

Based on the  
**Singapore Electricity Market Rules**

# **Application form For Registration of Commissioning Generation Facility**

including explanatory notes.

**Please read this important information before completing this form.**

#### **Why do I need to complete this form?**

Energy Market Company Pte Limited (“EMC”) is licensed by the Energy Market Authority (“Authority”) to operate the *wholesale electricity market* in Singapore. One of the EMC’s responsibilities is to manage the registration of facilities in the *wholesale electricity market*. You must complete and submit this form to apply to have a facility registered by the EMC if you wish to:

- participate in the *wholesale electricity market* and/or;
- convey any *physical services* into, through or out of the *transmission system* and
- subject your *generation facility* of over 1MW (as rated in its name plate) to dispatch by the PSO whilst the facility is undergoing commissioning tests.

#### **Why did EMC develop this form?**

The EMC has developed this form to facilitate the registration process described in the *market rules*. You should read the relevant sections of the *market rules* prior to completing the forms. Please also refer to the EMC disclaimer at the end of this form.

#### **Am I eligible to apply for registered facility status?**

You must have at least conditional registration status in the *market participant* registration process before the EMC can process your application for facility registration.

#### **What are the types of facility registration?**

The three types of *registered facilities* are:

- *Generation settlement facility*
- *Generation registered facility*
- *Commissioning generating facility*

You should register as a ***commissioning generation facility*** if you have a *generation facility* of 10MW or more (as rated in its name plate) undergoing commissioning tests. You should register as a ***commissioning generation facility*** if you have a *generation facility* of 1MW or more but less than 10MW (as rated in its name plate) and you wish to subject it to *dispatch* by the PSO whilst the facility is undergoing commissioning tests. This registration is a transitional arrangement.

Subsequently, you should use the Application form for Generation Facility Registration if you are registering this commissioned facility as a *generation settlement facility* or a *generation registered facility*.

#### **When will I know the outcome of my application?**

The EMC will notify you in writing of the outcome within 30 *business days* of the receipt of your fully completed registration form or any further information or clarification requested by the EMC, whichever is the later (unless you and the EMC have agreed a longer time for this process). If your application is declined, the notification will identify why this was the case. A complete and accurate form will help the EMC to process your *participant registration application* within the above stated period.

#### **What should I do if I have more than one facility to register?**

Please fill in separate sets of forms for each facility to be registered. To do this, you may wish to download more forms from the EMC’s website: [www.emcsg.com](http://www.emcsg.com).

#### **Is there an application fee for facility registration?**

There is no application fee for facility registration.

**Summary of registration requirements for a commissioning generation facility (10MW and above or 1MW to less than 10MW and subject to PSO dispatch)**

The key requirements for the registration of a *commissioning generation facility*

- of 10MW or above (as rated in its name plate) or
- 1MW or more and less than 10MW (as rated in its name plate) and subject to *PSO* dispatch

are set out in the table below:

A	<b>Meet pre-registration requirements</b>	You must be sure you can satisfy all applicable technical requirements before submitting your registration application. The <i>EMC</i> may test and inspect your equipment to ensure compliance. Successful completion of these tests is a pre-condition for registration. You must also ensure you have adequately qualified staff and identify your <i>dispatch coordinator</i> , who is authorised to submit <i>dispatch data</i> for your <i>registered facility</i> . You can change your <i>dispatch coordinator</i> only with the <i>EMC</i> 's prior approval.
B	<b>Meet the <i>PSO</i>'s requirements</b>	You must complete the <i>PSO</i> 's 'Facility Data Registration Form', meeting all their technical requirements and attaching any required documents during submission.
C	<b>Prepare and attach required documents</b>	As a pre-requisite for registration, you must attach; <ul style="list-style-type: none"> <li>• A copy of your <i>connection agreement</i> with the <i>transmission licensee</i>.</li> <li>• Identification of the <i>physical services</i> to be provided by the facility.</li> <li>• A <i>standing offer</i> for each <i>physical service</i> to be provided by the facility.</li> <li>• An undertaking that you have operational control and authority over the facility.</li> </ul>
D	<b>Registration as a <i>commissioning generation facility</i></b>	The <i>EMC</i> shall approve your registration when it is satisfied that: <ul style="list-style-type: none"> <li>• The facility is capable of operating as described in your registration (the <i>EMC</i> may consult with the <i>PSO</i>).</li> <li>• The <i>PSO</i> has approved the facility's <i>standing capability data</i>.</li> </ul> <p>If the <i>EMC</i> is satisfied that you meet the requirements of a <i>commissioning generation facility</i>, we will register you as one. The <i>EMC</i> will advise the terms and conditions of the registration in an official notice to you. If your application is declined, the <i>EMC</i> will write to you stating the reasons. If your facility is located outside Singapore, you may have to meet additional the <i>EMC</i> requirements.</p>

**How can I find more information?**

In addition to this form and the *market rules*, you can find more information by contacting the *EMC* Market Administration Team by telephone +65 6779 3000. Alternatively, you may visit the *EMC* website at <http://www.emcsg.com>.

Please print clearly. Illegible or incomplete forms may delay the processing of your application.

**A. REGULATORY DETAILS**

**1. What *electricity licence(s)* for the *wholesale electricity market* do you hold?**

**Note:** You may only tick one licence on this form. You should complete a separate form if you intend to perform different functions in the *wholesale electricity market*.

- Generator *electricity licence*
- Retailer *electricity licence*
- Transmission *electricity licence*
- An *electricity licence* other than a generator or retailer licence permitting the holder to trade in the *wholesale electricity market*
- I/We have been exempted by the *Authority* from the need to hold an *electricity licence*
- Electricity licence* number \_\_\_\_\_

**2. What is the name plate capacity of the *commissioning generation facility*?**

- 1 to less than 10 MW     10 MW and above

**3. Derogation requested**             Yes             No

**4. Wholesale Electricity Market Settlement account** \_\_\_\_\_

**B. FACILITY DETAILS**

**5. Name of the facility:** \_\_\_\_\_

**6. Name of owner of the facility:** \_\_\_\_\_

**7. Physical address of the facility:** \_\_\_\_\_  
 \_\_\_\_\_

**8. Meter ID number** \_\_\_\_\_  
 (Please complete Appendix A)

**9. Designated *dispatch coordinator* for the facility** \_\_\_\_\_  
 (*Market Participant* authorised to submit *dispatch data* with respect to the *registered facility*)

**10. Designated *dispatch coordinator* contacts for the facility:**

	<b>Main Contact</b>	<b>Alternate contact</b>
Full Name & Designation		
Contact Numbers		
Email Address		
Hand phone Nos.		
Fax Nos.		

**C. STANDING OFFER DATA (For each *generation commissioning facility*)**

Please provide '*standing offer*' data for *energy* in a CSV file format to Helpdesk@emcsg.com . For details please refer to the *EMC's MARKET OPERATIONS MARKET MANUAL* on Standing Offers, Offer Variations and Standing Data (Chapter 6 *market rules*)

**D. GENERATION FACILITY REGISTRATION  
(FOR SUBMISSION TO PSO)**

Please see attached *PSO* data form. The form shall be considered complete only if all the relevant sections are completed and relevant documentation is attached.

**E. SUPPORTING DOCUMENTS REQUIRED**

You must attach certified true copies of the following documents to your application form:

- Copy of metering agreement with the MSSL.
- Copy of *connection agreement* with the *transmission licensee*.
- An undertaking stating that adequate personnel and organizational arrangements are met for that facility, which include reliable services during normal and emergency situations.

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**FOR EMC OFFICIAL USE**

1. Assigned MNN number(s) for this registered facility \_\_\_\_\_

***INFORMATION PROVIDED BY MSSL TO EMC***

2. Respective RQM (as defined by MSSL) Id no(s) \_\_\_\_\_

2.1. Physical address of the facility \_\_\_\_\_

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## F. COVENANT AND DECLARATION

I/We, the undersigned applicant(s), having read and fully understood the Singapore Electricity Market Rules (the 'Rules'), the Companies Act (Chapter 50) (the "CA"), and any other applicable laws, codes, rules, procedures or policies that are relevant to or regulate the Singapore Electricity Market or the electricity industry (the 'Laws'), and/or having had the benefit of relevant independent legal advice, hereby apply to register the relevant facilities as stated hereinabove under the Rules and covenant to comply with and be legally bound by the Electricity Act (Chapter 89A) of Singapore, the Rules, the CA and the Laws (as the same may be amended from time to time) in relation to such facilities.

