GOVERNMENT OF PUERTO RICO
PUBLIC SERVICE REGULATORY BOARD
PUERTO RICO ENERGY BUREAU

IN RE: ANNUAL PERFORMANCE TEST PROCEDURE – THERMAL GENERATION EQUIPMENT	**CASE NO.: NEPR-MI-2023-0003** **SUBJECT:** Motion to Submit Revised Annual Performance Test Procedure in Compliance with Resolution and Order Dated August 29, 2023

MOTION TO SUBMIT REVISED ANNUAL PERFORMANCE TEST PROCEDURE IN COMPLIANCE WITH THE RESOLUTION AND ORDER DATED AUGUST 29, 2023

TO THE HONORABLE PUERTO RICO ENERGY BUREAU:

COMES NOW GENERA PR, LLC ("Genera"), as agent of the Puerto Rico Electric Power Authority ("PREPA"),[1] through its counsels of record, and respectfully submits and prays as follows:

1. On June 16, 2023, the Energy Bureau of the Puerto Rico Service Regulatory Board ("Energy Bureau") issued a Resolution and Order titled *Commencement of Proceeding for the Evaluation of the GENERA Annual Performance Test Procedure under Section 4.2(v) of the Generation Operation and Maintenance Agreement*, thereby initiating the current proceeding for the "review and consideration of Genera's annual performance testing procedures."

2. On June 30, 2023, the Energy Bureau issued a Resolution and Order titled *Review of the Genera Annual Performance Test Procedure under Section 4.2(v) of the Generation Operation and Maintenance Agreement* ("June 30th Order"), whereby it conditionally approved

[1] Pursuant to the *Puerto Rico Thermal Generation Facilities Operation and Maintenance Agreement* ("LGA OMA"), dated January 24, 2023, executed by and among PREPA, the Puerto Rico Public-Private Partnerships Authority ("P3 Authority") and Genera, Genera is the sole operator and administrator of the Legacy Generation Assets (as defined in the LGA OMA) and the sole entity authorized to represent PREPA before PREB concerning any matter related to the performance of any of the O&M Services provided by Genera under the LGA OMA.

Genera's Annual Performance Test Procedures ("APT") submitted on June 20, 2023,[2] subject to the revision and clarifications stipulated in Attachment A of the June 30th Order. Consequently, in the June 30th Order, the Energy Bureau ordered Genera to file its revised version of the APT, incorporating the guidance in Attachment A, within thirty (30) days from the notification of the June 30th Order. The deadline for the submission of the revised APT was July 31, 2023.

3. On July 20, 2023, Genera filed a document titled *Motion to Request Comments and Approval on Genera's Preliminary Response to the June 30, 2023, Order* ("July 20th Motion"), whereby Genera submitted its preliminary responses to Attachment A of the June 30th Order and requested that the Energy Bureau provide comments, feedback, and recommendations. Subsequently, on July 31, 2023, Genera filed another Motion titled *Motion to Inform Genera's Compliance Efforts and Request for Feedback on Response Submitted on July 20, 2023, Motion to Request Comments and Approval on Genera's Preliminary Responses to the June 30, 2023, Order*. Through this latter motion, Genera reiterated its petition for the Energy Bureau to provide comments on the preliminary responses initially submitted in the July 20th Motion.

4. On August 29, 2023, the Energy Bureau issued a Resolution and Order titled *Determination of Genera's Annual Performance Test Procedure* ("August 29th Order"). In this Order, the Energy Bureau **conditionally approved** Genera's APT, **subject** to Genera's filing – within fifteen (15) days after the notification of the August 29th Order – of a revised version of the APT that incorporates the requirements and modifications delineated in Attachments A and B of the August 29th Order ("Revised APT").

[2] On June 20, 2023, Genera filed a document titled *Motion to Submit Genera PR LLC's June 5th Annual Performance Testing Submission in Compliance with the June 16, 2023 Order* ("June 20th Motion"), wherein Genera submitted its proposed APT to the Energy Bureau in accordance with Section 4.2(v) of the LGA OMA.

5. On September 13, 2023, in compliance with the August 29th Order, Genera submitted a document titled *Motion to Submit Response in Compliance with Resolution and Order Dated August 29, 2023, and Request for Extension of Time* ("September 13th Motion"), through which Genera provided its responses to the requirements specified in Attachment A of the August 29th Order. Additionally, Genera requested an extension of time, until September 28, 2023, to submit the Revised APT, which includes all requirements and modifications proposed by the Energy Bureau in the August 29th Order, along with the Report Content as detailed in Attachment B of the same order.

6. In compliance with the August 29th Order and in accordance with the September 13th Motion, Genera hereby submits its Revised APT, incorporating all requirements and modifications proposed by the Energy Bureau, attached herein as **Exhibit A**.

WHEREFORE, Genera respectfully requests that the Energy Bureau **take notice** of the above for all purposes and **deem** Genera in compliance with the August 29th Order.

We hereby certify that we filed this motion using the electronic filing system of this Energy Bureau.

RESPECTFULLY SUBMITTED.

In San Juan, Puerto Rico, this 28th day of September 2023.

ECIJA SBGB
PO Box 363068
San Juan, Puerto Rico 00920
Tel. (787) 300.3200
Fax (787) 300.3208

/s/ Jorge Fernández-Reboredo
Jorge Fernández-Reboredo
jfr@sbgblaw.com
TSPR 9,669

/s/ Alejandro López-Rodríguez
Alejandro López-Rodríguez
alopez@sbgblaw.com
TSPR 22,996

CERTIFICATE OF SERVICE

We hereby certify that a true and accurate copy of this motion was filed with the Office of the Clerk of the Energy Bureau using its Electronic Filing System.

In San Juan, Puerto Rico, this 28th day of September 2023

/s/ Alejandro López-Rodríguez
Alejandro López-Rodríguez

Exhibit A

Genera's Revised APT

O&M - Generation Equipment Performance Test Procedure

Revision Date: 09/22/2023

O&M GENERATION EQUIPMENT - PERFORMANCE TEST PROCEDURE

TABLE OF CONTENTS

LIST OF TABLES

1.0 OBJECTIVE

The purpose of this document is to identify the Annual Performance Test procedure to be followed in determining the overall Net Capacity and Net Heat Rate of each of the thermal units. If a unit is permitted to operate on multiple fuels, the Performance Test will be conducted for each fuel. The procedure outlined in this document should only be used for the Net Capacity and Net Heat Rate Performance Test.

This document will outline:

- Guidelines that should be adhered to for the testing process
- Parameters to be measured during a test
- Roles and responsibilities of all personnel involved in the conducting of the test
- Guidelines for analyzing the results and preparing reports
- The process for determining the validity of the test and its results
- Approval and finalization of the Performance Test results

The results of a Performance Test will provide fairly accurate output and heat rate data that is essential for utilization in the economic dispatching of each of the Legacy Generation units and for use as a performance indicator. Heat rate test data will be used to analyze a thermal unit's efficient use of fuel and can also be used to determine the overall performance of the following:

- A gas or combustion turbine compressor and turbine.
- A steam unit's boiler, steam turbine and all their support systems.

2.0 GENERAL

A Performance Test will be conducted for the oil and/or gas -fired Steam, Combustion Turbines, Combined Cycle and Diesel Generators (excluding diesel generators used for backup power). The Capacity and Heat Rate Test, for reasons of economy, must first be scheduled for periods during which economic dispatch would normally require the units to be on-line. If this is not possible then another time frame should be selected when the unit would be online and able to produce full power.

All Performance Tests will be scheduled and coordinated with the System Operator (LUMA) and the Administrator to allow the witnessing of the tests by LUMA and PREB, as required.

Prior to and during the test, the following shall be taken into consideration. All items below must be mutually agreed upon.

