



VERIFICATION / CERTIFICATION REPORT

‘SHENZHEN XIAPING LANDFILL GAS COLLECTION AND UTILIZATION PROJECT’ IN CHINA

UNFCCC Registration Ref No.: 0887

Monitoring Period
1 February 2009 to 30 September 2009
(Fourth Periodic Verification)

REPORT No. 2009-1910

REVISION No. 03

DET NORSKE VERITAS



VERIFICATION / CERTIFICATION REPORT

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Summary:

Det Norske Veritas Certification AS has performed a verification of the emission reductions reported from the 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project' (SXLGCUP) in China for the period 1 February 2009 to 30 September 2009.

In DNV's opinion the GHG emission reductions reported for the period 1 February 2009 to 30 September 2009, as reported in the revised monitoring report dated 08 November 2010 are fairly stated.

The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology (ACM0001, version 4) and registered PDD, version 7 of 7 January 2007 and the revised monitoring plan approved on 31 May 2008. The project was registered as a CDM project on 4 May 2007 with the registration number of 0887.

Det Norske Veritas Certification AS is able to certify that the emission reductions from the 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project' during the period 1 February 2009 to 30 September 2009 amount to 173 780 tCO₂ equivalent.

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<i>Table of Content</i>	<i>Page</i>
1 INTRODUCTION	1
1.1 Objective	1
1.2 Scope	1
1.3 Description of the Project Activity	1
2 METHODOLOGY	2
2.1 Review of Documentation	3
2.2 Site Visits	3
2.3 Assessment	4
2.3.1 Factors and datum determined ex-ante	4
2.3.2 Factors and data monitored or calculated ex-post	4
2.4 Reporting of Findings	8
3 VERIFICATION FINDINGS	10
3.1 Remaining Issues, CARs, FARs from previous Validation or Verification	10
3.2 Project Implementation	10
3.3 Completeness of Monitoring	10
3.4 Accuracy of Emission Reduction Calculations	10
3.5 Quality of Evidence to determine Emission Reductions	14
3.6 Management System and Quality Assurance	14
4 CERTIFICATION STATEMENT	15
5 REFERENCES	17
Appendix A Corrective action requests, clarification requests and forward action requests	
Appendix B Verification Checklist	

***Abbreviations***

CAR	Corrective Action Request
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CER	Certified Emission Reduction(s)
CH ₄	Methane
CO ₂	Carbon dioxide
CO _{2e}	Carbon dioxide equivalent
DNV	Det Norske Veritas
DNA	Designated National Authority
ERU	Emission Reduction Units(s)
FAR	Forward Action Request
GHG	Greenhouse gas(es)
IPCC	Intergovernmental Panel on Climate Change
MP	Monitoring Plan
MVP	Monitoring and Verification Plan
N ₂ O	Nitrous oxide
NGO	Non-governmental Organisation
ODA	Official Development Assistance
PDD	Project Design Document
UNFCCC	United Nations Framework Convention for Climate Change
GWP	Global Warming Potential



1 INTRODUCTION

Shenzhen Lisai Development Co. Ltd. has commissioned Det Norske Veritas Certification AS (DNV) to carry out the verification and certification of emission reductions reported by the 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project' for the period 1 February 2009 to 30 September 2009. This report contains the findings from the verification and a statement for the certified emission reductions.

1.1 Objective

Verification is the independent review and ex-post determination by the Designated Operational Entity (DOE) of the monitored reductions in GHG emissions that have occurred as a result of the project activity during a defined verification period.

Certification is the written assurance by the DOE that, during a specific period in time, a project activity achieved the emission reductions as verified.

1.2 Scope

The Verification scope is:

- To verify that actual monitoring systems and procedures are in compliance with the monitoring systems and procedures described in the monitoring plan for the project activity,
- To evaluate the GHG emission reduction data and express a conclusion with a reasonable level of assurance about whether the reported GHG emission reduction data is free from material misstatement,
- To verify that the reported GHG emission data is sufficiently supported by evidence.

The verification is meant to ensure that reported emission reductions are complete and accurate to be certified.

1.3 Description of the Project Activity

Project Parties:	<i>China (Host Party) and the United Kingdom of Great Britain and Northern Ireland and Switzerland (Annex I Parties)</i>
Title of project activity:	<i>'Shenzhen Xiaping Landfill Gas Collection and Utilization Project'</i>
UNFCCC registration No:	<i>0887</i>
Project Participants:	<i>Shenzhen Lisai Development Co. Ltd. From China and Climate Change Capital Carbon Fund s.à r.l. from the UK and Switzerland</i>
Location of the project activity:	<i>in the Xiaping Landfill site of the Luohu District, Shenzhen City, Guangdong Province, P. R. China</i>
Project's crediting period	<i>1 July 2007 to 30 June 2014 (1st renewable crediting period).</i>
Verification period	<i>1 February 2009 to 30 September 2009</i>



The project is located in the Xiaping Landfill site of the Luohu District, Shenzhen City, Guangdong Province, P. R. China. The project is based on LFG recovery and its utilization for power generation. The project activity involved the construction of LFG collection system, enclosed flaring equipment and an electricity generation plant with the total installed capacity of 8.512MW.

During the site visit for the verification period (1 February 2009 to 30 September 2009), DNV was able to confirm (in terms of project implementation) six power generating units (3* 1.064 MW, 1* 1.048 MW and 2* 1.100 MW generators) and two enclosed flares to be in operation during the period. One new 1.064 MW power generation unit had also been commissioned during the current verification period. It is also confirmed that the total installed capacity of all the turbines put together does not exceed the 8.512 MW capacity indicated in the PDD.

The details regarding the reciprocating engine-generators and two flares with respect to their numbers, type and model of the machines were verified. For the new generator, it is made by GE-Jenbacher and found to be in line with the details provided in the PDD

The monitoring plan was revised and approved by CDM Executive Board on 31 May 2008, which addresses the replacement of the main pipe with two parallel ones to widen the measurement range of the LFG flow rate, that was verified in the previous monitoring period.

