VALIDATION OPINION FOR REVISION OF REGISTERED MONITORING PLAN

Lihir Gold Limited

Lihir Geothermal Power Project

UNFCCC Ref. No. 0279

SGS Climate Change Programme
SGS United Kingdom Ltd
SGS House
217-221 London Road
Camberley Surrey
GU15 3EY
United Kingdom

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<tr><td colspan="3">Validation Team:</td></tr>
<tr><td colspan="3">Kunal Sharma – Lead Assessor
Sarang Khati – Assessor
Bruce Telfer – Local Assessor
Kevin Brown – Sectoral Expert (Sector scope 1- Geothermal)</td><td colspan="2" rowspan="2">☒ No Distribution (without permission from the Client or responsible organisational unit)</td></tr>
<tr><td colspan="2">Technical Review:</td><td>Trainee Technical Reviewer:</td></tr>
<tr><td colspan="2">Date: 25-11-2010
Name: Kaviraj Singh</td><td>Name: Insert Name</td><td colspan="2" rowspan="2">☐ Limited Distribution</td></tr>
<tr><td colspan="3">Authorised Signatory:</td></tr>
<tr><td colspan="3">Name: Siddharth Yadav
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Abbreviations

ASTM	American Society for Testing and Materials
CAR	Corrective Action Request
CDM EB	Clean Development Mechanism Executive Board
CER	Certified Emission Reduction
CL	Clarification Request
CM	Combined Margin
GEF	Grid Emission Factor
ISO	International organisation for Standardization
LGL	Lihir Gold Limited
LGPP	Lihir Geothermal Power Project
NCG	Non Condensable Gas
PDD	Project Design Document
PNG	Papua New Guinea
QA/QC	Quality Assurance and Quality Check
RMP	Revised Monitoring Plan
TFT	Tracer Flow Tests

Table of Content

1. Validation Opinion

Paragraph 57 of the modalities and procedures for the CDM allows project participants to revise monitoring plans in order to improve accuracy and/or completeness of information, subject to the revision being validated by a Designated Operational Entity.

SGS United Kingdom Ltd has been contracted by Lihir Gold Ltd to perform such a validation of the revision of monitoring plan according to the procedure detailed in Annex 28 to EB 49 meeting report; the registered monitoring plan is part of the PDD of registered CDM project Lihir Geothermal Power and UNFCCC ref. no 0279. The purpose of a validation is to have an independent third party assessment of the revision of monitoring plan. In particular, the level of accuracy and/or completeness in the proposed revision of the monitoring plan, and the conformity with approved monitoring methodology applicable to the project activity.

By applying the proposed revision of monitoring plan, the project proponent would like to make the verification process more transparent and accurate. The project activity has applied ACM0002 version 04 as the baseline and monitoring methodology. During the third monitoring period (01/10/2007 to 31/08/2008), some of the steam used in the LGPP was sourced from well heads drilled specifically for power generation and as a result the non-condensable gases in this steam need to be counted as project emissions (this scenario was considered a possibility in the registered PDD and outlined on pages 19 and 30). Hence, to account the project emissions, the request for revision of the monitoring plan is being submitted for UNFCCC approval because the procedures to account the project emissions are not detailed in the registered PDD. Nevertheless, PDD mentions that "Only condensable gases will be monitored from steam from wells specifically drilled for the LGPP" (Table D2.1.1, page 22). The RMP adds the parameters; the *"Quantity of steam produced from well i during year y ($MS_{i,y}$)"* and *"Percentage of total flow (Ms,y) attributable to well i (%Flow)"*.

As per the registered PDD's monitoring plan and previously approved revised monitoring plan, the total steam flow to the LGPP should be measured with a venturi flow meter (or other equipment with at least the same accuracy). Currently Orifice meters, with the same accuracy as Venturi meters, are being used at site as detailed in the later section of the document. However no emergency procedures have been defined in case of failure of any flow meter. This RMP also defines and establish the emergency procedures (in the event of failure of venturi flow meters) that steam flow to LGPP can be calculated taking the very conservative assumptions and the metered power generation data (24hour average for each turbine), ejector steam flow and turbine performance curves will be used to determine the total steam flow to the LGPP.

This revision improves the accuracy of information provided and consistency in the registered PDD and the monitoring plan.

Furthermore, we confirm that:

(a) the proposed revision points have been described, and an assessment has been provided to substantiate the reasons for each of the proposed revision points of the registered monitoring plan, using objective evidence;

(b) the proposed revision of the monitoring plan ensures that the level of accuracy or completeness in the monitoring and verification process is not reduced as a result of the revisions;

(c) the proposed revision of the monitoring plan is in accordance with the approved monitoring methodology applicable to the project activity whilst ensuring the conservativeness of the emission reductions calculation.

(d) the findings of the previous verification reports have been taken into account

Signed on Behalf of the Validation Body by Authorized Signatory

Signature: 

Name: *Siddharth Yadav*

Date: *26-11-2010*

2. Introduction

2.1 Objective

Paragraph 57 of the modalities and procedures for the CDM allows project participants to revise monitoring plans in order to improve accuracy and/or completeness of information, subject to the revision being validated by a Designated Operational Entity.

SGS United Kingdom Ltd has been contracted by Lihir Gold Ltd to perform such a validation of the revision of monitoring plan according to the procedure detailed in Annex 28 to EB 49 meeting report; the registered monitoring plan is part of the PDD of registered CDM project Lihir Geothermal Power and UNFCCC ref. no 0279. The purpose of a validation is to have an independent third party assessment of the revision of monitoring plan. In particular, the level of accuracy or completeness in the proposed revision of the monitoring plan, and the conformity with the approved monitoring methodology applicable to the project activity.

The Validation was performed in accordance with the UNFCCC criteria for the Clean Development Mechanism (CDM) and the host country criteria, as well as criteria given to provide for consistent project operations, monitoring and reporting.

SGS reviewed the project design documentation (revised monitoring plan), using a risk based approach and conducted follow-up interviews.

2.2 Scope

The scope of the validation is defined as an independent and objective review of revision of monitoring plan. The information in these documents is reviewed against the Kyoto Protocol requirements, the UNFCCC rules and associated interpretations.

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

2.3 GHG Project Description

Refer to *http://cdm.unfccc.int/Projects/DB/DNV-CUK1143246000.13/view*, the project web page. There is no change in the project activity description. The project was registered on 29 May‘06 under UNFCCC ref. no 0279.

3. Methodology

3.1 Review of CDM-PDD and Additional Documentation

The validation is performed primarily as a document review of the publicly available project documents. The assessment is performed by trained assessors using a validation protocol.

3.2 Use of the Validation Protocol

The validation protocol used for the assessment is partly based on the templates of the CDM Validation and Verification Manual version 1 (EB44 Annex.3):

- it organises, details and clarifies the requirements the project is expected to meet; and
- it documents both how a particular requirement has been validated and the result of the validation.

The validation protocol consists of several tables. The different columns in these tables are described below.

Checklist Question	Ref ID	Means of Verification (MoV)	Comment	Draft and/or Final Conclusion
The various requirements are linked to checklist questions the project should meet.	Lists any references and sources used in the validation process. Full details are provided in the table at the bottom of the checklist.	Explains how conformance with the checklist question is investigated. Examples of means of verification are document review (DR) or interview (I). N/A means not applicable.	The section is used to elaborate and discuss the checklist question and/or the conformance to the question. It is further used to explain the conclusions reached.	This is either acceptable based on evidence provided (Y/OK), or a Corrective Action Request (CAR) due to non-compliance with the checklist question (See below). A Clarification request (CL) is raised if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

The validation protocol is attached with the report as Annex 1.

