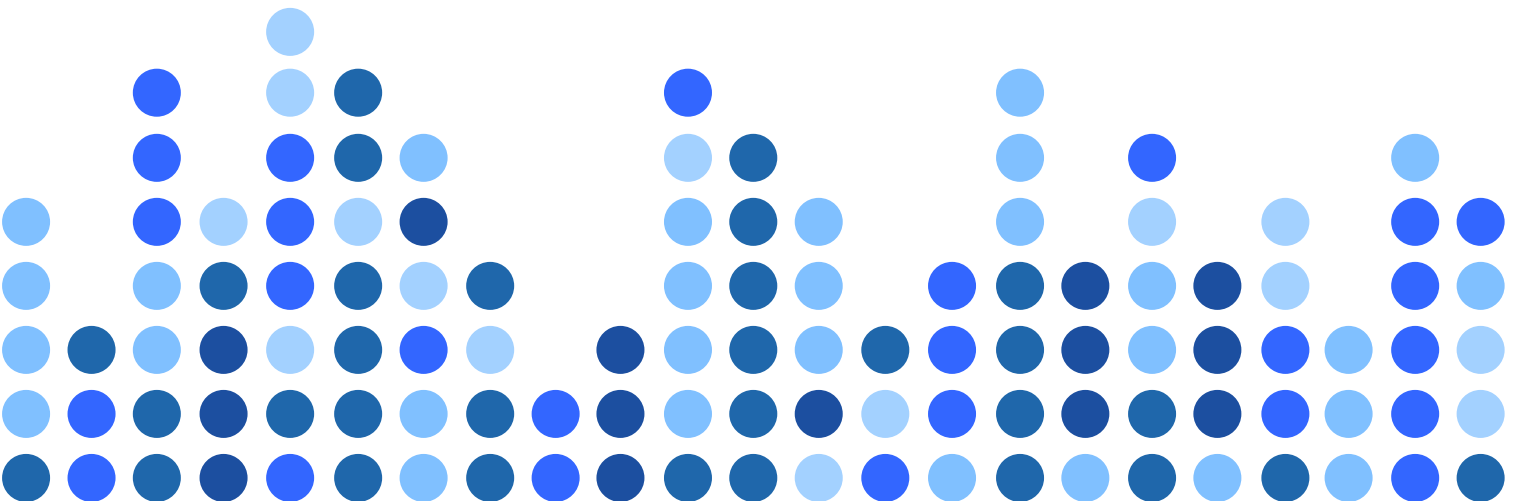


# MARKET ADMINISTRATION MARKET MANUAL (Part 2 of 4)

## REGISTRATION AND AUTHORISATION

This market manual contains the following application form –

- ◆ Application Form for Generation Facility Registration



# Application form for Generation Facility Registration

including explanatory notes

**IMPORTANT: Please read this carefully before completing this form. Italicised words and expressions used herein (but not otherwise defined herein) shall have the same meanings respectively ascribed to them in the Singapore Electricity Market Rules.**

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

Under the *market rules*, if you are not a *market support services licensee*, you are **not permitted** to participate in the *real-time markets* or to cause or permit any *physical service* to be conveyed into, through or out of the *transmission system* unless you have been registered by the *EMC* as a *market participant*, and your facility to or from which the *physical service* is to be so conveyed has been registered by the *EMC* as a *registered facility*, a *commissioning generation facility* or as a *generation settlement facility* in accordance with the *market rules*.

The *EMC* is licensed by the Energy Market Authority (the “*Authority*”) to operate the *wholesale electricity markets* (to which the *real-time markets* form a part) in Singapore. One of the *EMC*’s responsibilities is to manage the registration of facilities in the *wholesale electricity markets*. You must complete and submit this form to apply to have a facility registered by the *EMC* if you wish to convey any *physical services* into, through or out of the *transmission system* and that facility is required or permitted to be registered under the *market rules*.

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

The *EMC* has developed this form for applicants to apply for the relevant facility registration described in the *market rules*. You should read the relevant sections of the *market rules* prior to completing this form. Please also read the *EMC* disclaimer at the end of this form.

#### **Who is eligible to apply for registration?**

You must be registered as a *market participant* before you are eligible to apply for registration of your facilities.

If you are only granted *conditional registration* as a *market participant*, you may also apply for registration of your facilities, but your facilities will not be registered unless you become registered as a *market participant* within the relevant conditional registration deadline.

