REGULATED INDUSTRIES COMMISSION

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

January
2019

Final Decision

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1. Background

The Regulated Industries Commission (RIC) is the economic regulator for the electricity and water sectors in Trinidad and Tobago. In the conduct of its 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 prescribe standards for services; monitor service providers to assess performance with the established standards; and impose sanctions for non-compliance. Section 6(2) of the Act also mandates the RIC to consult with all parties it considers as having an interest in matters before it. In keeping with this mandate, the RIC developed a draft ***Quality of Service Standards (QSS) Scheme for Electricity Generating Entities in Trinidad and Tobago***, and invited comments from key stakeholders through a pre-consultation exercise that was conducted in January 2018. After review of the feedback received, the RIC revised the document and published it for public consultation in August 2018. The consultation document is available on the RIC's website at www.ric.org.tt/consultations.

1.1 Purpose of this Document

The purpose of this document is to report on the comments received during the public consultation, and to present the RIC's response and final decisions on the QSS Scheme for Electricity Generating Entities in Trinidad and Tobago. A copy of this document is available on the RIC's web site at http://www.ric.org.tt/publications.

2. Regulating Service Quality - Performance Monitoring and Reporting Scheme for Power Generation in Trinidad and Tobago

2.1 The scheme

The RIC will implement a performance monitoring and reporting scheme for the power generation sector in Trinidad and Tobago. The scheme is expected to bring public awareness and scrutiny to the performance of the sector, and thereby incentivize the service providers to maintain acceptable standards of services. This is intended to contribute to the promotion of economic efficiency, reliability, energy security and transparency within the sector. Under the scheme, the electricity generators are required to collect specific performance data and that will be reported to the RIC on a quarterly basis. The RIC will also provide the templates to be used for collecting and reporting data. This is to ensure that the information provided conforms to the format required by the RIC, and is consistent across different entities, as well as to ensure that the data submitted is reliable and valid. The RIC will use the information reported to prepare annual performance reports on the electricity generation sector. These will be published for public information in various media. The RIC also intends to conduct full or partial reviews of the scheme on a periodic basis to ensure that it remains fit for purpose.

2.2 Performance Metrics

In considering standards for electricity generation, the RIC has chosen to limit the number of indicators, and confine the scheme to quality of service indicators and thermal efficiency at this time. Preference was given to indicators that cover key areas of concern to the RIC, including those which have significant impact on tariffs paid by retail electricity customers. Accordingly, the service providers will be required to collect and report the following information.

Net Heat Rate

The heat rate is a measure of the thermal efficiency of a power plant or electrical generating unit. It is the amount of heat energy used to produce an output of one kilowatt-hour (kWh) of electricity. It can be expressed as either gross or net heat rate, depending on whether the gross or net output is used. The service provider will be required to report net heat rate in kJ/kW. This is calculated using the formula:

Net Heat Rate = Fuel Flowrate * Higher Heating Value of Fuel / Net Power Output

Capacity Factor

Capacity factor for a power plant is the ratio of the actual kilowatt-hours of electricity produced in a given period, to the maximum possible, i.e. running full time at rated power. It is influenced by plant utilization, operational and maintenance efficiency, type of power unit (whether base-load, load-following or peaking), and may reflect excess capacity relative to load requirements.

Availability

Availability is fraction of a given operating period in which a generating unit is available without any outages. A higher fraction is an indication of a better availability. A plant may be out of service (unavailable) for maintenance or because of breakdowns or deratings. Good operation and maintenance management will help to keep these to a minimum. A reliable supply of electricity depends on the plant being available when needed.

Equivalent Availability Factor (EAF)

The ***equivalent availability factor*** (EAF) is the fraction of a given operating period in which a generating unit is available without any outages and equipment or seasonal deratings.

Equivalent Unplanned Outage Factor (EUOF)

The ***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.

Equivalent Forced Outage Factor (EFOF)

The ***equivalent forced outage factor*** (EFOF) represents the fraction of a given period in which a generating unit is not available due to forced outages and forced deratings. This metric is useful in assessing the performance of power plants for which the total capacity is not contracted to supply the grid.

Baseline Information

In addition to the performance data identified, the service providers are required to provide basic identifying information, and also report on data that is necessary to provide the context of operation. This includes number of generating units, type of units, kWh generated, etc.