3.3 Findings

As an outcome of the validation process, the team can raise different types of findings

In general, where insufficient or inaccurate information is available and clarification or new information is required the Assessor shall raise a **Clarification Request (CL)** specifying what additional information is required.

Where a non-conformance arises the Assessor shall raise a **Corrective Action Request (CAR).** A CAR is issued, where:

I. Non-conformities with the monitoring plan or methodology are found in monitoring and reporting, or if the evidence provided to prove conformity is insufficient;

II. Mistakes have been made in applying assumptions, data or calculations of emission reductions which will impair the estimate of emission reductions;

III. Issues identified in a FAR during validation to be verified during verification have not been resolved by the project participants.

A Forward Action Request (FAR) is raised during verification for actions if the monitoring and reporting require attention and/or adjustment for the next verification period.

The validation process may be halted until this information has been made available to the assessors' satisfaction. Failure to address a CL/FAR may result in a CAR. Information or clarifications provided as a result of a CL/FAR may also lead to a CAR.

Corrective Action Requests, Clarification Requests and Forward Action Requests are raised in the draft validation protocol and detailed in a separate form (Findings Overview). In this form, the Project Developer is given the opportunity to address and "close" outstanding CARs and respond to CLs and FARs. The detailed Finding Overview is attached with this document as Annex 2.

3.4 Internal Quality Control

Following the completion of the assessment process and a recommendation by the Assessment team, all documentation will be forwarded to a Technical Reviewer. The task of the Technical Reviewer is to check that all procedures have been followed and all conclusions are justified. The Technical Reviewer will either accept or reject the recommendation made by the assessment team.

4. Validation Findings

4.1 Application of Monitoring Methodology and Monitoring Plan

Type of Revision

The revision of monitoring plan is a result of a recommendation by the PP/DOE as mentioned in section D under "Application of the monitoring methodology and description of the monitoring plan" of the registered PDD.

The proposed revision of the monitoring plan ensures that the level of accuracy and completeness in the monitoring and verification process is not reduced as a result of the revisions (details below).

The Project Activity involves the construction of the Lihir Geothermal Power Plant (LGPP) on Lihir Island, Papua New Guinea (PNG). The project has applied ACM0002 version 04 as the baseline and monitoring methodology. The revision of monitoring plan was necessary on account of inclusion and exclusion of some parameters from the previous monitoring plan to improve the transparency and completeness of monitoring procedure.

The request for revision in monitoring plan covers a proposed change in the monitoring procedure as described in the registered PDD and approved revised monitoring plan. It may be important to note here that a revision in monitoring plan has already been approved by CDM EB for this project activity which included the changes required, in the monitoring plan, at that point of time. However, there is still a need to revise the monitoring plan to make it inline to the methodology and actual monitoring practice on site basically to cover up the gaps which occurred later (after the approval of revised monitoring plan).The proposed changes have been discussed below.

1. ***Calculate the steam flow from individual wellheads:*** steam flow from individual wellheads is required to enable the calculation of project emissions, as only the project emissions from the wells drilled for the purpose of power generation need to be accounted for; and

2. ***Monitor the quantity of steam produced during year y (MS, y):*** only in the event of failure of the flow meter in one of the main supply lines (emergency procedure).

The proposed revision in monitoring plan is explained further, for each of these two items below:

1. *Calculation of steam flow from individual wellheads*

During 3rd monitoring period (01/10/2007 to 31/08/2008), it was found, during site visit (dated 12/11/2008), that new wells have been drilled to source steam for the LGPP and therefore the non-condensable gases (CO_2, H_2S and CH_4) in the steam resulting from these wells have to be accounted as project emissions. Following the registered PDD (page 19 & 30), drilling of additional holes are allowed, *"Based on projections of steam to be vented as a component of mining operations and the steam demand of the potential power outputs of the LGPP, it is envisaged that the mining operations will release sufficient steam to power the 31.7 MW and 52.8 MW potential net capacity of the LGPP. However, some uncertainty does exist over whether this upper 52.8 MW net capacity can be reached using the steam released during mining operations. Due to this, and the fact that projections of steam to be released by the mining operations are highly uncertain, LMC may have to drill additional holes to source additional steam for the LGPP. In the event that extra drilling is necessary, the non-condensable gases in the steam resulting from these additional wells will be counted as project emissions. LMC will monitor the amount of steam released by the mining operations, the amount of steam consumed by the LGPP, the drilling of new wells specifically for the LGPP, and the quantity of greenhouse gases in the steam in order to determine project emissions if wells in excess of those required the mining operations are necessary."*
In accordance with the approved monitoring plan, steam flow is being measured using flow meters installed on each of the 33MW (tag # PGS: S100_FTn_011_TOTn) and 22MW (tag # PGS: S400_FTn_011_TOTn)

main supply lines before the inlet to the power station. The meters are located downstream of the crossovers between each of the supply lines, and therefore the individual flow meters record the total steam flow going to the 33MW, or 22MW plant, regardless of the wells that the steam is obtained from.

The procedure to account the project emissions due to above stated reason is not detailed in the registered PDD. Nevertheless, in order to calculate the project emissions it is necessary to apportion steam flow to individual wellheads, as only the emissions from the wells drilled for the purpose of power generation need to be included when calculating project emissions.

However, although the registered PDD and also the approved revised monitoring plan clearly states that "Only condensable gases will be monitored from steam from wells specifically drilled for the LGPP" (Table D2.1.1, page 22), neither ACM0002 version 04 nor the registered PDD specify how steam flow is to be apportioned. In addition, this is not specified in any subsequent versions of ACM0002 as well.

As all of the wells used during the first and second monitoring periods were depressurisation wells as verified from http://cdm.unfccc.int/Projects/DB/DNV-CUK1143246000.13/view, apportioning had not previously been an issue. The project proponent has therefore developed an appropriate method which has been verified and is outlined below.

During the third monitoring period some of the steam used in the LGPP was sourced from well heads drilled specifically for power generation and as a result the non-condensable gases in this steam need to be counted as project emissions. This scenario was considered a possibility in the registered PDD and outlined on pages 19 and 30. It has been identified that which wells are depressurisation wells and which wells have been drilled for the purpose of power generation. Since the LGPP was commissioned the number of wells has been monitored daily in accordance with the monitoring plan. It was verified that during this monitoring period, five wells (GW49, GW53, GW56, GW48 & GW51) were drilled specifically to source additional steam for LGPP requirements and the dates that they came on line are shown in the table below /10/:

Well Number	Date Online
48	03 June 2007
49	18 March 2008
51	01 May 2008
53	07 May 2008
56	25 July 08

Note: Well 48 was originally drilled for mining operation purposes as verified during second verification period i.e. 01st October '06 to 30th September '07 (http://cdm.unfccc.int/Projects/DB/DNV-CUK1143246000.13/iProcess/SGS-UKL1191924815.58/view). However, due to poor performance of the well which resulted in a uncertainty as to its role in depressurization well 48 was conservatively reclassified as a well drilled to provide steam for power generation during the third monitoring period and the non-condensable gases in this steam quantified as project emissions.

The below mentioned parameters have been included in the section D.2.1.1 of the proposed revision in monitoring plan which will be used to calculate project emissions:

Quantity of steam produced from well 'i' during year y, t, ($MS_{i,y}$):- The parameter will be calculated by apportioning the total steam consumed by the LGPP to individual wellheads. MS i,y is used in the calculation of project emissions, as only the emissions from steam from wellheads drilled specifically for the purpose of power generation are included. The parameter will be recorded daily and will be archived electronically.

Percentage of total flow (Ms,y) attributable to well i, %, (% flow):- In order to apportion the steam, the results of the Tracer Flow Tests (TFT) undertaken on individual wellheads are used to determine the percentage contribution to total flow of each of the individual well heads. The TFT results provide a steam flow rate in tonnes/hour for each well head, and this is divided by the sum of all of the well head's flow rates

to give a percentage. This percentage is then multiplied by the total steam flow rate ($MS_{,y}$), to determine a flow rate for each well. The parameter will be recorded monthly and will be archived electronically.This has been accepted as suitable.