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

The three types of *registered facilities* are:

- *Generation registered facility*
- *Generation settlement facility*
- *Commissioning generation facility* (you need to complete a separate form for this type of registration).

This application form is to be used for application for registration of either a *generation registered facility* or a *generation settlement facility* only. If you wish to register your facility as a *commissioning generation facility*, please use the Application Form for Commissioning Generation Facility Registration.

#### Generation Registered Facility

If all the *generation facilities* of a *generating station* together have an aggregate name-plate rating of 10 MW or more, all such *generation facilities* must be registered as either a single *generation registered facility* or two or more *generation registered facilities* in accordance with the *market rules*. A *generation registered facility* is subject to *dispatch* by the *PSO*. A *generation registered facility* shall at all times have a valid *standing offer* for each *physical service* that it intends to provide in the *real-time markets*.

#### Generation Settlement Facility

A *generation settlement facility* is registered for the delivery of *energy* only and is not subject to *dispatch* by the *PSO*. If all the *generation facilities* of a *generating station* together have an aggregate name-plate rating of 1 MW or more but less than 10 MW, all such *generation facilities* must be registered as either a single *generation settlement facility* or two or more *generation settlement facilities* in accordance with the *market rules*. But if any of such *generation facility* is to be subject to *dispatch* by the *PSO*, that *generation facility* must be registered as a *generation registered facility* instead.

**When will you know the outcome of your application?**

The *EMC* will notify you in writing of the outcome within 30 *business days* of the *EMC* being satisfied that your application meets all the requirements for *generation facility* registration under the *market rules*, the applicable *market manuals* and the *system operation manual*. If your application is declined, the notification will identify why this was the case. A duly and accurately completed form will expedite *EMC*'s processing of your application.

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

Please fill in a separate form for **each** application for registration of a *generation registered facility* or *generation settlement facility*. You can download additional copies of the form from the *EMC* website at [www.emcsg.com](http://www.emcsg.com).

**Is there an application fee for your application to register your facility?**

There is no application fee payable for your application to register your facility.

## Summary of registration requirements for a generation registered facility

The key requirements in the process for the registration of your facility as a *generation registered facility* are outlined in the table below:

A	<b>Meet the EMC's requirements</b>	<p>You must be sure that</p> <ul style="list-style-type: none"> <li>○ your facilities and equipment meet all applicable technical requirements set forth in the <i>market rules</i>, any applicable <i>market manuals</i> or <i>the system operation manual</i>; and</li> <li>○ you are able to perform all the functions and obligations applicable to you under the <i>market rules</i>, <i>market manuals</i> or <i>system operation manual</i>.</li> </ul> <p>If your facility is located outside of Singapore, the <i>EMC</i> may impose additional requirements for the registration of your facility.</p>
B	<b>Meet the PSO's requirements</b>	<ul style="list-style-type: none"> <li>• You must complete the <i>PSO's</i> Data Form for Generation Facility Registration, meeting all the applicable technical requirements and attaching any required documents during submission.</li> <li>• The registration of your facility is subject to the <i>PSO</i> advising the <i>EMC</i> that such facility poses no threat to the <i>reliability</i> or <i>security</i> of the <i>PSO controlled system</i>.</li> </ul>
C	<b>Meet metering requirements</b>	<p>You must secure the <u>market support services licensee's MSSL's</u> written confirmation to the <i>EMC</i> that the <u>market support services licensee MSSL</u> is ready to submit all <u>relevant settlement settlement</u> data required under the <i>market rules</i> for your facility to the <i>EMC</i>.</p>
D	<b>Prepare and attach required documents</b>	<p>You must duly complete this application form in respect of your facility and provide all required supporting documents with your application, including the following:</p> <ul style="list-style-type: none"> <li>• A certified true copy of your duly executed <i>connection agreement</i> with the <i>transmission licensee</i> for your facility.</li> <li>• A certified true copy of your duly executed <i>market participant - market support services support licensee</i> agreement with the <del>MSSL</del> <u>market support services licensee</u> for your facility.</li> <li>• An original duly completed Data Form for Generation Facility Registration required by the <i>PSO</i> (as set out in <b>Appendix C</b> of this application form) for your facility.</li> <li>• An original duly completed and executed Certificate and Undertaking (in the form and terms prescribed in <b>Appendix B</b> of this application form) for your facility.</li> </ul>
E	<b>Standing Offer Data</b>	<p>You must comply with section D.</p>
F	<b>Registration as a generation registered facility</b>	<p>Your facility will be registered as a <i>generation registered facility</i> if the <i>EMC</i> is satisfied that your facility meets all the requirements for such facility registration under the <i>market rules</i>, the applicable <i>market manuals</i> or the <i>system operation manual</i>. The <i>EMC</i> will notify you of 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.</p>