Table of Performance Indicators & Baseline 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	System 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	%

No.	Metric	Description	Unit of Measure
		during the reporting period to the maximum 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***	%

3. Consultation Comments and RIC's Response

The RIC received written comments from the following respondents:

- The Energy Chamber of Trinidad and Tobago (ECTT)
- National Gas Company of Trinidad and Tobago (NGC)
- Environmental Management Authority (EMA)
- Consumer Affairs Division (CAD)
- Ministry of Public Utilities (MPU)
- Trinidad and Tobago Electricity Commission (T&TEC)
- University of Trinidad and Tobago (UTT)
- Ms. Sharon Lakhan-King

The table below is a compilation of the comments received during the public consultation and RIC's response to these comments.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
Question 1: ***Do you agree with the rationale for quality of service standards for electricity generation in Trinidad and Tobago?***	
MPU: The Ministry is in agreement with the rationale provided by the RIC for the implementation of a system of Standards for power generation.	The RIC notes the response.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
Due to the limited competition of power producers, economic regulation should make it mandatory for the power producers to purchase the gas necessary for power generation at market pricing.	This suggestion lies outside of the ambit of the QSS for Generators. The changes suggested require a policy decision from the Government of the Republic of Trinidad and Tobago. The RIC wishes to point out that this can result the risks of fuel pricing being transferred to the generator which can in turn result in an increase in the conversion cost.
The Ministry advises that the QSS for generation must be associated with the eventual consumer of electricity and the QSS should ensure that the consumer is justly charged for this essential commodity.	The RIC notes that the sole purchaser/'customer' of generated electricity is T&TEC. As such, matters of quality arising out of the QSS for Generators will have bearing on T&TEC. The QSS for T&TEC have been in effect from 2004 onwards and this QSS ensures that the quality of the service for the eventual consumer of electricity is maintained to standard.
In light of the present excess generation capacity, the traditional form of a PPA requires adjustments in the context of flexibility, to allow a reduction in the amount of power purchased, rather than continuing to pay for fully contracted capacity which is not needed.	This is a policy matter for GORTT, and as shareholder for T&TEC it can raise these concerns. The PPA is a legally binding agreement between T&TEC and the respective Independent Power Producer (IPP). Changes will require negotiation and agreement by both parties.
CAD: The CAD is in agreement with the rationale for the QSS.	The RIC notes the response.
NGC: Agree with the rationale	The RIC notes the response.
UTT:	The RIC notes the response.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
In order to exceed customer's expectations, a holistic approach is required by T&TEC that pays attention to the following attributes. a) Performance, b) Features, c) Reliability, d) Conformance, e) Durability, f) Serviceability, g) Aesthetics, h) Response, and i) Reputation. From vendor quality control to consumer satisfaction and research, an extended process is necessary for "total quality management".	
EMA: There is definitely a need for standards to regulate the quality of service for electricity generation in Trinidad and Tobago. In light of the limited competition, this is necessary to ensure that there is a fair and reliable system for all involved. The need for electricity is as important today as any time before and the reliance on technology to do everything is evident. The need for a more efficient way of producing energy not only benefits the environment but it also saves money and gas reserves which can be used as an export product, earning more money for the country.	The RIC notes the response.
ECTT: Agree with the rationale.	The RIC notes the response.
T&TEC: The background provided is comprehensive. However, we have no official position on whether the facts presented justify a QSS scheme.	The RIC notes the response.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
Question 2: ***The RIC considers Performance Reporting mechanism as the most appropriate scheme for power generation at this time. Do you agree with this position?***	
MPU: The Ministry is in agreement and supports a move in this direction, for implementation of a performance reporting mechanism for power generation.	The RIC notes the response.
The Ministry is also in agreement that a Performance Incentive Mechanism is not suitable at this time as it requires a complex series of performance assessing techniques, which are time consuming to implement, and uses an elaborate data collection system.	The RIC notes the response.
The Ministry is in favour of Legal Compensation and or Application of Statutory Penalties as these are effective mechanisms for service providers to be mindful of the services they provide.	The RIC carefully considered this matter when it was reviewing the type of scheme most appropriate for the sector. On balance the RIC is of the view, that at this time, a Performance Reporting mechanism is best suited for the Sector.
CAD: The Consumer Affairs Division views the Performance Reporting mechanism as an appropriate scheme however it should not be done in isolation. The administration of the scheme should be done in such a way that the published actual performance of the different power generating schemes is compared to the target recommended in the said publication. Moreover, public scrutiny within the current culture does not serve as the best source of persuasion as it does not currently work in other sectors. Companies in Trinidad and Tobago do not fear public scrutiny. Rather, T&TEC should be fined for the non-performance of targets set for their contracted power generating entities. This would encourage T&TEC to	The RIC wishes to point out that the QSS being established will apply to the generation aspect of the service providers. The recommendation of an omnibus penalty being applied to T&TEC solely is therefore incongruent with the principles being established. Furthermore, the PPA is the legally binding agreement between T&TEC and the respective Independent Power Producer (IPP) currently in force. Changes will require negotiation and agreement by both parties.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
fine these power generating entities for non-performance as part of future contracts. No company would invest the significant capital needed to improve its efficiency if it does not significantly affect their revenue or future eligibility of being able to enter into contractual obligations with T&TEC.	
NGC: Justification for solely selecting Performance Reporting mechanism is not clear. The limitation for not selecting the other seemingly more stringent and effective methods should be clearly stated. There should be provisions for: Addressing non-compliance related to performance standards and therefore, a hybrid approach incorporating 'Performance Reporting' with the 'Guaranteed Standards Scheme' would provide consequences to the generator for inefficient operations Mechanisms for the regulator to conduct independent monitoring and audits for validating the integrity of data.	The generators have one customer, T&TEC which, it can be argued, wields significant market power through its position as a single buyer. Under the 'Guaranteed Standards Scheme' the compensatory payment is meant to incentivise the service provider to improve performance rather than to compensate the customer for any loss or inconvenience suffered. The scheme is best suited where there is a monopoly service provider serving many customers with little market power. Mechanisms for the regulator to conduct independent monitoring and audits for validating the integrity of data will form an integral part of the QSS for Generators.
