pt. Lisas Power Station. The examination of the margin between the overall capacity factor and the overall availability factor for the four power stations showed that there was always sufficient machine availability at each of the four power stations to serve the generation requirements placed on them throughout the period. Furthermore, the margin between the overall capacity factor and the overall availability factor is an indication of the utilisation of the plant in a power station. The smaller the value of the margin, typically, the longer the running time of the available plant. This margin was smallest at PowerGen's Penal Power Station (which had the lowest computed heat rates over the period), followed by T&TEC's Cove Power Station, CGTPL's Power Station and the PowerGen Pt. Lisas Power Station (which had the highest computed heat rates over the period).

SECTION 1.0 INTRODUCTION

1.1 Background

The RIC is the economic regulator of the electricity, water and wastewater sectors in Trinidad and Tobago. In carrying out its regulatory functions, the RIC is guided by the legislative and regulatory framework set out in the RIC Act No. 26 of 1998. Section 6(1) of the RIC Act empowers the RIC to, amongst other things, prescribe standards for services; monitor service providers to assess performance with the established standards; impose sanctions for non-compliance; carry out studies of efficiency and economy of operation and of performance by service providers; and publish the results thereof. In accordance with this mandate, the RIC developed the *"Quality of Service Standards (QSS) Scheme for Electricity Generating Entities in Trinidad and Tobago"* in 2019 to establish a framework to monitor the services[4] of the regulated service providers in the electricity generating sector. In developing the standards for electricity generation in 2019, the RIC chose to limit the number of indicators to specific quality of service indicators and thermal efficiency, which have a significant impact on tariffs paid by retail electricity customers. The QSS Scheme for Electricity Generating Entities in Trinidad and Tobago became effective through Legal Notice No. 202, "*The Regulated Industries Commission (Supply of Electricity) Order, 2021*" in July 2021.

The Trinidad and Tobago Electricity Commission (T&TEC) is the sole electricity transmission and distribution utility in Trinidad and Tobago. T&TEC owns and operates the electricity generating plant on the island of Tobago and there are three independent power producers (IPPs) located in Trinidad: Power Generation Company of Trinidad and Tobago Limited (PowerGen), Contour Global Trinity Power Limited (CGTPL) and Trinidad Generation Unlimited (TGU). TGU is not listed in the First Schedule of the RIC Act and, therefore, is not a regulated electricity generating entity and has no obligation to report under the QSS Scheme for Electricity Generating Entities in Trinidad and Tobago (2021).

The QSS Scheme for Electricity Generating Entities in Trinidad and Tobago (2021) is expected to bring public awareness and scrutiny to the performance of the electricity generating sector, and the

[4] Services in this context refer to the supply of electricity by the regulated generating entities to T&TEC for onward transmission and distribution to T&TEC's customer base.

regulated electricity generating entities are expected to maintain acceptable standards of service in compliance with the QSS Scheme. This is intended to contribute to the promotion of economic efficiency, reliability, energy security and transparency within the sector. Following the promulgation of the Order in July 2021, the RIC met with T&TEC, PowerGen and CGTPL to establish the reporting framework that became effective on October 1, 2021. Accordingly, the regulated electricity generating entities are required to report to the RIC on a quarterly basis on the operational data and performance indicators for the generating machines at their respective facilities. The RIC has reviewed and collated the regulated electricity generating entities' submissions and this report is the first publication of the performance of the regulated electricity generating entities. The report will be published annually. All the data in this report was supplied by T&TEC, PowerGen and CGTPL.

1.2 Purpose of Document

The purpose of this document is to report on the performance of the regulated electricity generating entities with respect to the QSS Scheme for Electricity Generating Entities in Trinidad and Tobago (2021) over the period October 2021 to December 2022. The operations at both the power station level and those of the individual machines in each power station will be discussed in relation to the performance indicators set out in the QSS Scheme.

1.3 Structure of Document

This document is divided into four sections. **Section 1.0** states the background, purpose and structure of the report. **Section 2.0** presents the operational data for the power stations of the regulated electricity generating entities and details the number of generating units at the respective power stations, the type, the capacity, and specifications of each generating unit, and the quantum of electrical energy generated over the review period. **Section 3.0** presents the computed performance indices of heat rate, and the capacity, availability, equivalent availability, equivalent unplanned outage and equivalent forced outage factors. Lastly, **Section 4.0** presents a summary comparison of the operational data and performance indicators of the regulated electricity generating entities. The list of performance indicators for the regulated generating entities in the electricity generating sector is presented in the appendix.

SECTION 2.0 OPERATIONAL DATA

T&TEC receives the electricity generated by the various electricity-generating entities located in Trinidad and Tobago, which it then transmits and distributes to its customers across an interconnected electricity grid. T&TEC seeks to maintain an adequate and reliable electricity supply to its customers by interfacing with all electricity-generating entities to match, in real time, the power that is obtained from the electricity-generating entities with the demand for energy.

T&TEC owns and operates the utility scale generating facility located in Tobago. There are four utility scale generating facilities located in Trinidad, of which two are owned and operated by PowerGen, one by CGTPL, and one by TGU. T&TEC is responsible for purchasing all of the fuel that is supplied to the electricity generating facilities, both T&TEC owned and those owned by the IPPs. All of the electricity generating entities are directed by T&TEC on the amount of power to produce at any given period and consequently on which generating machines in their facilities should be run and which should be on standby given the demand/load on the grid. It is necessary to have generating machines on standby to ensure that they can be brought online quickly in response to unforeseen events, such as the loss of output from a generating machine that is operating or the rapid increase in the load on the grid. Without this arrangement, there may be power outages or instability across the electricity grid while waiting for the machines to be started and brought into operation.

The dispatch of power, which is coordinated by T&TEC, is dynamic in nature and determines the amount of power that is taken from a power plant and which of the available machines are either supplying power, are in standby mode, or are offline. Power-generating machines are operated in one of three ways based on their unique operating characteristics:

- The base load (B) is the minimum level of demand on an electrical grid over a span of time and the machines that supply the base load are traditionally operated at maximum output with little adjustment to the output level. They are typically the most efficient of the available generating machines. They are generally shut down, or the output is reduced only to perform maintenance or repair or due to grid constraints.

- A load-following (LF) generating machine is adjusted to match the fluctuations in the demand for electricity throughout the day and is typically less efficient than the machine used to supply base load.
- Peaking power (PP) plants are generally run only when there is a high demand, known as the peak demand, for electricity and are typically the least efficient of the available machines but are capable of being rapidly started up when required.

The types of machines installed at the various power stations include internal combustion engines (IC), combustion gas turbines (GT) and one steam turbine (ST) as part of a combined cycle power plant[5] (CC) with two GTs at the PowerGen Penal Power Station. The primary difference between internal combustion engines and combustion gas turbines is the way they convert fuel into the mechanical energy used to generate electricity. Internal combustion engines use pistons to convert pressure into rotating motion, while combustion gas turbines use the pressure from the exploding fuel to turn a turbine and produce thrust. In terms of efficiency, gas turbines are more efficient than internal combustion engines at the machine's maximum power output. However, internal combustion engines are more efficient at part load. Natural gas (G) is the main fuel supplied to the electricity-generating machines. The internal combustion engines, located at the Cove power station, have the capability to be configured to operate on either natural gas or diesel fuel (D), while the combustion gas turbines, located at all the power stations, can only be operated on natural gas.

The nameplate capacity is the maximum rated output of a generator or other electric power production equipment under specific conditions designated by the manufacturer. It is commonly expressed in megawatts (MW) and is usually indicated on a nameplate physically attached to the machine. The derating of an electricity generating machine is the declared decrease in the nameplate capacity of the unit, and represents the maximum capacity of the unit at that time. Derating can result from a system or equipment modification or environmental, operational, or reliability factors. Generator capacity deratings may be caused by high cooling water temperatures, equipment degradation, or a change in performance during peak demand periods. The operational

[5] A combined cycle power plant uses both gas and steam turbines together to produce more electricity from the same fuel than a traditional simple-cycle plant. The waste heat from the gas turbine/s is routed to the steam turbine, which generates the extra power.

data for the power plants of the regulated service providers will now be presented. The station peak is not necessarily the sum of the peaks of the individual machines at the particular power station, as the peaks of all the machines may not have occurred at the same time.

2.1 T&TEC - Cove Power Station, Friendship, Tobago

There are five (5) generating units at the Cove Power Station (CPS) with a total nameplate capacity of 84 MW. Table 1 lists the machines and their characteristics.

For the period October 1, 2021 to December 31, 2021, the station peak at the Cove Power Station was 56.5 MW and occurred on December 23, 2021. The total energy generated over the period was 101,086 MWh. Table 1 shows the breakdown of each machine's characteristics and the energy generated by each unit over the period.

Table 1: Generating machine details and Operational data per unit (October 1, 2021 to December 31, 2021) - Cove Power Station.

Machine Name	Type	Fuel Type	Main Use	Nameplate Capacity (MW)	Range of Derated Capacity (MW)	Peak Output (MW)	Energy Generated (MWh)
CPS#1	IC	G/D	LF	16	13 - 16	15.5	20,400
CPS#2	IC	G/D	LF	16	0 - 16	14.8	3,240
CPS#3	IC	G/D	LF	16	14 - 16	15.5	20,892
CPS#4	IC	G/D	LF	16	14 - 16	14.6	24,032
CPS#5	GT	G	LF	20	16 - 20	20.0	32,522

Abbreviations: IC – Internal Combustion, GT – Gas Turbine, G – Natural Gas, D - Diesel, LF – Load following.

For the period January 1, 2022 to December 31, 2022, the station peak at the Cove Power Station was 61.1 MW and occurred on August 16, 2022. The total energy generated over the period was 396,399 MWh. Table 2 shows the breakdown of each machine's characteristics and the energy generated by each unit over the period.

Table 2: Operational data per unit (January 1, 2022 to December 31, 2022 - Cove Power Station.

Machine Name	Nameplate Capacity (MW)	Range of Derated Capacity (MW)	Peak Output (MW)	Energy Generated (MWh)
CPS#1	16	12.9 - 16	15.0	62,242
CPS#2	16	14.2 - 16	16.0	81,470
CPS#3	16	14.0 - 16	16.0	73,428
CPS#4	16	13.3 - 16	15.6	70,501
CPS#5	20	16.0 - 20	20.0	108,758

For the period October 1, 2021 to December 31, 2022, the quantum of electrical energy generated varied between 28,507 MWh and 35,514 MWh on a monthly basis, with the highest amount being in July (Q3 2022) and the lowest amount in February (Q1 2022), as shown in Figure 1.

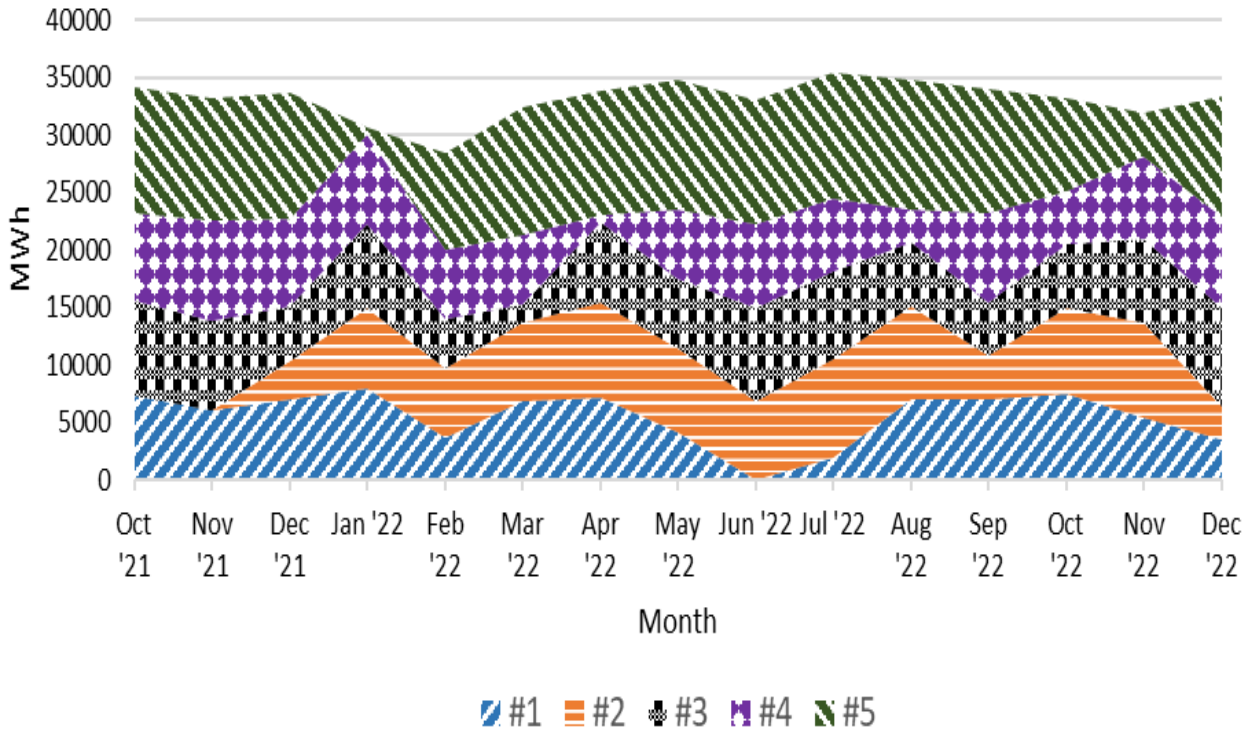

Figure 1. Breakdown of Energy Generated (MWh) at the Cove Power Station by Machine

All the machines were operated throughout the period. Machine #2 was taken out of service in October and November 2021. Machine #5 contributed the largest share of the total energy produced by the power station, followed by machines #4, 3, 2 and 1, respectively.

2.2 Contour Global Trinity Power Station, Couva, Trinidad

There are three (3) generating units at the CGTPL Power Station with a total nameplate capacity of 225 MW. Table 3 lists the machines and their characteristics.

For the period October 1, 2021 to December 31, 2021, the station peak at the power station was 210 MW and occurred in each month of the period. The total energy generated over the period was 307,065 MWh. Table 3 shows the breakdown of each machine's characteristics and the energy generated by each unit over the period.

Table 3: Generating machine details and Operational data per unit (October 1, 2021 to December 31, 2021) - Trinity Power Station.