- No adjustments shall be made to enhance the short-term performance of the unit. However, if a water wash system is installed, as conditions and operation requirements allow, an off-line water wash should be performed prior to testing.
- Only unit auxiliary equipment that is necessary to maintain the normal operation of the unit shall be in operation during the test.
- All support systems that would either remove or introduce heat, from the test boundary or thermodynamic cycle, for use in another plant process other than that required for the operation of the unit undergoing the test, should be completely isolated for the duration of the test.
- All instrumentation relevant to the test will be calibrated and checked for accuracy. The plant management is responsible for providing documentation to verify that these instruments are calibrated and checked for accuracy.
- Personnel collecting data during the testing period should all have a stopwatch to ensure that the timing of data collection for any manual collection points is synchronized with other plant personnel.
- Where Legacy units have performance or environmental control limitations that need to be maintained during the testing period, operating limitations affecting maximum load capacity or general unit performance during testing should be recorded and indicated within the Performance Test results and associated report (e.g. exhaust temperature limits, pressure restrictions, flow, supply, MW, fuel quality, etc.).

3.0 DEFINITIONS

- **Heat Rate**: The ratio of the fuel energy input, or fuel/heat consumption, (Btu/hr in Lower Heating Value [LHV]) to the gross power output produced by the fuel input as measured at the test boundaries. It is a measure of a power plant's thermal efficiency, commonly expressed as Btu/kWh. The basis of the value should always be expressed on the basis of the fuels' lower heating value, which will be determined by laboratory testing as part of the Performance Test.

- **Heating Value** The measured calorific value of the fuel in Btu/lb, Btu/ft^3 (fuel gas), or Btu/gal, Btu/lb (fuel oil).

- **Gross Generation Output**: The electrical output based upon direct measurement at the test boundary. This should be measured at the generator terminals excluding excitation losses.

- **Test Boundary**: The thermodynamic cycle that is to undergo testing for which all of the energy flows (heat and electrical energy) in and out of the cycle must be determined.

- **Auxiliary Power**: The amount of electrical power required by a thermal unit's auxiliary or support equipment that sustains the normal operation of the unit.

- **Net Capacity**: The gross electrical power output of the unit under test, exclusive of the auxiliary power being supplied by the unit itself. Measured and reported in kilowatts (kW) or megawatts (MW). If the net power inclusive of all auxiliary loads cannot be measured, the auxiliary loads should be

measured separately and subtracted to calculate the net power.

- **Net Heat Rate**: The ratio of the fuel energy input to the net capacity output produced by a thermal unit.

- **Corrected Performance**: A performance parameter that has been adjusted mathematically by certain factors to a specified reference condition.

- **Parameter**: A direct measurement or a physical quantity at a location, which is determined by a single instrument, or by the average of several measurements of the same physical quantity.

- **Specified Reference Conditions**: The values of all the conditions to which the test results are corrected as agreed upon by all involved parties.

- **Test Run**: Group of measurement readings taken over a specific time period over which operating conditions remain constant or nearly so. During a test run, the gross and net electrical power output and the amount of fuel used are recorded at a specified test load (fixed load setting for part load testing) or specified disposition (base load testing) .

- **Test Load**: For a fixed load test, a fixed load setting that should be maintained for each test run (and for all fuels) during which required data is collected and recorded in a data sheet. For a specified disposition (i.e. base load testing) a fixed operating disposition should be maintained for the duration

of the test. The measured load for the duration of these tests is the test load.

- **Variable**: A quantity that cannot be measured directly but is calculated from other measured parameters.

- **Stability** According to ASME PTC 22, it is the point at which continuous monitoring indicates that all readings are within the maximum permissible deviations as established by OEM recommendations and PTC 22. All historical data available will be compared to the test results considering any changes that have been implemented since the units were installed.

- **Calibration** The process of adjusting the output or indication on a measurement instrument to a reference standard that is in line with recognized international standards.

- **Ramp Rate** This is the average loading rate (MW/hr) that each generator takes to increase from full speed no load to the maximum capacity.

- **Major Maintenance** A planned equipment overhaul including inspection, repair, replacement, upgrades and/or restoration of critical equipment such as turbine/generator and auxiliaries, boiler pressure parts, large pumps/motors (i.e. CW, BFP, etc.), emission controls, and preventive/corrective activities to be performed during a scheduled outage.

4.0 TEST VALIDITY

The following criteria must be used to determine whether or not the results obtained during a Performance Test are valid and acceptable or not:

- If, during the conduct of the test or during the subsequent analysis or interpretation of the observed data, an inconsistency is found which significantly impacts the accuracy of the results, the parties identified in Section 6 should make every reasonable effort to adjust or eliminate the inconsistency by mutual agreement. Failure to reach such an agreement will constitute rejection of the test run in question or the entire performance test itself.

- During a test run if any of the variables, outlined in the maximum permissible standard deviations table for any of the generating technologies, deviate outside of their predefined limits then the cause of the operating variable's deviation should be identified and eliminated. The test run should then be completed for the remainder of its duration once the cause of the deviation has been eliminated and all variables are operating within the permissible standard deviations, as outlined in the respective measurements table. If the cause cannot be eliminated during the test run, then the results of that test run should be discarded. The test should recognize the condition and age of the equipment and document specific test procedure deviations, if any, that may be required due to specific equipment configuration.

- Five successful test runs must be conducted within a 5 working day time period. If five test runs were conducted, and for some reason the results of a test run are rejected then another test run possibly at a different test load would need to be conducted in order to satisfy the quota of five test runs. If a different test load is needed, the reason why the load condition cannot be achieved must be reported, and then, if acceptable to all parties, the test may be run at a different load condition. Recommended test loads for each site should be determined based on the maximum and minimum generating capability of the unit so that loads at various operating points within that range are tested in addition to the minimum and maximum loads. Where feasible, ramp rate may be verified during minimum and maximum generating capacity, if possible during the allocated testing period.

- If while examining the test results, inconsistencies are observed in the data set which exceed the allowable deviations, then the results of the test should be discarded and completely invalidated**.**

5.0 INSTRUMENTATION

- All measuring instruments that will be used for data collection should be calibrated or checked for accuracy as close as possible to the schedule date of the Performance Test. Review of prior logs and records based on previous 12 months will be reviewed within 6-moths of testing to ensure the accuracy of test measurements. Where erroneous readings are present a calibration program will be implemented. The calibration of the instrumentation and the values collected by the DCS and any data recording devices used for data collection during testing should be correct and traceable to standards.

- All thermal plants should be able to provide documentation of calibration procedures and records of previous instrumentation calibration upon request.

- The Performance Tests will use station instrumentation for primary and secondary parameter measurements. Every effort shall be made to ensure that the instrumentation is calibrated and in good working order; however, due to the age and condition of the instrumentation, any suspected deviations observed which may affect the accuracy of results should be recorded and included within the Performance Test report..

- The test team will monitor and record gas emissions, such as NOx, PM, CO, Oz, and others, depending on the fuel, using the available plant instrumentation.

- All calibration standards must be similar and be traceable to the U.S. National Institute of Standards and Technology (NIST), or equivalent international standard

6.0 AREAS OF RESPONSIBILITY

The following are the areas of responsibility for all the parties that should be involved in the conducting of performance testing, from test scheduling, executing the actual testing, through calculation of the Performance Test results and test results acceptance.

Head of Operations - Generation (Genera)

- Responsible for reviewing the report and recommendations and then signing off on the results of the test as being official and accepted.

Power Plant Station Manager

- Responsible for ensuring that all the relevant operation and maintenance activities are planned and conducted before the schedule performance test. This is to ensure that the unit that is to undergo testing is close to its optimum performance prior to the date of the actual Performance Test.
- Review and approve the Plant Report as prepared by the Operations Engineer and forward the final Plant Report to Head of Operations/Generation. This final report must be submitted to P3A, LUMA, and any other parties as required within twenty (20) working days following the receipt of all test data including fuel sample analysis, and a copy of this report should be sent to the Planning Engineer that observed the test.