UTT: Given that fuel cost is a major operating cost for power plants, performance reporting on the power generation side is most practical. Quality of fuel and fuel combustion is directly related to plant performance. Internal quality checks on stoichiometric fuel/air ratios and flue gas analysis is necessary for optimizing fuel consumption. Savings can then be passed on the consumers.	The RIC notes the response.
EMA: The EMA supports the use of the Performance Reporting mechanism to regulate the quality of service for power generation. The selection of relevant performance indicators is critical to ensure that this mechanism is	The RIC notes the response.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
effective. Matters of national interests are being discussed more openly over the years in a public setting and this forum allows for public pressure to shape a company and ultimately improve performance.	
ECTT: Agree with the rationale.	The RIC notes the response.
T&TEC: Apart from renegotiating the PPAs, a QSS scheme seems to be the only method of getting more performance out of EXISTING supply contracts. However, enforcing it may be very expensive, due to contractual change-of-law clauses. For NEW supply contracts, the QSS should be incorporated in the agreement from the start to avoid this problem.	The RIC notes the response.
Question 3: ***Do you agree with the choice of the proposed performance indicators for electricity generation in Trinidad and Tobago?***	
MPU: The Ministry is not in full agreement with the choice of the proposed performance indicators for electricity generation in Trinidad and Tobago. There is a preference for more measurements and transparency. The performance indicators, which the Ministry recommends for measurement, monitoring and reporting, are discussed below:	It should be noted that the monitoring and reporting of performance metrics should support the objective of the QSS and not be unnecessarily onerous on the service provider.
Frequency The frequency of operation of the generators is dependent on the loading of the generators; that is the bigger the load, the greater the effect on the frequency. Therefore, this parameter requires tight controls.	The RIC is satisfied that frequency is adequately managed under the current arrangements and does not need to be a part of the initial quality of service mechanism.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
Harmonic Distortion Harmonic distortion is an important aspect in power systems that arises at interconnection points of the generator to the grid and it should be kept as low as possible. Lower harmonic distortion in power systems means higher power factor, lower peak currents, and higher efficiency. Low total harmonic distortion is such an important feature in power systems that international standards such as IEC 61000-3-2 set limits on the harmonic currents of various classes of power equipment.	The RIC is mindful of the impact of harmonic distortion on the efficiency of a power system. However, regulation of this technical parameter is not envisaged at this time.
Power factor The power factor of a turbine generator is an indication of the amount of maximum kilowatt power which can be delivered by that generator. However, the type of load used by the consumer also has an effect on the power factor. This metric can be increased or decreased depending on the load type. Therefore, the PPAs normally set a range of operation for the utility to maintain the aggregate one-hour rolling average power factor between .88 lagging and .9 leading as determined at the high voltage side of the generating unit transformer. It is therefore the responsibility of the IPP to work with the utility to manage such standard.	The RIC notes the response.
Gas Savings Every percentage of gas saved should be valued under a transparent agreement wherein the power producer shows how much gas is used in a certain period compared to how much was used for similar periods by each turbine, starting with a 5-year history so savings can be demonstrated and reported on a monthly basis.	Comparing periods purely on the basis of gas usage may produce misleading information. It is considered more appropriate to use standard efficiency metrics.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
Power Purchase Agreement The length of years of the Power Purchase Agreement contract should be tied to performance of the turbines as it relates to the specifications of the turbines.	This is essentially a policy matter for the Government of the Republic of Trinidad and Tobago (GORTT) to decide upon and this lies out of the ambit of the QSS for Generators. However, the RIC wishes to point out that this is a non-standard approach, which introduces uncertainty and additional risks to the IPPs, and ultimately can increase the conversion cost.
Net generation A generator's output may vary according to conditions at the power plant, fuel costs, and/or as instructed by the electric power grid operator. Electricity net generation is the amount of gross electricity generation a generator produces minus the electricity used to operate the power plant. A generator's usage of electricity within the plant itself can provide regulators with a good way of comparing between IPP's. It would give an indication of the levels of efficiency of the equipment used within the plant itself, separate from the turbines. As mentioned earlier, with renewable energy generation being intended, this metric may become even more relevant.	This is adequately captured using efficiency metrics.
Maximum gas temperature possible One key to a turbine's fuel-to-power efficiency is the temperature at which it operates. Higher temperatures generally mean higher efficiencies, which in turn, can lead to more economical operation. Gas flowing through a typical power plant turbine can be as hot as 2300 degrees F, but some of the critical metals in the turbine can withstand temperatures only as hot as 1500 to 1700 degrees F. Therefore, air from the compressor might be used for cooling key turbine components, reducing ultimate thermal efficiency.	This metric will show improvement in the efficiency of the plant. Therefore, efficiency metrics will capture this in the overall context of economy and cost effectiveness and not as an isolated metric.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
A simple cycle gas turbine can achieve energy conversion efficiencies ranging between 20 and 35 percent. Future hydrogen and syngas fired gas turbine combined cycle plants are likely to achieve efficiencies of 60 percent or more. When waste heat is captured from these systems for heating or industrial purposes, the overall energy cycle efficiency could approach 80 percent. The Ministry is of the view that the aforementioned performance metrics must be measured in association with the standards set in the PPAs, and that these are reasonable to be monitored by the RIC, and should be implemented.	
CAD: The CAD is in agreement with the choice of the proposed performance indicators for electricity generation in Trinidad and Tobago.	The RIC notes the response.
NGC: Agreed. Parameters discussed within Section 5 of the document are adequate. Clarification should be provided regarding the progression of performance standards so they remain flexible to advances in technological solutions and robust enough to ensure generators adhere to best practice.	The QSS for Generators will be subject to periodic review which will take into account the prevailing conditions at the time of the review.
UTT: Thermal efficiency analysis of power plants relies on the 1st law of thermodynamics and is the typical approach employed by industry. It does not take into consideration losses and irreversibilities in the power generation process. Although, it is easy to use, thermal efficiency cannot be used for accurately "improving efficiency" of power plants. Exergy indicators (based on 2nd law of thermodynamics) will provide a better indication on the use of the fuel throughout the power plant. With respect to reliability, capacity factor, availability and equivalent forced outage factor are good indicators for reporting performance for	The RIC notes the response.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
