Voluntary Carbon Standard 2007.1
Validation Report

Report No.53601108 – 08/239

Validation Report:

Name of Validation company:	Date of the issue:
TÜV NORD CERT GmbH	2009-11-14
Report Title:	Approved by:
4.5 MW grouped Small Hydropower Projects for Grid system by Bhoruka Power Corporation Limited in Karnataka State, India.	Mr. Winter Rainer
Client:	Project Title:
Bhoruka Power Corporation Limited	4.5 MW grouped Small Hydropower Projects for Grid system by Bhoruka Power Corporation Limited in Karnataka State, India.
Summary:	

Bhoruka Power Corporation Limited (BPCL) has commissioned the TÜV NORD JI/CDM Certification Program to carry out the validation of the project – "4.5 MW grouped Small Hydropower Projects for Grid system by Bhrouka Power Corporation Limited in Karnataka State, India", with regard to the relevant requirements of VCS 2007.1 Standard.

The bundled project activity, consists of two small hydro power projects of capacities 1 MW and 3.5 MW, which utilise the hydrological head of running river (3.5 MW) / irrigation canal (1 MW)/ to generate electricity and feed it to the Southern Regional Grid of India.

A risk based approach has been followed to perform this validation. In the course of the validation 12 Corrective Action Requests (CAR) and 9 Clarification Requests (CR) were raised and successfully closed out.

The validation is based on the VCS PD, proof of title, and other supporting documents made available to the validators by project proponent.

As a result of the validation, the validators confirm that:

- The project fulfils criteria of VCS 2007.1 provided.
- The project additionality is sufficiently justified in the PD.
- The monitoring plan is transparent, adequate and inline with applied baseline and monitoring methodology of AMS-I.D, Version 13
- The calculation of the project emission reductions is carried out in a transparent and conservative manner, so that the calculated emission reductions of 1, 55,891 t CO2e (total) is most likely to be achieved in the 10 years crediting period.

No restrictions or uncertainties were identified related to the validation.

Work carried out by:	Number of pages:
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1 Introduction

1.1 Objective

The purpose of this validation is to have an independent third party assessment of the project design, in particular the project's baseline, the monitoring plan (MP), and the project's compliance :

- With the requirements of VCS 2007.1 program guidelines;
- With the requirements of the CDM Approved methodology, **AMS.I.D "Grid connected renewable electricity generation"** version 13, which is approved by VCSA;
- To assess the project's compliance with other relevant rules, including the project country (India) legislation, and
- Other relevant rules, of VCS sustainability criteria are validated in order to confirm
  that the project design as documented is sound and reasonable and meet the stated requirements and identified criteria. Validation is seen as necessary to provide assurance to stakeholders on the quality of the project and its intended generation of Verified emission reductions (VERs/ VCUs[1]) without any double counting.

1.2 Scope and Criteria

The validation scope is given as an independent and objective review of the project design, the project's baseline study and monitoring plan (based on CDM approved methodology AMS-1.D. /Version 13: Renewable electricity generation for a grid) are included in the VCS PD and other relevant supporting documents.

The items covered in the validation are described below:

- VCS 2007.1 & Host Country Criteria
  - To meet the requirements of VCS 2007.1 guidelines requirements in particular,
  - Host country requirements / criteria
- VCS Project Description
  - Project design
  - Project boundaries and Predicted VCS project GHG emissions
- Project Baseline
  - Baseline methodology
  - Baseline GHG emissions
- Monitoring Plan
  - Monitoring methodology
  - Indicators/data to be monitored and reported
  - Roles and Responsibilities
- Project Additionality
- Background investigation and follow up interviews
- Draft validation reporting with CARs, CRs & FARs, if any
- Final validation reporting
  –

[1] As per VCS, Verified Emission Reductions (VERs) are considered to be VCUs only after successful registration in an approved VCU Registry

The information included in the PD/PD 1-3/ and the supporting documents were reviewed against the requirements and criteria mentioned above. The TÜV NORD CERT GmbH JI/CDM CP has employed a risk-based approach in the validation, focusing on the identification of significant risks for project implementation and the generation of VERs. The validation is based on the information made available to TÜV NORD JI/CDM CP and on the contract conditions.

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

1.3 **VCS project Description**

The project activity essentially consists of generation of hydro power at two locations. A 1 MW capacity hydropower plant is installed on the Shahpur Branch Irrigation Canal (Distributory 9)near the village Banathal Shahpur in Gulbarga District of Karnataka State ($16^0 41' 30'' N$ & $76^0 45' 30'' E$). The canal has seven drops which provides a cumulative head of 10 M and a chute structure provides a further head of 11 M (Total gross head: 21 M). The 1 MW rated turbine is expected to generate 4,310 MWh (PLF 49.2%) out of which about 4,260 MWh (98.84 % of generated power) is expected to be available for export (at 33KV) to the Karnataka State distribution grid which is a part of the country's Southern Regional Grid. The Plant Load Factor of 49.2% has been arrived at in the DPR /DPR1/ after conducting power potential studies and is approved by the Energy Department vide Government Order (GO) no. DE 54 /NCE/ 99 (E). The discharge details have been sourced from Krishna Bhagya Jala Nigama Limited and is found to vary from 0.42 cubic meter per second to 7.76 cubic meter per second. Flow duration analysis has been carried out for two water years and the PLF has been arrived at on the basis of such analysis. Shahpur has employed a surface hydro power station with rotating exciters; for this type, 0.2% auxiliary consumption and 0.5% transformation and 0.5% transmission losses are permitted as per Central Electricity Regulatory Commission. Such losses have been rounded off to 50 MWh and balance quantity is indicated as being available for export.

Another hydropower generating facility of installed capacity 3.5 MW (2 x 1.75 MW) is located near Mandagere Village (($12^0 44'' N$ & $76^0 12' 30'' E$) in Mandya District of Karnataka State. Located downstream of the existing Mandagere Dam, the project utilizes the spill-over quantities from the releases of water from the Gorur Dam across the River Hemavathi. Two turbines, each of rated capacity 1.75 MW, utilise the 8 M head available and are together expected to generate about 15,800 GWh (PLF 51.53%)(as per approved DPR), out of which 15,480 MWh (97.975% (as per approved DPR) of generated electricity) is planned to be fed (at 66 KV) to the grid. The PLF is based on flow duration analysis carried out considering the discharge from 1997 – 2000 and is recorded in the DPR /DPR2/ which has been approved by the Energy Department, Government of Karnataka, vide GO no. 134/NCE/2000. The auxiliary consumption, transformation and transmission losses, and outages is shown as 2.15%.

The estimated electricity supplied to the grid from both the facilities is 19,740 MWh per year. The estimated GHG emission reductions are 15,589 tCO_2e per year.