Power Plant Operations Manager

- Ensure that the unit to be tested is prepared in accordance with the contents of this procedure before the scheduled date of the test.
- Arrange for the testing of fuel samples and the collection of the laboratory reports of the fuels used on the unit that was tested.
- Responsible for overseeing the actual Capacity and Heat Rate test and ensure that all of the unit's operational procedures and Performance Test procedures are adhered to.

Power Plant Operations Engineer

- Responsible for ensuring that all data and fuel samples are collected during the actual Performance Test.
- Responsible for ensuring that the operations staff are operating the unit being tested within the unit's expected performance and the maximum permissible standard deviations outlined in Tables 1 through 3 for each respective generating technology.

- Responsible for preparing the Plant Report and submitting a draft copy to the Power Plant Operations and Power Plant Manager.
- Act as unit controller.

Planning Engineer

- Prepare a Performance Test schedule one month in advance of the actual test in coordination with the System Operator.
- Act as an independent observer during the actual Performance Test.
- The Planning Engineer (Planner) overseeing the test has the authority and responsibility to determine the readiness of the plant and the unit in question for test. The Planner also has the responsibility to ensure that the capacity and heat rate test is being conducted in accordance with the contents of the Performance Test procedure.
- The Planning Engineer will identify if abnormal operation requires termination of the testing; however, consultation will all parties of the test is expected when deciding to terminate or carry on with a test.
- The Planner shall consult with all parties to determine to terminate the Performance Test until a suitable time for test resumption or to re-schedule the test in the event of any of the following:
    - Deviation of the procedures within this procedure.
    - Abnormal operating scenarios.
    - System emergencies, such as generation shortfall or transmission and distribution disturbances that would require the unit to be dispatched outside of the test loads for any particular test run.
- Preparing the official final report as outlined in the report template located in this document. The report should include a copy of any reporting or plant output provided by the Power Plant Manager.

System Operator (LUMA)

- Responsible for System Operations.
    - The Grid Operator has the authority to terminate the Performance Test until a suitable time for test resumption or to re-schedule a test in the event of a system emergency, such as generation shortfall or transmission and distribution disturbances that would require the unit to be dispatched outside of the test loads for any particular test run.
- Witness the collection of fuel samples, if desired.
- Act as an independent observer during the Performance Test, if desired

- Confirm that the unit may be dispatched at test load during the planed duration of the test

Independent Engineer

- Provide oversight, reviews, and support prior to testing
- Witness Performance Test, including witnessing collection of fuel samples
- Provide independent review and calculations of testing results
- Provide independent report for reference and comparison purposes

7.0 STEAM UNIT CAPACITY AND HEAT RATE TEST

7.1 Preliminary Requirements

- The boiler must be soot blown no more than two (2) hours prior to the start of the test.

- A system backwash should be conducted on the entire condenser circulating water system no more than five (5) working days prior to the scheduled date of the test.

- In the planning stage of the capacity and heat rate test, the Plant Manager, the Planning Engineer, and the Grid Operator should agree and sign off on the facility that will be used to conduct the analysis on the fuel samples.

- Any steam and/or combustion air leak that could possibly have a significant effect on the unit's heat rate and that can be permanently rectified in the short term (no more than 4 weeks) should be rectified before conducting a Performance Test. If the plant has outlined valid reasons why the steam and/or combustion air leak cannot be corrected prior to the scheduled test date and these reasons are deemed valid by the Head of Generation, then the test should be re-scheduled to a date not exceeding one (1) month after the previous schedule date. If this is not fulfilled, then the Planning Engineer should conduct the Performance Test with this outstanding defect and all reports should be prepared based on the results of this test.

7.2 Prior to the start of the test

- Duplicate fuel samples should be collected at the start and the end of the test to determine the heating value to be used during the calculation process. The purpose of taking duplicate samples is a matter of redundancy and to eliminate the possibility of contamination.

  Note: Fuel samples should not be taken from the fuel storage or service tanks. The reason behind this is that the quality and the composition of the fuel samples must be a true representation of the fuel just before it enters the boiler combustion system. Therefore, fuel samples should be taken, when possible, from any drain lines or sample points near the boiler's fuel burners.

The Power Plant Operations will ensure that all plant personnel are assigned to the various locations for data collection. The System Operator, LUMA, should not be instructing the unit to do anything during the test unless a system emergency occurs and the test needs to be stop for system security.

- The Operations Engineer and the other plant personnel collecting data should have a stopwatch in hand and the Operations Engineer should ensure that the timing for data collection for any manual collection points among all relevant individuals is synchronized with each other.

- For hydrogen cooled generators, the hydrogen purity should be maximized to ensure efficient operation of the unit's electrical generator. If for some reason, the hydrogen purity is below the manufacturer's specifications, then the heat rate test should be re-scheduled with the aim of correcting the unit's hydrogen purity prior to retesting.

- Apart from the isolations to the thermal cycle, the capacity and heat rate test should be conducted on the unit under normal operating conditions, with no performance enhancing adjustments outside of design specifications for normal operations.

- Before the start of the capacity and heat test, some internal and external systems should be isolated from the thermal cycle. This is to reduce or eliminate fluid flow that is entering or leaving the thermal cycle under test. The following is a list of equipment/systems that must be completely isolated:
    - Auxiliary steam lines from other thermal cycles/units.
    - Drain lines from all stop valves (boiler, turbine) and all control valves.
    - Drain lines on the main steam line and extraction steam piping.
    - All chemical feed equipment into the condensate system along with all sampling lines.
    - All vent lines and other drains.
    - Hogging Ejectors.
    - Any other fluid interconnecting lines to other units or thermal cycles.
    - Steam operated soot blowers.
    - All condensate and feed water heaters bypass valves.
    - Bypass lines for all primary flow measuring devices.
    - All condensate and feed water heaters drain bypasses.

- Boiler blow down.
- De-superheating water flow.
- Steam flow to the steam coil air heaters.

- The Test Procedures to be developed for each unit will provide a list of all pertinent information that could affect the unit performance including:
  - Known maintenance issues associated with system outages that can affect performance of the units, e.g., 3 out of 4 cooling water pumps were available for operations.
  - Dates when maintenance and cleaning of systems, i.e., intake filters, which can affect performance was last performed.
  - All auxiliary power systems, with a description of each of these systems and a note as to whether they are typically operated during service or are operated only and for special operations.
  - When the last curve of Fuel flow Vs Air flow and Steam flow (firing rate curve) was developed and updated in the DCS and if it is necessary to develop a new curve prior to the annual performance test of the unit.

Notes:

- The Operations Engineer should confirm that all the above equipment/systems are isolated by:
  - Conducting visual inspections on all isolating valves.
  - Using measuring instruments located before and after isolation points to ensure that there is no flow across the isolation points.
  - Checking for steam flowing from drains and vents that should be isolated.

  If the equipment/systems cannot be isolated in accordance with the testing procedure, all parties must agree that the unit is ready for testing before proceeding. The planning engineer will provide identification of all instrumentation used for testing (measurement points) and a cycle isolation list to indicate valve positions during testing.

- When available, a careful review of the P&ID's should be undertaken to assure that the isolation called for will not cause condensate to back up into the steam turbine casing causing blade damage. Relevant P&ID's will be made available to all parties.

7.3 Maximum Permissible Standard Deviations

The steam unit should be operated for at least sixty (60) minutes before the schedule start of the test and during the test to ensure that the following operating variables are within the permissible standard typical variations during the test runs, If operating conditions vary during the test run beyond the limits prescribed in Table 1 below, the results of the test run shall be discarded This is to minimize the possibility of errors and ensure acceptable mechanical operation and stable control of the steam unit being tested.