electricity generation. However, for continuous operating equipment a predictive maintenance plan should be used for monitoring and reporting performance of specific equipment involved in the process. A predictive maintenance program would result in less equipment downtime, fewer emergencies, reliable customer delivery and lower maintenance costs amongst others.	
EMA: The EMA agrees with the proposed performance indicators as it relates to quality of service and operational efficiency. Performance indicators are appropriate to effectively measure improvements in quality or the need for improvements. New plants can have new efficiency values that must be adhered to and older plants can try to become more efficient given the right circumstances with economic considerations.	The RIC notes the response.
ECTT: Agreed. However, the document treats renewables as though they are out of scope. Considering the government's plans for renewables, the integration of gas fired generation must be accounted for from a metrics perspective.	The RIC has indicated that the current scheme is for non-renewable generation plants. The RIC will give consideration to the development of quality of service for RE Generation.
T&TEC: Items 1,2,4,5 are excellent key indicators which are generally under the control of the generation supplier. In contrast, item 3 is heavily influenced by T&TEC's dispatch instructions. The World Energy Council recommends Energy Availability for these situations.	The RIC notes the response.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
Question 4: ***Do you agree with the list of parameters that are identified for performance monitoring and reporting?***	
MPU: The Ministry is not in full agreement with the proposed performance indicators; there are some other parameters that can be included for reporting based on broad areas of concern. These include: Financial Indicators Operation and maintenance (O&M)- related costs reported as a fixed sum or as a function of generation. Capital costs, per unit of installed capacity and per unit of generation. Enhanced production costs (non-fuel O&M plus maintenance capital plus fuel) Operational Indicators Equivalent availability Factor, EAF - the availability factor of a power plant is the amount of time that it is able to produce electricity over a certain period divided by the amount of the time in the period. When Partial capacity is deducted, the metric is titled equivalent availability factor (EAF). Equivalent Demand Forced Outage Rate - the portion of time a unit is in demand but is unavailable due to forced outages or deratings. Maintenance Indicators Preventative Maintenance, PM - Complete PM programme for each turbine, with completion rate and backlog.	The RIC notes the suggestion of MPU. However, at this time the RIC has chosen to confine the scheme to certain quality of service and operational efficiency indicators.
CAD: The CAD is in agreement with the list of parameters for performance monitoring and reporting.	The RIC notes the response.
NGC: Agreed.	The RIC notes the response.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
UTT: In general, the list of parameters identified is practical for reporting and monitoring performance.	The RIC notes the response.
EMA: Yes.	The RIC notes the response.
ECTT: Agreed.	The RIC notes the response.
Question 5: ***Are there other parameters that you believe should be monitored and reported?***	
MPU: The Ministry is of the view that other parameters should be monitored and reported. The service provider's performance in many areas is reflective of a high standard of reliability but a very low standard with respect to usage of gas efficiently, whether or not these situations are under their control. Therefore, there are a several areas indicated below which require monitoring through the following monthly reports on: each turbine's efficiency gas usage for each turbine reliability metrics of each turbine unplanned shutdowns of each turbine maintenance reporting on each turbine quality of gas received payments related to percentages of power sold to T&TEC for each turbine spinning reserve the likelihood that customers may experience unplanned outages history of each turbine that presently operates including the technical operations each turbine's specification benchmarked reporting indicators surrounding availability of turbines	The RIC is of the view that the requirement to report granular data at the turbine level on a monthly basis would not add significant value to the objective of the QSS and would be unnecessarily onerous on the service providers.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
comparison on present performance of each turbine with international standards.	
CAD: At this time, the CAD cannot identify any other parameters to be included.	The RIC notes the response.
NGC: Yes, and these include: system resilience within the 'availability' parameter for addressing contingency options for disasters (man and natural) and, environmental impact accounting greenhouse gas emissions.	The RIC is of the view that the system operator T&TEC is responsible for addressing contingency issues as they arise and therefore this aspect will not be covered under the QSS. The RIC is of the view that the environment impact accounting will be separately factored under the relevant policies and responsible regulatory agencies.
UTT: Two other major parameters that should be monitored and reported are: Exergoeconomic (exergy and economics) indicators Predictive maintenance schedule The Utilities Engineering Unit wishes to propose the use of exergoeconomic indicators as oppose to the energy indicators (i.e. thermal efficiency or heat rate) as a means of assessing the performance of power generating systems in Trinidad and Tobago. This recommendation is based on the following reasons: Energy efficiencies do not always provide a measure of how nearly the performance of a system approaches ideal performance. Thermodynamic losses are not accurately identified and assessed with energy analysis. Exergy analysis provides the true areas of energy wastes (exergy destruction and loses). Energy analysis can indicate the main inefficiencies to be within the wrong sections of the system. An exergy analysis identifies the sources,	The RIC notes the response. The use of exergoeconomic indicators is considered to be complex and difficult to monitor at this time.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
magnitude and location of thermodynamic inefficiencies in a thermal system. This information which cannot be provided by an energy analysis is very useful for improving the overall efficiency and by extension the cost effectiveness of a system. In an energy analysis, all forms of energy are considered equivalent. The loss of quality of energy is not taken into account. For example, an energy analysis cannot properly gauge the quality (or usefulness) of 1kJ of electricity generated by a power plant versus 1kJ of energy in a plant cooling water stream. Electricity clearly has the greater quality and the greater economic value. When exergy and economic analyses are combined (Exergoeconomics or Thermoeconomics) the cost of exergy destroyed and exergy loses in a plant's components become measurable. Such information would otherwise not be obtained with the use of a conventional energy analysis. Exergoeconomics, therefore, provides the plant operator with information critical to the plant as costs due to thermodynamic inefficiencies are identified and evaluated and hence can be reduced, creating opportunities for the optimization of the system. Emphasis is therefore placed on achieving a cost-optimal system, as oppose to high thermodynamic efficiencies. In addition, if a system has more than one product, as for example the net power and saturated vapor of a cogeneration system, exergoeconomics allows us to know the production cost for each product. Independent power producers should also monitor and report on performance of equipment using an appropriate predictive maintenance schedule. Vibration monitoring and analysis amongst other methods can be conducted on typical power plant equipment. Common causes of unbalance, misalignment, bad bearings and corrosion and erosion of blades and impellers can be identified before total failure.	