1.4 Level of assurance

The validation report is based on VCS PD/PD1//PD2//PD3/ Financial Spreadsheets /XLS1/ /XLS2/, Emission Reduction calculation sheets/ER1//ER2/, documents provided by the project proponent, as well as information got from on-site visit. The validation opinion is assured provided the credibility of all above.

2 Methodology

The validation of the project was carried out from September 2008 to November 2009.

Preparations: 2008-09-05 to 2008-09-10
On-site validation: 2008-09-11 and 2008-09-12
(Draft) Reporting: 2008-09-30
(Final) Reporting: 2009-11-14

However, some of the documentary evidences required for the project could not be submitted by the client in time as a result of which the validation could not be completed immediately. After receiving the final set of revised documents from the clients on 16 September 2009, the final reporting was completed by 24 September 2009.

The validation consisted of the following three phases:

- a desk review of the project design and the baseline and monitoring methodology
- follow-up interviews
- the resolution of outstanding issues and the issuance of the final validation report and opinion

2.1 Review of Document

The draft PD/PD1/ submitted by the Bhoruka Power Corporation Limited in August 2008 and supporting background documents related to the project design and baseline were reviewed. Furthermore, the validation team used additional documentation by third parties like host party legislation, technical reports referring to the project design and the basic conditions and technical data.

The documents that were considered during the validation process are given in chapter 5 of this report. They are listed as follows:

- Documents provided by the project proponent (Table 5-1)
- Background investigation and assessment documents (Table 5-2)
- Websites used (Table 5-3).

2.2 Follow-up Interviews

On 11/09/2008 and 12/09/2008, TÜV NORD JI/CDM CP performed validation site visits with the project proponent in 2 districts, Mandya and Gulbarga Districts of Karnataka State. During this visit, as well as after, interviews with the project proponent, the consultant, project stakeholders and with local authorities were carried out to confirm selected information and to resolve issues identified in the document review.

The key interviewee and main topics of the interviews are summarised in table 2-1.

Table 2-1 Interviewed persons and interview topics

Interviewed Persons / Entities	Interview topics
1. Projects & Operations Personnel /IM01/	- Desk review findings - General aspects of the project - Project design, Commissioning and implementation - Technical equipment and operation of the project - Performance of the project
2. Consultants /IM02/	- Bundling criteria - Applicability of chosen methodology - Involved personnel and responsibilities - Training and practice of the operational personnel - Implementation of the monitoring plan - Monitoring and measurement equipment - QA/QC Testing and calibration procedures - Monitored data management - Data quality, archiving and reporting procedures - Data uncertainty and residual risks - GHG calculation

A detailed list including the functions or designations of the interviewed persons is given in chapter 5 (see. Table 5-4). This table also includes reference codes to be used in the validation protocol.

2.3 Resolution of any material discrepancy

The report includes Corrective action and Clarification Requests (CAR and CR) identified in the course of this validation.
A Corrective Action Request is established if:

- mistakes have been made in assumptions or the project documentation which directly will influence the project results,

- the requirements deemed relevant for validation of the project with certain characteristics have not been met .

A clarification Request is issued where information is insufficient, unclear or not transparent enough to establish whether a requirement is met.
After resolution of these CARs and CRs by the project proponent the validator is issuing the (final) validation report and opinion.
12 CARs and 10 CRs were raised during pre-validation. Please refer to Section 3.

3 Validation Findings

The findings of validation and the resolution of issues raised during such validation are summarised as below:

Summary of CAR, CR and FAR issued

Validation topic	No. of CAR	No. of FAR	No. of CR
D- Project Design	3	-	3
B- Baseline and additionality	4	-	2
M- Monitoring plan	4	-	2
C- Calculation of GHG emissions	1	-	2
E- Environmental Impact	-	-	-
L- Local Stakeholder Comments	-	-	-
SUM	**12**	**-**	**9**

For an in depth analysis/evaluation of all CARs and CRs, refer to the below sections from 3.1 to 3.6.

3.1 Project Design

The project uses run-of-river/canal hydrological head for electricity generation. Total installed capacity of the bundled project is 4.5MW (1 MW at irrigation canal site and 2 x1.75 MW at an existing reservoir site). The estimated electricity supplied to the grid is 19,740 MWh per year. Technical details and equipment specifications used in the project are as detailed below:

TECHNICAL DETAILS OF THE PROJECT

SHAHPURA – D9 Project (1 x 1 MW):

The project is equipped with a Horizontal Francis type turbine coupled to a synchronous generator (1 x 1 MW). The generated power is stepped up to 33 KVA and is evacuated to the State Power Grid at Gugi Sub-station of the Karnataka Power Transport Corporation Limited (KPTCL), which is a part of the Southern Regional Grid.
At this project site, about 4,310 MWh is expected to be generated out of which 4,260 MWh will be available for evacuation to the grid after providing for 50 MWh of auxiliary consumption. The unit was synchronised with the grid on 29.08.2003 as evidenced by letter of the Executive Engineer (Electrical) of the Gulbarga Division.
The details of connected meters are as follows:

Make: Secure Meters Limited, 0.2 Accuracy class (both main and check meters)
Serial No.: Main Meter: KAB 01428 Check Meter: KAB 01429
Most recent (with respect to the date of site visit on 11.09.2008) calibrations conducted on: 23.12.2007 and 09.09.2008

MANDAGERE Project (2 x 1.75 MW):

At the Mandagere project site, two Horizontal Kaplan type turbines are installed which are connected to synchronous Crompton & Greaves make turbines (2 x 1.75 MW). The generated power is stepped up to 66 KVA and is evacuated to the State Grid at Kikkeri Sub-station of the Karnataka Power Transport Corporation Limited (KPTCL), which is a part of the Southern Regional Grid.
Two lines are provided in this site for uninterrupted evacuation and accordingly each line is fitted with a main and check meter, details of which are as follows:

Make: L & T Make, Trivector, Electronic type, of 0.2 class accuracy (All 4 meters)
Serial Numbers:
Line 1: Main: 03157703; Check: 03157704
Line 2: Main: 03157705; Check: 03157706
Most recent calibrations (with respect to the date of site visit on 12.09.2008) conducted on: 04.09.2007 and 27.03.2008

The unit was synchronised with the grid on 22.09.2004 (1 x 1.75 MW) and 19.03.2005 (1x .75 MW) as evidenced by letter of the Executive Engineer (Electrical) of the Mysore Division.