2 METHODOLOGY

The verification of the emission reductions has assessed all factors and issues that constitute the basis for emission reductions from the project. As the CDM Executive Board has not yet formally endorsed the application of any materiality principle for verification of emission reductions from CDM projects - implying that emphasis should be on the significant contributors to emission reductions - DNV has for this assignment decided to check all factors and issues with the same emphasis. Despite this, the team has during its preparations identified the key reporting risks and used the assessment to determine to which extent the project operator's control systems were adequate for mitigation of these key reporting risks.

**Verification team**

Role/Qualification	Last Name	First Name	Country	Type of involvement					
				Desk review	Site visit / Interviews	Reporting	Supervision of work	Technical review	Expert input
CDM Verifier / Technical team leader	Ramesh	Ramachandran	India	√		√	√		
GHG Auditor / Project manager	Li	Tao	China	√	√	√			
GHG Auditor	Tang	Zhiang	China	√		√			
GHG Auditor	Liu	Qing	China			√			
Sector Expert	Ramesh	Ramachandran	India						√
Technical reviewer	Chandrashekhara	Kumaraswamy	India					√	

Duration of verification

Preparations: *From 16 November 2009 to 17 November 2009*

On-site verification: *From 18 November 2009 to 19 November 2009*

Reporting: *From 23 November 2009 to 17 February 2010*

2.1 Review of Documentation

The monitoring report /1/ dated 3 November 2009 and the revised version dated 08 November 2010 submitted by Shenzhen Lisai Development Co. Ltd. and additional background documents /2/-/30/ related to the registered project design, and the monthly monitoring records by Shenzhen Lisai Development Co. Ltd. were assessed as a part of the verification. In addition, the monitoring plan contained in the registered PDD /2/ and the revised monitoring plan which was approved by the EB on 31 May 2008 were also assessed /7/ /8/.

The basis for the verification is the revised monitoring report from the project proponent for the period from 1 February 2009 to 30 September 2009 dated 08 November 2010, the registered PDD /2/, the revised monitoring plan, the approved baseline and the monitoring methodology applicable to the project (ACM0001 version 04) /9/. The project operator has in addition supplied the verification team with instructions from its management system and monitoring manual /27/.

2.2 Site Visits

In the period of 18 November 2009 to 19 November 2009, DNV auditor Li Tao from Beijing office performed a site visit at 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project'. During this visit, DNV interviewed the representative /31/-/34/ of Shenzhen Lisai



Development Co. Ltd., Shenzhen Xiaping Landfill plant, and verified the actual implementation of the project as described in the registered PDD and revised monitoring plan. The monitoring meters and calibration records of the meters were checked and found to be in order.

2.3 Assessment

The data presented in the monitoring report were assessed in detail by review of detailed project documentation and production records, interviews with personnel at Shenzhen Lisai Development Co. Ltd., collection of measurement records of all parameters, observation of established monitoring and reporting practices and assessment of the reliability of monitoring equipment. This has enabled the verification team to assess the accuracy and completeness of reported monitoring results and verify the correct application of the approved monitoring methodology. Data from other sources, such as the calibration certificates issued by qualified third-parties have also been assessed. The project test and joint inspection reports (TJIR) /4/ /5/ have been verified during the previous verification period and indicated that the project is implemented as planned and is satisfied with the requirement of operation and environment protection as required in environment impact assessment (EIA).

2.3.1 Factors and datum determined ex-ante

During the site visits, DNV assessed all the factors that are determined *ex ante* in accordance with the monitoring methodology ACM0001 version 04, issues required for reporting in the PDD as well as necessary management system issues were also assessed during the site visit. This included the following:

- ***The emission factor for electricity displaced in the South China Power Grid***

As per the registered PDD, the emission factor of 0.608 t CO₂/MWh is determined ex-ante and the same is applied during the whole crediting period.

- ***The adjustment factor (AF)***

As per the methodology ACM0001 version 04 and the registered PDD, the adjustment factor is ex-ante determined as zero for the first crediting period.

- ***The global warming potential of CH₄***

As per the registered PDD and the methodology ACM0001 version 04, the global warming potential of CH₄ is determined as 21.

2.3.2 Factors and data monitored or calculated ex-post

The following data reported in the monitoring report from the project has been assessed in detail. The numbers reported are found to be correct.

- ***Total amount of LFG capture***

This amount is reported on daily log sheets (CDM project log sheet) and aggregated into monthly reports. The verification team has assessed all daily log sheets and the monthly reports and found these to be correct /31/.

The project has reported these numbers based on reading from the flow meters, in accordance with the registration requirements of the methodology for this project. The readings have been recorded automatically. Shenzhen Lisai Development Co. Ltd. applies PLC system, which can record the data automatically.

The calibration records of the flow meters were assessed and found to be in order /11/-/16/.

- ***Amount of LFG combusted in flare***

This amount is reported on daily log sheets (CDM project log sheet) and aggregated into monthly reports. The verification team has assessed all daily log sheets and the monthly reports



and found these to be correct.

The project has reported these numbers based on reading from the flow meters, in accordance with the registration requirements of the methodology for this project. The readings have been recorded automatically. Shenzhen Lisai Development Co. Ltd. applies PLC system, which can record the data automatically.

The calibration records of the flow meters were assessed and found to be in order/11/ /15/.

- ***Amount of LFG used for power generation***

This amount is reported on daily log sheets (CDM project log sheet) and aggregated into monthly reports. The verification team has assessed all daily log sheets and the monthly reports and found these to be correct.

The project has reported these numbers based on reading from the flow meter readings, in accordance with the registration requirements of the methodology for this project. The readings have been recorded automatically. Shenzhen Lisai Development Co. Ltd. applies PLC system, which can record the data automatically.

The calibration records of the flow meter were assessed and found to be in order/11/ /14/.

- ***Amount of electricity exported out of the project***

This amount is reported on daily log sheets (CDM project log sheet) and aggregated into monthly reports. The verification team has assessed all daily log sheets and the monthly reports and found these to be correct.

The project has reported these numbers based on readings of electricity meters, in accordance with the registration requirements of the methodology for this project. The readings have been recorded automatically. Shenzhen Lisai Development Co. Ltd. applies PLC system, which can record the data automatically.