Following formulae will be applied to determine the quantity of steam produced from individual well heads that are included in the calculation of project emissions:

$M_{S,y\ (project\ emissions)} = \sum M_{S,y,\ i}$
Where $M_{S,y,i} = \%flow_{,i} \times M_{S,y}$

$M_{S,y}$ is the total quantity of steam produced during the year y
$M_{S,y\ (project\ emissions)}$ is the quantity of steam counted towards project emissions during the year y
$M_{S,y,\ i}$ is the quantity of steam produced from well i during the year y
$\%flow_{,i}$ is the percentage of total flow (Ms,y) attributable to well i
$w_{i,CO2}$ and $w_{i,CH4}$ for each well head steam are obtained from the sampling done at the respective well heads

If during future monitoring periods the steam for the LGL will be supplied only by wells drilled specifically for power generation there will be no requirement to apportion the steam. In this circumstance:
$M_{S,y\ (project\ emissions)} = M_{S,y}$

In this case, $w_{i,\ CO2}$ and $w_{i,\ CH4}$ are also not required, and $w_{Main,\ CO2}$ and $w_{Main,\ CH4}$ are taken from the sampling point immediately upstream of the venturi flow.

It has been verified that the total steam entering into the turbines is being measured with a continuous orifice flow meter (including the steam coming out from additional wellheads) and is fully in compliance with the methodology ACM 0002 version 04 which says *"the steam quantity discharged from the geothermal wells should be measured with a venturi flow meter (or other equipment with at least the same accuracy)"*.

Now, the above mentioned procedure *"calculation of steam flow from individual wellheads"* has been applied only to account the project emissions from the additional wellheads which have been drilled specifically for power generation. The methodology ACM 0002 version 04 and the latest version of the methodology has no provision for the quantity of steam to be measured from individual wellheads and does not contemplate a scenario where project emissions only need to be quantified from a proportion of the total steam used.

The geothermal steam at the LGPP is two phase steam consisting of brine and steam[/19/]. Before the steam flow from each well head can be monitored the brine needs to be extracted via a separation unit. LGL has a central single separation unit on site for operational purposes (for separation of brine and steam) and the same has been verified from the site layout [/20/].

The use of flow meters at individual wellheads to measure steam would require the installation of individual separation units at each individual well drilled for power generation before the flow meter. This is not practicable for the following reasons:

1. LGL are drilling additional wells for power generation purposes.
2. LGL continue to drill depressurization wells providing geothermal steam relief and power generation.
3. Each separation unit requires discharge lines to the ocean to drain the brine. If individual separation units were installed on site, many additional kilometres of pipeline would be required to discharge the brine to the ocean resulting in significant environmental and safety issues.
4. The operation and maintenance requirements for each separation unit are substantial.
5. It is more accurate to measure steam flow in a single larger pipe than numerous smaller pipes.

If the geothermal steam at the LGPP was "dry steam" (i.e. it did not contain brine), measurement of the steam from individual wellheads using flow meter will be practicable.

Hence, considering the above mentioned points, it would not be a practical approach to install steam flow meters at individual well heads and also, may lead to the inaccuracy of steam measurement, environmental and safety issues and several operational and maintenance issues at site. Therefore, this was concluded that the above mentioned approach is acceptable.

It has been further verified that the following parameters have been removed from the revised monitoring report which were mentioned in the approved revised monitoring plan:
1. $M_{t, y}$, Quantity of steam generated during well testing,
2. $W_{t, CH4,}$ Fraction of CH4 in steam produced during well testing and;
3. $W_{t, CO2}$ Fraction of CO2 in Steam Generated during well testing

This is found to be satisfactory considering the following justification:
1. These parameters have no role in the calculation of emission reductions.
2. As per ACM 0002 version 04, page 10, footnote 07,*"Fugitive carbon dioxide and methane emissions due to well testing and well bleeding are not considered as they are negligible".*
3. These parameters have been removed from latest versions of the methodology ACM0002 (http://cdm.unfccc.int/methodologies/DB/TZFK7NUO5DYE5AI2PDMLG65BFIWMG5/view.html) due to the fact that the fugitive carbon dioxide and methane emissions due to well testing and well bleeding are negligible.

It is concluded that these parameters became redundant with respect to ER calculation. Hence, the removal of these parameters is accepted.

Further, it has been verified that the proponent has implemented all the proposed monitoring procedures correctly. The proponent has submitted "Tracer Flow Testing Operations Manual" independently developed by Sinclair Knight Merz (SKM) which is being followed by LGL on site /11/. As the TFT testing is intermittent and does not take into account the operation of the power station, and daily fluctuations in steam supply, however, the relative percentage contribution of each wellhead does not change significantly over the month between testing dates and therefore using the TFT results to apportion the total flow is considered to be a robust approach. To undertake the testing two chemical tracers, one for the steam and one for the brine, are injected into the two-phase pipeline through sampling ports close to the well head at known concentrations and dose rates using a portable metering pump. The tracers mix with steam and water in the pipeline and are sampled at a downstream sampling point. The concentration of the tracers after mixing are entirely dependent on the injection rate and the mass flow in the line: the higher the flow rate the lower the concentration (i.e.: the greater the dilution). Miniature sampling separators are used to collect steam and brine samples at the downstream sampling point. The samples are sent offsite for analysis and from the concentration of tracers measured in the samples, steam and brine flow are calculated for the pipeline pressure at which the sampling was done.

Industry practice is to measure steam flow from individual well heads with two phase production wells is via the TFT method, which provides for spot readings. A prototype is being developed by supplier Thermochem for measurement of steam using the TFT method, but this is not yet commercially available.

2. *Monitor the quantity of steam produced during year y (MS,y):*

In line with the applied methodology ACM 0002 version 04, registered PDD and approved revised monitoring plan (http://cdm.unfccc.int/Projects/DB/DNV-CUK1143246000.13/view) the steam quantity discharged from the geothermal wells should be measured with a venturi flow meter (or other equipment with at least the same accuracy) but during 3rd verification monitoring period (i.e. 1st October 2007 to 31st August 2008) on 26th March 2008, the flow meter in the 33MW steam line failed. To cover the issue for that specific period, the proponent had submitted request for deviation and to avoid similar situations in future, the project proponent is proposing the back-up method to calculate steam generated as an emergency procedure in this proposed revision in monitoring plan. This back up method will be used to calculate the quantity of steam produced as emergency procedure. In accordance with the approved monitoring plan, steam flow to the LGPP is metered using flow meters installed on each of the 33MW (tag # PGS: S100_FTn_011_TOTn) and 22MW (tag # PGS: S400_FTn_011_TOTn) main supply lines before the inlet to the power station.

Now, the proponent has revised the monitoring plan mentioning that venturi flow meter (or other equipment at least the same accuracy) will be used to measure the total steam flow to the LGL and in the event of failure of venturi flow meter (or other equipment at least the same accuracy), the metered power generation data (24hour average for each turbine), the ejector steam flow and the turbine performance curves will be used to determine the total steam flow to the LGL until the meters can be repaired or replaced.

Ejector steam flow:

This has been further verified that there was no information on the monitoring of ejector steam flow in the previous approved revised monitoring plan. The proponent has explained that the ejector steam flow is a constant value based on flow rates recorded during the full load performance testing, which is conservative value representative of the maximum flow that would be seen through the ejectors and were verified with the ejector full load performance test sheet. This is evidenced by the ejector flow trend data recorded in 2009 in the PI system (results attached in file *0279_LGPP_Ejector Steam Flow Supporting Data.xls*) which shows that sample trend values are consistently lower than those recorded during full load performance testing. The results of the full load performance testing of ejectors have been provided by the proponent and were verified /13/.

Turbine Steam Consumption:

Turbine steam consumption is proportional to the output of the generator (power produced in MW). Based on the metered power output and the turbine performance curves supplied by the turbine manufacturer at the time of purchase the steam consumption is therefore calculated using the following method:

The 24 hour average generation (MW) of each of the five turbines on each suitable day in a month is entered is obtained from the Daily Power Station report, and summed to get the total daily 24 hour generation for the LGPP. This value is entered into the monitoring spreadsheet.

To get the conservative figures while calculating CER calculation, the maximum daily 24 hour average generation for each suitable day in the month is selected as being the daily generation for each day in that month. Using this for each day in the month ensures that the steam consumption is conservative and an overestimation of the amount of steam consumed in the month. The corresponding steam flow rate is obtained from the performance curve, and this value is used as the steam flow for each day in that month. Selecting the maximum generation for the month ensures that the steam consumption is conservative and results in an overestimation of the amount of steam consumed in the month.

A suitable day is defined as a day where there is stable generation over the 24 hour period with the vent valves closed at the end of the 24 hour period (as indicated in the Power Station Daily Report) and wellhead valves in the same state as the previous day. Where one or more vent valves are open on the maximum generation day, additional steam (based on the maximum capacity of each vent valve and number of valves open) is added to the calculated turbine steam consumption and applied for the entire month. Where there are no stable 24 hours generation periods (minimum and maximum within 10% of the daily average) for the month, the total steam flow is based on the total capacity with all five vent valves fully open for the month. This ensures the most conservative approach is always taken based on reliable data.

The impact of the proposed back-up method on the quantity of steam measured (t/day), project emissions from the non-condensable gas in the steam sourced from well heads drilled specifically for power generation (PESy) and emission reductions compared to the direct metering approach for the period 1st October 2007 to 25th March 2008 (the dates of the third verification period when the steam flow meter was functional and verified data has been used for the comparative analysis) are shown below /16/ & /17/. As project emissions from the combustion of fossil fuels related to the operation of the geothermal power plants in tons of CO2 (PEFFy) are zero when the steam is sourced from well heads drilled specifically for power generation, project emissions PEy are equal to PESy.

	Direct Metering	Proposed emergency procedure	Variation (%)
Steam (t/day)	489,116.40	496,761.88	1.56%
Project Emissions (PES_y)	2,155	2,293	6.40%
Emission Reductions	102,885	102,747	0.13%

As the table indicates the back-up method proposed in this deviation results in a higher quantity of steam measured, which in turn results in a higher estimate of project emissions and a more conservative estimate of emission reductions compared to the direct metering method. The CDM EB has already approved a deviation request to use the same emergency procedures when the original annubar failed (http://cdm.unfccc.int/Projects/deviations/95059).

The period 1st October 2007 to 25th March 2008 is the only period that the two methods can be compared as from 26th March 2008 to31st August 2008 the steam meter failed and hence direct metering was not possible. During the first two verifications periods steam was sourced from wells drilled as a component of mining operations and thus project emissions (PESy) were zero.

It has also been verified that the orifice plate installed has a low likelihood of failure. It was specifically designed for the geothermal steam properties on site, particularly the contaminants in the steam and the condensate flow that occur at the LGPP which were the primary causes of the annubar flow meter failure. The orifice plate was designed by SMEC International Pty Ltd, geothermal power specialists/21/.

This emergency procedure is being included in the proposed revision of the monitoring plan just to avoid any delay in future monitoring periods. Further, it has been validated that the emergency procedure will only be utilized for a maximum period of 15 days for situations where the steam flow meters face any minor issues that can be repaired onsite technical staff. However, if the steam flow meter can not be repaired within 15 days a deviation from the registered monitoring plan will be submitted to the UNFCCC.

Accuracy of the steam flow meter:

It has been verified that during current verification (1st October 2007 to 31st August 2008), the proponent has replaced the annubar flow meter (Rosemount 3051SFA ProBar Flow meter) with orifice flow meter due to its failure. However, the applied methodology ACM0002 version 04 states that "*the steam quantity discharged from the geothermal wells should be measured with a venturi flow meter (or other equipment with at least the same accuracy)*". Therefore, firstly the accuracy of annubar and venturi flow meter was compared and this was verified from the product data sheet of the annubar flow meter series, Catalog 2005 that the previously installed Annubar Flow meter series (Rosemount 3051SFA) has accuracy up to +/-0.8% of volumetric flow rate (this was also verified during previous verification, http://cdm.unfccc.int/Projects/DB/DNV-CUK1143246000.13/view) and the typical accuracy of the venturi flow meters lies around +/-1% (http://enxahl.en.alibaba.com/product/273759696-209858406/Venturi_Tubes.html). Hence, this is evident that the accuracy of the annubar flow meter is equivalent to venturi flow meter and is in line with the methodology ACM 0002 version 04. Further, the accuracy of the new orifice flow meter was also verified and explained as following:

The main steam line carries significant amounts of condensate which would potentially build up upstream of a venturi flow meter affecting accuracy. As a result, the original system was designed with an annubar for flow measurement. However, given the aggressive geothermal steam properties, it proved unreliable. To ensure reliability, a metering orifice plate was installed. The orifice plate is robust, and it is generally accepted both orifice and venturi have equivalent accuracies when installed correctly. This has been verified from an engineering research paper which states that *"An orifice flow meter is a very forgiving device and for most applications, with normal care in installation and instrumentation, the measurement accuracy is consistently better than ±1%"* /14/. Hence, the orifice meter has the same accuracy as of venturi meter and is in compliance with ACM 0002 version 04.

The proponent has submitted a spreadsheet that gives basic comparison of the primary element, i.e. the orifice plate against the venturi. The comparison was done on the uncertainty of discharge co-efficient, C based on ISO-5167-1, ISO-5167-2 and ISO-5167-3 /15/. For the beta ratio (the throat diameter of the flow device relative to the pipe diameter) selected (based on the actual design of the orifice plate), the orifice plate is actually less uncertain than the venturi. Uncertainty level is calculated as 0.67% for orifice flow meter in comparison to 1.00% for Venturi flow meter for a given Beta ratio of 0.7 /18/.

Other significant errors from a pressure transmitter or PLC will be identical for both types of flow devices. So, it can be concluded that the orifice flow meter will give less uncertain reading as compared to the venturi flow meters.

Quality Assurance and Quality Control procedures:

The Quality Assurance and Quality Control procedures for the parameters being monitored are clearly defined in the revision in monitoring plan (under section D.3). QA/QC procedures are planned for these data as these data will be directly used for calculation of emission reductions. Sales record to the grid and other records are used to ensure the consistency. In case of Tracer Flow Tests (TFT), the methodology for TFT testing was independently developed by the supplier-Sinclair Knight Merz (SKM) of the testing equipment. LGL has developed a Standard Operating Procedure based on this methodology. The test is undertaken by suitably qualified personnel, in accordance with standard ASTM E1675 – Sampling Two Phase Geothermal

Fluid for Purpose of Chemical Analysis. This is the testing standard also used for determining non condensable gases (NCG) in the steam. Samples are analysed offsite by an accredited laboratory and the tests conducted are performed in accordance with its terms of accreditation.
Real power produced by each of the five turbines is monitored continuously and recorded in the PI system. The data records are retrievable at any time. The 24 hour average generation (MW) is collated and circulated in the Power Station Daily Report for review and checking by relevant LGPP senior staff. This is standard operating procedure for the LGPP irrespective of the CDM monitoring plan. The turbine performance curves for the turbines are prepared based on standard performance testing as part of standard procurement practices for purchasing a turbine as given in the Turbine Manual./09/ Ejector full load performance testing was undertaken immediately after the LGPP was commissioned when all instruments were calibrated and new. A constant value is used throughout the monitoring period to ensure conservatism. /07/ & /08/
All archived data will be kept until two years after the last issuance of CERs for this project. The electricity generated by the LGPP will be measured with energy meters with an accuracy of within 1%. The Utilities Superintendent of LGL will be responsible for the monitoring and storing of this data. Data will be archived in LGL's existing information storage system on a monthly basis.