Machine Name	Type	Fuel Type	Main Use	Nameplate Capacity (MW)	Range of Derated Capacity (MW)	Peak Output (MW)	Energy Generated (MWh)
Unit 101	GT	G	PP	75	75 (no derating)	74	97,355
Unit 201	GT	G	PP	75	75 (no derating)	73	97,895
Unit 301	GT	G	PP	75	75 (no derating)	72	111,815

Abbreviations: GT – Gas Turbine, G – Natural Gas, PP – Peak Power.

For the period January 1, 2022 to December 31, 2022, the station peak at the power station was 210 MW and occurred in each month of the year. The total energy generated over the period was 1,085,166 MWh. Table 4 shows the breakdown of each machine's characteristics and the energy generated by each unit over the period.

Table 4: Operational data per unit (January 1, 2022 to December 31, 2022) - Trinity Power Station.

Machine Name	Nameplate Capacity (MW)	Range of Derated Capacity (MW)	Peak Output (MW)	Energy Generated (MWh)
Unit 101	75	75 (no derating)	75	383,267
Unit 201	75	75 (no derating)	75	353,503
Unit 301	75	75 (no derating)	75	348,396

For the period October 1, 2021 to December 31, 2022, the quantum of electrical energy generated varied between 32,068 MWh and 136,765 MWh on a monthly basis, with the highest amount being in August (Q3 2022) and the lowest amount in December (Q4 2022), as shown in Figure 2.

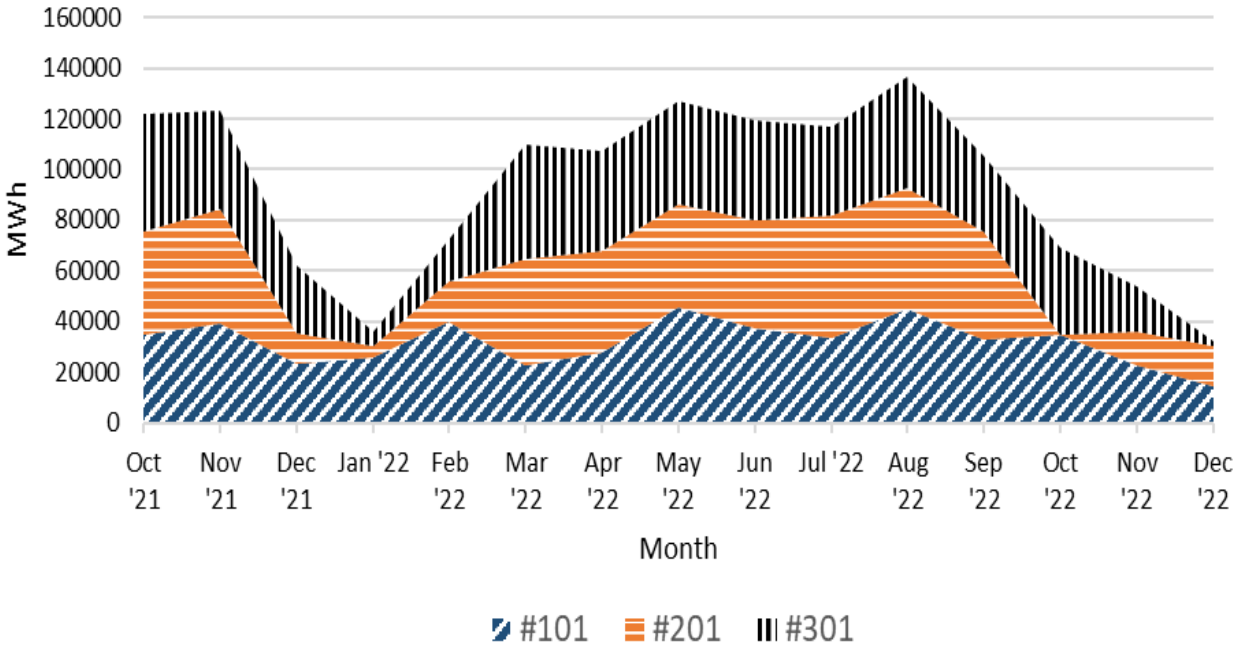

Figure 2. Breakdown of Energy Generated (MWh) at the Contour Global Trinity Power Station by Machine

All the machines were operated throughout the period. Machine #201 was taken out of service in October, 2022. Machine #101 contributed the largest share of the energy produced by the power station, followed by machines #301 and 201, respectively.

2.3 PowerGen

2.3.1 Pt. Lisas Power Station, Couva, Trinidad

There are 11 generating units at the Pt. Lisas Power Station with a total nameplate capacity of 795 MW. Table 5 lists the machines and their characteristics.

For the period October 1, 2021 to December 31, 2021, the total energy generated over the period at the Pt. Lisas Power Station was 569,999 MWh. Table 5 shows the breakdown of each machine's characteristics and the energy generated by each unit over the period.

Table 5: Generating machine details and Operational data per unit (October 1, 2021 to December 31, 2021) - Pt. Lisas Power Station.

Machine Name	Type	Fuel Type	Main Use	Nameplate Capacity (MW)	Range of Derated Capacity (MW)	Peak Output (MW)	Energy Generated (MWh)
PTL#3	GT	G	PP	15	15 (no derating)	14.0	2
PTL#5	GT	G	LF	80	79.4 - 80	72.3	4,133
PTL#6	GT	G	LF	80	80 (no derating)	84.5	51,296
PTL#7	GT	G	LF	62.5	61 – 62.4	63.3	78,497
PTL#8	GT	G	LF	62.5	62.5 (no derating)	0.0	0
PTL#9	GT	G	LF	62.5	60.3 – 62.5	64.1	72,732
PTL#10	GT	G	LF	62.5	62.5 (no derating)	63.9	72,603
PTL#11	GT	G	LF	80	65 – 65.6	70.5	15,893
PTL#12	GT	G	LF	80	79.1 – 79.9	80.9	46,803
PTL#13	GT	G	B	105	99.1 – 100.1	105.6	146,700
PTL#14	GT	G	B	105	100.1	105.3	81,340

Abbreviations: GT – Gas Turbine, G – Natural Gas, LF – Load following, PP – Peaking Power, B - Baseload.

For the period January 1, 2022 to December 31, 2022, the total energy generated over the period at the Pt. Lisas Power Station was 2,298,763 MWh. Table 6 shows the breakdown of each machine's characteristics and the energy generated by each unit over the period.

Table 6: Operational data per unit (January 1, 2022 to December 31, 2022) - Pt. Lisas Power Station.

Machine Name	Nameplate Capacity (MW)	Range of Derated Capacity (MW)	Peak Output (MW)	Energy Generated (MWh)
PTL#3	15	10-15	13.8	233
PTL#5	80	75.1-80	81.2	102,254
PTL#6	80	80 (no derating)	82.5	159,168
PTL#7	62.5	61-62.5	62.8	248,347
PTL#8	62.5	61-62.5	62.3	15,998
PTL#9	62.5	62.5 (no derating)	65.3	147,061
PTL#10	62.5	61-62.5	69.9	248,809
PTL#11	80	60.3-80	84.1	181,648
PTL#12	80	77-79.2	94.2	201,372
PTL#13	105	92.6-100.25	105.3	541,964
PTL#14	105	97.7-102	103.8	451,909

For the period October 1, 2021 to December 31, 2022, the quantum of electrical energy generated varied between 88,552 MWh and 289,129 MWh on a monthly basis, with the highest amount being in August (Q3 2022) and the lowest amount in December (Q4 2022), as shown in Figure 3.

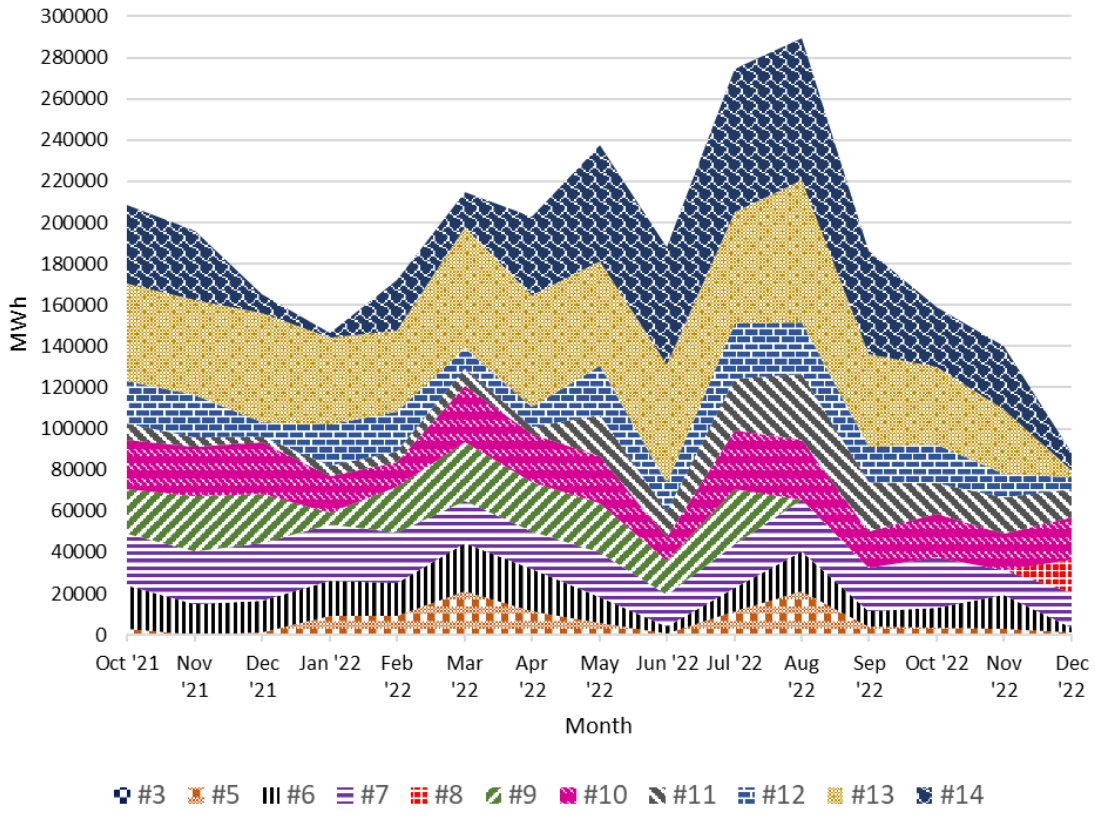

Figure 3. Breakdown of Energy Generated (MWh) at the Pt. Lisas Power Station by Machine

The outputs of machines #3 and 8 are small compared to the other machines. Therefore, the representation in Figure 3 is barely visible. All the machines were operated throughout the period. Machines #3, 6, 8 and 9 were either on standby or not in service in various months. Machine #13 contributed the largest share of the energy produced by the power station, followed by machines #14, 7, 10, 12, 9, 6, 11, 5, 8 and 3, respectively.

2.3.2 Penal Power Station, Penal, Trinidad

There are five (5) generating units at the Penal Power Station with a total nameplate capacity of 234 MW. Table 7 lists the machines and their characteristics.

For the period October 1, 2021 to December 31, 2021, the total energy generated over the period at the Penal Power Station was 393,103 MWh. Table 7 shows the breakdown of each machine's characteristics and the energy generated by each unit over the period.

Table 7: Generating machine details and Operational data per unit (October 1, 2021 to December 31, 2021) - Penal Power Station.

Machine Name	Type	Fuel Type	Main Use	Nameplate Capacity (MW)	Range of Derated Capacity (MW)	Peak Output (MW)	Energy Generated (MWh)
PEN#6	GT	G	PP	15	15 (no derating)	17.4	2,813
PEN#7	GT	G	PP	15	14.9 – 15	16.6	58
PEN#8	GT/CC	G	B	72	71.7 – 72	77.6	138,235
PEN#9	ST/CC	G	B	60	52.9 – 56.9	60.3	116,192
PEN#10	GT/CC	G	B	72	71.4 – 71.7	74.9	135,805

Abbreviations: GT – Gas Turbine, ST – Steam Turbine, CC – Combined Cycle, G – Natural Gas, PP – Peaking Power, B - Baseload.

For the period January 1, 2022 to December 31, 2022, the total energy generated over the period at the Penal Power Station was 1,463,893 MWh. Table 8 shows the breakdown of each machine's characteristics and the energy generated by each unit over the period.

Table 8: Operational data per unit (January 1, 2022 to December 31, 2022) - Penal Power Station.

Machine Name	Nameplate Capacity (MW)	Range of Derated Capacity (MW)	Peak Output (MW)	Energy Generated (MWh)
PEN#6	15	15 (no derating)	16.6	2,906
PEN#7	15	15 (no derating)	15.3	4,145
PEN#8	72	71.9-72	78.0	522,463
PEN#9	60	40.1-57	61.4	443,294
PEN#10	72	71.4-72	75.5	491,085

For the period October 1, 2021 to December 31, 2022, the quantum of electrical energy generated varied between 87,245 MWh and 141,346 MWh on a monthly basis, with the highest amount being in October (Q4 2022) and the lowest amount in February (Q1 2022), as shown in Figure 4.

