



Validation opinion

Notification of changes from the project activity as described in the registered project design document

Title of project activity:			
Up-gradation of Gas Turbine 1 (GT 1) and Gas Turbine 2 (GT 2) at co-generation plant of Hazira Gas Processing Complex (HGPC) of Oil and Natural Gas Corporation Limited (ONGC)			
CDM reference number:		DNV project No.:	
0847		PRJC-335372-2011-CCS-IND	
Type of request:	<input checked="" type="checkbox"/> Notification of changes from project activity as described in the registered PDD (i.e. changes do <u>not</u> raise any concerns with regard to i) additionality, ii) the scale of CDM project activity and/or iii) the applicability and application of baseline methodology <input type="checkbox"/> Request for approval of changes from project activity as described in the registered PDD		
Date	Work carried out by:	Work verified by:	Approved by:
11 January 2012	 K V Raman and Thamizharasi K	 Chandrashekara Kumaraswamy	 Michael Lehmann

1 Description of the changes as compared to the description in the registered PDD

The project activity is the replacement of critical components of the hot gas path (HGP) in the gas turbine machines of GT1 and GT2 of Oil and Natural Gas Corporation Limited (ONGC) – Hazira Gas Processing complex (HGPC). The technology adopted for the project activity is the MS5001 P N/T turbine model which incorporates the latest gas turbine technology that has been adapted to the MS5001 turbines. The new technology hardware includes the hot gas path hardware from the combustion liners through to the second stage bucket. The P N/T package improves output power significantly due to improved aerodynamics, primarily due to an increase in firing temperature. Output is further improved with the recommended options of reduced camber Inlet Guide Vane IGV's and advanced seals.

As a result of the above mentioned replacement with up-rated parts in GT1 and GT2, fuel efficiency is improved with a reduction in heat rate by 3.3%, which ultimately results in reduction of fuel consumption at a rate of 3 926 673 SCM/year.

This notification of change is with respect to revising the baseline heatrate of the GTs (fixed ex-ante) from 3 302 kCal/kWh as stated in the registered PDD to 3 483 kCal/kWh due to the application of a conversion factor for the conversion of baseline Natural Gas (NG) consumption in GT1 and GT2 from Nm³ to Sm³. The fuel consumption is measured in Nm³ and converted to Sm³, using the conversion factor of 1.055. The conversion factor has been arrived at on the basis of Ideal gas law $PV = nRT$, where

P = absolute pressure of the gas measured in atmospheres

V = volume

N = amount of substance of gas

R = Ideal / universal, gas constant.

Sm^3 is the unit of volumetric flow rate measurement of gas at standard conditions (Temperature: 15°C or 288 K, Pressure: 1.01325 bar (absolute))

Nm^3 is unit of volumetric flow rate measurement of gas at normal conditions (Temperature: 0 °C or 273 K, Pressure: 1.01325 bar (absolute)).

Therefore,

$$\begin{aligned} P_s V_s / T_s &= P_n V_n / T_n \\ (1.01325) V_s / 288 &= (1.01325) V_n / 273 \\ V_s (\text{Sm}^3) &= (288/273) V_n (\text{Nm}^3) \\ V_s (\text{Sm}^3) &= 1.055 V_n (\text{Nm}^3) \end{aligned}$$

The subscript s indicates standard conditions

The subscript n indicates normal conditions.

The originally calculated baseline heat rate (as in the registered PDD of version 5 dated 27 December 2006) was 3 302 kCal/kWh, based on the NG consumption measured in Nm^3 . The recalculated baseline heat rate using the NG consumption in Sm^3 is 3 483 kCal/kWh.

2 Assessment of the changes

The first verification site visit for this project activity (covering the monitoring period from 1 March 2007 to 30 June 2011) was conducted on 20 and 21 October 2011. The project was registered on 1 March 2007.

Assessment of when the changes occurred

The application of conversion factor for the conversion of Nm^3 to Sm^3 of the baseline NG consumption had been erroneously missed out during the project validation. To calculate the baseline heat rate (kCal/kWh), the required parameters are a) total heat energy (kCal) and b). total power generation (kWh). Total heat energy is the product of total fuel (NG) consumption and its calorific value. Fuel consumption has been monitored continuously in Nm^3 and the calorific value is being monitored in kCal/SCM. Hence scientifically, the fuel consumption in Nm^3 is to be converted to Sm^3 , using the conversion factor of 1.055, to multiply with its calorific value in kCal/SCM to get the total heat energy in kCal. As stated earlier the conversion factor (1.055) has been erroneously missed out during the project validation and the same has been identified during the project's first verification period.