The calibration for the electricity meters dated 25 February 2008 and 10 February 2009 are assessed and found in order /13/ /17/.

- ***Amount of electricity imported to meet the requirement of the project***

This amount is reported on daily log sheets (CDM project log sheet) and aggregated into monthly reports. The verification team has assessed all daily log sheets and the monthly reports and found these to be correct.

The project has reported these numbers based on readings of electricity meters, in accordance with the registration requirements of the methodology for this project. The readings have been recorded automatically. Shenzhen Lisai Development Co. Ltd. applies PLC system, which can record the data automatically.

The calibration for the electricity meters dated 22 February 2008 and 10 February 2009 are assessed and found in order /13/ /18/.

- ***Flare efficiency***

As per the registered PDD and the methodology ACM0001 version 04, the flare efficiency will be determined annually by the operating hours and the methane content in the exhaust gas. The enclosed flare is used in the project. The methane components were determined annually and the operation hours have been determined continuously. The efficiency of the 1# flare was tested on 12 June 2008 and 10 June 2009, 2# flare was tested on 5 January 2009, with a validity of one year, which is evidenced by the Flare Test Report for Shenzhen Xiaping LFG project prepared by Centre Testing International (Shen Zhen) Limited /23/ Centre Testing International (Shen Zhen) Limited is a qualified third party for the flare test, which is evidenced by the flare test certificate issued by China National Accreditation Service for Conformity Assessment on 30 June 2006 with 5 years valid period /24/.



The calculation of flare efficiency used in the test is in accordance with the “Methodological tool to determine project emissions from flaring gases containing methane” which came into effect along with ACM0001, version 05 and prior to the monitoring period of the project activity. The efficiency ((99.215% in 12 June 2008 and 95.1% in 10 June 2009 for 1# flare, 99.690% in 5 January 2009 for 2# flare)) in the test report /23/ is the same as described in the monitoring report. The test report has been checked by DNV.

- ***Adjustment factor (AF)***

As per the registered PDD, the AF (used to consider the amount of methane destroyed in the baseline scenario), will be monitored by checking the regulation on the web site [www.es.org.cn /25/](http://www.es.org.cn/25/) and [www.szepb.gov.cn /26/](http://www.szepb.gov.cn/26/) annually. Since the relevant regulations have not changed during the monitoring period, landfill operator is not required to flare any amount of LFG that it currently emits, and hence the adjustment factor (AF) remains the same as in the validated PDD.

- ***Operation of the energy plant***

The operation of flares and generators is measured hourly to monitor whether the operation is normal or not. Shenzhen Lisai Development Co. Ltd. applies PLC system, which can record the data automatically.

- ***Methane fraction in the landfill gas W_{CH_4}***

This amount is reported on daily log sheets (CDM project log sheet) and aggregated into monthly reports. The verification team has assessed all daily log sheets and the monthly reports and found these to be correct /30/.

The project has reported these numbers based on reading from the gas analyzer, in accordance with the registration requirements of the methodology for this project. The readings have been recorded hourly (there are 5 739 data recorded in the monitoring period from 1 February 2009 to 30 September 2009). Shenzhen Lisai Development Co. Ltd. applies PLC system, which can record the data automatically.

Moreover, according to the “guidance to calculate the fraction of methane in the landfill gas from periodical measurement” in Annex 13 of EB 48, the projects using the older versions (from version 1 to version 10) of ACM0001 is applicable to the guidance. The project applies version 04 of ACM0001, hence, it will be calculated based on the guidance.

As per the guidance’s requirement:

- A systematic random sampling scheme was implemented. The samples were taken starting at zero point on 1 February 2009 with increment 1 hour throughout the project year, in the monitoring period from 1 February 2009 to 1 October 2009, there are 5 739 samples monitored.
- A minimum of 4 measurements of fraction of methane in the landfill gas per year should be conducted. A total of 5 739 measurements have been taken in the monitoring period with monitored hourly. It will be reasonable.
- Based on the set of 5 739 data collected, the value correspondent to the lower bound of the 95% confidence level was calculated in the ER spreadsheet.

The calibration for the methane analyzer dated 16 January 2008 and 13 January 2009 are assessed and found in order /19/.

- ***The methane density***

As per the methodology ACM0001 version 04, the methane density is $0.0007168 \text{ t CH}_4/\text{Nm}^3$ at standard temperature and pressure. However, it was specified that temperature (T) and pressure



(P) of the landfill gas, are required to determine the density of methane in the landfill gas in the methodology ACM0001 version 04. Because the project was always operated at non-standard conditions, to comply with the approved methodology and fit for the project's actual conditions, the density of methane was calculated based on the temperature and pressure measured. The main procedure for calculating density of methane was as follow:

1. The temperature and pressure of LFG was monitored on an hourly basis and recorded automatically by the PLC system, total 5 739 data were recorded
2. The equation of ideal gas was applied to calculate the density of methane.

According to the equation of ideal gas

$$PV = nRT$$

Where P is the absolute pressure of gas (Pa); V is the volume (m³); n is the amount of substance (mol); R is the universal gas constant (J/(mol.K) and T is the absolute temperature (K).

Since “nR” is constant, thus

$$\frac{P_{s \text{ tan dard}} \times V_{s \text{ tan dard}}}{T_{s \text{ tan dard}}} = \frac{P_{non-s \text{ tan dard}} \times V_{non-s \text{ tan dard}}}{T_{non-s \text{ tan dard}}}$$

where,

P_{standard} is standard atmospheric pressure, 101.325kPa;

V_{standard} is the volume under standard conditions.

T_{standard} is standard temperature, 0 degrees Celsius.