I/We, the undersigned applicant(s), further hereby declare that the information provided by me/us in this form is both true and accurate to the best of my/our knowledge, information and belief and hereby covenant to be subject to any sanctions, penalties or orders as may be imposed by the relevant authorities under the Act, the Rules, the CA, or the Laws, in the event that such information is found to be untrue, misleading or inaccurate by the relevant authorities.

I/We, the undersigned applicant(s), further hereby covenant to be legally bound by the relevant dispute resolution provisions under the Rules, in the event that this application for registration is denied and a dispute arises from such unsuccessful application.

Signed for and on behalf of the \_\_\_\_\_  
(Name of Applicant)

Signature: \_\_\_\_\_

Name: \_\_\_\_\_

Position: \_\_\_\_\_

Date: \_\_\_\_\_

## G. EMC'S DISCLAIMER

Energy Market Company Pte Limited ("*EMC*") has produced this publication for use in connection with the Singapore Electricity Market. This publication is not a substitute for and should not be read in lieu of the Singapore Electricity Market Rules or any other applicable laws, codes, rules, procedures, manuals or policies that are relevant to or regulate the Singapore Electricity Market or the electricity industry. The contents of this publication do not constitute legal or business advice and should not be relied upon as a substitute for obtaining such advice.

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Any modifications or amendments to this publication shall be made in accordance with the relevant provisions of the Singapore Electricity Market Rules.

# Generation Facility Registration

## Appendix A : Metering Details (per Generation Licensee)

S/No	Generating Facilities Name	Meter Type (Main, Check or Auxiliary)	Meter Serial Number	Station Load Meter Name (Please show tagging, if any)	Station Load Meter Serial Number	Market Network Node (assigned by EMC)
1						
2						
3						
4						

Note:

Please tag the station loads (if any) to the generating facilities.

# **Power System Operator (PSO) Data Form For Generation Facility Registration<sup>1</sup> (Revision 1-Dec-2010)**

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<sup>1</sup> This Power System Operator (*PSO*) Data Form For Generation Facility Registration is not part of the Market Manual which this application form forms a part of. A copy of that form (being the current version as of the date of *publication* of this Application Form For Registration of Commissioning Generation Facility) is appended hereto for your convenient reference only. Please note that the Power System Operator (*PSO*) Data Form For Generation Facility Registration may be amended, updated or replaced from time to time and you should ensure that you obtain and use the most up-to-date version available at the time of your application.

## Appendix 3A – Facility Registration Form

<b>TABLE 1 - GENERATION FACILITY STANDING CAPABILITY DATA</b>			
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>			
Description of Data Submission (New / Revised / Removed):			
Name of Generation Facility:			
Type of Generation Facility: If CCP, State Configuration	Steam/Gas Turbine/CCP		
Maximum Generation Capacity (Continuous)			MW @ 32 °C
GT/ST or GT/GT/ST capacities	GT1: MW	GT2: MW	ST: MW
Maximum Ramp-Up Rate:	MW/min		
Maximum Ramp-Down Rate:	MW/min		
Maximum Reserve Capacity			
• Primary:	MW		
• Secondary:	MW		
• Contingency:	MW		
LowLoad	MW		
Reserve Capacity @	LowLoad	MediumLoad	HighLoad
• Primary:	MW	MW	MW
• Secondary:	MW	MW	MW
• Contingency:	MW	MW	MW
Maximum Combined Generation Capacity and Reserve Capacity			
• Primary:	MW		
• Secondary:	MW		
• Contingency:	MW		
Reserve Proportionality Factor			
• Primary:			
• Secondary:			
• Contingency:			
Maximum Regulation Capacity:	MW		
Maximum Energy Output at which AGC can Operate:	MW		
Minimum Output at which AGC can Operate:	MW		
Time Delay before Responding to Contingency Event			
• Primary:	Seconds		
• Secondary:	Seconds		
• Contingency:	Seconds		

<b>To be completed by PSO</b>			
AGC B1 – B2 – B3:			
SCADA B1–B2–B3 (ST):			
Default Bus:			
Alternate Default Bus:			
Default line:			
SCADA B1–B2–B3 (GT1):			
Default Bus:			
Alternate Default Bus:			
Default line:			
SCADA B1–B2–B3 (GT2):			
Default Bus:			
Alternate Default Bus:			
Default line:			
SU Type:	Dependent / Independent		
Mapping Protocol:	Include / Replace		
Reserve Provider Group:			
Additional Information:	^ Denotes a space		

<b>TABLE 2 - GENERATION FACILITY OPERATIONAL PARAMETERS</b>			
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>			
Description of Data Submission (New / Revised / Removed):			
Name of Generation Facility:			
Type of Generation Facility: If CCP, State Configuration	Steam/Gas Turbine/CCP		
Installed capacity	MW		
Maximum Generation Capacity (Emergency)	MW @32 oC	MVA	
	Duration:		
Generation Facility Works Units			
• Auxiliaries Load:	MW	MVar	
• Station Load:	MW	MVar	
Voltage Level of Connection Point to Grid:	kV		
Minimum Stable Load: (MSL)	MW		
Maximum Transient Ramp-Up Rate:	MW/min		
Maximum Transient Ramp-Down Rate:	MW/min		
Minimum Shutdown Time:	Hours		
Minimum On-Time:	Hours		
Time from Minimum Stable Load to Full Load:	Hours		
Automatic Generation Control [AGC] Capability?	Yes/No		
If there is AGC capability, complete the following AGC data:			
Droop Factor:	%		
AGC command Reaction Delay:	Seconds		
Step Change in Unit Set-point per AGC command			
• Raise:	MW/0.1 sec		
• Lower:	MW/0.1 sec		
Average Turbine Time Constant:	Seconds		
Prime Mover Time Constant:	Seconds		
Maximum Stored Energy in Boiler:	MW		
Governor Dead Band:	MW		
Start Up Data			
Time Unit has been Offline to have status Hot/Warm/Cold			
• Hot:	Hour		
• Warm:	Hour		
• Cold:	Hour		
Time from Notification given to Synchronisation to the Grid			
• Hot:	Hour		
• Warm:	Hour		
• Cold:	Hour		
Start-Up Curve (from Synchronisation to MSL)			
• Hot:	(MW,Hr)		
• Warm:	(MW,Hr)		
• Cold:	(MW,Hr)		

<b>TABLE 3 - GENERATING UNIT TECHNICAL PARAMETERS</b>	
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>	
Description of Data Submission (New / Revised / Removed):	
<b><i>Generating Unit's main technical data</i></b>	
Name of Generating Unit:	
Unit Number:	
Manufacturer:	
Model:	
Rated Terminal Voltage:	kV
Rated MVA Capacity:	MVA
Rated Power Factor	
• Over-Excited (lag):	
• Under-Excited (lead):	
Short Circuit Ratio at Rated Voltage and Current:	
Direct Axis Short-Circuit Time Constants	
• Td':	sec
• Td'':	sec
Direct Axis Open-Circuit Time Constants	
• Tdo':	sec
• Tdo'':	sec
Quadrature Axis Open-Circuit Time Constants	
• Tqo':	sec
• Tqo'':	sec
Armature Winding Short-Circuit Time Constant (Ta):	sec
MVA base for all Impedance Data:	MVA
kV base for all Impedance Data:	kV
Direct Axis Synchronous Reactance (Xd)	
• Unsaturated:	%
Direct Axis Transient Reactance (Xd')	
• Unsaturated:	%
• Saturated:	%
Direct axis sub-transient reactance (Xd'')	
• Unsaturated:	%
• Saturated:	%
Quadrature Axis Synchronous Reactance (Xq)	
• Unsaturated:	%
Quadrature Axis Transient Reactance (Xq')	
• Unsaturated:	%
Quadrature Axis Sub-Transient Reactance (Xq'')	
• Unsaturated:	%
Potier Reactance (Xp):	%
Leakage Reactance (Xl):	%
Negative Sequence Reactance (X2):	
• Unsaturated:	%
• Saturated:	%
Zero Sequence Reactance (X0):	%
Grounding Resistance:	Ohm
Grounding Reactance:	Ohm
Main Field Current at No-Load and Rated Voltage:	Amp
Main Field Current at Full-Load and Rated Voltage and Rated Power Factor Overexcited:	Amp
Short Circuit Current Contribution at the Point of Common Coupling and Basis of Computation:	kA
Resistance of Main Field Windings at Operating Temperature of 75 °C	Ohm
Machine Damping Factor (K <sub>D</sub> ):	
"Turbine + Generator" Inertia Constant (H):	MW*seconds/MVA