Bhoruka Power Corporation Limited has ownership of the two hydro power projects. The installed capacity of the plants are 1 MW at Shahpur and 3.5 MW at Mandagere and the aggregate capacity of the grouped project is 4.5 MW and is well below the threshold limit of 15 MW stipulated for consideration as a Small Scale GHG reduction activity.
The Start date of the projects is as below:

29.08.2003 for the 1 MW capacity Shahpur D-9 project/CR2/, 16.09.2004 and 19.03.2005 for the 3.5 MW Mandagere project/CR1/1/, CR/1/2/.
The licence from Karnataka Renewable Energy Development Limited /KREDL1/, and approval for use of revenue land from the District Commissioner, Gulbarga/DCGUL1/, attest to this. Letter confirming synchronisation and the Power Purchase Agreements (PPA) are /PPA1/ /PPA2/ treated as proof of title.

The start date of crediting period is 01.04.2006 and the duration is 10 years. Estimated emission reductions have been based on actual generation for the periods 01.04.2006 to 31.12.2006 and 1.1.2007 to 31.12.2007 and are as per estimated likely generation from 01.01.2008 to 31.03.2016/ER1/, /ER2/. The generation for the period 01.04.2006 to 31.1.2.2007 have been verified by verifying the monthly joint meter readings issued/FORM_B_samples/ by the GESCOM and CESCOM and is found to tally with the net quantity of power shown as exported. The emission reduction has not been double counted.

However, **3** Corrective Action Requests (CAR) and **3** Clarification Requests (CR) were raised and based on the satisfactory response of the project proponent these were successfully closed out.

CAR/CR	Reference	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
CAR 1: Confirm the correct spelling for "Bhoruka" in the title of the project and in section 1.15 and in all other places where the name appears	/PD/ 1.1, 1.15	The spelling for "Bhoruka" is corrected in section 1.1 and other places.	/PD/ 1.1, 1,15	The revised sections have been verified. OK. CAR 1 is closed.
CAR 2: Million units (MU) has been used as the unit for power in various sections of the PDD. All such references should be replaced by standard units	/PD/ 1.4	The standard units kWh, MWh or GWh has been used in place of MU in various sections of revised VCS PD	/PD/ 1.4	Verified, OK. CAR 2 is closed.

CAR/CR	Reference	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
such as kWh, MWh or GWh.				
CAR 3: Maintain consistency in spelling for proper names such as the name of the village Mandagere in Table 2	/PD/ 1.5	The spelling of the village Mandagere is corrected in Table 2 of the revised VCS PD	/PD/ 1.5	Verified. OK. CAR 3 is closed.
CR 1: The distances mentioned between the generating station and sub-station mentioned in section 1.4 differs from what is stated in section 1.9.	/PD/ 1.4	The distance between the generating station and sub-station has been corrected in sec. 1.4 in line with the information furnished under sec. 1.9 of revised VCS PD.	/PD/ 1.4, 1.9	OK. CR 1 is closed.
CR 2: Section 1.9 of the PDD indicates a PLF of 50%. Please indicate the basis for the assumption. In section 1.9 of the PDD, figures for gross electricity generated, auxiliary consumption and export to the grid are given along with percentages.	/PD/ 1.9	The PLF has been calculated after a study of long term water availability. This has been included in the DPR for the respective projects submitted for DOE verification.	/PD/ 1.9	OK. Karnataka Renewal Energy Development Board, a government of Karnataka undertaking and nodal agency for issue of licence for renewable energy projects has vide letter dated /KREDL3/approved 4.31 GWh from Shahpur project and 15.8 GWh from Mandagere project as Estimated Energy Generation. DPR has also been

CAR/CR	Reference	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
The figures and the percentages do not tally. The basis may be clarified				verified which has been approved by the licencing authorities /DWR1//DWR2/ CR 2 is closed.
CR 3 In section 1.10 of the PD, the list of compliance with local requirements provided is not comprehensive. Also, the records attesting for such compliance is not indicated	/PD/ 1.10	The comprehensive details of the compliance requirements and the means have been incorporated under Sec. 6 of VCS PD. Copies of consents/approvals which pertain to the compliance with local requirements are furnished to the DOE for verification	/PD/ 1.10	Verified. OK. CR 3 is closed.

3.2 Baseline

The proposed project uses CDM approved methodology AMS-1.D. /Version 13: Renewable electricity generation for a grid, which is approved by the CDM EB and hence is applicable under VCS 2007.1.

The project satisfies all criteria for AMS-1.D. There is no deviation from methodology.

The project activity is a grouped project and consists of two project activities generating power utilising the renewable hydraulic head and evacuates it to the grid. It has no non-renewable component and the total installed capacity of the two projects is 1 MW and 3.5 MW, total 4.5 MW and is below the threshold ceiling of 15 MW. It is not a co-generation activity.

Thus, it fulfils all the requirements for applicability of the chosen methodology.

It does not involve addition of new units to any existing project, retrofitting, or modification.

As per section 9 of the methodology, the baseline is the kWh produced by the project activity multiplied by the emission coefficient of the connected grid.

The first version of the PDD was prepared in August 2008 /PDD1/ and the grid emission factor has been sourced from the most recent data which was available at the time of preparation of the PDD at that time. Accordingly, data published by the Central Electricity Authority, Ministry of Power, Government of India, under the title "CO_2 Baseline Database", Version 03, dated 15 December 2007 has been used to fix the grid emission factor. http://www.cea.nic.in/planning/c%20and%20e/database_publishing_ver3.zip

The Southern Regional Grid is the grid to which the project evacuates the power generated and thus is the system grid. The average of Simple Operating Margin values for three most recent years for the system grid is used as the OM and the build margin for the most recent year is used the build margin. The average of the two (with a 50% weightage factor) is used as the grid emission factor. Accordingly, 0.8545 tCO_2 e / MWh is fixed as the emission coefficient of the system grid on an *ex-ante* basis.

The validation team has verified the calculation of the emission coefficient and is convinced of the correctness of the calculation. It is deemed to be adequate, transparent and conservative.

The additionality is assessed using project test, implementation barriers and common practice approach as per the requirements of VCS 2007.1

Step as per VCS 2007.1	**Argument**	**Assessment**
STEP 1; Regulatory Surplus	The project activity is not mandated by any Government regulation, statuette, and or directive. There is neither a general nor a specific mandate that requires the PP to set up a project to generate power either from a renewable or from a non-renewable resource.	The assertion of the PP that it is not mandated by any law is true and correct. This is a voluntary effort by the PP to contribute its mite to climate change mitigation efforts. The argument is appropriate and correct. Additionally, the DOE has verified and confirmed that the PP has complied with all the legal requirements mandated for implementing such a project./CfE1/, /CfE2/, /CfO1/, /CfO2/, /NoC1/, NoC2/, /FLIC1/, /FLIC2/, /DWR1/, /DWR2/, /Elecins1/,/Elecins2/ ☒Step passed ☐Step not passed ☐ Not applicable
STEP 2: Implementation barriers	1. Firstly, the PP cites lack of infrastructure as a disincentive for any investor wishing to pursue with the project implementation. As a consequence, availability of skilled personnel in the	Such deficiencies do pose a problem and the argument by the PP is convincing. Ultimately, all these result in increased project costs and financial viability of the project activity is all that is decisive.