P_{non-standard} is the pressure of the landfill gas under Non-Standard Conditions. Such pressure is calculated as a mean of the value recorded hourly and the value recorded an hour before;

V_{non-standard} is the volume measured under non-standard conditions;

T_{non-standard} is the temperature of the landfill gas, monitored hourly under Non-Standard Conditions. Such temperature is calculated as a mean of the value recorded hourly and the value recorded an hour before;

Thus, V_{standard} was concluded as:

$$V_{s \text{ tan dard}} = \frac{P_{non-s \text{ tan dard}} \times V_{non-s \text{ tan dard}} \times T_{s \text{ tan dard}}}{P_{s \text{ tan dard}} \times T_{non-s \text{ tan dard}}}$$

And the density equation,

$$\rho = M / V, \text{ Then } M = \rho \times V$$

Where ρ is density (g/m³), M is mass (g) and V is volume (m³);

Since mass “M” always remains the same under both standard conditions and non-standard conditions, thus:

$$\rho_{s \text{ tan dard}} \times V_{s \text{ tan dard}} = \rho_{non-s \text{ tan dard}} \times V_{non-s \text{ tan dard}}$$

Where,



$\rho_{s \text{ tan dard}}$ is the density of methane at standard temperature and pressure, i.e. 0.0007168 t/m³

V_{standard} is the volume under standard conditions;

$\rho_{\text{non-s tan dard}}$ is the density of methane under Non-Standard Conditions;

$V_{\text{non-standard}}$ is the volume measured under non-standard conditions;

Then

$$\text{Concluded } \rho_{\text{non-s tan dard}} = (P_{\text{non-s tan dard}} \times T_{s \text{ tan dard}} \times \rho_{s \text{ tan dard}}) / (T_{\text{non-s tan dard}} \times P_{s \text{ tan dard}})$$

3. Because there is no clearly specification for the calculation of the density of methane, the density of methane was calculated as followed the “guidance to calculate the fraction of methane in the landfill gas from periodical measurement” in Annex 13 of EB 48.

A systematic random sampling scheme was implemented. The samples were taken starting at zero point on 1 February 2009 with increment 1 hour throughout the project year, in the monitoring period from 1 February 2009 to 1 October 2009, there are 5 739 samples for pressure and temperature monitored. DNV has verified the monitored values of P and T /30/.

- A minimum of 4 measurements of temperature and pressure in the landfill gas per year should be conducted. A total of 5 739 measurements have been taken in the monitoring period with monitored hourly. This is considered reasonable.
- Based on the set of 5 739 data collected, the value correspondent to the lower bound of the 95% confidence level was calculated in the ER spreadsheet.

Based on the above calculation method, the density of methane is 0.0006577 t CH₄/m³.

2.4 Reporting of Findings

Findings established during the verification may be that:

- i) the verification is not able to obtain sufficient evidence for the reported emission reductions or part of the reported emission reductions. In this case these emission reductions shall not be verified and certified;
- ii) the verification has identified material misstatements in the reported emission reductions. Emission reductions with material misstatements shall be discounted based on the verifiers ex-post determination of the achieved emission reductions.

A Forward Action Requests (FAR) should be issued, where:

- the actual project monitoring and reporting practices requires attention and /or adjustment for the next consecutive verification period, or
- an adjustment of the monitoring plan is recommended.

In the context of FARs, risks have been identified, which may endanger the delivery of high quality CERs in the future, i.e. by deviations from good reporting or management procedures. As a consequence, such aspects should receive a special focus during the next verification.



VERIFICATION / CERTIFICATION REPORT

During this monitoring period, one CAR, two CL and one FAR were raised, details were described in the Annex 1: Corrective action requests, clarification requests and forward action requests.



3 VERIFICATION FINDINGS

In the following sections the findings of the verification are stated. The verification criteria (requirements), the means of verification and the results from verifying the identified criteria are documented in more detail in the verification checklist described in Appendix A to the verification/certification report.

3.1 Remaining Issues, CARs, FARs from previous Validation or Verification

This is the 4th periodic verification and there are no remaining issues from previous validation or verification.

3.2 Project Implementation

The project has been implemented as planned. During the site visit, it was confirmed that the construction of the gas collection system, two enclosed flares and six power generating units were already complete. Hence, for the current verification period, six power generating units (3* 1.064 MW, 1* 1.048 MW and 2*1.100 MW generators) and two flares were available.

To be most specifically, one generator made by GE-Jenbacher was installed during this monitoring period, this generator was tested and inspected by the project owner and the generator manufacturer on 4 August 2009 /29/.

During the first periodic verification, the commissioning certificates for the project were verified against the commissioning capacity details and found to be correct. After the commissioning, the project test and joint inspection reports /4//5/ for the project had been approved by local government, which proved that the project was constructed as planned and was able to satisfy the requirement of operation and environment protection as required in environment impact assessment (EIA).

The registered PDD states that the total capacity for the project will be 8*1.064 MW in 2009, while the actual capacities for 3 of the total of six installed units are slightly different from that estimated in the registered PDD. However, the capacity of the two units with 1.1 MW is only 3.4% higher than, the capacity of the unit with 1.048 MW is only 1.5% lower than the unit capacity estimated (1.064 MW) in the registered PDD. This variation is within normal variations that occur during actual implementation of projects. Moreover, project implementation is not yet completed and will be completed in 2010 by installing the remaining two generators. Due to actual capacities only being slightly different from the capacities stated in the PDD, it is DNV's opinion that the actual project activity and its operation are in compliance with the registered PDD in accordance with paragraph 62(g) of the CDM Modalities and Procedure. DNV considered it thus not necessary to submit a notification of change or request for approval of changes for this monitoring period.

3.3 Completeness of Monitoring

The monitoring of the project is complete and in accordance with the approved monitoring methodology. The monitoring methodologies and sustaining records are sufficient to enable verification of emission reductions.

3.4 Accuracy of Emission Reduction Calculations

Emissions reductions have been calculated as per the following formula:



$$\text{Emission reductions (ERs)} = (\text{MD}_{\text{project},y} - \text{MD}_{\text{reg},y}) * \text{GWP}_{\text{CH}_4} + \text{EL}_y * \text{CEF}_{\text{electricit.},y}$$

Where:

$\text{MD}_{\text{project},y}$: Methane destroyed/combusted in the project activity which is equivalent to methane destroyed in the flare (MD_{flare}) and methane destroyed in the electricity generation (MD_{elect}).

$\text{MD}_{\text{reg},y}$: amount of methane that would have been destroyed/combusted during the year “y” in the absence of the project (tCH₄).