Operating Variable	Standard Deviation
Power Output	5.00%
Steam Throttle Pressure	0.25%
Steam Throttle Temperature	4°F (27°F-50°F superheat)
	7°F (>50°F superheat)
Feed water temperature from final high pressure feed water heater	10.00°F
Condenser Vacuum	2.5%
Feed water heaters extraction steam pressures	5.00%
Voltages	5.00%
Rotating Shaft Speed	0.25%

Table 1: Steam Unit Maximum Permissible Standard Deviations of Recorded Variables

7.4 Steam Unit Capacity and Heat Rate Test Procedures

As a guideline, the Power Plant Operations Engineer should ensure that the steam unit is operated within the manufacturer's specifications (recognizing the age and condition of the equipment) throughout the duration of the test. The Planning Engineer/Performance Test Specialist is to decide in consultation with the Independent Engineer and the representatives of the Other Parties on site if an event is considered abnormal.

Once the Performance Test has started, there should be no further adjustments to the steam unit during each test run. It is important to note that for each test load, the unit should be operated on load limit and not on governor control. This is to ensure that there will not be any change in the steam unit loading due to any system frequency fluctuations.

Immediately following testing, the Planning Engineer will review recorded data to ensure instruments were reading correctly, locate any errors or inaccuracy in the data sets, and confirm the test runs meet the required stability requirements and, in consultation with the Independent Engineer and the representatives of the Other Parties on site, if a re-test is required.

Once all personnel are in place and all prerequisites satisfied, then the controller should coordinate with LUMA who has dispatch authority to issue instructions to the unit controller to ramp up or down to the test load for the first test run. Each test run must be conducted at a fixed load set point and should be an hour in length. Each Performance Test must consist of no less than five (5) test runs, each at five different fixed load set points ranging from the unit's minimum load to maximum (or rated) load settings. The minimum load test is to be conducted at minimum emissions compliant load (MECL). For each different load point, one (1) test run is required, but two (2) test runs are recommended to confirm the repeatability of the results. If the facility operates on dual fuels or mixed fuels, tests must be performed for all fuel options.

1. The operating instruction and every operating instruction thereafter should be issued by the Assistant Control Engineer-Generation with due cognizance of the unit's normal ramp rate. This is to ensure that the unit can achieve the desired test load and reach stability within 60 minutes before the scheduled start of each test run.

1.1. Once the unit has reached its first target test load and has achieved stability, the Operations Engineer and other personnel collecting data should digitally record all data specified in the data collection sheet located in the appendices and start timing the test run using the plant DCS. Required data that cannot be digitally recorded is to be manually collected by test members under sheets prepared for each unit, in general accordance with those provided in the appendices to the Annual Performance Test procedure.

1.2. Prior to testing, the Operations Engineer should confirm that the nominal frequency and transmission voltages are within a+/- 5% tolerance of the reference value. During testing, the stability shall be maintained in accordance with Section 7.3 of this specification.

1.3. During each test run, the Operations Engineer should record the frequency at the busbar of the unit being tested as well as its transmission busbar voltage.

1.4. The Operations Engineer should record the gross megawatt (MW) output every thirty (30) seconds of the unit under test for the duration of each test run.

Note: During the performance test, the Operations Engineer is responsible for ensuring that all the data necessary to complete the unit's Performance Test datasheet(s) as outlined in the appendices, is recorded.

Note: All raw digital data recorded by the DCS, relevant to the performance tests shall be provided to all parties in non-processed (native) format generated by the DCS.

2. For each test run, all the required data in the data sheet should be recorded for the first test load. The actual time-of-day the test run commenced, i.e., time when starting at 0:00 hours, should also be recorded for each test run. If recorded digitally, the data should be collected in 30-second intervals, where feasible. If any manual data is required, this data should be collected with a frequency of no less than 5 minutes.

3. After the completion of the first test run and the collection of data for that test run, the Operations Engineer must repeat the test run at the same load before changing to a different test load. Once two runs have been completed at the first test load, the Operation Engineer must inform the LUMA Control Center Shift

Engineer-Generation of the completion of the first test runs and their intention to change the test load from one set point to another to commence a second test load run.

3.1. The LUMA Control Center Shift Engineer-Generation at this point should issue the operating instruction for the steam unit to move from the previous test load to the new test load for the second test run. After carrying out this instruction, the Unit Controller should allow sixty (60) minutes to elapse to achieve stability at this new test load.

3.2. After stability has been achieved for the second test run, the Operations Engineer and other personnel collecting data should record all data specified in the data collection sheet located in the appendices for the second test run and start timing this test run.

4. Repeat step 2 as outlined in this section, ensuring that all the required data in the data sheet is recorded for the second test run.

5. At the completion of the second test load runs, steps 3 to 4 should be repeated for data collection for the other test runs at the three different test loads.

6. At the end of the test runs, the Operations Engineer should inform the LUMA Control Center Shift Engineer-Generation of the completion of the Performance Test, following which the steam unit should be dispatched to the required loading as directed by the LUMA Control Center Shift Engineer-Generation.

Note: All abnormal events that occur, as decided by the Planning Engineer, during the Performance Test should be recorded on the data sheet with the time of the occurrence and the name of the observer.

Note: In the event that incorrect data is recorded, then a line should be drawn through the incorrect data, signed and an explanation given for the reasons for the adjustment.

Note: Immediately following testing, the Planning Engineer will review recorded data to ensure instruments were reading correctly, locate any errors or inaccuracy in the data sets, and confirm the test runs meet the required stability requirements. By doing so, the integrity of

the test data and each test run itself can be analyzed. The aim of identifying inconsistencies and errors that might exist in the data being collected or due to possible instrumentation errors and based on the findings, is to make the necessary adjustments to rectify such errors or inconsistencies.

Following the completion of the test, the following individuals should sign and date the Performance Test datasheet(s) and any other log sheets that were used during the test:

- Operations Engineer
- Planning Engineer
- Operation Manager
- Plant Manager

A softcopy of the signed datasheet and any other log sheets should be issued to the overseeing Planning Engineer, the Operations Manager and the Plant Manager.

8.0 GAS/COMBUSTION TURBINE CAPACITY AND HEAT RATE TEST

8.1 Preliminary Requirements

- If operational conditions allow, a compressor wash shall be performed on units, where installed and operational, within 100 hours of operation before the test is conducted if the unit is so equipped. The date and time of the compressor wash should be recorded.

- In the planning stage of the Performance Test, the Plant Manager, System Operator, and the Planner should all agree and sign off on the facility that will be used to conduct the analysis on the fuel samples.

8.2 Prior to the start of the test

- Duplicate fuel samples should be collected at the start and the end of the test to determine the heating value to be used during the calculation process. If the facility utilizes dual fuels, samples shall be collected for both fuels. The purpose of taking duplicate samples is just a matter of redundancy.

  Note: Fuel samples should not be taken from the fuel storage or service tanks. The reason behind this is that the quality and the composition of the fuel samples must be a true representation of the fuel just before it enters the gas turbine combustion process.

- Only auxiliary equipment that is utilized during normal operation should be in service prior to and during the test. A status check should be performed on all auxiliary equipment prior to the start of the test to verify normal operation.

- The Power Plant Operations Engineer should ensure that all plant personnel are assigned to the various locations for data collection.

- The Operations Engineer and the other plant personnel collecting data should have a stopwatch in hand and the Operations Engineer should ensure that the timing for data collection among all relevant individuals is synchronized with each other.

8.3 Maximum Permissible Standard Deviations

The gas turbine should be operated for at least thirty (30) minutes before the schedule start of the test to ensure that the following operating variables are within the permissible standard variations that are typical, , ASME PTC 22 may be used as reference. The calculated standard deviation of the data sample shall not exceed the values given in Table 3-3.5-1 in ASME PTC 22. If operating conditions vary during the test run beyond the limits prescribed in Table 2 below, the results of the test run shall be discarded. This is to ensure acceptable mechanical operation and stable control of the gas/combustion turbine being tested.

Operating Variable	Standard Deviation
Power Output	0.65%
Barometric Pressure	0.16%
Inlet Air Temperature	1.3°F
Fuel Source Pressure	0.65%
Fuel Flow	0.65%
Generator Rotating Shaft Speed	0.65%

Note: The standard deviations are the calculated standard deviations of the data and not tolerances.