<b>TABLE 3 - GENERATING UNIT TECHNICAL PARAMETERS</b>			
<b>Generator Step-up Transformer</b>			
Name of Transformer:			
Unit Number:			
Manufacturer:			
Model:			
Winding Connection & Vector Group:			
Rated Voltage			
• Primary:			kV
• Secondary:			kV
Rated MVA Capacity:			MVA
Nominal Voltage Ratio, Primary/Secondary			
MVA base for all Impedance Data:			MVA
kV base for all Impedance Data:			kV
Positive Sequence Impedances		R	X
• @ Maximum Tap:		%	%
• @ Minimum Tap:		%	%
• @ Nominal Tap:		%	%
Zero Phase Sequence Impedance:			%
Tap Changer Range:	+		%
	-		%
Tap Changer Step Size:			
Tap Changer Type:	On-load / Off-load		
Earthing Resistor of Transformer (if any)			
• Primary			Ohm
• Secondary			Ohm
Magnetising Curve: <i>to indicate references of submission</i>			
Transformer Iron (Fixed) loss			kW
Transformer Copper losses: (to provide loss curve if available)			
• @ 25% rated capacity:			kW
• @ 50% rated capacity:			kW
• @ 75% rated capacity:			kW
• @ 100% rated capacity:			kW
<b>To be completed by PSO</b>			
B1 – B2 – B3:			
From TA (B1 – B2 – B3):			
	<i>Bus / Con</i>		
To TA (B1 – B2 – B3):			
	<i>Bus / Con</i>		
Additional Information:	^ Denotes a space		
<b>Generator Excitation System</b>			
Name of Generating Unit:			
Type:			
Voltage Regulator Model Name:			
<b>Steam Turbine Unit</b>			
Rated MW Capacity:			
Model:			
Manufacturer:			
Power Fraction ( <i>to submit heat balance diagram</i> )		HP:	
		IP:	
		LP:	
<b>Gas Turbine Unit (Open Cycle &amp; Closed Cycle)</b>			
Rated MW Capacity:			MW
Model:			
Manufacturer:			

<b>TABLE 3 - GENERATING UNIT TECHNICAL PARAMETERS</b>												
<b>Steam Turbine Unit on Combined Cycle</b>												
Rated MW Capacity:							MW					
Model:												
Manufacturer:												
Power Fraction (to submit heat balance diagram)							HP: IP: LP:					
<b>Generating Unit /Generation Facility Protection</b>												
Functional description and settings of the following:												
<ul style="list-style-type: none"> <li>• Loss of excitation relays <ul style="list-style-type: none"> <li>○ CT ratio</li> <li>○ VT ratio</li> <li>○ Setting</li> </ul> </li> <li>• Under-Frequency Relay Setting</li> <li>• Over-Frequency Relay Setting (to state the highest frequency the generation facility can operate, ie remains connected to the grid prior to tripping)</li> <li>• Under-Voltage Relay Setting</li> <li>• Over-Voltage Relay Setting</li> </ul>												
<b>Unit Transformer</b>												
Name of Transformer:												
Manufacturer, Country:												
Model:												
Winding connection and Vector Group:												
Rated MVA Capacity:							MVA					
Rated Voltage:							Primary:		kV			
							Secondary:		kV			
Nominal Voltage:							Primary:		kV			
							Secondary:		kV			
Tap Changer:							Type:		On-Load / Off-Load			
							Tap setting:					
step size:							Range:		+ %		- %	
							Tap side					
Positive Sequence Impedance:							R: %		X: %			
Zero Sequence Impedance:							R: %		X: %			
Shunt Susceptance:											%	
Primary Side Neutral Grounded? If yes, Ground Resistance:							Yes/No				Ohm	
Secondary Side Neutral Grounded? If yes, Ground Resistance:							Yes/No				Ohm	
<b>To be completed by PSO</b>												
Off-take Load B1 – B2 – B3:												
Additional Information:							^ Denotes a space					
<b>Generation Facility Input/Output Data</b>												
Average heat rate curve shall be provided in addition to the tabulated data below:												
HTRC – Input / Output curve of the generator (in step of 10% of rated capacity)												
	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%		
MW												
MJ/Hrs												
IHRC –Incremental Heat Rate Curve (in step of 10% of rated capacity)												
	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%		
MW												
MJ/Hrs												

<b>TABLE 3 - GENERATING UNIT TECHNICAL PARAMETERS</b>		
Fuel Type:	Oil / Gas / Diesel	
Primary Fuel	Type:	Source:
Alternate Fuel	Type:	Source:
<b><i>Fuel Changeover Facility (for combined-cycle/co-generation plants)</i></b>		
<i>To submit detailed fuel changeover report. The report shall include the following:</i>		
<ul style="list-style-type: none"> <li>• Conditions for initialisation of fuel changeover</li> <li>• Mode of changeover (auto/manual)</li> <li>• Deloading level</li> <li>• Time taken to complete the changeover process</li> <li>• Test results/plots</li> </ul>		

<b>TABLE 3A - GENERATING UNIT TEST REPORT SUBMISSION</b>	
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>	
Description of Data Submission (New / Revised / Removed):	
Generating Unit Capability Curves:	References No of submission
<ul style="list-style-type: none"> <li>• Saturation curve: to indicate the corresponding field current values at 1.0 pu and 1.2 pu of terminal voltage on the air-gap and open circuit curves.</li> </ul>	
<ul style="list-style-type: none"> <li>• V-curve</li> </ul>	
<ul style="list-style-type: none"> <li>• Reactive Power capability curve</li> </ul>	
Test reports	
<ul style="list-style-type: none"> <li>• Factory test reports</li> <li>• Commissioning test reports</li> </ul>	
<b><i>Generator transformer:</i></b>	
Factory test report: (to include loss curve)	
<b><i>Generator Excitation System</i></b>	
Functional description and block diagram showing transfer function of individual element of the excitation system and the Automatic Voltage Regulator.	
The setting and block diagram showing transfer function of individual element of the minimum and maximum excitation limiters.	
The setting of limiters is to be plotted on the Generator Reactive Capability Curve.	
Exciter saturation data, if available (or applicable).	
Commissioning tests report.	
<b><i>Power System Stabiliser (PSS)</i></b>	
Functional description and block diagram showing transfer function of individual element of the PSS	
Report on methodology in deriving the PSS setting, including simulation results and tuning procedures	
Commissioning tests report	
<b><i>Steam Turbine Unit</i></b>	
heat balance diagram	
Control Design - Functional description and block diagram showing transfer function of individual element of the governor/turbine/boiler.	
Test Data/report	
<ul style="list-style-type: none"> <li>• Control and intercept valve curves <ul style="list-style-type: none"> <li>○ Position vs. signal</li> <li>○ Valve opening vs. signal</li> <li>○ Closing/opening speed tests</li> </ul> </li> <li>• Load rejection tests</li> <li>• Frequency response tests</li> </ul>	
General boiler control strategy	
<ul style="list-style-type: none"> <li>• State whether constant or variable pressure</li> </ul>	Constant/Variable