The proposed revision of the monitoring plan is in accordance with the approved monitoring methodology applicable to the project activity (details below).

The proposed revision of the monitoring plan is in accordance with the approved monitoring methodology applicable to the project activity i.e. ACM0002 version 04. It has been further assured that there will be no effect by revision in monitoring plan on the original chosen baseline mentioned in the registered PDD and it will remain the same. This is demonstrated as mentioned below:

The Project Activity involves the construction of a Geothermal Power Plant (LGL) and ACM0002 version 04 is applicable to grid-connected renewable power generation project activities which apply to electricity capacity additions from geothermal sources. Therefore, the project activity satisfies the applicability criteria of ACM0002 version 04 and the approach discussed above in the proposed revision in monitoring plan will not deviate with the applicability criterions of the applied methodology.

It has been demonstrated in the proposed revision in monitoring plan that parameters "Quantity of steam produced from well 'i' during year y, t, ($MS_{i,y}$" and Percentage of total flow (Ms,y) attributable to well i, %, (% flow) are being introduced to improve the transparency and accuracy of the monitoring plan.

Also, as per ACM0002 version 04, the baseline for the project activity would be: - For project activities that do not modify or retrofit an existing electricity generation facility, the baseline scenario is the following:
Electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations demonstrated in the registered PDD. So, as stated in the registered PDD and approved revised monitoring plan, the project activity was proposed to supply electricity to the grid.

This is clear from the above description that in the case of proposed revision in monitoring plan, the baseline of the project activity would still remain the same. Hence, there will be no change in emission reduction calculation due to change in monitoring plan.

Rest of the monitoring plan remains the same as mentioned in the registered PDD available at UNFCCC website *http://cdm.unfccc.int/Projects/DB/DNV-CUK1143246000.13/view* and revised monitoring plan is attached with the revised validation opinion.

There is no other change in the Validation Report by DNV, dated *17/03/2005* available on UNFCCC webpage *http://cdm.unfccc.int/Projects/DB/DNV-CUK1143246000.13/view.*

This revision improves the accuracy of information provided and consistency in registered PDD and the monitoring plan.

4.2 Findings of Previous Verification Reports

No FAR was observed from the verification report for the monitoring period 01/10/2006 – 30/09/2007 dated 15/02/2008. This has been verified from the information available on UNFCCC webpage *http://cdm.unfccc.int/Projects/DB/DNV-CUK1143246000.13/view.*

5. List of Persons Interviewed

Date of site visit	Name	Position	Short description of subject discussed
14/11/2008	Andrew Reid J. Maragau	Principal Advisor Environment, Lihir Gold Limited Environmental Officer, Lihir Gold Limited	▪ Assessment of Project Boundary ▪ Plant Operations ▪ CDM monitoring & reporting documentation ▪ Quality Assurance – Management and operating system
	Adam Pemberton Simon Maclean Mark Thompson	Powerhouse Superintendent Senior Electrical Supervisor: Electrical Manager:	Monitoring and measuring system ▪ Collection of measurements ▪ Observations of established practices ▪ Data Verification of monitoring parameters

6. Document References

Category 1 Documents (documents provided by the Client that relate directly to the GHG components of the project, (i.e. the CDM Project Design Document, confirmation by the host Party on contribution to sustainable development and written approval of voluntary participation from the designated national authority):

/1/ Revised Monitoring Plan (07th December 2009)

Category 2 Documents (background documents used to check project assumptions and confirm the validity of information given in the Category 1 documents and in validation interviews):

/2/ Registered PDD version 02 dated 7th November 2005
/3/ Validation Report, 15/02/2008
/4/ Approved Methodology ACM0002 Version 04
/5/ UNFCCC website project view page: http://cdm.unfccc.int/Projects/DB/DNV-CUK1143246000.13/view
/6/ Approved revised monitoring plan dated 17/08/2008
/7/ LGPP Full Load Performance Test for Ejectors
/8/ LGPP Ejector Steam Flow Supporting Data
/9/ Turbine performance curves from Turbine Manual, Lihir Geothermal Power Plant
/10/ Snapshots of Vulcan Geodata Manager-Geothermal Well Commissioning dates (GW48, 49, 51, 53 & 56)
/11/ Tracer Flow Testing Operations Manual, July 2006 independently developed by Sinclair Knight Merz (SKM)
/12/ 0279_LGPP_Ejector Steam Flow Supporting Data.xls
/13/ LGPP Full Load Performance Test Ejectors and LGPP_Ejector Steam Flow Supporting data
/14/ Theoretical uncertainty of orifice flow measurement, Zaki D. Husain, PhD Daniel Flow Products, Inc. (http://www2.emersonprocess.com/siteadmincenter/PM%20Daniel%20Documents/Theoretical-Uncertainty-of-Orifice-Flow-Measurement-techWpaper.pdf)
/15/ International standard, ISO 5167-1 (General principles and requirements), ISO 5167- 2 (Orifice plates) and ISO 5167-3 (Nozzles and Venturi nozzles).
/16/ Steam Flow and ER Calculation from Oct'07 to March'08, Direct Metering
/17/ Steam Flow and ER Calculation Oct'07 to March'08, Proposed Deviation
/18/ 30MW orifice comparison uncertainty analysis based on ISO 5167-1 (General principles and requirements), ISO 5167- 2 (Orifice plates) and ISO 5167-3 (Nozzles and Venturi nozzles).
/19/ Steam Flow Summary including steam and brine flow trends from Jan'08 to Nov'10
/20/ General overall site layout, revision 03, Lihir Steam field Geothermal
/21/
a) Drawing of mechanical steam field orifice arrangement and detail

b) Engineering calculation of orifice flow meter 700-FT-020

Annex 1: Validation Protocols

Checklist Question	Reference	MoV*	Comments	Conclusion/ CARs/CLs

Checklist Question	Reference	MoV*	Comments	Conclusion/ CARs/CLs
A.1. General Requirements *(Note that the sections A.1.1- A.1.4 may be completed after the other sections are completed)*				
A.1.1. Is the revision in the monitoring plan based on a decision by the CDM EB	EB49, Annex 29	DR	Not based on a decision by CDM EB.	*OK*
A.1.2. Is the revision based on a decision by CDM EB but also additional revisions are proposed by the PP/DOE	EB49, Annex 29	DR	No revision is not based on a decision by CDM EB.	*OK*
A.1.3. Is the need for revision in monitoring plan spotted during the first monitoring period?	EB49, Annex 29 Project page on UNFCCC website	DR	NO, this is identified during third verification.	*OK*
A.1.4. Is the revised monitoring plan complete and does the revised monitoring plan follow the registered PDD template?	Registered PDD	DR	Revised Monitoring Plan submitted as per the registered PDD template	*OK*
A.1.5. Has the revised monitoring plan submitted in track change mode for each of the revision point (issue)?	Revised monitoring plan	DR	RMP is submitted in track change mode for each of the Revision Point	**OK**
A.1.6. is there an objective evidence for each of the proposed revision point (issue)?		SV	Evidence has been verified during site visit	**OK**
A.1.7. Does the revised monitoring plan also include the Annex 4?	Registered PDD	DR	All the necessary information required in Annex 4 has been included in the section D.2.1.1 and D.3 of the RMP.	**OK**