Table 2: Gas/Combustion Turbine Maximum Permissible Standard Deviations of Recorded Variables

8.4 Gas/Combustion Turbine Heat Rate Test Procedures

As a guideline, the unit operator along with the Operations Engineer should ensure that the gas/combustion turbine is operated within the manufacturer's specifications throughout the duration of the test. The Planning Engineer/Performance Test Specialist is to decide in consultation with the Independent Engineer and the representatives of the Other Parties on site if an event is considered abnormal.

Once the Performance Test has started, there should be no further adjustments to the gas/combustion turbine during each test run. It is important to note that for each test load, the unit should be operated on load limit (or pre-selected load) and not on governor/ speed control. This is to ensure that there will not be any change in the gas/combustion turbine loading due to any system frequency fluctuations. For gas turbines that can achieve 100% base load, the units should operate on maximum exhaust temperature control, and, where applicable, at maximum inlet guide vane (IGV) angle.

Immediately following testing, the Planning Engineer will review recorded data to ensure instruments were reading correctly, locate any errors or inaccuracy in the data sets, and confirm the test runs meet the required stability requirements and, in consultation with the Independent Engineer and the representatives of the Other Parties on site, if a re-test is required.

Once all personnel are in place and all prerequisites satisfied, then the controller should issue dispatch instructions to the unit controller to ramp up or down to the test load for the first test run. Each test run must be conducted at a fixed load set point and should be an hour in length. Each performance test must consist of no less than five (5) test runs, each at five different fixed load set points ranging from the unit's minimum load to maximum (or rated) load settings. The minimum load test is to be conducted at minimum emissions compliant load (MECL). For each different load point, one (1) test run is required, but two (2) test runs are recommended to confirm the repeatability of the results. If the facility operates on dual fuels, tests must be performed for both fuels.

1. The dispatch instruction and every dispatch instruction thereafter should be issued by the Assistant Control Engineer-Generation with due cognizance of the unit's normal ramp rate. This is to ensure that

the unit can achieve the desired test load and reach stability within 30 minutes before the scheduled start of each test run. Where feasible, ramp rate should be demonstrated.

1.1. Once the unit has reached its first target test load and has achieved stability, the Operations Engineer and other personnel collecting data should digitally record all data specified in the data collection sheet located in the appendices and start timing the test run.

1.2. Prior to testing, the Operations Engineer should confirm that the nominal frequency and transmission voltages are within a+/- 5% tolerance of the reference value. During testing, the stability shall be maintained in accordance with Section 8.3 of this specification.

1.3. During each test run, the Operations Engineer should record the frequency at the busbar of the unit being tested as well as its transmission busbar voltage.

1.4. The Operations Engineer should record the gross megawatt (MW) output of the unit under test for the duration of each test run.

Note: During the Performance Test, the Operations Engineer is responsible for ensuring that all the data necessary to complete the unit's capacity and heat rate datasheet as outlined in the appendices, is recorded.

2. For each test run, all the required data in the data sheet should be recorded for the first test load. The actual time-of-day the test run commenced, i.e., time when starting at 0:00 hours, should also be recorded for each test run. If recorded digitally, the data should be collected in 30-second intervals, where feasible. If any manual data is required, this data should be collected with a frequency of no less than 5 minutes.

3. After the completion of the first test run and the collection of data for that test run, the Operations Engineer must repeat the test run at the same load before changing to a different test load. Once two runs have been completed at the first test load, the Operation Engineer must inform the LUMA Control Engineer-Generation of the completion of the first test runs and their intention to change the test load from one set point to another to commence a second test load run.

3.1. The LUMA Control Center Shift Engineer-Generation at this point should issue the operating instruction for the gas/combustion turbine unit to move from the previous test load to the new test

load for the second test run. After carrying out this instruction, the Unit Controller should allow at least thirty (30) minutes to elapse to achieve stability at this new test load.

3.2. After stability has been achieved for the second test run, the Operations Engineer and other personnel collecting data should record all data specified in the data collection sheet located in the appendices for the second test run and start timing this test run. Stability will be assessed by monitoring the parameters specified in Table 2 for units governed by ASME PTC 22 and the proper tables from other ASME PTC standards for the unit.

4. Repeat step 2 as outlined in this section, ensuring that all the required data in the data sheet is recorded for the second test run**.**

5. At the completion of the second test load runs, steps 3 to 4 should be repeated for data collection for the other test runs at the three different test loads.

6. At the end of the test runs, the Operations Engineer should inform the LUMA Control Center Shift Engineer-Generation of the completion of the Performance Test, following which the unit should be dispatched to the required loading as directed by the LUMA Control Center Shift Engineer-Generation.

Note: All abnormal events that occur during the Performance Test, as decided by the Planning Engineer, should be recorded on the data sheet with the time of the occurrence and the name of the observer.

Note: In the event that incorrect data is recorded, then a line should be drawn through the incorrect data, signed and an explanation given for the reasons for the adjustment.

Following the completion of the Performance Test, the following individuals should sign and date the Performance Test datasheet(s) and any other log sheets that were used during the test:

- Unit Operator
- Operations Engineer
- Planning Engineer

- Operation Manager
- Plant Manager

A softcopy of the signed datasheet and any other log sheets should be issued to the overseeing Planning Engineer, the Operations Manager and the Plant Manager.

9.0 COMBINED CYCLE CAPACITY AND HEAT RATE TEST

9.1 Preliminary Requirements

- If operational conditions allow, a compressor cleaning should be performed on the unit within 100 hours of operation before the test is conducted, if the unit is so equipped.

- In the planning stage of the Performance Test, the Station Manager, System Operator, and the Planner should all agree and sign off on the facility that will be used to conduct the analysis on the fuel samples.

9.2 Prior to the start of the test

- Duplicate fuel samples should be collected at the start and the end of the test to determine the heating value to be used during the calculation process. The purpose of taking duplicate samples is just a matter of redundancy.

  Note: Fuel samples should not be taken from the fuel storage or service tanks. The reason behind this is that the quality and the composition of the fuel samples must be a true representation of the fuel just before it enters the gas turbine combustion process.

- Only auxiliary equipment that is utilized during normal operation should be in service prior to and during the test. A status check should be performed on all auxiliary equipment prior to the start of the test.

- The Power Plant Operations Engineer should ensure that all plant personnel are assigned to the various locations for data collection.

- The Operations Engineer and the other plant personnel collecting data should have a stopwatch in hand and the Operations Engineer should ensure that the timing for data collection among all relevant individuals is synchronized with each other.

- Apart from the isolations to the thermal cycle, the Performance Test should be conducted on the unit under normal operating conditions, with no performance enhancing adjustments outside of design specifications for normal operations.

- Before the start of the Performance Test, some internal and external systems should be isolated from the thermal cycle. This is to reduce or eliminate fluid flow that is entering or leaving the thermal cycle under test. The following is a list of equipment/systems that must be completely isolated:
  - Auxiliary steam lines from any external thermal processes/units.
  - Drain lines from all stop valves (HRSG, turbine) and all control valves.
  - Drain lines on the main steam line and extraction steam piping.

- All chemical feed equipment into the condensate system along with all sampling lines.
- All vent lines and other drains.
- Any other fluid interconnecting lines to other units or thermal cycles.
- Bypass lines for all primary flow measuring devices.
- HRSG HP drum blow down.
- HRSG LP drum blow down
- De-superheating water flow.

- The Test Procedures to be developed for each unit will provide a list of all pertinent information that could affect the unit performance including:
  - Known maintenance issues associated with system outages that can affect performance of the units, e.g., 3 out of 4 cooling water pumps were available for operations.
  - Dates when maintenance and cleaning of systems, i.e., intake filters, which can affect performance was last performed.
  - All auxiliary power systems, with a description of each of these systems and a note as to whether they are typically operated during service or are operated only and for special operations.
  - When the last curve of Fuel flow Vs Air flow and Steam flow (firing rate curve) was developed and updated in the DCS and if it is necessary to develop a new curve prior to the annual performance test of the unit.

Notes:

- The Operations Engineer should confirm that all the above equipment/systems are isolated by:
  - Conducting visual inspections on all isolating valves.
  - Using measuring instruments located before and after isolation points to ensure that there is no flow across the isolation points.
  - Checking for steam flowing from drains and vents that should be isolated.

If the equipment/systems cannot be isolated in accordance with the testing procedure, all parties must agree that the unit is ready for testing before proceeding.

- When available, a careful review of the P&ID's should be undertaken to assure that the isolation called for will not cause condensate to back up into the steam turbine casing causing blade damage.

9.3 Maximum Permissible Standard Deviations

The gas/combustion turbines should be operated for at least sixty (60) minutes before the schedule start of the test to ensure that the following operating variables are within the permissible standard variations during the test runs per industry practice. The calculated standard deviation of the data sample shall not exceed the values given in Table 3-3.5-1 in ASME PTC 22. If operating conditions vary during the test run beyond the limits prescribed in Table 3 below, the results of the test run shall be discarded. This is to ensure acceptable mechanical operation and stable control of the gas/combustion turbines with the combine cycle operation being tested.

Operating Variable	Standard Deviation
Power Output	0.65%
Barometric Pressure	0.16%
Inlet Air Temperature	1.3°F
Fuel Source Pressure	0.65%
Fuel Flow	0.65%
Generator Rotating Shaft Speed	0.65%

Note: The standard deviations are the calculated standard deviations of the data and not tolerances.

Table 3: Gas/Combustion Turbine Maximum Permissible Standard Deviations of Recorded Variables

9.4 Combined Cycle Capacity and Heat Rate Test Procedures

As a guideline, the unit operator along with the Operations Engineer should ensure that the combined cycle plant is operated within the manufacturer's specifications throughout the duration of the test. The unit specific test procedures shall describe how the unit is typically operated at the test loads and how it was run during the performance test. The Planning Engineer/Performance Test Specialist is to decide in consultation with the Independent Engineer and the representatives of the Other Parties on site if an event is considered abnormal.

Once the Performance Test has started, there should be no further adjustments to the combine cycle plant during each test run. It is important to note that for each test load, the unit should be operated on load limit (or pre-selected load) and not on governor/ speed control. This is to ensure that there will not be any change in the combined cycle loading due to any system frequency fluctuations. Where feasible, the units should operate on maximum exhaust temperature control for maximizing the base load of the GT.

Immediately following testing, the Planning Engineer will review recorded data to ensure instruments were reading correctly, locate any errors or inaccuracy in the data sets, and confirm the test runs meet the required stability requirements and, in consultation with the Independent Engineer and the representatives of the Other Parties on site, if a re-test is required.

Once all personnel are in place and all prerequisites satisfied, then the controller should issue operating instructions to the unit controller to ramp up or down to the test load for the first test run. Each test run must be conducted at a fixed load set point and should be an hour in length. Each Performance Test must consist of no less than five (5) test runs, each at five different fixed load set points ranging from the unit's minimum load to maximum (or rated) load settings. The minimum load test is to be conducted at minimum emissions compliant load (MECL). For each different load point, one (1) test run is required, but two (2) test runs are recommended to confirm the repeatability of the results. If the facility operates on dual fuels, tests must be performed for both fuels.

1. The operation instruction and every operation instruction thereafter should be issued by the Assistant Control Engineer-Generation with due cognizance of the unit's normal ramp rate. This is to ensure that

the unit can achieve the desired test load and reach stability within 30 minutes before the scheduled start of each test run. Additional ramp rates can be considered where feasible.

1.1. Once the unit has reached its first target test load and has achieved stability, the Operations Engineer and other personnel collecting data should digitally record all data specified in the data collection sheet located in the appendices and start timing the test run.

1.2. Prior to testing, the Operations Engineer should confirm that the nominal frequency and transmission voltages are within a+/- 5% tolerance of the reference value. During testing, the stability shall be maintained in accordance with Section 9.3 of this specification.

1.3. During each test run, the Operations Engineer should record the frequency at the busbar of the unit being tested as well as its transmission busbar voltage.

1.4. The Operations Engineer should record the gross megawatt (MW) output of the unit under test for the duration of each test run.

Note: During the performance test, the Operations Engineer is responsible for ensuring that all the data necessary to complete the unit's Performance Test datasheet(s) as outlined in the appendices, is recorded.

2. For each test run, all the required data in the data sheet should be recorded for the first test load. The actual time-of-day the test run commenced, i.e., time when starting at 0:00 hours, should also be recorded for each test run. If recorded digitally, the data should be collected in 30-second intervals, where feasible. If any manual data is required, this data should be collected with a frequency of no less than 5.

3. After the completion of the first test run and the collection of data for that test run, the Operations Engineer must repeat the test run at the same load before changing to a different test load. Once two runs have been completed at the first test load, the Operation Engineer must inform the LUMA Control Center Shift Engineer-Generation of the completion of the first test runs and their intention to change the test load from one set point to another to commence a second test load run.

3.1. The LUMA Control Center Shift Engineer-Generation at this point should issue the operating instruction for the gas/combustion turbine unit to move from the previous test load to the new test load for the second test run. After carrying out this instruction, the Unit Controller should allow at least sixty (60) minutes to elapse to achieve stability at this new test load.

3.2. After stability has been achieved for the second test run, the Operations Engineer and other personnel collecting data should record all data specified in the data collection sheet located in the appendices for the second test run and start timing this test run. Stability will be assessed by monitoring the parameters specified in Table 2 for units governed by ASME PTC 22 and the proper tables from other ASME PTC standards for the unit.

4. Repeat step 2 as outlined in this section, ensuring that all the required data in the data sheet is recorded for the second test run**.**

5. At the completion of the second test load runs, steps 3 to 4 should be repeated for data collection for the other test runs at the three different test loads.

6. At the end of the test runs, the Operations Engineer should inform the LUMA Control Center Shift Engineer-Generation of the completion of the Performance Test, following which the steam unit should be dispatched to the required loading as directed by the LUMA Control Engineer-Generation.

Note: All abnormal events that occur, as decided by the Planning Engineer, during the Performance Test should be recorded on the data sheet with the time of the occurrence and the name of the observer.

Note: In the event that incorrect data is recorded, then a line should be drawn through the incorrect data, signed and an explanation given for the reasons for the adjustment.

Following the completion of the Performance Test, the following individuals should sign and date the Performance Test datasheet(s) and any other log sheets that were used during the test:

- Unit Controller
- Operations Engineer
- Planning Engineer
- Operation Manager
- Plant Manager

A softcopy of the signed Performance Test datasheet(s) and any other log sheets should be issued to the overseeing Planning Engineer, the Operations Manager and the Plant Manager.

10.0 CAPACITY AND HEAT RATE TEST RESULTS

10.1 Fuel

- The heat rate test value should always be expressed based on the fuels' lower heating value.
- The Performance Test results shall be determined from the average of the characteristics of the fuel samples taken before and after the heat rate test.

10.2 Energy Calculations

- In a Performance Test, the gross and net electrical energy readings are recorded from either a disk type watt-hour meter or an electronic watt-hour meter. The instruments must be calibrated and traceable to applicable standards as described in Section 5.0. In addition to a direct readout from both types of watt-hour meter, more accurate energy measurements, with an increase in resolution, can be obtained by recording the time for a specified number of revolutions of the watt-hour meter disk or blinks of the electronic watt-hour meter LCD display. The unit specific test procedures shall describe how the unit is typically metered (e.g., electronic watt-hour meters or other) and how metering is to be recorded during the performance test.

  The recorded time, ***t*** (sec), and the specified number of revolutions, ***n***, are used in the formula below to calculate the average power output for the time frame in question.

$$\text{Average kW} = (n/t) * \text{Pri } K_h * (3600/1000)$$

  where:

  Pri K_h = PTR * CTR * meter K_h, Wh
  PTR = Potential Instrument Transformer Ratio
  CTR = Current Instrument Transformer Ratio

- Alternatively, if the site has a direct measurement for the net output or energy delivered available in the distributed control system, this may be used for the capacity calculations.

11.0 CAPACITY AND HEAT RATE CALCULATIONS

The general formula for calculating the heat rate of any thermal generating unit is:

$$H_R = H_I / E$$

Where

H_R = Heat Rate (net), Btu/kWh or kJ/kWh

H_I = Heat Input (provided from fuel source), Btu/h

E = Generator Energy Output (net), kW

In a heat rate test, for any test run the Heat Input, H_I, is calculated by using the measured difference from the fuel source flow meter (or integrator) reading taken at the beginning and the end of the test run.

$$H_I = (FM_{final} – FM_{initial}) * CV$$

Where

H_I = Heat Input (provided from fuel source), Btu/h

FM_{final} = Fuel Flow Meter reading at the end of the test run, gallon/h or lb/hr

$FM_{initial}$ = Fuel Flow Meter reading at the beginning of the test run, gallons/hr or lb/hr

CV = Measured Calorific or Heating Value of the fuel, Btu/gal or Btu/lb

This fuel source flow meter is located just upstream of the gas/combustion turbine fuel stop (or trip) valve. The Generator Energy Output, E, for any test run, is the difference between the gross generator watt-hour readings taken at the beginning and the end of the test run. This method is used only for the gross heat rate calculations. As for a net heat rate calculation, the Generator Energy Output, E, is the difference of the gross generator watt-hour reading and the auxiliary watt-hour readings, as shown below:

$$E_{net} = (GW_{final} – GW_{initial}) – (AW_{final} – AW_{initial})$$

Where

E_{net} = Net Generator Energy Output of the test run, kWh

GW_{final} = Gross Generator watt-hour reading at the end of the test run, kWh

$GW_{initial}$ = Gross Generator watt-hour reading at the beginning of the test run, kWh

AW_{final} = Auxiliary watt-hour reading at the end of the test run, kWh

$AW_{initial}$ = Auxiliary watt-hour reading at the beginning of the test run, kWh

For each Performance Test, capacity and heat rate calculations should be corrected to standard conditions. This correction is performed to provide consistent and comparable Performance Test results, allowing tested units to be ranked by heat rate (efficiency) which is essential for utilization in the economic dispatching, and also for use as a performance indicator to understand the units' performance and opportunities for upgrades, as well as a mechanism to understand how units are performing year over year. For these comparisons to be valid, performance data must be evaluated at the same, standard conditions.

Standard conditions may be considered as either industry accepted conditions (e.g., ISO standard at 59 deg F and 14.7 psia/sea-level) or a common climatic condition agreed to for the LGA sites in Puerto Rico (e.g., 80 deg F and 14.7 psia).

Where performance correction curves are available and/or can be generated, this will be included accordingly in the individual unit Performance Test procedures. Correction curves available for each LGA unit may be available in instruction books/operating manuals or provided through the OEM. If correction curves are not readily available, the OEM should be contacted to obtain them or to provide the best alternative recommendation for correcting the site performance test results at base and part load operating conditions. Correction curves may include ambient air temperature, ambient pressure, relative humidity, inlet/exhaust pressure drops, supply steam pressure and temperature, feedwater temperature and pressure, etc. If correction curves are not available, all test results and reports should clearly highlight this situation, annotating the risk of comparing the impacted unit's Performance Test results to any other unit, since consistent comparisons will not be possible..

12.0 CAPACITY AND HEAT RATE SCHEDULING

12.1 Schedule

A Performance Test is to be scheduled once annually on all generating units. A list will be prepared each year and shared with the System Operator to plan and coordinate the testing sequence. The Performance Test Schedule is to be established by December 1st of the year right before the year the schedule is effective with required monthly updates documenting the reasons for any changes. The schedule and monthly updates are to be filed with the Energy Bureau in NEPR-MI-2023-0003.

All tests are to be scheduled for periods during which economic dispatch would normally require the units to be on-line. If this is not possible then another time frame should be selected when the unit would be online and able to produce full power.

Note: The Performance Test Schedule should be established by December 1st of the year right before the year the schedule is effective with required monthly updates documenting the reasons for any changes.

Note: The Planning Engineer is responsible for giving fourteen (14) days notice to each plant of the specific date of the Performance Test.

12.2 Adjustments

The test schedule can be adjusted under the following conditions:

- If a unit is to perform major maintenance within two (2) months of the originally scheduled test date then the test should be rescheduled to be performed immediately upon return of the unit from maintenance, after the unit has been officially declared as being available for dispatch

- All units upon completion of major maintenance are required to perform a Performance Test.

- If major maintenance is done on a unit after a Performance Test was already scheduled and conducted within the same year, then the results of the Performance Test, conducted after the completion of this major maintenance, should supersede the results of the previous test. The results of this test will replace the scheduled test result as the official record for the year.

12.3 Re-test

A retest can be done under the following conditions:

- The Plant Manager can request a re-test, by writing to the LUMA Director Energy Management and TOC, within thirty (30) days of completion of the scheduled test if he/she can provide evidence that maintenance has been done on the unit, which would correct any limitation that would have had a significant negative impact on the unit's heat rate obtained during the scheduled test or that the scheduled test contains some fundamental errors that affected the result.

- The LUMA Director Energy Management and TOC, can request a re-test at any time within the year if by his/her analysis of the actual and dispatch monthly heat rate figures, there seems to be some significant variance between both set of numbers that might point to some incorrect data, especially from the dispatch standpoint.

- The Head of Generation can request a retest, by writing to the LUMA Director Energy Management and TOCl at any time after he deems that circumstances have materially changed that can affect a unit's heat rate capability.

Note: The plant must be given a minimum of five (5) days and a maximum of ten (10) days notice, to make preparations, upon approval of a request for retest.

Note: The results of the last official Performance Test shall take precedence until the re-test is completed and all reports have been submitted and approved by the Head of Generation.

13.0 CAPACITY AND HEAT RATE TEST REPORT

13.1 Introduction

The final Performance Test Report is made up of the contents of two sub-reports that should be submitted from the plant for which the unit is being tested. The Plant Manager is then responsible for submitting his report to the Head of Generation and a copy of this report should be submitted to the Planning Engineer, and LUMA. If required, and independent engineer or third party may be introduced to observe the Performance Test execution to provide witnessing support for the testing to ensure procedures are followed and that the units are operated in accordance with the testing plans.

The Planning Engineer will compile the Performance Test report for submission to Head of Generation. The recommended format of all reports from each department is outlined below.

13.2 Plant Report

The Plant Operations Engineer in collaboration with the Plant Operations Manager is responsible for preparing the Plant Performance Test Report as outlined below:

- *Overview*
  - Date and time of test.
  - Name and location of unit.
  - Persons present.
  - Comments on any limitations or abnormal events that were encountered during the test.
  - A brief history of the unit operation from startup through the performance tests.
  - A description of the equipment to be tested and all such ancillary equipment that may influence the test.
  - A cycle diagram showing the test boundary.
  - A detailed PID/block diagram showing where all the measurements required for the test are to be taken, including if they are digitally recorded or manually recoded, where all the valves are that are to be opened/closed during the test and what state they should be in for the test.

- *Reports*
  - Copies of Performance Test datasheets.
  - Copies of laboratory report on fuel samples.
  - Preliminary checklists that were submitted to the Planning Department before the actual test.
  - Report on instrumentation used.

- *Calculations and Results*
  - Perform actual capacity and heat rate calculations corrected to standard conditions.
  - Provide detailed correction curves and equations and descriptions of where the information came from.

- *Summary*
  - A detailed summary of all results.