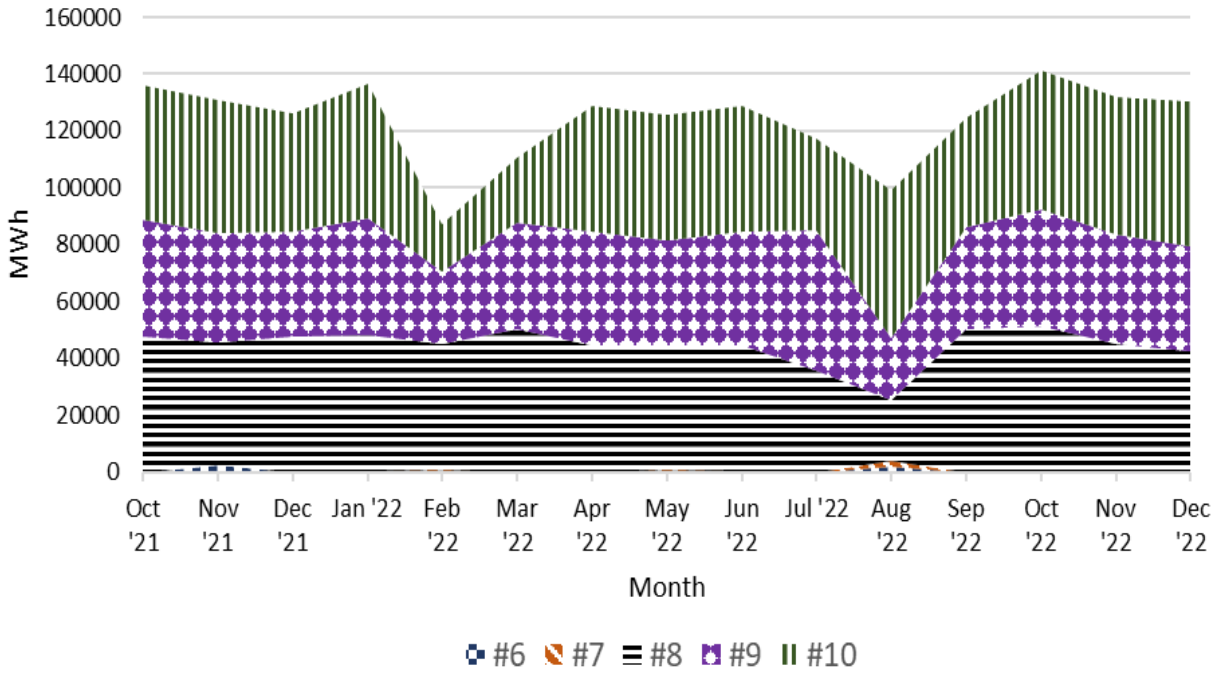

Figure 4. Breakdown of Energy Generated (MWh) at the Penal Power Station by Machine

The outputs of machines #6 and 7 are small compared to the other machines. Therefore, the representation in Figure 4 is barely visible. All the machines were operated throughout the period. Machines #6 and 7 were either on standby or not in service in various months. Machine #8 contributed the largest share of the energy produced by the power station, followed by machines #10, 9, 6 and 7, respectively.

SECTION 3.0 PERFORMANCE INDICATORS

This section, presents the performance over the reporting period of the generating machines in the power stations with respect to the performance indicators: heat rate, capacity factor, availability factor, equivalent availability factor and equivalent unplanned outage factor.

3.1 T&TEC- Cove Power Station

3.1.1 Heat Rate

The heat rate of the Cove Power Station varied between 10,706.7 KJ/kWh and 11,040.4 KJ/kWh on a quarterly basis over the period October 1, 2021 to December 31, 2022. During the period, the heat rates for the individual generating machines varied on a monthly basis between:

- Machine #1: 9,314.37 and 10,372.74 KJ/kWh.
- Machine #2: 9,570.62 and 10,622.15 KJ/kWh.
- Machine #3: 9,503.98 and 10,222.29 KJ/kWh.
- Machine #4: 9,459.04 and 10,196.43 KJ/kWh.
- Machine #5: 10,998.84 and 15,762.30 KJ/kWh.

Machines # 1, 2, 3 and 4, which are internal combustion engines, are more thermally efficient than machine #5 at full load conditions, which is a gas turbine engine. The heat rates of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 9.

Table 9: Heat Rates (KJ/kWh) of Generating Machines – Cove Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine					Power Station
	#1	#2	#3	#4	#5	
Oct '21	10,082.74	Not in Service	9,802.34	9,789.21	13,246.71	11,040.4
Nov '21	10,119.01	Not in Service	9,705.25	9,688.47	13,572.49	
Dec '21	10,210.97	10,144.38	9,840.59	9,870.20	13,507.94	
Jan '22	9,988.08	10,118.14	9,935.33	9,642.16	10,998.84	10,841.9
Feb '22	10,131.31	10,622.15	10,222.29	9,945.54	13,336.39	
Mar '22	10,372.74	10,522.56	9,503.98	10,129.19	13,554.20	
Apr '22	10,142.34	9,912.71	9,956.39	9,724.74	13,096.62	10,996.9
May '22	9,990.04	10,121.09	9,762.11	10,012.25	12,864.63	
Jun '22	9,825.06	10,124.06	9,747.62	10,100.17	13,407.06	
Jul '22	9,314.37	10,010.83	9,890.11	9,459.04	15,762.30	11,220.6
Aug '22	9,880.47	9,926.46	9,768.33	9,773.68	13,529.94	
Sep '22	9,757.05	10,024.18	9,743.36	9,755.63	13,453.98	
Oct '22	10,309.85	10,134.48	9,916.94	10,196.43	13,240.50	10,706.7
Nov '22	9,822.12	9,570.62	9,603.40	9,867.42	14,375.05	
Dec '22	9,953.95	9,760.51	9,864.59	9,860.76	13,286.46	

3.1.2 Capacity Factor

The capacity factor of the Cove Power Station varied between 56.1% and 73.5% on a quarterly basis over the period October 1, 2021 to December 31, 2022. During the period, the quantum of the capacity factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #1: 0.4 and 82.2%
- Machine #2: 27.6 and 79.3%
- Machine #3: 14.3 and 80.1%
- Machine #4: 6.5 and 87.0%
- Machine #5: 4.0 and 95.0%

The capacity factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 10.

Table 10: Capacity Factors of Generating Machines – Cove Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine					Power Station
	#1	#2	#3	#4	#5	
Oct ‘21	75.5%	Not in Service	80.1%	72.6%	75.3%	73.5%
Nov ‘21	64.4%	Not in Service	76.6%	87.0%	92.6%	
Dec ‘21	72.8%	40.8%	43.3%	71.1%	91.7%	
Jan ‘22	82.2%	62.1%	71.4%	70.6%	4.0%	56.1%
Feb ‘22	42.7%	62.1%	44.1%	62.3%	73.8%	
Mar ‘22	70.3%	64.5%	14.3%	55.3%	75.0%	
Apr ‘22	76.7%	79.3%	64.9%	6.5%	74.4%	60.7%
May ‘22	43.6%	68.8%	54.0%	61.3%	76.2%	
Jun ‘22	0.4%	65.4%	74.2%	69.7%	75.4%	
Jul ‘22	20.6%	78.4%	68.6%	56.4%	93.2%	64.8%
Aug ‘22	72.1%	74.8%	51.0%	26.3%	95.0%	
Sep ‘22	74.4%	37.8%	43.6%	74.9%	93.3%	
Oct ‘22	77.7%	69.5%	51.3%	41.8%	55.4%	58.5%
Nov ‘22	58.6%	78.7%	70.6%	68.5%	26.1%	
Dec ‘22	35.9%	27.6%	78.8%	74.0%	70.9%	

3.1.3 Availability Factor

The availability factor of the Cove Power Station varied between 86.9% and 98.6% on a quarterly basis over the period October 1, 2021 to December 31, 2022. During the period, the quantum of the availability factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #1: 1.9 and 100.0%.
- Machine #2: 51.3 and 100.0%.
- Machine #3: 19.6 and 100.0%.
- Machine #4: 30.1 and 100.0%.
- Machine #5: 6.0 and 100.0%.

The availability factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 11.

Table 11: Availability Factors of Generating Machines – Cove Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine					Power Station
	#1	#2	#3	#4	#5	
Oct ‘21	98.2%	Not in Service	100.0%	90.4%	97.5%	80.6%
Nov ‘21	85.1%	Not in Service	97.6%	100.0%	99.2%	
Dec ‘21	100.0%	62.0%	73.5%	96.6%	96.0%	
Jan ‘22	100.0%	94.9%	100.0%	97.9%	6.0%	85.3%
Feb ‘22	94.6%	100.0%	76.3%	95.9%	99.3%	
Mar ‘22	100.0%	100.0%	19.6%	99.4%	99.5%	
Apr ‘22	97.1%	100.0%	96.8%	96.8%	99.3%	90.9%
May ‘22	94.4%	97.7%	93.2%	94.1%	99.7%	
Jun ‘22	1.9%	96.8%	95.6%	99.0%	100.0%	
Jul ‘22	25.9%	100.0%	97.5%	85.4%	98.9%	79.3%
Aug ‘22	90.8%	95.4%	73.0%	30.1%	100.0%	
Sep ‘22	92.2%	51.3%	58.9%	99.1%	100.0%	
Oct ‘22	100.0%	98.7%	98.0%	78.8%	79.4%	95.9%
Nov ‘22	91.1%	100.0%	98.8%	100.0%	98.8%	
Dec ‘22	97.8%	99.3%	99.9%	99.9%	99.1%	

3.1.4 Equivalent Availability Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent availability factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #1: 1.6 and 81.3 %
- Machine #2: 41.4 and 90.6 %
- Machine #3: 17.8 and 90.5 %
- Machine #4: 26.9 and 90.7 %
- Machine #5: 6.0 and 100.0 %

The equivalent availability factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 12.

Table 12: Equivalent Availability Factors of Generating Machines – Cove Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine					Power Station
	#1	#2	#3	#4	#5	
Oct ‘21	79.9%	Not in Service	87.5%	79.5%	94.5%	68.3%
Nov ‘21	69.3%	Not in Service	85.6%	87.5%	99.2%	68.3%
Dec ‘21	81.3%	41.4%	68.5%	87.4%	96.1%	74.9%
Jan ‘22	81.3%	88.8%	87.5%	90.1%	6.0%	70.7%
Feb ‘22	76.9%	90.6%	66.7%	87.0%	85.1%	81.3%
Mar ‘22	81.2%	90.5%	17.8%	90.1%	99.5%	75.8%
Apr ‘22	78.8%	90.6%	90.4%	90.7%	99.3%	89.9%
May ‘22	76.3%	86.7%	87.4%	78.4%	99.6%	85.7%
Jun ‘22	1.6%	87.9%	89.9%	89.7%	100.0%	73.8%
Jul ‘22	22.5%	90.6%	91.6%	80.1%	98.8%	75.1%
Aug ‘22	73.8%	86.4%	68.4%	26.9%	100.0%	71.1%
Sep ‘22	74.7%	46.4%	53.0%	89.7%	100.0%	72.8%
Oct ‘22	81.1%	89.4%	88.6%	72.8%	78.4%	82.1%
Nov ‘22	73.9%	90.6%	89.5%	90.6%	98.7%	88.7%
Dec ‘22	79.3%	89.8%	90.5%	90.5%	99.0%	89.8%

3.1.5 Equivalent Unplanned Outage Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent unplanned outage factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #1: 18.8 and 98.4%.
- Machine #2: 9.4 and 58.6%.
- Machine #3: 8.4 and 82.2%.
- Machine #4: 9.3 and 73.1%.
- Machine #5: 0.0 and 94.0%.

The equivalent unplanned outage factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 13.

Table 13: Equivalent Unplanned Outage Factors of Generating Machines – Cove Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine					Power Station
	#1	#2	#3	#4	#5	
Oct ‘21	20.1%	Not in Service	12.5%	20.5%	5.5%	31.7%
Nov ‘21	30.7%	Not in Service	14.4%	12.5%	0.8%	31.7%
Dec ‘21	18.8%	58.6%	31.5%	12.6%	3.9%	25.1%
Jan ‘22	18.8%	11.2%	12.5%	9.9%	94.0%	29.3%
Feb ‘22	23.1%	9.4%	33.3%	13.0%	14.9%	18.7%
Mar ‘22	18.8%	9.5%	82.2%	9.9%	0.5%	24.2%
Apr ‘22	21.2%	9.4%	9.6%	9.3%	0.7%	10.1%
May ‘22	23.7%	13.3%	12.6%	21.6%	0.4%	14.3%
Jun ‘22	98.4%	12.1%	10.1%	10.3%	0.0%	26.2%
Jul ‘22	77.5%	9.4%	8.4%	19.9%	1.2%	24.9%
Aug ‘22	26.2%	13.6%	31.6%	73.1%	0.0%	28.9%
Sep ‘22	25.3%	53.6%	47.0%	10.3%	0.0%	27.2%
Oct ‘22	18.9%	10.6%	11.5%	27.2%	21.6%	17.9%
Nov ‘22	26.1%	9.4%	10.5%	9.4%	1.3%	11.3%
Dec ‘22	20.7%	10.2%	9.5%	9.5%	1.0%	10.2%

3.1.6 Equivalent Forced Outage Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent forced outage factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #1: 0.3 and 26.2%
- Machine #2: 9.4 and 58.6%
- Machine #3: 2.4 and 27.4%
- Machine #4: 3.9 and 17.5%
- Machine #5: 0.0 and 94.0%

The equivalent forced outage factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 14.

Table 14: Equivalent Forced Outage Factors of Generating Machines – Cove Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine					Power Station
	#1	#2	#3	#4	#5	
Oct ‘21	18.3%	Not in Service	12.5%	11.5%	4.6%	29.4%
Nov ‘21	30.7%	Not in Service	12.8%	12.5%	0.0%	31.2%
Dec ‘21	18.8%	58.6%	27.4%	9.9%	2.2%	23.4%
Jan ‘22	18.8%	11.2%	12.5%	7.8%	94.0%	28.8%
Feb ‘22	17.7%	9.4%	9.6%	8.9%	14.1%	11.9%
Mar ‘22	18.8%	9.5%	2.4%	9.9%	0.1%	8.1%
Apr ‘22	18.3%	9.4%	7.0%	6.7%	0.7%	8.4%
May ‘22	18.5%	13.3%	8.4%	17.5%	0.1%	11.6%
Jun ‘22	0.3%	12.1%	8.6%	10.3%	0.0%	6.3%
Jul ‘22	3.3%	9.4%	8.1%	5.4%	1.2%	5.5%
Aug ‘22	26.2%	13.6%	4.6%	3.9%	0.0%	9.7%
Sep ‘22	17.5%	4.8%	10.5%	10.3%	0.0%	8.6%
Oct ‘22	18.9%	10.6%	10.9%	12.3%	2.3%	11.0%
Nov ‘22	18.0%	9.4%	9.3%	9.4%	1.3%	9.5%
Dec ‘22	20.7%	10.2%	9.5%	9.5%	1.0%	10.2%

3.2 Contour Global Trinity Power Station

3.2.1 Heat Rate

The heat rate of the Trinity Power Station varied between 12,767.23 KJ/kWh and 14,022.22 KJ/kWh on a monthly basis for the period October 1, 2021 to December 31, 2022, and is presented in Table 15. The heat rates for the individual machines are not available because the fuel consumption of the individual machines is not metered and this information would be required to perform the computations.