Step as per VCS 2007.1	Argument	Assessment
	project area poses a serious problem for implementing such projects, which require construction, mechanical engineering and electrical engineering related skilled personnel for implementation. 2. Secondly, the PP compares investment cost per MW (IC/MW) for various options. The IC/MW is INR 56 M for the Mandagere project, INR 72 M for Shahpur project, INR 40 M for coal based project, and about INR 27 M for gas, diesel, naphtha, LNG based power projects. The very high initial cost of implementation, the PP argues, acts as a disincentive for the project. 3. The PP states that the distances between the generating stations and the nearest sub-stations are 5 and 8 kms for which the PP had to bear the cost of laying the transmission lines. 4. The PP has proved that the Project IRR is not attractive for any investor to consider the project activity as a desirable investment destination. In order to prove this, the PP has chosen the WACC as the benchmark and the project IRR as the financial indicator. For calculating the WACC, cost of debt is computed as 10.75% and 11.5% separately for the two projects, being the PLR at the time of	The DOE considers these as convincing barriers but not as decisive barriers. Because of the very low installed capacity of the hydro power projects under consideration and the huge capacities of the other competing fuels, the figures of investment per MW may get distorted. Again, what would be decisive is the return on such investments, which the PP has to prove are not attractive enough. The barriers caused by lack of infrastructure such as absence of a transmission line is for all new generating plants and so is not considered project specific. Moreover, it increases the project cost and hence the real barrier would be unattractiveness of investing such sums if the returns are not adequate. Accordingly, the PP has proceeded to present financial analysis/XLS1/ to /XLS4/. The project cost has been verified against copies of purchase orders for turbines, generators, transformers and other electro mechanical equipment,/E&MSha//E&Mmanda/ construction contract awards /civilShah/ /civilmanda/ and is found that the project cost tallies with the figures reflected in the Excel sheet. The PLF is based on analysis of long term water availability. The PLF, transformation and transmission losses and distribution losses have been enumerated in the DPR /DPR1//DPR2/ of the respective projects and is approved by the concerned authorities./DWR1//DWR2/ The loan amount, moratorium period, repayment terms and interest rates used in financial analysis have been verified and found to be in

Step as per VCS 2007.1	Argument	Assessment
	project investment decision, and cost of equity is computed as 16.3% as per the CRISIL data published. Refer: http://cercind.gov.in/rep1304.pdf 5. Based on the above, WACC works out to 14.64% for Mandagere project and 10.74% for Shahpur project. The Project IRR works out to 7.42% and 10.53% for the Mandagere and Shahpur project respectively. Sensitivity analysis has been carried out for a ±10% variation in generation (PLF), investment cost, O&M costs, and tariff. Highest Project IRR is indicated for a +10% increase in generation at 13.01% for Mandagere project and 9.88% for Shahpur project. Since the projects have already been commissioned and actual figures are available, the PP has also calculated the project IRR as per DPR estimations and as per actual. Due to lower O&M costs actually incurred than indicated in the DPR, the project IRR improves to 12.07% for Shahpur project but falls to 6.46% for Mandagere project. Thus, in all scenario it is demonstrated that the Project IRR is well below	agreement with the terms of loan sanction letter of IREDA /LOAN1/ dated 14 February 2002 and of State Bank of India dated 15 April 2002 /LOAN2/. Depreciation and income tax rates used are in accordance with the stipulated rates of Indian Companies Act and IT Rules respectively. The financial analysis has been presented for 20 years duration and a reasonable salvage value has been added back to the cash flow to arrive at the project IRR. WACC is chosen as the benchmark and its calculation is also presented in a transparent manner/XLS1//XLS2/ The IRR calculation presented is transparent and the assumptions and estimates used are based on actual / prevailing at the time of decision making, whichever is more conservative. The loans availed are liable for interest at the rate of 12.25% for Mandagere project from SBI and 13.5% for Shahpur project as per IREDA loan sanction letters. However, for calculating the WACC, PLR at the time of decision making, being 10.75% for Mandagere and 11.5% for Shahpur project, have been considered for computing the cost of debt, which is lower than the actual cost of debt. Similarly, for computing the cost of equity, the return on equity earned by Central Government power generating undertakings as estimated by CRISIL have been used. While the average of such returns on equity works out to 18.86%, the actual cost of equity for WACC calculation is reckoned as 16.3% only, being the lowest of such returns. The generation is based on figures approved by

Step as per VCS 2007.1	Argument	Assessment
		the statutory authority which issues licence for such projects and the tariff for calculating the revenue is based on the Power Purchase Agreement. A sensitivity analysis has also been carried out to demonstrate that the project IRR does not equal or better the WACC even under the best circumstances. Thus, the project activity suffers from a barrier which prevents flow of investments to its implementation owing to unattractive returns. Hence, STEP 2 is satisfactorily passed. ☒ Step passed ☐ Step not passed ☐ Not applicable
STEP 3: Common Practice	If the installed power generating stations are considered, the share of hydropower is very meagre, both at the national and at the State level. Especially, the share of Small Hydro Projects is very low, because the generation potential in these streams is dependent on the water availability and is regulated by authorities whose primary concern is irrigation. Published data from Ministry of New and Renewable Energy (Ministry of Non-conventional Energy Sources, till recently) has been reproduced to establish that the project type is not common practice. The PD has given details of identified potential for power generation from Small Hydro projects as well as the projects implemented for the period 2001-2002 when the decision to invest in this project was finalized as well as the current scenario. On an all India basis, only 9.5% of the potential was tapped.	All the run-of-river hydropower potential identified in Karnataka fall under the control of Department of Irrigation and hence the water discharge pattern is dictated by the irrigation requirements and not continuous power generation. The PP has used data published by the Ministry of New and Renewable Energy which is the national nodal agency for renewable energy projects. The data provided by Karnataka Renewable Energy Development Limited agrees with this larger picture. Projects aggregating to a total of 432 MW only have been implemented till the end of 2008, which is less than 15% of the available potential. http://kredl.kar.nic.in/ProgressReport.htm Thus, the contention that investing in Small Hydro Power Projects is not common practice is found valid and correct.