<ul style="list-style-type: none"> <li>• If constant pressure, boiler follow, turbine follow, or coordinated control</li> </ul>	
<ul style="list-style-type: none"> <li>• If coordinated control, frequency and pressure biases</li> </ul>	
<ul style="list-style-type: none"> <li>• If variable pressure, pressure and control valve position as a function of load level</li> </ul>	
<b><i>Gas Turbine Unit (Open Cycle &amp; Closed Cycle)</i></b>	
Performance data and curves:	
<ul style="list-style-type: none"> <li>• Power vs. Fuel Consumption</li> </ul>	
<ul style="list-style-type: none"> <li>• Exhaust Temperature vs. Fuel Consumption</li> </ul>	
<ul style="list-style-type: none"> <li>• Power vs. Ambient Temperature</li> </ul>	
<ul style="list-style-type: none"> <li>• Power vs. Speed</li> </ul>	
<ul style="list-style-type: none"> <li>• Inlet Guide Vane Effects</li> </ul>	
Control Design - Functional description and block diagram showing transfer function of individual element of gas turbines units (including effect of Ambient Temperature).	
Test Data/report:	
<ul style="list-style-type: none"> <li>• Load Rejection Tests</li> </ul>	
<ul style="list-style-type: none"> <li>• Frequency response tests</li> </ul>	
<b><i>Steam Turbine Unit on Combined Cycle</i></b>	
Control Design:	
<ul style="list-style-type: none"> <li>• Functional description and block diagram showing transfer function of individual element of the steam turbine unit.</li> </ul>	
<ul style="list-style-type: none"> <li>• Control strategy following outages of one or more gas turbine units</li> </ul>	
Steam unit power vs. exhaust temperature, air flow and power of gas turbine units	
Test data/report:	
<ul style="list-style-type: none"> <li>• Load rejection tests</li> </ul>	
<ul style="list-style-type: none"> <li>• Change in steam turbine unit output for a sudden change in gas turbine unit output (including gas turbine unit outage)</li> </ul>	
<b><i>Site commissioning test report</i></b>	
Load Swing Tests:	
On Load Trip Tests:	
Performance Tests:	
Load Runback Tests:	
HP/LP Heater Tests:	
Power System Stabiliser Tests:	
Vacuum Loss Runback Tests:	
Governor Valve Linearing Tests:	
Boiler Feedpump Runback Tests:	
FDF Runback Tests:	
Cold/Warm/Hot Start Tests:	
Automatic Generation Control Tests:	
CCP Verification Tests for consideration as multiple independent generation facilities	
Fuel changeover tests	
Generator lagging Var test	

<b>TABLE 4 - BLACK START GENERATING UNIT CAPABILITY DATA</b>	
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>	
Description of Data Submission (New / Revised / Removed):	
Name & Location of Unit:	
Type of Generating Unit:	Diesel/Gas
Unit Number:	
Manufacturer:	
Model:	
Rated Terminal Voltage:	kV
Rated MVA Capacity:	MVA
Rated Power Factor	
<ul style="list-style-type: none"> <li>• Over-Excited (lag)</li> </ul>	
<ul style="list-style-type: none"> <li>• Under-Excited (lead)</li> </ul>	
Time from Notification given to Synchronisation:	Hours
Start-Up Curve (from Synchronisation to Minimum Stable Load)	
Time from Minimum Stable Load to Full Load:	Hours
Maximum Ramp Rate:	MW/min
<i>to indicate references of the following submissions</i>	References
Capability Curve:	
<ul style="list-style-type: none"> <li>• Reactive Power Capability Curve</li> </ul>	
<ul style="list-style-type: none"> <li>• Factory Test Reports and field test result, if any</li> </ul>	
Black Start capability test report shall includes the following:	
<ul style="list-style-type: none"> <li>• Detailed Single Line Diagram of the Station/Unit Board, Auxiliaries, Emergency diesel generating units &amp; Black-Start generating units connection.</li> </ul>	
<ul style="list-style-type: none"> <li>• Detailed Test Procedures, from Initial isolation from the Transmission System, start-up of Black-Start Generating Unit(s) till synchronisation to the Transmission System.</li> </ul>	
<ul style="list-style-type: none"> <li>• Records of key timing, load (both real &amp; reactive power) profile, voltage profile of black start generating unit(s) during run-up of auxiliary equipment, etc.</li> </ul>	

<b>TABLE 5 - KEY DATES OF GENERATION FACILITY</b>	
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>	
Description of Data Submission (New / Revised / Removed):	
<b>For Generation Registered Facility registration:</b>	
Date of Generating Unit's first synchronization to the transmission system.	
Date Generating Unit completed spinning reserve test.	
Date Generating Unit completed reactive power test.	
Date Generating Unit completed AGC test.	
Date Generating Unit completed Power System Stabiliser test.	
Date Generating Unit completed 100% rated capacity performance test.	
Date Generating Unit completed Fuel change-over tests	
Date Generating Unit commences commercial operation.	
<b>For commissioning generation facility:</b>	
Date Generating Unit is expected to synchronise to the transmission system.	
Date Generating Unit is expected to commence commercial operation.	
Commissioning Test Schedules: All Test Schedules to indicate date, time and unit's output profile as well as low / medium / high risks of machine outage	
Excitation Tests:	
Load Rejection Tests:	
Load Swing Tests:	
On Load Trip Tests:	
Combustion Tests:	
Performance Tests:	
Load Runback Tests:	
HP/LP Heater Tests:	
Power System Stabiliser Tests:	
Vacuum Loss Runback Tests:	
Governor Valve Linearing Tests:	
Boiler Feedpump Runback Tests:	
FDF Runback Tests:	
Cold/Warm/Hot Start Tests:	
Automatic Generation Control Tests:	
Spinning Reserves Capability Tests:	
Fuel changeover tests	
Reliability Test: CCP Verification Tests for consideration as multiple independent generation facilities	
Others:	

<b>TABLE 6 - SUBSTATION/SWITCH-HOUSE DATA</b>	
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>	
Description of Data Submission (New / Revised / Removed):	
Name of Substation/Switch-house:	
Synchronisation Facilities:	Yes/No
<i>to indicate references of the following submissions</i>	References
Detailed Single Line Diagram showing the following: <ul style="list-style-type: none"> <li>• Location and layout plans of all existing and proposed Generating Unit including the switch-house for power station.</li> <li>• the substation/switch-houses equipment including transformer, busbar, bus-section, breaker etc, and protection systems, CT/PT ratio of each incoming &amp; outgoing circuits etc.</li> <li>• Station/Unit Board, Auxiliaries, Emergency diesel generating units &amp; Black-Start generating units (if any) for power station.</li> </ul> <i>All impedances in % shall be on 100 MVA base unless otherwise are to be specified.</i>	

<b>TABLE 7 - REMOTE TERMINAL UNIT DATA</b> <b>(For interface with the Energy Management System of the PSO)</b>	
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>	
Description of Data Submission (New / Revised / Removed):	
Preliminary/As-Built Submission	Preliminary/As-Built
<b>General Information</b>	
Name of Substation	
Type (RTU/SCS)	
Equipment Make & Model	
Protocol	IEC 870-5-101
Commission Date (dd/mm/yyyy)	
Modem (V.34/Optical)	
Communication (Pilot/Phone/OFC)	
Total Number of Digital Points	
Total Number of Measurands Points	
Total Number of Generators (AGC)	
<b>Control Points</b> (E.g. circuit breaker, transformer tap raise/lower, AGC raise/lower etc) <b>(To be submitted for each point)</b>	
Type of Point (Single/Double Point)	
Station Diameter/Bay	
Point Description	
IOA	
IEC Type	
Time-Tag (Yes/No)	
<b>Indications/Alarms</b> (E.g. circuit breakers, isolators, earth switches, local/remote alarms, load limiter status, etc.) <b>(To be submitted for each point)</b>	
Type of Point (Single/Double)	
Station Diameter/Bay	
Point Description	
IOA	
IEC Type	
Time-Tag (Yes/No)	
Alarm Description	
Alarm To Appear (Operated/Trip/On/Alarm etc)	
<b>Measurands</b> (E.g. MW, MVar, transformer taps, voltage, generator terminal voltage, load limiter limits, and frequency of station buses, etc.) <b>(To be submitted for each point)</b>	
Type of Measurand	
Station Diameter/Bay	
IOA	
IEC Type	
Engineering/Raw Value Conversion	Engineering Value 1
	Raw Value 1
	Engineering Value 2
	Raw Value 2
	Engineering Value 3
	Raw Value 3