## Summary of registration requirements for a generation settlement facility

The key requirements in the process for the registration of your facility as a *generation settlement facility* are outlined in the table below:

A	<b>Meet the EMC's requirements</b>	<p>You must be sure that</p> <ul style="list-style-type: none"> <li>○ your facility meets all applicable technical requirements set forth in the <i>market rules</i>, any applicable <i>market manuals</i> or the <i>system operation manual</i>; and</li> <li>○ you are able to perform all the functions and obligations applicable to you under the <i>market rules</i>, <i>market manuals</i> or <i>system operation manual</i>.</li> </ul> <p>If your facility is located outside of Singapore, the EMC may impose additional requirements for the registration of your facility.</p>
B	<b>Meet the PSO's requirements</b>	<ul style="list-style-type: none"> <li>• You must complete the PSO's Data Form for Generation Facility Registration, meeting all the applicable technical requirements and attaching any required documents during submission.</li> <li>• The registration of your facility is subject to the PSO advising the EMC that such facility poses no threat to the <i>reliability</i> or <i>security</i> of the PSO controlled system.</li> </ul>
C	<b>Meet metering requirements</b>	<p>You must secure the <i>MSSL's market support services licensee's</i> written confirmation to the EMC that the <i>market support services licensee MSSL</i> is ready to submit all <u>relevant settlement</u> <del>settlement</del> data required under the <i>market rules</i> for your facility to the EMC.</p>
D	<b>Prepare and attach required documents</b>	<p>You must duly complete this application form in respect of your facility and provide all required supporting documents with your application, including the following:</p> <ul style="list-style-type: none"> <li>• A certified true copy of your duly executed <i>connection agreement</i> with the <i>transmission licensee</i> for your facility.</li> <li>• A certified true copy of your duly executed <i>market participant - market support services support licensee</i> agreement with the <i>market support services licensee MSSL</i> for your facility.</li> <li>• An original duly completed Data Form for Generation Facility Registration required by the PSO (as set out in <b>Appendix C</b> of this application form) for your facility.</li> <li>• An original duly completed and executed Certificate and Undertaking (in the form and terms prescribed in <b>Appendix B</b> of this application form) for your facility.</li> </ul>
E	<b>Registration as a generation settlement facility</b>	<p>Your facility will be registered as a <i>generation settlement facility</i> if the EMC is satisfied that your facility meets all the requirements for such facility registration under the <i>market rules</i>, the applicable <i>market manuals</i> or the <i>system operation manual</i>. The EMC will notify you of the terms and conditions of the registration in an official notice to you. If your application is declined, the EMC will write to you stating the reasons.</p>

### How can you find more information?

In addition to this form and the *market rules*, you may obtain 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](http://www.emcsg.com).

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

**A. APPLICANT DETAILS**

Name of applicant: \_\_\_\_\_

Company registration number: \_\_\_\_\_

Registered Address: \_\_\_\_\_

**B. REGULATORY DETAILS**

**1. Authorised activities relating to *electricity* under your *electricity licence(s)*?**

**Note:** You may check one or more of the following boxes indicating the type of activities authorized under your *electricity licence(s)*

- generate *electricity*
- retail *electricity*
- transmit *electricity*
- transmit *electricity* for or on behalf of a *transmission licensee*
- import *electricity*
- export *electricity*
- trade in *wholesale electricity market*

*Electricity licence* number(s) \_\_\_\_\_

State activities exempted from licensing requirement \_\_\_\_\_

Exemption order number \_\_\_\_\_

**2. What type of facility registration are you applying for?**

- generation registered facility*       *generation settlement facility*

**3. Derogation requested**       Yes       No

**4. Wholesale Electricity settlement account number:** \_\_\_\_\_

**C. FACILITY DETAILS**

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

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

**7. Location of the facility:** \_\_\_\_\_  
\_\_\_\_\_

**8. Meter ID number(s)** \_\_\_\_\_  
(Please also complete **Appendix A** of this application form.)

9. **Dispatch coordinator for the facility:** \_\_\_\_\_  
 (for registration of *generation registered facility* only)

10. **Contacts of the dispatch coordinator for the facility:**

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

11. **Physical service intended to be provided from the facility:**

- Energy
- Reserve  (Primary  Secondary  Contingency )
- Regulation

(In the case of a facility to be registered as a *generation settlement facility*, please tick “energy” only.)