GWP_{CH_4} : Global Warming Potential value for methane which in accordance with the methodology has been considered as 21 tCO₂e/t CH₄.

EL_y : Net electricity export (generated by using LFG as fuel) to China South power grid.

$\text{CEF}_{\text{electricit.},y}$: Grid emission factor of the China South power grid. As per registered PDD, the grid emission factor has been fixed ex ante for the entire first crediting period. Hence, for the calculations, the validated grid emission factor of 0.608 tCO₂/MWh has been used.

1) As discussed above, $\text{MD}_{\text{project},y} = \text{MD}_{\text{Flare}} + \text{MD}_{\text{elect}}$

- $\text{MD}_{\text{flare}} = \text{Amount of LFG to flare (LFG}_{\text{flare}}) * \text{methane fraction of LFG (W}_{\text{CH}_4}) * \text{Density of methane (D}_{\text{CH}_4}) * \text{Flare efficiency (FE)}$

DNV was able to confirm that all parameters are monitored in accordance with the validated monitoring plan and also the monitoring methodology ACM0001, version 04.

The efficiency of the flare operated during this verification period for 1# flare was tested on 12 June 2008 and 10 June 2009, 2# flare was tested on 5 January 2009 with validity duration of one year, which is evidenced by the Flare Test Report for Shenzhen Xiaping LFG Project prepared by Centre Testing International (Shen Zhen) Limited/21/. Centre Testing International (Shen Zhen) Limited is a qualified third party for the flare test, which is evidenced by the flare test certificate issued by China National Accreditation Service for Conformity Assessment on 30 June 2006 /22/.

The calculation of flare efficiency used in the test is in accordance with the “Methodological tool to determine project emissions from flaring gases containing methane” which came into effect along with ACM0001, version 05 and prior to the monitoring period of the project activity.

The efficiency (99.215% in 12 June 2008 and 95.1% in 10 June 2009 for 1# flare, 99.690% in 5 January 2009 for 2# flare) in the test report is the same as described in the monitoring report. The test report has been checked by DNV.

- $\text{MD}_{\text{elect}} = \text{Amount of LFG for electricity generation (LFG}_{\text{elect}}) * \text{methane fraction of LFG (W}_{\text{CH}_4}) * \text{Density of methane (D}_{\text{CH}_4})$



A total of 5 739 measurements have been taken for this monitoring period under verification and the measured hourly methane concentrations were reported in the spreadsheet submitted with the request for issuance. Hence, while the methane concentration in the LFG was not measured continuously, the hourly measurements give a good representative spread of the methane concentrations.

As per the Annex 13 of EB48 meeting “Guidelines to Calculate the Fraction of Methane in The landfill Gas From Periodical Measurement”, the methane fraction is calculated as follows:

(1) Calculate sample mean (μ).

$$\mu_{WCH4,y} = \frac{\sum_{m=1}^{n_m} W_{CH4,m,y}}{n_m}$$

Where:

$\mu_{WCH4,y}$ = Mean of the fraction of methane in the landfill gas in year y (m^3CH_4/m^3 LFG)

$W_{CH4,m,y}$ = Monitored fraction of methane in the landfill gas in measurement m in year y (m^3CH_4/m^3 LFG)

n_m = Number of measurements m in year y (minimum is 4)

The measurement is hourly taken for Xiaping project. The n_m amounts to 5 739, and the $\mu_{WCH4,y}$ is calculated to 57.60 as per the $W_{CH4,m,y}$ (refer to the worksheet) monitored and n_m .

(2) Calculate the sample standard deviation (σ).

$$\sigma_{WCH4,y} = \sqrt{\frac{\sum_{m=1}^{n_m} (W_{CH4,m,y} - \mu_{CH4,y})^2}{n_m - 1}}$$

Where:

$\sigma_{WCH4,y}$ = Standard deviation of the fraction of methane in the landfill gas in year y (m^3CH_4/m^3 LFG)

Use the value calculated in equation step (1), the $W_{CH4,m,y}$ monitored and n_m , to calculate the $\sigma_{WCH4,y}$ as 3.06 during this monitoring period.

(3) Calculate the 95% confidence interval.

$$\mu_{WCH4,y} - t \cdot \frac{\sigma_{WCH4,y}}{\sqrt{n_m}} \leq W_{CH4,y} \leq \mu_{WCH4,y} + t \cdot \frac{\sigma_{WCH4,y}}{\sqrt{n_m}}$$

Where:

t = Value from standard t distribution for a confidence level of 95% with degrees of freedom $n_m - 1$

When the confidence level is 95% and $n_m - 1 = 5738$ t concludes to 1.96.

(4) Use the lower bound of the 95% confidence interval obtained below to ensure conservativeness.

$$W_{CH4,lb,y} = \mu_{WCH4,y} - t \cdot \frac{\sigma_{WCH4,y}}{\sqrt{n_m}}$$

Where:

$W_{CH4,lb,y}$ = Lower bound of the 95% confidence interval of fraction of methane in the landfill



gas ($\text{m}^3\text{CH}_4/\text{m}^3$ LFG)

As per the data monitored and values concluded from Step (1) --(4), the $W_{\text{CH}_4, \text{lb}, y}$ is calculated to 57.54 during this period.

(5) The value of $W_{\text{CH}_4, \text{lb}, y}$ estimated in equation 4 should be used in the methodology as the final value for fraction of methane in the landfill gas during this monitoring period

The density of methane was also calculated with temperature and pressure of the landfill gas applied the 95% confidence interval refer to the “guidance to calculate the fraction of methane in the landfill gas from periodical measurement” in Annex 13 of EB 48.

In this verification period, the cumulative flow meters recorded a total of 15 233 006 m^3 of LFG to the generators and 4 989 418 m^3 to the flare. Hence, $\text{MD}_{\text{project}}$ (the quantity of methane destroyed by project activity) is calculated to 20 573 374 tCH_4 as per the clarification AM_CLA_0095 and updated ACM0001 version 9.1 and the Guidelines to Calculate the Fraction of Methane in The landfill Gas From Periodical Measurement of EB 48 /28/. The calculation provided in the project participant’s response has been verified by DNV.