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
EMA: GHG emissions (methane, carbon dioxide, nitrous oxide). Other parameters typically associated with power generation include Particulate Matter, Carbon Monoxide (CO), Oxides of Nitrogen (NOx), Sulphur Dioxide (SO2) and Volatile Organic Compounds (VOCs).	The RIC is of the view that the environment impact accounting will be separately factored under the relevant policies and responsible regulatory agencies.
ECTT: Yes, including: − Environmental Impact Reporting. − Efficiency of overall T&T Generation Mix and individual IPP's plant / system efficiency which contributes to T&T generation mix.	The RIC is of the view that the environment impact accounting will be separately factored under the relevant policies and responsible regulatory agencies. The RIC is of the view that the monitoring of the service providers will allow for a comprehensive analysis of the generation sector.
T&TEC: Financial penalties for non-availability of functional black start machines. Loss of Revenue penalty paid to TTEC by IPPs when a generator trips or is unable to meet declared capacity or is unable to synchronize (in a timely manner) and customers are shed. (similar to original 1994 PPA). Starting Reliability should be included	The RIC is of the view that these may be considerations for the PPAs that govern the contractual arrangements between T&TEC and the service providers.
Question 6: ***Do you agree with the frequency with which the information should be reported to the regulator?***	
MPU: The Ministry is not in support of the suggested frequency with which the information should be reported to the regulator. The frequency should be monthly or quarterly as the case may be for all the performance indicators listed in the answer to question 5 above. Additionally, these reports ought to be made available to the Ministry of Energy and Energy Industries and the Ministry of Public Utilities. This is necessary and critical to allow the government to strategically analyse and direct the usage of the country's gas in an efficient and optimised manner.	While it may be necessary to collect some of the data on a monthly basis, given the need to verify and validate the information submitted, it is usually not feasible to report on a monthly basis.