Table 15: Heat Rate (KJ/kWh) of Contour Global Trinity Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Aggregate Heat Rate of the Generating Machines
Oct '21	13,391.84
Nov '21	13,187.93
Dec '21	13,480.66
Jan '22	13,163.99
Feb '22	13,562.16
Mar '22	13,399.92
Apr '22	14,022.22
May '22	13,571.03
Jun '22	13,667.21
Jul '22	13,405.76
Aug '22	13,264.33
Sep '22	13,423.67
Oct '22	13,350.29
Nov '22	12,767.23
Dec '22	13,554.32

3.2.2 Capacity Factor

The capacity factor of the Trinity Power Station varied on a quarterly basis between 31.1% and 72.1% over the period October 1, 2021 to December 31, 2022. During the period, the quantum of the capacity factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #101: 25.5 and 82.2%.
- Machine #202: 7.7 and 86.1%.
- Machine #301: 2.6 and 83. %.

The capacity factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 16.

Table 16: Capacity Factors of Generating Machines – Trinity Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine			Power Station
	#101	#201	#301	
Oct '21	62.2%	73.0%	83.1%	61.9%
Nov '21	72.3%	83.9%	72.1%	
Dec '21	42.3%	21.3%	47.5%	
Jan '22	46.3%	7.7%	11.2%	45.0%
Feb '22	79.0%	32.1%	32.1%	
Mar '22	40.5%	32.1%	32.1%	
Apr '22	51.4%	74.8%	72.0%	71.8%
May '22	82.2%	72.1%	72.8%	
Jun '22	69.2%	79.3%	72.7%	
Jul '22	60.6%	86.1%	62.4%	72.1%
Aug '22	81.0%	85.3%	78.8%	
Sep '22	60.8%	78.9%	55.3%	
Oct '22	62.8%	Not in Service	61.1%	31.1%
Nov '22	42.5%	23.7%	33.0%	
Dec '22	25.5%	29.4%	2.6%	

3.2.3 Availability Factor

The availability factor of the Trinity Power Station varied between 31.1% and 72.1% on a quarterly basis over the period October 1, 2021 to December 31, 2022. During the period, the quantum of the availability factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #101: 68.4 and 100.0%.
- Machine #201: 83.7 and 100.0%.
- Machine #301: 79.5 and 100.0%.

The availability factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 17.

Table 17: Availability Factors of Generating Machines – Trinity Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine			Power Station
	#101	#201	#301	
Oct '21	84.3%	97.5%	98.0%	97.0%
Nov '21	99.1%	97.4%	99.6%	
Dec '21	100.0%	97.4%	100.0%	
Jan '22	94.4%	100.0%	99.1%	92.5%
Feb '22	100.0%	98.9%	79.5%	
Mar '22	68.4%	95.1%	98.0%	
Apr '22	100.0%	100.0%	100.0%	98.6%
May '22	100.0%	95.8%	94.7%	
Jun '22	97.8%	100.0%	99.1%	
Jul '22	96.2%	100.0%	100.0%	97.6%
Aug '22	98.3%	100.0%	98.9%	
Sep '22	92.6%	96.6%	96.2%	
Oct '22	100.0%	Not in Service	100.0%	86.9%
Nov '22	100.0%	83.7%	100.0%	
Dec '22	100.00%	100.00%	98.83%	

3.2.4 Equivalent Availability Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent availability factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #101: 68.4 and 100.0%.
- Machine #201: 83.7 and 100.0%.
- Machine #301: 79.5 and 100.0%.

The equivalent availability factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 18.

Table 18: Equivalent Availability Factors of Generating Machines – Trinity Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine			Power Station
	#101	#201	#301	
Oct '21	84.3%	97.5%	98.0%	93.3%
Nov '21	99.1%	97.4%	99.6%	98.7%
Dec '21	100.0%	97.4%	100.0%	99.1%
Jan '22	94.4%	100.0%	99.1%	97.8%
Feb '22	100.0%	98.9%	79.5%	92.8%
Mar '22	68.4%	95.1%	98.0%	87.2%
Apr '22	100.0%	100.0%	100.0%	100.0%
May '22	100.0%	95.8%	94.7%	96.8%
Jun '22	97.8%	100.0%	99.1%	99.0%
Jul '22	96.2%	100.0%	100.0%	98.7%
Aug '22	98.3%	100.0%	98.9%	99.1%
Sep '22	92.6%	96.6%	96.2%	95.1%
Oct '22	100.0%	Not in Service	100.0%	66.7%
Nov '22	100.0%	83.7%	100.0%	94.6%
Dec '22	100.0%	100.0%	98.8%	99.6%

3.2.5 Equivalent Unplanned Outage Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent unplanned outage factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #101: 0.0 and 31.6%
- Machine #201: 0.0 and 16.3%
- Machine #301: 0.0 and 20.5%

The equivalent unplanned outage factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 19.

Table 19: Equivalent Unplanned Outage Factors of Generating Machines – Trinity Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine			Power Station
	#101	#201	#301	
Oct '21	15.7%	2.5%	1.9%	6.7%
Nov '21	0.9%	2.6%	0.4%	1.3%
Dec '21	0.0%	2.6%	0.0%	0.9%
Jan '22	5.6%	0.0%	0.9%	2.2%
Feb '22	0.0%	1.1%	20.5%	7.2%
Mar '22	31.6%	4.9%	2.0%	12.8%
Apr '22	0.0%	0.0%	0.0%	0.0%
May '22	0.0%	4.2%	5.3%	3.2%
Jun '22	1.7%	0.0%	0.9%	0.9%
Jul '22	3.8%	0.0%	0.0%	1.3%
Aug '22	1.7%	0.0%	1.1%	0.9%
Sep '22	7.4%	3.4%	3.8%	4.9%
Oct '22	0.0%	Not in Service	0.0%	33.3%
Nov '22	0.0%	16.3%	0.0%	5.4%
Dec '22	0.0%	0.0%	1.2%	0.4%

3.2.6 Equivalent Forced Outage Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent forced outage factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #101: 0.0 and 12.5%.
- Machine #201: 0.0 and 0.6%.
- Machine #301: 0.0 and 1.6%.

The equivalent forced outage factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 20.

Table 20: Equivalent Forced Outage Factors of Generating Machines – Trinity Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine			Power Station
	#101	#201	#301	
Oct '21	12.5%	0.0%	0.0%	4.2%
Nov '21	0.0%	0.6%	0.4%	0.3%
Dec '21	0.0%	0.0%	0.0%	0.0%
Jan '22	0.0%	0.0%	0.0%	0.0%
Feb '22	0.0%	0.0%	0.0%	0.0%
Mar '22	0.1%	2.9%	0.0%	1.0%
Apr '22	0.0%	0.0%	0.0%	0.0%
May '22	0.0%	0.3%	0.2%	0.2%
Jun '22	0.0%	0.0%	0.9%	0.3%
Jul '22	0.0%	0.0%	0.0%	0.0%
Aug '22	0.0%	0.0%	0.0%	0.0%
Sep '22	0.0%	0.0%	1.6%	0.5%
Oct '22	0.0%	Not in Service	0.0%	0.0%
Nov '22	0.0%	0.0%	0.0%	0.0%
Dec '22	0.0%	0.0%	0.0%	0.0%

3.3 PowerGen

3.3A PowerGen - Pt. Lisas Power Station

3.3A.1 Heat Rate

The heat rate of the Pt. Lisas Power Station varied between 14,336.3 KJ/kWh and 15,155.8 KJ/kWh on a quarterly basis over the period October 1, 2021 to December 31, 2022. During the period, the heat rates for the individual generating machines varied on a monthly basis as shown below:

- Machine #3: 16,672.32 – 22,959.24 KJ/kWh
- Machine #5 14,915.25 – 36,649.97 KJ/kWh
- Machine #6: 14,343.61 – 17,204.93 KJ/kWh
- Machine #7: 16,013.60 – 20,521.85 KJ/kWh
- Machine #8: 15,569.72 KJ/kWh (Only operated in December 2022)
- Machine #9: 14,541.34 – 16,290.64 KJ/kWh
- Machine #10: 15,179.62 – 19,819.51 KJ/kWh
- Machine #11: 14,228.12 – 34,708.95 KJ/kWh
- Machine #12: 15,680.59 – 43,203.34 KJ/kWh
- Machine #13: 7,859.51 – 15,484.46 KJ/kWh
- Machine #14: 11,309.41 – 16,414.57 KJ/kWh

The heat rates of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 21.

Table 21: Heat Rates (KJ/kWh) of Generating Machines – Pt. Lisas Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine											Power Station
	#3	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	
Oct '21	On Standby	15,978.07	14,993.57	16,151.03	Not in Service	14,629.52	15,270.42	22,083.91	16,350.57	15,484.46	12,522.61	
Nov '21	On Standby	Not in Service	15,015.35	16,013.60	Not in Service	14,541.34	15,179.62	26,908.48	17,660.25	7,859.51	11,309.41	14,567.6
Dec '21	On Standby	21,281.08	15,315.14	16,638.27	Not in Service	15,667.67	15,492.18	34,708.95	17,896.73	12,842.64	13,584.97	
Jan '22	On Standby	16,324.11	15,481.74	16,411.59	Not in Service	15,145.45	15,563.30	26,630.58	16,729.66	12,931.10	16,414.57	
Feb '22	16,672.32	16,480.39	15,339.79	18,642.67	Not in Service	15,054.63	16,040.87	26,206.00	16,511.32	12,894.03	12,324.71	15,836.7
Mar '22	On Standby	16,114.25	15,513.33	16,447.00	Not in Service	15,134.46	16,620.41	23,685.64	43,203.34	13,118.34	12,496.41	
Apr '22	On Standby	17,116.30	16,184.64	16,090.51	Not in Service	15,947.25	17,785.91	28,342.56	20,649.22	13,371.05	12,322.51	
May '22	22,959.24	16,758.93	16,015.42	16,139.53	Not in Service	15,954.25	17,906.45	18,393.64	17,187.37	13,191.56	12,497.33	15,155.8
Jun '22	On Standby	36,649.97	17,204.93	16,226.88	Not in Service	16,290.64	19,819.51	21,074.06	18,365.55	13,134.24	12,679.19	
Jul '22	On Standby	16,300.42	15,921.97	16,656.90	Not in Service	14,921.61	15,199.92	15,712.50	16,185.72	12,758.67	12,681.33	
Aug '22	On Standby	14,915.25	14,343.61	20,521.85	Not in Service	Not in Service	15,274.19	14,228.12	15,680.59	12,789.32	12,411.96	14,336.3
Sep '22	On Standby	16,434.25	16,302.09	16,650.53	Not in Service	Not in Service	15,255.25	15,696.54	16,467.30	12,742.92	12,664.71	
Oct '22	On Standby	17,463.30	16,840.57	17,500.48	Not in Service	Not in Service	15,837.50	16,080.00	16,818.71	12,760.81	12,821.76	
Nov '22	On Standby	17,495.36	16,889.71	17,690.45	Not in Service	Not in Service	16,078.69	16,525.01	17,252.17	12,982.88	12,824.68	15,187.8
Dec '22	On Standby	16,255.20	15,325.40	16,958.21	15,569.72	Not in Service	15,436.63	15,973.71	16,422.15	13,524.83	12,634.60	

3.3A.2 Capacity Factor

The capacity factor of the Pt. Lisas Power Station varied between 22.8% and 43.7% on a quarterly basis over the period October 1, 2021 to December 31, 2022. During the period, the quantum of the capacity factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #3: 0.6%.
- Machine #5: 1.4 and 35.7%.
- Machine #6: 3.4 and 38.9%.
- Machine #7: 25.7 and 60.7%.
- Machine #8: 35.2% (Only operated in December 2022).
- Machine #9: 12.1 and 61.1%.
- Machine #10: 26.0 and 63.6%.
- Machine #11: 6.2 and 53.5%.
- Machine #12: 9.9 and 45.3%.
- Machine #13: 5.4 and 94.8%.
- Machine #14: 3.0 and 94.4%.

The capacity factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 22.

Table 22: Capacity Factors of Generating Machines – Pt. Lisas Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine											Power Station
	#3	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	
Oct '21	On Standby	5.0%	34.9%	54.5%	Not in Service	46.7%	51.2%	17.0%	33.8%	63.6%	51.0%	33.6%
Nov '21	On Standby	Not in Service	25.9%	57.9%	Not in Service	59.6%	52.9%	9.9%	35.4%	65.3%	46.8%	
Dec '21	On Standby	2.0%	26.2%	60.7%	Not in Service	53.9%	53.7%	6.2%	11.1%	70.9%	13.0%	
Jan '22	On Standby	15.4%	28.7%	60.4%	Not in Service	12.1%	37.6%	10.6%	34.6%	56.0%	3.0%	32.1%
Feb '22	0.6%	16.9%	29.8%	59.2%	Not in Service	53.0%	29.0%	11.8%	37.4%	57.9%	35.6%	
Mar '22	On Standby	35.7%	38.9%	45.7%	Not in Service	61.1%	59.0%	17.7%	16.3%	78.8%	22.2%	
Apr '22	On Standby	20.1%	35.8%	41.3%	Not in Service	53.3%	51.3%	6.5%	16.5%	75.5%	51.5%	36.7%
May '22	0.6%	10.1%	20.3%	48.2%	Not in Service	51.3%	48.5%	34.1%	40.9%	67.6%	74.3%	
Jun '22	On Standby	1.4%	5.8%	34.7%	Not in Service	36.1%	26.0%	22.0%	23.9%	79.2%	77.7%	
Jul '22	On Standby	19.3%	19.5%	46.4%	Not in Service	57.5%	61.4%	41.9%	45.3%	72.6%	91.8%	43.7%
Aug '22	On Standby	35.8%	32.7%	55.7%	Not in Service	Not in Service	63.6%	53.5%	42.0%	94.8%	94.4%	
Sep '22	On Standby	7.5%	12.9%	47.3%	Not in Service	Not in Service	40.9%	41.7%	30.1%	62.2%	70.6%	
Oct '22	On Standby	6.4%	16.5%	53.7%	Not in Service	Not in Service	46.5%	24.2%	32.7%	50.3%	38.6%	22.8%
Nov '22	On Standby	5.7%	28.7%	25.7%	Not in Service	Not in Service	40.5%	31.0%	20.3%	43.7%	41.7%	
Dec '22	On Standby	2.6%	3.4%	37.1%	35.2%	Not in Service	44.0%	23.0%	9.9%	5.4%	11.6%	

3.3A.3 Availability Factor

The availability factor of the Pt. Lisas Power Station varied between 70.9% and 85.2% on a quarterly basis over the period October 1, 2021 to December 31, 2022. During the period, the quantum of the availability factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #3: 69.0 and 100.0%.
- Machine #5: 7.2 and 100.0%.
- Machine #6: 43.2 and 100.0%.
- Machine #7: 49.8 and 100.0%.
- Machine #8: 58.5% (Only operated in December 2022).
- Machine #9: 36.8 and 100.0%.
- Machine #10: 49.3 and 100.0%.
- Machine #11: 14.8 and 100.0%.
- Machine #12: 53.1 and 100.0%.
- Machine #13: 67.4 and 100.0%.
- Machine #14: 62.2 and 100.0%.