For calculating the quantity of LFG consumed by the 2 flares, due to the difference of flare efficiency, the efficiency of 99.215% in 12 June 2008 and 95.1% in 10 June 2009 for 1# flare and 99.690% in 5 January 2009 for 2# flare were verified and the lower value was used for conservative purpose.

DNV was able to confirm that all parameters are monitored in accordance with the validated monitoring plan and also the approved monitoring methodology ACM0001, version 04. DNV was able to verify the calculations.

2) Net electricity supply to the China South power grid: This parameter has been calculated as the difference of total export to the grid and the total import from the grid for internal use. DNV was able to confirm that both the parameters are monitored using the calibrated electricity meters and the monitoring is in accordance with the validated monitoring plan. DNV has verified the records for the monitoring period under consideration. For emission reduction calculations, electricity supply figures as mentioned in the invoices have been considered. It was observed that the invoice figure is less as compared to the monitored value due to the line losses. Hence, the selection is conservative. Based on this, DNV was able to confirm the total electricity supplied to the grid during the monitoring period.

The actual emission reduction for the monitoring period of 1 February 2009 to 30 September 2009 has been verified to be 173 780 tonnes of CO_2 . Consequently, the estimated emission reduction for the entire year 2009 will be 260 669 ($173\,780/8 \times 12$) tonnes of CO_2 . In the registered PDD, the estimated annual emission reduction is determined to be 466 284 tonnes of CO_2 , the verified emission reduction for the current monitoring period is lower than the estimated value due to the quantity of landfill gas being lower than that estimated in the PDD.

Furthermore, DNV was also able to confirm the following:

The electricity meters to measure the electricity delivered to grid and self consumption was calibrated by Shenzhen Academy of Metrology and Quality Inspection /17/ /18/, which is authorized by Guangdong Provincial Quality Supervision Bureau/13/. So DNV was able to verify that the electricity meters were in order during the monitoring period. DNV checked the calibration report /19/ for CH_4 components analyzer and was able to verify that the calibration was also performed by Shenzhen Academy of Metrology and Quality Inspection/12/. The flow meters to measure the total CH_4 destroyed, CH_4 to generator and CH_4 to flare were calibrated by



Guangzhou City Energy Supervision and Inspection Institute /14/ /15/ /16/, which is authorized by Guangdong Provincial Quality Supervision Bureau/11/. So DNV was able to verify that the flow meters were in order during the monitoring period. The calibration frequency of monitoring equipments is in line with the registered PDD.

All measuring equipments have been calibrated by qualified third-party /11/-/13/ as required in the methodology.

3.5 Quality of Evidence to determine Emission Reductions

All necessary documentation is collected, referenced and aggregated and is easily accessible in hard-copy or electronic format. Measurements are performed by calibrated equipment, and the key data can also be cross-checked via other sources, such as sales and inventory data. No assumptions are used that have any material influence on reported emission reductions.

3.6 Management System and Quality Assurance

Shenzhen Lisai Development Co. Ltd. has established a CDM manual, “The Monitoring Programme and Plan for ‘Shenzhen Xiaping Landfill Gas Collection and Utilization Project’, version 6, and has implemented its management system.



4 CERTIFICATION STATEMENT

Introduction

Det Norske Veritas Certification AS (DNV) has been commissioned by Shenzhen Lisai Development Co. Ltd. to examine the greenhouse gas (GHG) emission reductions reported from the 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project' for the period of 1 February 2009 to 30 September 2009, equating to 173 780 tonnes of CO₂ equivalents.

The project has applied the approved baseline and monitoring methodologies ACM0001 version 04. The emission reductions are as reported in the revised monitoring report dated 08 November 2010.

Responsibilities of the 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project' management of Shenzhen Lisai Development Co. Ltd. and DNV

The management of the project is responsible for the preparation of the GHG emissions data and the reported GHG emission reductions on the basis set out within the revised CDM Monitoring Report of the 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project' (08 November 2010). The development and maintenance of records and reporting procedures in accordance with the approved monitoring methodology ACM0001 version 04, including the calculation and determination of GHG emission reductions from the project, is the responsibility of the management of the project.

It is DNV's responsibility to express an independent verification statement on the reported GHG emission reductions from the project for the period of 1 February 2009 to 30 September 2009, based on the verified emissions for the same period and the project's compliance with the approved baseline and monitoring methodology ACM0001 version 04.

Basis of GHG verification opinion

DNV's verification approach was based on the requirements as defined under the Kyoto Protocol, the CDM modalities and procedures, as well as those defined by the CDM Executive Board and by the baseline and monitoring methodology ACM0001 version 04.

DNV's verification approach draws on an understanding of the risks associated with reporting GHG emissions data and the controls in place to mitigate these. DNV's examination includes assessment of evidence relevant to the amounts and disclosures in relation to the project's GHG emission reductions for the period of 1 February 2009 to 30 September 2009.

DNV planned and performed the work to obtain the information and explanations that DNV considered necessary to provide sufficient evidence to give reasonable assurance that the reported amount of GHG emission reductions for the period of 1 February 2009 to 30 September 2009 are fairly stated.

DNV conducted the verification on the basis of the monitoring methodology ACM0001 version 04 and the revised monitoring plan approved on 31 May 2008. The verification included:

- *collection of evidence supporting the reported data*
- *checking whether the provisions of the monitoring methodology ACM0001 version 04 and the revised monitoring plan approved on 31 May 2008 were consistently and appropriately applied.*

DNV has verified whether the information included in the CDM Monitoring Report for the 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project' (08 November 2010) is correct and that the emission reductions achieved have been determined correctly.

**Opinion**

In DNV's opinion, the GHG emission reductions stated in the CDM Monitoring Report (08 November 2010), for the 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project' for the period of 1 February 2009 to 30 September 2009 are fairly stated.

The GHG emission reductions were calculated correctly on the basis of the approved Monitoring Methodology (ACM0001 version 04) and the monitoring plan contained in the project's Project Design Document. Hence, Det Norske Veritas Certification AS is able to certify that the reported emission reductions from the project during the period of 1 February 2009 to 30 September 2009, amount to 173 780 tonnes of CO₂ equivalent.