Step as per VCS 2007.1	Argument	Assessment
	In the state of Karnataka too, only about 17% of the allotted projects were commissioned till 2001 and has marginally gone up to 18% till 2008.	☒ Step passed ☐ Step not passed ☐ Not applicable

Project Test:
It has been established in the VCS PD that the project is not mandated by any legal requirements and is a voluntary step undertaken by the promoters. And no national or local regulation mandates are binding on the PP for power generation through hydro sources.

Implementation barriers:
Under implementation barriers, it has been argued that many factors favour establishment of large scale fossil fuel fired power generating stations and not small hydro projects. Lack of infrastructure in the form of access roads to identified sites, absence of evacuation facilities and the uncertainty of the availability of water for hydropower generation are cited as barriers which have prevented the implementation of such projects.While the DOE acknowledges the existence of such barriers, it does not concur with the view that these are decisive barriers. The only decisive barrier would be if the returns on the investment are not attractive or are not on par with other investment opportunities.
Investment barrier:
Financial barriers of two kinds are enumerated – one is in respect of investment required per MW installed capacity. While coal or biomass based power projects need an investment of about INR 40 Million / MW, the investment per MW has been INR 56.86 Million / MW at Mandagere and INR 72.13 /MW at Shahpur. NG, diesel, naphtha and LNG based projects have even a lower investment requirement of about INR 27 M/MW.
While the DOE concedes these figures, it is of the opinion that the large installed capacities of the alternatives compared to the ultra low installed capacity of the project activity may vitiate such comparison as the huge variation renders it prone to distortion.
The PP also has carried out a financial analysis considering WACC as the financial benchmark and project IRR as the financial indicator.
WACC is calculated as 14.76% for the Shahpur project and at 14.64% for Mandagere project. Lower of the two may be considered as the common benchmark. The IRR works out to be 7.42% for the Shahpur project and 10.53% for Mandagere project. A sensitivity analysis has also been carried out and the IRR has been calculated with a ±10% variation in PLF, tariff, O&M costs and Investment costs. It is demonstrated that even under the best circumstances, the IRR at 13.01% does not equal the benchmark.
The DOE has verified all the input parameters and the basis for such values. The PLF is based on the generation potential approved by the licence issuing statutory body and the tariff, which is the source of revenue, is based on the PPA. Interest is calculated as per the loan

sanction letter and rest of the parameters are as per the prevailing tax laws governing depreciation and tax rates.
Thus, it is adequately demonstrated that the project IRR is well below the WACC and therefore, investment in the project is not an attractive destination for any investor, posing a serious barrier.

Thirdly, statistics published by the Ministry of New and renewable Energy (Ministry of Non-conventional Energy Sources) are cited to show that the percentage of Small Hydropower exploited is only a small fraction of the potential available. Data published by the Karnataka Renewable Energy Development Limited, a Government of Karnataka undertaking, also support this contention. In addition to the above cited disincentives such as high initial project cost and power generation cost, another inhibiting factor that has been indicated is the uncertainty of availability of water in the allotted irrigation canal for power generation on which the project promoter can have very little control.
Thus, TUV is able to confirm that as a result of the above explanations provided on existence of such barriers, the project activity has not become a common practice and is deemed additional.
However, to obtain clarity following 4 CARs and 2 CR issues were raised and consequent upon the satisfactory response received from the project promoter, these issues have been closed out.

CAR/CR	Reference	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
CAR 4: Provide the basis for the assumed PLF; please establish that such assumed PLF has been approved by the licence issuing authority / financial institution.	2.5 /PD	The PP has considered PLF's mentioned in the respective DPRs wherein the PLFs were arrived based on the Hydrology studies and these DPRs were approved by Krishna Bhagya Jala Nigam Limited (KBJNL). Copies of relevant documentary proofs have been provided to DOE for verification.	2.5 /PD	The Department of Water Resources /DWR1//DWR2/ has endorsed the generation potential of the Shahpur and Mandagere projects as 4310 MWh and 15800 MWh respectively. This has been included in the DPR of the respective projects which have been approved. PLF assumed has been verified and is found acceptable. CAR 4 is closed.
CAR 5: Ensure that O&M Charges and yearly escalation of O&M Charges are in line	Cells G22 and G23 of the MS Excel sheet	Considered O&M charges & yearly escalation on O&M charges conform to guidelines issued by CERC for IRR analysis.	MS Excel Sheet, Financial analysis sheet	The O&M Charges & annual escalation charges are in line with CERC guidelines for hydro projects. CAR 5 is closed.

CAR/CR	Reference	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
with the guidelines issued by CERC.		Also provided the source in VCS PD as well as in excel spread sheets.		
CAR 6: It is observed that CERC stipulated ROE (16%) is chosen as the benchmark. Further, Project IRR is chosen as the financial indicator. This is incompatible.	MS Excel file /XLS1/	Reviewed and modified the investment analysis Excel sheet and in revised VCS PD.	Revised MS Excel sheet dated 15.09.09 and VCS PD section 2.5	In the revised spreadsheet, WACC is chosen as benchmark and project IRR is chosen as financial indicator which are acceptable. CAR 6 is closed.
CAR 7: Proof regarding total investments made in the two hydro power projects needs to be submitted.	MS Excel sheet	Copies of Purchase orders for electromechanical equipment, and copies of civil construction contract and Certificate by Chartered Accountants for investments made in the two hydro power projects have been provided to DOE for verification. This is as per the audited balance sheets of the company.	n/a	The copies of PO and civil contract agreements have been verified and found OK. Certificate for preoperative expenses and interest paid during construction is accepted. CAR 7 is closed.

CAR/CR	Reference	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
CR 4: In section 2.5, the practice of investing in Small Hydro Power projects is to be analysed. That it forms a small part of the total installed power is not relevant as the total identified potential of such small hydro projects itself as a percentage of the total capacity is meagre.	2.5 of PD	Necessary changes have been made under sec. 2.5 of revised VCS PD.		PP has reviewed and compared the common practice with hydro resource instead of all sectors which was considered earlier. This is satisfactory and CR 4 is closed.
CR 5: Under data source, provide complete reference of the data source.	Financial Spreadsheet	Data source for input values have been mentioned in both VCS PD and excel spread sheet and relevant documentary evidences are provided to DOE for verification.	MS Excel file, Financial analysis sheet	Correct cross references have been provided in the MS Excel sheet. CR 5 is closed.

3.3 Monitoring Plan

The proposed project uses CDM approved methodology AMS-1.D. /Version 13: Grid Connected Renewable electricity Generation, which is approved under VCS 2007.1.

The project satisfies all criteria for AMS-1.D. The application of monitoring methodology is assessed as correct.

The monitoring plan provides detailed information related to the collection and archiving of all relevant data needed to:

- Estimate or measure emissions occurring from GHG sources, sinks and reservoirs
- Determine the baseline emissions
- Estimate changes in emissions from the site

The parameters to monitor are electricity exported to the grid, electricity imported to the grid, net electricity delivered.