13.3 Control Report

The Plant Manager is responsible for preparing the Control Performance Test Report as outlined below:

- *Overview*
  - Date and time of test.
  - Comments on any system disturbances or abnormal events that were encountered during the test.

- *Reports*
  - All dispatch and operating instructions issued to the Unit Operator during the test.
  - Recorded frequencies and voltages on the transmission busbar attached to the step-up transformer of the unit under test (where applicable).
  - Recorded megawatt (MW) output of the unit in during the test (e.g. 30-second intervals if recorded digitally or 5-minute intervals if manual readings are required).

13.4 Final Report

The Planning Engineer is responsible for preparing the final Performance Test Report as outlined below:

- ❑ *Overview*
  - ➢ Date and time of test.
  - ➢ Comment on any limitations or abnormal events that were encountered during the test.

- ❑ *Calculations and Results*
  - ➢ Review plant calculations and results and the Control Report.
  - ➢ Review and confirm the correction of as-tested site performance to standard conditions
  - ➢ Plot the Unit's Heat Rate and Input/ Output curves.

- ❑ *Summary & Recommendations*
  - ➢ Comment on results and make any recommendations if necessary.

- ❑ *Appendices*
  - ➢ Include both the Plant Report and the Control Report.

APPENDIX A

PERFORMANCE TEST DATASHEETS

Note: All sheets are typical for general reference only; unit specific conditions and test protocols are to be confirmed and updated with actual parameters, documentation, equipment, limitations and any other relevant information available that is required to properly perform the Performance Test for each unit and/or site.

APPENDIX A

Parameters	Units	OBSERVED VALUES											
		TIME											
Gross Generation	MW												
Reactive Generation	MVAR												
Gross Generation	MWh												
Auxiliary Power	MWh												
Net Capacity (Generation)	MWh												
Fuel Oil Integrator	gallons												
Turbine Throttle Press.	psig												
Turbine Throttle Temp.	^{0}F												
Feedwater Temp.	^{0}F												
Feedwater Press.	psig												
Condenser vacuum	In Hg												
% Excess Oxygen	%												
Fuel Oil Heater Temp-inlet	^{0}F												
Fuel Oil Heater Temp-outlet	^{0}F												
CW temp.-inlet	^{0}F												
CW temp.-outlet A side	^{0}F												
CW temp.-outlet B side	^{0}F												

STEAM UNIT HEAT RATE DATASHEET

Sheet 1 of 1

Reviewed By: _____ Plant Engineer

Approved by: _____ Operations Manager

Approved by: _____ Plant Manager

APPENDIX A

Parameters	Units	OBSERVED VALUES											
Gross Generation	MW												
Reactive Generation	MVAR												
Gross Generation	MWh												
Auxiliary Power	MWh												
Net Capacity (Generation)	MWh												
Fuel Oil Integrator	gallons												
Mean Exhaust Gas Temp.	^{0}F												
Exhaust Temperature Spread	^{0}F												
Ambient Temperature	^{0}F												
Air Filter Differential	In H_2O												
Compressor Discharge Press.	psig												
IGV Position	Deg.												
Generator Winding Temp.	^{0}F												
Generator Stator Current	A												
Generator Field Current	A												
Turbine Speed	rpm												
Frequency	Hz												

INDUSTRIAL GAS TURBINE HEAT RATE DATASHEET

Sheet 1 of 1

Reviewed By: _____ Plant Engineer

Approved by: _____ Operations Manager

Approved by: _____ Plant Manager

APPENDIX A

Parameters	Units	OBSERVED VALUES											
		TIME											
Gross Generation	MW												
Reactive Generation	MVAR												
Steam Turbine Gross Generation	MWh												
Gas Turbine Gross Generation	MWh												
Auxiliary Power	MWh												
Net Capacity (Generation)	MWh												
Fuel Oil Integrator	gallons												
Exhaust Gas Path Temp.	^{0}F												
Steam Turbine Pressure	psig												
Steam Turbine Temperature	^{0}F												
Makeup Water Percentage	%												
Steam Flow	lbs/hr												
Condenser vacuum	In Hg												
HRSG LP Drum Temp	^{0}F												
HRSG HP Drum Temp	^{0}F												
CW temp.-inlet A side	^{0}F												
CW temp.-inlet B side	^{0}F												
CW temp.-outlet A side	^{0}F												
CW temp.-outlet B side	^{0}F												

COMBINED CYCLE (STEAM CYCLE) HEAT RATE DATASHEET

Sheet 1 of 1

Reviewed By: _____ Plant Engineer

Approved by: _____ Operations Manager

Approved by: _____ Plant Manager

APPENDIX A

Parameters	Units	OBSERVED VALUES											
		TIME											
Gross Generation	MW												
Reactive Generation	MVAR												
Gross Generation	MWh												
Auxiliary Power	MWh												
Net Capacity (Generation)	MWh												
Fuel Oil Integrator	gallons												
Mean Exhaust Gas Temp.	^{0}F												
Exhaust Temperature Spread	^{0}F												
Ambient Temperature	^{0}F												
Air Filter Differential	In H_2O												
Compressor Speed, N1													
Compressor Speed, N2													
Generator Winding Temp.	^{0}F												
Generator Stator Current	A												
Generator Field Current	A												
Free Turbine Speed, N3	rpm												
Frequency	Hz												

AERODERIVATIVE GAS TURBINE HEAT RATE DATASHEET

Sheet 1 of 1

Reviewed By: _____ Approved by: _____ Approved by: _____

Plant Engineer Operations Manager Plant Manager

APPENDIX B

UNIT SPECIFICATION SHEETS

APPENDIX B

STEAM UNIT SPECIFICATIONS

STEAM UNIT OPERATING SPECIFICATIONS		
Parameters	**Units**	**Rated Values**
Gross Generation	MW	
Reactive Generation	MVAR	
Station Use	MW	
Net Capability	MW	
Power Factor		
Gen. Air Outlet Temperature	^{0}F	
Gen. Cold Gas Temperature	^{0}F	
Gen. Winding Temperature	^{0}F	
Gen. Stator Current	Amps	
Gen. Rotor Current	Amps	
Air-Heater Gas Outlet Temperature	^{0}F	
Furnace Pressure	PSIG	
Fuel Oil Pressure	PSIG	
Opacity		
Condenser Vacuum	In Hg	
Turbine Throttle Pressure	psig	
Turbine Throttle Temperature	^{0}F	
% Excess Oxygen	%	
Cooling Water Inlet Temperature	^{0}F	

APPENDIX B

AERODERIVATIVE SPECIFICATIONS

AERODERIVATIVE COMBUSTION TURBINE OPERATING SPECIFICATIONS		
Parameters	**Units**	**Rated Values**
Reactive Generation	MVAR	
Gross Generation	MW	
Station Use (Manual)	MW	
Net Capability	MW	
Power Factor		
Mean Exhaust Temperatures	^{0}F	
Exhaust Temperature Spread	^{0}F	
Ambient Temperature	^{0}F	
Compressor Discharge Pressure (P3)	PSI	
Air Filter Differential (Manual)	PSI	
Compressor Speed Ratio- NH/NL	" H2O	
IGV Position	--	
VSV Position	%	

APPENDIX B
INDUSTRIAL GAS TURBINE SPECIFICATIONS

INDUSTRIAL COMBUSTION TURBINE OPERATING SPECIFICATIONS		
Parameters	**Units**	**Rated Values**
Reactive Generation	MVAR	
Gross Generation	MW	
Station Use (Manual)	MW	
Net Capability	MW	
Power Factor		
Mean Exhaust Temperatures	^{0}F	
Exhaust Temperature Spread	^{0}F	
Ambient Temperature	^{0}F	
Compressor Discharge Pressure (P3)	PSI	
Air Filter Differential	" H2 O	
Exhaust Pressure Differential	" H2 O	
IGV Position (Should be taken Manually)	Deg	
Gen. Winding Temperature	^{0}F	
Gen. Stator Current	Amps	
Gen. Rotor Current	Amps	