Beijing, 22 November 2010

Ramesh Ramachandran

CDM Verifier

Oslo, 22 November 2010

Micahel Lehmann

Director of Services and Technologies

Det Norske Veritas Certification AS



5 REFERENCES

Category 1 Documents:

Documents provided by the Project Participants that relate directly to the GHG components of the project. These have been used as direct sources of evidence for the periodic verification conclusions, and are usually further checked through interviews with key personnel.

- /1/ Monitoring Report of 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project' version 1 dated 3 November and version 2 dated 19 November 2009, version 3 dated 31 May 2010 and version 04 dated 08 November 2010.
- /2/ Registered Project Design Document for 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project', version 7 of 7 January 2007.
- /3/ SGS, Validation Report of "'Shenzhen Xiaping Landfill Gas Collection and Utilization Project'", 24 January, 2007
- /4/ Shenzhen Environmental Sanitation Administrative Department, Test and Joint Inspection Reports for flare, dated 10 July 2008
- /5/ Test and Joint Inspection Reports for generators, 03 November 2008
- /6/ Shenzhen Lisai Development Co. Ltd., CDM Project ER calculation Spreadsheet, (Confidential Document)
- /7/ Revised Monitoring Plan, Version 8, dated 20 Mach 2008, approved by CDM Executive Board on 31 May 2008.
- /8/ DNV Validation Opinion for the revised Monitoring Plan, dated 18 April 2008.

Category 2 Documents:

Background documents related to the design and/or methodologies employed in the design or other reference documents. Where applicable, Category 2 documents have been used to cross-check project assumptions and confirm the validity of information given in the Category 1 documents and in verification interviews.

- /9/ CDM Executive Board: Approved Baseline and Monitoring methodology ACM0001 version 04, version 8 and version 9.1
- /10/ Shenzhen Lisai Development Co. Ltd., The Monitoring Programme and Plan for 'Shenzhen Xiaping Landfill Gas Collection and Utilization Project' version 6, March 2008.
- /11/ Guangdong Provincial Quality Supervision Bureau, Calibration Certificate for flow meters to Guangzhou City Energy Supervision and Inspection Institute valid from 28 June 2006 to 27 June 2010
- /12/ Guangdong Provincial Quality Supervision Bureau, "Calibration Certificate for CH₄ component analyzer to Shenzhen Academy of Metrology and Quality Inspection" valid from 22 November 2007 to 27 January 2010
- /13/ Guangdong Provincial Quality Supervision Bureau, "Calibration Certificate for electricity gauge to Shenzhen Academy of Metrology and Quality Inspection" valid from 22 November 2007 to 27 January 2010



- /14/ Calibration report for the flow meter measuring the LFG to generator, 22 April 2007, 06 March 2008 and 09 February 2009 and the meter replacement record
- /15/ Calibration report for the flow meter measuring the LFG to flare, 21 March 2007, 06 March 2008 and 09 February 2009 and the meter replacement record.
- /16/ Calibration report for the flow meter measuring the total LFG destroyed (meter for 1# main pipeline), 23 April 2007, 25 February 2008, 09 February 2009, flow meter measuring the total LFG destroyed (meter for 2# pipeline installed from October 2008) 25 February 2008 and 18 February 2009 and the meter replacement record.
- /17/ Calibration report for the meter measuring the electricity to grid, 19 March 2007, 25 February 2008, 10 February 2009.
- /18/ Calibration report for the meter measuring the electricity self consumption by generation plant, 14 March 2007, 22 February 2008, 10 February 2009 and the meter replacement record
- /19/ Calibration report for the CH₄ analyzer with the serial number of 47552, 17 January 2007, 16 January 2008 and 13 January 2009.
- /20/ CDM Executive Board: “*Validation and Verification Manual*”, version 1.1, adopted at annex 3 of EB51: http://cdm.unfccc.int/EB/051/eb51_repan03.pdf.
- /21/ Equipment purchase contract between project owner and the provider of GE-Jenbacher power generator, dated 26 September 2006 and 13 August 2008.
- /22/ Equipment purchase contract between project owner and the provider of Caterpillar power generator, dated 27 June 2007.
- /23/ Flare Test Report for Shenzhen Xiaping LFG Project provided by Centre Testing International (Shen Zhen) Limited on 12 June 2008 and 10 June 2009 for 1# flare, 5 January 2009 for 2# flare .
- /24/ Flare Test Certificate for Centre Testing International (Shen Zhen) Limited issued by China National Accreditation Service for Conformity Assessment on 30 June 2006
- /25/ China environment standard web: www.es.org.cn
- /26/ Official website of Shenzhen environment protection bureau: www.szepb.gov.cn
- /27/ Project management and monitoring manual version 3.0 dated March 2008.
- /28/ Guidelines to Calculate the Fraction of Methane in The landfill Gas From Periodical Measurement of EB 48
- /29/ Test and inspect report for new generator by the project owner and the manufacturer dated 4 August 2009.
- /30/ daily log sheets and the monthly reports of ‘Shenzhen Xiaping Landfill Gas Collection and Utilization Project’, from February 2009 to September 2009.

Persons interviewed:

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

- /31/ Gao Niyang, monitoring manager, Shenzhen Lisai Development Co. Ltd.
- /32/ Chen Fengkai, engineer, Shenzhen Lisai Development Co. Ltd.
- /33/ Lu Di, engineer, Shenzhen Lisai Development Co. Ltd.
- /34/ Li Zhiqin, Shenzhen Xiaping Landfill plant.