Checklist Question	Reference	MoV*	Comments	Conclusion/ CARs/CLs
A.1.8. Does the revised monitoring plan lead/associate to any kind of change in the project registered design?	Registered PDD & EB48 Annex 66-67	DR	Revision in monitoring plan is not the out come of any change in the project design not even leading to such cases as per guidance published in EB48 Annex 66 and 67.	**OK**
A.2. Data and Parameters Monitored				
A.2.1. Does the revised monitoring plan in the PDD comply with the approved methodology provided for the collection and archiving of all relevant data necessary for estimation or measuring the emission reductions within the project boundary during the crediting period?	VVM Para. 91a/91d/121 Revised MP Section B.7 EB49, annex 2, para 9	DR	RMP Checked and found that it has complicacies with the monitoring plan in accordance to the approved methodology. **1.** Parameter included in the revised monitoring plan "quantity of steam produced from well 'i' during year y" is not clear. In the comment section, the parameter is referred to note 3 which is not at all related to the parameter. The back-up method is used for calculating the steam produced during year,y. 2. In future, LMC might have to drill more holes to source additional steam for the LGPP and no parameter have been included to determine the percentage contribution to total flow of each of the individual well heads through Tracer Flow Tests (TFT) in the revised monitoring plan as clearly mentioned in the deviation form. In monitoring plan you have mentioned that the parameter % Flow will be measured 'M' but if we have a look on description given under the note 3 it is clear that this parameter will be calculated 'C' from steam flow rate in tonnes/hour for each well head, and the sum of all of the well head's flow rates. 3. Parameters *"Mty i.e. Quantity of steam generated during well testing"* and *"Wt, CO2 Fraction of CO2 in Steam Generated during well testing" which were present in* earlier approved monitoring plan was not included in this monitoring plan. Pls. clarify**.**	CAR#01 Closed Out
A.2.2. Are the changes in the monitoring plan inline to the	*ACM002 Ver 04*	DR	The revision of monitoring plan was necessary on account of inclusion and exclusion of some parameters from the previous monitoring plan. As per ACM0002, Version 04; Project proponent has included "quantity of steam produced from well 'i' during year y	CAR#02 Closed out

Checklist Question	Reference	MoV*	Comments	Conclusion/ CARs/CLs
applied methodology and tool?			($MS_{i,y}$)" and the same will be calculated "C". This is found to be satisfactory as this parameter will be used in calculating project emissions and thus this value will be calculated apportioning the total steam (MS_y) consumed by the LGPP. PP has added another parameter "% flow" in table D.2.1.1 as a calculated value. Tracer Flow Tests (TFT) will be used to apportion the percentage contribution of flow from individual wellhead to the total steam flow to the LGPP. This has been accepted as suitable. No information is provided regarding the ejector steam flow monitoring in the revised monitoring plan.**CAR#02** *The parameters "$M_{t,\ y}$ i.e. Quantity of steam generated during well testing", "$W_{i,\ CH4\ Fraction}$ of CH4 in produced steam from well I " and "$W_{t,\ CO2}$ Fraction of CO2 in Steam Generated during well testing" were deleted from the revised monitoring report, which were there in earlier report. This is found to be satisfactory as these parameters have no role in calculation of the project CER. Although both these parameters were mentioned in ACM0002, version 04, the same has been removed from amended methodology and thus became redundant with respect to CER calculation.*	
A.2.3. Are the changes affecting the ER calculation (directly/indirectly)?	Revised MP	DR	**"quantity of steam produced from well 'i' during year y ($MS_{i,y}$)"** and the same will be calculated "C". This parameter will be used in calculating project emissions and thus this value will be calculated apportioning the total steam (MS_y) consumed by the LGPP. • Earlier PP has mentioned "% flow" in table D.2.1.1 as a measured value which has been now changed to calculated value. Tracer Flow Tests (TFT) will be used to apportion the percentage contribution of flow from individual wellhead to the total steam flow to the LGPP.. The parameters given below were deleted from the revised monitoring report "**$M_{t,\ y}$** i.e. Quantity of steam generated during well testing", "**$W_{i,\ CH4\ Fraction}$** of CH4 in produced steam from well I " and "**$W_{t,\ CO2}$** Fraction of CO2 in Steam Generated during well testing"	OK

Checklist Question	Reference	MoV*	Comments	Conclusion/ CARs/CLs
			These parameters have no role in calculation of the project CER.	

Checklist Question	Reference	MoV*	Comments	Conclusion/ CARs/CLs
A.2.4. Is the information given for each monitoring variable by the presented table sufficient to ensure the verification of a proper implementation of the monitoring plan?	RMP Section B.7	DR	It has assessed that information describing the intentions of the project participants is detailed enough to assess the appropriateness of monitoring.	*OK*
A.2.5. Has there been an issuance with the original monitoring plan of the registered PDD in the past? A.2.6. if so how did the identified gaps effect the ER calculations for the monitoring periods in the past?	Project page on UNFCCC website	DR	Yes two issuances have been done in the past. Since the new wells have been drilled in this verification period so the condensable gases has to be taken into account as project emissions. This RMP broadly covers this inclusion. Also, in cases of failure of venturi flow meter the emergency procedures, for calculating the flow of steam using conservative estimation, has been defined. Identified revision does not impact the previous issuance since the wells have been drilled in this verification period only. Even the defined emergency procedures, for calculation of steam flow, doest affect the previous issuances. In summary the RMP has no impact on issuance made in past.	*OK*
A.2.7. Is the information given for each monitoring variable by the presented table sufficient to ensure the delivery of high quality data free of potential for biases or intended or unintended changes in data records?	RMP Section – B.7	DR	It has ensures the verifiability of data quality and correctness, in discussion with Technical Expert of this sector.	*OK*
A.2.8. Is the monitoring approach in line with current good practice, i.e. will it deliver data in a reliable and reasonably acceptable accuracy?	RMP Section- B.7	DR	Parameters are assessed for high quality data in monitoring plan and found appropriate.	*OK*
A.2.9. Are all formulae used to	Revised MP	DR	Formulae used in the spreadsheets are assessed for compliance and found ok as per	OK

Checklist Question	Reference	MoV*	Comments	Conclusion/ CARs/CLs
determine project emission clearly indicated and in compliance with the monitoring methodology.	Section -B.7		PDD & methodology .	
A.3. Quality Control (QC) and Quality Assurance (QA) Procedures				
A.3.1. Is the selection of data undergoing quality control and quality assurance procedures complete?	VVM Para. 121	DR	Newly added monitoring parameter & calibration plan are quantitatively identified QA/QC are inline with Methodology.	OK
A.3.2. in case, a revision is proposed, the impact of the revision should be assessed and it not result in reduced level of accuracy and completeness in the monitoring and verification process	EB49, annex 2, para 9		RMP has taken to improve the level of accuracy and completeness in the monitoring and verification process.	*OK*
A.3.3. Are quality control procedures and quality assurance procedures sufficiently described to ensure the delivery of high quality data?	VVM Para 121	DR	Quality control procedures and quality assurance procedures are sufficiently described including safeguards the proper operations of all data capture, data analysis and data compilation systems of PP.	*OK*
A.3.4. Is it ensured that data will be bound to national or internal reference standards?	VVM Para. 86d	DR	Monitoring data are clearly reproducible (CDM manual) and not dependent on site-specific adjustments.	*OK*
A.4. Operational and Management Structure				