<b>TABLE 8 - TRANSMISSION CIRCUIT/INTERCONNECTOR DATA</b>			
Interconnector data refers to transmission circuit connected to the external party			
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>			
Description of Data Submission (New / Revised / Removed)			
Preliminary/As-Built Submission		Preliminary/As-Built	
Name of Substation:			
from (End A):			
to (End B):			
Circuit Number:			
Manufacturer:			
Type of Cable:		XLPE/Oil-filled	
Type of Core Conductor:		AL/CU/etc.	
Length of Cable: (Circuit Length)		m	
Commissioned Date: (dd/mm/yyyy)			
Original Commissioned Date (for re-commissioning equipment)			
Surge Impedance:		Ohm	
Rated Voltage:			
• Continuous Rating:		Max: _____ kV	Min: _____ kV
• Emergency Rating		Limit: _____ kV	Duration:
Fault Level Rating (3 phase):		kA (rms)	Duration:
Fault Level Rating (1 phase):		kA (rms)	Duration:
Positive Sequence Impedance: Base MVA = 100MVA Base kV = Equipment Rated Voltage kV		R:	%
		X:	%
		B:	%
Zero Sequence Impedance: Base MVA = 100MVA Base kV = Equipment Rated Voltage kV		R:	%
		X:	%
		B:	%
Rated Capacity:			
• Continuous Rating (CR):		MVA	
• Emergency Rating:		<i>Submit overload capability curve</i>	
➤ 110% of CR		MVA,	Duration:
➤ 120% of CR		MVA,	Duration:
➤ 130% of CR		MVA,	Duration:
➤ 140% of CR		MVA,	Duration:
➤ 150% of CR		MVA,	Duration:
➤ > 150% of CR		MVA,	Duration:
Maximum Charging Current:		Amp/km	
Metal sheath Current Limit:		Amp	
Dielectric Loss:		kW/km	
For Overcurrent Relay (From) (End A)		Time multiplier:	
		Plug multiplier:	
		CT ratio:	
For Overcurrent Relay (To) (End B)		Time multiplier:	
		Plug multiplier:	
		CT ratio:	
Test Reports (As-Built)			
<b>To be completed by PSO</b>			
B1 – B2 – B3:			
From TA (B1 – B2 – B3):			
Bus / Con			
To TA (B1 – B2 – B3):			
Bus / Con			
Additional Information:		^ Denotes a space	

<b>TABLE 9 - SWITCHGEAR DATA</b>		
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>		
Description of Data Submission (New / Revised / Removed):		
Preliminary/As-Built Submission	Preliminary/As-Built	
Name of Substation:		
Name of Switchgear / Busbar:		
Manufacturer:		
Model:		
Type:	GIS, etc	
Configuration:	Single, Double, Mesh, One & half, etc	
Commissioned date: (dd/mm/yyyy)		
Original Commissioned Date (for re-commissioning equipment)		
Rated Voltage:		
• Continuous Rating:	Max: _____kV	Min: _____kV
• Emergency Rating	Limit: _____kV	Duration:
CB Fault Level Rating (3 phase):	kA (rms)	Duration:
CB Fault Level Rating (1 phase):	kA (rms)	Duration:
Busbar Rated Capacity:	A	
Drawings (Preliminary/As-Built)		

<b>To be completed by PSO</b>					
<u>Buses</u>					
(1) B1 – B2 – B3:				Ref/Non	Fic/Non
(2) B1 – B2 – B3:				Ref/Non	Fic/Non
(3) B1 – B2 – B3:				Ref/Non	Fic/Non
(4) B1 – B2 – B3:				Ref/Non	Fic/Non
(5) B1 – B2 – B3:				Ref/Non	Fic/Non
(6) B1 – B2 – B3:				Ref/Non	Fic/Non
(7) B1 – B2 – B3:				Ref/Non	Fic/Non
(8) B1 – B2 – B3:				Ref/Non	Fic/Non
<u>SwitchBay/SwitchingFields</u>					
(1) B1 – B2 – B3:					
(2) B1 – B2 – B3:					
(3) B1 – B2 – B3:					
(4) B1 – B2 – B3:					
(5) B1 – B2 – B3:					
(6) B1 – B2 – B3:					
(7) B1 – B2 – B3:					
(8) B1 – B2 – B3:					
(9) B1 – B2 – B3:					
(10) B1 – B2 – B3:					
(11) B1 – B2 – B3:					
(12) B1 – B2 – B3:					
Additional Information:	^ Denotes a space				

<b>TABLE 10 - REACTORS DATA</b>			
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>			
Description of Data Submission (New / Revised / Removed):			
Preliminary/As-Built Submission	Preliminary/As-Built		
Name of Substation:			
Name of Reactor:			
Attached To:	Transformer/Cable/Stand-alone		
Able to Carry Out Remote Switching:	Yes/No		
Type:	Shunt reactor/shunt capacitor		
Manufacturer:			
Model:			
Commissioned Date: (dd/mm/yyyy)			
Original Commissioned Date (for re-commissioning equipment)			
Rated Voltage:			
• Continuous Rating:	Max: _____ kV	Min: _____ kV	
• Emergency Rating:	Limit: _____ kV	Duration: _____	
Fault Level Rating (3 phase):	_____ kA (rms)	Duration: _____	
Fault Level Rating (1 phase):	_____ kA (rms)	Duration: _____	
Rated Capacity:	_____ MVar		
Minimum Reactive Power Output:	Qmin	_____ MVar	
Maximum Reactive Power Output:	Qmax	_____ Mvar	
Minimum Power Losses:	Pmin	_____ kW	
Maximum Power Losses:	Pmax	_____ kW	
Zero Sequence Impedance	R: _____ %	X: _____ %	
Dielectric Leakage:	_____ kW		
For Thyristor Controlled Reactors			
Minimum Step:			
Maximum Step:			
Nominal Step:			
Drawings (Preliminary/As-Built)			

<b>TABLE 11 - 66/22KV OR STATION TRANSFORMER DATA</b>			
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>			
Description of Data Submission (New / Revised / Removed):			
Preliminary/As-Built Submission	Preliminary/As-Built		
Name of Substation:			
Name of Transformer:			
Manufacturer:			
Model:			
Commissioned Date: (dd/mm/yyyy)			
Original Commissioned Date (for re-commissioning equipment)			
Configuration:	3-phase/3 single-phase/auto-transformer		
Vector Group:	DY/YD/YY		
Rated Capacity:			
• Continuous Rating (CR):			MVA
• Emergency Rating:	<i>Submit overload capability curve</i>		
➤ 110% of CR	MVA,	Duration:	
➤ 120% of CR	MVA,	Duration:	
➤ 130% of CR	MVA,	Duration:	
➤ 140% of CR	MVA,	Duration:	
➤ 150% of CR	MVA,	Duration:	
➤ > 150% of CR	MVA,	Duration:	
Rated Voltage:	Primary:	kV	
	Secondary:	kV	
Short Circuit Limit:	Primary:	kA	
	Secondary:	kA	
Nominal Voltage:	Primary:	kV	
	Secondary:	kV	
Minimum Voltage:	Primary:	kV	
	Secondary:	kV	
Maximum Voltage:	Primary:	kV	
	Secondary:	kV	
Positive Sequence Impedance: Base MVA = 100MVA Base kV = Equipment Rated Voltage kV	R: %	X: %	%
Zero Sequence Impedance: Base MVA = 100MVA Base kV = Equipment Rated Voltage kV	R: %	X: %	%
Shunt Susceptance:	%		
Primary Side Neutral Grounded?	Yes/No		
If yes, Ground Resistance:	Ohm		
Ground Reactance:	Ohm		
Secondary Side Neutral Grounded?	Yes/No		
If yes, Ground Resistance:	Ohm		
Ground Reactance:	Ohm		
For Overcurrent Relay:	Time multiplier:		
	Plug multiplier:		
	CT ratio:		
Transformer Iron (Fixed) Loss:	MW		
Transformer Copper Losses: <i>(to provide loss curve if available)</i>			
• @ 25% Rated Capacity			kW
• @ 50% Rated Capacity			kW
• @ 75% Rated Capacity			kW
• @ 100% Rated Capacity			kW
Drawings (Preliminary/As-Built)			

<b>To be completed by PSO</b>			
Off-take Load B1 – B2 – B3:			
Additional Information:	^ Denotes a space		