At the Mandagere project, there are two lines for evacuation to enable uninterrupted power evacuation of the generated energy. However, at Shahpur evacuation is done through one line and in the event of any shut down of this line, evacuation will be temporarily stopped.

Each evacuation line is fitted with main and a check meters. Both meters are located side by side and are of 0.2 accuracy class as per standard industry norms. The quantities of electric power exported and imported are measured by these meters on a continuous basis. The difference between the two parameters (export and import) is the net power exported to the grid.
At Shahpur the arrangements are similar except that there is only one evacuation line and only one set of Main and Check meters are installed. The serial numbers of main and check meters installed on both lines at Mandagere and on single line at Shahpur, their make, serial numbers, accuracy levels and calibration details were noted and verified against entries in the commissioning report.

The export and import readings of both main and check meters (of all connected transmission lines) are recorded on a monthly basis by an authorised officer of the KPTCL/ESCOM, which is a State Government undertaking in the presence of the representative of the power producing company (BPCL). All the readings are jointly recorded in a format called as 'FORM B' and the actual quantum of power exported is calculated and is duly signed by the Officer. Samples of FORM-B were received and verified for their allegiance to the monitoring plan.

Based on the FORM-B entries, , the project owner raises an invoice on the buyer at the rates stipulated in the Power Purchase Agreement for such quantities as determined to have been exported and copies of such invoices are maintained as part of monitoring records. A comparison of such invoiced quantity of power serves as a check for the net monthly power exported to the grid based on which the emission reductions are calculated.

For all practical purposes, it is the reading in the main meter that is reckoned for calculation, as long as the readings in the main and check meters are within acceptable limits. The Power Purchase Agreement (PPA) has detailed procedure to be adopted in the eventuality of malfunctioning of the main meter or when the difference between the main and check meter is beyond the limits of accuracy.

The meters are calibrated at least once a year and the PPA also has defined the procedure to be followed for meters that exceed the error tolerance limits. Meter test reports at the time of commissioning of 1x1 1 MW turbine at Shahpur and 2x1.75 MW at Mandagere have been verified.
Diesel based power generating sets are used in the project for emergency purposes. The quantity of diesel used and the emissions caused thereof are almost negligible. However, the PP has included the monitoring of the following to arrive at the project emissions:

1. Quantity of diesel used($F_{d,y}$)
2. Density of diesel used
3. Emission factor for diesel (EF_{CO2})
4. Caloric fuel value for diesel (NCV_{diesel}), and
5. Oxidation factor (OXID)

Quantity of diesel used is measured by level gauge and can be counter checked with the diesel purchased for running of DG set. Entries made in the log book kept in the DG set room which contained details of duration of DG set running, initial final levels of diesel, and diesel consumed were verified. Density is sourced from values published by the Society of Indian Automobile Manufacturers and the others are default values as per IPCC 2006.

Project emissions due to combustion of diesel are calculated by using the following formula:

$$PE_{diesel,y} = F_{d,y} \times Density \times NCV_{Diesel} \times EF_{CO2} \times OXID / 10^{6}$$

Responsibilities related to monitoring are clearly defined in the monitoring plan.

However, following 4 CAR and 3 CR issues were raised and successfully closed out.

CAR/CR	Ref	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
CAR 8 Specify the interval for calibration of the electric meters mentioned in section 3.4 o the PD.	3.4	Details mentioned in revised PD.	3.4	The interval for calibration of energy meters has been incorporated under section 3.4 of revised VCS PD. CAR 5 is closed
CAR 9 In Section 3.4 clarify on the Joint Meter Reading Practice and details The energy meter details are not provided. Clarify?	3.4	Quantity of net electricity exported to the grid by the grouped project will be measured monthly using calibrated Trivector meters by both project proponent & KPTCL and the same is being recorded in FORM B. PP has considered these readings for estimation of emission reductions.	3.4	The set of FORM-B received have been verified for their correctness and against invoices raised. The quantum of power shown as exported and billed tallies and is correctly taken for calculation of estimation reduction during such period. Details of energy meters were verified during site visit and were found to tally.

CAR/CR	Ref	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
		The energy meter type, accuracy class, permissible error limit, etc. Are provided under sec. 3.4 of revised VCS PD and test reports of the energy meters are furnished to the DOE for verification.		OK CAR 9 is closed.

CAR/CR	Ref	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
CAR 10 Elaborate on the Joint Meter Reading Practice and details in section 2.4	3.4 of the VCS PD	Quantity of net electricity exported to the grid by the grouped project will be measured monthly using calibrated Trivector meters by both project proponent & KPTCL and the same is being recorded in FORM B. PP has considered these readings for estimation of emission reductions.	2.4	FORM – B issued, and emission reduction calculations were verified and found OK. CAR 10 is closed
CAR 11 Details of energy meters are not provided.	3.4	The energy meter type, accuracy class, permissible error limit, etc. are provided under sec. 3.4 of revised VCS PD and test reports of the energy meters are furnished to the DOE for verification.	3.4	Details verified against actual during site visit. Found OK CAR 11 is closed.
CR 6 Please clarify what is meant by "uncertainties in monitoring procedure" mentioned in section 3.4 of the PDD.	3.4	Uncertainties may happen in monitoring of data and not in the monitoring procedures. In view of this pp has corrected in sec. 3.4 of revised VCS PD.	3.4	OK, CR 6 is closed.

CAR/CR	Ref	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
		However, any uncertainty like inconsistency/ discrepancy of data parameters will be dealt with various corrective actions are described in article 7 of Power purchase agreement(PPA).		
CR 7: Under Section 3.3, review the information provided against "Source of data used" in respect of $EG_{Export,y}$ and $EG_{Import,y}$.	3.3 of VCS PD	Reviewed and provided the data Source for $EG_{Export,y}$ and $EG_{Import,y}$ in revised VCS PD.		OK. CR 7 is closed.

3.4 Calculation of GHG Emissions

GHG emission reductions achieved by the project activity are calculated as baseline emission minus project emission.
Following the AMS-I.D methodology, the combined margin (CM) calculated ex-ante was chosen to calculate the baseline emission factor.

The first version of the PD was prepared during August 2008, and at that time the power distribution was managed by five regional grids, namely, the Southern, the Western, the Eastern, the Northern and the North-Eastern. The project is connected to the Southern Grid which was then called Southern regional grid. In India, the Central Electricity Authority (CEA) is an autonomous body under the Ministry of Power and is mandated to periodically publish the grid emission factor for all the power grids of India. http://www.cea.nic.in/planning/c%20and%20e/database_publishing_ver3.zip
The PP has been allowed to retain the values as per Version 3 of the CO_2 database of CEA as the first version of the PD was submitted before the revised version was published.