The monthly availability factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 23.

Table 23: Availability Factors of Generating Machines – Pt. Lisas Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine											Power Station
	#3	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	
Oct '21	86.5%	29.0%	100.0%	94.7%	Not in Service	89.0%	94.7%	100.0%	100.0%	100.0%	76.2%	79.1%
Nov '21	98.2%	Not in Service	98.6%	95.3%	Not in Service	99.2%	99.0%	96.4%	99.2%	88.0%	97.4%	
Dec '21	100.0%	7.2%	100.0%	99.2%	Not in Service	98.7%	99.9%	100.0%	65.0%	100.0%	100.0%	
Jan '22	100.0%	92.8%	95.3%	100.0%	Not in Service	36.8%	79.7%	100.0%	98.7%	100.0%	100.0%	82.8%
Feb '22	92.7%	100.0%	96.2%	99.7%	Not in Service	100.0%	49.3%	98.6%	93.8%	100.0%	94.9%	
Mar '22	100.0%	100.0%	96.2%	85.1%	Not in Service	98.7%	97.1%	78.4%	53.1%	95.9%	100.0%	
Apr '22	100.0%	100.0%	100.0%	96.4%	Not in Service	99.3%	100.0%	14.8%	78.3%	98.7%	89.2%	85.2%
May '22	97.8%	91.4%	100.0%	100.0%	Not in Service	97.9%	100.0%	100.0%	95.9%	100.0%	100.0%	
Jun '22	100.0%	100.0%	100.0%	91.9%	Not in Service	90.7%	71.1%	100.0%	97.6%	100.0%	98.5%	
Jul '22	100.0%	99.4%	77.3%	89.6%	Not in Service	91.9%	100.0%	94.6%	96.9%	97.7%	100.0%	78.9%
Aug '22	69.0%	82.3%	98.5%	98.6%	Not in Service	Not in Service	99.7%	99.7%	97.1%	100.0%	100.0%	
Sep '22	90.8%	92.7%	78.9%	93.2%	Not in Service	Not in Service	90.4%	100.0%	98.3%	80.2%	84.6%	
Oct '22	100.0%	92.1%	91.1%	90.1%	Not in Service	Not in Service	100.0%	73.0%	99.8%	90.1%	62.2%	70.9%
Nov '22	96.8%	85.4%	43.2%	49.8%	Not in Service	Not in Service	94.3%	100.0%	100.0%	82.0%	82.3%	
Dec '22	100.0%	98.0%	56.6%	68.6%	58.5%	Not in Service	90.9%	95.9%	100.0%	67.4%	70.2%	

3.3A.4 Equivalent Availability Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent availability factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #3: 60.6 – 100.0%.
- Machine #5: 7.0 – 100.0%.
- Machine #6: 43.2 – 100.0%.
- Machine #7: 49.8 – 97.6%.
- Machine #8: 56.1% (Only operated in December 2022).
- Machine #9: 36.8 – 100.0%.
- Machine #10: 49.3 – 100.0%.
- Machine #11: 14.7 – 100.0%.
- Machine #12: 52.3 – 99.9%.
- Machine #13: 79.5 – 100.0%.
- Machine #14: 61.8 – 100.0%.

The monthly equivalent availability factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 24.

Table 24: Equivalent Availability Factors of Generating Machines – Pt. Lisas Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine											Power Station
	#3	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	
Oct '21	86.5%	28.3%	100.0%	94.6%	Not in Service	89.0%	94.7%	81.3%	99.9%	100.0%	76.2%	77.3%
Nov '21	98.2%	Not in Service	98.6%	93.6%	Not in Service	99.2%	99.0%	78.3%	98.0%	87.0%	97.4%	77.2%
Dec '21	100.0%	7.0%	100.0%	96.8%	Not in Service	95.2%	99.9%	81.3%	64.2%	100.0%	100.0%	76.8%
Jan '22	100.0%	92.8%	95.3%	97.6%	Not in Service	36.8%	79.7%	79.4%	97.4%	100.0%	100.0%	79.9%
Feb '22	92.7%	100.0%	96.2%	97.3%	Not in Service	100.0%	49.3%	74.0%	92.6%	100.0%	94.9%	81.5%
Mar '22	100.0%	100.0%	96.2%	83.0%	Not in Service	98.5%	97.1%	58.8%	52.3%	95.9%	100.0%	80.2%
Apr '22	100.0%	98.8%	100.0%	94.1%	Not in Service	99.3%	100.0%	14.7%	77.4%	98.7%	89.2%	79.3%
May '22	97.8%	90.3%	100.0%	97.6%	Not in Service	97.9%	100.0%	99.3%	94.8%	100.0%	100.0%	88.9%
Jun '22	100.0%	98.8%	100.0%	90.5%	Not in Service	90.7%	71.1%	100.0%	96.4%	100.0%	98.5%	86.0%
Jul '22	100.0%	98.1%	77.3%	87.5%	Not in Service	91.9%	100.0%	94.6%	95.7%	97.7%	100.0%	85.7%
Aug '22	61.6%	80.8%	98.5%	96.2%	Not in Service	Not in Service	97.4%	99.7%	95.9%	97.9%	95.8%	74.9%
Sep '22	60.6%	86.9%	78.9%	91.0%	Not in Service	Not in Service	88.2%	100.0%	97.0%	79.5%	81.7%	69.4%
Oct '22	74.3%	86.3%	91.1%	88.0%	Not in Service	Not in Service	97.6%	73.0%	98.0%	89.3%	61.8%	69.0%
Nov '22	64.6%	80.1%	43.2%	49.8%	Not in Service	Not in Service	92.0%	100.0%	96.3%	81.6%	82.3%	62.7%
Dec '22	66.7%	91.9%	56.6%	68.6%	56.1%	Not in Service	88.7%	95.9%	96.3%	55.9%	68.5%	67.7%

3.3A.5 Equivalent Unplanned Outage Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent unplanned outage factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #3: 0.0 – 35.4%.
- Machine #5: 0.0 – 20.1%.
- Machine #6: 0.0 – 22.7%.
- Machine #7: 0.4 – 31.4%.
- Machine #8: 39.7 % (Only operated in December 2022).
- Machine #9: 0.0 – 11.0%.
- Machine #10: 0.0 – 28.9%.
- Machine #11: 0.0 – 26.0%.
- Machine #12: 0.1 – 47.7%.
- Machine #13: 0.0 – 20.5%.
- Machine #14: 0.0 – 37.8%.

The equivalent unplanned outage factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 25.

Table 25: Equivalent Unplanned Outage Factors of Generating Machines – Pt. Lisas Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine											Power Station
	#3	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	
Oct '21	13.5%	20.1%	0.0%	5.4%	Not in Service	11.0%	5.3%	18.8%	0.1%	0.0%	23.8%	18.0%
Nov '21	1.8%	Not in Service	0.0%	2.8%	Not in Service	0.0%	0.0%	18.1%	1.2%	3.6%	2.6%	11.8%
Dec '21	0.0%	1.3%	0.0%	3.2%	Not in Service	3.4%	0.1%	18.8%	35.8%	0.0%	0.0%	14.8%
Jan '22	0.0%	7.2%	4.7%	2.4%	Not in Service	0.0%	18.0%	20.6%	2.6%	0.0%	0.0%	14.1%
Feb '22	7.3%	0.0%	3.8%	2.7%	Not in Service	0.0%	0.6%	26.0%	7.4%	0.0%	5.1%	13.9%
Mar '22	0.0%	0.0%	3.8%	17.0%	Not in Service	1.5%	2.9%	22.8%	47.7%	4.1%	0.0%	18.2%
Apr '22	0.0%	1.3%	0.0%	5.2%	Not in Service	0.7%	0.0%	0.1%	7.2%	0.0%	6.7%	11.0%
May '22	2.2%	9.7%	0.0%	2.4%	Not in Service	2.1%	0.0%	0.7%	5.2%	0.0%	0.0%	11.1%
Jun '22	0.0%	1.3%	0.0%	9.5%	Not in Service	9.3%	28.9%	0.0%	3.6%	0.0%	1.5%	4.9%
Jul '22	0.0%	1.9%	22.7%	12.5%	Not in Service	8.1%	0.0%	5.4%	4.3%	2.3%	0.0%	5.2%
Aug '22	34.2%	19.2%	0.0%	3.3%	Not in Service	Not in Service	2.6%	0.3%	4.1%	2.1%	4.2%	15.5%
Sep '22	34.7%	6.0%	10.9%	9.0%	Not in Service	Not in Service	11.8%	0.0%	3.0%	20.5%	18.3%	19.5%
Oct '22	25.7%	13.7%	8.9%	2.2%	Not in Service	Not in Service	2.4%	15.2%	2.0%	10.7%	37.8%	19.9%
Nov '22	35.4%	19.9%	0.0%	0.4%	Not in Service	Not in Service	8.0%	0.0%	3.8%	18.4%	17.7%	18.5%
Dec '22	33.3%	8.1%	5.0%	31.4%	39.7%	Not in Service	11.3%	0.0%	3.8%	16.7%	31.5%	25.5%

3.3A.6 Equivalent Forced Outage Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent forced outage factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #3: 0.0 – 35.4%
- Machine #5 0.0 – 20.1%
- Machine #6: 0.0 – 10.9%
- Machine #7: 0.0 – 9.3%
- Machine #8: 19.3% (Only operated in December 2022)
- Machine #9: 0.0 – 8.1%
- Machine #10: 0.0 – 18.0%
- Machine #11: 0.0 – 24.7%
- Machine #12: 0.1 – 7.0%
- Machine #13: 0.0 – 1.8%
- Machine #14: 0.0 – 23.8%

The equivalent forced outage factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 26.

Table 26: Equivalent Forced Outage Factors of Generating Machines – Pt. Lisas Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine											Power Station
	#3	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	
Oct '21	0.0%	20.1%	0.0%	0.6%	Not in Service	0.3%	0.0%	18.8%	0.1%	0.0%	23.8%	14.9%
Nov '21	1.8%	Not in Service	0.0%	2.8%	Not in Service	0.0%	0.0%	18.1%	1.2%	1.0%	0.8%	11.4%
Dec '21	0.0%	0.2%	0.0%	2.4%	Not in Service	3.4%	0.0%	18.8%	7.0%	0.0%	0.0%	12.0%
Jan '22	0.0%	7.2%	4.7%	2.4%	Not in Service	0.0%	18.0%	20.6%	1.2%	0.0%	0.0%	4.9%
Feb '22	7.3%	0.0%	3.8%	2.4%	Not in Service	0.0%	0.0%	24.7%	1.2%	0.0%	0.8%	3.7%
Mar '22	0.0%	0.0%	1.2%	2.0%	Not in Service	1.5%	0.0%	19.6%	6.6%	0.0%	0.0%	2.8%
Apr '22	0.0%	1.3%	0.0%	3.7%	Not in Service	0.0%	0.0%	0.1%	1.7%	0.0%	0.0%	0.6%
May '22	0.0%	1.1%	0.0%	2.4%	Not in Service	0.0%	0.0%	0.7%	5.2%	0.0%	0.0%	0.9%
Jun '22	0.0%	1.3%	0.0%	1.4%	Not in Service	7.7%	0.0%	0.0%	1.2%	0.0%	0.0%	1.0%
Jul '22	0.0%	1.9%	5.1%	9.3%	Not in Service	8.1%	0.0%	0.0%	1.2%	0.0%	0.0%	2.3%
Aug '22	34.2%	19.1%	0.0%	3.3%	Not in Service	Not in Service	2.6%	0.3%	4.1%	1.1%	4.2%	15.3%
Sep '22	34.7%	6.0%	10.9%	2.2%	Not in Service	Not in Service	2.2%	0.0%	1.2%	0.3%	2.9%	14.6%
Oct '22	25.7%	9.8%	3.3%	2.2%	Not in Service	Not in Service	2.4%	15.2%	2.0%	0.4%	14.0%	15.9%
Nov '22	35.4%	19.9%	0.0%	0.4%	Not in Service	Not in Service	2.3%	0.0%	3.8%	0.2%	0.0%	14.7%
Dec '22	33.3%	8.1%	0.0%	0.0%	19.3%	Not in Service	3.7%	0.0%	3.8%	1.8%	8.9%	16.3%

3.3B PowerGen - Penal Power Station

3.3B.1 Heat Rate

The heat rate of the Penal Power Station varied between 9,337.5 KJ/kWh and 9,811.1 KJ/kWh on a quarterly basis over the period October 1, 2021 to December 31, 2022. Machines # 8, 9, and 10 are operated in combined cycle mode. Machine #9 uses heat recovered from the exhaust of machines (#8 and 10); hence, there is a combined computed heat rate for these machines. During the period, the heat rates for the generating machines varied on a monthly basis as shown below:

- Machine #6: 16,732.42 – 40,187.97 KJ/kWh.
- Machine #7: 17,465.52 – 21,156.65 KJ/kWh.
- Machine #8: 12,725.03 – 13,270.13 KJ/kWh.
- Machine #10: 13,073.44 – 23,232.35 KJ/kWh.

The heat rates of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 27.