12. **Other authorisations/approvals granted by the Authority**

- \* ~~Authorisation for classification of your facility as an *embedded generation facility* for the purposes of (USEP+HEUC)/Nodal Price Neutralisation~~  Yes  No
- ~~Approval for classification of your facility as a *non-injecting generation facility*~~ an *embedded generation facility* for the purposes of net treatment on non-reserve charges  Yes  No  
 [(If the answer to the above is no, is such approval being sought?  Yes  No)]
- Approval for your facility to be assigned to an *EGF group* to be, or an *EGF group* which has been, granted *price neutralisation*  Yes  No  
 [(If the answer to the above is no, is such approval being sought?  Yes  No)]

(If yes, please provide a copy of the Authority’s written authorisation or approval as the case may be.)

#### D. STANDING OFFER DATA

(This section is only applicable if your facility is to be registered as a *generation registered facility*.)

Please provide a *standing offer* for each *physical service* to be provided from your facility to be registered as a *generation registered facility*. Each such *standing offer* for your facility must be submitted to the EMC in the data format required by and in accordance with the EMC’s Market Operations Market Manual on Standing Offers, Offer Variations and Standing Data (Chapter 6 Market Rules).

**E. GENERATION FACILITY REGISTRATION  
(FOR SUBMISSION TO THE PSO)**

Please complete the *PSO Data Form for Generation Facility Registration* which is attached as **Appendix C** of this application form. All relevant sections in the form must be duly completed. The duly completed form must be sent to the *EMC* together with all supporting documentation.

**F. CHECKLIST OF SUPPORTING DOCUMENTS REQUIRED**

You must attach the following documents to your application form:

- A certified true copy of your duly executed *connection agreement* with the *transmission licensee* for your facility.
- A certified true copy of your duly executed *market participant - market support services licensee agreement* with the ~~MSSL~~ market support services licensee for your facility.
- ~~A certified true copy of written authorisation/approval (if any) from the Authority for~~
  - ~~classification of your facility as an embedded generation facility for the purposes of (USEP+HEUC)/Nodal Price Neutralisation~~
  - ~~classification of your facility as a non-injecting generation facility, for the purposes of net treatment on non-reserve charges~~
- An original duly completed Data Form for Generation Facility Registration required by the *PSO* for your facility.
- An original duly completed and executed Certificate and Undertaking (substantially in the form and terms prescribed in **Appendix B** of this application form) for your facility.

=====

**FOR EMC OFFICIAL USE**

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

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

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

2.1. Location of the facility \_\_\_\_\_

**G. COVENANT AND DECLARATION**

We, the undersigned applicant, having read and fully understood the *market rules*, the terms of this application form, the applicable *market manuals*, the *system operations manual*, the Electricity Act, and any other applicable laws, codes, rules, procedures or policies that are relevant to or regulate the *wholesale electricity markets* (collectively the 'Regulations'), and/or having had the benefit of relevant independent advice, hereby apply to register our facility either as a *generation registered facility* or a *generation settlement facility* as stated in this application form.

We hereby agree to be bound by, and to comply with, all the Regulations which may be applicable to us, our registration application herein, our facility and our participation in the relevant *wholesale electricity markets*.

We further hereby declare that the information provided by us (or on our behalf) in or in connection with this registration application is true, complete and accurate and not misleading or omitting any material particular (to the best of our knowledge, information and belief after having carried out all necessary due diligence to determine the same) and hereby covenant to be subject to any sanctions, penalties or orders as may be imposed by the relevant authorities/parties under the Regulations, in the event that such information is found to be untrue, misleading or inaccurate in any material particular.

We further hereby covenant to be legally bound by the relevant dispute resolution provisions under the *market rules* and any applicable *market manual*, in the event that this registration application is denied and a dispute arises from such unsuccessful application.