Assessment of the reasons for these changes taking place

The application of conversion factor for the conversion of Nm^3 to Sm^3 of the baseline NG consumption had been erroneously missed out during the project validation. Scientifically, the fuel consumption in Nm^3 has to be converted to Sm^3 , with a conversion factor of 1.055, to multiply with its calorific value in kCal/SCM to have the total heat energy in kCal.

Assessment of whether the changes would have been known to the project participants prior to registration of the project activity

The project participant was not aware of the non - application of the conversion factor of 1.055 to convert the baseline gas consumption from Nm^3 to Sm^3 , prior to the registration of the project activity.

Assessment of how the changes may impact the overall operation/ability of the project activity to deliver emission reductions as stated in the PDD

The project is an energy efficiency project. DNV confirms that the design and the installed capacity of the project activity has not been changed from as envisaged in the registered PDD.

The application of conversion factor of 1.055 for the conversion of baseline NG consumption from Nm^3 to Sm^3 does not affect the overall operation of the project activity. However, the application of conversion factor of 1.055 increases the estimated emission reduction stated in the registered PDD by 5%, from 7 802 to 8 231 tCO_2e . As explained in later section, the increase in the ERs does not affect the additionality of the project.

In DNV's opinion, the above mentioned change does not in any way impact the operation/ability of the project activity to deliver emission reductions as stated in the registered PDD.

3 Assessment of the impact of the changes

Do the changes raise concerns with regard to any of the following aspects?

- ☐ Additionality
- ☐ Scale of CDM project activity
- ☐ Applicability and application of baseline methodology
- ☒ Not applicable (the changes do not raise any concerns)

Assessment of impacts of the changes on additionality

The additionality of the project was established based on an investment comparison analysis and technological barrier.

The application of conversion factor of 1.055, to convert baseline NG consumption from Nm^3 to Sm^3 does not have any impact in the project additionality, since the investment comparison analysis already takes care of the conversion factor in its savings component and technological barrier is unaffected by the application of conversion factor.

Assessment of impacts of the changes on the scale of the CDM project activity

The project is an energy efficiency project and the installed capacity of the project activity has not been changed and hence there will not be any impact of the scale of the CDM project activity.

Assessment of impacts of the changes on the applicability and application of baseline methodology

Applicability: The PDD is based on AMS-II.D “Energy efficiency and fuel switching measures for industrial facilities” version 8. Since the project still an energy efficiency measure implemented at a single industrial facility and the aggregate energy saving does not exceed the equivalent of 60 GWh_e per year, the scale of the methodology does not change.

Monitoring plan: As the project is based on AMS-II.D, version 8 and the monitoring plan envisages monitoring of

1. Documenting the specifications of the equipment replaced
2. Metering the energy use of the equipment affected by the project activity
3. Calculating the energy savings using the metered energy obtained from the above metered value.

Thus the change to convert the baseline NG consumption from Nm³ to Sm³ will not have any impact on the applicability and the application of the monitoring methodology.

4 Validation opinion

DNV's evaluation of the project activity during the verification site visit on 20 and 21 October 2011 revealed the change from the registered PDD as the project applies a conversion factor of 1.055 to convert the baseline NG consumption from Nm³ to Sm³ in the calculation of the ex-ante fixed baseline heat rate. The fuel consumption is measured in Nm³ and converted to Sm³, using the conversion factor of 1.055. The originally calculated baseline heat rate (as in the registered PDD) was 3 302 kCal/kWh, based on the NG consumption measured in Nm³. The recalculated baseline heat rate using the NG consumption in Sm³ is 3 483 kCal/kWh. Considering the assessment presented above, DNV is able to confirm that the changes in the project does

- i. not impact the additionality of project activity negatively
- ii. not change the scale of CDM project activity
- iii. not change the applicability of AMS-II.D, version 8.

Moreover, the application of conversion factor of 1.055 to convert the baseline NG consumption from Nm³ to Sm³ does not affect the monitoring parameters and monitoring plan in the registered PDD, thus, no revision in the monitoring plan of the PDD is needed.

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