<b>TABLE 12A – POWER/PHASE-SHIFT TRANSFORMER DATA</b> (400/230kV, 230/66kV, 230/22kV where applicable)			
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>			
Description of Data Submission (New / Revised / Removed):			
Preliminary/As-Built Submission	Preliminary/As-Built		
Name of Substation:			
Name of Transformer:			
Manufacturer:			
Model:			
Type:	Power Transformer /Phase-Shift Transformer (PST)		
Commissioned Date: (dd/mm/yyyy)			
Original Commissioned Date (for re-commissioning equipment)			
Construction: (shell/core/etc.)			
Configuration:	3-phase/3 single-phase/auto-transformer		
Vector Group:	DY/YD/YY		
Cooling Types:			
Rated Capacity:			
• Continuous Rating (CR):			MVA
• Emergency Rating:	<i>Submit overload capability curve</i>		
➤ 110% of CR	MVA,	Duration:	
➤ 120% of CR	MVA,	Duration:	
➤ 130% of CR	MVA,	Duration:	
➤ 140% of CR	MVA,	Duration:	
➤ 150% of CR	MVA,	Duration:	
➤ > 150% of CR	MVA,	Duration:	
Rated Voltage:	Primary		kV
	Secondary		kV
	Tertiary		kV
Short Circuit Limit:	Primary		kA
	Secondary		kA
	Tertiary		kA
Nominal Voltage:	Primary		kV
	Secondary		kV
	Tertiary		kV
Minimum Voltage:	Primary		kV
	Secondary		kV
	Tertiary		kV
Maximum Voltage:	Primary		kV
	Secondary		kV
	Tertiary		kV
Tap Changer:	Type:	On-Load / Off-Load	
	Nominal tap:		
	Tap setting		
	Range: +		%
	Range: -		%
	Step size:		%
	Tap side	HV/LV	
Step Angle (for PST transformer)	radians		
Positive Sequence Impedance: Base MVA = 100MVA Base kV = Equipment Rated Voltage kV		R	X
	Primary – Secondary (ZPS)	%	%
	Primary – Tertiary (ZPT)	%	%
	Secondary – Tertiary (ZST)	%	%
	Primary (ZP)	%	%
	Secondary (ZS)	%	%
	Tertiary (ZT)		

<b>TABLE 12B - TRANSFORMER DATA</b> (400/230kV, 230/66kV, 230/22kV where applicable)			
<b>To be completed by Market Participant (with initial and company stamp on every page)</b>			
Zero Sequence Impedance: Base MVA = 100MVA Base kV = Equipment Rated Voltage kV		R	X
	Primary – Secondary (ZPS)	%	%
	Primary – Tertiary (ZPT)	%	%
	Secondary – Tertiary (ZST)	%	%
	Primary (ZP)	%	%
	Secondary (ZS)	%	%
	Tertiary (ZT)	%	%
Shunt Susceptance:			
Primary Side Neutral Grounded?	Yes/No		
If yes, Ground Resistance:	Ohm		
Ground Reactance:	Ohm		
Secondary Side Neutral Grounded?	Yes/No		
If yes, Ground Resistance:	Ohm		
Ground Reactance:	Ohm		
Tertiary Side Neutral Grounded?	Yes/No		
If yes, Ground Resistance:	Ohm		
Ground Reactance:	Ohm		
For Overcurrent Relay:	Time multiplier:		
	Plug multiplier:		
	CT ratio:		
Transformer Iron (Fixed) Loss:	MW		
Transformer Copper Losses: <i>(to provide loss curve if available)</i>			
• @ 25% Rated Capacity	kW		
• @ 50% Rated Capacity	kW		
• @ 75% Rated Capacity	kW		
• @ 100% Rated Capacity	kW		
Drawings (Preliminary/As-Built)			

<b>To be completed by PSO</b>			
<b>B1 – B2 – B3 (Primary – Fictitious):</b>			
From TA (B1 – B2 – B3):			Bus / Con
To TA (B1 – B2 – B3):			Bus / Con
<b>B1 – B2 – B3 (Secondary – Fictitious):</b>			
From TA (B1 – B2 – B3):			Bus / Con
To TA (B1 – B2 – B3):			Bus / Con
<b>B1 – B2 – B3 (Tertiary - Fictitious):</b>			
From TA (B1 – B2 – B3):			Bus / Con
To TA (B1 – B2 – B3):			Bus / Con
		$Z_S = \frac{Z_{PS} + Z_{ST} - Z_{PT}}{2}$ $Z_P = \frac{Z_{PT} + Z_{PS} - Z_{ST}}{2}$ $Z_T = \frac{Z_{ST} + Z_{PT} - Z_{PS}}{2}$	
Additional Information:		^ Denotes a space	

<b>TABLE 13A – OFFTAKER’S METERING STATION DETAILS</b> (To be completed by Generation or Wholesaler (Generation) Licensee)		
Name of Offtaker Metering Station		
(Brief description on the type of loads such as for open-cycle gas turbines, combined-cycle plants or others that the natural gas is used for in the installation.)		
<b>Description of Data Submission (New/Revised/Removed):</b>		
<b>Natural Gas Supplier</b>		
• Name of supplier		
Minimum contractual pressure	barg	psig
Maximum contractual pressure	barg	psig
Maximum allowable operating pressure	barg	psig
Maximum contractual energy		bbtu/day
Maximum contractual flow	mmscfd	Sm <sup>3</sup> /hr
Maximum design flow	mmscfd	Sm <sup>3</sup> /hr
Flow limiter installed		Yes/No*
To provide P&ID diagram of the natural gas metering station	(To indicate reference of submission)	

<b>TABLE 13B – OFFTAKER’S RECEIVING STATION DETAILS</b> (To be completed by Generation or Wholesaler (Generation) Licensee)		
Name of Offtaker Receiving Station		
(Brief description on the type of loads such as for open-cycle gas turbines, combined-cycle plants or others that the natural gas is used for in the installation.)		
<b>Description of Data Submission (New/Revised/Removed):</b>		
Numbers and types of Generator Registered Facility (GRF) installed		
Type of GRF/GSF	Open-Cycle Gas Turbine/Combined-Cycle Plant (single-shaft or multi-shaft)/Steam Turbine*	
Total installed capacity	MW	
<b>Total Natural Gas Consumption</b>		
For generation output (total)	Typical	Peak
	MW	MW
	bbtu/day	bbtu/day
	mmscfd	mmscfd
For other loads (total) (if applicable)	Typical	Peak
	MW	MW
	bbtu/day	bbtu/day
	mmscfd	mmscfd
Maximum Design Flow Limit	mmscfd	Sm <sup>3</sup> /hr
To provide P&ID diagram of the natural gas receiving station	(To indicate reference of submission)	

\* delete accordingly

<b>TABLE 13C – DETAILS FOR EACH GENERATING UNIT</b> <i>(To be completed by Generation or Wholesaler (Generation) Licensee)</i>				
<b>Description of Data Submission (New/Revised/Removed):</b>				
Name of Generation Registered Facility (GRF)				
Type of Generating Unit	Open-Cycle Gas Turbine/Combined-Cycle Plant (single-shaft or multi-shaft)/Steam Turbine *			
Rated Capacity	MW@ 32°C			
Gas consumption	Typical		Peak	
<b>Volume</b>	mmscfd	Sm <sup>3</sup> /hr	mmscfd	Sm <sup>3</sup> /hr
<b>Energy</b>	bbtu/day		bbtu/day	
Nominal Operating Pressure at Regulating Station	Inlet		Outlet	
	barg		psig barg	psig
Operating Pressure at Generating Unit Inlet	Nominal		Minimum	
	barg	psig	barg	psig
Low Pressure Trip Setting at Generating Unit Inlet	barg		psig	
Arrangement in % between Primary/Alternate natural gas supplier if commingled during normal operation				
Primary gas source				%
Secondary gas source				%

\* delete accordingly

<b>TABLE 13D – COMPRESSOR DETAILS (if applicable)</b> <i>(To be completed by Generation or Wholesaler (Generation) Licensee)</i>		
Description of Data Submission (New/Revised/Removed):		
Name of ORF/offtakers/others*		
Compressor Type	Centrifugal/Generic/Reciprocating*	
Generic	<i>(To indicate reference of submission)</i>	
• Adiabatic Efficiency		%
Centrifugal	<i>(To indicate reference of submission)</i>	
• Centrifugal Performance Curve (CPID)		
Reciprocating	<i>(To indicate reference of submission)</i>	
• Centrifugal Performance Curve (CPID)		
• Adiabatic Efficiency		%
• Valve Loss	ft-lbf/lbm	Nm/kg
Compressor Driver		
• Mechanical Efficiency		%
• Auxiliary Load	hp	W
• Ambient Temperature	deg C	deg F
Hydraulic Constraint		
• Maximum Down Pressure	barg	psig
• Minimum Up Pressure	barg	psig
• Maximum Power	hp	W
• Compressor Ratio		
• Maximum Speed		rpm
• Minimum Speed		rpm
• Maximum Flow	mmscfd	Sm <sup>3</sup> /hr
Thermal Constraint		
• Maximum Down Temperature	deg C	deg F
• Minimum Down Temperature	deg C	deg F

