



VALIDATION REPORT

Date of first issue: 29/10/2012	Organizational unit: Bureau Veritas Certification Holding SAS
Client: PacificLight Power Pte. Ltd.	Client ref.: Mr. K.K. Shiva Kumara

Summary:

Bureau Veritas Certification has conducted the validation of Grid connected electricity generation plant using natural gas at Jurong Island in Singapore, owned by PacificLight Power Pte. Ltd. , which is located in LOT 01962A PT MK 34, Seraya Place, Jurong Island, Singapore 627867., on the basis of UNFCCC criteria for the CDM, as well as criteria given to provide for consistent project operations, monitoring and reporting. UNFCCC criteria refer to Article 12 of the Kyoto Protocol, the CDM rules and modalities and the subsequent decisions by the CDM Executive Board, as well as the host country criteria.

The validation scope is defined as an independent and objective review of the project design document, the project's baseline study, monitoring plan and other relevant documents, and consisted of the following three phases: i) desk review of the project design document and additional background documents; ii) follow-up interviews with project stakeholders; iii) resolution of outstanding issues and the issuance of the final validation report and opinion. The overall validation, from Contract Review to Validation Report & Opinion, was conducted using Bureau Veritas Certification internal procedures.

The first output of the validation process is a list of Clarification Requests, Corrective Actions Requests, and Forward Actions Requests (CLs, CARs and FARs), presented in Appendix A. Taking into account this output, the project proponent revised its project design document.

In summary, it is Bureau Veritas Certification's opinion that the project correctly applies the baseline and monitoring methodology AM0029 Version 03 and meets all relevant UNFCCC requirements for the CDM and the relevant host country criteria. Bureau Veritas Certification thus requests the registration of the project as a CDM project activity.

Report No.: COUNTRY- VD/SINGAPORE/038/2012	Subject Group: CDM
Project title: Grid connected electricity generation plant using natural gas at Jurong Island in Singapore	
Work carried out by: Mr. Ram M. Desai - Team Leader Ms. So Shuk Ling - Team Member Mr. Sushil Budhia - Financial Specialist	
Internal Technical Review carried out by: Mr. H. B. Muralidhar	
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Abbreviations

BVCH	Bureau Veritas Certification Holding SAS
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CL	Clarification Request
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
DOE	Designated Operational Entity
FAR	Forward Action Request
GHG	Green House Gas(es)
MoV	Means of Verification
MP	Monitoring Plan
PDD	Project Design Document
PLF	Plant Load Factor
PP	Project Participant
PPA	Power Purchase Agreement
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Validation and Verification Standard
EMA	Energy Market Authority, Singapore
EMC	Energy Market Company, Singapore

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1. INTRODUCTION

PacificLight Power Pte. Ltd. has commissioned Bureau Veritas Certification to validate its CDM project Grid connected electricity generation plant using natural gas at Jurong Island in Singapore (hereafter called "the Project") at LOT 01962A PT MK 34, Seraya Place, Jurong Island, Singapore 627867.

This report summarizes the findings of the validation of the Project, performed on the basis of UNFCCC criteria, as well as criteria given to provide for consistent project operations, monitoring and reporting.

1.1. Objective

The objective of a validation is to provide a thorough and independent third party assessment of the project design. In particular, the project's baseline, the monitoring plan, and the project's compliance with relevant UNFCCC and host country criteria are validated in order to confirm that the project design, as documented, is sound and reasonable, and meets the applicable CDM requirements and the identified criteria. Validation is a requirement for all CDM projects and is seen as necessary to provide assurance to stakeholders of the quality of the project and its intended generation of certified emission reductions (CERs).

1.2. Scope

The validation scope is defined as an independent and objective review of the project design document, the project's baseline study and monitoring plan and other relevant documents. The information in these documents is reviewed against the requirements of paragraph 37 of the CDM M&Ps, the applicability conditions of the selected methodology and guidance issued by the Board.

The validation is not meant to provide any consulting towards the project participants. However, stated requests for clarifications and/or corrective actions may provide input for improvement of the project design.

1.3. Validation Team

The assessment team and internal technical reviewer team consist of the following personnel:

FUNCTION	NAME	TA 1.1	TA X.X	TASK PERFORMED*
Team Leader	Mr. Ram M. Desai	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> DR <input checked="" type="checkbox"/> SV <input checked="" type="checkbox"/> RI <input type="checkbox"/> TR
Team Member	Ms. So Shuk Ling	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> DR <input type="checkbox"/> SV <input type="checkbox"/> RI <input type="checkbox"/> TR
Financial Specialist	Sushil Budhia	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> DR <input type="checkbox"/> SV <input type="checkbox"/> RI <input type="checkbox"/> TR
Internal Technical Reviewer (ITR)	Mr. H. B. Muralidhar	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> DR <input type="checkbox"/> SV <input type="checkbox"/> RI <input checked="" type="checkbox"/> TR
Specialist supporting ITR	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> DR <input type="checkbox"/> SV <input type="checkbox"/> RI <input type="checkbox"/> TR



*DR = Document Review; SV = Site Visit; RI = Report issuance; TR = Internal Technical Review

2. METHODOLOGY

The overall validation, from Contract Review to Verification Report & Opinion, was conducted using Bureau Veritas Certification internal procedures.

In order to ensure transparency, a validation protocol was customized for the project, according to the version 03.0 of the Clean Development Mechanism Validation and Verification Standard, issued by CDM Executive Board at its 70th meeting on 23/11/2012 **/Ref-79/**. The protocol shows, in a transparent manner, criteria (requirements), means of validation and the results from validating the identified criteria. The validation protocol serves the following purposes:

- It organizes, details and clarifies the requirements a CDM project is expected to meet;
- It ensures a transparent validation process where the validator will document how a particular requirement has been validated and the result of the validation.

The completed validation protocol is enclosed in Appendix A to this report.

2.1. Review of Documents

The Project Design Document (PDD) submitted by General Carbon Advisory Services Pvt. Ltd. and additional background documents related to the project design and baselines were reviewed.

Furthermore, cross checks were made between information provided in the PDD and information from sources other than those used.

To address Bureau Veritas Certification corrective action and clarification requests, General Carbon Advisory Services Pvt. Ltd. revised the PDD and resubmitted it on 03/03/2014.

The validation conclusions presented in this report relate to the project as described in the PDD version 05.1.

2.2. Follow-up Interviews

On 27/09/2012 to 29/09/2012, Bureau Veritas Certification performed a site visit and interviews with project stakeholders to confirm selected information and to resolve issues identified in the document review. Representatives of PacificLight Power Pte. Ltd. and General Carbon Advisory Services Pvt. Ltd. were interviewed (see References). The main topics of the interviews are summarized in Table 1.

Table 1 Interview topics

Interviewed organization	Interview topics
PacificLight Power Pte. Ltd. (the Project Owner)	<ul style="list-style-type: none"> ➤ Project background information and CDM consideration. ➤ Project technology, operation and maintenance. ➤ Project approval and implementation status. ➤ Project management and monitoring plan. ➤ Stakeholder consultation process.



	<ul style="list-style-type: none"> ➤ Common practice in the area. ➤ Government policies related to the project activity.
Local Stakeholder	<ul style="list-style-type: none"> ➤ Project background in details ➤ Stakeholder comments ➤ Social and environmental impact of the project
General Carbon Advisory Services Pvt. Ltd. (the Consultant)	<ul style="list-style-type: none"> ➤ Applicability of selected methodology. ➤ Baseline determination. ➤ Emission reductions calculation. ➤ Emission reduction monitoring plan.

2.3. Resolution of Clarification, Corrective and Forward Action Requests

The objective of this phase of the validation is to resolve issues that require further elaboration, research or expansion prior to Bureau Veritas Certification's positive conclusion on the project design.

A Corrective Action Request (CAR) is raised, if one of the following situations occurs:

- (a) The project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable, verifiable and additional emission reductions;
- (b) The applicable CDM requirements have not been met;
- (c) There is a risk that emission reductions cannot be monitored or calculated.

A Clarification Request (CL) is raised, if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

A Forward Action Request (FAR) may also be raised during validation, to identify issues related to project implementation that require review during the first verification of the project activity.

To guarantee the transparency of the validation process, the issues raised, the responses provided by the project participants, the means of validation of such responses and references to any resulting changes in the PDD or supporting annexes are documented in the Validation Protocol in Appendix A.

2.4. Internal Technical Review

The validation report underwent an Internal Technical Review (ITR) before requesting registration of the project activity.

The ITR is an independent process performed to examine thoroughly that the process of validation has been carried out in conformance with the requirements of the validation scheme as well as internal Bureau Veritas Certification procedures.

The Team Leader provides a copy of the validation report to the reviewer, including any necessary validation documentation. The reviewer reviews the submitted documentation for



conformance with the validation scheme. This will be a comprehensive review of all documentation generated during the validation process.

When performing an Internal Technical Review, the reviewer ensures that:

- The validation activity has been performed by the team by exercising utmost diligence and complete adherence to the CDM rules and requirements.
- The review encompasses all aspects related to the project which includes project design, baseline, additionality, monitoring plans and emission reduction calculations, internal quality assurance systems of the project participant as well as the project activity, review of the stakeholder comments and responses, closure of CARs and CLs during the validation exercise, review of sample documents.

The reviewer may raise Clarification Requests to the validation team and will discuss these matters with the Team Leader.

After the agreement of the responses to the Clarification Requests from the validation team as well as the PP(s), the finalized validation report is accepted for further processing such as uploading via the UNFCCC interface.

3. VALIDATION CONCLUSIONS

In the following sections, the conclusions of the validation are stated.

The findings from the desk review of the original project design documents and the findings from interviews during the follow up visit are described in the Validation Protocol in Appendix A.

The Clarification, Corrective and Forward Action Requests are stated, where applicable, in the following sections and are further documented in the Validation Protocol in Appendix A. The validation of the Project resulted in 11 CAR(s), 20 CL(s) and 00 FAR(s).

The CARs and CLs were closed out based on adequate responses from the Project Participant(s) which meet the applicable requirements. They have been reassessed before their formal acceptance and closure.

The number between brackets at the end of each section corresponds to the VVS paragraph.

3.1. Approval (43-44)

The letters of approval have been received and the following support documentation has been verified by Bureau Veritas Certification:

The DNA of Singapore has issued a Letter of Approval **/Ref-5a/** on 24/04/2013 authorizing GMR Energy (Singapore) Pte. Ltd, however due to the change in the PP from GMR Energy (Singapore) Pte. Ltd. to PacificLight Power Pte. Ltd. , DNA has issued a letter of approval Dated 13/05/2013 for this change in the name, as the objective and design of project is unchanged. Based on these documents submitted by PP in original Validation team herewith confirm that



PacificLight Power Pte. Ltd. is an authorized Project Participant **/Ref-5b/** and confirms that the Project contributes to Singapore's Sustainable development.

There is no Annex I Country participating in the proposed CDM project activity at this time, hence no LOA from Annex I DNA is obtained.

Bureau Veritas Certification received these letters of approval from the project participants and does not doubt the letters' authenticity. The Validation team has crosschecked the issuance of Approval Letter independently by discussing with NEA officials over telephone.

The letters of approval do not refer to a specific version of the validation report.

In accordance with para. 39 – 42/VVS, Bureau Veritas Certification considers that:

- (a) Each letter confirms the Party is a Party to the Kyoto Protocol;
- (b) Each letter confirms the participation is voluntary;
- (c) In the case of the host Party, the letter confirms that the proposed project activity contributes to the sustainable development of the country;
- (d) Each letter refers to the precise proposed project activity title in the PDD being submitted for registration.
- (e) The letter(s) of approval is unconditional with respect to the items above.
- (f) The letter(s) of approval has been issued by the respective Party's DNA and is valid for the proposed project activity under validation.

3.2. Authorization (49)

The participation for each project participant has been authorized by a Party of the Kyoto Protocol.

The validation team concludes this by checking UNFCCC Website, where it is clearly mentioned that the Host Country Singapore is a party to the Kyoto protocol is authorized to participate in CDM Project as Annex II country. This was confirmed using following information.

The host party for this project is Singapore and Singapore has ratified the Kyoto protocol on 12th April 2006¹/**Ref-51/**. This was cross-checked on the UNFCCC website.

<http://maindb.unfccc.int/public/country.pl?country=sq>

Ratification Status:

Kyoto Protocol

Date of signature: not given on the UNFCCC Website

Date of ratification: 12 April 2006

¹ <http://maindb.unfccc.int/public/country.pl?country=sq>



As reported above in Section 3.1 the participation of the project participant has been approved by National Environmental Agency as DNA.

The Validation team verified the original letter of approval dated 24/04/2013 **/Ref-5a/** & Letter for approving change in the name of PP Dated 13/05/2013 **/Ref-5b/**, and it is confirmed that the letter of approval clearly states that Singapore has ratified the Kyoto Protocol and the approval is for the voluntary participation in CDM project activity. The letter also mentions that Project activity fulfills all national criteria for the CDM activities and will help in achieving sustainable development in host country i.e. Singapore.

3.3. Sustainable Development (52)

The host Party's DNA has confirmed the contribution of the Project to the sustainable development of the host Party. Please refer to section 3.1 of this report.

3.4. Modalities of Communications (58,61)

The validation team has performed due diligence on the MoC statement and validated the corporate identity of all project participants and focal points included in the Modalities of Communication (MoC) statement, as well as the personal identities, including specimen signatures and employment status, of their authorized signatories.

Bureau Veritas Certification confirms that the MoC statement complies with all relevant forms and requirements.

3.5. Project Design Document (63)

Bureau Veritas Certification hereby confirms that the PDD complies with the latest forms of the guidance documents for completion of PDD.

3.6. Changes in the Project Activity (17)

During the site visit, no physical changes pertaining to the project design was observed as compared to details mentioned in the webhosted PDD.

The major differences between the final version PDD and the webhosted PDD are listed in Table 2 below:

Table 2 Changes between the final PDD and the webhosted PDD

ITEM	PDD Version 01 (Webhosted)	PDD Version 04 (Final)	Validation Opinion
PDD Front Page / PDD Section A.1 / A.4 and Appendix 1	PP name was GMR Energy (Singapore) Pte. Ltd.	PP name Changed to PacificLight Power Pte. Ltd.	Validation team has verified this name change using Press release and ACRA documentation /Ref- 94/ . ACRA is the legal requirement in host country Singapore.



			<p>PP has also communicated this Change to the Local DNA and DNA has approved and acknowledged this Change.</p> <p>Further PP has communicated this change to EB, through emails and is found satisfactory hence the change in the name of PP is accepted and regularized as per the PCP procedure.</p>
PDD Section A.2.4	Site Address and Geographical Coordinates were not correctly Mentioned (Refer CAR 01)	Correct Site address and Geographical Coordinates are now provided in this Section	Revised information is found satisfactory and acceptable
PDD Section B.5	Demonstration of Additionality i.e. Financial Additionality was not in accordance with the EB guideline and approved Methodology used to develop the project activity (Refer CAR 5,6 &7)	<p>PP has corrected this section by providing correct information in accordance with EB 62 Annex 5 and Approved Methodology. PP has also incorporated information on Peak, off peak and shoulder periods of operations, Vesting contract, Retail contract and Un contracted revenue.</p> <p>Equity IRR is provided as 13.74% and Benchmark calculated as 15.70%.</p>	Revised information is found satisfactory and acceptable
PDD Section B.4 & B.5 (Change in Version 5)	LCOE Cost for Both options is found revised to address CL16 and CL19	PP has accounted the escalation in the fuel cost (i.e. Natural Gas and Coal), Hence the LCOE is found revised in the PDD and Investment analysis (LCOE Analysis Spread sheet.	Revised information is found satisfactory and acceptable

3.7. Project Description (69)

The Project is newly built combined cycle natural gas based power plant located at Lot 01962A PT MK 34 Seraya Place, Juraong Island, Singapore 627867, which has geographical coordinates of north latitude 1°17'24" (1.1724) and east longitude 103°43'30" (103.4330).

The project activity involves installation and operations of new natural gas based combined cycle 800 MW power plant. It includes two SCC5-4000F1S /32-100GT turbines and HRSGs units and ancillary equipment's. Project will be using combustion turbine generator with multi stage axial flow compressor with modulating vanes for natural gas combustion/Ref-/ and the hot gases are recovered using unfired, three pressure, reheat natural circulation drum type HRSG's.

HRSG's are designed for 52 hot starts, 52 warm start and 12 cold starts per year, total plant is having design life of 25 years and complies with ABMA/Ref-14/ & /Ref-76/. The high pressure, intermediate pressure and low pressure sections will consist of economizer, evaporator and super heater. The re heater section will heat IP steam and exhaust steam from the HP section of the steam turbine for admission into the IP turbine. HRSG's are designed to operate within maximum exhaust gas flow and temperature ranges of the CTG's.

The validation team has noted the equipment capacity from the manufacturer's technical specifications and EPC contract document, name plate details cannot be taken during the site visit as the turbine installation work was in progress. The capacities are as follows:

Parameters	Manufacturer Specification	PDD information
Model	SGT5-4000F	SGT5-4000F
Make	Siemens	Siemens
Mode	Siemens Combined Cycle Power Plant	Siemens Combined Cycle Power Plant
Type	Single Shaft	Single Shaft
Grid frequency (Hz)	50	50
Net power output (MW)	423 X 2 @ ISO Conditions	385.5 X 2 /Ref- 14/ EPC contract Section 1.2.2 and 1,2,1,1 Page 1 of 1 Rev 02
Net efficiency (%)	58.16	58.16
Net heat rate (kJ/kWh)	6,164	6190 – Based on the Heat flow diagram No. SIN154-EFES11- A18001 GR2-30 June 2010 (SIEMENS AG EF ES EN11
Net heat rate (Btu/kWh)	5,842	Standard values as per manufacturer Specifications Applied hence not presented in the PDD. And there is no bearing on emission reduction calculations and financial analysis.
Exhaust mass flow (kg/s)	692	
Pressure ratio	18.2	
Exhaust temperature (°C/°F)	577/1,071	
Exhaust mass flow (lb/s)	1,526	
Steam parameter	565°C/125 bar (1,050°F/1,815 psi) 565°C/30 bar (1,050°F/435 psi) 235°C/5 bar (455°F/75 psi)	

The PP has obtained an Electricity license for generation License from EMA under the Electricity Act (Cap.89 A) of host country, Dated 16 September 2002/Ref-17/. As per the



schedule A of Generation License, sanctioned generation capacity of Plant is 800 MW. Further it was observed that PP has signed a connection agreement with SP Power Assets Limited (Agreement No. 003904095), from 2nd supplementary of the connection agreement Dtd. 29 June 2007 it was evidenced that the generation capacity mentioned was 745 MW. Whereas Webhosted PDD refers to 800 MW and 771 MW as generation capacity of the Project activity, Validation team raised CL1 to clarify this difference in the generation capacity. In response to the CL 1, PP has clarified that the project has changed hands, earlier the project owner was Island Power Company Ltd, and as per the earlier Concept Island Power wanted to develop a cogeneration project and hence 745 MW capacity was found mentioned in the connection agreement. Later on the PP i.e. GMR Energy Singapore Pte. Ltd. bought over the project and changed /Ref-72/ the concept to Combined cycle Power plant. The correct installed capacity of the project is 800 MW, which was validated using EPC contract /Ref-14/, Generation License /Ref-17/ and Bank Mandate letter Dated 03/06/2011 /Ref- 58/. Power generation capacity of 771 MW is the rated capacity arrived after accounting auxiliary load of power plant, the calculation of auxiliary load is transparently demonstrated by the PP /Ref-14/. Based on the response and supporting documents validation team closed the the CL 1.

In accordance with the requirements specified in paragraph 64 the VVS ver. 03.0, the validation team conducted a physical visit to the project site on 27/09/2012 to 29/09/2012 and observed that CTG's and ST's are installed and alignment work is in progress. HRSG units are under installation and the power plant is expected to start generating electricity by November 2013 /Ref -18/. On the basis of site visit observations and verification of project specific documents, validation team herewith confirm that the project description of the proposed project activity in the PDD is accurate, complete, and provides an clear understanding of the proposed CDM project activity.

The implementation of project activity will result in annual emission reductions of 286,755 tCO₂e during the seven years of its first renewable crediting period.

The validation did not reveal any information indicating that the Project can be seen as a diversion of official development assistance (ODA) funding towards the host country.

The processes undertaken by the validation team to validate the accuracy and completeness of the project description include conducting a physical site inspection, sampling, reviewing available designs

Bureau Veritas Certification hereby confirms that the project description in the final PDD is accurate and complete in all respects.

3.8. Baseline and Monitoring Methodology

3.8.1. Applicability of the selected Methodology (77)

The Project uses the approved baseline methodology AM0029 Version 03 – “Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas” /Ref-76/.

The applicability of the selected methodology is justified and assessed as follows:



Applicability condition 1: The project activity is the construction and operation of a new natural gas fired grid-connected electricity generation plant;²

The project activity involves the construction and operation of a new natural gas fired electricity generation plant. This was validated using various project specific documents i.e. EPC contract with Siemens and consortium partners for construction, supply and installation of combined cycle power plant **/Ref-14/**, Specification of Project Equipment's **/Ref-20/**, Generation License and Connection Agreement **/Ref-17/**.

From the Equipment Specifications **/Ref-14/**, it was observed that Natural Gas is the primary fuel to be used in the project activity. Back up fuel diesel and start up fuel is LPG. PP has made adequate arrangement to monitor the record the back up fuel consumption and it will not be more than 1% of total fuel used on annual energy basis. This was confirmed during site visit. During site visit it was seen that Natural gas pipeline is reached up to the intake point in the plant premises. During site visit it was also observed that PP has installed 04 Storage tanks of capacity 25000 M³ each at site to store back up fuel i.e. Diesel, Validation team raised a clarification request (CL-3). In response to the clarification request PP explained that installation of Diesel storage tanks of such huge capacity is a regulatory requirement in host country Singapore as prescribed under 'Electricity License for Generation Licensee' **/Ref-17/ &/Ref-18/** from EMA to the project activity. (pg. 10, para. 10), it is a mandatory requirement to maintain 90 days of fuel reserve 'on site'. This is in accordance with the energy security concerns of the host country and to be used only in case of emergencies, i.e. War.

PP has also made a provision to monitoring diesel used and its energy content (NCV). If in some emergency, PP has to use more than 1% of back up fuel (other than NG), the emission reduction will not be claimed in that monitoring period. Based on the response provided by PP and documentary evidences verified, validation team has closed CL-3.

Applicability condition 2: The geographical/physical boundaries of the baseline grid can be clearly identified and information pertaining to the grid and estimating baseline emissions is publicly available;

The project activity is located in Jurong Island of Singapore. Host country Singapore has only one small grid catering to the power demand of entire Island nation. The information on the grid system in Singapore is available with Energy Market Authority and the grid emission factor is published regularly by National Environmental Agency.

The project activity is connected to the Singapore's grid. Therefore, as per the AM 0029, the Singapore grid is also the baseline grid for the project activity.

The geographical/physical boundaries of the baseline grid, i.e. the Singapore grid, are clearly identifiable as this applicability condition of the methodology is met by the project activity. In this case the baseline grid is Singapore grid and the information pertaining to the grid and estimating baseline emission is publicly made available by the NEA on its web site **/Ref-70/**.

Validation team confirm the locations of Gas entry point and monitoring arrangements through engineering drawings **/Ref-51/** and actual physical location where Gas metering devices which

² Natural gas should be the primary fuel. Small amounts of other startup or auxiliary fuels can be used, but can comprise no more than 1% of total fuel use, on energy basis.



comprises of Flow Meter, NCV Monitor etc. will be installed during project scenario. Validation team has also crosschecked the Technical Specifications of these instruments.

Validation team also verified the location of Substations from where Electricity will be exported to the Singapore Grid and observed that there are totally 04 Electricity meters are installed 2 main meters and 2 check meters all four meters are bi-directional type. This was verified using Engineering Drawings approved by the EMA /Ref-55/.

Applicability condition 3: Natural gas is sufficiently available in the region or country, e.g. future natural gas based power capacity additions, comparable in size to the project activity, are not constrained by the use of natural gas in the project activity.³

The PDD has provided a calculation of the natural gas requirement for the project activity, which is based on the full generation of power as per the plant capacity of 771 MW at 72% of annual capacity utilization/Ref-06/ as this is the contractually agreed value as per the connection agreement /Ref-66/, however PP has conservatively considered Peak period (87.5%) and off peak periods (57.7%) of agreed annual capacity utilization. This is only a theoretical assumption; however, the gas consumption by the plant with this value of the annual capacity utilization can be the maximum possible and the plant will not require any additional gas over and above such a quantity computed. The calculation also uses values of station heat rate (6190 MMBTU /Ton) kcal/kWh) and the net calorific value of natural gas (52.20 MMBtu/Ton).With this calculation, the maximum gas consumption by the plant is 32,913 billion BTU. It was verified from the gas supply contracts /Ref-15/ signed by GMR Energy (S) Pte. Ltd. with Singapore LNG Corporation Pte. Ltd. and indicates that this quantity of gas supply had been contracted and was assured to the project activity.

As a known fact, Singapore does not have any gas production source and hence dependent on the import of Natural Gas from neighboring countries i.e. Malaysia and Indonesia. PP has transparently demonstrated the pre project gas consumption scenario in Singapore. Currently Singapore is importing natural gas transports from Malaysia through the first transnational natural gas pipeline built in East Asia. About 80% of Singapore's electricity demand /Ref-22/ is generated from Natural Gas. Three main import pipelines serve the Natural Gas system:

- 150 million standard cubic feet per day from Malaysia
- 325 million standard cubic feet per day from Northeast Indonesia
- 350 million standard cubic feet per day from Southwest Indonesia

Further PP has explained that Singapore government is working on energy mix diversification strategy which includes building energy generation capacity using various types of fuels ie. Coal, Diesel, MFO, Biomass and Natural Gas. In accordance with the energy mix diversification strategy, Singapore government has installed a LNG terminal of capacity 6 million ton per annum –MTPA in two phase of 3 MTPA each in 2013 and 2018 and its development has started and is expected to be commissioned in mid-2013 /Ref-62/. The pre project Gas consumption scenario as explained above was validated by validation team using publically available information and press releases through Singapore government and it is confirmed that the

³ In some situations, there could be price-inelastic supply constraints (e.g. limited resources without possibility of expansion during the crediting period) that could mean that a project activity displaces natural gas that would otherwise be used elsewhere in an economy, thus leading to possible leakage. Hence, it is important for the project proponent to document that supply limitations will not result in significant leakage as indicated here.



natural gas availability in the host country is sufficient and there are no price-inelastic supply constraints observed. In accordance with AM_CLA_0091/**Ref-74/**, it is established that there will not be any shortages in supplies of the natural gas to other projects within the country due to implementation of the proposed project activity.

Bureau Veritas Certification hereby confirms that the selected baseline and monitoring methodology, tool and other methodology component is previously approved by the CDM Executive Board, and is applicable to the Project, which, complies with all the applicability conditions therein.

3.8.2. Project Boundary (86-87)

The validation team has validated the project boundary by observing the physical site and equipment's installed / under installation at the Project site i.e. Lot 01962A PT MK 34 Seraya Place, Jurong Island, Singapore 627867 for generating power.

The spatial extent of the project boundary is clearly defined in line with AM0029 Version 03. The project boundary is assessed through the description in the webhosted PDD and the grid structure in Singapore as known from the official data available from the Energy Market Authority, Singapore **/Ref-44/**. The project activity boundary therefore includes the project plant and also all power plants connected physically to the Singapore Power grid. The grid connectivity of the project plant was verified by the validation team during its site visit on 27/09/2012 and 28/09/2012. The power plant is physically connected to the grid, as observed from electrical single line diagram and physical inspection at the project site switchyard from where the electricity generated by the plant will be exported to the grid. The project activity is a new plant that has been set up and the validation team confirms from the site visit observations that the following equipment has been installed as a part of the project activity:

- Combustion Turbine Generators (CTG) (02 Numbers)
- Heat Recovery Steam Generators (HRSG) (02 Numbers)
- Steam Turbine Generator (02 Numbers)
- Power Transformers (02 Numbers)
- Auxiliary Equipment's of Gas Turbines and Generators, HRSGs and Steam Turbines and Generators;
- Gas Metering Station and gas supply pipelines.
- Electricity metering station and Electricity distribution arrangement for internal consumption

Validation team herewith confirms that above equipment's can be considered as a part of the project boundary. The delineation of the project boundary is clearly marked on the plant layout drawing **/Ref- 67/** verified during site visit.

The greenhouse gases and emission sources included in the project boundary are presented in the PDD Section B.4 in a tabular manner and sources includes

- Power Generation in baseline
- On-site fuel combustion due to the project activity



Both identified sources will result in CO₂ emission and hence project participant has selected CO₂ as the major emission that will take place in the project activity. These emissions are accounted for in the project emissions calculations presented in section B.6.1 & B.6.3 of the PDD and validated by BVCH in section 3.8.4 of this report. The validation team noted in its observations at the project site and the discussions held with the project participant's representatives that the power plant uses natural gas as fuel. As the combustion of natural gas gives rise to CO₂ emissions, the consideration of this gas as an emission source is regarded as appropriate by the validation team.