Checklist Question	Reference	MoV*	Comments	Conclusion/ CARs/CLs
A.4.1. Is the authority and responsibility of project management clearly described?	PDD Section B.7.2 /Annex 4	DR	CDM Monitoring Officer within its Department for External Affairs and Sustainability Development who will be responsible for monitoring emission reductions.	OK
A.4.2. Is the authority and responsibility for registration, monitoring, measurement and reporting clearly described?	PDD Section B.7.2/Annex 4	DR	CDM Monitoring Officer within its Department for External Affairs and Sustainability Development who will be responsible for monitoring emission reductions.	OK
A.5. Monitoring Plan (Annex 4)				
A.5.1. Does the monitoring plan completely describe all measures to be implemented for monitoring all parameter required, including measures to be implemented for ensuring data quality?	VVM Para. 122b	DR	Yes, the monitoring plan completely describe all measures to be implemented for monitoring all parameter required, including measures to be implemented for ensuring data quality in the section D.2.1.1 and the same will be discussed in the validation report.	OK
A.5.2. Does the monitoring plan provide information on monitoring equipment and respective positioning in order to safeguard a proper installation?	VVM Para. 122b	DR	Yes monitoring plan provide information on monitoring equipment and respective positioning in order to safeguard a proper installation	OK
A.5.3. Is there any change proposed in the specifications of the monitoring equipment or their positioning or installation then the impact of the change due to revision should be assessed and it not result in reduced level of accuracy and completeness in the monitoring and verification	EB49, annex 2, para 9	DR/SV	For steam related data: The project activity Tracer Flow Tests (TFT) will be used to apportion the percentage contribution of flow from individual wellhead to the total steam flow to the LGPP. Calculation added to improve the level of accuracy and completeness in the monitoring and verification process.	

Checklist Question	Reference	MoV*	Comments	Conclusion/ CARs/CLs
process				
A.5.4. Are procedures identified for calibration of monitoring equipment?	VVM Para. 122a-c	DR	Procedures clearly described in RMP for maintenance and calibration of monitoring equipment	OK
A.5.5. Is there any change proposed in the calibration procedures, if yes then the impact of the change due to revision should not result in reduced level of accuracy and completeness in the monitoring and verification process	EB49, annex 2, para 9		No changes proposed, completeness and Level of accuracy of Monitoring Plan will be remain same.	OK
A.5.6. Are procedures identified for day-to-day records handling (including what records to keep, storage area of records and how to process performance documentation)	VVM Para. 122a-c	DR	CDM Monitoring Officer within its Department for External Affairs and Sustainability Development who will be responsible for monitoring emission reductions.	OK
A.5.7. Are procedures identified for project performance reviews before data is submitted for verification, internally or externally?	VVM Para. 122a-c	DR	CDM Monitoring Officer within its Department for External Affairs and Sustainability Development who will be responsible for monitoring emission reductions.	OK

Annex 2: Overview of Findings

Findings Overview Summary

	CARs	CLs	FARs
Total Number raised	02	00	-

Date:	14/08/2009		Raised by:	Kunal Sharma	
Type:	CAR	Number:	01	Reference:	A.2.1

Lead Assessor Comment:

1. Parameter included in the revised monitoring plan "quantity of steam produced from well 'i' during year y" is not clear. In the comment section, the parameter is referred to note 3 which is not at all related to the parameter. The back-up method is used for calculating the steam produced during year,y.

2. In future, LMC might have to drill more holes to source additional steam for the LGPP and no parameter have been included to determine the percentage contribution to total flow of each of the individual well heads through Tracer Flow Tests (TFT) in the revised monitoring plan as clearly mentioned in the deviation form.

In monitoring plan you have mentioned that the parameter % Flow will be measured 'M' but if we have a look on description given under the note 3 it is clear that this parameter will be calculated 'C' from steam flow rate in tonnes/hour for each well head, and the sum of all of the well head's flow rates.

3. Parameters "Mty i.e. Quantity of steam generated during well testing" and "Wt, CO2 Fraction of CO2 in Steam Generated during well testing" which were present in earlier approved monitoring plan was not included in this monitoring plan. Pls. clarify!
See the revised monitoring plan (http://cdm.unfccc.int/Projects/DB/DNV-CUK1143246000.13/MonitoringPlanRevisions/01/RevisedMonitoringPlan) for this project activity. You have to use this document as base document for preparing the current monitoring plan. Although the meth was revised now and there is no need to monitor these parameters any more; this revision in meth is not applicable to this project activity as the project is registered on ver4 of ACM0002. If PP did not wish to monitor these parameters then during this revision of monitoring plan pls. clearly mention this and justify the reason for the same.

Project Participant Response:	**Date:** 20/08/2009

1. RMP revised for more clarity, revised note 3 in RMP. Same reproduced below,

Note 3: Quantity of steam produced from individual wellheads

MS i, y is the quantity of steam produced from wellhead i. In order to calculate this parameter it is necessary to apportion the total steam consumed by the LGPP to individual wellheads. MS i,y is used in the calculation of project emissions, as only the emissions from steam from wellheads drilled specifically for the purpose of power generation are included.

In order to apportion the steam, the results of the Tracer Flow Tests (TFT) undertaken on individual wellheads are used to determine the percentage contribution to total flow of each of the individual well heads. The TFT results provide a steam flow rate in tonnes/hour for each well head, and this is divided by the sum of all of the well head's flow rates to give a percentage. This percentage is then multiplied by the total steam flow rate (MS,y), to determine a flow rate for each well.

As geothermal wells discharge two phase fluid it is not practical to install continuous flow metering on individual lines.

2. Parameter % Flow has been added to table D.2.1.1

3. Please see monitoring plan with deletion in track changes. These parameters are no longer relevant, as per previous amendment to ACM0002 approved by EB

I confirm that the parameters below have been removed from the monitoring plan as per previous amendment to ACM0002 approved by EB. These parameters were removed as during a revision of the methodology as they are redundant parameters and do not need to be monitored in order to calculate the CERs.

1. MS i, y	Quantity of steam produced from well i during year y	LGL	t	C	Daily	100%	Electronic	See note 3
2. $w_{i,CO2}$	Fraction of CO_2 in produced steam from well i	LGL	tCO_2 / t steam	M	Every 4 months	100%	Electronic	See note 2
3. $w_{i,CH4}$	Fraction of CH_4 in produced steam from well i	LGL	tCH_4 / t steam	M	Every 4 months	100%	Electronic	See note 2

Documentation Provided by Project Participant:

RMP

Information Verified by Lead Assessor:

RMP

Reasoning for not Acceptance or Acceptance and Close Out:	**Date:** 26/08/2009

1. As the monitoring plan the parameter is measured 'M' but the note 3 mentions that this parameter as a calculated 'C'.
2. Corrections have been done in the revised monitoring plan.

3. The parameters "$M_{t, y}$ i.e. Quantity of steam generated during well testing", "$W_{i, CH4\ Fraction}$ of CH4 in produced steam from well I " and "$W_{t, CO2}$ Fraction of CO2 in Steam Generated during well testing" were deleted from the revised monitoring report, which were there in earlier report. This is found to be satisfactory as these parameters have no role in calculation of the project CER. Although both these parameters were mentioned in ACM0002, version 04, the same has been removed from amended methodology and thus became redundant with respect to CER calculation.