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
These monthly reports are necessary to analyze the numbers and to continuously strategize for the best ways to optimize the use of gas. The fact that electricity is a regulated commodity legally in this country, means that generation is a part of this regulation. Therefore, regular reporting of these performance indicators should be mandatory and this will contribute to the development of a modern electricity generation sector.	
CAD: The CAD is in agreement with the abovementioned.	The RIC notes the response.
NGC: Agreed.	The RIC notes the response.
UTT: A quarterly basis of reporting to the RIC seems practical.	The RIC notes the response.
EMA: The EMA fully supports the quarterly submission of data by the service providers to the regulator.	The RIC notes the response.
ECTT: Agreed.	The RIC notes the response.
T&TEC: Monthly is acceptable. Report on the previous month's operations.	While it may be necessary to collect some of the data on a monthly basis, given the need to verify and validate the information submitted, it is usually not feasible to report on a monthly basis.
Question 7: ***Do you agree that performance reports should be published annually for public information?***	
MPU: The Ministry is of the view that performance reports should be published biannually or annually for public information. The gas used for power	The RIC notes MPU's response and is of the view that annual performance reporting is the best use of the regulator's limited resources, and provides a good balance

RESPONDENTS' COMMENTS ON CONSULTATION QUESTIONS	RIC's RESPONSE TO COMMENTS
generation belongs to the country and consequently its usage should be publicly reported and accounted for at regular intervals.	between sufficient public information and reasonable reporting burden.
CAD: The CAD is in agreement that performance reports should be published annually for public information.	The RIC notes the response.
NGC: Agreed. Since T&TEC has the monopoly for transmission and distribution, there is no other option available to the public. While the overall reports can be published annually, it may be prudent for the RIC to make the quarterly data that it collects available to entities upon request. Data collected can be inputs for sources that could contribute to advances in the sector, including development and use of best practices.	The RIC notes the response.
UTT: Yes! Performance reports should be published annually for public information. Stakeholders can then make more informed decisions based on this vital information.	The RIC notes the response.
EMA: The EMA fully supports the publishing of annual performance reports for public information. Annual reports give the public a chance to comment, discuss and ultimately be a part of the process. This would also provide a forum for the public to give feedback, and much needed constructive criticism to ultimately improve the quality of service.	The RIC notes the response.
ECTT: Agreed however; while the overall reports can be published annually, it may be prudent for the RIC to make the quarterly data that it collects available to the public.	The RIC notes the response.
T&TEC: Can be done by the regulator or appropriate Ministry. Must not be done by the utility or suppliers who are parties to the contract(s) being scrutinized.	The RIC will be responsible for compiling and publishing the annual reports for public information.