Table 27: Heat Rates (KJ/kWh) of Generating Machines – Penal Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine			Power Station*
	#6	#7	Combined Cycle #8,9,10	
Oct '21	18,492.06	Not in Service	9,276.80	9,382.7
Nov '21	16,732.42	17,465.52	9,297.37	
Dec '21	On Standby	On Standby	9,414.10	
Jan '22	20,169.53	19,840.65	9,310.48	9,811.1
Feb '22	18,484.12	19,554.33	9,358.67	
Mar '22	On Standby	On Standby	10,672.29	
Apr '22	On Standby	On Standby	9,238.26	9,337.5
May '22	21,215.41	20,451.32	9,436.19	
Jun '22	On Standby	21,156.65	9,217.01	
Jul '22	On Standby	On Standby	9,502.08	9,457.1
Aug '22	On Standby	On Standby	9,738.94	
Sep '22	19,561.75	18,599.21	9,183.95	
Oct '22	40,187.97	20,147.19	9,297.57	9,389.5
Nov '22	27,450.78	20,153.60	9,393.66	
Dec '22	On Standby	On Standby	9,440.33	

*** Machines (#6 and 7) are operated for very short periods compared to the operating times for machines (#8, 9 and 10) and therefore factor less in the computation of the overall heat rate.**

3.3B.2 Capacity Factor

The capacity factor of the Penal Power Station varied between 69.1% and 79.9% on a quarterly basis over the period October 1, 2021 to December 31, 2022. During the period, the quantum of the capacity factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #6: 0.0 – 24.9%
- Machine #7: 0.0 – 16.7%
- Machine #8: 40.2 – 97.5%
- Machine #9: 73.8 – 100.0%
- Machine #10: 34.4 – 97.5%

The capacity factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 28.

Table 28: Capacity Factors of Generating Machines – Penal Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine					Power Station
	#6	#7	#8	#9	#10	
Oct '21	1.1%	Not in Service	88.7%	97.0%	89.0%	78.0%
Nov '21	24.9%	0.5%	83.1%	97.6%	90.5%	
Dec '21	On Standby	On Standby	89.4%	92.7%	78.6%	
Jan '22	0.5%	2.2%	89.7%	96.0%	89.8%	69.1%
Feb '22	4.0%	5.6%	91.8%	87.4%	34.4%	
Mar '22	On Standby	On Standby	94.2%	98.6%	42.7%	
Apr '22	On Standby	On Standby	86.6%	96.7%	85.9%	76.3%
May '22	2.7%	6.9%	81.3%	90.4%	83.0%	
Jun '22	On Standby	3.0%	85.9%	97.4%	84.9%	
Jul '22	On Standby	On Standby	66.5%	100.0%	60.6%	70.3%
Aug '22	On Standby	On Standby	40.2%	73.8%	97.5%	
Sep '22	0.4%	0.4%	97.5%	100.2%	74.7%	
Oct '22	0.3%	1.2%	95.6%	99.1%	91.6%	79.9%
Nov '22	0.8%	1.8%	87.0%	94.4%	93.9%	
Dec '22	On Standby	On Standby	79.7%	93.9%	94.4%	

3.3B.3 Availability Factor

The availability factor of the Penal Power Station varied between 22.8% and 43.7% on a quarterly basis over the period October 1, 2021 to December 31, 2022. During the period, the quantum of the availability factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #6: 20.2 – 100.0 %
- Machine #7: 30.2 – 100.0 %
- Machine #8: 43.0 – 100.0 %
- Machine #9: 82.8 – 100.0 %
- Machine #10: 39.2 – 100.0 %

The availability factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 29.

Table 29: Availability Factors of Generating Machines – Penal Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine					Power Station
	#6	#7	#8	#9	#10	
Oct '21	49.6%	Not in Service	100.0%	100.0%	100.0%	84.4%
Nov '21	99.7%	44.5%	92.6%	100.0%	100.0%	
Dec '21	99.9%	100.0%	98.3%	95.9%	86.6%	
Jan '22	50.6%	88.2%	100.0%	100.0%	100.0%	78.6%
Feb '22	20.2%	79.3%	100.0%	92.8%	39.2%	
Mar '22	23.2%	99.7%	100.0%	100.0%	79.7%	
Apr '22	95.2%	86.0%	99.8%	99.6%	99.8%	95.0%
May '22	85.6%	99.1%	94.1%	93.9%	97.6%	
Jun '22	73.7%	100.0%	100.0%	100.0%	100.0%	
Jul '22	100.0%	91.7%	72.3%	90.2%	100.0%	90.3%
Aug '22	99.9%	99.2%	43.0%	82.8%	100.0%	
Sep '22	100.0%	100.0%	100.0%	100.0%	76.5%	
Oct '22	100.0%	99.9%	100.0%	100.0%	94.9%	87.3%
Nov '22	92.3%	42.7%	96.8%	100.0%	100.0%	
Dec '22	69.8%	30.2%	84.5%	97.6%	100.0%	

3.3B.4 Equivalent Availability Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent availability factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #6: 20.2 – 100.0%.
- Machine #7: 30.2 – 100.0%.
- Machine #8: 43.0 – 100.0%.
- Machine #9: 38.5 – 95.0%.
- Machine #10: 39.0 – 100.0%.

The equivalent availability factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 30.

Table 30: Equivalent Availability Factors of Generating Machines – Penal Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine					Power Station
	#6	#7	#8	#9	#10	
Oct '21	49.6%	Not in Service	100.0%	95.0%	99.3%	68.8%
Nov '21	99.7%	44.2%	92.1%	91.4%	99.3%	85.3%
Dec '21	99.9%	100.0%	98.3%	84.2%	86.2%	93.7%
Jan '22	50.6%	88.2%	100.0%	95.0%	99.3%	86.6%
Feb '22	20.2%	79.3%	99.9%	38.5%	39.0%	55.4%
Mar '22	23.2%	99.7%	100.0%	73.9%	79.7%	75.3%
Apr '22	95.2%	86.0%	99.8%	94.6%	99.8%	95.1%
May '22	85.6%	99.1%	94.1%	84.9%	97.6%	92.3%
Jun '22	73.7%	100.0%	100.0%	95.0%	100.0%	93.7%
Jul '22	100.0%	91.7%	72.2%	73.6%	99.3%	87.4%
Aug '22	99.9%	99.2%	43.0%	49.5%	99.4%	78.2%
Sep '22	100.0%	100.0%	99.9%	82.6%	75.7%	91.6%
Oct '22	100.0%	99.9%	100.0%	92.7%	94.7%	97.5%
Nov '22	92.3%	42.7%	96.8%	92.9%	100.0%	84.9%
Dec '22	69.8%	30.2%	84.5%	77.8%	100.0%	72.5%

3.3B.5 Equivalent Unplanned Outage Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent unplanned outage factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #6: 0.0 – 79.8%.
- Machine #7: 0.0 – 69.7%.
- Machine #8: 0.0 – 27.8%.
- Machine #9: 3.8 – 50.5%.
- Machine #10: 0.0 – 24.3%.

The equivalent unplanned outage factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 31.

Table 31: Equivalent Unplanned Outage Factors of Generating Machines – Penal Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine					Power Station
	#6	#7	#8	#9	#10	
Oct ‘21	0.0%	Not in Service	0.0%	5.0%	0.7%	8.4%
Nov ‘21	0.3%	0.5%	7.9%	8.6%	0.7%	3.6%
Dec ‘21	0.0%	0.0%	1.7%	15.8%	13.8%	6.3%
Jan ‘22	49.3%	11.7%	0.0%	5.0%	0.7%	13.3%
Feb ‘22	79.8%	20.7%	0.1%	9.1%	0.3%	22.0%
Mar ‘22	76.7%	0.0%	0.0%	3.8%	1.3%	16.4%
Apr ‘22	4.7%	13.9%	0.2%	5.4%	0.2%	4.9%
May ‘22	14.4%	0.9%	5.9%	15.1%	2.4%	7.7%
Jun ‘22	26.2%	0.0%	0.0%	5.0%	0.0%	6.2%
Jul ‘22	0.0%	8.2%	27.8%	26.4%	0.7%	12.6%
Aug ‘22	0.0%	0.8%	0.0%	50.5%	0.6%	10.4%
Sep ‘22	0.0%	0.0%	0.1%	17.4%	24.3%	8.4%
Oct ‘22	0.0%	0.0%	0.0%	7.3%	0.2%	1.5%
Nov ‘22	7.7%	57.3%	3.2%	6.1%	0.0%	14.9%
Dec ‘22	30.2%	69.7%	15.5%	4.1%	0.0%	23.9%

3.3B.6 Equivalent Forced Outage Factor

For the period October 1, 2021 to December 31, 2022, the quantum of the equivalent forced outage factors for the individual generating machines varied on a monthly basis as shown below:

- Machine #6: 0.0 – 79.8%.
- Machine #7: 0.0 – 36.4%.
- Machine #8: 0.0 – 27.8%.
- Machine #9: 2.0 – 33.2%.
- Machine #10: 0.0 – 2.5%.

The equivalent forced outage factors of the individual machines over the period October 1, 2021 to December 31, 2022, are presented in Table 32.

Table 32: Equivalent Forced Outage Factors of Generating Machines – Penal Power Station – October 1, 2021 to December 31, 2022.

Month/Year	Generating Machine					Power Station
	#6	#7	#8	#9	#10	
Oct ‘21	0.0%	Not in Service	0.0%	5.0%	0.7%	8.4%
Nov ‘21	0.3%	0.5%	0.5%	4.7%	0.7%	1.3%
Dec ‘21	0.0%	0.0%	0.0%	7.1%	2.5%	1.9%
Jan ‘22	49.3%	11.6%	0.0%	5.0%	0.7%	13.3%
Feb ‘22	79.8%	20.7%	0.1%	2.0%	0.3%	20.6%
Mar ‘22	76.7%	0.0%	0.0%	3.8%	1.3%	16.4%
Apr ‘22	2.5%	13.9%	0.2%	5.4%	0.2%	4.4%
May ‘22	14.4%	0.9%	0.0%	4.2%	0.0%	3.9%
Jun ‘22	26.2%	0.0%	0.0%	5.0%	0.0%	6.2%
Jul ‘22	0.0%	8.2%	27.8%	16.6%	0.7%	10.7%
Aug ‘22	0.0%	0.8%	0.0%	33.2%	0.6%	6.9%
Sep ‘22	0.0%	0.0%	0.1%	17.4%	0.9%	3.7%
Oct ‘22	0.0%	0.0%	0.0%	7.3%	0.2%	1.5%
Nov ‘22	0.8%	0.0%	0.0%	4.7%	0.0%	1.1%
Dec ‘22	0.0%	0.0%	0.0%	4.1%	0.0%	0.8%

SECTION 4.0 CONCLUSION

The three regulated service providers generated energy over the period October 1, 2021 to December 31, 2022, as shown in Figure 5 below. PowerGen's Pt. Lisas Power Station generated 2,868,762 MWh over the period and PowerGen's Penal Power Station generated 1,856,996 MWh. CGTPL Power Station generated 1,392,231 MWh over the period. T&TEC's Cove Power Station generated 497,485 MWh over the period. Their performance against the various performance metrics discussed in the report is presented below.

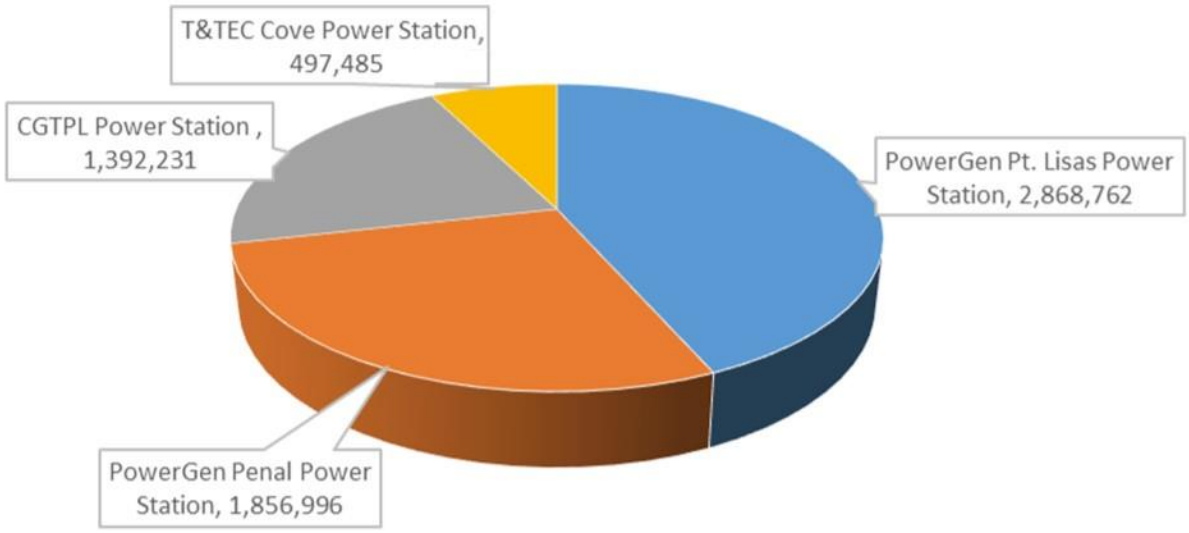

Figure 5. Energy Generated (MWh) at the Regulated Service Providers' Power Stations

The heat rates at the four power stations of the regulated electricity generating entities varied over the period October 1, 2021 to December 31, 2022, as shown in Figure 6. PowerGen's Penal Power Station had the lowest and most efficient quarterly computed heat rate values of the four power stations, which can be attributed to the operation of the combined cycle plant in the power station. The generating machines in the other three power stations are either internal combustion engines or combustion gas turbines operated in simple cycle mode which result in less efficient operations and higher heat rate computations.

The quarterly computed heat rate values at PowerGen's Penal Power varied between 9,337.5 and 9,811.1 KJ/kWh. PowerGen's Pt. Lisas Power Station had the highest quarterly computed heat rate values of the four power stations which varied between 14,336.3 and 15,836.7 KJ/kWh. The quarterly computed heat rate values at T&TEC's Cove Power Station varied between 10,706.7 and 11,220.6 KJ/kWh, and were the second lowest values, which would have been due in most part to simple cycle operation of higher efficiency internal combustion generating machines in this power station at full-load conditions compared to the operations of the combustion gas turbines operating in simple cycle mode at any of the regulated generating entities. CGTPL Power Station had the second highest quarterly computed heat rate values which varied between 13,223.9 and 13,375.4 KJ/kWh.