The project owner has used the published data of CEA 'Baseline carbon-di-oxide database version 3 and has calculated the Simple Operating

Margin (OM) as the average of the most recent 3-year generation weighted average. The value for Build Margin (BM) for 2006-2007 is directly used and a weightage factor of 50% is used for OM and BM to arrive at the combined Margin value of 0.8545 tCO_2/MWh. The calculation was checked and found to be ok.

In accordance with section 9 of AMS-I.D, the baseline is the kWh produced by the renewable generating unit multiplied by this emission coefficient.

As a measure of conservativeness, the project owner has opted to monitor the quantity of diesel (litres) used in the diesel driven power generating sets which have been installed in the project site to provide power for lighting etc., during power failure.

Latest published values for density of diesel from Society of Indian Automobile Manufacturers and values of NCV_{diesel}, OXID and EF_{CO2} will be sourced from the IPCC default values for the corresponding year. Project emissions shall then be calculated in accordance with the requirements of the "Tool to calculate project for leakage CO_2 emissions from fossil fuel combustion".

Net emission reductions are calculated as the difference between the baseline and project emissions.

From 1 April 2006 to 31 March 2016, over a ten year crediting period, emission reductions of 155,891 tCO_2e are expected to occur as a result of this project activity. The calculation was checked and deemed to be adequate, transparent and conservative.

Following 1 CAR and 2 CR issues were raised and were subsequently closed out in view of the satisfactory response received from the project promoters:
The corrective actions taken in respect of CAR 12, CR8 and CR9 are found satisfactory and hence closed out.

CAR/CR	Reference	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
CAR 12: Start date should be the date of reduction of GHG emissions by the project activity.	/PD/ 1.6	The start date is corrected as the date of reduction of emissions as per the latest Policy Announcement (10 Sep 2008) Clause 2 made available vide web-link http://www.v-c-s.org	/PD/ 1.6	OK. CAR 12 is closed.
CR 8: Provide web-link for	/PD/ 1.5	The web-link for the derived baseline emission factor has	/PD/ 1.5, 4.1	OK. CR 8 is closed.

CAR/CR	Reference	*Summary of project owner response*	*Revised sections (as applicable)*	Conclusion
emission factor data source in section 1.3		been incorporated under section 4.1 of revised VCS PD.		
CR 9: In section 1.11 – the risks mentioned are not clear. Clarify.	/PD/ 1.11	PP has reviewed the risk factors affecting the project's GHG emission reductions and necessary corrections have been made in revised VCS PD.	/PD/ 1.11	OK. CR 9 is closed.

3.5 Environmental Impact

Small hydro projects of this scale do not require an Environment Impact Assessment study to be conducted as per existing laws. However, the project promoters are required to obtain Consent for Establishment (CfE) prior to starting of the project from the State Pollution Control Board. Subsequently, Consent for Operation (CfO) of the project should be obtained prior to starting operation of the project activity. The CfO has to be periodically renewed. Copies of the CfE and valid CfO for both the projects have been submitted and verified and are found to be in order.

3.6 Comments by stakeholders

The respective Village Panchayats of the two sites have issued the requisite No Objection Certificate to the siting of the project which has been verified and found to be in order. No negative comments have been received for the project activity.

Other statutory stakeholders, such as the Inspector of Factories and Boilers, the Karnataka Electrical Inspectorate, Karnataka Renewable Energy Development Limited, concerned Land Revenue authorities have issued the necessary licenses for the project activity. These have been verified and found to be in order.

4 Validation conclusion

The proposed project activity meets the relevant criteria for VCS project activities and is likely to achieve estimated emission reductions.

Bhoruka Power Corporation Limited has commissioned the TÜV NORD JI/CDM Certification Program to carry out the validation of the project – "4.5 MW grouped Small Hydropower Projects for Grid system by Bhoruka Power Corporation Limited in Karnataka State, India" with regard to the relevant requirements of VCS 2007.1 Standard as well as criteria for consistent project operations, monitoring and reporting.

The project activity generates electricity which will be supplied to the Southern Regional Grid of India and then distributed to connected end users.

The review of the VCS PD and additional documents related to baseline and monitoring methodology; the subsequent background investigation, follow-up interviews and review of comments by parties, stakeholders have provided TÜV NORD JI/CDM CP with sufficient evidence to validate the fulfilment of the stated criteria.

A risk based approach has been followed to perform this validation. In the course of the validation 12 Corrective Action Requests (CAR) and 9 Clarification Requests (CR) were raised and successfully closed out.

The validation is based on the VCS PD, proof of title, additional documents related to baseline and monitoring methodology; the subsequent background investigation, follow-up interviews and supporting documents made available to the validators by project proponent.

As a result of the validation, the validators confirm that:

The project fulfils criteria of VCS 2007.1 provided.

- The project additionality is sufficiently justified in the PD.
- The monitoring plan is transparent, adequate and inline with applied baseline and monitoring methodology of AMS-I.D, Version 13.
- The calculation of the project emission reductions is carried out in a transparent and conservative manner, so that the calculated emission reductions of 155,891 tCO_2e (total) is most likely to be achieved within the 10 years crediting period.

No restrictions or uncertainties were identified related to the validation.



Ma. Paa. Puratchikkanal
Team Leader
Bangalore, 2009-11-13



Rainer Winter
Final approval
Essen, 2009-11-14

5 References

Table 5-1: Documents provided by the project proponent

Reference	Document
	Consent from the Karnataka State Pollution Control Board (KSPCB) for Establishment of facility:
/CfE/1/	No.KSPCB/RO (MND)/CFE/2002-03/1189 dated 8 Nov 2002 for Mandagere facility
/CfE/2/	No.KSPCB/D.O(GI.B)/CFE/GLB/LG/2001-02/2038 dated 30 Nov 2001 for Shahpur facility
	Consent from KSPCB for Operation of the facility:
/CfO/1/	No.46/KSPCB/RO-MND/ /APC/SG/AEO/ 2004-05/796 dated 31 Aug 2004 for Mandagere facility, valid till 31 Dec 2008
/CfO/2/	No.92 KSPCB/RO(GLB)/APC/AE0/MG IND/2006-07/918 dated for operation of Shahapur facility, valid till 31 Dec 2009
/NOC/1/	No Objection Certificate dated 16.04.2003 from the Gram Panchayat, Mandagere village
/NOC/2/	No Objection Certificate dated 01.01.2002 from the Gram Panchayat, Shahapur village
/REV/1/	Letter of allotment and approval for project use from the Department of Revenue, Govt. of Karnataka, No.RD:LGP 2002
/REV/2/	Letter of allotment and approval for project use from the Department of Revenue,, Govt.of Karnataka, No.KI 39 LRM 2002
/CR1/1/	Commissioning certificate dated 22.09.2004 of 1 x 1.75 MW turbine at Mandagere from the Karnataka Power Transmission Corporation Ltd.(KPTCL), considered for Proof of Title
/CR1/2/	Commissioning certificate dated 19.03.2005 of 1 x 1.75 MW turbine at Mandagere from the Karnataka Power Transmission Corporation Ltd, considered for Proof of Title
/CR2/	Commissioning certificate dated 29.08.2003 of 1 x 1 MW turbine at Shahpura D-9 from the Karnataka Power Transmission Corporation Ltd, considered for Proof of Title
	Power Purchase Agreement between KPTCL and Bhoruka Power Corporation Ltd.

Reference	Document
/PPA/1/	For Mandagere facility
/PPA/2/	For Shahpur D – 9 facility
/ORG/1/	Organization Chart– Mandagere facility – MGR/G/CK/01 dated 16.09.2004
/ORG/2/	Shahapur facility – BPCL/G/CL/01 dated 06.10.2003
/MET/1/ /MET/2/	Specifications of meter installed with complete details, such as, serial no, make, and all salient features For Mandagere facility For Mandagere facility For Shahpur D – 9 facility
/CAL/1/ /CAL/2/	Records of calibration of energy meters For Mandagere facility For Shahpur facility
/FLIC/1/ /FLIC/2/	Licence from the Inspectorate of Factories and Boilers For Mandagere facility For Shahpur facility
/DWR/1/ /DWR/2/	Letter of allotment from the Department of Water Resources, Government of Karnataka For Mandagere facility For Shahpur facility
/TRG/1/ /TRG/2/	List of employees attending training programmes For Mandagere facility For Shahpur facility
/ElecIns/ 1/ /ElecIns/ 2/	Approval from the Office of the Electrical Inspectorate, Government of Karnataka For Mandagere facility For Shahpur facility
/KREDL1/	Lease deed between Bhrouka Power Corporation Limited and Karnataka Renewable Energy limited, for Mandagere Project
/DCGUL1/	Approval for use of revenue land for Shahpur Project from

Reference	Document
	the District Commissioner, Gulbarga
/ER1/	Estimated emission reduction calculation dated August 2008
/ER2/	Estimated emission reduction calculation dated Oct 2009
/PD1/	VCS PD dated August 2008
/PD2/	VCS PD dated June 2009
/PD3/	VCS PD dated September 2009
/PD4/	VCS PD dated 10 Nov 2009
/DPR1/	Detailed Project Report "SHAPUR HYDEL SCHEME" and approval of the same by Energy Department, Government of Karnataka, vide Government Order No. DE 54 NCE 99 (E)
/DPR2/	Detailed Project Report "MANDAGERE HYDEL SCHEME" and approval of the same by Energy Department, Government of Karnataka, vide Government Order No. DE 134 NCE 2000 (E)
/FORM_B_Sample/	Monthly generation report issued by GESCOM and CESCOM authorities
/civilShah/	Agreements dated 26 April 2002 (INR 2.1.7 M) and 30 Nov 2002 (INR 1.86 M) for construction of project facilities at Shahpur, with Gannon Dunkerley & Co. Ltd
/E&MShah/	Agreement dated 25 May 2002 (INR 14.07 M) and 20 Oct 2002 (INR 1.37 M) with Jyoti Limited, for supply, erection and commissioning of electromechanical equipment for Shahpur project
/civilmanda/	Agreements dated 24.12.2002 (INR 70.5 M) and 30.01.2003 (INR 26.6 M) with A N S Constructions Limited for construction of project facilities at Mandagere
/E&Mmanda/	Purchase order dated 11.02.2003 (INR 8.76M) placed with ALSTOM Projects India Limited, for supply, erection, commissioning of turbine, generator and transformer with control panel
/XLS1/	IRR Calculations for Mandagere facility
/XLS2/	IRR Calculations for Shahpur facility
/XLS3/	IRR Calculations for Mandagere facility (revised)
/XLS4/	IRR Calculations for Shahpur facility (revised)

Table 5-2: Background investigation and assessment documents

Reference	Document
/AMS ID/	Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories (Version 13)
/ACM0002/	Consolidated baseline methodology for grid-connected electricity generation from renewable sources (Version 07: 19 May 2006)
/IPPC/	1996 IPCC Guidelines for National Greenhouse Gas Inventories: work book
/PD/	Project Document dated 16.10. 2008 submitted as per VCS 2007.1 PD Format

Table 5-3: Websites used

Reference	Link	Organisation
/vcs/	www.v-c-s.org	VCS website
/unfccc/	www.unfccc.int	UNFCCC website
/cea/	www.cea.nic.in	Central Electricity Authority
/satsig/	**http://www.satsig.net/maps/lat-long-finder.htm**	**Satellite Signal**
/mnes/	**http://www.mnes.nic.in**	**Ministry of New and Renewable Energy (earlier Ministry of Nonconventional Energy Source)**

Table 5-4: Interviewed Persons

Reference		Name	Organisation / Function
/IM01/	☒ Mr. ☐ Ms.	Prakash	Senior Engineer (Mech.), Shahpur D9 Project, Bhoruka Power Corporation Limited (BPCL)
/IM01/	☒ Mr. ☐	Shivaputrappa	Engineer (Mech.), Shahpur D9 Project, Bhoruka Power Corporation Limited (BPCL)

Reference		Name	Organisation / Function
	Ms.		
/IM01/	☒ Mr. ☐ Ms.	B.S. Kulkarni	Engineer (Mech.), Shahpur D9 Project, Bhoruka Power Corporation Limited (BPCL)
/IM01/	☒ Mr. ☐ Ms.	Anand Badiger	Engineer (Electrical), Shahpur D9 Project, Bhoruka Power Corporation Limited (BPCL)
/IM01/	☒ Mr. ☐ Ms.	Srikanth	Asst. Engineer (Electrical), Shahpur D9 Project, Bhoruka Power Corporation Limited (BPCL)
/IM01/	☒ Mr. ☐ Ms.	G.H. Kulkarni	Officer (HR), Shahpur D9 Project, Bhoruka Power Corporation Limited (BPCL)
/IM01/	☒ Mr. ☐ Ms.	Rajesh B.C.	Engineer – Mechanical
/IM02/	☒ Mr. ☐ Ms.	Sangameshwara G.B	Asst Engineer – CDM (EDP)
/IM03/	☒ Mr. ☐ Ms.	K.A. Satish	Asst. Manager – Electrical