GENERAL COMMENTS ON THE DOCUMENT	RIC's RESPONSE TO COMMENTS
MPU: The licensing provisions must therefore take into consideration all the factors and conditions associated with true demand planning for power generation procurement. It is noted that maintenance of the Licence is dependent on several factors including compliance with the QSS. As such, the Licence and the QSS are inextricably linked and are the major tools that empower the RIC to regulate the sector.	The RIC notes the response. However, a discussion of Licences is outside of the scope of this consultation.
Moreover, with the imminent arrival of renewable power generation, any standards on power generation, as is the case with the proposed QSS, will be deficient since they will not address quality of service standards related to renewable power generators. As such, having regard to the rapid development of the sector, and the projected entrance of renewable energy power generation on the market, the Ministry is of the view that the RIC ought to consider including a QSS for renewable power generators.	The RIC will give consideration to the development of quality of service standards for RE Generation.

GENERAL COMMENTS ON THE DOCUMENT	RIC's RESPONSE TO COMMENTS
NGC: Given the long-term nature of the PPAs, is there any opportunity for a review/reopening of the PPAs to: Ensure overall improved energy efficiency; and Ensure compliance with progressive parameters/standards (and possible use of penalties).	The RIC notes NGC's concern and recognizes that the overall drive to improve efficiency should include consideration of renegotiating the PPAs by the relevant parties.
As stated in the document, the structure of the holistic power value chain does not encourage overall energy efficiency. Is there an opportunity in reviewing the structure and anticipated steps to sustainable changes (including relevant participation of the Ministry of Energy and Energy Affairs and Ministry of Planning and Public Utilities)?	This is essentially a policy matter for the Government of the Republic of Trinidad and Tobago (GORTT) to decide upon and lies outside of the ambit of the QSS for Generators.
The NGC Group sees itself as an integral stakeholder in the power value chain. The NGC Group would like to be involved in future discussions regarding re-structuring the electricity sector.	This is essentially a policy matter for the Government of the Republic of Trinidad and Tobago (GORTT) to decide upon and lies outside of the ambit of the QSS for Generators.
From its research, has the RIC collected any international case studies that would support the effectiveness of the selected approach?	The RIC has chosen to use a performance monitoring and reporting scheme. This approach is a well-established practice in the regulation of service providers in the utility sector.