We confirm and acknowledge that the information provided by us (or on our behalf) in or in connection with this registration application may need to be disclosed, communicated or exchanged by the EMC to or with other parties, including but not limited to the Authority, the PSO and the market support services licensee MSSL, as necessary, desirable or expedient for the purposes of processing this registration application under the Regulations and we hereby consent to such disclosure, communication or exchange.

Signed for and on behalf of \_\_\_\_\_ (name of applicant):

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

Name of officer: \_\_\_\_\_

Position/designation: \_\_\_\_\_

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

## H. 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.

*EMC*, its directors and employees, subsidiaries, associates and affiliates make no representations, endorsements or warranties of any kind whatsoever in relation to the contents of this publication, and in no event shall *EMC*, its directors and employees, subsidiaries, associates and affiliates be liable to any party for any damages, claims, expenses or losses of any kind arising from or in connection with any use of or reliance on the accuracy, availability, currency, title, non-infringement, quality, reliability, suitability and completeness of the contents of this publication.

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

S/No	Generation 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 generation facilities.

Appendix B

**SAMPLE CERTIFICATE AND UNDERTAKING**  
[To be set out on the applicant's letterhead.]

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**CERTIFICATE AND UNDERTAKING**

To: **Energy Market Company Pte Ltd**  
(hereinafter referred to as the "*EMC*")

We, [state name of applicant], refer to our Application Form for Generation Facility Registration dated [state date] for the registration of [identify the relevant *generation facility* here] ("*our Facility*") as a [*generation registered facility / generation settlement facility*]<sup>1</sup> under the *market rules* and applicable *market manuals* of the *EMC* ("*our Application*").

Pursuant to our Application, we hereby confirm, certify and undertake to the *EMC* (with a view to the *EMC* relying upon our confirmations, certifications and undertakings herein in considering our Application) that:

- 1) we have (and we will continue to have through to, on and from the registration of our Facility by the *EMC*) operational control and authority over the Facility for the purposes of the *market rules*;
- 2) all our facilities and equipment to which our Application relates meet all applicable technical requirements under the *market rules*, the applicable *market manuals* and the *system operation manual*; and
- 3) we have adequate qualified personnel and organisational and other arrangements that are sufficient to enable us to perform all of our functions and obligations applicable to us as *market participants* under the *market rules*, the applicable *market manuals* and the *system operation manual*, including reliable services during normal and emergency situations, in respect of our participation in the *wholesale electricity market*.

Our confirmations, certifications and undertakings herein shall be governed by and construed in accordance with the laws of the Republic of Singapore. All italicised expressions used herein shall have the same meanings respectively ascribed to them in the Singapore Electricity Market Rules of the *EMC*.

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

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

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

Designation: \_\_\_\_\_

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

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\* Delete where inapplicable.

**Power System Operator (PSO)  
Data Form  
For  
Generation Facility Registration<sup>1</sup>  
(Revision 10-Oct-07)**

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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 Generation Facility Registration) 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.

<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	
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 (Xo):	%
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><i>Generator Step-up Transformer</i></b>	

<b>TABLE 3 - GENERATING UNIT TECHNICAL PARAMETERS</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><i>To be completed by PSO</i></b>			
<i>B1 – B2 – B3:</i>			
<i>From TA (B1 – B2 – B3):</i>			
		<i>Bus / Con</i>	
<i>To TA (B1 – B2 – B3):</i>			
		<i>Bus / Con</i>	
<i>Additional Information:</i>		^ Denotes a space	
<b><i>Generator Excitation System</i></b>			
Name of Generating Unit:			
Type:			
Voltage Regulator Model Name:			
<b><i>Steam Turbine Unit</i></b>			
Rated MW Capacity:			
Model:			
Manufacturer:			
Power Fraction ( <i>to submit heat balance diagram</i> )		HP:	
		IP:	
		LP:	
<b><i>Gas Turbine Unit (Open Cycle &amp; Closed Cycle)</i></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:				
							Range:		+ %	- %	
							step size:		%		
							Tap side		HV/LV		
							Positive Sequence Impedance:		R: %	X: %	
Zero Sequence Impedance:							R: %	X: %			
Shunt Susceptance:							%				
Primary Side Neutral Grounded?							Yes/No				
If yes, Ground Resistance:							Ohm				
Secondary Side Neutral Grounded?							Yes/No				
If yes, Ground Resistance:							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> <li>• V-curve</li> <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> </ul>	

<ul style="list-style-type: none"> <li>• Frequency response tests</li> </ul>	
<b>General boiler control strategy</b>	
<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> <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> <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
<p>Detailed Single Line Diagram showing the following:</p> <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> <p><i>All impedances in % shall be on 100 MVA base unless otherwise are to be specified.</i></p>	

<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)		
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)		
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)			
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)			
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)			
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 13 – INTERRUPTIBLE LOAD FACILITY (ILF) STANDING CAPABILITY DATA</b>				
<b>To be completed by Retailer / Market Participant (MP) (with initial and company stamp on every page)</b>				
Purpose of Submission: (New / Revised / Removed):				
Name of Retailer/ MP*:				
Owner Name of ILF:				
Site Address of ILF:				
Maximum Load of ILF:		MW		
Connection of ILF to the PSO controlled grid at voltage level:		*66000 / 22000 / 6600 / 400 V		
Name of Transmission Licensee's substation serving the ILF:				
	Primary Reserve	Secondary Reserve	Contingency Reserve	Recorder ID
Maximum Reserve Capacity (Total) <sup>1</sup> :	MW	MW	MW	
Maximum Reserve Capacity for Load #1:	MW	MW	MW	
Maximum Reserve Capacity for Load #2:	MW	MW	MW	
Maximum Reserve Capacity for Load #3:	MW	MW	MW	
Maximum Reserve Capacity for Load #4:	MW	MW	MW	
<sup>2</sup> Maximum Reserve Capacity for Load #5:	MW	MW	MW	
Under Frequency Relay Settings	Frequency	Hz	Hz	
	Time Delay		sec	
Monitoring-Recording-Activation (MRA) device Brand & Model: (To attached technical specifications)				
Under Frequency Relay Brand & Model: (To attached technical specifications)				
The following Supporting Documents must be submitted:				
1. Half-hourly load profile of Interruptible Load Facility for the immediate past 3 months (from Meter or MRA) controlled by the Designated Circuit-Breaker / Load-Management device				
2. Licensed Electrical Worker certified testing and commissioning reports of MRA device, Under-Frequency Relays (where applicable). The reports should include detailed single-line drawing of the ILF showing connection arrangement of relevant interruptible load, recorder, relays and switches.				

**To be completed by EMC-MO**

Name: B1-B2-B3	ILxxxxx-yyyyyyyy-zzzzzzzz
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**To be completed by PSO**

Reserve Provider Group:	
Reserve Provider Zone:	
Additional Information:	^ Denotes a space

\* delete accordingly

<sup>1</sup> This is the maximum reserve capacity of the load facility for each reserve class that the load facility is or seeks to be registered to provide. See Market Rules Chapter 6, Appendix 6E, Section E.2.1

<sup>2</sup> If number of load ID exceeds 5 numbers, pl submit in another sheet for Load#6 and beyond

<b>TABLE 14A – 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>		
Natural Gas Supplier		
• 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 14B – 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	
Total Natural Gas Consumption		
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

**TABLE 14C – DETAILS FOR EACH GENERATING UNIT***(To be completed by Generation or Wholesaler (Generation) Licensee)***Description of Data Submission (New/Revised/Removed):**

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 14D – 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 14E – 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			
<b>Hydraulic Constraints</b>			
• Maximum Down Pressure		barg	psig
• Coefficient			psi <sup>2</sup> /mmscfd <sup>2</sup>
<b>Thermal Constraints</b>			
• Maximum Down Temperature		deg C	deg F
• Maximum Delta Temperature		deg C	deg F
• Maximum Duty		hp	W

\* delete accordingly

<b>TABLE 14F – 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	
<b>Valve Operating Regime</b>			
• During normal operation		Open/Close *	
• During power supply failure		Open/Close/Follow Last Position *	
<b>Valve Operating Time</b>			
• From full open to close		sec	
• From close to full open		sec	
<b>Regulator (if applicable)</b>			
• 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 14G – 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

### 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.)

### The following data are required by PSO:

- 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.

## **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.

### Offtake Metering Station Description (Table 14A):

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.

### Offtaker's Receiving Station Description (Table 14B):

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.

**Generating Unit Physical Description (Table 14C):**

- 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.

**Compressor Physical Description (Table 14D):**

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.

#### **Heaters or Coolers Physical Description (Table 14D):**

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.

#### **Valve Physical Description (Table 14F):**

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.

### **Instrument Physical Description (Table 14G):**

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.