The consideration of only CO₂ gas for the baseline emissions is conservative and is in line with the methodology and hence appropriate. In the absence of the project activity, an equivalent of energy generated by the project activity would be produced in the grid. The power plants connected to the grid are mainly fossil fuel fired plants, as the Singapore power grid is dominated by such plants and hence, the emissions taking place in the baseline would also be CO₂ emissions.

The electricity imported by the project activity (EG_{import,y}) is accounted for as a separate monitoring parameter in the monitoring plan. The validation team confirms that there are no other sources of GHG emissions in the project boundary, other than the CO₂ emissions referred to above as project emissions.

Bureau Veritas Certification hereby confirms that the identified boundary and the selected sources and gases are justified for the project activity. The validation team did not identify any emission sources that will be affected by the implementation of the proposed project activity and which are expected to contribute more than 1% of the overall expected average annual emissions reductions, and are not addressed by the selected approved methodology.

3.8.3. Baseline Identification (94-95)

The procedure contained in the methodology to identify the most reasonable baseline scenario has been correctly applied.

The AM0029 methodology prescribes that the determination of the baseline for the project activity should be based on the identification of alternative scenarios. In the PDD, the Project participant has identified various plausible scenarios as alternatives to the project activity. The following scenarios were identified:

- a) **The project activity i.e. 800 MW NG based Combined Cycle power plant with an efficiency of 58.16% /Ref-21/ and with a lifetime of 30 years and not implemented as a CDM project activity.**

The methodology requires the project activity not implemented as CDM project to be considered as a plausible alternative and the same has been considered in the PDD. Hence, this is a plausible scenario.

- b) **Power generation using Natural Gas as the fuel but with different alternative technologies.**

The project participant has considered two different technologies for evaluating the alternative



b.1) Power generation using combustion turbine with an installed capacity of 800 MW with an efficiency of 39.8% in an open cycle mode of operations;

In the open cycle mode of operation, power generation takes place in the gas turbine generator and the heat content of the exhaust gas exiting the turbine is not utilized further. This is a simpler mode of operation and was identified as a baseline alternative having about 18.36% lower efficiency than the combined cycle. Thus, a gas turbine plant using the open cycle will consume a higher amount of fuel (natural gas). This will have the effect of increasing the cost of electricity generation (COG) which is the financial indicator used for baseline identification, making the generation of power through the open cycle an uneconomical option, compared to the combined cycle.

Also the share of open cycle power generation technology in host country is very small i.e. 3%, this is further justified with the host country scenario of energy generation spread published by Energy Market Authority in its annual report of 2011/**Ref-26/**. Where the licensed capacities by plant type are shown and the lowest share is of open cycle gas turbine as well as incineration and others. From the Annual Report it was also noticed that Singapore government is promoting efficient technologies for generating electricity in Singapore. And hence PP considers this as not a plausible alternative.

The validation team of BVCH affirms, therefore, that the assumptions and data used in the identification of the baseline scenario, viz., the open cycle plant efficiency are justified appropriately, are supported by evidence and can be deemed reasonable, in line with the requirement of paragraph 94 (c) of the VVS.

b.2) Power generation using Gas turbine in Cogeneration mode of operation;

The other alternative considered is the operation of the gas turbine power plant in cogeneration mode, which produces both power and steam. In this mode of operation the thermal efficiency is very high (63%)/**Ref-63/**, however the electrical efficiency is low in comparison with the Combined Cycle Mode of Operation (50%)/**Ref-27/**. The purpose of the project activity is to export power to the grid and hence, the outputs from a co-generation plant are different from the project activity. Since this alternative provides outputs which are different from the project activity, it is not considered to be a credible alternative.

c) Power generation using energy sources other than Natural Gas

While identifying alternatives for energy generation using energy source other than natural gas, PP has provided background information on energy Sector in Host country, by referring to the overview of fuel mix electricity for generation, it is clear the, due to the size and lack of natural resources Singapore has more than its fair share of energy challenges. Along with being heavily dependent on imports to meet countries energy demand, Singapore has no wind, Hydro or geothermal resources, or the land needed to deploy solar power on a significant scale. The Annual Report published by EMA for year 2011 is also revealing the fact that the Host country energy generation is totally dependent on the Natural Gas from the data it is observed that on an average for the period of 2006 – 2010 Natural gas contributes to 79%, fuel oil contributes to 15.4% and other fuels (Others consist of imulsion fuel (no longer available since Oct 2006), synthetic gas, diesel and refuse incineration) contributes to 5.6% of total energy generation. From the report it concluded that there is no other source of energy contributing to host country energy generation scenario.



With this background information it is well evidenced that energy generation using natural resources is highly impossible in Singapore, however PP has discussed such alternatives and eliminated satisfactorily from the identification of alternatives.

c.1) Power generation using wind as the energy source.

This alternative is not credible alternative due to space constraint as well as the wind availability constraint. From the publically available information on the energy potential in Singapore, it is observed that EMA has done a detailed study to evaluate wind energy potential. From the report it is observed that for generating wind energy it is very important that the wind speed should be at least 5m/s, however in Singapore the average wind speed is found to be 3m/s in a year **/Ref-28/**. Given that this wind speed will not be sufficient to cater the energy demand of Singapore in any way, hence EMA has declined this alternative **/Ref-28/**, however Singapore has still identified micro-wind technology as potential source of energy on a pilot scale (Test Bedding). Validation team herewith confirms that the exclusion of this alternative is justified and hence it is not a credible alternative.

c.2) Power generation using Hydro as the energy source (lifetime 35 years)

From the History of energy generation in host country Singapore, it is evidenced that hydropower has no contribution. This is mainly due to the unavailability of favorable terrain. In Singapore there is only one small river is flowing is not having enough potential to generate electricity. Also from the government published reports **/Ref-29/** it is clear that electricity from Hydropower is not generated in past and it is not possible in future, hence the alternative is not credible.

c.3) Power generation using fuel oil

From the Energy Generation statistics between 2006-2012 published by EMA, Statutory Authority dealing with Power generation and distribution in host country Singapore, it is observed that only 17-18% of the electricity generation is from the fuel oil in Singapore.

The utilization of fuel oil for energy generation is showing a declining trend in Singapore. In 2001, the contribution of fuel oil in energy generation was 71% of the total electricity generated and 26% from natural gas – this has changed significantly to 15% fuel oil and 81% natural gas in 2009 **/Ref-30/**. As a small city-state with no significant indigenous energy resources, Singapore is dependent on fossil fuel imports to meet her energy needs **/Ref-22/**. From the history of the license issuance for power generation available publically on EMA website it is confirmed that there was no new Fuel oil based power plant was commissioned or is in the planning stage in last ten years, hence power generation using fuel oil is not a plausible baseline scenario.

c.4) Power generation using Nuclear Fuel

From the History of energy generation in host country Singapore, it is evidenced that Nuclear power has no contribution in Power generation. This confirmed by the validation team using credible evidences In 2010, around 79% of Singapore's electricity was generated from natural gas, and another 19% from petroleum products such as fuel oil and diesel. The remaining 3% was generated through renewable sources such as biogas, municipal solid waste and solar. There is no mention of electricity generation from nuclear power. As per one of the press releases **/Ref-31/** in 2011 "The Government is conducting a study into the possible use of nuclear energy here, and will release its initial findings next year." Government is also thinking that Malaysia, Indonesia and Singapore could work together and build an offshore nuclear power plant on an island somewhere. From the



above discussion it is clear that till now in Singapore electricity generation from nuclear energy has not taken place. This is not a plausible baseline scenario

c.5) Power generation with thermal power plants using coal and/ or lignite as the energy source

As mentioned above Singapore is deprived of natural resources and fossil fuel reserves, hence the coal used for the power production in Singapore is imported from countries like Indonesia, Malaysia etc. There is only one Coal based power plant in Singapore which belongs to Tuas Power Company. The licensed capacity of this plant is 101 MW and the plant is expected to start generating power by January 2013/**Ref-78/**.

Validation team confirmed the capacity and fuel type for the power plant and it is understood that the plant will be using coal and biomass as fuel in order to keep emission levels down. From the published reports it was clear that Singapore government is not in favor of using coal for power generation 'solely or on a large scale' any time soon as this stems from its decision two years ago to import liquefied natural gas (LNG) and build an LNG terminal, to diversify Singapore's sources of natural gas./**Ref-64/**

While verifying publically available information it was noted that Tuas power has signed a contract with Indonesia's PT Bayan Resources/**Ref-32/** to supply 13.36 million tonnes of sub-bituminous coal over the next 15 years from Kalimantan, and has also struck a deal with South Korea's Samtam Co Ltd to supply coal. Tuas Power is also concluding a deal for the palm kernel Shells (PKS), which makes up the 20% biomass component of the plant feedstock (the other 80% is coal).

Based on the Power Strategy published by Singapore government, validation team confirmed that, the size of coal/ lignite based power plant equivalent to the project activity is exceptional in Singapore and based on power strategy of Singapore it will not be a possibility in near future. However, as per baseline methodology AM0029, several smaller plants may be a reasonable alternative to the project activity. Thus, five units of 160 MW each equivalent to Tuas Power's coal based power plant is a realistic scenario.

PP has also discussed the option of Supercritical Coal power plant in the revised PDD, however as supercritical power plant requires minimum size of 660 MW due to technical design of boilers that can operate on supercritical conditions. Thus, supercritical power plants cannot have sizes lower than 660 MW for single unit size and hence due to this limitation, this option was not considered as realistic scenario in Singapore where large scale coal based power plants are not allowed by Government decision.

PP has also considered the option of using lignite as fuel for baseline alternative, however due to its spontaneous combustion property; it cannot be transported over long distance or stored for longer durations/**Ref-34/**. Based on the independent web search/**Ref-65/** it is confirmed that lignite reserves are found only in Laos and Myanmar amongst all South east Asian countries and it is not feasible to import lignite to Singapore from such a long distance. Also from the fuel usage pattern in Singapore it is observed that Lignite was not consumed so far for any Power generation purpose. Thus, this alternative cannot be a practical for the project activity as Singapore does not have lignite reserves and fuel will need to be imported from other country which is not feasible.

From above validation conclusion it is confirmed that inclusion of Coal as a possible baseline alternative for either sub-critical / super critical power plant is a realistic scenario,



as there is one power plant is under construction in Singapore i.e. Tuas Power/**Ref-35/ & /Ref-36/**, this is found in accordance with the baseline methodological condition, where it is required to ensure that all relevant power plant technologies that have recently been constructed or are under construction or being planned are included as plausible alternative.

d) Import of electricity from connected grids, including the possibility of new interconnections.

Singapore Government is seriously considering electricity imports as a medium term option. The initial plan is to import 600 MW of electricity from neighbouring countries. Electricity imports allow countries like Singapore to access new energy options that may be unavailable or not economically feasible. EMA held a public consultation exercise from Jan-Mar 2012, on the regulatory framework to govern electricity imports to Singapore **/Ref-37/**. From the Official Document it was observed that Singapore government is looking at the option for importing electricity, by doing so two purposes will be met i.e. to free up valuable land in Singapore and to tap on the significant renewable energy potential such as hydro-electricity or geothermal power. Provided government has think over adequate safeguards to ensure the integrity and stability of power system in Singapore. From the publically available information at the time of Validation it is also noted that this project will take 4-5 years to develop and implement, hence it is not considered as a baseline alternative, which is found correct.

Based on the publically available information from the reliable source, Validation team herewith confirms that the identified alternative "Import of Electricity from connected grids, including the possibility of new interconnections" is found realistic and credible.

Validation team herewith confirms that in accordance with the methodological requirement Step 1 under Identification of Baseline Scenarios, PP has established criteria to demonstrate that all above identified alternatives are delivering similar services. The selected criterion is Base load power supplied to grid, this is found in accordance with the definition of Base load Power in ACM0013, Version 05.0.0. PP has selected the Base load power as the criteria for distinguishing identified alternatives and it is found appropriate, because the project Annual Capacity utilization rate is fixed as 72% i.e. 6307 Hours per annum.

Hence, Validation Team is of the opinion that PP has presented all relevant baseline alternatives in the Web hosted PDD and validation team confirms that all identified baseline alternatives are complying the methodological conditions prescribed under Step 1 under Identification of the Baseline Scenario.

At the end of Step 1, from the analysis of Plausible alternatives PP left with three plausible baseline alternatives, which are listed as below

- The project activity i.e. '800 MW NG based Combined Cycle power plant with an efficiency of 58.16% and with a lifetime of 30 years' not implemented as a CDM project activity.
- Power generation using coal as the energy source
- Import of electricity from connected grids, including the possibility of new interconnections

The validation team accepts these alternatives for the determination of the baseline due to the following reasons:

- It is technically possible to set up all three alternatives. The capacity of 800 MW can be set up either as a gas based plant (project activity itself). It would also be possible to set



up a coal plant as a unit of 160 MW X 5 capacity, as explained and justified in sections 3.8.4 and 3.9.3 of this report. Thus, all three alternatives are realistic.

- The power generation capacity added to the grid would comprise of thermal power plants as well as renewable power plants. Out of identified alternative two are thermal power plants and one is mix of thermal power as well as renewable power plant and hence they are credible alternatives.
- The alternatives are capable of providing base load power to the grid. Hence, the type of service provided by the alternatives is the same as that of the project activity. The outputs of both alternatives are similar to the project activity. The coal based power plant taken as an alternative is considered to have a capacity of 160 MW while the project activity has a capacity of 800 MW. However, the methodology permits the alternatives considered to have an output different from the project activity, further methodology AM0029 also allows, several smaller plants may be a reasonable alternative to the project activity as long as similar services are delivered. As the alternatives are capable of delivering base load power to the grid, the type of service delivered is the same as the project activity and meets the requirement of the methodology.
- The alternatives identified for baseline selection are available to stakeholders within the grid boundary which is also as per the methodology requirement.
- All relevant power plant technologies have been considered in the analysis and their efficiencies and technical lifetime are also included in the PDD.
- The alternatives selected are in compliance with legal and regulatory requirements in the host country.

The validation team therefore confirms that the selection and short listing of candidate baseline alternative scenarios is in line with the Step 1 of the AM 0029 methodology.

Step 2. Identify the economically most attractive baseline scenario alternative:

Step 2 of the methodology requires the identification of the economically most attractive scenario among the selected alternatives as the baseline scenario, by using investment analysis. The project participant has carried out the investment analysis in line with the guidance provided by the “Tool for the demonstration and assessment of additionality” version 06 /Ref-76/.

The project participant has demonstrated an investment comparison analysis. The validation team regards this as appropriate since the Step 2 requires the baseline identification to be done on the basis of the economically most attractive scenario and for that purpose a comparison will have to be made between three short listed alternatives i.e. (a), (c5) & (d) to determine which of these three is economically the more attractive option; hence, an investment comparison analysis is appropriate in this case.

The financial indicator chosen for the investment analysis is the levelized cost of electricity generation. The validation team accepts that this is an appropriate indicator for the purpose of the analysis as it gives the cost per unit of service delivered (i.e. kWh or unit of electricity produced) and is therefore as per the Sub-Step 2 (b) of the Additionality tool. PP has presented transparently the calculation of levelized cost in the form of spread sheets, which were validated by validation team using appointed external financial expert. The calculation demonstrates that

the "Power generation using coal as the energy source i.e. Alternative c5 is the most attractive scenario as the calculated Levelised cost is

Alternative No.	Baseline Scenario	Levelized Cost of generation (\$/MWh)	Source
(a)	Project activity implemented without the CDM	171.28	/Ref-08/
(c5)	Power generation using coal as the energy source	138.94	/Ref-08/

The Calculation was investigated for the sensitivity of various important parameters i.e. Heat Rate, Plant Load Factor, Fuel Cost and O&M Cost, which are the most sensitive factors for comparison. The sensitivity Range of +/- 10% is applied. This approach for sensitivity analysis is in compliance with EB 62 Annex 5 /Ref-85/. The Result of sensitivity shows that the alternative c5 is still the best option

S.N	Parameter varied	Levelized Cost of generation (\$/ kWh)			
		Project activity without CDM		Power generation using coal	
		+10%	-10%	+10%	-10%
1	Heat rate	203.58	142.06	149.17	128.71
2	Plant load factor	169.69	173.22	135.61	143.01
3	Fuel cost	186.66	155.90	149.17	128.71
4	Project cost	173.03	169.53	142.60	135.28
5	O&M cost	172.21	170.35	140.89	136.99

The Input values for the levelized electricity generation calculation were validated by validation team in accordance with VVS para 117 to 120 as below.

	<u>Alternative (a) Project activity without CDM</u>	<u>Alternative (c5) Power generation using Coal.</u>
Plant Installed Capacity	800 MW - The plant capacity is the installed capacity of the project, this value is confirmed by the validation team using EPC contract Dated, 12/01/2012, Amendment No. 11 and initial contract dated 22/01/2007. Initially as per EPC Contract the Capacity of the plant was 745 MW, however after GMR Energy taken over the Project from Island Power Company Pte. Ltd. The capacity of the plant was revised to 800 MW based on the review of design of the project equipment's, with Licensed capacity of 771 MW (Rated Capacity). Validation team has verified the revised documents Dated 08/12/2011, where it is clearly mentioned that turbines in earlier contract i.e. 10 m ² LP were changed to 12.5 M ² LP. Further Bank Mandate letter also found mentioning 771 MW as the Rated Capacity, validation team has confirmed the capacity by verifying the bank Mandate letter for the loan facility Dated. 03/06/2011 and found correctly applied.	800 MW – The plant capacity is the assumed capacity as there is only one coal based power plant in Singapore, which is under construction (Hypothetical value), the actual installed plant capacity of Tuas Power Plant is 160MW (licensed capacity 106MW) this was confirmed using publically available information and Generation license issued by EMA to Tuas Power.



Fuel Price	<p>21.29 S\$/MMBTU - Fuel cost is validated using Gas supply contract /Ref-15/ and the commodity price index on the world bank website and found that the price applicable is conservative and reflect correct representation of fluctuating price of Natural Gas. /Ref – 68/ This price is also found considered by the PP in the Financial Analysis/Ref-07/, and it is observed that the cost is approved by the Bank.</p>	<p>80 S\$/ton - Fuel cost is validated using Cost of coal taken to arrive at the levelized cost of electricity generation due to coal fired power plant is obtained from the report “Integrated Summary report for proposed Singapore LNG Terminal” by Energy Market Authority /Ref-25/, which is published on 7th august 2006. (Please refer Page 17 – http://www.ema.gov.sg/consultations/archive/2/id:93)</p> <p>PP has considered highest price for the coal as mentioned in the report i.e. US \$65/tonne (@ conversion rate of 1.2307 (Foot Note 37 in PDD), hence the coal cost is considered conservative.</p> <p>Further Validation Team verified the publically available information on internet to cross check the suitability of the cost. http://www.indexmundi.com/commodities/?commodity=coal-australian&months=60&currency=sgd /Ref-45/</p>
NCV Of Fuel used	<p>52.20 MMBTU/ton – The NCV Value is taken from the Design document i.e. Heat Flow diagram/Ref-19/and it is found that the value is 44170.6 kJ/Kg @ 25° Celsius. The value applied in the financial calculations and emission reduction calculations is in MMBTU/Ton, which is a converted value and the conversion is found correct. The applied value is further confirmed using IPCC Guidelines for National Green House Gas, which states that the NCV of Natural gas is 48.0 TJ/Gg and the range is 46.5(Lower Confidence Level) – 50.4 (upper Confidence level). Hence the applied value of NCV is found conservative.</p>	<p>25800000kJ/kWh – the Value is obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 2, Ch 1, Pg. 1.18 for other bituminous coal.</p>
Plant Heat Rate	<p>6190 KJ/kWh – Value is taken from the Design document i.e. Heat Flow diagram /Ref-19/, which is a design document and part of EPC Contract. This was further cross checked with an independent study carried out by KEMA, Appointed by EMA and presented the findings on Station Heat Rate in the report “Review of the LRMC costs of CCGT electricity generation in Singapore to establish the technical parameters for setting the Vesting Price for the period 1 January 2009 to 31 December 2010”. (10010665 Document 7 - Version 1.2)/Ref-60/. Report has presented the Range of Station heat Rate for the period 2009 – 2028 and the value applied by the PP is found conservative.</p>	<p>9196.64 KJ/kWh – The Plant Heat rate value is obtained from the CERC – (terms and conditions of tariff) Regulations – 2009 Pg. 46 (Heat rate is applicable for imported coal , hence applicable to any international site)/Ref-61/, This value is further cross checked with an independent study carried out by KEMA, Appointed by EMA and presented the findings on Station Heat Rate in the report “Review of the LRMC costs of CCGT electricity generation in Singapore to establish the technical parameters for setting the Vesting Price for the period 1 January 2009 to 31 December 2010”. (10010665 Document 7 - Version 1.2)/Ref-60/. Report has presented the Range of Station heat Rate for the period 2009 – 2028 and the value applied by the PP is found conservative.</p>
Quantity of Fuel	<p>32,913 billion BTU - Earlier PP has</p>	<p>1,799,405.16 ton – This is a calculated value</p>



VALIDATION REPORT

Required per Annum	considered 33,405 billion BTU - CAR 5 is raised to demonstrate transparently the calculation of gas consumption. In response to the CAR PP has revised Quantity of Gas consumption to 32,913 billion BTU , this is shown transparently calculated value and obtained from the Financial Analysis submitted to the Bank/ Ref-7/ .	based on the Annual Energy export considering capacity utilization of 72% and NCV Of Coal. This has been provided in the Financial Analysis Spread sheet /Ref-08/ . The formula used is also found correct.
Annual Capacity Utilization	72% - Annual capacity utilization if calculated value based on the average annual export in 30 years (From Financial Closure Model) / Ref-07/ . This is found in accordance with the licensed capacity approved by EMA for the Porject power plant /Ref-18/ and hence accepted.	72% - Annual capacity utilization if calculated value based on the average annual export in 30 years (From GMR Energy Singapore Financial Model) / Ref-08/ . This is found in accordance with the licensed capacity approved by EMA for the existing coal fired power plant under construction From EMA website and hence accepted.
Total Project Cost	1175 Million S\$ - Total Project cost is verified using EPC contract document where cost of project is mentioned. The project cost involves 70% of EPC cost + 14.5% Other cost components and regulatory fees + 6% Feasibility report + Financial Cost 9.5%, this was checked by the validation team physically through Board decision document /Ref-09/ . This was crosschecked using bank mandate letter where it is mentioned that Project equity is 505 Million S\$ and rest is the debt amount which accounts to 670 million S\$, hence it is confirmed that the total project cost is 1175 Million S\$.	2461.4 Million S\$ - This is obtained from the publically available source i.e. press release by the Singapore government. /Ref-69/ and this was further crosschecked with the ETSAP Data base on Coal Fired power plant © IEA ETSAP - Technology Brief E01 – April 2010 /Ref-48/ - www.etsap.org . (Refer to the CAR 06)
Annual O & M Cost	4% - At the time of validation, power plant is not in operation hence no record of Annual Operation and maintenance could be established and hence PP has obtained this value from the ETSAP Data base on Gas-Fired Power Plant © IEA ETSAP - Technology Brief E02 – April 2010/ Ref-49 - www.etsap.org . In absence of the factual data on the annual O&M cost for the proposed CCGT power plant, Validation team cross checked the estimated value by the PP in Financial Analysis using relevant third party publically available information in host country /Ref-79/ and other part of world /Ref-80/ . From /Ref-79/ which is available in host country it is observed that the research work presented on LCA of CCGT by the Nanyang Technical university, Singapore in 2004 states that the annual O&M cost is around 5.3% and from the /Ref-80/ it is confirmed that the annual O&M cost for other part of world is in the range of 3.6%. Hence Validation team concludes that the value considered by PP for Annual Maintenance cost is conservative and accepted.	4% - The Coal power plant considered by the PP as baseline alternative is still under construction and hence no real time data is available for financial analysis, hence PP has obtained 4% value from the ETSAP database on Coal Fired Power © IEA ETSAP - Technology Brief E01 – April 2010 /Ref-48/ - www.etsap.org . The Value is found conservative and hence accepted
Interest Rate	SIBOR+200 BPS – The rate of interest is given in the Bank Mandate /Ref-58/ and it is found that it is floating, as per Para 7 section 5 “Cost of Utilization” provided calculation of interest rate and it is found in accordance with SIBOR - Singapore Interbank Offered Rate.	SIBOR+200 BPS - The rate of interest is given in the Bank Mandate/ Ref-58/ and it is found that it is floating, as per Para 7 section 5 “Cost of Utilization” provided calculation of interest rate and it is found in accordance with SIBOR - Singapore Interbank Offered Rate. Bank has

	Bank has provided facility of Hedging and it observed that initial hedging is done for 1.4366 percent (SOR) using floating rate option as SGD-SOR-Reuters. During validation transaction reference was verified to confirm the hedging and this rate is applicable till 31/12/2012. This is found in accordance with the standard banking practice.	provided facility of Hedging and it observed that initial hedging is done for 1.4366 percent (SOR) using floating rate option as SGD-SOR-Reuters. During validation transaction reference was verified to confirm the hedging and this rate is applicable till 31/12/2012. This is found in accordance with the standard banking practice.
Inflation Rate	5.2% - inflation rate applied is taken from the publically available information from Department of Statistics of Singapore Government./Ref-59/ This rate is applicable for the year 2011 and the Department has updated the website on 25/01/2012 http://www.singstat.gov.sg/stats/keyind.html . The Applied Inflation rate found correct and applicable to the project activity as the investment Date is 15 th July 2011.	5.2% - inflation rate applied is taken from the publically available information from Department of Statistics of Singapore Government./Ref-59/ This rate is applicable for the year 2011 and the Department has updated the website on 25/01/2012 http://www.singstat.gov.sg/stats/keyind.html . The Applied Inflation rate found correct and applicable to the project activity as the investment Date is 15 th July 2011.
Discount Factor for Calculation of Levelized cost of Electricity Generation.	15.81 - Discount Factor for each year is calculated using Inflation rate 5.2%. The formula used for calculating the Discount Rate is $[1/(1+\text{Inflation Rate}) \times \text{Discount rate}]$ for previous year	15.81 - Discount Factor for each year is calculated using Inflation rate 5.2%. The formula used for calculating the Discount Rate is $[1/(1+\text{Inflation Rate}) \times \text{Discount rate}]$ for previous year
Depreciation Rate	3.6% - As per the Singapore tax structure any method of calculating Depreciation is acceptable, hence PP has selected Straight Line method for 25 years of Equipment life. The calculation of the Depreciation rate is done to achieve 10% of Salvage value at the end of 25 years, hence the Depreciation Rate presented is correct and acceptable.	3.6% - As per the Singapore tax structure any method of calculating Depreciation is acceptable, hence PP has selected Straight Line method for 25 years of Equipment life. The calculation of the Depreciation rate is done to achieve 10% of Salvage value at the end of 25 years, hence the Depreciation Rate presented is correct and acceptable.
Debt to Equity Ratio	57/43 – This is found in accordance with the Bank mandate letter /Ref –58/. Validation Team has verified the Equity share and it was observed that Base equity arranged by PP was 378 Million S\$ and subsequently 127 S\$ accounting to 505 S\$ which is 43% of the total Investment. From Equity contribution by PP it was observed that 70% of Equity is From GMR and 30% equity contribution is from Petronas.	57/43 – This is consider as same as that of Project activity for conservative purpose, hence acceptable.
Annual Coal Price Escalation	Not Applicable	PP has considered escalation in the coal price as 9.48% based on the price fluctuations since June 2001 to June 2011 i.e. 10 years available before investment decision from web based commodity price index i.e. Index Mundi Web site. This escalation is found realistic and conservative based on the current situation. The escalation in the coal price may be higher in coming years. The escalation in the coal price is acceptable.

From above validation it is confirmed that the approved baseline methodology has been correctly applied to identify a complete list of realistic and credible baseline scenarios, and the identified baseline scenario most reasonably represents what would occur in the absence of the proposed CDM project activity.

All the assumptions and data used by the PP are listed in the PDD and / or supporting documents. All documentation relevant for establishing the baseline scenario are correctly quoted and interpreted in the PDD. Assumptions and data used in the identification of the



baseline scenario are justified appropriately. Relevant national and /or sectoral policies and circumstances are considered and listed in the PDD **/Ref-02/**

The identified baseline scenario is also as per paragraph 86 of the VVS **/Ref-74/** and is the scenario that reasonably represents the anthropogenic emissions by sources of GHGs that would occur in the absence of the proposed CDM project activity.

Bureau Veritas Certification hereby confirms that:

- (a) All the assumptions and data used by the project participants are listed in the PDD, including their references and sources;
- (b) All documentation used is relevant for establishing the baseline scenario and correctly quoted and interpreted in the PDD;
- (c) Assumptions and data used in the identification of the baseline scenario are justified appropriately, supported by evidence and can be deemed reasonable;
- (d) Relevant national and/or sectoral policies and circumstances are considered and listed in the PDD;
- (e) The approved baseline methodology has been correctly applied to identify the most plausible baseline scenario and the identified baseline scenario reasonably represents what would occur in the absence of the proposed project activity.

3.8.4. Algorithms and/or Formulae used to determine Emission Reductions (99-100)

The steps taken and the equations and parameters applied in the PDD to calculate project emissions, baseline emissions, leakage and emission reductions comply with the requirements of the selected methodology including applicable tool(s).

The steps taken to assess the requirement outlined in paragraph 99 – 100 of the VVS **/Ref-74/** are described below:

The project participant has used the algorithms and formulae in accordance with the methodology applied viz. AM 0029 version 03 **/Ref-76/** and Tool to calculate emission factor for an electricity system. The detailed algorithms and/or formulae used in the calculations of baseline emissions, project emissions, leakage and emission reductions are explained in section B.6.1 of the PDD. The validation team confirms that the formulae have been applied correctly in line with the applied methodology AM 0029 Version 03.

Baseline emissions (BE_y):

The PP has calculated the baseline emissions by multiplying the electricity generated in the project plant (EG_{PJ,y}) with the baseline CO₂ emission factor (EF_{BL,CO2,y}) using Equation (2). This is as per the requirement of applied methodology AM0029 Version 03 for the calculation of baseline emissions. The project participant has considered the baseline CO₂ emission factor for the Singapore Power grid, the emission factor is published by the National environmental Agency (NEA). Also it is observed the same grid is the baseline grid as reported in section 3.6.3 above.



The AM 0029 methodology requires the project participant to calculate the baseline CO₂ emission factor as the lowest among three options:

Option I: The build margin (BM), calculated according to “Tool to calculate emission factor for an electricity system”.

The value of build margin emission factor has been taken directly by the Project Participant from the NEA Published Data Dated 20/04/2012, where emission factors for last seven years are provided i.e. since year 2005 to year 2011. The database is the only authentic information available in Singapore and Validation team has verified the calculations personally by visiting EMA office. PP has applied 0.4578 tCO₂/MWh. The validation team referred to the NEA database and verified that the value has been correctly taken.

Option II: The combined margin (CM), calculated according to “Tool to calculate emission factor for an electricity system”, using a 50/50 OM/BM weight. The project participant has used data from the NEA database Dated 20/04/2012 **/Ref-70/** to arrive at the value of the combined margin emission factor.

The combined margin emission factor is a weighted average of the Operating Margin (OM) and Build Margin (BM) emission factors. The build margin is directly specified by the NEA database for the year 2011 (i.e. the year in which the Investment Decision was taken by the PP and the same is applicable at the time of CDM-PDD submission to BVCH for validation). The operating margin is calculated as the simple average for the recent 3 years preceding the year in which the CDM-PDD was submitted to the BVCH for validation, i.e. 2009, 2010 & 2011.

The PP has calculated the combined margin from those values as a weighted average, applying 50/50 OM/BM weight, as prescribed by the methodology.

The value of CM calculated in the above manner was verified by the validation team and confirmed to be 0.4846 tCO₂e/MWh. The validation team confirms that the project participant has used the values of OM correctly from the NEA database Dated 20/04/2012 **/Ref-70/**.

Option III: The emission factor of the technology (and fuel) identified as the most likely baseline scenario under “Identification of the baseline scenario” Option III specified in the methodology requires the project participant to compute the emission factor for the technology and fuel identified for use in the baseline scenario. An assessment of the baseline scenario is presented in section 3.6.3. The baseline scenario, as validated by BVCH, is “the generation of power from a coal based thermal power plant”.

As mentioned above, the subcritical coal based power plant is most likely the baseline and its emission factor will always be higher than Singapore’s build margin reported above (as this is based on the last built NG based CCGT/s). Hence, option 3 is not being calculated by PP. Validation team has verified the history of Power generation in Singapore and it is understood that, the fuel mix used in the grid never comprise of the Coal as fuel and hence the emission factor for the grid is lesser as compare to other south east Asian countries i.e. Indonesia and Vietnam, where coal usage is significant. From the NEA Database on Emission Factor Dated 20/04/2012 it is observed that mainly the fuel mix consists of Natural Gas and smaller portion of Liquid fuel and waste derived fuel **/Ref-23 & 26/** & from NEA Data on Grid Emission factor **/Ref-70/**.

Based on the independent study by the validation team on energy generation history in Singapore, It accepted that if PP calculates the Emission factor for coal based power plant as



prescribed under Option III, it will be definitely higher than the existing emission factors published by NEA even after using conservative values from IPCC, this is due to the nature / characteristic of fossil fuel. It is a known fact that coal has the highest emission factor in the group of commonly used fossil fuel.

The expected electricity generation by the project activity, on the basis of the plant Capacity utilization (72%) and the plant capacity (800 MW) comes to 5,048,000 MWh. However, part of this generation would also be consumed by the plant itself for the running of auxiliary equipment of the plant (auxiliary consumption). This is assumed to be at 3.6% of the plant capacity (also justified in the table in section 3.7.3 of this report). The net generation by the project activity is therefore estimated as 4,865,010 MWh.

This is the electricity that the project activity would export to the grid for every year of its operation and corresponds to the parameter $EG_{PJ,y}$ of the methodology.

The capacity utilization values and auxiliary consumption have been validated by the validation team and justification of assessment is presented in section 3.7.3 of this report. With the estimated net generation ($EG_{PJ,y}$) of 4,865,010 MWh, the baseline emissions were calculated by the project participant using equation (2) of the methodology

$$BE_y = EG_{PJ,y} * EF_{BL,CO_2,y}$$

The baseline emissions are calculated as

$4,865,010 \text{ MWh} * 0.4578 \text{ tCO}_2/\text{MWh} = 2,227,202 \text{ tCO}_2 \text{ per year.}$

Project Emissions (PE_y)

The project activity involves the generation of power using natural gas as the fuel. As natural gas is a fossil fuel, its consumption in the project activity as a fuel will lead to CO₂ emissions that will also need to be accounted for as project emissions.

The project emissions are calculated as per equation (1) of the methodology

$$PE_y = \sum FC_{f,y} * COEF_{f,yf}$$

$FC_{f,y}$ denotes the quantity of natural gas that is combusted in the gas based power plant. This is in volumetric units (m³). The gas volume is considered in standard cubic meters (SCM) of volume. This measure corresponds to standard conditions of temperature (zero degrees Celsius) and absolute pressure (0.986atm), commonly abbreviated as STP conditions. The gas volume measured in terms of SCM is therefore independent of the actual conditions of gas flow that could vary from time to time.

The gas combusted in the project activity has been estimated at the time of Investment decision and the value presented in the Financial Analysis model is 32,913 billion BTU (829,408,155 M³). However PP has utilized the value 841,806,000 M³ of Natural Gas for calculation of Project emissions. As there is no clarity how PP has arrived at the Consumption of natural gas and there is difference between the quantities of natural gas, validation team has raised a CAR 12. PP has provided transparent calculation in the ER Spreadsheet and hence the CAR 12 was closed. The Project emission due to consumption of natural gas is calculated as 1,752,964 tCO₂/Year, using the equations (1) and (1a) of approved methodology AM0029.

Validation team herewith confirms that the calculation of project emissions is correct using relevant assumptions and hence found conservative.

Leakage (LE_y)

According to the AM0029 methodology, leakage emissions need to be taken into account to calculate the emission reductions. The leakage emissions are due to

a) Fugitive CH₄ emissions associated with fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of natural gas used in the project plant and fossil fuels used in the grid in the absence of the project activity [LE_{CH₄, y}] &

b) In the case LNG is used in the project plant: CO₂ emissions from fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression into a natural gas transmission or distribution system. [LE_{LNG,CO₂, y}]

The fugitive CH₄ emissions (LE_{CH₄, y}) are calculated net of those that would have occurred in the baseline scenario. This is allowed by the methodology as per the equation (5)

$$LE_{CH_4, y} = [FC_y \cdot NCV_y \cdot EF_{NG, upstream, CH_4} - EG_{PJ, y} \cdot EF_{BL, upstream, CH_4}] \cdot GWP_{CH_4}$$

Where

- FC_y : is the quantity of natural gas combusted in the project activity during year “y” and is estimated to be 32,913.02 Billion BTU/Year which is found obtained from the financial analysis model submitted to Bank for Loan Approval **/Ref-7/**. PP has converted the Billion BTU Gas consumption value to 829,408,155 M³/year, using conversion factor of 25200 (25.2 x 1000), this conversion factor is based on standard conversion 1 MMBtu = 25.2 m³ **/Ref-75/**. This is justified by providing detailed calculation presented in the ER Calculation spread sheet **/Ref-06/**
- EGP_{J, y} : is the electricity generation by the project Power plant in year “y” (in MWh). PP has considered 5,048,000 MWh. This was validated using installed capacity and the Generation License by EMA, Singapore.
- NCV : is the Net Calorific Value of Natural gas, PP has applied value of 52.20 MMBTU/Ton which is converted to 9000 Kcal/SCM while calculating leakage emission. The value applied found conservative and hence accepted.
- EF_{NG, upstream, CH₄} : The Value applied is 296 tCO₂/PJ. This value is applicable for other Oil exporting Countries/ Rest of World, and is found in accordance with the Table 2 provided in AM0029.
- EF_{BL, upstream, CH₄} : The Value applied is 0.00228 kg CH₄/kWh. This value is obtained from the published emission factors by the Host country DNA i.e. NEA. This is found in accordance with Option 1 of AM0029, PP has selected Build Margin option and the value calculated and published by Host Country DNA, i.e. NEA using correct equation, this was validated by visiting EMA Office to verify the approach independently by the Validation Team.
- GWP_{CH₄} : The value applied is 21 tCO₂e/tCH₄, which is a default IPCC value.
- LE_{LNG, CO₂, y} = FC_y x EF_{CO₂, upstream, LNG}
- LE_{LNG, CO₂, y} = Leakage emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system during the year y in t CO₂e
- FC_y = Quantity of natural gas combusted in the project plant during the year y in m³
- EF_{CO₂, upstream, LNG} = Emission factor for upstream CO₂ emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system. The default value mentioned in the baseline methodology 6 tCO₂/TJ will be used for this parameter in the project activity.



The calculated Leakage Emissions ($LE_{CH_4,y}$) value is -47,466 tCO₂/Annum. The calculation is provided transparently in the ER Spread sheet and as the value is negative, PP has considered leakage emissions as “Zero”. This is found in accordance with the Approved baseline methodology AM0029, page 10, where it is accepted if the total net leakage effects are negative ($LE_y < 0$), then it should be assumed as $LE_y = 0$.

Further PP has calculated emissions due to the upstream processing of LNG to convert it to Natural gas using the formulae provided in the approved Methodology AM0029, Version 3. This calculation is provided in the revised emission reduction calculation spread sheet in a transparent manner. PP has used default value of 6 tCO₂/TJ, as there is no specific emission factor found available in Host Country Singapore. This is found in accordance with the requirement of approved methodology *“Where reliable and accurate data on upstream CO₂ emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system is available, project participants should use this data to determine an average emission factor. Where such data is not available, project participants may assume a default value of 6 t CO₂/TJ as a rough approximation”*

The Ex ante calculated value of Leakage Emissions ($LE_{LNG,CO_2,y}$) due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system is 187,483 tCO₂e per annum. This is based on the Ex ante value of natural gas consumption during year.

Validation team observed that, in Singapore almost 80-85% of electricity generation is taken place using Natural gas as the Primary Fuel and hence the grid emission factor is lesser than any other country. Which is confirming the fact that upstream emission factor of natural gas is higher than that of the fugitive emission in the upstream due to consumption of natural gas for the project activity.

Emission reductions (ER_y)-

From the values of baseline emissions, project emissions and leakage emissions, the emission reductions are calculated using Equation (6) as given below

$$ER_y = BE_y - PE_y - LE_y$$

$$ER_y = 2,227,202 \text{ tCO}_2 / \text{Year} - 1,752,964 \text{ tCO}_2/\text{Year} - 187,483 \text{ tCO}_2/\text{Year}$$

$$ER_y = 286,755 \text{ tCO}_2\text{e}$$

The baseline emission estimate can be replicated using the data and parameter values provided in the PDD.

Based on the calculations and results presented in the sections above the implementation of the project activity will result in an average ex-ante estimation of emission reduction conservatively calculated to be 286,755 tCO₂e/Year for the selected crediting period.

The estimated annual average emission reduction over the 1st crediting period of 07 years represents a reasonable estimation using the assumptions considered by the project participant.



All the assumptions for this estimate either come from the assumptions used for investment analysis or based on official data sources in line with relevant EB guidelines. The assumptions used for investment analysis have been already validated in section 3.7.3 of this report. The validation team confirms that the estimates of baseline emissions can be replicated using the information provided. It also can be verified using the CER spreadsheet **/Ref-06/** for calculations of emission reductions.

Bureau Veritas Certification hereby confirms that:

- (a) All assumptions and data used by the project participants are listed in the PDD, including their references and sources;
- (b) All documentation used by project participants as the basis for assumptions and source of data is correctly quoted and interpreted in the PDD;
- (c) All values used in the PDD are considered reasonable in the context of the proposed project activity;
- (d) The baseline methodology and corresponding tool(s) have been applied correctly to calculate project emissions, baseline emissions, leakage and emission reductions;
- (e) All estimates of the baseline emissions can be replicated using the data and parameter values provided in the PDD.

3.9. Additionality (104)

As required by the selected methodology, the additionality of the Project has been demonstrated by applying EB 62 Annex 13 - Guidelines on the demonstration and assessment of prior consideration of the CDM (Version 04) and EB 69 Annex 20 - Methodological tool "Tool for the demonstration and assessment of additionality" (Version 06.1.0).

3.9.1. Prior consideration of the Clean Development Mechanism (112)

The timeline of the Project has been validated as in Table 3 below:

Table 3 Timeline of the Project

Date	Events	Reference
14/06/2011	Decision by Board of Director - Board considered CDM for the viability of project. This decision was found recorded in the Minutes of the meeting Dated 14/06/2011.	/Ref-09/
24/08/2011	Communication from EPC contractor for change in project specifications - Letter from PP to EPC contractor.	/Ref-71/
08/12/2011	CDM starting date - Approval of change to EPC design and revised EPC Contract signed by GMR with Samsung C&T Corporation and Siemens Pte. Ltd. for the installation	/Ref-10/



	of natural Gas Power Plant.	
09/03/2012	CDM prior consideration sent to UNFCCC and NCDMA.	CDM web site ⁴ and F-CDM-Form /Ref-12/ & /Ref-13/
19/07/2012	Public Notice inviting for Local stakeholders meeting.	Notice given in Strait Times
26/07/2012	Local stakeholders' meeting.	Minutes of the meeting /Ref-56/
01/01/2014	Expected commissioning of the project activity plant.	EPC schedule /Ref-14/

From the table above, the validation team is able to verify that the PP has identified project activity start date as 08/12/2011 in the PDD, however from the prior history of the project it was observed that the EPC contract was signed with Siemens and Samsung (EPC Consortium) on 29/06/2007, hence validation team has raised a clarification request CL09 to explain how the determined start date is correct. In response to CL09, PP explained that the project has changed hands, earlier the project owner was Island Power Company Pte. Ltd., and signed an EPC contract with Siemens and Samsung (EPC Consortium) on 29/06/2007 with a NTP Clause. Subsequently GMR Energy Pte. Ltd. took over Island power Company Pte. Ltd. on 19/05/2011, till that time there was no work executed through signed EPC Contract. On change of hand, PP reviewed the project design and at that time EPC Contractor came up with change in the specification of the project equipment i.e. Turbines. Based on the revised specification of turbine (keeping EPC contract amount unchanged) PP provided Notice to Proceed on 08/12/2011. Based on the response and subsequent verification of relevant evidences validation team closed CL09.

Earlier project owner Island Power Company Pte. Ltd. had entered into an EPC Contract agreement on 29/06/2007 Samsung C&T Corporation and Siemens Pte. Ltd. (Siemens Singapore) and Siemens Aktiengesellschaft (Siemens AG) for the proposed project activity /Ref-14/. A review of Clause 2.7 of the EPC Contract agreement (page 5 of 8) indicates that the project participant would issue a "Notice to proceed" to the EPC supplier and only then the supplier proceed with the further course of action. Hence this "Notice to proceed" can be seen as de facto permission by the project participant to start the commencement of work. The validation team noted that the EPC agreement in itself did not mandate a commitment or any intention of the project participant to release funds for commencement of work for the project activity.

The validation team verified the financial accounts of the project participant for the year 2010 /11 and observed that the first financial commitment of the project participant for the proposed project activity was only after reaching consensus on the Design specification change i.e. after 08/12/2011, on which Notice to proceed was issued to the Contractor to proceed with the supply and construction activities and hence PP considered this date as the start date of the project activity. Based on the evidences provided by PP to close CL09 i.e. Communication with EPC contractor on change in Project specifications and subsequent discussions and agreements

⁴ <https://cdm.unfccc.int/Projects/PriorCDM/notifications>



/Ref-10/, ACRA Registration Details for takeover of Island Power Company Pte. Ltd. **/Ref-72/**, EPC Contract documents (From amendment No 2 – to 11) **/Ref-14/**.

The validation team confirmed that notice to proceed was issued on 08/12/2011 from the original documents provided by the project participant. **/Ref-10/** and hence it is found appropriate and is the earliest of the dates at which either the implementation or construction or real action of the Project began. This is in accordance with the latest CDM glossary.

From the above validation of Start Date of project activity it is confirmed that the proposed project activity is with a start date after 2 August 2008, for which a PDD had not been published for global stakeholder consultation before the project activity start date. By referring to the list of prior consideration notifications from the UNFCCC website and communication between the project proponent, the secretariat (on 09/03/2012) and the host Party DNA (on 09/03/2012) regarding the commencement of a new project activity, the validation team confirms that the notifications have been provided by the project participants within 180 days of the project activity start date.

Bureau Veritas Certification hereby confirms that the proposed project activity complies with the requirements related to the prior consideration of the CDM.

3.9.2. Identification of Alternatives (116)

The plausible and credible alternatives to the Project were identified as per Approved Baseline Methodology AM0029 Version 03. As per methodology PP has to identify all possible realistic and credible alternatives that provide outputs or services comparable with the proposed CDM project activity (including the proposed project activity without CDM benefits), i.e., all type of power plants that could be constructed as alternative to the project activity within the grid boundary (as defined in "Tool to calculate emission factor for an electricity system").

Alternatives to be analysed should include, *inter alia*:

- The project activity not implemented as a CDM project;
- Power generation using natural gas, but technologies other than the project activity;
- Power generation technologies using energy sources other than natural gas;
- Import of electricity from connected grids, including the possibility of new interconnections.

In Accordance with the methodological requirement PP has identified credible alternatives and demonstrated how they are credible by providing detailed information in the PDD Section B.4. Validation team has verified the credibility of each identified alternative and provided validation comments in the section 3.8.3 of this report above.

The most plausible and credible baseline alternatives identified by PP are listed as below

1. The project activity i.e. 800MW NG Based Combined Cycle Power Plant with an efficiency of 58.16% and with a lifetime of 30 years, not implemented as a CDM project activity. (Alternative a)
2. Power generation using coal as the energy Source (Alternative c5)



3. Import of electricity from connected grids, including the possibility of new interconnections. (Alternative d)

Detailed assessment of the list of alternatives given in the PDD is provided in the Section 3.8.3 of this report above.

Bureau Veritas Certification considers the listed alternatives to be credible and complete.

3.9.3. Investment Analysis (123)

Analysis method

The Approved Baseline methodology AM0029 prescribes to demonstrate that the proposed CDM project activity is unlikely to be financially attractive by applying Sub-steps 2b (Option III: Apply benchmark analysis), Sub-step 2c (Calculation and comparison of financial indicators), and 2d (Sensitivity Analysis) of the latest version of the methodological tool "Tool for demonstration assessment and of additionality" (Version 06.1.0), EB 69 Annex 20.

In accordance with requirement of approved methodology PP has selected option III i.e. Benchmark analysis from the Additionality Tool, Version 06.1.0 and has used the levelised cost approach to analyze the identified alternatives to determine the baseline. With this approach, the levelised cost for each of the following alternatives was calculated:

Alternative 1 The project activity i.e. 800MW NG Based Combined Cycle Power Plant with an efficiency of 58.16% and with a lifetime of 30 years, not implemented as a CDM project activity. (Alternative a)

Alternative 2 Power generation using coal as the energy Source (Alternative c5)

There are two alternatives that remained in consideration for the determination of the baseline, as explained in section 3.8.3 above.

The levelised cost calculated for these two alternatives was based on assumptions of input parameters as detailed in the table below. The sources of information and means of cross-check used for each of the values are also provided in the right hand column of the table.

Further PP has chosen Equity IRR as the most appropriate financial indicator to demonstrate the financial Additionality of the Project activity. The Selection of Equity IRR is in Accordance with Guidance 12 of the EB 62, Annex 5, where it is mentioned that Required/expected returns on equity are appropriate benchmarks for equity IRR. The Proposed project activity has Debt to Equity ratio of 57:43, hence the choice of Equity IRR is acceptable.

Benchmark

There is no Benchmark determined by the PP to compare the financial indicator, hence validation team has raised CAR 07, in response to the CAR07, PP has revised PDD section B.5 and described how Benchmark is arrived, and hence the CAR closed.

The project participant has chosen default value for the expected return on equity as per the Annex A of EB 62 Annex 05. The default value selected by Project participant is 10.5% under Group 1 for host country Singapore. This value is classified under A3 category of Moody's Risk

Rating for bonds. As per the EB 62 Annex 5, the default value of 10.5% is in real term, PP has further added the inflation rate to this default value to commensurate the prevailing inflation rate of 5.20% in host country Singapore. Therefore the nominal Bench mark Value of 15.7% (10.5% {Default Value} + 5.20%{Inflation Rate}) is applied by the PP to compare the Equity IRR for the proposed project activity.

Hence the validation team was of the view that the expected return of 15.7% from the project was commensurate with the risk involved in the Group 1 project activity under sectoral Scope 1 particularly energy Industry which involves numerous uncertainties. Thus, the benchmark determined for the project activity (15.7%) was found in line with VVS Para 123 and EB 62 Annex 05.

The validation team considers that the type of benchmark applied is suitable for the type of financial indicator presented; the risk premiums applied in determining the benchmark reflect the risks associated with the project type OR activity; it is reasonable to assume that no investment would be made at a rate of return lower than the benchmark.

Data source

The project activity has changed hands; PP has taken over the project from previous owner Island Power Company Pte. Ltd. and at the time of change of hands, all input values are available to PP, in the form of EPC Contract. The formality of changeover was completed on 19/05/2011, and document pertaining to company registration was verified by the validation team **/Ref-72/**.

Based on the EPC contract, the PP decided to proceed with the Project on 14/07/2011 with the consideration of CDM revenues through boards decision **/Ref-09/**. As the EPC contract is already available, it is unlikely in the context of the underlying project activity that the input values would have materially changed.

Input value

The validation team has reviewed the Levelized Cost of Electricity Generation provided in a separate Spreadsheet. The LCOE analysis calculations were, cross-checked against the major input values using local knowledge as well as sectoral and financial expertise and confirm that:

<u>Input Parameter</u>	<u>Input Value</u>	<u>Validation Comment</u>
Plant Installed Capacity	800 MW	The plant capacity is the installed capacity of the project, this value is confirmed by the validation team using EPC contract Dated, 12/01/2012, Amendment No. 11 and initial contract dated 22/01/2007. Initially as per EPC Contract the Capacity of the plant was 745 MW, however after GMR Energy taken over the Project from Island Power Company Pte. Ltd. The capacity of the plant was revised to 800 MW based on the review of design of the project equipment's, with Licensed capacity of 771 MW (Rated Capacity). Validation team has verified the revised documents Dated 08/12/2011, where it is clearly mentioned that turbines in earlier contract i.e. 10 m ² LP were changed to 12.5 M ² LP. Further Bank Mandate letter also found mentioning 771 MW as the Rated Capacity, validation team has confirmed the capacity by verifying the bank Mandate letter for the loan facility Dated. 03/06/2011 and found correctly applied.
Fuel Price	21.29 S\$/MMBTU	Fuel cost is validated using Gas supply Contract Dated 15/03/2010 /Ref-15/ and the commodity price index on the world bank website and found that the price applicable is conservative and reflect correct



		representation of fluctuating price of Natural Gas. /Ref-69/ This price is also found considered by the PP in the Financial Analysis/Ref-7/, and it is observed that the cost is approved by the Bank.
NCV Of Fuel used	52.20 MMBTU/ton	The NCV Value is taken from the Design document i.e. Heat Flow diagram/Ref-19/and it is found that the value is 44170.6 kJ/Kg @ 25° Celsius . The value applied in the financial calculations and emission reduction calculations is in MMBTU/Ton, which is a converted value and the conversion is found correct. The applied value is further confirmed using IPCC Guidelines for National Green House Gas, which states that the NCV of Natural gas is 48.0 TJ/Gg and the range is 46.5(Lower Confidence Level) – 50.4 (upper Confidence level). Hence the applied value of NCV is found conservative. It is also observed that this value was available with PP at the time of financial decision taken by the Board of Directors and is an approved value by the Bank for financial calculation. The bank has approved the loan based on this value. Hence Validation team is of opinion that the NCV Value considered by PP is conservative while demonstrating the additionality.
Plant Heat Rate	6190 KJ/kWh	The Plant Heat rate value is obtained from the Heat Balance diagram/Ref-19/, which is a design document and part of EPC Contract. Hence this is available to PP at the time of Financial Decision. This was further cross checked with an independent study carried out by KEMA, Appointed by EMA and presented the findings on Station Heat Rate in the report "Review of the LRMC costs of CCGT electricity generation in Singapore to establish the technical parameters for setting the Vesting Price for the period 1 January 2009 to 31 December 2010". (10010665 Document 7 - Version 1.2)/Ref-60/.Report has presented the Range of Station heat Rate for the period 2009 – 2028 and the value applied by the PP is found conservative.
Quantity of Fuel Required per Annum	32,913 billion BTU	Earlier PP has considered 33,405 billion BTU - CAR 5 is raised to demonstrate transparently the calculation of gas consumption. In response to the CAR PP has revised Quantity of Gas consumption to 32,913 billion BTU , this is shown transparently calculated value and obtained from the Financial Analysis submitted to the Bank/Ref-7/.
Annual Capacity Utilization	72%	Annual capacity utilization if calculated value based on the average annual export in 30 years (From Financial Closure Model) /Ref-7/. This is found in accordance with the licensed capacity approved by EMA /Ref-17/ & /Ref-18/ and hence accepted.
Total Project Cost	1175 Million S\$	Total Project cost is verified using EPC contract document where cost of project is mentioned. The project cost involves 70% of EPC cost + 14.5% Other cost components and regulatory fees + 6% Feasibility report + Financial Cost 9.5%, this was checked by the validation team physically through Board decision document /Ref-9/. This was crosschecked using bank mandate letter where it is mentioned that Project equity is 505 Million S\$ and rest is the debt amount which accounts to 670 million S\$, hence it is confirmed that the total project cost is 1175 Million S\$.
Annual O & M Cost	4%	At the time of validation, power plant is not in operation hence no record of Annual Operation and maintenance could be established and hence PP has obtained this value from the ETSAP Data base on Gas-Fired Power Plant © IEA ETSAP - Technology Brief E02 – April 2010 - www.etsap.org . In absence of the factual data on the annual O&M cost for the proposed CCGT power plant, Validation team cross checked the estimated value by the PP in Financial Analysis using relevant third party publically available information in host country /Ref-79/ and other part of world /Ref-80/. From /Ref-79/ which is available in host country it is observed that the research work presented on LCA of CCGT by the Nanyang Technical university, Singapore in 2004 states that the annual O&M cost is around 5.3% and from the /Ref-80/ it is confirmed that the annual O&M cost for other part of world is in the range of 3.6%. Hence Validation team

		concludes that the value considered by PP for Annual Maintenance cost is conservative and accepted.
Interest Rate	SIBOR+200 BPS	The rate of interest is given in the Bank Mandate and it is found that it is floating, as per Para 7 section 5 "Cost of Utilization" provided calculation of interest rate and it is found in accordance with SIBOR - Singapore Interbank Offered Rate. Bank has provided facility of Hedging and it observed that initial hedging is done for 1.4366 percent (SOR) using floating rate option as SGD-SOR-Reuters. During validation transaction reference was verified to confirm the hedging and this rate is applicable till 31/12/2012. This is found in accordance with the standard banking practice.
Inflation Rate	5.2%	inflation rate applied is taken from the publically available information from Department of Statistics of Singapore Government. This rate is applicable for the year 2011 and the Department has updated the website on 25/01/2012 http://www.singstat.gov.sg/stats/keyind.html . The Applied Inflation rate found correct and applicable to the project activity as the investment Date is 15 th July 2011.
Discount Rate for Calculation of Levelized cost of Electricity Generation.	15.81	Discount Factor for each year is calculated using Inflation rate 5.2%. The formula used for calculating the Discount Rate is $[1/(1+\text{Inflation Rate})^{\text{Discount rate}}]$ for previous year
Depreciation Rate	3.0%	As per the Singapore tax structure any method of calculating Depreciation is acceptable, hence PP has selected Straight Line method for 30 years of Equipment life. The calculation of the Depreciation rate is done to achieve 10% of Salvage value at the end of 30 years, hence the Depreciation Rate presented is correct and acceptable.
Debt to Equity Ratio	57/43	This is found in accordance with the Bank mandate letter /Ref-58/ . Validation Team has verified the Equity share and it was observed that Base equity arranged by PP was 378 Million S\$ and subsequently 127 S\$ accounting to 505 S\$ which is 43% of the total Investment. From Equity contribution by PP it was observed that 70% of Equity is From GMR and 30% equity contribution is from Petronas.
Revenue - <u>Retail Revenue</u> Peak Period Shoulder Period Off Peak Period - <u>Uncontracted</u> Peak Period Shoulder Period Off Peak Period	295.4 S\$/MWh 179.6 S\$/MWh 175.6 S\$/MWh 296.4 S\$/MWh 180.8 S\$/MWh 176.6 S\$/MWh (Average Tariff for the crediting period)	As the Project power plant will be selling the electricity in open market on merchant basis, PP has considered the tariff based on past and current electricity tariff available with Energy Market Company. These tariffs are considered under two broad categories i.e. Retail and Uncontracted sale. The Average tariff for the peak period, shoulder period and off peak periods is validated by the Validation based on the past annual reports published by Energy Market Company of Singapore for year 2011 and 2010/ /Ref-89/& /Ref-90/ . Validation team also verified the current price index available on the Energy Market Company website /Ref-91/ and found that the electricity tariff considered for calculation in the Financial Closure Model /Ref-7/ , which was submitted to bank for loan approval is correct.