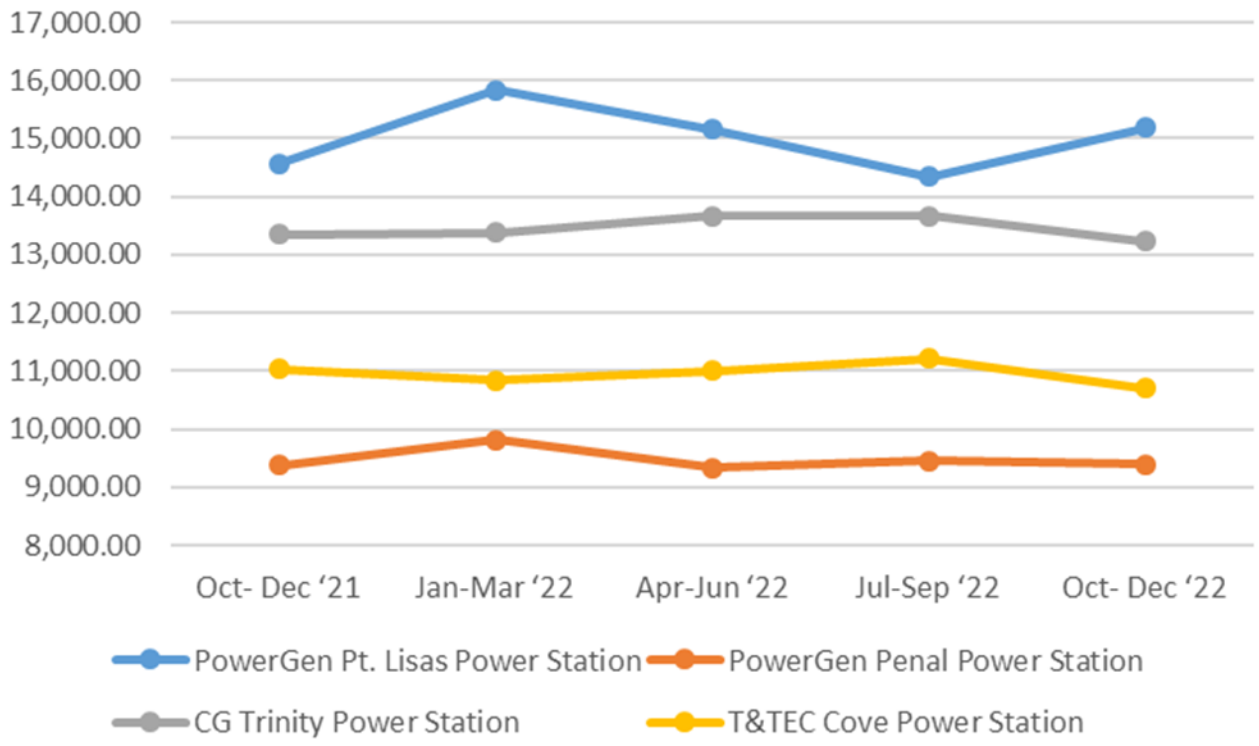

Figure 6. Heat Rates (KJ/kWh) at the Regulated Service Providers' Power Stations

PowerGen's Pt. Lisas Power Station had the lowest values for capacity factor over the period (22.8% - 43.7%) as many of the generating machines in the plant are used for load following. The highest values for capacity factor (69.1% - 79.9%) occurred at PowerGen's Penal Power Station, where three (3) machines are used in combined cycle to supply the base load. The values for

capacity factor at CGTPL Power Station varied between 31.1% and 72.1%, where the machines are used to supply peak power and at T&TEC's Cove Power Station, the values for capacity factor varied between 56.1% and 73.5%, where the machines are used for load following. The capacity factors at the four power stations over the period October 1, 2021 to December 31, 2022, are shown in Figure 7.

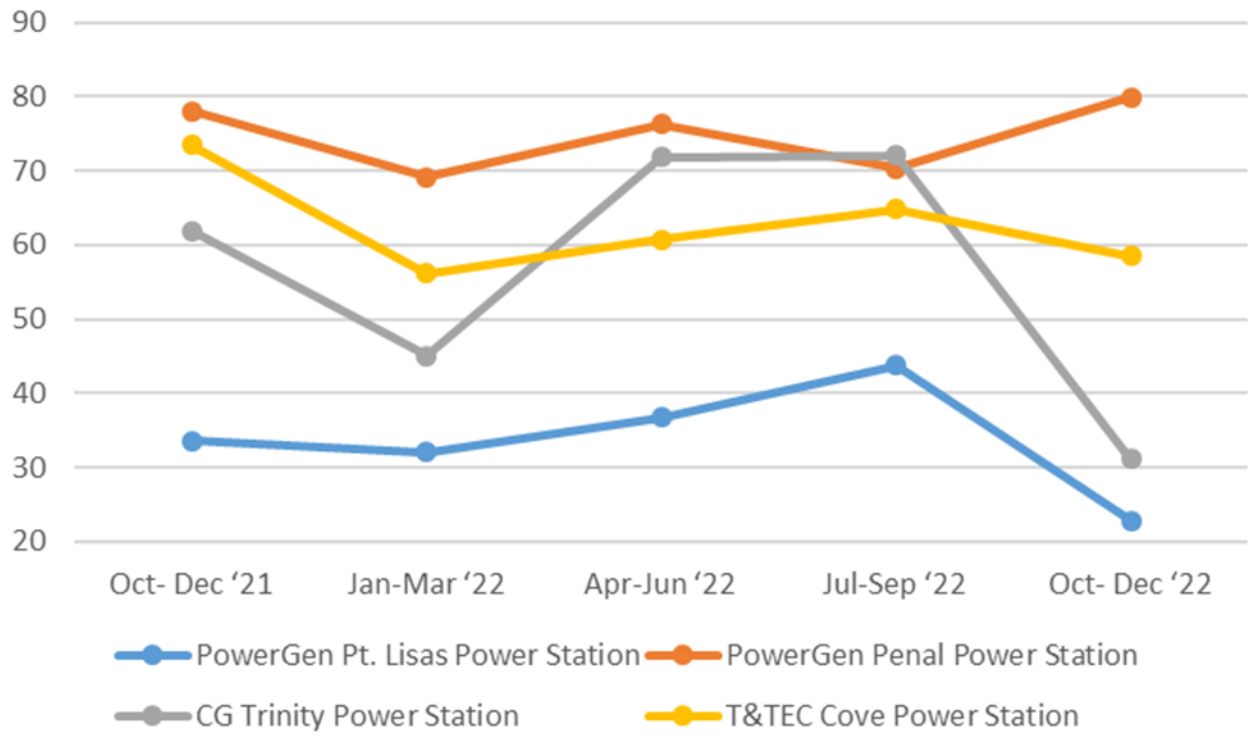

Figure 7. Capacity Factors (%) at the Regulated Service Providers' Power Stations

The availability of plant at all four power stations varied throughout the period as shown in Figure 8. The availability factor at the CGTPL Power Station varied between 86.9% and 98.6%. It varied between 79.3% and 95.9% at the T&TEC's Cove Power Station. It varied between 78.6% and 95.0% at the PowerGen's Penal Power Station. It varied between 70.9% and 85.2% at the PowerGen's Pt. Lisas Power Station.

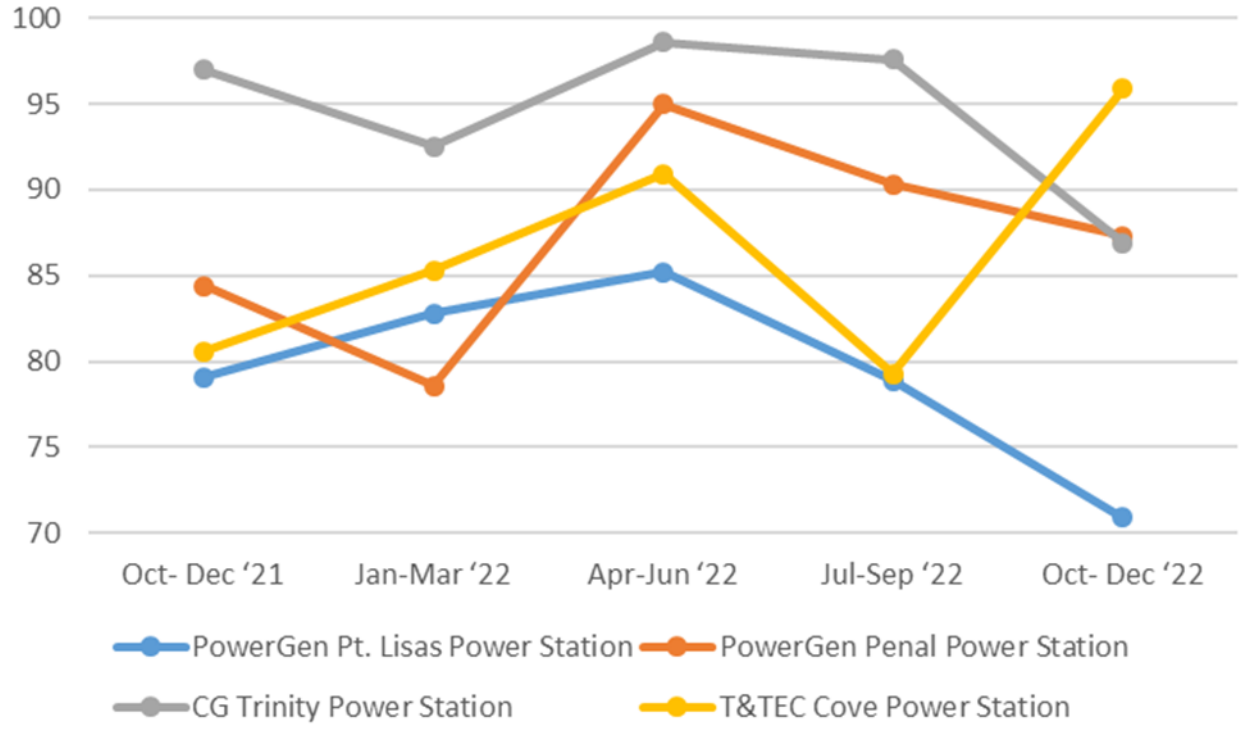

Figure 8. Availability Factors (%) at the Regulated Service Providers' Power Stations

The greatest margin between the overall capacity factor and the overall availability factor over the period October 1, 2021 to December 31, 2022 was at PowerGen's Pt. Lisas Power Station, where two (2) machines (#13 and 14) are used for base load, eight (8) machines are used for load following (# 5, 6, 7, 8, 9, 10, 11 and 12) and one (1) machine (#3) is used for peak power. The margins between the overall capacity factor and the overall availability factor at T&TEC Cove Power Station were lower than those at the PowerGen Pt. Lisas Power Station, where all five (5) machines were reportedly used for load following purposes. The margins between the overall capacity factor and the overall availability factor at Contour Global Trinity Power Station were lower than those at the T&TEC Cove Power Station, where all five (5) machines were reportedly used for peak power purposes. The smallest margin between the overall capacity factor and the overall availability factor was at PowerGen's Penal Power Station, where three (3) machines (# 8, 9 and 10) were used for base load and two (2) machines were used for peak power. Figure 9 shows the capacity factor versus the availability factor at the regulated service providers over the period from October 1, 2021 to December 31, 2022.

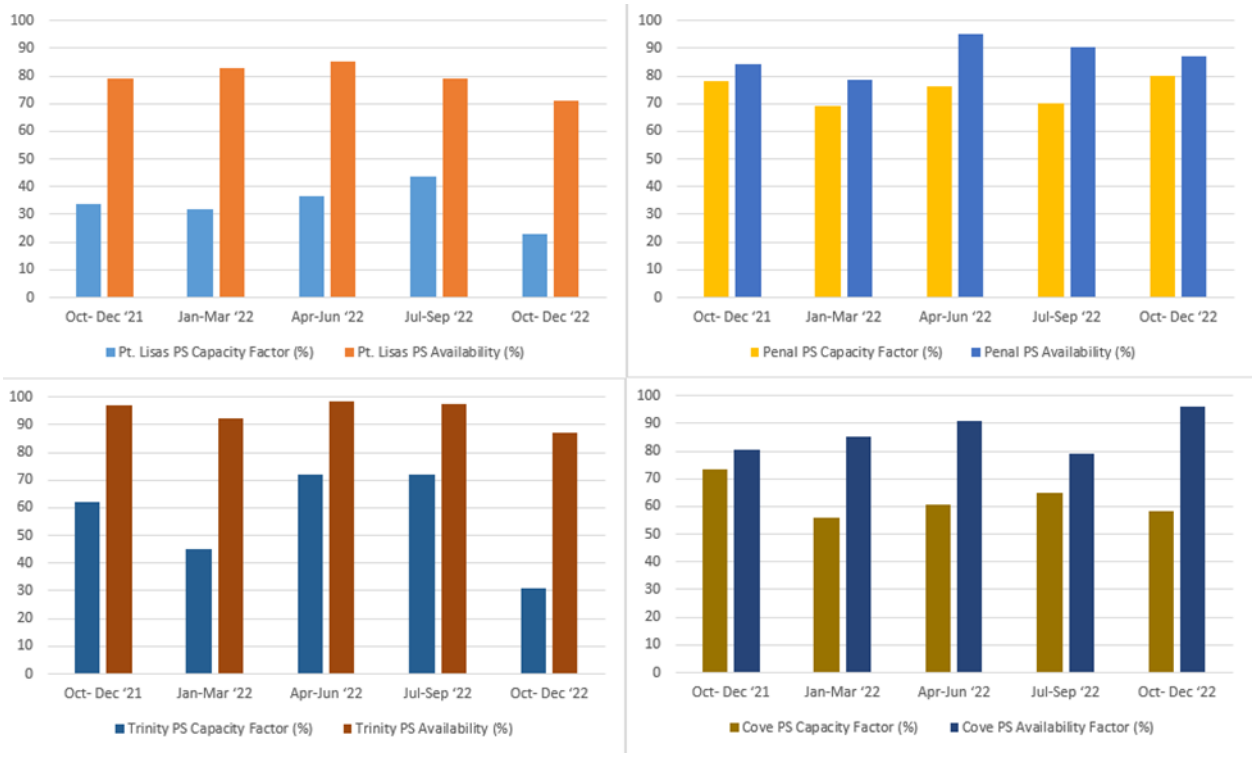

Figure 9. Overall Capacity versus Overall Availability Factors (%) at the Regulated Service Providers' Power Stations

The monthly computed equivalent availability factors at all four power stations varied between 55.4% and 100% throughout the period, as shown in Figure 10. The equivalent availability factor at the CGTPL Power Station varied between 66.7% and 100.0%. It varied between 68.3% and 89.9% at T&TEC's Cove Power Station. It varied between 55.4% and 97.5% at PowerGen's Penal Power Station. It varied between 62.7% and 88.9% at PowerGen's Pt. Lisas Power Station.

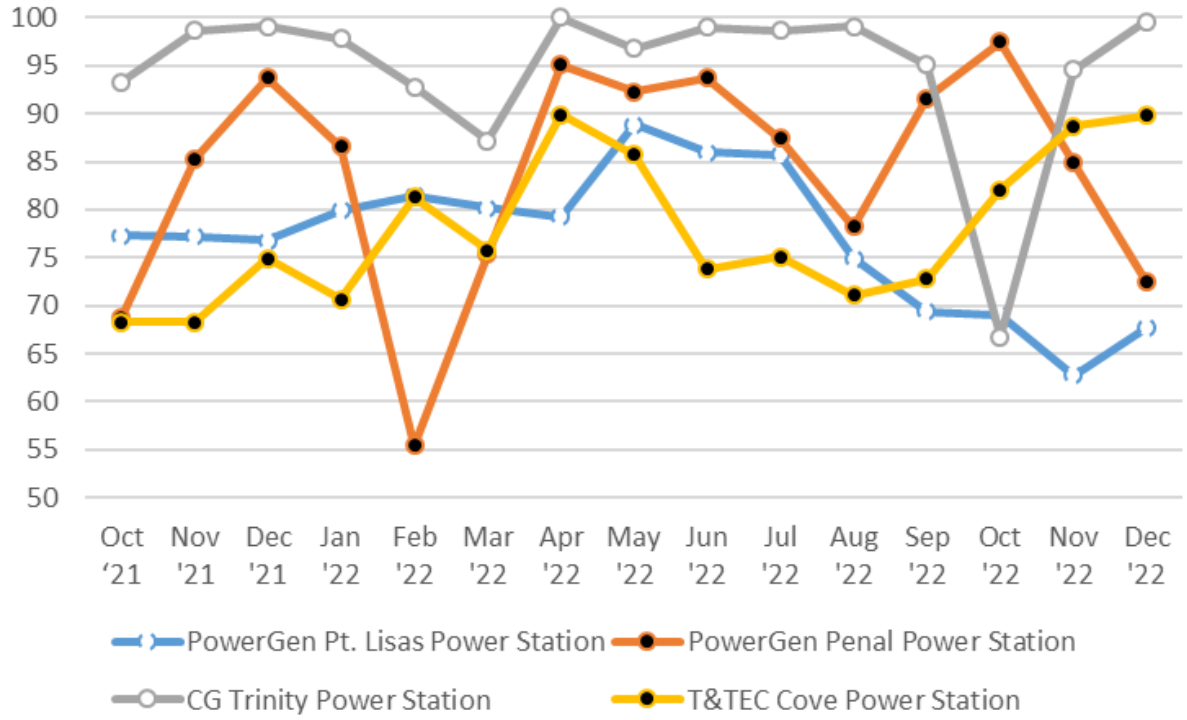

Figure 10. Equivalent Availability Factors (%) at the Regulated Service Providers' Power Stations

The monthly computed equivalent unplanned outage factors at all four power stations varied between 0% and 33.3% throughout the period, as shown in Figure 11. The equivalent unplanned outage factor at the CGTPL Power Station varied between 0% and 33.3%. It varied between 10.1% and 31.7% at T&TEC's Cove Power Station. It varied between 1.5% and 23.9% at the PowerGen's Penal Power Station. It varied between 4.9% and 25.5% at PowerGen's Pt. Lisas Power Station.

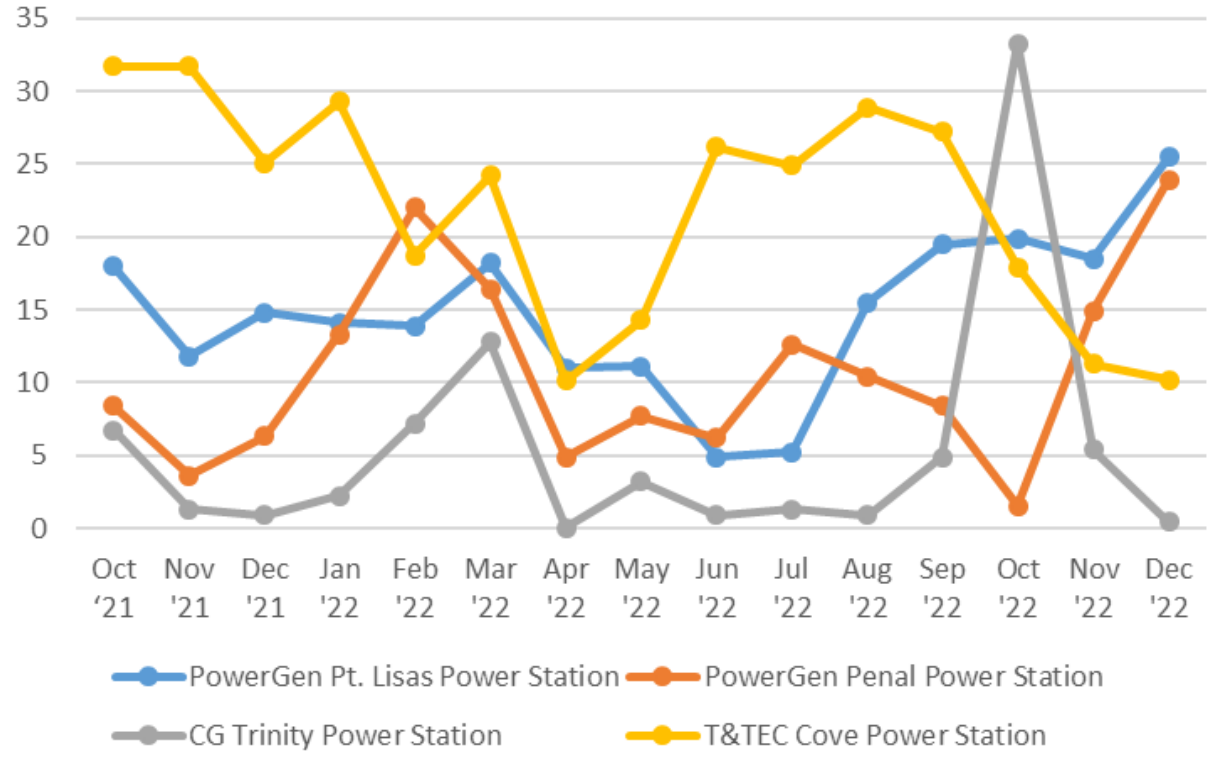

Figure 11. Equivalent Unplanned Outage Factors (%) at the Regulated Service Providers' Power Stations

The monthly computed equivalent forced outage factors at all four power stations varied between 0% and 31.2% throughout the period, as shown in Figure 12. The equivalent forced outage factor at the CGTPL Power Station varied between 0% and 4.2%. It varied between 5.5% and 31.2% at T&TEC's Cove Power Station. It varied between 0.8% and 20.6% at PowerGen's Penal Power Station. It varied between 0.6% and 16.3% at PowerGen's Pt. Lisas Power Station.

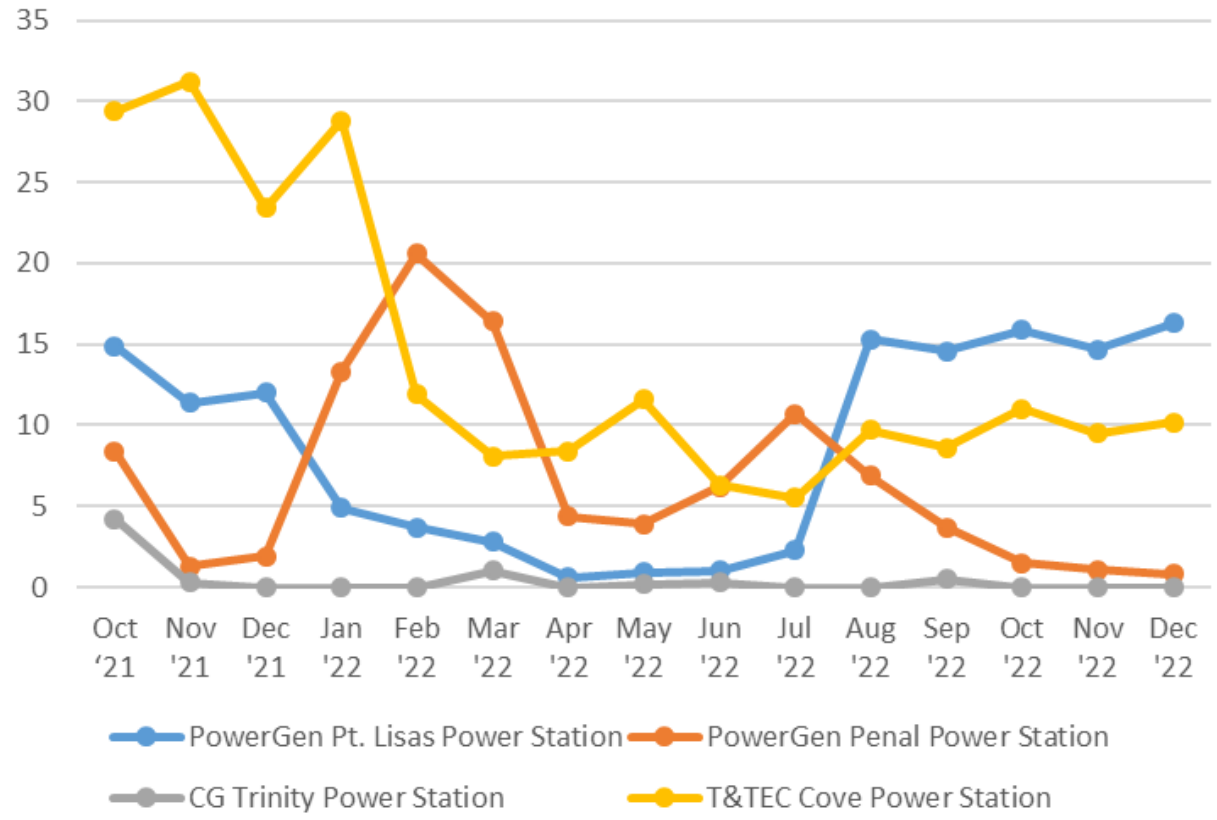

Figure 12. Equivalent Forced Outage Factors (%) at the Regulated Service Providers' Power Stations

The amount of electrical energy generated by the power stations of the regulated generating entities over the period showed some correlation to the nameplate capacity of the respective power stations. PowerGen's Pt. Lisas Power Station, with the largest nameplate capacity, generated the greatest amount of electrical energy, followed by PowerGen's Penal Power Station, CGTPL Power Station and T&TEC's Cove Power Station, similar to the order of their nameplate capacity.

The heat rates at the four power stations varied throughout the period, with PowerGen's Penal Power Station having the lowest computed values, an indication that it was the most efficient at converting fuel to electrical energy, followed by T&TEC's Cove Power Station, CGTPL Power Station and PowerGen's Pt. Lisas Power Station. The examination of the margin between the overall capacity factor and the overall availability factor for the four power stations showed that there was always sufficient machine availability at each of the four power stations to serve the

generation requirements placed on them throughout the period. Furthermore, the margin between the overall capacity factor and the overall availability factor is an indication of the utilisation of the plant in a power station; the smaller the value of the margin, typically, the longer the running time of the available plant. This margin was smallest at PowerGen's Penal Power Station (which had the lowest computed heat rates over the period), followed by T&TEC's Cove Power Station, CGTPL Power Station and PowerGen's Pt. Lisas Power Station (which had the highest computed heat rates over the period).

This is the RIC's first report on the Generation QSS. As the scheme matures and the performance of the generating entities is tracked over time, trends and significant changes in performance can be established with respect to the power stations and the individual generating machines installed in the power stations.

APPENDIX: LIST OF PERFORMANCE INDICATORS & OPERATIONAL DATA

No.	Metric	Description	Unit of Measure
1	Number of generating units	The total number of generating units that are operated by the power producer for supply to the electricity grid	Number
2	Type of power plant	For each power plant indicate the type of prime mover, whether combustion gas turbine (GT), combined cycle power plant (CC), or internal combustion engine (IC); and indicate the main use, whether baseload, load following, or peaking power	-
3	Capacity of Unit	Indicate the nameplate and derated generating capacity of each unit	MW
4	kWh generated by each unit and operating mode	Indicate the amount of kWh generated and the mode of operation, whether GT, CC or IC	kWh
5	Fuel type and consumption for each generating unit	Indicate whether natural gas or diesel, and the amount consumed for the reporting period	-
6	Peak power output	Highest instantaneous power generated during the reporting period	MW
7	Unit heat rate	Net heat rate for the generating unit during the reporting period. Formula: (***Fuel Flowrate * Higher Heating Value of Fuel) / Net Power Output of unit***	kJ/kWh
8	Station Heat Rate	Net heat rate for the station during the reporting period	kJ/kWh
9	Net heat rate	Overall net heat rate for the generation system of the service provider	kJ/kWh
10	Capacity factor	The ratio of the actual kilowatt-hours of electricity produced during the reporting period to the maximum	%

No.	Metric	Description	Unit of Measure
		possible running full time at rated power. Formula: ***kWh produced in the period/(Capacity of unit x period hours)***	
11	Availability Factor	The fraction of the total time that a generating unit is able to produce. It is calculated using the formula: ***(Available hours/Period hours) x 100***	%
12	Equivalent Availability Factor (EAF)	The fraction of maximum generation that could be provided if limited only by outages and deratings. Formula: ***{Available hours – (Equivalent derated hours + Equivalent seasonal hours)/Period hours} x 100***	%
13	Equivalent Unplanned Outage Factor (EUOF)	The unplanned outage period, including forced outage and derating, and maintenance outage and derating, as a fraction of the total period. Formula: ***{(Forced outage hours + equivalent forced derated hours + maintenance outage hours + equivalent maintenance derated hours)/Period hours} x 100***	%
14	Equivalent Forced Outage Factor	The fraction of the reporting period in which a generating unit is not available due to forced outages and forced deratings. Formula: ***{(Forced outage hours + Equivalent forced derated hours)/Period hours} x 100***	%