\* delete accordingly

<b>TABLES 13E – DETAILS OF HEATERS/COOLERS</b> (To be completed by Generation or Wholesaler (Generation) Licensees for each equipment)			
<b>Description of Data Submission (New/Revised/Removed):</b>			
Name of ORF/pipeline/metering station/receiving station *			
Tag Name			
Hydraulic Constraints			
• Maximum Down Pressure		barg	psig
• Coefficient			psi <sup>2</sup> /mmscfd <sup>2</sup>
Thermal Constraints			
• Maximum Down Temperature		deg C	deg F
• Maximum Delta Temperature		deg C	deg F
• Maximum Duty		hp	W

\* delete accordingly

<b>TABLE 13F – DETAILS OF VALVES</b> (To be completed by Generation or Wholesaler (Generation) Licensee for each equipment)			
<b>Description of Data Submission (New/Revised/Removed):</b>			
Name of ORF/pipeline/metering station/receiving station *			
Tag Name			
Valve Type		Emergency Shutdown Valve/Block valve/Check valve/Regulator*	
Coefficient (CV)			
Valve Size		mm	
Valve Operating Regime			
• During normal operation		Open/Close *	
• During power supply failure		Open/Close/Follow Last Position *	
Valve Operating Time			
• From full open to close		sec	
• From close to full open		sec	
Regulator (if applicable)			
• Maximum Down Pressure		barg	psig
• Minimum Up Pressure		barg	psig
• Maximum Delta Pressure		barg	psig
• Minimum Delta Pressure		barg	psig
• Maximum Flow		mmscfd	Sm <sup>3</sup> /hr

\* delete accordingly

**TABLE 13G – DETAILS OF INSTRUMENT DATA**

*(To be completed by Generation or Wholesaler (Generation) Licensee for each equipment)*

**Description of Data Submission (New/Revised/Removed):**

Name of ORF/pipeline/metering station/receiving station *		
Instrument Tag		
Instrument Location		
Measurements Units		
Repeatability		% Span
Accuracy		% Span
Instrument full scale range		
• Type of instrument	pressure/ flow/ temperature/Others*	
	If others, please state:	
• Minimum	barg	psig
	mmscfd	Sm <sup>3</sup> /hr
	deg C	deg F
	If others, please state:	
• Maximum	barg	psig
	mmscfd	Sm <sup>3</sup> /hr
	deg C	deg F
	If others, please state:	

\* delete accordingly

## EXPLANATORY NOTES FOR GENERATING FACILITY/UNIT

### Table 1: Generation Facility Standing Capability Data:

The following data are required according to Appendix 6E – Standing Capability Data, Chapter Six of Singapore Electricity Market Rules:

- Name of Generating Plant E1.1.1
- Maximum Generating Capacity E1.1.2 (This shall be the maximum continuous rating of the generation facility at ambient temperature of 32°C)
- GT/ST capacity (The maximum generating capacity breakdown into GT MW and ST MW. This applies only to Multi-shaft plant configuration.)
- Maximum ramp-up rate E1.1.3
- Maximum ramp-down rate E1.1.4
- Maximum Reserve capacity E1.1.5 (This shall be specified for frequency drop of 0.6 Hz.)
- Maximum combined generation capacity and reserve capacity E1.1.6 (This shall be specified for frequency drop of 0.6 Hz.)
- Reserve proportionality factor representing the ratio of the Reserve capability at lowest energy output level and Lowload (the lowest energy output level), calculated to three decimal places.E1.1.7  
$$\text{Reserve Proportionality factor} = \frac{\text{Reserve Capability @ Lowload}}{\text{Lowload}}$$
- Maximum regulation capacity E1.1.8
- Maximum energy output at which AGC can operate E1.1.9
- Minimum output at which AGC can operate E1.1.10
- Time delay before responding to contingency event E1.1.11
- Low Load E1.1.12
- Reserve capacity E1.1.13 (This shall be specified for frequency drop of 0.6 Hz.)

### Table 2: Generation Facility Operational Parameters

- Generator Type (steam/gas turbine/CCP), acceptable Types are
  - Conventional Steam Turbine Unit
  - Combustion Gas Turbine – Open Cycle Gas Turbine Unit
  - Combined Cycle Plant (To state CCP configuration, i.e GT & Steam combination)
  - Combined Steam & Power Generating Plant – Cogen Plant (To state Cogen configuration)A brief description of power plant configuration shall be provided.
- Maximum Generation Capacity (Emergency) shall be the maximum capability of the generation facility within the duration specified without damaging the facility
- Generating unit works units (auxiliaries and station load). Total power required for auxiliaries and internal load intended to be supplied.
- Voltage Level of Connection Point to Grid

This normally refers to the High voltage end of Generating Unit's Step-Up Transformer.

- **Minimum Stable Load**  
Minimum Stable Load (MSL) is the minimum power output at which the generating unit can maintain stable operation. Being an operational parameter based on engineering design, it should not change under normal operation of the Unit.  
Typical values of MSL:
  - For conventional steam turbines, MSL is normally around 50% to 60% of its Nominal Rated Capacity.
  - For combustion gas turbines (Open Cycle) MSL is normally around 20% to 30% of its Nominal Rated Capacity.
  - For CCP & Cogen MSL depends very much on the configuration. For Full Block (all GTs & STs are in service), it is normally around 50% to 60% of its Nominal Rated Capacity.
  
- **Maximum transient ramp-up rate**
- **Maximum transient ramp-down rate**  
This is the maximum loading/deloading rate, which do not have to be sustained in the long term. It is applicable to generating units that is capable of supporting transient loading conditions via its thermal inertia. E.g. generating unit that provides Regulation service.
  
- **Minimum Shutdown Time**  
This is an operation parameter of a generating unit that represents the minimum time that the generating unit must be shutdown before being restarted.
  
- **Minimum On-Time**  
This is an operation parameter of a generating unit that represents the minimum time that the generating unit must operate after start-up and synchronisation before being shutdown.
  
- **Droop Factor**  
This is the generating unit's frequency bias (unit governor sensitivity) as p.u. (percentage) value. It is normally within the range of 3% to 5%.
  
- **AGC command Reaction Delay**  
This is the number of seconds before a command starts to take effect on the unit after receiving a step change (raise/lower) command from the Automatic Generation Control (AGC) System.
  
- **Step Change in Unit Set-point per AGC command**  
This is the MW step change of generating unit in response to a 0.1 Second raise/lower pulse-width issued by the AGC system. It is usually measured at the most responsive region of the generating unit.  
The AGC system would issue commands equivalent to pulses of width varying from 0.1 second to 1.0 second, depending on above characteristic

of the generating unit and the required step change as a result of fluctuation in load frequency of the system.

- **Average Turbine Time Constant**  
This is the unit's average response time in seconds, which measures the time response of unit to reach 63% of its steady state value. E.g. if the unit receive a command (pulse) to raise its output by 10MW, and it takes 6 seconds to increase its output by 6MW, then the Average Turbine Time Constant would be 6 seconds assuming there is no command delay.
- **Prime Mover Time Constant**  
This is the basic turbine time constant of the generating unit. It is normally same as the Average Unit Response Time above.
- **Maximum Step Change in Unit Output/Max. Stored Energy in Boiler**  
This is the maximum allowed MW step change in generation. It normally represents the maximum stored energy in drum type boiler. AGC system would issue raise/lower commands to the generating unit, at interval of 4 seconds for the required step change in output until this Maximum is reached.
- **Governor Dead Band**  
This value, in MW, represents the backlash present in the governor linkage system. AGC system would normally not issue raise/lower command to the generating unit if the difference between the desirable output and actual output is less than the Governor Dead Band.

### **Generating Facility Startup Data**

- **Time Unit has been Offline to have status Hot/Warm/Cold**  
This states the profile to be used when a generating unit is in Hot, Warm or Cold state (determined by the number of hours since the unit was last shutdown). In the following example, Warm: 32 mean that the unit is Warm if the unit was last shutdown not more than 32 hours but longer than 8 hours.
- **Time from Notification given to Synchronisation to the Grid**  
Conventional Steam Turbine Generating Unit typically takes hours to synchronise to the Grid after receiving instruction from System Control; while Combustion Gas Turbine (Open Cycle) Generating Unit can be synchronised to the Grid in less than 15 minutes.
- **Startup curve (from Synchronisation to MSL)**  
The step of each profile refers to the average loading in MW to be maintained within the time taken. E.g. step 1 of cold profile means that the unit must maintain its average output at 32MW for 1 hour.