Indicator Calculation

Based on the input values from EPC Contract that are valid and applicable at the time of investment decision, the equity IRR of the Project without CDM revenues is 13.74%, lower than the benchmark, which shows that the Project is not financially attractive in the absence of CDM benefits.

The validation team has reviewed the IRR calculation spreadsheet **/Ref-08/** and confirms that the calculation and presentation are consistent with the "Guidelines on the assessment of investment analysis" version 05. The data sources as well as the analysis approach are reliable and in accordance with local accounting regulations or international best practice.

Sensitivity Analysis

The project participant has carried out a sensitivity analysis in order to determine whether small changes in the values of the input parameters were likely affect the overall result of the analysis. Paragraph 20 of the EB 62 Annex 05 guidance on investment analysis requires sensitivity analysis to be carried out for all variables that contribute to 20% of either total project costs or total project revenues. Accordingly, the sensitivity analysis carried out by the project participant has subjected the following variables to variation in the levelised cost analysis for both alternatives, viz., gas based power generation and coal based power generation :

1. Heat Rate
2. Plant Load Factor
3. Fuel Cost
4. Project Cost
5. O & M Cost

S.N	Parameter varied	Levelized Cost of generation (\$\$/ MWh)	
		Project activity without CDM	
		+10%	-10%
1	Heat Rate	203.58	142.06
2	Plant Load Factor	169.69	173.22
3	Fuel Cost	186.66	155.90
4	Project Cost	173.03	169.53
5	O&M Cost	172.21	170.35

Sensitivity analysis for equity IRR (Project without CDM):

S.N	Parameter varied	Equity IRR		Benchmark
		+10%	-10%	
0	Base case	13.74		15.70%
1	Plant load factor	15.80	11.57	
2	Fuel cost	13.63	13.87	
3	Project cost	12.91	14.71	

1) Heat Rate of the power plant:

For alternative-1 (gas based power generation), the station heat rate parameter used in the financial analysis was subjected to a variation of +/-10%. The validation team regards this range as appropriate since the Heat Rate determined by the PP is the designed value provided by the EPC Contractor and Turbine Manufacturer /Ref-14/. Heat Rate is the function which is inversely proportional to the efficiency of the Thermal Power Plant i.e if the Heat Rate is lower the plant efficiency is considered to be higher. The Heat rate considered by the PP was cross checked with the technical report published by Energy Market Authority (EMA), Singapore, where a detailed study on the heat rate is provided with an average yearly Heat Rate of 6879 BTU/KWh (7257.145 KJ/KWh) based on the estimated heat rate for period of 2009 – 2028. http://www.ema.gov.sg/media/files/vesting_contracts/10010665_CCGT_RMC_Calcs_Final.pdf

The levelised cost and project IRR values resulting from subjecting the Station Heat Rate to this range of variation are as follows:

Variation	LCOE – NG (\$\$/MWh)	Equity IRR (Without CDM)
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Heat Rate	10%	203.58	Not performed by PP as heat rate of a gas turbine is naturally degrading during life of plant and on account of lower than optimal load operations/ Ref-93 , the fuel consumption will go up and hence IRR will increase. Since, the heat rate cannot increase for a gas turbine technology after it is installed once, the heat rate reduction will not be realistic. As heat rate is directly proportional to the Gas consumption this is acceptable.
	-10%	142.06	

For alternative -2 (coal based power generation), the sensitivity was carried out over a range of +/-10% and is accepted by the validation team since it is as per the requirements in paragraph 21 of EB 62 Annex 05 which specifies the general range of variation that should be applied to parameters being subjected to the sensitivity analysis.

The corresponding values of levelised cost for alternative -2 are as follows:

	Variation	LCOE – Coal (S\$/MWh)
Heat Rate	10%	149.17
	-10%	128.71

2) Plant Load Factor:

This input parameter used in the financial analysis was subjected to a variation of +/- 10% in the case of alternative -1 (gas based power generation). The project activity plant will be commissioned and start its commercial operation in 2013. Hence, actual operational data from the plant after its commissioning is not available to the validation team. PP has arrived at the PLF Value of 72% is based on the Financial Model calculations which are submitted to Bank for Loan approval. The Calculation of Plant load Factor is based on the conservative estimate of the maintenance time and the plant availability. From the study published by the EMA /**Ref-73**/ the desired PLF for the F class CCGT Power plant is 74% for Singapore, hence Validation team found it conservative and is acceptable.

On +10% variations in PLF, the PLF becomes 79.2%, which is not feasible in Singapore, and this is confirmed from the report that the average Plant Load Factor Calculated for 20 years is estimated as 65.96% and hence EMA has recommended to utilize 74% Plant load factor as conservative. This ensures that the rise in PLF to 79.2% is not at all possible as the Singapore *electricity generation and supply is controlled by EMA*. Thus, likelihood of condition where PLF will increase by +10% is unlikely.

The validation team regards the range of variation of +/-10% for the PLF to be appropriate, as this range of variation is found conservative and it is not expected to exceed beyond +10%.

The levelised cost and project IRR values resulting from subjecting the PLF to this range of variation are as follows:

	Variation	LCOE – NG (S\$/MWh)	Equity IRR (Without CDM)
Plant Load Factor	10%	169.69	15.80%
	-10%	173.22	11.57%

For alternative -2 (coal based power generation), the sensitivity was carried out over a range of +/-10% and is accepted by the validation team since it is as per the requirements in paragraph

21 of EB 62 Annex 05 which specifies the general range of variation that should be applied to parameters being subjected to the sensitivity analysis. The corresponding value of levelised cost for alternative -2 are as follows:

	Variation	LCOE – Coal(\$\$/MWh)
Plant Load Factor	10%	135.61
	-10%	143.01

3) Fuel Cost:

The fuel cost (i.e. cost of natural gas) for the project activity in alternative -1 (gas based power generation) was confirmed Fuel cost is validated using Gas supply contract and the commodity price index on the world bank website and found that the price applicable is conservative and reflect correct representation of fluctuating price of Natural Gas. /Ref-68/. This price is also found considered by the PP in the Financial Analysis/Ref-07/, and it is observed that the cost is approved by the Bank.

The cost is the landed cost of the Natural Gas in Singapore, hence the price also includes transportation cost of LNG, Gasification and regasification at the SLNG Corporation premises. While Singapore's electricity is mainly generated from imported natural gas, the prices of natural gas (which are determined by commercial contracts) are indexed to fuel oil prices. This is the market practice in Asia for natural gas contracts. Hence, if the prices of fuel oil increase by 10%, natural gas prices would also increase by 10%. Hence, the validation team accepted the range of variation of +/-10% for this parameter. The levelised cost is therefore very conservative as the actual cost of gas is based on the world price index. The levelised cost computed for this range of variation of the fuel cost is as follows:

	Variation	LCOE – NG (\$\$/MWh)	Equity IRR (Without CDM)
Fuel Cost	10%	186.66	13.63%
	-10%	155.90	13.87%

The fuel cost (i.e. cost of coal) was also subjected to a +10%/-10% range of variation in the sensitivity analysis for alternative-2 (coal based power generation). The prices of coal are administered and controlled by the Government of India's Ministry of Coal. Hence, a rise in coal prices beyond this range is not a likely scenario and hence the range of variation (+/-10%) is accepted as appropriate by the validation team. The range of variation is also in line with paragraph 21 of the EB 62 Annex 05 guidance on investment analysis.

The corresponding value of levelised cost for alternative -2 are as follows:

	Variation	LCOE – Coal (\$\$/MWh)
Fuel Cost	10%	149.17
	-10%	128.71

4) Total project cost:

The total project cost assumed in the financial analysis for levelised cost is based on the information available at the time of the decision.

Hence, it is appropriate to subject this parameter to sensitivity analysis. In the case of the project activity, the validation team noted that actual cost incurred for implementing The actual project cost, stated in EPC Contract and Bank Mandate Letter on Loan approval, there will not be any change in the project Cost anticipated at this point of project implementation. Hence Validation Team accepts the applied variation of +/- 10% for this parameter.

With this range of variation, the levelised cost of power produced (For alternative 1-Gas based power generation) was worked out to the following:

	Variation	LCOE – NG (S\$/MWh)	Equity IRR (Without CDM)
Total Project Cost	10%	173.03	12.91%
	-10%	169.53	14.71%

For the baseline alternative 2 (i.e. coal based power generation), the sensitivity was carried out over a range of +/- 10% and is accepted as appropriate by the validation team because it is as per the requirements in paragraph 21 of EB 62 Annex 05 which specifies the general range of variation that should be applied to parameters being subjected to the sensitivity analysis.

The levelised cost of generation in case of alternative -2 works out as below for the range of variation of +/-10%.

	Variation	LCOE – Coal (S\$/MWh)
Total Project Cost	10%	142.60
	-10%	135.28

5) O & M cost:

The proposed power plant has not yet started its commercial operation and the O&M cost is an estimated cost which PP has obtained this value from the ETSAP Data base on Gas-Fired Power Plant © IEA ETSAP - Technology Brief E02 – April 2010 - www.etsap.org.

The value is found conservative and hence accepted.

The validation team observed that the O&M expenses stated in the agreement come to 4 % of the total project cost, on an average basis, hence the sensitivity is not impacting much on the Calculation of LCOE for proposed project activity.

The resulting values of levelised cost of generation and project IRR for the both the alternatives are as follows:

	Variation	LCOE – NG (S\$/MWh)	Equity IRR (Without CDM)
O&M Cost	10%	172.21	Not performed by PP as the total cost considered by PP for the O&M is 4% of the total investment cost hence this has no impact on the IRR. This is found in accordance with Guidance 20 under Section VI of EB 62 Annex 5.
	-10%	170.35	

The corresponding value of levelised cost for alternative -2 is as follows:

	Variation	LCOE – Coal (S\$/KWh)
O&M Cost	10%	140.89
	-10%	136.99

The results of the sensitivity analysis performed on various parameters as described above indicate that for the range of variations of these parameters,

- the levelised cost of generation of coal based power generation continues to be lower than that of gas based power generation even with the range of variations applied in the sensitivity analysis
- ✓ the baseline alternative to the project activity is a coal based power plant of capacity 800 MW as stated in the PDD
- ✓ the Step 1 of the applied methodology AM0029 ver. 03, combined with the Tool for the demonstration and assessment of additionality EB 65 Annex 21, regarding the assessment of additionality is fulfilled.

BVCH, based on the assessment result by the financial expert engaged, hereby confirms that the underlying assumptions are appropriate and the financial calculations are correct.

3.9.4. Barrier Analysis (127)

The PP has not used the barrier analysis to demonstrate the additionality of the Project. Hence the Barrier Analysis is not applicable for the proposed project activity.

The validation team confirms that issues that have a direct impact on the financial returns of the project activity are not considered barriers and have been assessed by investment analysis, and the detailed validation of Investment analysis is provided in 3.9.3 section of this report above.

3.9.5. Common Practice Analysis (130)

The boundary for the common practice analysis is Country level, i.e. Singapore. The proposed project activity will be supplying energy to the Singapore Grid and hence all power plants operating in Singapore are under the coverage of the boundary.

PP has demonstrated the Common Practice Analysis in the PDD section B.5. As per the requirement of EB 69 Annex 8, Step 1 PP has calculated the applicable output range using limiting factor of +/- 50% of the design output or capacity of the proposed project activity. From the PD it was observed that the proposed project activity capacity is 800 MW and hence the range for common practice analysis is 400 MW (-50%) – 1200 MW (+50%). And PP has identified all similar projects i.e Power only plants using Combined Cycle technology for the Common Practice.

PP has identified totally 05 (Five) projects, which are commercially operating in Singapore and the List of these power plants with capacity is provided as given below

Sr.No.	Power Plant	Capacity	Validation Opinion
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1.	YTL Power Seraya Pte. Ltd.	1472*	<p>Power Seraya has overall Licensed Capacity of 3100 MW</p> <ol style="list-style-type: none"> 6 X 250 MW steam plants running on Heavy Fuel Oil (Excluded) 2 X 370 MW Combined Cycle Power Plants running on Natural Gas (Excluded) For being web hosted for CDM (https://cdm.unfccc.int/Projects/Validation/DB/SGP0QXF901ZSA7UYRDJB0LSIJ88JB3/view.html) 2 X 105 MW Open Cycle Gas Turbines running on Diesel (Excluded) 2 X 400 MW Co-Generation Combined Cycle Power Plant (Excluded) <p>This information is available on company website http://www.ytlpowerseraya.com/index.php?option=com_content&task=view&id=40&Itemid=13 and this was further crosschecked using License No. EMA/GE/ 016 – Schedule A (Effective Date 08 Feb 2012 (Revised))</p>
2.	Senoko Energy Pte Ltd	2807*	<p>Senoko Power plant has overall Licensed Capacity of 3300 MW Capacity which includes Open cycle gas turbine power plant of 105 MW. Senoko Power plant is having three Power plants of Various capacities</p> <ol style="list-style-type: none"> 2 x 250 MW Steam Thermal Plant (Excluded) <u>2 X 425 MW Combined-Cycle Plant (Included)</u> <u>3 X 365MW Combined-Cycle Plant (converted from Stage I oil-fired steam plant) (Included)</u> <u>2 X 431 MW Combined-Cycle Plant(Included)</u> 2 X 250 MW Gas Turbine (Excluded) <p>This was validated using Licence No. EMA/GE/012 – Schedule A (Revised on 07 August 2012) available publically on the EMA web site.</p>
3.	Tuas Power Generation Pte. Ltd.	1470*	<p>Tuas Power Generation Pte. Ltd. Power has total Licensed plant capacity is 1470 MW, with 04 Turbine units in operation. However out of these 04 units two units of 367.5 MW capacity were installed in October 1999, and hence these two units are not included in the analysis due to the significant difference from capital cost, Government policy shifts, competitive tariff policy etc. as the these two units were installed 10 years before the start date of the project activity.</p> <p>The remaining two CCGTs construction had started in October 2001 and hence these two units with total Power generation capacity of 735 MW is considered for the common practice analysis, this is found correct.</p> <ol style="list-style-type: none"> 2 x 367.5 MW CCGT Plant installed in October 1999 (Excluded) <u>2 X 367.5 MW Combined-Cycle Plant (Included)</u> <p>Total capacity of 735 MW with two CCGT units of 367.5 MW Tuas Power Plant is qualifying the Capacity Range i.e.</p>

			<p>400MW-1200MW identified by PP as per The EB 69 Annex 8. This is confirmed using Company web site http://www.tuaspower.com.sg/ourbusiness/index.html and the generation licences from EMA Web site. Hence the inclusion of this power plant in the common Practice analysis is justified.</p> <p>This is verified from the Tuas Power License No – EMA/GE/009 – Schedule A(Effective on Oct 2012 (Revised)) available publically on the EMA Website.</p>
4.	SembCorp Cogen Ptd Ltd	785	<p>Sembcorp Cogeneration Plant is supplying steam as well as power to the industrial consumers and Grid, hence this plant is not considered as similar to the Proposed project activity and therefore excluded from the common practice analysis.</p> <p>This is verified from the Keppel Merlimau Cogen Plant License No – EMA/GE/004 – Schedule A(Effective on 22nd November 2011(Revised)) available publically on the EMA Website.</p>
5.	Keppel Merlimau Cogen Pte. Ltd.	500	<p>Keppel Marlimau Cogeneration Plant is supplying steam as well as power to the industrial consumers and Grid, hence this plant is not considered as similar to the Proposed project activity and therefore excluded from the common practice analysis.</p> <p>This is verified from the Keppel Merlimau Cogen Plant License No – EMA/GE/006 – Schedule A(Effective on 24th June 2011(Revised)) available publically on the EMA Website.</p>

*Actual total Installed Capacity of Power only Plants.

Validation team has crosschecked the information using EMA web site <http://www.ema.gov.sg/page/115/id:129/>, where Licenses and Exemption orders are made publically available against each Power generation plant in Singapore and it is confirmed that the information provided by PP in the PDD is real and credible.

Validation Team confirms that PP has applied analysis method correctly and outcome of this analysis is provided as below.

Calculation of Factor F:

PP has consider $N_{diff} = 2$ and $N_{all} = 4$, refer above Table where it is clearly shown that 01 Project from Tuas Power Generation Pte. Ltd. and 03 projects from Senoko Energy Pte Ltd are identified as similar type of projects as the proposed project activity and have started commercial operations before start date of the project activity.

Other Projects are excluded from the analysis as they are not of similar technology, this is found In accordance with Para 47, Step 2 of the applied “Tool for the demonstration and assessment of additionality” Version 06.1.0 /Ref-83/. Hence by applying the prescribed formula $1 - N_{diff} / N_{all}$ to this situation, the outcome is **0.5**, which is **NOT** complying with the criteria (a) i.e. factor should be lower than 0.2 as per Para 47, Step 4 of the applied Tool /Ref-83/.

Calculation of Difference between Technologies ($N_{all} - N_{diff}$):

As mentioned above $N_{diff} = 2$ and $N_{all} = 4$, which is validated by the Validation team based on publically available evidences listed in above Table. The outcome of this step is 2, which is lesser than the established criteria (b) i.e. the difference should not be greater than 3 as per Para 47, step 4 of the applied tool /Ref-78/.

The project activity fulfills Criteria (b) established by the applied tool and hence validation team concludes that the project activity is not a common practice in the host country Singapore.

In conclusion, as demonstrated in accordance with "Tool for the demonstration and assessment of additionality" Version 06.1.0 /REF-78/ The proposed CDM project activity is additional.

Bureau Veritas Certification hereby confirms that the proposed CDM project activity is not common practice.

In conclusion, as demonstrated in accordance with the latest version of the methodological tool "Tool for demonstration assessment and of additionality" (Version 06.1.0), EB 69 Annex 20, the proposed CDM project activity is additional.

3.10. Monitoring Plan (133)

The Project uses the approved baseline methodology AM0029 Version 03. Applicability of this methodology is justified in PDD Section B.2. As per the methodology the project activity is applicable if it fulfills all three Applicable conditions and amongst them important one is "The project activity is the construction and operation of a new natural gas fired grid-connected electricity generation plant". Referring to the discussions on the applicability of the methodology in section 3.8.1 above, the validation team considers that the selected monitoring methodology is applicable to the Project.

Data and Parameters Monitored (Ex Ante)

Data Parameter	Unit	Description	Applicability
EF _{electricity,y}	tCO ₂ /MWh	The combined margin emission factor of Singapore national grid	Calculated as the weighted average of the build margin emission factor and operating margin emission factor (with 50/50 weights to OM and BM), using OM and BM values from NEA published Data on Grid Emission Factor for Singapore Grid Dated 20/04/2012. PP has applied 0.4846 tCO ₂ /MWh value for calculating baseline emissions. Validation team confirms that the value is the Conservative value and is applicable for Ex Ante calculations.
EF _{BM,y}	tCO ₂ /MWh	The Build Margin emission factor of Singapore national grid	PP has applied the most recent value of Build Margin published by NEA for the Singapore Grid Dtd. 20/04/2012. PP has applied 0.4578 tCO ₂ /MWh as BM. The value applied is found conservative and is applicable for Ex Ante Calculations of Baseline emissions.

Data Parameter	Unit	Description	Applicability
$EF_{OM,y}$	tCO ₂ /MWh	The Operating Margin emission factor of Southern grid	Calculated Average of Operating Margins for Year 2009, 2010 & 2011. PP has used Published OM values by NEA for last three years and applied 0.5114 tCO ₂ /MWh. Values of Operating Margin were published by NEA for the Singapore Grid Dated. 20/04/2012. The applied value is found conservative and is applicable for Ex Ante Calculations of Baseline emissions.
$EF_{NG, Upstream, CH_4}$	t CH ₄ /PJ	Emission factor for upstream fugitive methane emissions of natural gas from production, transportation, distribution, and, in the case of LNG, liquefaction, transportation, re-gasification and compression into a transmission or distribution system, in tCH ₄ per GJ fuel supplied to final consumers.	PP has applied value of 56,100 t CH ₄ /PJ value for calculating Project emission due to usage of natural gas in project scenario. This value is sourced from Table 1.4, Chapter 1, Volume 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, as there is no country specific data is available. The application of this value is found appropriate.
$EF_{BL, Upstream, CH_4}$	t CH ₄ /MWh	Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in terms of ton of methane per MWh	PP has applied 0.00228 t CH ₄ /MWh and the value is sourced from the NEA's 'Information on emission factors (for CDM projects in Singapore)', published 20/04/2012. This value is applied to calculate project emissions.
$EF_{CO_2, FF, y}$	kgCO ₂ e/TJ	Emission Factor of diesel	PP has applied default value of 74,100 kgCO ₂ e/TJ, in case auxiliary fuel will be used during Project Scenario. This is value will be applied Ex Post as there is no consumption of Auxiliary fuel is considered while calculating Project emissions. The Auxiliary fuel will be used only in emergency situations, hence it is found acceptable.

Data and Parameters Monitored (Ex Post)

Data Parameter	Unit	Description	Applicability
$FC_{NG,y}$	m3	Quantity of NG consumed in the project activity in year y	PP has applied Value of 829,408,155 m3 per year. This is obtained from Financial closure model, "Rev" sheet, cell O109+P109. Where the Gas consumption is given as 33405 billion BTU, which is converted to m3 using standard conversion. The Value is applied for Ex Ante determination of Project Emissions, however this parameter will be monitored Ex Post on continuous basis using Calibrated Gas meters. CL/CAR for Accuracy class and calibration frequency, in response to CAR / CL PP has revised the Monitoring plan in Section B.7.1 to update accuracy Class and calibration frequency based on the technical specifications provided by the EPC contractor for Gas meters. Validation Team Verified supporting evidences and found satisfactory and hence the Car/ CL is closed.

Data Parameter	Unit	Description	Applicability
EG _{Export,y}	MWh	Net electricity exported by the project plant in year y	This is a calculated value and PP has calculated 50,45,760 MWh electricity to be exported by the Project power plant in a year to the Singapore Grid. This is calculated Ex Ante, however the quantity of electricity generated and to be exported to the grid shall be monitored Ex Post using bidirectional electricity meters, and these meters will be calibrated to the desired accuracy level. PP has identified the Accuracy level of 0.2s with an annual frequency. The applied Ex ante value is found conservative based on the validation of Project equipment specifications and found conservative and hence it is accepted. PP has utilized correct formulae to calculate this ex ante value.
NCV _{NG,y}	GJ/m ³	Net Calorific Value of Natural Gas	PP has applied value of 0.0377 GJ/m ³ for calculating the project emission in the PDD and Excel spreadsheet. This value is the assumed value based on the specifications provided by GAIL India /Ref-88/. This value was cross checked with the latest Gas Supply Code /Ref-95/ issued by Energy Market Authority in Singapore and found matching, hence accepted. PP has applied lower range, which is found conservative while calculating Project emissions. PP has applied 52.67 MMBTU/Ton as Natural gas NCV in PDD Section B.5 to demonstrate financial Additionality which is also found conservative as it is an upper range and approved by the Bank for financial calculations. Although PP has utilized 0.0377 GJ/m ³ value as NCV at the time of validation, but this parameter shall be monitored during crediting period (Ex-post). The monitoring of this parameter will be done using gas suppliers bills, this is found acceptable by the approved methodology and hence accepted. However PP has made a provision of gas monitoring station for cross checking bill quantities at the inlet point of PP's Project Boundary. This facility will later be under the control of Gas supplier hence this facility is excluded from the monitoring of the NCV _{NG,y} . Validation team has verified the technical specification of Gas monitoring station at the time of Validation. (Please refer CL-18).
COEF _{NG,y}	tCO ₂ /m ³	CO ₂ emission coefficient	PP has applied 0.0023 tCO ₂ /m ³ value, which is a calculated value using Eq 2 of AM0029 Version 3. This value is calculated using input values as given below 1) Net Calorific Value of gas (NCV y): 10,000 kcal/ m ³ 2) CO ₂ emission factor (EF CO _{2,f,y}): 0.0561 t CO ₂ /GJ 3) Oxidation factor of gas (OXID f): 1 Calculated value will be used for Ex ante calculation, however PP will monitor this value Ex post using equation No. 2 and NCV of natural gas. This is found in accordance with requirement of Methodology and hence acceptable.
EF _{CO₂,NG,y}	kgCO ₂ e/TJ	Emission Factor of Natural Gas	PP has applied value of 56,100 kgCO ₂ e/TJ, which is a IPCC default value and obtained from Table 1.4, Chapter 1, Volume 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, hence found conservative. This is used Ex ante and will be used Ex post for calculating Project emissions.

Data Parameter	Unit	Description	Applicability
OXID _{NG}	Unit less factor	Oxidation Factor of NG	PP has applied 1 as the unit less value for calculating Project emissions. This value is obtained from IPCC and latest available report (IPCC Guidelines for National Greenhouse Gas Inventories). Which is found acceptable
PE _y	tCO ₂	Project emission due to combustion of fuel	PP has applied ex ante value of 1,752,964 tCO ₂ , which is a calculated value using Eq (1) & (1a). PP has presented calculation of Project emission in the PDD as well as in the emission Reduction Spread sheet. Validation team found the calculation correct and hence it is acceptable. The Parameter will be monitor ex post using same equations as mentioned above.
EF _{CO₂,upstream,LNG}	tCO ₂ /TJ	Emission factor for upstream CO ₂ emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, regasification and compression of LNG into a natural gas transmission or distribution system	PP has Applied Ex Ante Default value of 6 tCO ₂ /TJ to calculate upstream leakage emissions due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, regasification and compression of LNG into Natural gas transmission or distribution system .
LE _{LNG,CO₂,y}	tCO ₂	Leakage emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, regasification and compression of LNG into a natural gas transmission or distribution system during the year y in t CO ₂ e	<p>PP has calculated leakage emissions using correct formulae provided by Approved Methodology AM0029, Version 3 i.e. $LE_{LNG,CO_2,y} = FC_y \times EF_{CO_2,upstream,LNG}$.</p> <p>PP has used Gas consumption quantity 829,408,155 m³ per year and Calorific Value of natural gas i.e 9000 kcal /M³ and Default emission factor of 6 tCO₂/TJ.</p> <p>The Calculation is found correct.</p>

The validation team considers that the description of the monitoring plan contains all necessary parameters, that they are described and that the means of monitoring described in the plan complies with the requirements of the methodology including applicable tool(s).

Implementation of the Monitoring Plan

PP has defined an adequate monitoring plan and required resources to monitor all relevant project parameters. The project team has been entrusted with the responsibility of storing, recording the data related to the project activity. The project team is also responsible for calculation of actual creditable emission reduction in the most transparent and relevant manner. Installed meters are calibrated according to the maintenance schedule programmed at the start of the operation and recalibrated according the plants performance requirement.



All the monitoring data will be stored, recorded and kept under safe custody of the Plant Manager at the plant site for a period of crediting period or the last issuance whoever later + 2 years. The data will be achieved in both hard copies and electronic format (excel sheets). Also, any change within the project boundary, such as change in spare and or equipments will be recorded and any change in the emission reduction due to such alteration will also be studied and recorded.

PP has provided adequate infrastructure i.e. Electricity Meters, gas meters etc. to monitor important parameters. From the PDD description it was also noticed that PP has made an emergency plan ready to avoid potential error in the Monitoring of parameters by keeping back up meters.

The project activity will be using Diesel as a backup fuel / auxiliary fuel, and it will be used only in case of emergency i.e. No supply of Natural gas. PP has made adequate arrangements in the monitoring plan to ensure that emergency situations where Diesel is used for power generation are captured and diesel consumption is recorded.

Monitoring of sustainable development indicators is not required for such Projects in host country Singapore, however it is required to maintain compliance to relevant Environmental Regulations during the operation phase of proposed power plant. Presently it was confirmed that PP is complying with all relevant Environmental Regulations of host country.

The validation team considers that the means of implementation of the monitoring plan, including the data management and quality assurance and quality control procedures, are sufficient to ensure that the emission reductions achieved by/resulting from the proposed project activity can be reported ex post and verified.