Acceptance and Close out by Lead Assessor:	**Date:** 26/08/2009

Date:	14/08/2009		Raised by:	Kunal Sharma	
Type:	CAR	Number:	02	Reference:	A.2.2
Lead Assessor Comment:					
No information is provided regarding the ejector steam flow monitoring in the revised monitoring plan.					
Project Participant Response:			**Date:** 20/08/2009		
RMP revised for more clarity, revised note 1, Same reproduced below, In the event that the venturi flow meters fail, the metered power generation data (24hour average for each turbine), ejector steam flow and turbine performance curves are used to determine the total steam flow to the LGPP until the meters can be repaired or replaced. The performance curves are obtained from the turbine manufacturer and are based on turbine performance testing. Ejector steam flow is a constant value based on flow rates recorded during the full load performance testing, which is a conservative value representative of the maximum flow that would be seen through the ejectors. The daily 24hour average generation in MW is obtained by summing the daily 24hour average generation of each turbine (Ei). In order to be conservative, the maximum daily 24 hour average generation for each suitable day in the month is selected as being the daily generation for each day in that month. The corresponding steam flow rate is obtained from the performance curve, and this value is used as the steam flow for each day in that month. Selecting the maximum generation for the month ensures that the steam consumption is conservative and results in an overestimation of the amount of steam consumed. A suitable day is defined as a day where there is stable generation over the 24 hour period with the vent valves closed at the end of the 24 hour period (as indicated in the Power Station Daily Report) and wellhead valves in the same state as the previous day. Where one or more vent valves are open on the maximum generation day, additional steam (based on the maximum capacity of each vent valve and number of valves open) is added to the calculated turbine steam consumption and applied for the entire month. Where there are no stable 24 hour generation periods (minimum and maximum within 10% of the daily average) for the month, the total steam flow is based on the total capacity with all five vent valves fully open for the month. This ensures the most conservative approach is always taken based on reliable data.					
Documentation Provided by Project Participant:					
RMP					
Information Verified by Lead Assessor:					
RMP					
Reasoning for not Acceptance or Acceptance and Close Out:			**Date:** 26/08/2009		
Ejector steam flow monitoring is now defined in the revised monitoring plan (Note 1).					
Acceptance and Close out by Lead Assessor:			**Date:** 26/08/2009		

Statement of Competence

Name: Sharma, Kunal SGS Affiliate: SGS India

Status

-	Lead Assessor	x	-	Expert	x
-	Assessor	x	-	Financial Expert	
-	Local Assessor	x	-	Technical Reviewer	

Scopes of Expertise

1. Energy Industries (renewable / non-renewable)
Sub scope(s):

2. Energy Distribution
Sub scope(s):

3. Energy Demand
Sub scope(s):

4. Manufacturing **x**
Sub scope(s): Lime Production and Use

5. Chemical Industry
Sub scope(s):

6. Construction
Sub scope(s):

7. Transport
Sub scope(s):

8. Mining/Mineral Production
Sub scope(s):

9. Metal Production
Sub scope(s):

10. Fugitive Emissions from Fuels (solid, oil and gas)
Sub scope(s):

11. Fugitive Emissions from Production and Consumption of Halocarbons and Sulphur Hexafluoride
Sub scope(s):

12. Solvent Use
Sub scope(s):

13. Waste Handling and Disposal **x**
Sub scope(s): Wastewater and sludge treatment

14. Afforestation and Reforestation
Sub scope(s):

15. Agriculture
Sub scope(s):

Approved Member of Staff by: Siddharth Yadav Date: 28/10/2009

Statement of Competence

Name: Kevin Brown SGS Affiliate: SGS India

Status

-	Lead Assessor		-	Expert	x
-	Assessor		-	Financial Expert	
-	Local Assessor		-	Technical Reviewer	

Scopes of Expertise

1. Energy Industries (renewable / non-renewable)	**x**
Sub scope(s): Geothermal	
2. Energy Distribution	
Sub scope(s):	
3. Energy Demand	
Sub scope(s):	
4. Manufacturing	
Sub scope(s):	
5. Chemical Industry	
Sub scope(s):	
6. Construction	
Sub scope(s):	
7. Transport	
Sub scope(s):	
8. Mining/Mineral Production	
Sub scope(s):	
9. Metal Production	
Sub scope(s):	
10. Fugitive Emissions from Fuels (solid, oil and gas)	
Sub scope(s):	
11. Fugitive Emissions from Production and Consumption of Halocarbons and Sulphur Hexafluoride	
Sub scope(s):	
12. Solvent Use	
Sub scope(s):	
13. Waste Handling and Disposal	
Sub scope(s):	
14. Afforestation and Reforestation	
Sub scope(s):	
15. Agriculture	
Sub scope(s):	

Approved Member of Staff by: Siddharth Yadav Date: 26.02.2010

Statement of Competence

Name: Khati Sarang SGS Affiliate: SGS India

Status

-	Lead Assessor		-	Expert	x
-	Assessor	x	-	Financial Expert	
-	Local Assessor	India	-	Technical Reviewer	

Scopes of Expertise

5. Energy Industries (renewable / non-renewable) **x**
Sub scope(s): Fuel switch (fossil fuels only).

6. Energy Distribution
Sub scope(s):

7. Energy Demand
Sub scope(s):

8. Manufacturing
Sub scope(s):

16. Chemical Industry **x**
Sub scope(s): CO2 substitution from fossil fuel or fuels of mineral origin

17. Construction
Sub scope(s):

18. Transport
Sub scope(s):

19. Mining/Mineral Production
Sub scope(s):

20. Metal Production
Sub scope(s):

21. Fugitive Emissions from Fuels (solid, oil and gas) **x**
Sub scope(s): Oil and Natural Gas - Natural Gas

22. Fugitive Emissions from Production and Consumption of Halocarbons and Sulphur Hexafluoride
Sub scope(s):

23. Solvent Use **x**
Sub scope(s): Solvents Use

24. Waste Handling and Disposal
Sub scope(s):

25. Afforestation and Reforestation
Sub scope(s):

26. Agriculture
Sub scope(s):

Approved Member of Staff by: Siddharth Yadav Date: 14/5/2010

Statement of Competence

Name:	Bruce Telfer	SGS Affiliate:	SGS Papua New Guinea

Status

-	Lead Assessor		-	Expert	
-	Assessor	x	-	Financial Expert	
-	Local Assessor	Papua New Guinea	-	Technical Reviewer	

Scopes of Expertise

9. Energy Industries (renewable / non-renewable)
Sub scope(s):

10. Energy Distribution
Sub scope(s):

11. Energy Demand
Sub scope(s):

12. Manufacturing
Sub scope(s):

27. Chemical Industry
Sub scope(s):

28. Construction
Sub scope(s):

29. Transport
Sub scope(s):

30. Mining/Mineral Production
Sub scope(s):

31. Metal Production
Sub scope(s):

32. Fugitive Emissions from Fuels (solid, oil and gas)
Sub scope(s):

33. Fugitive Emissions from Production and Consumption of Halocarbons and Sulphur Hexafluoride
Sub scope(s):

34. Solvent Use
Sub scope(s):

35. Waste Handling and Disposal
Sub scope(s):

36. Afforestation and Reforestation
Sub scope(s):

37. Agriculture
Sub scope(s):

Approved Member of Staff by:	Siddharth Yadav	Date:	29/04/2010

Statement of Competence

Name: Singh, Kaviraj

Status

-	Lead Assessor	x	-	Expert	x
-	Assessor		-	Financial Expert	
-	Local Assessor		-	Technical Reviewer	x

Scopes of Expertise

1. Energy Industries (renewable / non-renewable)
Sub scope(s):

2. Energy Distribution
Sub scope(s):

3. Energy Demand
Sub scope(s):

4. Manufacturing
Sub scope(s):

5. Chemical Industry
Sub scope(s):

6. Construction
Sub scope(s):

7. Transport
Sub scope(s):

8. Mining/Mineral Production
Sub scope(s):

9. Metal Production
Sub scope(s):

10. Fugitive Emissions from Fuels (solid, oil and gas)
Sub scope(s):

11. Fugitive Emissions from Production and Consumption of Halocarbons and Sulphur Hexafluoride
Sub scope(s):

12. Solvent Use
Sub scope(s):

13. Waste Handling and Disposal **x**
Sub scope(s): Landfill gas, Wastewater and sludge treatment, Composting

14. Afforestation and Reforestation
Sub scope(s):

15. Agriculture
Sub scope(s):

Approved Member of Staff by: Siddharth Yadav Date: 16/12/2009