### **Table 3/3A: Generating Unit Technical Parameters**

The following references give examples of the required modelling detail and structure. Modelling information that includes block diagrams must use standard symbols for blocks such as integration blocks, summation blocks, and so forth, as used in these references. When necessary, written material explaining the functions of equipment controls shall also be provided.

- Block Diagram Symbols for Dynamic Systems
  - “Conventions for Block Diagram Representation”, IEEE Transactions on Power Systems, Vol. PWRS-1, No. 3, August 1986, pp. 95-100.
  
- Automatic Voltage Regulators and Power System Stabilizers
  - “IEEE Recommended Practice for Excitation Systems for Power Stability Studies”, IEEE Standard 421.5-1992.
  - “Computer Models for Representation of Digital-Based Excitation Systems”, IEEE Transactions on Energy Conversion, Vol. 11, No. 3, September 1996.
  
- Governor, Prime Mover, Energy Source
  - “Dynamic Models for Fossil Fueled Steam Units in Power System Studies”, IEEE Transactions on Power Systems, Vol. 6, No. 2, May 1991.
  - “Dynamic Models for Combined Cycle Plants in Power System Studies”, IEEE Transactions on Power Systems, Vol. 9, No. 3, August 1994.
  - “Simplified Mathematical Representation of Heavy-Duty Gas Turbines”, *Journal of Engineering for Power*, October 1983, Vol. 105.
  - “Simplified Mathematical Representation of Single Shaft Gas Turbines”, *Turbomachinery International*, July/August 1992.
  - “Boiler Models for System Dynamic Performance Studies”, IEEE Transactions on Power Systems, Vol. 6, No. 1, February 1991.

### **Generating facility Input/Output Data**

The Heat (input/output) Rate curve of a unit shows the heat power input for an electrical power output and is a machine characteristic. The incremental heat rate curve is obtained by differentiating the Heat Rate curve. To be mathematically processed, this characteristic has to be monotonically increasing function of the power output (convex input/output curves).

Separate tables may be provided for each of the fuel type. In addition to the tabulated data, average heat rate curve shall also be provided.

The fuel type and its source(s) of supply for both primary and alternate firing shall be provide.

## EXPLANATORY NOTES FOR INFORMATION ON NATURAL GAS FACILITY

General:

- For all information submitted, it must be accompanied with copies of the schematic drawing with changes highlighted.
- Specifically the *Generation or Wholesaler (Generation) Licensee* shall provide details of the following:
  - What is the general control methodology or operating philosophy used to operate the receiving/metering station (e.g. pressure or flow control)?
  - Operating Procedures - Detailed descriptions of the operating procedures, control logic and methodology used to operate the stations.

### **Table 13A: Offtake Metering Station Description:**

This section describes the data that are required for the modeling of the offtakes:

- Generator Registered Facility (GRF) installed – Break down of all the GRF(s) connected to this offtake.
- Total installed capacity – Total generator rated installed capacity connected to this offtake.
- Minimum / maximum contractual pressure – Minimum / maximum contractual pressure arrangement between gas supplier and offtaker.
- Maximum allowable operating pressure - The maximum gas pressure at which the system is allowed to operate.
- Maximum contractual energy – Maximum contractual energy arrangement between gas supplier and offtaker.
- Maximum contractual flow – Maximum contractual flow arrangement between gas supplier and offtaker.
- Maximum design flow – Maximum allowable operating flow of offtaker.
- Flow limiter – Device use to set the maximum permissible gas flow into the offtake.

### **Table 13B: Offtaker's Receiving Station Description:**

This section describes the data that are required for the modeling of the offtakes:

- Generator Registered Facility (GRF) installed – Break down of all GRF(s) connected to this offtake.
- Total installed capacity – Total generator rated installed capacity connected to this offtake.
- Minimum / maximum contractual pressure – Minimum / maximum contractual pressure arrangement between gas supplier and offtaker.
- Maximum allowable operating pressure - The maximum gas pressure at which the system is allowed to operate.

- Maximum contractual energy – Maximum contractual energy arrangement between gas supplier and offtaker.
- Maximum contractual flow – Maximum contractual flow arrangement between gas supplier and offtaker.
- Maximum design flow – Maximum allowable operating flow of offtaker.
- Flow limiter – Device use to set the maximum permissible gas flow into the offtake.
- Maximum design flow – Maximum allowable operating flow limited by the technical constraint in the offtaker’s receiving station.

**Table 13C: Generating Unit Physical Description:**

- Nominal Operating Pressure at Metering Station Outlet – Pressure measured at metering station outlet during normal operating condition.
- Nominal Operating Pressure at Regulation Station – Pressure measured at regulation station during normal operating condition.
- Nominal Operating Pressure at Generating Unit Inlet – Pressure measured at generating unit Inlet during normal operating condition.
- Low Pressure Trip Setting at Generating Unit Inlet – Pressure trip set point for each generating unit.
- Maximum Design Flow Limit – Maximum allowable physical flow limit.

**Table 13D: Compressor Physical Description:**

This section describes the data that are required for the modeling of the compressor:

- Adiabatic Efficiency –Performance of a compressor during heat exchange.
- Centrifugal CPID (Compressor) – Centrifugal Performance curve ID (CPID) for the compressor.
- Valve Loss – Valve loss during operation of compressor.
- Mechanical Efficiency (Compressor) – Ratio of the actual output mechanical power to the rated power of the compressor.
- Auxiliary Load – Additional load for the network element, to increase the power requirements.
- Ambient Temperature – Ambient air temperature value, which will be used for the driver’s power calculations.
- Maximum Down Pressure – Maximum discharge pressure constraint allowed at the downstream node of the compressor.
- Minimum Up Pressure – Minimum suction pressure constraint allowed at the upstream node of the compressor.
- Maximum Power – Maximum power constraint to limit the horsepower available for the compressor's operation.
- Compression Ratio –  $\frac{\text{Downstream pressure in absolute units}}{\text{Upstream pressure in absolute units}}$
- Maximum Speed – Maximum speed at which the compressor will be allowed to operate.

- Minimum Speed – Minimum speed at which the compressor will be allowed to operate.
- Maximum Flow – Maximum flow permitted through the compressor.
- Maximum Down Temperature – Maximum temperature set point for the downstream node of a compressor.
- Minimum Down Temperature – Minimum temperature set point for the downstream node of a compressor.

**Table 13E: Heaters or Coolers Physical Description:**

This section describes the data that are required for the modeling of the heaters or coolers:

- Maximum Down Pressure – Downstream node pressure constraint (discharge pressure) for the heater.
- Coefficient – Pressure loss through the heater, as a function of the flow rate through the heater.
- Maximum Down Temperature – Discharge temperature setpoint for the heater.
- Maximum Delta Temperature – Maximum differential temperature setpoint across the heater.
- Maximum Duty – Maximum Duty of a heater/cooler is used to control the amount of energy available to change the enthalpy of the fluid to meet the required temperature change.

**Table 13F: Valve Physical Description:**

This section describes the data that are required for the modeling of the valve:

- Tag Name – Description/Name given to the Valve.
- Valve operating regime during power supply failure – Valve operating regime in the event of power supply or control system failure; i.e. open, close or remain in the status before power failure.
- Valve operating time – Response time from full open to close and from close to full open.
- Maximum Down Pressure – Maximum pressure that is allowed at the downstream side of a regulator valve.
- Minimum Up Pressure – Minimum pressure that is allowed at the upstream side of a regulator valve.
- Maximum Delta Pressure – Maximum differential pressure set point across the regulator valve.
- Minimum Delta Pressure – Minimum differential pressure set point across the regulator valve.
- Maximum Flow – Maximum volumetric flow through valve.

### **Table 13G: Instrument Physical Description**

This section describes the data that are required for the modeling of the instrument:

- Instrument Tag – Description/name of the Instrument.
- Instrument Location – Actual location of the Instrument.
- Measurement Units – Units of the Instruments (psig, barg, etc).
- Repeatability (% Span) – Enter the instrument’s repeatability as specified by the manufacturer. The value is to be entered as the absolute value of the percent of calibrated span.
- Accuracy (% Span) – Absolute value of the Instrument's accuracy as a percent of the instrument's calibrated span.
- Instrument Full Scale Range – Range of the Instrument (e.g. 500 - 1500psig) for which the instrument is calibrated.