Bureau Veritas Certification hereby confirms that the monitoring plan complies with the requirements of the methodology including applicable tool(s), the monitoring arrangements described in the monitoring plan are feasible within the project design and the project participants are able to implement the described monitoring plan.

3.11. Environmental Impacts (137)

The project participants conducted an analysis of the environmental impacts of the proposed project activity, including trans boundary impacts by appointing a third party agency Environmental Resources Management (S) Pte. Ltd. A complete EIA was carried on in the month of October 2010, to ascertain the impacts due to implementation of the proposed project in host country Singapore. This is found in accordance with local Environmental Regulation.

The project is implemented in Jurong Island, which is considered as an exclusive industrial area of Singapore. The Environmental impacts due to implementation of the proposed project will not be affecting any residential or environmentally sensitive area i.e. wild life sanctuary, natural forest or any water body. All impacts identified are local and are mainly pertaining to construction phase. There is no significant impact identified during the Study and the same is found approved by the local environmental Authority i.e. NEA.

PP has implemented all relevant Environmental Mitigation Plans, to ensure that Identified impacts are controlled and mitigated. Controls established are found effective and there is no



violation observed so far. During site visit Validation team verified approvals obtained by the PP for implementing the Project Activity from Local Environmental Agency i.e. NEA and these approvals are found valid. Details of approvals are given as below

1. Ref No. NEA/EP/PDD/05 -10443(A44860-6290/R0) Dated 09/06/2005 for Allocation of Land based on the Pollution control Study submitted to NEA.
2. Ref No, NEA/EP/PDD/05 -10443 Dated 24/05/2011 on the basis of EIA Report submission

Bureau Veritas Certification hereby confirms that the project participants have undertaken an analysis of environmental impacts and an environmental impact assessment in accordance with procedures as required by the host Party.

3.12. Local Stakeholder Consultation (140)

The project participants have completed a local stakeholder consultation process and that due steps were taken to engage stakeholders and solicit comments for the proposed project activity. As mentioned above the project power plant is implemented on an exclusive Industrial Island of host country Singapore and hence the stake holders identified by the PP are mainly neighboring industries on Jurong Island, local residents in Singapore, representatives of local government authorities from electricity distribution, pollution control departments etc.

PP has published an advertisement in a local by newspaper (The Straits Times) on 19/07/2012 for inviting all relevant stakeholders. In response to this advertisement totally 19 participants attended the stake holder consultation meeting on 26/07/2012. Validation team has verified the attendance list and the comments received from the participants. There were few comments received during this consultation and PP has taken due account of those received comments and addressed them appropriately. During Stake holders consultation process there was no adverse comment received.

Validation team interview two participants independently to understand their views on the implementation of project. During personal interview with these two stakeholders Validation team did not come across any negative feedback or any major concern.

Bureau Veritas Certification hereby confirms that comments that are relevant for the proposed project activity have been invited from local stakeholders, the summary of the comments received as provided in the PDD is complete, the project participants have taken due account of all comments received and have described this process in the PDD.

4. COMMENTS BY PARTIES, STAKEHOLDERS AND NGOS

The PDD using approved baseline methodology for **Grid Connected Electricity Generation Plants using Natural Gas**, Version 03 was webhosted on the UNFCCC for global stakeholders comments as per CDM requirements. The project was webhosted from 12/09/2012 to 11/10/2012.

Comments were received from 01 person. The project participant provided response to these comments. The validation team took due account of these comments and the respective responses while making the validation opinion. The details of the comments received,



responses by the project participants and the explanation of how due account of these is taken by the validation team are attached as Appendix B with this validation report.

5. VALIDATION OPINION

Bureau Veritas Certification has performed a validation of the Grid connected electricity generation plant using natural gas at Jurong Island in Singapore, which is located in LOT 01962A PT MK 34, Seraya Place, Jurong Island, Singapore 627867.. The validation was performed on the basis of UNFCCC criteria for the CDM, and host country criteria, as well as criteria given to provide for consistent project operations, monitoring and reporting.

The validation consisted of the following three phases: i) desk review of the project design document and additional background documents; ii) follow-up interviews with project stakeholders; iii) resolution of outstanding issues and the issuance of the final validation report and opinion.

The project correctly applies the approved consolidated baseline and monitoring methodology AM0029 Version 03 and uses the latest Methodological tool "Tool for the demonstration and assessment of additionality" (Version 06.1.0), EB 69 Annex 20 for demonstration of the additionality.

By implementation of proposed new natural gas fired grid-connected electricity generation plant, the project is likely to result in reductions of GHG emissions that are real, measurable and give long-term benefits to the mitigation of climate change. It is demonstrated that the project is not a likely baseline scenario. Emission reductions attributable to the project are hence additional to any that would occur in the absence of the project activity.

Given that the project is implemented and maintained as designed, the project is likely to achieve the estimated annual emission reductions of 286,755 tCO₂e during the seven years of its first renewable crediting period.

The review of the project design documentation and the subsequent follow-up interviews have provided Bureau Veritas Certification with sufficient evidence to determine the fulfillment of stated criteria. In our opinion, the project meets all relevant UNFCCC requirements for the CDM and the relevant host country criteria. Bureau Veritas Certification thus requests registration of the project as a CDM project activity.



Mr. H. B. Muralidhar
Internal Technical Reviewer
10/03/2014



Mr. Ram M. Desai
Team Leader
10/03/2014

6. REFERENCES

Category 1 Documents:

Documents provided by project participants that relate directly to the GHG components of the project.

- /1/ PDD Version 01, Dated 07/09/2012 (GSP Version)
- /2/ PDD Version 02, Dated 08/10/2012
- /3/ PDD Version (final)
- /4/ MOC
- /5/ a. LOA – Host Country Approval for GMR Energy (Singapore) Pte. Ltd.
b. Letter of Approval against the name change in PP i.e. PacificLight Power Pte.Ltd.
- /6/ CER Calculation Spread sheet
- /7/ SCB ICP Financial Model (Financial Closure Model)
- /8/ GMR Energy Singapore Financial Model
- /9/ Investment Decision by the Board of directors Dated 14/06/2011
- /10/ Approval of Change to EPC design dated 08/12/2011
- /11/ Contract with CDM Consultant for advisory services Dated 20/02/2012
- /12/ CDM Prior Consideration communication with UNFCCC Dated 09/03/2012
- /13/ CDM Prior Consideration Communication with NCDMA i.e. NEA, Dated 09/03/2012
- /14/ EPC Contract
 - a) Book II – Scope Book Part I and II
 - b) Book III – Volume 1 – Siemens AG / Siemens Pte. Ltd.
 - c) Book III – Volume II – Siemens AG / Siemens Pte. Ltd.
 - d) Book III – Volume III – Samsung C & T
 - e) Book IV – Appendix G/M/P/R/U/W
 - f) Amendment No. 8 / 9 / 10 /11
- /15/ Natural Gas / LNG Supply Agreement Dtd.15/03/2010 with BG Singapore Gas Marketing Pte. Ltd.
- /16/ Gas License for Shipper Licensee – License No. EMA/GS/007 Dated 21/05/2010
- /17/ Electricity License for Generation Licensee Granted by EMA under The Electricity Act (Cap. 89A) – License No. EMA /GE/005, Dated 16/09/2002 – Initially issued on Island Power Company Pte. Ltd. <http://www.ema.gov.sg/page/69/id:129/>
- /18/ Schedule A To Electricity License for Generation Licensee, Effective on 16/09/2010 – For Capacity with commercial operation Dates (Unit 1 - 30/11/2013 and Unit 2 – 31/01/2014)
- /19/ Heat Flow Diagram No. SIN-154-E-FES-EN11-A18-00IGR2 (Siemens AG-EF-ES-EN11) for NCV of Natural Gas, Plant Out Put, Plant Efficiency and Plant Heat Rate.
- /20/ Siemens Gas Turbine (SGT5-4000F) Brochure for Technical Specification of main Power plant equipment's i.e. Turbine and HRSG
- /21/ Siemens Specification for Efficiency of F-Class Turbine with Combined Cycle mode of Operation (http://www.siemens.com/about/en/businesses/energy/energy_service.htm) This link shows rounded off value 56%. However, heat balance diagram from Siemens for project activity shows efficiency 58.16%, so same is chosen for conservativeness)
- /22/ Singapore Energy Statistics 2011- "Energizing our Nation (ESSN2251-2624) and official report published by EMA- for Electricity Tariff.
- /23/ An official Report by EMA on Power Generation in Singapore
- /24/ Singapore Strategies to meet it energy challenge – Press release by Singapore Government – Diversify Energy Supply and Adding LNG to its Energy Mix and Import of Electricity from other countries.
- /25/ Integrated Summary report for proposed Singapore LNG Terminal by Energy Market Authority
- /26/ EMA Annual Report 2010/2011 – "Charting The FUTURE" for baseline information
- /27/ Research Paper on Cogeneration for CO2 reduction and Polygeneration for CO2 Sequestration by SFA Pacific Inc. – For Efficiency of Cogeneration Plants (Baseline



- Information)
- /28/ Discussion on Wind Energy Potential in Singapore by EMA – Baseline Information
 - /29/ Country Energy Information Singapore – September 2006 for Share of Renewable Fuel in Energy Generation Mix in Singapore.
 - /30/ Singapore electricity Fuel Mix – By NCCS (National Climate change Secretariat – Prime Minister Office) – <http://app.nccs.gov.sg/page.aspx?pageid=83>
 - /31/ Singapore looking into importing electricity (and possibility of nuclear energy) – Public sharing of document by Singapore Government to obtain feedback Dated 08/11/2011. <http://cicpig.wordpress.com/2011/11/08/singapore-looking-into-importing-electricity-and-possibility-of-nuclear-energy/>
 - /32/ Public Document on the Use of Coal in Singapore - <http://www.lowcarbonsq.com/2011/07/19/the-use-of-coal-in-singapore/>
 - /33/ Property Of Lignite – <http://www.geology.ar.gov/energy/lignite.htm>
 - /34/ Geology of Coal Fires – Case Studies around the world.
 - /35/ Press Release by EMA - On Government Approves new Biomass – Coal – Mutli utilities complex on Jurong Island – Dated 25/09/2008 - <http://www.ema.gov.sg/news/view/18>
 - /36/ Press Release on masialogistics.com – Tuas Power sources Coal Supplies Dated 1/02/2011 – The Business Times
<http://www.sgprocessindustries.com/SingleNews.aspx?DirID=114&re>
 - /37/ Regulatory Framework for electricity Imports – Consultancy Paper by EMA Dated 12/12/2011
 - /38/ Statement of Opportunity – for Singapore Energy Industry 2010 by EMA
 - /39/ Details of Tuas Power Station – 1200 MW (2 X 600 MW) Capacity.
 - /40/ Details of Tuas Power Combined Cycle Power Plant – 2670 MW
 - /41/ Details of Senoko Power Supply Pte. Ltd
 - /42/ Energy Journal on LCI (Life Cycle Inventory) Analysis of Fuel and Electricity Generation in Singapore – www.sciencedirect.com
 - /43/ Research Paper on Gas Fired Combined Cycle Power Plant in Singapore : Energy use, GWP and cost – Life cycle Approach – www.sciencedirect.com
(Energy Conversion and Management 46 (2005) 2145-2157)
 - /44/ Summary of NCCS – NRF Smart Grid Technology Primer for Grid Structure in Singapore.
 - /45/ Coal, Australian thermal coal Monthly Price - Singapore Dollar per Metric Ton , 12000-btu/pound, less than 1% sulfur, 14% ash, FOB Newcastle/Port Kembla,
<http://www.indexmundi.com/commodities/?commodity=coal-australian&months=60¤cy=sgd>
 - /46/ LNG Procurement Framework – Consultation Paper Dated 30/03/2012
 - /47/ Press Release, Dated 10/05/2011- Tuas Power to Decide this year on Phase 2 at Jurong Island of it clean coal / Biomass Multi utilities facility - <http://www.eco-business.com/news/tuas-power-to-decide-this-year-on-phase-2-at-jurong-island/>
 - /48/ IEA ETSAP – Technology Brief E01- April 2010 on Coal fired Power – www.etsap.org
 - /49/ IEA ETSAP – Technology Brief E02- April 2010 on Gas fired Power – www.etsap.org
 - /50/ Press Release - Singapore's coal-firing plant seems in good hands Published : Tuesday, November 2nd, 2010 By : [The Business Times](http://www.eco-business.com/news/singapores-coal-firing-plant-seems-good-hands/) - <http://www.eco-business.com/news/singapores-coal-firing-plant-seems-good-hands/>
 - /51/ Technical specification document for Power plant equipments
 - /52/ Technical Specification for Metering system of Natural gas at receiving station in Project boundary
 - /53/ Bank Update Letter
 - /54/ Evidence of Project Location – Location Map (General Layout of the Site)
 - /55/ Schematic Line Diagram for Confirming Tariff Metering system and distribution of electricity to Grid.
 - a) SIN154-00AQ-EEC020-045920_REVA – Tariff Metering Technical Specification
 - b) SIN154-B-EFA010-708101_REVE – Single Line diagram SCC5-4000F-1 unit 10
 - c) SIN154-B-EFA010-708102_REVE - Single Line diagram SCC5-4000F-1 unit 20
 - d) SIN154-00AD-EFA010-045160_R1-Single Line Diagram for GIS



- /56/ Local Stake holders Meeting Dated 26/07/2012 – Minutes of the meeting and attendance sheet
- /57/ EIA Report
- /58/ Bank Mandate Letter for Bank Loan Facility, Dated 03/06/2011
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- /60/ Review of the LRMC costs of CCGT electricity generation in Singapore to establish the technical parameters for setting the Vesting Price for the period 1 January 2009 to 31 December 2010". (10010665 Document 7 - Version 1.2)
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- /64/ <http://wildsingaporenews.blogspot.sg/2008/09/singapores-first-clean-coal-power-plant.html>
- /65/ South East Asia Coal Review – http://www.marston.com/Portals/0/MARSTON_Southeast_Asia_Coal_Review.pdf
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- /67/ Plant Layout showing key facilities i.e. Gas Receiving stations, auxiliary Fuel storage facility, Gas Turbine, HRSG, Steam turbine and Power house etc. Document No.
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- /70/ INFORMATION ON EMISSION FACTORS (For CDM projects in Singapore) Electricity Grid Emission Factor Dated 20/04/2012
- /71/ Communication from EPC contractor for change in project specifications - Letter from PP to EPC contractor
- /72/ ACRA Registration of GMR Energy Singapore Pte. Ltd. (Company No. 199901043 R Dated 30/07/2012)
- /73/ Review of the LRMC costs of CCGT electricity generation in Singapore to establish the technical parameters for setting the Vesting Price for the period 1 January 2009 to 31 December 2010. The study was done by the third party KEMA Limited, http://www.ema.gov.sg/media/files/vesting_contracts/10010665_CCGT_RMC_Calcs_Final.pdf
- /74/ DC clearance, in-principle approval for the proposed power plant - Ref No. NEA/EP/PCD/10-00395(DC-A66390-12881/R2) Dated 23 October 2012
- /75/ <http://www.epa.gov/airmarkets/resource/docs/coal-fired.pdf> - COAL-FIRED POWER PLANT HEAT RATE REDUCTIONS - SL-009597 FINAL REPORT, JANUARY 22, 2009
- /76/ 2611202A - 2x400MW ISLAND POWER COMBINED CYCLE POWER PROJECT DEVIATION AND CLARIFICATIONS – Discussion on Deviations & Clarifications Final Dated 24 August 2010
- /77/ National Energy Market of Singapore, Monthly Trading Report, Dec. 2010. – For the Cost of Electricity.
- /78/ Electricity license for generation licensee by EMA – Schedule A for Tembusu Multiutilities complex (Coal fired plant) http://www.ema.gov.sg/media/files/licences/TPU%20Utilities%20Pte%20Ltd/License/TPU_Schedule_A.pdf
- /79/ Third Party research paper published on www.sciencedirect.com website (http://s3.amazonaws.com/zanran_storage/portal.jnu.edu.cn/ContentPages/115075199.pdf) Topic – “Gas Fired Combined Cycle Plant in Singapore, Energy USE GDP and Cost – a Life Cycle Approach” Dtd. 18 December 2004 by School of Mechanical and Production Engineering, Nanyang Technical University, Singapore.
- /80/ Third Party report on Electricity Generation cost Model -2011 update Revision 1 (UK) – Research paper by Department for Energy and Climate change UK, estimating LCA cost for the CCGT power plants.

**Category 2 Documents:**

Background documents related to the design and/or methodologies employed in the design or other reference documents used for cross-check.

- /81/ EB 65 Annex 4 - CLEAN DEVELOPMENT MECHANISM VALIDATION AND VERIFICATION STANDARD (Version 03.0)
- /82/ EB 66 Annex 8, GUIDELINES FOR COMPLETING THE PROJECT DESIGN DOCUMENT FORM (Version 01.0)
- /83/ AM0029: Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas --- Version 3.0
- /84/ ACM0013: Construction and operation of new grid connected fossil fuel fired power plants using a less GHG intensive technology --- Version 5.0.0
- /85/ EB 69 Annex 20 - Methodological tool "Tool for the demonstration and assessment of additionality" (Version 06.1.0)
- /86/ EB 63 Annex 19 - Methodological Tool "Tool to calculate the emission factor for an electricity system" (Version 02.2.1)
- /87/ EB 62 Annex 5 - GUIDELINES ON THE ASSESSMENT OF INVESTMENT ANALYSIS (Version 05)
- /88/ EB 62 Annex 13 - GUIDELINES ON THE DEMONSTRATION AND ASSESSMENT OF PRIOR CONSIDERATION OF THE CDM (Version 04)
- /89/ Clarification of AM0029 v1.1 applicability conditions AM_CLA_0091
- /90/ Standard Conversion factor for MMBTU to M3 for Natural Gas
http://www.gailonline.com/final_site/energyconversionmatrix.html
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http://www.emcsg.com/f280,71613/MSCP_Report_2011_for_website.pdf
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http://www.emcsg.com/f280,59412/EMC_MSCP_2010b-FINAL_Public_Version_.pdf
- /93/ Real Time Electricity Price and Demand (<http://www.emcsg.com/>)
- /94/ EB 69 Annex 8 - Guidelines on Common Practice Analysis, Version 02.0
- /95/ EMA report 'Review of the vesting contract parameters for 2013 and 2014 – Draft report' pg. 19 (pg. 23 of pdf file); refer Table 10 for impact of load factor on heat rate, at 72% annual load factor of project activity, the heat rate will be from 104-105% of the design heat rate
- /96/ ACRA Documents for GMR and for Changed company name PacificLight Power Pte. Ltd.
- /97/ Gas Supply Code – 2008, issued by Energy Market Authority for the specification of Natural Gas supplied in Singapore http://www.ema.gov.sg/images/files/codes/Gas_Supply_Code.pdf

Persons interviewed:

Persons interviewed during the validation or persons that contributed with other information that are not included in the documents listed above.

PacificLight Power Pte. Ltd.

- /1/ Mr. K.K. Shiva Kumara Project director
 - /2/ Mr. Shivaprasad L Sr. Manager, Mechanical Lead
 - /3/ Mr. Vikram Rao Sr. Manager, Commercial & Contract
 - /4/ Mr. G. Chellaiah HSE Manager
 - /5/ Ms. Aminah Ahmad Document Controller
 - /6/ Mr. Apurva Jhalani Chief Financial Officer
 - /7/ Ms. Clare Savereux Sr. Manager Legal
- General Carbon Advisory Services Pvt. Ltd.
- /8/ Mr. Pravin Jadhav Associate Vice President
 - Local Stakeholder
 - /9/ Mr. Jian Long Teo Stakeholder



7. CURRICULA VITAE OF THE DOE'S VALIDATION TEAM MEMBERS

Mr. Ram M. Desai	Bureau Veritas Certification, Singapore	<p>Team Leader, Climate Change Lead Verifier, <i>Environmental Engineer with over all 13 years of experience in various industries related to Water & Waste water engineering design, installation & Commissioning, Integrated Facility Management for Environmental Services operations in various industries i.e Automotive, Pharmaceutical , IT & Electronics (With Clean Room). Management System Implementation and Maintenance, Green Building concept implementation, Lean Management Implementation, Water & Waste Water engineering Design & project Management, Project Environmental Compliance etc for a construction company.</i></p> <p><i>He is the lead auditor for Environment management system, Quality management system and Occupational health and safety management system and his auditing experience spans for 3 year with BVCI & BVCS. He has undergone intensive training on Clean Development Mechanism and was trained as Lead Verifier for CDM in the year 2005 and working as a lead Verifier for validation and verification of CDM/VCS projects</i></p>
Ms. So Shuk Ling	Bureau Veritas Certification, Singapore	<p>Team Member, Climate Change Verifier. <i>She is Bachelor degree in Chemistry and statistic and Master degree in Manufacturing and Polymer Science. He has been working in auditing for quality and Environmental management system more than 9 years and in Electronics Manufacturing company more than 8 years. She has undergone intensive training on Clean Development Mechanism.</i></p>
Mr. H.B. Muralidhar	Bureau Veritas Certification, India	<p>Technical Reviewer, Climate Change Lead Verifier. <i>(Internal Reviewer) Lead auditor in Bureau Veritas Certification for Environment Management System, Quality Management System and Occupational Health and Safety Management System. Graduate in Electrical Engineering with 25 years of experience power generation and distribution related fields as well as in management system auditing. He is the Lead auditor for Environmental Management System, Quality Management system and Occupational Health and Safety Management System. He has undergone intensive training on Clean Development Mechanism. He is the technical expert & conducted Validation / Verification for more than 50 CDM Projects</i></p>
Mr. Sushil Budhia	Bureau Veritas Certification, India	<p>Financial Expert. <i>He has been practicing as Chartered Accountant for 25 years and he has very wide experience on project finance, taxation and financial auditing. He has undergone training on Clean Development Mechanism and has conducted verification of financial indicators like IRR for more than 70 CDM projects.</i></p>



APPENDIX A: CDM PROJECT VALIDATION PROTOCOL

Appendix A: GRID CONNECTED ELECTRICITY GENERATION PLANT USING NATURAL GAS AT JURONG ISLAND IN SINGAPORE VALIDATION PROTOCOL

Table 1 Validation requirements based on VVS version 03.0 (EB 65 Annex 4), PS version 01.0 (EB 65 Annex 5), PCP version 02.0 (EB 66 Annex 64), and Guidelines for completing the PDD form version 01.0 (EB 66 Annex 8)

CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
Part I Cover Page					
(a) Is the title of the project activity provided?	PDD		Yes, Grid connected electricity generation plant using natural gas at Jurong Island in Singapore	OK	OK
(b) Is the version number of the PDD indicated?	PDD		Yes, version 01	OK	OK
(c) Is the completion date of the PDD provided in DD/MM/YYYY format?	PDD		Yes, 07/09/2012	OK	OK
(d) Are project participants indicated?	PDD		Yes, PP is PacificLight Power Pte. Ltd.	OK	OK
(e) Is the host party(ies) indicated?	PDD		Yes, Singapore	OK	OK
(f) Is the sectoral scope and selected methodology(ies) indicated?	PDD		Yes, Sectoral scope is 01- Energy Industries (renewable / non-renewable source)	OK	OK
(g) Is the estimated amount of annual average GHG emission reductions indicated?	PDD		Yes, estimated reduction- 530,302tCO ₂ e	OK	OK
Part II PDD					
A. Description of project activity					
A.1 Purpose and general description of project activity					
A.1.1 Is a brief description of the project activity provided,	PDD		Yes, the project activity is construction and	OK	OK

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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
including a summary of the scope of activities/ measures that are to be implemented within the project activity?	PS	31(b)	operation of new 800MW natural gas based power plant. The electricity generated will be exported to the Singapore national grid. At the site ambient conditions and a frequency of 50Hz, the rated capacity of plant will be 800 MW +/-10% (two units): Each of the two units has one combustion turbine, one heat recovery steam generators (HRSG) and one steam turbine generator (STG). The heat content of the exhaust gas from the combustion turbine will be recovered in individual HRSG. The steam generated will be expanded in a condensing type steam turbine driving an electric generator. Diesel oil will be used as back up fuel for which LPG is start up fuel.		
A.1.2 Are the scenario existing prior to the start of project and baseline scenario indicated?	PDD		Yes, the project activity is a new independent natural gas based power plant, hence no power generating equipment existed in the project site before the project start. The project scenario is continuation of existing fuel mix in the grid to generate the power.	OK	OK
A.1.3 Does it explain how the project activity will reduce GHG emissions or increase GHG removals?	PS	31(c)	Yes, in the absence of project activity, PP will continue to use the coal based power plant which will generated higher CO ₂ emission than the project activity which will reduce anthropogenic GHG emissions into the atmosphere due to the use of relatively lower GHG intensive fuel (ie. Natural Gas) and have higher efficient power generation due to combined cycle operation in comparison to coal.	OK	OK
A.1.4 Is the estimated of annual average and total GHG	PDD		Yes, estimated GHG emission reductions is 530,302 tCO ₂ e in 7-year crediting period	OK	OK



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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
emission reductions for the chosen crediting period provided?			(renewable twice)		
A.1.5 Is a brief description of how the project activity contributes to sustainable development provided?	PDD		Yes, Environmental sustainability: lower GHG emission Economic sustainability: the project activity is utilizing latest F class turbines which is more efficient and environment friendly compared to coal power plant. Social sustainability: the project activity will provide direct employment to persons during the construction and operation.	OK	OK
A.1.6 In order to determine whether the description of the proposed project activity in the PDD is accurate, complete, and provides an understanding of the proposed CDM project activity, does the DOE conducted a physical site visit to assess the Project? If not, please justify.	VVS	65	Yes, on site validation visit was performed from 27/09/2012 to 29/09/2012. And during site visit it was understood that the project description provided in the webhosted PDD is in accordance with the actual project implementation.	OK	OK
A.1.7 For all other proposed CDM project activities not referred to in VVS paragraphs 65-66, does the DOE undertaken the validation of project description by reviewing available designs and feasibility studies and should conduct comparison analysis with equivalent projects, as appropriate.	VVS	67	There was no feasibility study report available for the proposed project activity. Validation team has verified the EPC contract which is already signed by the PP. Validation team has crosschecked the values using website and publically available information.	OK	OK
A.1.8 If the proposed CDM project activity involves the alteration of an existing installation or process, does the project description state the differences resulting from the project activity compared to the	VVS	68	NA. this is new construction of natural gas power plant.	NA	NA



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pre-project situation?					
A.2 Location of project activity					
A.2.1 Is the host party(ies) indicated?	PDD		Yes, Singapore	OK	OK
A.2.2 Is region/state/province etc. indicated?	PDD		Yes, Singapore	OK	OK
A.2.3 Is City/Town/Community etc. indicated?	PDD		Yes, Jurong Island	OK	OK
A.2.4 Are the details of physical location of the project activity provided?	PDD		Yes, Jurong Island Geographical coordinates: N 29596.585 and E15906.933 – CAR01	CAR-01	OK
A.3 Technologies and measures					
A.3.1 Are there a list and the arrangement of the main manufacturing/ production technologies, systems and equipment involved?	PDD		Yes, the project Participant has selected Siemens Gas Turbine SGT5-4000F Two units of frequency of 50HZ with rated capacity 800 MW +/- 10%. Each of the two units has one combustion turbine, one heat recovery steam generators (HRSG) and one steam turbine Generator (STG)	OK	OK
A.3.1.1 Is the information about the age and average lifetime of the equipment based on manufacturer's specifications and industry standards, and existing and forecast installed capacities, load factors and efficiencies included in the description?	PDD		The project activity has chosen Siemens Gas Turbine SGT5-4000F. The project plant will have two units of net capacity of 385.5 MW each. The plant will be using natural gas and /or re-gasified LNG as primary fuel. Diesel oil will be used as back up fuel for which LPS is start up fuel. No other start up or auxiliary fuel will be used in the plant. The plant is expected to operate at 88% annual capacity utilization. Efficiency of 39.8% using Opening cycle mode of operation with a lifetime of 30 years.	OK CAR-02	OK
A.3.1.2 Are the monitoring equipments and their	PDD		CAR 03	CAR-03	OK



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location in the systems included in the description?					
A.3.2 Are energy and mass flows and balances of the systems and equipment included in the project activity provided?	PDD		CAR 03	CAR-03	OK
A.3.3 Are the types and levels of services provided by the systems and equipment that are being modified and/or installed under the project activity and their relation, if any, to other manufacturing/ production equipment and systems outside the project boundary provided?	PDD		NA, the project activity is new construction of natural gas power plant.	NA	NA
A.3.4 Does the description clearly explain how the same types and levels of services provided by the project activity would have been provided in the baseline scenario?	PDD		Yes, in the absence of the project activity PP has demonstrated that Coal fired power plant is the most plausible alternative option available in Singapore as host country. As per AM 0029, the identification most plausible baseline is required to be discusse using all technologies available for in the host country.	OK	OK
A.3.5 Is a list of facilities, systems and equipment in operation under the existing scenario prior to the implementation of the project activity provided?	PDD		NA, the project activity is new construction of natural gas power plant. No equipment there before the implementation of the project activities.	NA	
A.3.6 Is a list of facilities, systems and equipment in the baseline scenario provided?	PDD		CAR 03	CAR-03	OK
A.3.7 Is a description of how technologies and measures and know-how to be used are transferred to the Host Party(ies) included?	PDD		NA. No technology transfer from Annex 1 country or any other country.	NA	NA



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A.4 Party(ies) and project participant(s)					
A.4.1 Are following information provided in a tabular format?					
A.4.1.1 List of project participants and parties	PDD		Yes, PP is PacificLight Power Pte. Ltd.	OK	OK
A.4.1.2 Identification of Host Party	PDD		Yes, Singapore	OK	OK
A.4.1.3 Indication whether the Party wishes to be considered as project participant	PDD		No, the Party – Singapore is not considered as project participant.	OK	OK
A.5 Public funding of project activity					
A.5.1 Is it indicated whether the project activity receives public funding from Annex I Parties?	PDD		No, there is no public funding from Annex 1 parties.	OK	OK
A.5.2 In case where public funding from Annex I Parties is involved, are followings provided? (a) Information on Parties providing public funding (b) Attached in Appendix 2: the affirmation obtained from such Parties that such funding does not result in a diversion of official development assistance, is separate from, and is not counted towards the financial obligations of those Parties	PS	34	NA	NA	NA
B. Application of selected approved baseline and monitoring methodology					
B.1 Reference of methodology					
B.1.1 Is the selected methodology (ies) indicated with	PDD		Yes, AM0029 Version 3 Baseline Methodology	OK	OK



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exact reference (number, title and version)?			for Grid Connected Electricity Generation Plants using Natural Gas		
B.1.2 Are the baseline and monitoring methodologies selected by the project participants the valid versions of those approved by the Board?	VVS	70	Yes	OK	OK
B.1.3 Are there any tools and other methodologies to which the selected methodology indicated?	PDD		Yes, - Tool for demonstration and assessment of additioanlity Version 06.0.0 - Tool to calculate the emission factor for an electricity system, Version 02.2.1	OK	OK
B.1.4 Has specific guidance and/or clarifications provided by the Board with respect to the approved methodology and any applicable tools been applied?	VVS	71	NA	NA	NA
B.1.5 Is there any deviation or clarification requested for the approved methodology?	VVS	78-81	NA	NA	NA
B.2 Applicability of methodology					
B.2.1 Is the selected baseline and monitoring methodology applicable to the project activity and that the selected version valid at the time of submission of the proposed project activity for registration?	VVS	73-75	Yes, The selected version of AM0029 Version 3 is the latest version used for the project activities.	OK	OK
B.2.2 Does the project activity meet each of the applicability conditions of the approved methodology or other methodology component	PDD VVS	76	3 applicability conditions were justified: Applicability 1: The project activity is the construction and operation of a new natural gas	CL10	OK



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referred to therein?			<p>fired grid connected electricity generation plant. Justification for 1: the project activities is new construction of natural gas fired electricity generation plant. – Site Visit has been done to confirm it is new construction.</p> <p>Applicability 2: The geographical / physical boundaries of the baseline grid can be clearly identified and information pertaining to the grid and estimating baseline emission is publicly available.</p> <p>Justification for 2: The baseline grid is the Singapore Power grid and the information pertaining to the grid and estimating baseline emission is publicly available in Singapore Government agent National Environmental Agent (NEA) website.</p> <p>Applicability 3: Natural gas is sufficiently available in the region or country, e.g future natural gas based power capacity additions, comparable in size to the project activity, are not constrained by the use of Natural Gas in the project activity.</p> <p>Justification for 3: all the natural gas are imported at upcoming LNG terminal. So the project activity will not divert natural gas from existing users in the country and will not constrain future capacity addition. 3 main import pipelines serve the natural gas system from Malaysia, Northeast and</p>	OK	

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			Southwest east of Indonesia.		
B.3 Project boundary					
B.3.1 Are the emission sources and GHGs included in the project boundary for the purpose of calculating project emissions and baseline emissions described using the table provided?	PDD		Yes, mainly CO2 emission for baseline and project activities is identified.	OK	OK
B.3.2 Is a flow diagram of the project boundary presented, physically delineating the project activity?	PDD		Yes, the project boundary is delineating in PDD Section B.3 include the all power plants connected in Singapore grid.	OK	OK
B.3.3 Does the flow diagram include the equipment, systems and flows of mass and energy described? In particular, is the emission sources and GHGs included in the project boundary and the data parameters to be monitored indicated in the diagram?	PDD VVS	82	Yes, CO2 is indicated in the flow diagram.		OK
B.4 Establishment and description of baseline scenario					
B.4.1 Is an explanation how the baseline scenario is established in accordance with the selected baseline methodology provided?	PDD VVS	89	Yes, the identify plausible baseline scenarios are identified as per the AM0029 Version 3 and clearly described in the PDD Section B.4.	OK	OK
B.4.2 When establishing the baseline scenario, and where “future anthropogenic emissions by sources are projected to rise above current levels due to the specific circumstances of the host Party”, do the project participants follow the “Guidelines on	PS	42	NA. there is no specific circumstances of host part on future anthropogenic emission.	NA	NA



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the consideration of suppressed demand in CDM methodologies”?					
B.4.3 Does the approved methodology that is selected by the proposed CDM project activity prescribe the baseline scenario and hence no further analysis is required?	VVS	113, 115	NA	NA	NA
B.4.4 If no, does the PDD identify credible alternatives to the project activity in order to determine the most realistic baseline scenario?	VVS	114	Yes	OK	OK
B.4.5 Does the list of alternatives given in the PDD ensure that: (a) One of the options that the project activity is undertaken without being registered as a proposed CDM project activity (b) The list contains all plausible alternatives (c) The alternatives comply with all applicable and enforced legislation	VVS	114	Yes. A list of alternatives baseline scenarios have been provided in PDD Section B.4. a. the project activity i.e 800MW natural gas combined cycle power plant with an efficiency of 58.16% and with a lift time of 30 years and not implemented as a CDM project activity. b.1 Power generation using natural gas as the fuel but with different alternative technologies such as Open cycle mode with efficiency of 39.8% and 30 years lift time operation.- It has justified this is not a realistic and credible alternative due to lower efficiency than the combined cycle mode operation. b.2. Power generation using gas turbine in cogeneration mode of operation with efficiency 63%. However, the cogeneration mode of operation is mainly used to provide electricity and steam for industrial facility not for power grid, hence, it is justified not a realistic and credible	OK	OK



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			<p>alternative.</p> <p>c. 1 power generation using energy sources other than natural gas. Ie Wind power. Justification provided wind in Singapore is seasonal in nature and the capacity utilization factor is very low. Hence it is not a credible and realistic alternative.</p> <p>c.2 Power generation using hydro. It has justified in Singapore has no hydro potential, hence, it is not a credible and realistic alternative.</p> <p>c.3. Power generation using fuel oil. As per the statistics provided by Energy Management Authority (EMA) from Singapore government Energy Sector presented data that fuel oil has about 17% usage in year 2010, hence, it can be considered as plausible baseline scenario.</p> <p>c.4. Power generation using nuclear fuel. As of today, Singapore government still only under study the potential of collaboration with other countries of build an offshore nuclear power plant, hence, at this stage, it is still not a realistic and credible alternative.</p> <p>c.5. Power generation with thermal power plants using coal and or lignite as the energy source. Where the coal used for the power production in Singapore is imported from countries like Indonesia, Malaysia. Tuas Power company has installed new coal and biomass based plant at Jurong island with contract signed with Indonesia's PT Bayan Resource to supply sub-bituminous coal over next 15 years operation. It is possible that five units f 160 MW each</p>		

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			equivalent to Tuas Power's coal based power plant is a realistic scenario. As for lignite, Singapore does not have lignite reserves and do not imported lignite from other countries, hence, this is plausible alternative. d. Import of electricity form connected grids, including the possibility of new interconnections. Singapore government is considering the option of electricity import from other countries through long distance high-voltage cable. Hence, this is plausible baseline scenario.		
B.4.6 Has any procedure contained in the methodology to identify the most reasonable baseline scenario, been correctly applied?	PDD VVS	89	Yes as according to AM0029 Version 3.	OK	OK
B.4.7 Is the baseline identified for the proposed project activity the scenario that reasonably represents the anthropogenic emissions by sources of GHGs that would occur in the absence of the proposed project activity?	VVS	88	Yes, PP has identified 3 baseline scenario:	OK	OK
B.4.8 Does the selected methodology require use of tools (such as the "Tool for the demonstration and assessment of additionality" and the "Combined tool to identify the baseline scenario and demonstrate additionality") to establish the baseline scenario?	VVS	89	Yes, it has required to use Tool for the demonstration and assessment of additonality. PP utilize the Tool for the demonstration and assessment of additonality- Version 06.0.0	OK	OK
B.4.9 Does the methodology require several alternative scenarios to be considered in the identification of the most reasonable baseline scenario?	VVS	90	Yes, it is according to AM0029 Version 3.	OK	OK

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B.4.10 Are the documents and sources referred to in the PDD correctly quoted and interpreted and are they crosschecked with other verifiable and credible sources, such as local expert opinion, if available?	PDD VVS	91	Yes, cross check with EMA statistics, government press.	CAR04	OK
B.4.11 Does the PDD provide a description of the identified baseline scenario, including a description of the technology that would be employed and/or the activities that would take place in the absence of the proposed project activity?	VVS	92	Yes, it has described in each baseline scenarios.	OK	OK
B.4.12 Have all applicable CDM requirements been taken into account in the identification of the baseline scenario for the proposed project activity?	VVS	93	Yes, it is according to the AM0029 Version 3.	OK	OK
B.4.13 Has relevant national and/or sectoral policies and circumstances (type E+ or E-), such as sectoral reform initiatives, local fuel availability, power sector expansion plans, and the economic situation in the project sector been taken into account?	VVS	93	Yes, it has included the Singapore Government policy on import electricity consideration. Publication form EMA website.	OK	OK
B.4.14 Is a transparent description of the baseline scenario provided?	PDD		Yes.	OK	OK
B.5 Demonstration of additionality					
B.5.1 Is the project activity demonstrated additional in accordance with the selected methodology (ies)?	PDD		Yes, PP has demonstrated the additionality using <i>EB 69 Annex 20 - Methodological tool "Tool for the demonstration and assessment of additionality" (Version 06.1.0)</i>	OK	OK
B.5.2 Where the procedure in the selected	PDD		Yes, the Approved methodology prescribes the step by step approach as mentioned in the EB 69	OK	OK

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methodology(ies) and/or tool involves several steps, is it described how each step is applied and is the outcome of each step transparently documented?			Annex 20 - Methodological tool "Tool for the demonstration and assessment of additionality" (Version 06.1.0). PP has opted financial additionality and hence provided a detailed investment analysis to calculate LCOE of electricity generation using benchmark approach.		
B.5.3 Is the method selected to demonstrate additionality clearly indicated?	PDD		Yes	OK	OK
B.5.4 If investment analysis is used:					
B.5.4.1 Are all relevant assumptions and parameters used in the analysis listed?	PDD		PP has used investment analysis to demonstrate the additionality of the project activity. PP has selected Levelized cost analysis for electricity generation for both scenarios i.e. baseline as well as for the project activity, this is found in accordance with the methodology requirement.	OK CAR-05 CAR-06	OK
B.5.4.2 Is the latest version of the "Guidelines on the assessment of investment analysis" applied?	VVS	118	Yes, PP has demonstrated the investment analysis in clear and transparent manner using EB 62 Annex 5 - GUIDELINES ON THE ASSESSMENT OF INVESTMENT ANALYSIS (Version 05)	OK	OK
B.5.4.3 Is project activity one of the following cases in regards to investment analysis:	VVS	119			
B.5.4.3.1 The proposed project activity would produce no financial or economic benefits other than CDM-related income;	VVS	119(a)	No, Sale of electricity is also an additional revenue PP will be generating by implementing this project activity	NA	NA
B.5.4.3.2 The proposed project activity is less	VVS	119(b)	Yes, PP has demonstrated using guidance provided by Approved methodology, that there	OK	OK

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economically or financially attractive than at least one other credible and realistic alternative;			are two plausible baseline alternatives are available in Host country Singapore to the proposed project activity which are economically or financially attractive i.e., <ul style="list-style-type: none"> - Electricity generation using Coal - Import of electricity from other SEA countries through already available grid network. 		
B.5.4.3.3 The financial returns of the proposed project activity would be insufficient to justify the required investment.	VVS	119(c)	Using LCOE approach PP has demonstrated that Project activity has higher cost of electricity generation than other two credible alternative identified, however the there is no benchmark analysis done demonstrate that the financial returns of the project activity would be insufficient to justify the required investment and hence CAR 07 was raised	CAR07	
B.5.4.4 Has the accuracy of financial calculations carried out for investment analysis been verified as follows:	VVS	120			
B.5.4.4.1 Determine the suitability of the financial indicator selected by the project participants and conduct a thorough assessment of all parameters and assumptions used in calculating such financial indicators, and determine the accuracy and suitability of these parameters using available evidence and applying its expertise in relevant accounting practices	VVS	120(a)	The financial indicator Levelized cost of electricity generation is found and appropriate indicator for the financial analysis.	OK	OK



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B.5.4.4.2 Cross-check the parameters against third-party or publicly available sources, such as invoices or price indices	VVS	120(b)	Yes, Validation team has used various publically available information to cross check the input values and variables.	CL13 CAR06	OK
B.5.4.4.3 Review, as appropriate, feasibility reports, public announcements and annual financial reports related to the proposed project activity and the project participants	VVS	120(c)	There is no feasibility report required by the EMA of Singapore to approve the power plant. Hence all values are cross checked against the information available with EMA website and various other relevant sources.	OK	OK
B.5.4.4.4 Assess the correctness of computations carried out and documented by the project participants; and	VVS	120(d)	Yes, the Computation of LCOE is found correct, this is reconfirmed by using external financial Expert..	CL 14 CL 15 CL 16 CL 19	Ok
B.5.4.4.5 Assess, where applicable, the sensitivity analysis by the project participants to determine under what conditions variations in the result would occur, and the likelihood of these conditions.	VVS	120(e)	PP has performed Sensitivity analysis for the LCOE of Baseline scenario and project scenario as prescribed by the approved methodology, however there is no Sensitivity analysis performed for the Benchmark i.e. IRR, hence CAR 08 was raised.	CAR 08	OK
B.5.4.5 If benchmark analysis is used:					
B.5.4.5.1 Is the benchmark clearly indicated?	PDD		There is no Bechmark identified by the PP hence CAR 08 and CAR 09 were raised	CAR 08 CAR 09	OK
B.5.4.5.2 Is the type of benchmark applied suitable for the type of financial indicator presented?	VVS	121(a)	CAR 08 & CAR 09	CAR 08 CAR 09	OK
B.5.4.5.3 Does the risk premiums applied in determining the benchmark reflect the risks	VVS	121(b)	CAR 08 & CAR 09	CAR 08 CAR 09	OK



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associated with the project type or activity?					
B.5.4.5.4 Is it reasonable to assume that no investment would be made at a rate of return lower than the benchmark?	VVS	121(c)	CAR 08 & CAR 09	CAR 08 CAR 09	OK
B.5.4.6 If cost comparison is used:					
B.5.4.6.1 Are the scenarios compared described?	PDD		Yes	OK	OK
B.5.4.7 If PPs rely on values from FSR:	VVS	122			
B.5.4.7.1 Has the FSR been the basis of the decision to proceed with the investment in the project?	VVS	122(a)	No, The Decision making was done based on the Offer by the EPC contractor.	OK	OK
B.5.4.7.2 Are the values used in the PDD and associated annexes fully consistent with the FSR? If inconsistencies occur, was the appropriateness of the values validated?	VVS	122(b)	Although there is no FSR available, however the values applied are found consistent.	OK	OK
B.5.4.7.3 On the basis of its specific local and sectoral expertise, is confirmation provided, by cross-checking or other appropriate manner, that the input values from the FSR are valid and applicable at the time of the investment decision?	VVS	122(c)	Yes, the decision was taken during Board of directors meeting and it is found documented that the decision was taken based on the EPC contract Signed earlier by the Island Power Company Pte. Ltd. with a NTP clause.	OK	OK
B.5.5 If barriers analysis is used:					
B.5.5.1 Is the "Guidelines for objective demonstration and assessment of barriers" followed?	PS	48	NA. using Benchmark analysis and common practice analysis	NA	NA
B.5.5.2 Is it ensured that only the most relevant	PDD		NA	NA	NA



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barriers selected?					
B.5.5.3 Is the credibility of the barriers justified with key facts and/or assumptions and the rationale?	PDD		NA	NA	NA
B.5.5.4 Is it ensured that issues that have a direct impact on the financial returns of the project activity are not considered as barriers but assessed by investment analysis? This does not refer to either: (a) Risk related barriers (b) Barriers related to the unavailability of sources of finance for the project activity	VVS	125	NA	NA	NA
B.5.5.5 Were the barriers determined as real?	VVS	126(a)	NA	NA	NA
B.5.5.6 Were the barriers determined as preventing the implementation of the project activity but not the implementation of at least one of the possible alternatives?	VVS	126(b)	NA	NA	NA
B.5.6 Common Practice Analysis					
B.5.6.1 If the project type is first-of-its kind, do the project participants consider "Guidelines on additionality of first-of-its-kind project activities"?	VVS PS	128 49(a)	NA. This is not first of its kind.	NA	NA
B.5.6.2 If the project type is not first-of-its kind, has common practice analysis been conducted considering "Guidelines on common practice"?	VVS PS	128 49(b)	Yes, as per EB 65 annex 20	OK	OK

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B.5.6.3 Was it assessed whether the geographical scope of the common practice analysis is appropriate for the assessment related to the project activity's technology or industry type?	VVS	129(a)	5 power plants were included for assessment related to project activities or similar industry type	OK	OK
B.5.6.4 Was it determined to what extent similar and operational projects, other than CDM project activities, and have been undertaken in the defined region?	VVS	129(b)	Within Singapore. Consideration include 800 MW project from the applicable range 400MW to 1200 MW.	OK	Ok
B.5.6.5 Are similar and operational projects, other than CDM project activities, already "widely observed and commonly carried out" in the defined region? Is it assessed whether there are essential distinctions between the proposed CDM project activity and the other similar activities?	VVS	129(c)	As per the common practice guideline if one of the following condition is not fulfilled: $F > 0.2$ and $N_{all-Ndiff} > 3$, then the project activity is not a common practice. PP has analysis the factor $F = 0.5$ and $N_{all-Ndiff} = 2$ Hence, it is not a common practice.	OK	OK
B.5.7 Prior consideration of the clean development mechanism					
B.5.7.1 If the project activity start date prior to the date of publication of the PDD for stakeholder comments, were the CDM benefits considered necessary in the decision to undertake the project as a proposed CDM project activity?	PDD VVS	105	Yes, project start date on 08/12/2011 as the approval of change to EPC design. CDM prior consideration sent to UNFCCC on 09/03/2012 which is within 6 month of the project start date.	CL09	OK
B.5.7.2 Is the start date of the project activity, reported in the PDD, the earliest date at which either the implementation or construction or real action of a project activity begins?	VVS	106	Yes, project start date on 08/12/2011 as the approval of change to EPC design.	CL09	OK



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B.5.7.3 If the project activity requires construction, retrofit or other modifications, is it ensured that the date of commissioning not considered as the project activity start date?	VVS	106	Yes	OK	OK
B.5.7.4 Is it a project activity with a start date on or after 02 August 2008, or before 02 August 2008?	VVS	106	After 02 Aug 2008	OK	OK
B.5.7.5 For a project activity with a start date on or after 02 August 2008, are the following provisions to be satisfied:			<i>for which PDD has not been published for GSC or a new methodology proposed to the EB before the project activity start date</i>		
B.5.7.5.1 Has the PP informed the Host Party DNA and the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status within 180days of the project activity start date?	VVS	107	NA	NA	NA
B.5.7.5.2 Do the project participants inform the secretariat of the progress of the project activity every subsequent two years after the initial notification, until the PDD regarding the project activity has been published for global stakeholder consultation or, a new baseline and monitoring methodology is proposed or a revision of an approved baseline and monitoring methodology is requested for the project activity before the start date?	PCP	9	NA	NA	NA
B.5.7.6 For a project activity with a start date before 02	VVS	108	<i>for which the start date is prior to the date of</i>		

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August 2008, are the following elements to be satisfied:			<i>publication of the PDD for global stakeholder consultation</i>		
B.5.7.6.1 Are evidence of their awareness of the CDM prior to the project activity start date, and that the benefits of the CDM were a decisive factor in the decision to proceed with the project provided?	VVS	108	NA	NA	NA
B.5.7.6.2 Are evidence that continuing and real actions were taken to secure CDM status for the project in parallel with its implementation provided?	VVS	108-110	NA	NA	NA
B.5.7.6.3 Is an implementation timeline of the proposed CDM project activity provided?	PS	28(c)	NA	NA	NA
B.6 Emission reductions					
B.6.1 Explanation of methodological choices					
B.6.1.1 Does the PDD explain how the methods or methodological steps in the selected methodology, for calculating project emissions, baseline emissions, leakage emissions and emission reductions are applied?	PDD VVS	96	Yes, it is according to AM0029 version 3	OK	OK
B.6.1.2 In case the methodology(ies) include different scenarios or cases, does the PDD indicate and justify which scenario or cases applies to the project activity?	PDD		Yes, Project emission is on site combustion of natural gas to generate electricity. $PE_y = \sum FC_{f,y} * COEF_{f,y} = 1,752,964 \text{ tCO}_2e$	CL-17 CL-18 CL-20	OK



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			<p>Baseline emission is calculated by multiplying the electricity generated in the project plant ($EG_{pJ,y}$) with a baseline CO2 emission factor ($EF_{BL, CO2,y}$)</p> $BE_y = EG_{pJ,y} * EF_{BL, CO2,y} = 2,227,202 \text{ tCO2e}$ <p>Leakage $LE_y = LE_{CH4,y} = -45,102$ which is a negative value and means the upstream emission of fuel used in the country are higher than that of natural gas required for the project activity. As per AM002 version 3 indicated where total net leakage effects are negative, the project participants can assume $LE_y = 0$.</p> <p>$LE_{LNG,CO2,y} = 187483$ – PP used appropriate formulae to arrive at the this value – Used default Emission factor for upstream emission due to regasification and compression to NG in transfer system i.e. 6 tCO2/TJ.</p> <p>Emission reduction $ER_y = BE_y - PE_y - LE_y$ $ER_y = 2,227,202 - 1,752,964 - 187,483$ $ER_y = 286,755 \text{ tCO2e}$</p>		
B.6.1.3 In case the methodology(ies) provide different options to choose from, does the PDD indicate	PDD VVS	97	Yes	OK	OK



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and justify which option is chosen for the project activity?					
B.6.1.4 In case the methodology (ies) allow different default values, does the PDD indicate and justify which of the default values have been chosen for the project activity?	PDD		Yes, default value is explained in the calculation.	OK	OK
B.6.2 Data and parameters fixed ex ante					
B.6.2.1 If data and parameters will not be monitored throughout the crediting period of the proposed project activity but have already been determined and will remain fixed throughout the crediting period, are all data sources and assumptions: (a) Appropriate and correct? (b) Applicable to the proposed CDM project activity? (c) Resulting in a conservative estimate of the emission reductions?	PDD VVS	98	Yes, it is listed clearly the fixed value in PDD Section B.6.2	CL-17 CL-18 CL-20	OK
B.6.2.2 For each piece of data or parameter, are tables provided in accordance with the instructions?	PDD		Yes, it is as per AM0029 Version 3	CL-17 CL-18 CL-20	OK
B.6.3 Ex ante calculations of emission reductions					
B.6.3.1 Is a transparent ex ante calculation of project emissions, baseline emissions (or, where applicable, direct calculation of emission	PDD		Yes, as per PDD Section 6.1	OK	OK

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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
reductions) and leakage emissions expected during the crediting period, applying all relevant equations provided in the approved methodology provided?					
B.6.3.2 Is the information how each equation is applied, in a manner that enables the reader to reproduce the calculation, provided?	PDD		Yes	OK	OK
B.6.3.3 Is the information of additional background information and/or data provided in Appendix 4, including relevant electronic spreadsheets?	PDD		Yes, as per PDD Section 6.1	OK	OK
B.6.3.4 Is a sample calculation for each equation used provided, substituting the values used in the equations?	PDD		Yes, relevant values have been applied to the equation.	OK	OK
B.6.4 Summary of the ex ante estimates of emission reductions					
B.6.4.1 Are the results of the ex ante estimation of emission reductions for all years of the crediting period, provided in a tabular format?	PDD		Yes, it is provided in PDD Section B.6.4 for 7 years crediting period from 2014- 2020.	OK	OK
B.7 Monitoring Plan					
B.7.1 Data and parameters to be monitored					
B.7.1.1 Is specific information on how the data and parameters that need to be monitored would actually be collected during monitoring included?	PDD		Yes, it is described in PDD Section B.7.1	OK	OK



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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
B.7.1.2 For each data or parameter, is the information completed, in a tabular format:					
B.7.1.2.1 The source(s) of data that will be actually used for the proposed project activity (e.g. which exact national statistics). Where several sources may be used, explain and justify which data sources should be preferred.	PDD		Yes, the sources of data are provided.	OK	OK
B.7.1.2.2 Is an estimate of the data/ parameter that will be monitored during the crediting period provided?	PDD		Yes	OK	OK
B.7.1.2.3 Where data or parameters are to be measured, does it specify the measurement methods and procedures, standards to be applied, accuracy of the measurements, person/entity responsible for the measurements, and, in case of periodic measurements, the measurement intervals?	PDD		Yes however PP has not mentioned the Accuracy Classes and the clabration frequencies against key monitoring instruments / equipments, hence CAR 09 Raised	CAR-09	OK
B.7.1.2.4 Is a description of the QA/QC procedures including the calibration procedures, where applicable, provided?	PDD		Yes, it has been described as per AM0029 Version 3 requirement.	CAR-09	OK
B.7.1.2.5 Is the purpose of data indicated?	PDD		Yes, Purpose of (i) Calculation of baseline emissions; (ii) Calculation of project emissions; (iii) Calculation of leakage	OK	Ok



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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
			Are clearly stated for each parameter.		
B.7.1.3 Is this monitoring plan based on the approved monitoring methodology applied to the proposed CDM project activity?	VVS	131	Yes, as per AM0029 Version 3.	OK	OK
B.7.1.4 Does the monitoring plan contain all necessary parameters?	VVS	132(a)	Yes, as per AM0029 Version 3	OK	OK
B.7.1.5 Do the means of monitoring described in the plan comply with the requirements of the methodology including applicable tool(s)?	VVS	132(a)	Yes, measurement methods, produces and frequency have been stated clearly in PDD Section B.7.1	OK	OK
B.7.1.6 Are the monitoring arrangements described in the monitoring plan feasible within the project design?	VVS	132(b)	Yes	OK	OK
B.7.1.7 Are the means of implementation of the monitoring plan sufficient to ensure that the emission reductions achieved by/resulting from the proposed CDM project activity can be reported ex post and verified?	VVS	132(b)	Yes	OK	OK
B.7.2 Sampling plan					
B.7.2.1 Are there any data and parameters monitored in section B.7.1 above to be determined by a sampling approach?	PDD		NA, no sampling plan apply to this AM0029	NA	NA
B.7.2.2 Is a description of the sampling plan provided in accordance with the recommended outline for a sampling plan in the "Standard for	PDD		NA	NA	NA



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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
sampling and surveys for CDM project activities and programme of activities”?					
B.7.3 Other elements of monitoring plan					
B.7.3.1 Is the operational and management structure, that the project operator will implement in order to monitor emission reductions and any leakage generated by the project activity, described in the PDD?	PDD PS	56(a)	Yes, project team structure will consists of Station Manager, Shift in-charge and Shift engineers and O& M team.	OK	OK
B.7.3.2 Are the responsibilities for and institutional arrangements for data collection and archiving clearly indicated?	PDD PS	56(c)	Yes, responsibility has defined for the Project Team in PDD section B7.3	OK	OK
B.7.3.3 Does the monitoring plan include provisions to ensure that data monitored and required for verification and issuance be kept and archived electronically for two years after the end of the crediting period or the last issuance of CERs, whichever occurs later?	PS	56(b)	Yes, it has defined data will keep for crediting period or the last issuance whoever later + 2 years.	OK	OK
B.7.3.4 Does the monitoring plan include uncertainty levels, methods and the associated accuracy level of measuring instruments to be used for various parameters and variables?	PS	56(e)	Yes, it has been stated in the QA/QC procedure.	OK	OK
B.7.3.5 Does the monitoring plan include specifications of the calibration frequency for the measuring equipments?	PS	56(f)	Yes, gas metering will be subject to regular (in accordance with manufacturers' specification) maintenance and testing to ensure accuracy.	OK	OK
C. Duration and crediting period					

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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
C.1 Duration of project activity					
C.1.1 Start date of project activity					
C.1.1.1 Is the start date of the project activity stated, in the format of DD/MM/YYYY?	PDD		Yes, 08/12/2011 the approval to the EPC contractor date for implementation of the project activity. As per the NTP clause of EPC contract PP has given notice to proceed on 08/08/2012 hence the start date is considered as correct.	OK	OK
C.1.1.2 Does it describe how the start date has been determined and provide evidence to support this date?	PDD		Yes, it is base on the dated of approval of change to EPC design. Letter from PP to EPC contractor as the evidence, however the PDD section C.1.1.2 is found mentioning wrong start date and hence CAR 10 was raised.	CAR-10	OK
C.1.2 Expected operational lifetime of project activity					
C.1.2.1 Is the expected operational lifetime of the project activity stated in years and months?	PDD		Yes, 30 years. CAR 11 – In Webhosted PDD section C.1.2 PP has mentioned 30 years as expected operational lifetime of project activity, however there is no evidence to suggest that this claim is substantiated by proving the technical life of the project equipment inaccordance with EB 50 Annex 15	CAR-11 CL11	OK
C.2 Crediting period of project activity					
C.2.1 Type of crediting period					
C.2.1.1 Is the type of crediting period chosen for the project activity stated?	PDD		Yes, 7-year renewal twice.	OK	OK
C.2.1.2 In case a renewable crediting period was chosen, does it indicate whether it is the first,	PDD		Yes,	OK	OK



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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
second or third?					
C.2.2 Start date of crediting period					
C.2.2.1 Is the start date of crediting period stated in the format of DD/MM/YYYY?	PDD		Yes, 01/01/2014 expected new plant operation or the date of CDM project activity registration, whichever is later.	OK	OK
C.2.3 Length of crediting period					
C.2.3.1 Is the length of crediting period stated in years and months?	PDD		Yes, 7 years 0 month	OK	OK
D. Environmental impacts					
D.1 Analysis of the environmental impacts					
D.1.1 Is a summary of the analysis of the environmental impacts of the project activity and references to all related documentation provided?	PDD		Yes, An environmental impacts study was done by Environmental Resources Management (S) Pte Ltd (ERM) in Oct 2010 and a report "Construction Impacts of the Power Plant) is available during validation.	OK	OK
D.2 Environmental impact assessment					
D.2.1 If an environmental impact assessment is required, are conclusions and references to all related documentation provided?	PDD		Yes, Impact during construction phase of the power plant has been provided in PDD Section D.2	OK	OK
D.2.2 Have the project participants undertaken an analysis of environmental impacts activity, including transboundary impacts, and whether those impacts are considered significant by the project participants or the host Party?	VVS	134	No significant impact identified. No transboundary impact applicable to the project activity.	OK	OK
D.2.3 If the host Party requires an environmental impact	VVS	135	Yes, refer to the Construction Impacts of the	OK	OK



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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
assessment, have the environmental impact assessment approved by local government?			Power Plant Report for the environmental impacts analysis.		
E. Local stakeholder consultation					
E.1 Solicitation of comments from local stakeholders					
E.1.1 Did the project participants complete a local stakeholder consultation process and that due steps were taken to engage stakeholders and solicit comments for the proposed project activity?	VVS	138	Yes, advertisement on 19/07/2012 to invite local government authorities and public stakeholders. Actual local stake holder meeting on 26/07/2012	OK	OK
E.1.2 Is the process by which comments from local stakeholders have been invited provided?	PDD		Yes, agenda of meeting has been provided	OK	OK
E.2 Summary of comments received					
E.2.1 Are stakeholders that have made comments identified?	PDD		Yes, most comments are general question on the project activities.	OK	OK
E.2.2 Have comments by local stakeholders that can reasonably be considered relevant for the proposed CDM project activity been invited?	VVS	139 (a)	Yes	OK	OK
E.2.3 Is the summary of comments provided complete?	PDD VVS	139 (b)	Yes	OK	PK
E.3 Report on consideration of comments received					
E.3.1 Is information provided to demonstrate that all comments received have been considered?	PDD VVS	139 (c)	Yes, reply from PP has been provided.	OK	OK
F. Approval and authorization					



CHECKLIST QUESTION	Ref.	§	COMMENTS		Draft Concl	Final Concl
F.1 General						
F.1.1 Is it indicated whether the letter(s) of approval from Party(ies) available at the time of submitting the PDD to the validating DOE?	PDD		Received LOA and verified the contents <ul style="list-style-type: none"> - Letter of Approval from NEA for GMR Energy (Singapore) Pte. Ltd. Dated 23/04/2013 - As there is a change in the name of PP from GMR Energy (Singapore) Pte. Ltd. to PacificLight Power Pte. Ltd., PP has approached NEA to issue a fresh approval, however DNA has issued a letter approving the said change and hence it is concluded that new PP i.e. PacificLight Power Pte. Ltd. is and authorized PP for the proposed CDM Project 		Pending	OK
F.2 Approval			Singapore	Not Applicable		
F.2.1 Has the DNA of each Party indicated as being involved in the proposed CDM project activity in section A.3 of the PDD provided a written letter of approval?	VVS	38	Obtained and validated	NA	Pending	OK
F.2.2 Does the letter of approval from DNA of each Party confirm that : (a) The Party is a Party of the Kyoto Protocol (b) The participation is voluntary (c) In the case of the host Party, the proposed CDM project activity contributes to the sustainable development of the country (d) Refers to the precise proposed CDM project	VVS	39	Yes LOA is confirming a,b,c and d requirements as per VVS Para 39	NA	Pending	OK



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CHECKLIST QUESTION	Ref.	§	COMMENTS		Draft Concl	Final Concl
activity title in the PDD being submitted for registration						
F.2.3 Is(are) the letter(s) of approval unconditional with respect to (F.2.2) above?	VVS	40	Yes LOA is unconditional	NA	Pending	OK
F.2.4 Has(ve) the letter(s) of approval been issued by the respective Party's DNA? If there is doubt with respect to (F.2.2) above, was it verified with the DNA that the letter of approval is valid for the proposed CDM project activity under validation?	VVS	41,42	No. these letters were submitted to DOE by PP	NA	Pending	OK
F.2.5 Does the letter of approval by the DNA of the host Party confirm the contribution of the proposed CDM project activity to the sustainable development of the host Party?	VVS	51	Yes		Pending	OK
F.3 Authorization						
F.3.1 Has each project participant been authorized by at least one Party involved in a letter of approval?	VVS	45	Yes PP has obtained authorization from host Party DNA i.e. Singapore. PP is intended to registered the project unilaterally and hence there is no identification of Annex I party is done at this time.		Pending	OK
F.3.2 Is the information in tabular form in the PDD consistent with the contact information for project participants provided?	VVS	46	Yes		Pending	OK
F.3.3 Are any entities other than those approved as project participants included in the PDD?	VVS	47	No		Pending	OK



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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
F.3.4 Has the approval of participation issued from the relevant DNA? And if in doubt, was it verified with the DNA that the approval of participation is valid for the proposed CDM project participants?	VVS	48	Yes, approval of participation is done by the Singapore DNA and there is no doubt in the approval. The Approval is found valid	Pending	OK
Part III Others					
A. Appendixes of PDD					
A.1 Appendix 1: Contact information of project participants					
A.1.1 For each organization listed in section A.4 of PDD, is the table in PDD completed, with the following mandatory fields: Organization, City, postcode, Country, Telephone and Fax, e-mail and Name of contact person?	PDD		Yes, all have been provided in Appendix 1	OK	OK
A.2 Appendix 2: Affirmation regarding public funding					
A.2.1 If applicable, is the affirmation obtained from Parties providing public funding to the project Activity attached?	PDD		NA, confirmed no public funding	OK	OK
A.3 Appendix 3: Applicability of the selected methodology(ies)					
A.3.1 Is the background information on the applicability of the selected methodology provided?	PDD		Yes, as per AM0029 Version 3	OK	OK
A.4 Appendix 4: Further background information on ex ante calculation of emission reductions					



CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
A.4.1 Is the background information on the ex ante calculation of emission reductions provided?	PDD		Yes, as per PDD Section B.6.1	OK	OK
A.5 Appendix 5: Further background information on monitoring plan					
A.5.1 Is the background information used in the development of the monitoring plan provided?	PDD		Yes, as per PDD Section B.7.3	OK	OK
A.6 Appendix 6: Summary of post registration changes					
A.6.1 Is a summary of the post registration changes provided?	PDD		NA. project not yet registered.	NA	NA
B. Global Stakeholder Consultation					
B.1.1 Is there any comment on the PDD of the proposed project activity received during Global Stakeholder Consultation process?	VVS	34	Yes there were 23 comments received on 12/09/2012 and are submitted to the PP for providing responses.	OK	OK
B.1.2 If yes, have all comments been taken into account during the validation of the proposed project activity?	VVS	35	Yes, Validation team has taken due account of all comments received, and discussed each comments with PP and observed that Few comments are not relevant to project activity and those which are have bearing on the project activity were discussed in large to ensure that project activity is in accordance with the EB rules.	OK	OK
B.1.3 If comments indicate that the proposed project activity does not comply with the CDM requirements and are not substantiated, is there any further clarification from the entity providing the	VVS	36	<i>Yes, PP has responded to all comments adequately and Validation team has taken due account of al responses provided by the PP.</i>	OK	OK



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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
comment?					
B.1.4 If yes, how comments received have been taken due account?	VVS	36	Yes, Please find Annex B to the validation Report for complete details on Due account of the Commentaires received during one month webhosting period.	OK	OK
B.1.5 If no, are the comments as originally provided proceeded to assess?	VVS	36	Not applicable	NA	NA
C. Modalities of Communications (MoC)					
C.1.1 Has the corporate identity of all project participants and focal points included in MoC statement, as well as the personal identities, including specimen signatures and employment status, of their authorized signatories been validated by:	VVS	53	Yes MoC is signed by 1. Mr. Loknath Shivaprasad 2. Mr. Srinivasan Rangachari	OK	OK
C.1.1.1 Directly checking evidence for corporate, personal identity and other relevant documentation; or	VVS	54(a)	Identities were cross checked using Passport and a written letter from PP.	OK	OK
C.1.1.2 Notarized documentation; or	VVS	54(b)	Not Applicable	NA	NA
C.1.1.3 Written confirmation from the project participant or the coordinating/managing entity that all corporate and personal details, including specimen signatures, are valid and accurate.	VVS	54(c)	Yes	OK	OK
C.1.2 If (C.1.1.3) above was chosen, is it ensured that the MoC statement is received from a project participant with whom the DOE has a contractual	VVS	55	Yes	OK	OK



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CHECKLIST QUESTION	Ref.	§	COMMENTS	Draft Concl	Final Concl
relationship?					
C.1.3 If (C.1.1.3) above was chosen, is it ensured that the official who submits the MoC statement to the DOE and the official who signed the written confirmation (if a different person) is/are duly authorized to do so on behalf of the respective project participant?	VVS	56	Yes, the official who submits the MoC statement to the DOE and the official who signed the written confirmation are authorized to do so on behalf of the new Project Participants i.e. PacificLight Power Pte. Ltd.	OK	OK
C.1.4 If it is unable to validate the requirements by applying C.1.1.1 to C.1.1.3 above, are any further validation activities performed?	VVS	57	Not Applicable	NA	NA
C.1.5 Has the latest version of the form "Modalities of Communication statement" (F-CDM-MOC) been used?	VVS	60(a)	Yes	OK	OK
C.1.6 Is the information required as per F-CDM-MOC, including its annex 1, correctly completed?	VVS	60(b)	Yes, There is no Annex 1 Party involved	OK	OK
C.1.7 Do the project participant's authorized signatories signing the F-CDM-MOC correspond to the project participant's authorized signatories included in F-CDM-MOC, annex 1?	VVS	60(c)	Yes, Authorized Signatories are 1. Mr. Loknath Shivaprasad 2. Mr. Srinivasan Rangachari	OK	OK

**Table 3 Resolution of Corrective Action and Clarification Requests**

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 1 and 2	Summary of project owner response	Validation team conclusion
<u>CORRECTIV ACTION REQUEST (CAR)</u>			
CAR 01 Webhosted PDD section A.2.4 does not provide correct site address and the geographical coordinates provided in the PDD are not matching with the coordinates taken during site visit at both turbine installations	A.2.4	The geographical coordinates of the project activity are now updated in the revised PDD, Section A.2.4 as '1°17'0" N and 103°43'11" E'. This matches with the locations noted in the site visit.	PDD section A.2.4 is found corrected and the updated geographical coordinates are found in accordance with the physical measurement at both turbine locations done during the Site visit, hence acceptable. CAR 01 is Closed.
CAR 02 The technology involved is combined cycle electricity generation system. However it is not clear if there will be supplementary firing in HRSG.	A.3.1.1	The PDD, Section A.3 is updated to clarify that 'The HRSG is unfired type and no supplementary fuel firing will happen in it.'	Ok closed by verifying the EPC contract Specification of HRSG in Scope book Part I & II Part 2 Section. It is clearly mentioned in the specification that HRSG will be of Unfired type with three pressure, reheat, natural circulation drum type units with horizontal gas flow. The response to CAR provided by PP and corrections in PDD are acceptable and hence the CAR is closed.
CAR 03 In webhosted PDD section A.3 PP has presented	A.3.6	The PDD, Section A.3 is updated to give 1) list and the arrangement of the main	PP has updated the PDD to address CAR 03 and corrections made by



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description on Technology and measure, however there is no evidence to suggest that it includes description on list and the arrangement of the main manufacturing/production technologies, systems and equipment involved. Energy and mass flows and balances of the systems and equipment included in the project activity in accordance with EB guideline EB 66 Annex 8.		manufacturing/production technologies 2) systems and equipment involved 3) Energy and mass flows and balances of the systems and equipment included in the project activity	PP are verified by the validation team and found acceptable and hence CAR 03 is closed
CAR 04 In Webhosted PDD section B.4, page 11 PP has presented the levelized cost of generation for power generation using coal as energy source and cost of electricity imported from other country, however there is no evidence to suggest that how these cost are arrived and what are the assumptions considered and how these assumptions are supported using credible evidences.	B.4.10	The PDD is now updated to give detailed techno-economic assumptions for the investment analysis. The supporting excel sheet based financial models and evidences for the assumptions used are also being submitted to the DOE with this response.	Validation team has verified revised PDD Section B.4 and found that Techno-economic assumptions are provided satisfactorily. Input parameters considered found relevant and hence CAR 04 is closed.
CAR 05 In Webhosted PDD section B.5 table showing Techno economic parameters for 800 MW NG power plant consists of various techno commercial parameters while verifying these parameters it is observed that (a) Out of these parameters following parameters are found not explained clearly i.e. Interest Rate, O&M Cost including insurance, Annual Escalation on O&M Cost. (b) Capacity utilization, auxiliary consumption and Net station heat	B.5.4.1	The explanation of these inputs parameters is corrected and supporting evidences are being submitted to the DOE with this response. The electricity consumption for generation of electricity during project scenario is met from the generation of project activity plant and thus only net export is used for the investment analysis (and emission reduction calculation).	<u>Validation Team Comment on the Response Dtd. 09/10/2012:</u> <i>From the Financial model submitted for verification it is observed from the assumption sheet that the gas quantity is referred to the "Financial closure model, "Rev" sheet, cell O109+P109", However there is no evidence how this gas quantity is arrived at in a transparent manner, Please provide transparent calculation using Plant capacity and mass balance.</i>



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values provided are found wrong. Gas Consumption for generation of electricity during project scenario is not considered.		PP response 2: The calculation of annual gas requirement (based on annual electricity generation and plant heat rate, gas NCV) for project is shown in the emission reduction and financial analysis sheets now. The necessary assumptions and its sources are also discussed	07/11/2012 <i>Verified revised Emission reduction calculations and found that the the Gas consumption value is changed from 33405 BBTU to 32913BBTU, this shown transparently calculated using relevant assumptions, hence accepted and closed.</i>
CAR 06 PP has presented a table in webhosted PDD section B.5 showing techno economic parameters of power generation using coal as the energy source, however there is no supporting evidences provided during site visit.	B.5.4.1/ B.5.4.4.2	<p>The evidences for the investment analysis of coal based power plant as a based alternative are now provided to the DOE with this response.</p> <p>PP response 2:</p> <p>1) The CERC, India recommended value of heat rate for subcritical coal based power plant using high quality imported coal is 2197 kcal/kWh (this translates into efficiency = $859.9/2197 = 39.14\%$). The efficiency calculated here is higher than the default efficiency 38.7% mentioned for sub-critical technology as per baseline methodology ACM0013, version 05.0.0, Appendix - Specifications of power generation technologies. Thus, the value used using CERC reference (that PP's subsidiary in India shared) may be accepted.</p>	<p><u>Validation Team Comment on the Response Dtd. 09/10/2012:</u></p> <p><i>In the financial model it is mentioned that “CERC-(Terms-and-Conditions-of-Tariff)-Regulations-2009; pg. 46 (heat rate applicable for imported coal - so taken for any international site)” – Please explain how Indian Terms and conditions are applicable in Singapore?</i></p> <p><i>Further while crosschecking total investment cost of coal fired power plant, the evidence provided is the cost of another coal power plant in Singapore, from the document it was observed that the total cost is 2 Billion S\$, for 160 MW Power plant, in this case how evidence is supporting the estimated cost of 1000 Million S\$. Also from the Document submitted i.e IEA ETSAP – Technology Brief E01- April 2010 on Coal fired Power –</i></p>



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		<p>2) The reference used earlier seems to have quoted value of total complex for 'Tuas Power – Multi utility services plant'. As this translates into US\$12.5 million/MW, this source is not used. The capital cost is now taken from IEA, 2010 reference cited and highest value recommended for supercritical power plant (even though different technology than that of baseline alternative – subcritical plant) is used conservatively. The capital cost used is S\$ 2,461.4 million/MW. (Please note that as PP has considered 160 MW x 5 units due to Government decision not to allow high capacity coal plants, supercritical power technology which has minimum size requirement of 660 MW for one unit is not considered realistic baseline alternative. However capital cost of this technology being conservative, is used for the financial analysis).</p>	<p>WWW.ETSAP.ORG, a conservative assumption for the Coal fired plant investment cost is provided and as per the document 2500\$/kWh is considered as conservative estimate for investment cost. If the We consider this the investment cost for 800MW capacity coal fired plant comes to 2000 Million \$, please explain the discrepancy in the calculation of investment cost for Coal fired plant. (Please refer My mail Dtd. 16/10/2012)</p> <p>07/11/2012</p> <p>Based on the response and independent search on website it is observed that the value of heat rate applied is comparable to the default value provided by ACM0013 Version 05.0.0 and it found correct. It was cross checked with the independent study available publically on website that the heat rate of 9857 Kj/kWh is applied in USA by EPA for coal boiler Heat Rate reduction study conducted in 2009 for operating coal fired boilers /Ref-75/.</p> <p>PP has revised the Assumption for the investment and is found in accordance with IEA ETSAP – Technology Brief E01- April 2010 on Coal fired Power –</p>
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			<u>WWW.ETSAP.ORG,</u> HENCE THE CAR 06 IS CLOSED.
<p>CAR 07</p> <p>In webhosted PDD Section B.5 it is explained that PP will be demonstrating project additionality using Bench mark Investment analysis (As per Sub Step 1 of Approved Methodology AM0029), however it is not clear</p> <ul style="list-style-type: none"> (a) Which IRR is selected Project IRR or Equity IRR. (b) How PP has calculated the IRR without CER and With CER (c) How PP has selected and calculated the benchmark value to compare the IRR 	B.5.4.4.1	<p>The financial indicator chosen for the demonstration of additionality is 'levelised cost of electricity generation'. The justification of this parameter is given in the revised PDD. Thus, IRR is not calculated. The benchmark is chosen as the lowest levelised cost of electricity generation among all alternative scenarios.</p> <p>The impact of CDM revenue is also discussed now in the revised PD.</p> <p>PP response 2:</p> <ul style="list-style-type: none"> 1) The equity IRR is now calculated and compared with the benchmark i.e. default expected ROE as per the guidance EB 62, Annex 5. 2) The impact of CDM revenue is also discussed. 	<p><i>Further to my discussion with financial expert and refereeing to other registered projects, it is recommended to demonstrate the Additionality of project through Benchmark approach. Levelized cost of coal fired plant cannot be considered as the Benchmark. If we do that way then it is just like investment comparison analysis, which is not permitted by the approved methodology.</i></p> <p>07/11/2012</p> <p><i>PP has revised the financial analysis and carried out Equity IRR calculation,, which is found correct as the Debt to Equity Ratio is 57:43. PP has identified 10.5 % as default benchmark value on real term from the EB guideline EB 62 Annex 5 Appendix and added inflation rate 5.2% to make nominal value of 15.7%. The Benchmark calculation is found correct and applicable for the proposed project activity hence the CAR is closed.</i></p>
<p>CAR 08</p> <p>Sensitivity analysis is not performed to check how IRR is behaving with +/- 10% variation.</p>	B.5.4.4.5	<p>The financial indicator chosen for the demonstration of additionality is 'levelised cost of electricity generation'. The</p>	<p><i>Please Refer above comment.</i></p>



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		<p>justification of this parameter is given in the revised PDD. Thus, IRR is not calculated.</p> <p>The sensitivity analysis is performed on important parameters and its justification is given in the revised PDD.</p>	<p>07/11/2012 – Please refer Closure remark of CAR 07. CAR 08 is closed.</p>
<p>CAR 09</p> <p>In webhosted PDD section B.7.1, it was observed that Accuracy classes is not mentioned against relevant instruments selected to monitored important parameters during crediting period e.g. EGExport.y, FCNG.y.</p>	<p>B.7.1.2.3/ B.7.1.2.4</p>	<p>The Section B.7.1 of the PDD is revised to give accuracy class of measurement instruments for the parameters to be monitored.</p> <p>PP response 2:</p> <p>The details of this monitoring parameter are filled now in the updated PDD.</p>	<p><u>Validation Team Comment on the Response Dtd. 09/10/2012:</u></p> <p>Accuracy class and other details are found blank against parameter $FC_{FF,y}$</p> <p>07/11/2011</p> <p>Section B.7.1 is found updated by adding Accuracy requirement for the Monitoring instrument, the accuracy class is taken from the Manufacturer's specification of Gas flow meter hence accepted and closed the CAR.</p>
<p>CAR 10</p> <p>Webhosted PDD section C.1.1 is found mentioning wrong start date of project activity</p>	<p>C.1.1</p>	<p>The Section C.1.1 of the PDD is revised to give correct CDM starting date. The evidence of same is shared with the DPE during site visit.</p>	<p>PDD section C.1.1 is now revised with the correct start date of project, which is 08/12/2011. The correction found satisfactory hence accepted and closed.</p>
<p>CAR 11</p> <p>In Webhosted PDD section C.1.2 PP has claimed 30 years as expected operational life time of project activity, however there is no evidence to suggest that this claim is substantiated by proving the technical life of the</p>	<p>C.1.2.1</p>	<p>In line with the guidance of EB guideline EB 50 Annex 15, first two options are not applicable as (a) manufacturer of GTs did not specify any technical life (b) expert opinion is not taken by PP. Thus, based</p>	<p>Based on the response provided by PP and evidences provided the assumption of 30 years Technical lifetime of project is justified and hence the CAR is closed.</p>



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project equipment in accordance with EB guideline EB 50 Annex 15.		<p>on option 'c' default value of "Gas turbines, above 50 MW capacity = 200,000 hours". Considering 72% capacity utilization as per PP's financial analysis at investment decision, the useful life of plant is</p> <p>$200,000 / (24 \times 365 \times 72\%) = 31.7$ years. The PP had estimated 30 year life at investment decision and for the financial analysis submitted for bank loan approvals. This value being close to the default recommended in the above referred guidance a life of 30 years is considered here.</p>	<p>Further refer to CL11, as it is clearly mentioned that the Technical lifetime of Plant is 25 years in the EPC contracts and various other Technical Queries answered by the EPC Consortium, PP has revised the PDD with 25 years of Life time.</p> <p>However maintained 30 years lifetime while carrying out financial analysis. Considering PLF of 72%, the lifetime of 25 years is extended to 31 years, which is conservative for the financial analysis hence it is acceptable and CAR is closed on the basis of response to CAR 11 and CL 11.</p>
<u>CLARIFICATIONS (CL)</u>			
<p>CL 01</p> <p>In Webhosted PDD PP has described that the Capacity of the proposed CDM project is 800 MW, however in various other technical documents and approvals obtained by the PP it shows 771MW (385.5MW + 385.5MW) and 745 MW, please explain why this discrepancy exists in the capacity of the proposed project activity capacity. Also it was observed from the Legal approval document that project is a cogeneration type of project; please explain how this is in compliance with the Methodological requirement?</p>	A.1	<p>The installed capacity of the project is 800 MW. This is evident from the</p> <ol style="list-style-type: none"> 1) EPC contract with Siemens for 2 X 400 MW CCP project 2) 'Mandate letter for bank loan facility, 03/06/2011, pg. 17 of 98' <p>The other referred capacity 771 MW is based on the 'net available for same after accounting for auxiliary consumption'.</p> <p>Before present management (GMR</p>	<p><u>Validation Team Comment on the Response Dtd. 09/10/2012:</u></p> <p>- In the response it is mentioned that "Referred capacity 771 MW is based on the net generating capacity available after accounting Auxiliary consumption" – please provide relevant evidences to demonstrate the auxiliary load of power plant. Also please explain when the net generation capacity is 771 MW then</p>



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		<p>Energy) took over project ownership, earlier owner of plant was considering to develop project as cogeneration to be able to sell steam to nearby industries. However, the latest clearances mention plant as only a combined cycle power (only) plant. Thus, there is no cogeneration in project activity and methodological requirement is met.</p> <p>PP response 2:</p> <p>1) The EPC contract (Book III, Vol I, Section 1.2.1.1, pg. 1 of 1, Rev. 2) gives power plant will have two units of net 385.5 MW each. This will give total net capacity as 771 MW. Thus, 3.6% auxiliary consumption is calculated based on the 800 MW gross installed capacity.</p> <p>2) The net electricity export in the CER sheet is calculated based on 800 MW nameplate capacity and 72% annual capacity utilization, which is calculated based on the 25 year net export calculated for the financial analysis used for the loan approvals. Thus, this will not result in overestimation of the emission reductions due to the project activity.</p>	<p><i>why 800 MW capacity is used while calculating CER Calculation?</i></p> <p>07/11/2012</p> <p><i>Verified Response and subsequent corrections in the ER Calculation spread sheet and found acceptable hence the CL 01 is closed.</i></p>
CL 02 PP has demonstrated that the LNG supply will be	B.4	Price inelastic supply as referred in the footnote of methodology is '(limited	OK Accepted and Closed



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from Indonesia and Malaysia, Please explain how PP considers the price-inelastic supply constraints for this arrangement.		resources without possibility of expansion during the crediting period). In the case of host country, the LNG terminal is under construction and its capacity 3 MTPA x 2 phases is designed considering all future NG demand till 2018 ⁵ . Thus, with LNG terminal in place, there will not be 'price-inelastic supply constraint'. Also, after capacity of under construction LNG terminal is exhausted, the Government is also considering allowing more LNG import license (please refer footnote 1 referred above). Thus, there is no price inelastic supply constraint in the host country.	
CL 03 During site visit it was observed that PP has installed 04 Storage tanks of capacity 25000 M ³ each at site to store back up fuel i.e. Diesel, please explain how the project activity fulfills the applicability condition i.e. "the project activity is the construction and operation of a new natural gas fired grid connected electricity generation plant" with foot note No 1, specifying Natural gas as the primary fuel and only small amounts of other startup or auxiliary fuels is allowed provided it should not be more than 1% of total fuel use, on energy basis. Further project participant needs to	B.2	As discussed by the management and clarified about this regulatory requirement during the site visit – 1) management has no intention to use diesel for electricity generation as liquid fuels are very costly and PP cannot sell merchant power in competition to other plants if project activity uses diesel. 2) The diesel fuel storage is provision to meet regulatory requirement of 'Electricity License for Generation Licensee' from EMA to the project activity. As per, pg. 10,	Based on the Legal Requirement in the Host country the back up fuel storage in such huge quantity is mandatory. PP has made a provision of monitoring the consumption of back fuel during crediting period and the PDD is found revised accordingly, hence the CL is closed.

⁵ Refer Pg. 3, para 3. http://www.ema.gov.sg/media/com_consultations/attachments/4f755f26e9d75-Post-3_Mtpa_Consultation_Paper_FINAL.pdf



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clarify how it is ensured that the natural gas would be the primary fuel to be used in the project activity at all times.		<p>para. 10, PP is requirement to maintain 90 days of fuel reserve 'on site'. This is in line with the energy security concerns of the country and to be used only in case of emergencies.</p> <p>PP has also made a provision to monitoring diesel used and its energy content (NCV). If in some emergency, PP has to use more than 1% of this fuel (other than NG), the emission reduction will not be claimed in that monitoring period.</p>	
<p>CL 04</p> <p>From the South East Asian grid structure it is understood that Malaysian grid is also connected to Singapore Grid, however this is not mentioned in the project boundary, please explain why Malaysian grid is excluded from the project boundary and how emission factor calculated for the Singapore grid considers the Emission factor of Malaysian grid?</p>	B.3	<p>As per PP's information, there is no electricity import till date in Singapore⁶ and a concept paper was put up by EMA in Dec. 2011 for public consultation⁷. There is plan to import 600 MW by 2017-18.</p> <p>Thus, Malaysian grid is not included in the project boundary and its impact on grid emission factor is not considered.</p>	<p>Based on the Grid Structure in Singapore it was confirmed that although the grid is connected, however there is no power import or export happening currently.</p> <p>This was further confirmed through a telephonic discussion with Energy Market Authority of Singapore, The response provided by PP is acceptable and hence CL 04 is closed.</p>
<p>CL 05</p> <p>PDD Section B4 under the c3 Power generation using fuel oil PP has justified it is a plausible</p>	B.4	As per the publication 'Singapore Energy Statistics 2011, pg. 14' between 2006-2012, only 17-18% of the electricity	The justification provided by the PP is found acceptable based on the credible evidences from EMA

⁶ <http://www.ema.gov.sg/page/58/id:127/>

⁷ http://www.ema.gov.sg/media/com_consultations/attachments/4ee55a713fe04-EMA-_Consultation_Paper_on_Elect_Import_Framework__final_12_Dec_11.pdf



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<p>baseline scenario, however, PP only consider 3 plausible alternative which are</p> <ul style="list-style-type: none"> a. Project activity implemented without CDM b. Power generation using coal as the energy source c. Cost of electricity imported from other countries. <p>Please clarify why did not include the power generation using fuel oil.</p>		<p>generation is from the fuel oil in Singapore. This again is from the old power plants in the country and no new fuel oil (any other liquid fuel like naphtha, diesel) power plants have been commissioned in last 10 years. Thus, this alternative 'power generation using fuel oil' is not considered realistic.</p>	<p>showing that there is no increase in the Power plant using fuel oil, hence the CL 05 is closed.</p>
<p>CL 06</p> <p>While identifying the Plausible baseline scenario, PP has identified Base load for comparing various alternative delivering similar services, please explain rational behind selecting Base load as similar services.</p>	B.4	<p>The project activity plant is expected to operate at 72% annual PLF i.e. 6,307 hours/ year. As per the other baseline methodology, ACM0013, Version 05.0.0 "base load is defined as a load factor of more than 3,000 hours per year".</p> <p>Thus, the project activity is considered base load and baseline alternatives providing base load services are considered similar.</p>	<p>The response is found in accordance with ACM 0013 and hence the CL 06 is closed.</p>
<p>CL 07</p> <p>PP has selected levelized cost of generation as a financial indicator for demonstrating financial additionality of the proposed project; however there is no justification provided in the webhosted PDD, why PP considered levelized cost as an appropriate financial indicator.</p>	B.5	<p>The PDD is now updated to give justification for choice of financial indicator chosen for the demonstration of additionality.</p>	<p>Verified revised PDD and found the justification for selection of financial indicator is provided and found satisfactory hence CL07 is closed.</p>
<p>CL 08</p> <p>In Webhosted PDD section B.6.3 PP has presented calculation of $EG_{PJ,y}$ considering 800</p>	B.6.3	<p>The PDD is now updated to show annual export same as that used for the bank loan application (financial closure model).</p>	<p>Verified the corrected PDD and found the assumption in the PDD are in accordance with the Financial</p>



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MW capacity and 6000 annual operating hours, please explain how this is in line with base load selection and what is the rational for calculating EG _{PJ,y} considering highest capacity.		This electricity export is used in the investment decision making process and also the loan sanction process, thus considered conservative. The emission reduction calculation and investment analysis now used this consistent value of EG _{PJ,y} .	analysis Sheet and hence the CL 08 is closed.
CL 09 While validating prior consideration for the proposed project activity it was observed that PP has taken decision to implement the project on 15/07/2011 and identified the start date of the project activity as 08/12/2011, however from the prior history it was noticed that the EPC contract was signed for the project activity dtd. 29th June 2007, please justify how Board decision came later than the EPC contract and how the project is categorized as the project activity with a start date from 2 nd August 2008 (as per EB 62 Annex 13).	B.5.7.1 / B.5.7.2	<p>EPC contract with Siemens was signed on 08/12/2011 and it has a clause on 'notice to proceed - NTP'. As per this, unless PP achieves financial closure and gives notice to proceed with first payment, the EPC contract is not valid. Thus, this condition being there in the EPC contract, this is not considered as the commitment of PP to implement the project. As discussed with DOE, there are examples that EPC contracts are signed and in case project developer fails to achieve financial closure and give NTP, the power projects are not implemented.</p> <p>Later, during financial closure and NTP process, the EPC contractor informed PP about major changes in the equipment specifications due to accident involving similar unit of Siemens (evidence shared with DOE). At that point of time, PP had option to terminate EPC contract and in that case, project activity would not have</p>	<p>Validation team has verified EPC contract document carefully and found that there is a provision of the NTP clause. The transition of changes in the EPC contract are demonstrated correctly.</p> <p>Validation team verified the actual construction start date through various documents listed below</p> <ol style="list-style-type: none"> 1. Internal progress meeting between consortium partners and PP 2. Project Schedule 3. And a formal letter issued by the Consirtium partner to PP for the start date of construction activity which is found after the investment decision date and hence accepted. <p>Based on the response provided by</p>



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		<p>been implemented.</p> <p>Thus, approval of the changes to EPC equipments on 08/12/2011 is considered as the commitment to expenditure for implementation of the project activity and hence 'start date of CDM' (EB 41 meeting report, pg. 17, para 67).</p> <p>Thus, the start date is considered after 02/08/2008 in line with EB 62, Annex 13.</p>	PP and relevant evidences submitted, CL 09 is closed.
<p>CL 10</p> <p>Approved baseline methodology AM0029 Rev 03 prescribes to Describe the impact of the registration of the project activity by applying Step 5 (Impact of CDM registration) of the latest version of the "Tool for demonstration assessment and of additionality" agreed by the CDM Executive Board, Please explain how the project activity fulfils this requirement.</p>	B.2.2	<p>The PDD is now updated to discuss the impact of CDM registration and how it will alleviate barrier in line with the referred guidance.</p>	Verified revised PDD and found satisfactory hence the response provided by PP is Accepted and CL 10 is closed.
<p>CL 11</p> <p>While verifying the EPC contract and Specification of HRSG from the Scope document and it is observed that the design life time of HRSG is 20 years. Please find herewith reproduced para from the Scope Document as given below,</p> <p>"HRSG's are designed for 52 hot starts, 52 warm start and 12 cold starts per year, total plant is design life is 20 years and complies with ABMA/Ref-/. The high pressure, intermediate</p>	c.1.2.1	<p>PP's team had noted this and had a discussion with consortium during technical clarification stage and raised this issue in Aug 2010.</p> <p>EPC Consortium had then agreed to design the plant life as 25 years. The contract amendment is attached for your reference.</p> <p>Thus, in the PDD, when technical life is discussed, we will revise it to 25 years (as</p>	<p>Verified DEVIATION AND CLARIFICATION document submitted by PP and subsequent correction in the Life time of the equipment. PP has corrected the Lifetime to 25 years, which is found more conservative as per the manufacturer's specification and hence the crediting period of 21 years is justified.</p> <p>PP has utilized 30 years as lifetime</p>

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<p>pressure and low pressure sections will consists of economizer, evaporator and super heater. The re heater section will heat IP steam and exhaust steam from the HP section of the steam turbine for admission into the IP turbine. HRSG's are designed to operate within maximum exhaust gas flow and temperature ranges of the CTG's"</p> <p>Please explain how lifetime of 30 years is justified for HRSG units?</p>		<p>this is as per manufacturer specifications and fits option (a) of lifetime related CDM guidance.</p> <p>Further, I will call you to decide if we can keep additionality same as presented now for 30 years considering</p> <p>(1) PP used same for investment decision and loan approvals</p> <p>(2) the 30 year cash flows will present more conservative analysis; and</p> <p>(3) considering annual operating hours 6,307/ year at 72% capacity utilization may increase total operating years (due to lower utilization of plant).</p>  <p>Adobe Acrobat Document</p>	<p>while carrying out financial analysis as the total lifetime increases due to assumption of 72% PLF, this found acceptable and hence the CL 11 is closed.</p>
<p>CL12</p> <p>PP has identified Power generation using coal as the energy source, however from the publically available information it is very clear that Singapore government is not very keen and supportive in promoting coal based power plants in Singapore. Also it is understood that Tuas Power Plant will be using Biomass as another fuel and supplying Power as well as Steam to Tembusu Multi Utilities Complex, in such</p>	<p>B.4</p>	<p>The EMA media release clearly says that new large coal based power plants will not be allowed till LNG demand stabilizes from the under construction Singapore LNG terminal. At least three media reports already state that up to 2.85 MTPA capacity out of 3 MTPA (terminal scheduled to be commissioned next year) is sold out. Thus, the coal based alternative is not likely to affect the LNG</p>	<p>Submitted evidences i.e. press releases were verified carefully by Validation team and found correct .</p> <p>Also the justification provided by PP is in accordance with the Approved methodology utilized by the PP to develop the proposed CDM Project hence the CL 12 is closed.</p>



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scenario, please explain how PP considers this alternative as credible and most plausible.		<p>demand.</p> <p>Also, another media report suggests that Taus Power is already considering phase 2 of their 160 MW coal based power plant. Thus, clearly there is no objection to the new coal based power plants of similar size. PP has also considered 160 MW x 5 units for possible baseline alternative.</p> <p>These baseline plants are electricity only power plants and not cogen like Tuas plant. The reference to Tuas plant is made only to justify credibility of coal based alternative (practical and regulatory approvals possible). Thus, there no direct relation between Tuas power plant and baseline of this project activity.</p> <p>Hence, coal based power generation option is considered as the credible.</p>	
<p>CL 13</p> <p>Please submit evidence of calculating Levelized cost for alternative (d) i.e. Import of Electricity form Other countries in SEA region.</p> <p>Also from PDD Version 1 it was observed that PDD is found referring to estimates from Power Market Analyst contracted by PP- Please provide contract document signed with Power analyst and his credentials.</p>	B.5.4.4.2	<p>The estimate of this electricity import was given based on the National Energy Market of Singapore, Monthly Trading Report, Dec. 2010. The report showed daily average price between S\$151-177/MWh.</p> <p>Since the import of electricity is scheduled to start (if at all takes off) only in 2018, the pricing estimate may not be considered realistic. In any case, the most attractive</p>	<p>Evidence provided by the PP is correct and credible to justify that identified baseline alternative is plausible and applicable in host country Singapore and hence the CL 13 is closed</p>



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		baseline alternative is coal based power generation and hence cost of electricity import is not discussed in the PDD further for additionality.	
CL 14 Loan repayment is considered as cost in levelized cost working. Loan repayment cannot be cost component. Interest can be considered but not loan repayment. Please clarify.	B.5.4.4.4	The levelised cost calculation is now updated to rectify identified discrepancy.	Revised Financial Analysis spread sheet was verified and found that Only Interest on loan is considered for calculating the LCOE for the project hence found acceptable therefor the CL14 is closed.
CL 15 Salvage value is considered as negative value. Please clarify.	B.5.4.4.4	The levelised cost calculation has shown all expenses in the cash flow and since the salvage value is a revenue for the PP, this is shown as negative (to differentiate from the other expenses and net out in the total cost of electricity generation). This will be same impact as all expense shown as negative cash (out) flow and salvage as positive cash inflow.	This considered negative for the ease of showing the LCOE as positive value otherwise as all other components are cash outflow and the Salvage value is net inflow, to show the difference salvage value is shown as negative. The response provided by the PP is accepted and hence CL 15 is closed.
CL 16 The fuel cost of gas is 4 times that of coal. Please confirm. In India scenario the variance on fuel cost between coal and gas is not so steep.	B.5.4.4.4	The fuel prices are already discussed from the authentic sources before investment decision. In India, the price of domestic gas production before New Exploration Licensing Policy (NELP) only for KG-D6 basin is fixed at US\$ 4.2/MMBTU. However, even in India, the cost of	The Natural gas price is now revised to 21.29 S\$ /MMBTU which is taken from Price Mundi Index for the Natural gas and PP has considered one year historical price of Natural gas before the Investment decision.



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		<p>imported LNG is more than US\$13/MMBTU in 2012⁸. Considering new LNG terminal in Singapore (where capital cost will be higher than already operating terminals elsewhere from which the LNG cost is compared), Imported coal costs about USD 100/ton in India⁹. Thus, fuel costs can vary within countries.</p> <p>The Escalation in the fuel price is accounted properly in the investment analysis and accordingly PDD Section B.4 and B.5 are revised. There is a change in the LCOE now which is correctly representing the difference between cost of operations of both plants.</p>	PP has revised PDD section and LCOE calculations considering the escalation in the fuel cost in both scenarios. The correction found satisfactory and hence the CL 16 is closed.
<p>CL 17</p> <p>From the Gas quantity estimated per Annum i.e. 33405 Billion BTU and given that Current supply level of natural gas is 850 Million SCF/Day to Singapore and in future SLNG Gas terminal will have capacity of 6 Million TPA, it is not clear that how supply v/s Demand is meeting the methodological condition. Please clarify by providing transparent calculations.</p>	B.6.2.1 / B.6.2.2	<p>The energy conversion matrix of GAIL shared with the DOE shows that</p> <p>1 MMTPA of LNG =3.60 MMSCNMD</p> <p>Power Generation from 1 MMSCMD Gas =242 MW</p> <p>Thus, total gas requirement of project activity is 3.31 MMSCMD and 3 MTPA LNG terminal will deliver 10.8 MMSCMD.</p>	The justification provided by PP is verified and found that the calculation of Gas requirement and availability of gas in Singapore is correct, and it is demonstrated correctly, hence CL 17 is closed.

⁸ <http://www.thehindubusinessline.com/industry-and-economy/article3770999.ece>

http://greatlakes.edu.in/gurgaon/pdf/Pricing_of_Natural_Gas_in_India.pdf

⁹ <http://www.livemint.com/Politics/XeCwzooapLjC1yACQY1PIN/Wide-variance-in-price-of-imported-coal.html>



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		EMA – Integrated summary on proposed Singapore LNG terminal project. This capacity of LNG terminal is designed by considering the projects which are under development (including the project activity power plant) and future capacity planned). Thus, project activity will not diver gas from existing users and will not hamper future capacity addition and meets applicability condition. Further, in line with the methodological clarification AM_CLA_0091, PP has also proposed monitoring of gas source for the project activity to confirm compliance to this applicability condition.	
CL 18 PP has considered Natural Gas NCV value of 52,67 MMBTU/Ton in the assumption's, however used 10000 Kcal / M3 as NCV value in the ER Calculations. Approved Methodology Formulae for Emission Calculation required NCV to be used in (GJ/m ³), Please explain why there is an inconsistency in applying NCV value while calculating Emissions.	B.6.2.1 / B.6.2.2	The NCV is now corrected to 9,000 kcal/m3 based on same reference (that gives GCV= 10,000 and GCV-NCV delta 10%). The conversion of these units to MMBTU/ton is also shown in the financial sheet now	ER calculation spreadsheet is revised by PP to demonstrate the NCV in required measuring unit i.e. GJ/M3 and is a converted value from 9000 Kcal/M3 using standard conversion rates, hence meeting the methodological formulae requirement. Therefore the CL is closed.
CL 19 Given that 16-17 \$ is the cost of Landed cost of LNG, but the cost which is considered in the financial analysis is 31.935 S\$/ MMBTU is very high, does gasification and re - gasification cost is double that of LNG landed cost?, Please explain	B.5.4.4.4	The LNG price is used from the evidence available to PP before investment decision. The price of landed LNG in Singapore could be higher due to new terminal still under construction will always be capital intensive and will	Verified the Financial analysis and it is observed that the same was submitted to Bank for the Loan Approval purpose. The same is accepted by the Bank and Validation team further cross



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the Cost assumptions in a transparent and consistent manner with host country scenario Taking reference of EMA Report "Integrated Summary report for proposed Singapore LNG Terminal by Energy Market Authority" (one of the support document provided by you.)		impact the LNG price accordingly towards depreciation of asset and return on capital. Further, it may be noted that the price of LNG presented in the Investment analysis is based on the relevant documents i.e, EMA Report "Integrated Summary report for proposed Singapore LNG Terminal by Energy Market Authority. This analysis was submitted to the Bank for loan approval and this is approved by the bank hence the value used in the Investment analysis may be accepted.	checked with EMA for the proposed cost and it was observed that the price is correct, hence Accepted and closed
CL 20 Comment on Emission reduction calculations. Please refer attached word file. (Refer my email Dated 17/10/2012)	B.6.2.1 / B.6.2.2	The emission reduction calculation is transparently presented in the revised sheet now.	Revised ER Calculation shows gas consumption calculation transparently considering net generation and using relevant assumptions i.e. Station heat rate and revised annual Capacity utilization of 72.8% (In accordance with evidence Document "review of vesting contract parameters for 2013 and 2014 Draft Report – By EMA, Singapore)



APPENDIX B:
Comments by Parties, Stakeholders and NGOs

S.N.	Global stakeholder comments Submitted by: Jhon Pereira	PP's response	DOE conclusion
1	No plan has been submitted regarding use of 2% of the net revenue accrued from the sale of CER toward achieving the sustainable development goals.	There is not specific guidance from NCDMA in Singapore on CSR spending from CDM revenue. However, PP had discussion related to CSR activities in the local stakeholders' meeting as can be seen from the minutes of the meeting.	From the knowledge of local Environmental Regulations and CDM Strategy by the DNA, it is confirmed that there is no such specific requirements established required to be followed by the PP's. PP has demonstrated the compliance towards all Sustainable development criteria established and prescribed by Singapore DNA.
2	The investment analysis is incomplete and fails to provide the data and assumptions necessary for reader to reproduce the result.	The investment analysis is revised during course of validation and detailed financial analysis sheets are presented to the DOE.	There were few CAR's and CL's raised during the validation to address inadequacies of the Data to support the financial analysis presented in the webhosted PDD. (Pending)
3	No information has been provided regarding the cost of fuel switch in the PDD.	The project activity is not a fuel switch project, hence the comment is irrelevant.	PP has applied Approved Methodology AM 0029 Version 03, which is not applicable to the Fuel Switch Projects. As per the specific applicability condition "The project activity is the construction and operation of a new natural gas fired grid-connected electricity generation plant", only those plant which are newly constructed and using Natural gas as fuel are applicable under this



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			methodology. Hence the comment found irrelevant.
4	As per the EIA report the noise level recorded in the individual process units exceeded the stipulated standards of Central Pollution Control Board (CPCB).	The EIA report of this project activity has clearly noted impact of 'noise' as 'insignificant'. The comment seems not related to project activity as there is no agency called 'CPCB' in the host country whose noise related standard is applicable to the project activity.	The Power plant is under construction stage and the EIA was done by PP for construction phase. The EIA found approved by the NEA and PP has implemented all mitigation measures during construction and it is observed that there were no violations evidenced during entire construction period.
5	The PDD does not explain about identified training, monitoring and maintenance as per the Technology requirements for contractors / engineers by the client. There is no mention of field quality Assurance systems & procedures that are available at site, field quality plans and their approval.	The Section B.7.3 of the PDD discussed inputs required as per the PDD Guidance.	Section B.7.3 of PDD has adequately covered the requirement of monitoring plan implementation and QA / QC requirement as required by the Approved methodology AM0029, Version 03 and hence it is acceptable.
6	Chronology of events with corresponding emails, letters need to be validated by DOE.	Chronology of events and corresponding evidences are already submitted to the DOE.	All Support documents required to establish the chronology of the events were verified by the validation team and found satisfactory, hence acceptable. Please refer Validation Report Section 3.9.1.
7	The leakage calculation is not correct as per applied meth AM29.	The leakage calculation is in line with the baseline methodology guidance.	Validation Team has raised CL To address this issue during its validation. Response to CL 20 is pending.
8	What is the basis for arriving discount factor since it has more bearing on the levelised cost.	The discount factor is taken as the prevailing inflation in the host country at investment decision. Since the same factor is applied to both the alternatives (NG and coal), this will affect LCOE in same manner.	Discount factor Calculation is done in the transparent manner and presented in the Financial Analysis Spread sheet. To arrive at discount factor PP has considered 5.2% as an inflation rate in host country Singapore and the same was validated using Information on Singapore annual Inflation Rate 2011 –



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			http://www.singstat.gov.sg/stats/keyind.html
9	The input values taken for calculation of levelised cost of generation are not provided. Pls. clarify.	The input values for LCOE are now given in the PDD and evidences along with calculations in excel sheet is presented to the DOE.	Validation Team has raised CAR 04/CAR05 / CAR 06 to address this discrepancy during the Site visit on 27/09/2012 – 29/09/2012. In Response to these CAR's PP has revised the PDD and provided necessary information for arriving at the LCOE in a transparent manner.
10	The argument for opting out of other energy sources from the baseline is not adequately demonstrated in the PDD. Where is the proof for each of the argument? PP has duty to provide to all the points it raised to opting out of renewable and other sources.	The discussion on baseline alternatives is presented with proper justifications. The renewable energy installed even in entire host country is not significant compared to the project activity. Also, EMA - a Government agency's report is referred citing unavailability of renewable energy options in country. Hence, this is not a realistic option.	PP has provided adequate information while eliminating other energy sources and referred to various studies and reports by the EMA and other relevant government bodies in Singapore. The justification found satisfactory hence accepted.
11	The reason for excluding the power generation using natural gas with different technologies is not clear. It is mentioned in the PDD that the project activity is a combined cycle power plant with the modern state of art technology and significant efficiency improvement is not possible with current technology status to reduce GHG intensity any further. As CCPP is very efficient technology there are no higher efficient technologies available to the project proponent for power generation utilizing natural gas.	The comment is not clear on which technology stakeholder is referring to. The project activity is a natural gas based combined cycle power plant and same is also called as CCPP (as short form of combined cycle power plant).	PP has eliminated other natural gas based technologies i.e. Open Cycle power plant or Cogeneration power plants as CCPP, OCPP & Cogeneration plants works at different efficiency levels. Justification provided in the PDD are clear and transparent hence accepted by the validation team.
12	Project proponent conveniently hides the past history of the project and presents it as if it is a new project. DOE to check the prehistory of the project.	The DOE was appraised about Island Power company and its history. There was no development on the site before present PP took over management and hence history is irreverent from CDM point of view. The CDM starting date is justified in the PDD.	Validation Team has verified all historical development of the project since Island Power Company Pte. Ltd. initiated the project and subsequent Leal clearances, Generation Licenses and EPC contract changes. PP has



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			provided all documents in a transparent manner.
13	DOE to check the DPR, tender documents inviting proposals, tender correspondence, proposals etc. to clearly validate.	The requested documents for validation by DOE are already presented.	All Project specific documents including Legal Clearances, Generation licenses, EPC contracts, Design Change Requests, Communications between EPC Contractors and PP, Project ownership change documents, Bank updates and bank mandates for Loan approval verified by the Validation team and found satisfactory hence accepted.
14	The PP states that they have considered 80% accelerated depreciation. However the PDD is silent on the tax shielding as a result from accelerated depreciation. PPs cleverly do not consider the accounting tax offsetting in their companies while calculating the IRR. This is evident from the recently registered projects and those requesting registration.	The PP has never stated claimed depreciation and tax shielding. The comment is irrelevant to the project activity.	In the financial Analysis PP has not considered and Tax calculations and not applied accelerated Depreciation.
15	The DOE is therefore requested to critically analyze how the accelerated depreciation benefit has been taken into account and confirm the accounting of the cash inflows as a result of the negative tax liability in the initial years. DOE should not be misguided by the financial presented by the PP or consultant which are custom made for CDM purposes and not the actual financial considered at the investment decision. Note that considering cash inflows results in an increase in the IRR making wind projects a profitable venture.	As discussed above, PP has not applied any accelerated depreciation and even the taxation/ review side as only levelised cost of electricity generation is presented. The comment is irrelevant to the project activity.	In the financial Analysis PP has not considered and Tax calculations and not applied accelerated Depreciation
16	Please also check the offer from WTG	The project activity does not include WTGs and the	The Project activity involves installation of



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	supplier and Purchase Order while validating the PLF. It may be so that the third party report which is made after investment decision making - indicates a lower PLF. The PLF seems to be very low. Also check the tariff order.	comment is irrelevant to the project activity. The PLF is properly justified in the analysis presented to the DOE.	Natural gas based Combined Cycle Power plant and hence WTG is not applicable for this project. The PLF calculation is based on the Connection agreement and the Conservative assumption of Plant Availability in an year y. Hence it is acceptable to validation team.
17	methodology selection is wrong – applicability condition 1 of AM0029 requires ‘The project activity is the construction and operation of a new natural gas fired grid-connected electricity generation plant.’ This project plant is only a modification of an existing plant that operated for many years now.	There is not existing project at site and this was also confirmed during the site visit by DOE. The comment is irrelevant to the project activity.	The Project activity involves installation of new natural gas based Power plant and Validation team has validated applicability condition No.1 as given below “The project activity involves the construction and operation of a new natural gas fired electricity generation plant. This was validated using various project specific documents i.e. EPC contract with Siemens and consortium partners for construction, supply and installation of combined cycle power plant /Ref -14/, Specification of Project Equipment’s /Ref-20/, Generation License and Connection Agreement /Ref-17/”
18	If the plant is just a retrofit, how baseline can be a coal based plant? Was it possible to retrofit this GTs to use coal? This is a ridiculous claim by behalf of PP and consultants.	There is not existing project at site and this was also confirmed during the site visit by DOE. The comment is irrelevant to the project activity.	The Project activity involves installation of new natural gas based Power plant and Validation team has validated applicability condition No.1 as given below “The project activity involves the construction and operation of a new natural gas fired electricity generation plant. This was validated using various project specific documents i.e. EPC contract with Siemens



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			and consortium partners for construction, supply and installation of combined cycle power plant /Ref -14/, Specification of Project Equipment's /Ref-20/, Generation License and Connection Agreement /Ref-17/
19	Whether uninterrupted supply of Natural Gas has been ensured from suppliers for continuous operation? Whether gas will be provided from existing network of pipeline or modification is needed?	The gas availability is discussed in line with the methodology requirement and related clarification from the Meth Panel. A provision for monitoring gas source is made in the parameters to be monitored.	Validation team has validated the availability of gas in Singapore and supply v/s demand situation in detailed and the validation opinion on this is provided in the validation Report Section 3.8.1 above.
20	Host country is already encouraging sustainable development on basis of clean technology and cleaner fuel, in this case how this project meet additionality criteria of CDM process?	The additionality of the project activity is adequately presented in the PDD and supporting investment analysis sheets are presented to the DOE.	PP has demonstrated the Additionality using EB 69 Annex 20 - Methodological tool "Tool for the demonstration and assessment of additionality" (Version 06.1.0). PP has adopted Investment analysis approach and identified Benchmark Analysis as suitable method, which is found in accordance with Approved Methodology AM0029 and EB 62 Annex 5 - GUIDELINES ON THE ASSESSMENT OF INVESTMENT ANALYSIS (Version 05)
21	Whether Environment Public Hearing as process of Environment Clearance was arranged for this gas based power plant? If yes, what were major discussion and decisions of Environment Public Hearing?	The project activity is coming up at a notified industrial premise and hence EIA related public hearing was not required by the applicable regulations. The necessary statutory clearances are available and shared with the DOE already.	Validation Team has verified the method of conducting Stake holders consultation and found that PP has invited local stakeholder and legal authorities through a public notice and written invitation letters. Records of Stake holder meetings are maintained. Validation team has independently cross checked with 2 stakeholders about the consultation process and their feedback n project implementation and did not received any negative feedback.
22	Additionality	The baseline methodology AM0029, Ver. 03 gives	Consideration of LCOE of Coal Power plant



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	<p>The methodology considers a project additional under the following circumstances</p> <p>a) There is a more economically attractive and GHG intensive alternative available to the project activity (lower levelized cost when compared to the project activity); and</p> <p>b) The project on a standalone basis is not financially attractive (low IRR as compared to standard industry benchmark)</p> <p>While the PP has demonstrated that there is a more economically attractive option available as compared to the project activity, it has not demonstrated that the project on a standalone basis is not financially viable. As the project activity involves displacement of power on the grid and the alternative can be set up by any other entity as well, it needs to undertake a benchmark analysis. In order to perform benchmark analysis, the PP needs to take into account the tariff that it receives from the sale of power.</p> <p>The plant is being setup as a Merchant Power Plant (MPP) and hence may not enter into a long term PPA. It is a well known fact that merchant power plants are very attractive, because they get higher tariff than PPA based power</p>	<p>option to choose financial indicator most suitable in the decision making context. Please note following on pg. 3 of the methodology</p> <p><i>“The baseline scenario alternative that has the best indicator can be pre-selected as the most plausible baseline scenario; then a sensitivity analysis shall be performed for all alternatives.”</i></p> <p>Further, the methodology also refers <i>“Demonstrate that that the proposed CDM project activity is unlikely to be financially attractive by applying Sub-steps 2b (Option III: Apply benchmark analysis), Sub-step 2c (Calculation and comparison of financial indicators)”</i></p> <p>Thus, PP has chosen Option <i>Sub-step 2c (Calculation and comparison of financial indicators)</i> and presented comparison of LCOE using baseline alternatives.</p>	<p>can not be considered as Benchmark, hence PP has to demonstrate the IRR calculation along with the LCOE.(Pending for closure.)</p> <p>In response to CAR PP has demonstrated how Project is financially additional using LCOE and Equity IRR.</p> <p>Assumptions and financial calculations were verified by the validation team and appointed financial specialist and found correct.</p>
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