GENERAL COMMENTS ON THE DOCUMENT	RIC's RESPONSE TO COMMENTS
EMA: A more robust justification for why the 'guarantee standards scheme' is not appropriate would be beneficial.	The RIC notes the response.
It was stated that TGU is owned by the GoRTT but it was also stated that TGU does not fall under the RIC'S remit. Can clarifications or reasons for this be given in the document?	Such a discussion, while important, lies outside of the ambit of the QSS for Generators.
With regard to the discussion presented on 'Tightening Natural Gas Supply and Energy Security" the EMA suggest to state additional examples in developing countries with economics similar to Trinidad and Tobago (Wider Caribbean, Latin America, Asia) other than the Middle East, noting that those countries have significant fuel reserves, a significant renewable resource (solar) and land space compared to T&T.	The RIC notes the response.
In Section 5 "Proposed Performance Standards for Power Generation in Trinidad and Tobago" state the reason(s) for the statement "At this time, the RIC has chosen to confine this scheme to quality of service indicators and operational efficiency."	The RIC notes the response.
For Tables 5.1 and 5.2 the EMA suggests to insert a column/columns with the ideal heat rate(s) which will be used to measure performance. Please define the column titled "System". It is not clear whether this is the "average heat rate" but please clarify why the heat rates are compared when the technology, equipment and capacity varies with each plant. It may be useful to compare plants with similar technologies or capacity.	The RIC notes the response

GENERAL COMMENTS ON THE DOCUMENT	RIC's RESPONSE TO COMMENTS
ECTT: Given the take-or-pay nature of the PPAs in the context of public best interest, can the RIC broker any opportunity for a renegotiation of the PPAs to: Ensure overall improved energy efficiency and, Ensure compliance with progressive parameters/ standards (and possible use of penalties).	The RIC notes ECTT's concern and recognizes that the overall drive to improve efficiency should include consideration of renegotiating the PPAs.
Does RIC research on international best practice support RIC recommendations for T&T?	Yes.
Thermal efficiency of plants or units cannot be use to compare to each other unless they are being used for the same purpose, for example TGU is a baseload plant and cannot be compared to Point Lisas as it is a peaking plant. The heat rate of a gas turbine is heavily dependent on the load it operates at, a gas turbine is most efficient at 80-100% of its capacity once you go below that the efficiency drop off is significant. Also benchmarking at ISO conditions is only relevant if the gas turbine is at baseload, it is not accurate to benchmark varying loads for various gas turbine technologies since too many variables will be affecting performance at the same time. What can be done is set benchmark ranges for the different functions such as 7000-9000 kJ/kWh for baseload, 9000-13000 for intermediate load and 13000-17000 for peaking load. This is also important for the subsequent integration of renewables and how they influence the way gas turbines are used in the future.	The RIC notes the response, and will take this into consideration when setting relevant targets and comparing performances.

GENERAL COMMENTS ON THE DOCUMENT	RIC's RESPONSE TO COMMENTS
MTBF and MTTR are established reliability factors but are not used by NERC to report reliability of supply that is done by the following metrics Equivalent Availability (EA), Equivalent Force Outage Factor (EFOF), and Equivalent Unplanned Outage Factor (EUOF). EUOF gives a better indication of how often breakdowns occurs and that coupled with the EA gives the whole picture of the reliability of a unit. If would be difficult to classify failures that would contribute to MTBF and MTTR but the NERC has defined causes for derates and unplanned outages.	The RIC has given consideration to the suggestions and has included the measures in the metrics to be reported .
Sharon Lakhan-King: I would like to suggest that the need for adequately incorporating the use of renewable energy production by households (e.g. solar and wind energy) to coexist with the TTEC supply and that provisions made for the compensation to persons producing surplus energy via renewable sources that flows back into the TTEC grid.	The RIC notes the response. The current scheme is for non-renewable electricity generation. However, the RIC will give consideration to the development of quality of service for RE Generation.
T&TEC: The RIC already has the capability and skills required to assess generation contracts. As an independent body, the RIC is thus very well placed to be assigned responsibility for oversight of generation contracts.	The RIC notes the response.