APPENDIX A

**CORRECTIVE ACTION REQUESTS, CLARIFICATION REQUESTS AND
FORWARD ACTION REQUESTS**

Clarification requests

CL ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CL 1	In the monitoring report version 1 dated 3 November 2009, when project participant describe the information on calibration of monitoring instruments, the expiry date is earlier than the calibration date, this is not reasonable and to be clarified .	It is a typo mistake. The instruments are annually calibrated, so the expiry date should be one year after the calibrated date. The revised calibration information is attached as follows.	All the calibration reports and the revised Monitoring Report were verified, the date of calibration information in the Monitoring Report deemed to be in order. The CL is closed
CL 2	This monitoring period is started from 1 February 2009, however, in the monitoring report version 1 dated 3 November 2009, when project participant describe the information on calibration of monitoring instruments, most calibration reports were later than the start date of this monitoring period, more information about calibration need to be provide.	More information is provided in the revised calibration information attached as follows.	The revised MR was verified, the calibration information for all monitoring equipments and provided and the calibration report were cover the entire monitoring period. The CL is closed

Corrective action requests

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 1	The data of August from invoice in the CER calculation spreadsheet does not match the data in the actual invoice, this should be corrected according to the actual information.	This has been corrected in the Data Worksheet submitted to DNV.	The correct value was updated in the MR and spreadsheet. The CAR was closed.

APPENDIX B

VERIFICATION CHECK LIST

	Assessment/ Observation	Assessment/ Observation	Assessment/ Observation	Assessment/ Observation	Assessment/ Observation	Assessment/ Observation	Assessment/ Observation	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD): Instrument Tag number	1. $LFG_{total,y}$ Total amount of LFG captured	2. $Q_{flared,y}$ Amount of gas flared	3. $Q_{electricity,y}$ Amount of LFG used in power generation	4. FE Flare/combustion efficiency	5. $W_{LFG-CH_4,y}$ Methane fraction of LFG	8. $EL_{EX,LFG}$ Total amount of electricity exported out of the project.	9. EL_{IMP} Total amount of electricity imported to meet project requirement.	10.Regulatory requirements relating to LFG projects
Measuring frequency:	Continuously	Continuously	Continuously	Methane content of flare exhaust gas will be measured annually. The operation time of flare will be measured continuously by a run time flame detector	Continuously/ periodically	Continuously	Continuously	Annually
Reporting frequency:	monthly and yearly	monthly and yearly	monthly and yearly	monthly and yearly	monthly and yearly	monthly and yearly	monthly and yearly	Annually
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Type of monitoring equipment:	Mass Flow meter	Mass Flow meter	Mass Flow meter	gas quality analyzer and flame detector	Gas quality analyzer	electricity meter	electricity meter	Not applicable
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not	Yes. the accuracy of the monitoring equipment is 1.0 class	Yes. the accuracy of the monitoring equipment is 1.0 class	Yes. the accuracy of the monitoring equipment is 1.0 class	Not applicable	Yes. The accuracy of the monitoring equipment is $\pm 3\%$.	Yes. the accuracy of the monitoring equipment is 0.5s class	Yes. the accuracy of the monitoring equipment is 1.0 class	Not applicable

specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?								
Calibration frequency /interval:	Yearly	Yearly	Yearly	Not applicable	Yearly	Yearly	Yearly	Not applicable
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Yes, it is done annually.	Yes, it is done annually.	Yes, it is done annually.	Not applicable	Yes, it is done annually.	Yes, it is done annually.	Yes, it is done annually.	Not applicable
Company performing the calibration:	Guangzhou City Energy Supervision and Inspection Institute	Guangzhou City Energy Supervision and Inspection Institute	Guangzhou City Energy Supervision and Inspection Institute	Not applicable	Shenzhen Academy of Metrology and Quality Inspection	Shenzhen Academy of Metrology and Quality Inspection	Shenzhen Academy of Metrology and Quality Inspection	Not applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Not applicable
Is (are) calibration(s) valid for the whole reporting period?	Yes. Calibration was performed on 25 February 2008, 09	Yes. Calibration was performed on 06 March 2008 09 February 2009	Yes. Calibration was performed on 06 March 2008, 09 February 2009	Not applicable	Yes. Calibration was performed on 16 January 2008, 13 January 2009.	Yes. Calibration was performed on 25 February 2008, 10 February 2009.	Yes. Calibration was performed on 22 February 2008, 10 February 2009	Not applicable

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	February 2009							
If applicable, has the reported data been cross-checked with other available data?	The monitoring data has been cross-checked with the value on the DCS system.	The monitoring data has been cross-checked with the value on the DCS system.	The monitoring data has been cross-checked with the value on the DCS system.	Not applicable	The monitoring data has been cross-checked with the value on the DCS system.	The monitoring data has been cross-checked with the value on the sales receipt.	The monitoring data has been cross-checked with the value on the sales receipt.	Not applicable
How were the values in the monitoring report verified?	This data was recorded by the DCS system, we use the data exported from this system, and cross check the monthly report. Some data were selected randomly and 2 records including the closing and opening of each month were also selected. No error was found.	This data was recorded by the DCS system, we use the data exported from this system, and cross check the monthly report. Some data were selected randomly and 2 records including the closing and opening of each month were also selected. No error was found.	This data was recorded by the DCS system, we use the data exported from this system, and cross check the monthly report. Some data were selected randomly and 2 records including the closing and opening of each month were also selected. No error was found.	Not applicable	This data was recorded by the DCS system, we use the data exported from this system, and cross check the monthly report. Some data were selected randomly and 2 records including the closing and opening of each month were also selected. No error was found	Randomly sampling records for each month and 2 records including the closing and opening of the subsequent month value. No error was found. But compare to the value on the receipt, there are some error was found and a CL was raised.	Randomly sampling records for each month 2 records including the closing and opening of the subsequent month value. No error was found.	There is no change about the environment regulation was found on these web site.

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Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, All data was recorded by the DCS system and the transfer of the data from DCS system to the monthly and annually report deemed to be in order.	Yes, All data was recorded by the DCS system and the transfer of the data from DCS system to the monthly and annually report deemed to be in order.	Yes, All data was recorded by the DCS system and the transfer of the data from DCS system to the monthly and annually report deemed to be in order.	Not applicable	Yes, All data was recorded by the DCS system and the transfer of the data from DCS system to the monthly and annually report deemed to be in order.	Yes, All data was recorded by the DCS system and the transfer of the data from DCS system to the monthly and annually report deemed to be in order.	Yes, All data was recorded by the DCS system and the transfer of the data from DCS system to the monthly and annually report deemed to be in order.	Not applicable
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable