

PERIODIC VERIFICATION REPORT

- 1ST PERIODIC –

ARAPUTANGA CENTRAIS ELÉTRICAS
S.A.

VERIFICATION OF THE “ARAPUTANGA
CENTRAIS ELÉTRICAS S. A. -
ARAPUCEL – SMALL HYDROELECTRIC
POWER PLANTS PROJECT”
(BRAZIL)

MONITORING PERIOD 09/2002 – 12/2006

Report No: 4847/07-07/33 - V01

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Client: Araputanga Centrais Elétricas S.A.	Client ref.:									
Summary: Araputanga Centrais Elétricas S.A. has commissioned the TÜV NORD JI/CDM Certification Program to carry out the 1st periodic verification of the project: "ARAPutanga Centrais ELétricas S. A. - ARAPUCEL – Small Hydroelectric Power Plants Project", with regard to the relevant requirements for CDM project activities. The project reduces GHG emissions by displacement of conventional generated electricity in the Brazilian interconnected grid by renewable power from a hydro power plant. This verification covers the period from 2002-09-01 to 2006-12-31. A risk based approach has been followed to perform this verification. In the course of the verification 2 Corrective Action Request (CAR) were raised. No Clarification Request (CR) was raised. To ensure the improvement of the future monitoring system 2 Forward Action Requests (FARs) were raised and should be checked during the next periodic verification. The verification is based on the draft monitoring report (December 2006) the revised monitoring report (September 2007), the monitoring plan as set out in the validated PDD, the validation report and supporting documents made available to the TÜV NORD JI/CDM CP by the project participants. As a result of this periodic verification, the verifier confirms that: - all operations of the project are implemented and installed as planned and described in the validated PDD, - the monitoring plan is accordance with the applied approved CDM methodology, - the installed equipment essential for generating emission reductions runs reliable and is calibrated appropriately, - the monitoring system is in place and fully functional. The project is ready to generate GHG emission reductions. As the result of the 1st periodic verification, the verifier confirms that the GHG emission reductions are calculated without material misstatements in a conservative and appropriate manner. TÜV NORD JI/CDM CP herewith confirms that the project has achieved emission reductions in the above mentioned reporting period as follows: <table> <tr> <td>Baseline emissions:</td> <td>432,630</td> <td>t CO₂eq</td> </tr> <tr> <td>Project emissions:</td> <td>0</td> <td>t CO₂eq</td> </tr> <tr> <td>Emission reductions:</td> <td>432,630</td> <td>t CO₂eq</td> </tr> </table>		Baseline emissions:	432,630	t CO ₂ eq	Project emissions:	0	t CO ₂ eq	Emission reductions:	432,630	t CO ₂ eq
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Report No.: 4847/07-07/33-V01	Subject Group: Environment
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Work carried out by: Rainer Winter, M. C. Coelho	
Work verified by: Eric Krupp	
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Indexing terms

Climate Change, CDM, Small Hydro Power, Verification, Kyoto Protocol

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Abbreviations

CAR	Corrective Action Request
CCEE	Câmara de Comercialização de Energia Elétrica
CDM	Clean Development Mechanism
CEMAT	Electric Center of Mato Grosso State (Centrais Elétricas do Estado do Mato Grosso)
CER	Certified Emission Reduction
CO₂	Carbon dioxide
CO_{2eq}	Carbon dioxide equivalent
CP	Certification Program
CR	Clarification Request
EF	Emission Factor
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
kW	Kilowatt
LoA	Letter of Approval
MR	Monitoring Report
MP	Monitoring Plan
MW	Megawatt
O&M	Operation & Maintenance
PDD	Project Design Document
QMS	Quality management system
SHP	Small Hydro Power
UNFCCC	United Nations Framework Convention on Climate Change

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1. INTRODUCTION

Araputanga Centrais Elétricas S.A has commissioned the TÜV NORD JI/CDM Certification Program (CP) to carry out the 1st periodic verification of the project: “ARAPUtanga Centrais ELétricas S.A - ARAPUCEL – Small Hydroelectric Power Plants Project (Brazil)”, with regard to the relevant requirements for CDM project activities. The verifiers have reviewed the GHG data collected for the period between 2002-09-01 and 2006-12-31.

1.1. Objective

The objective of the periodic verification is the review and ex post determination by an independent entity of the GHG emission reductions. It includes the verification of the data given in the monitoring report by checking the monitoring records and the emission reduction calculation.

1.2. Scope

The verification of this registered project is based on the validated project design document ^{/PDD/}, the monitoring report ^{/MR/}, supporting documents handed over to the verifier and information got by performing interviews and during the on-site assessment. Furthermore publicly available information was considered as far as available and required.

The documents and information are reviewed against the requirements and criteria mentioned below. The TÜV NORD JI/CDM CP has, based on the recommendations in the Validation and Verification Manual ^{/VVM/} employed a risk-based approach in the verification, focusing on the identification of significant risks and reliability of project monitoring and generation of emission reductions.

The verification is carried out on the basis of the following requirements, applicable for this project:

- Article 12 of the Kyoto Protocol ^{/KP/},
- guidelines for the implementation of Article 12 of the Kyoto Protocol as presented in the Marrakech Accords under decision 17/CP.7 ^{/MA/}, and the annex II to decision 21/CP.8 and subsequent decisions made by the Executive Board,
- other relevant rules, including the host country legislation,
- monitoring plan as given in the PDD ^{/PDD/} and
- the consolidated CDM Large Scale Methodology ACM0002 ^{/ACM/}, version 5

1.3. GHG Project Description

1.3.1. Project Characteristics

Essential data of the project is presented in the following Table 1-1

The GHG project can be classified as a large-scale CDM project in the sector given in Table 1-1 (according to UNFCCC sectoral scope numbers for CDM).

Table 1-1: Project Characteristics

Item	Data	
Project title	ARAPUtanga Centrais ELétricas S.A – ARAPUCEL – Small Hydroelectric Power Plants Project (Brazil)	
CDM registration No.	530	
Date of registration	2006-12-15	
Project Scope (according to UNFCCC sectoral scope numbers for CDM)	1: Energy Industries (renewable - / non-renewable sources)	
Applied Methodology	ACM0002: Consolidated methodology for grid-connected electricity generation from renewable sources (V.5)	
Crediting period	Renewable Crediting Period (7 y)	
Start of crediting period	2002-09-01 (as per PDD)	
Projects actual starting date	SHP	Start of operation
	Alto Jauru	September 2002
	Indiavaí	August 2003
	Ombreira	July 2005
Host country	Brazil	

1.3.2. Project Parties

Brazil.

1.3.3. Project Participants

The following project participants are involved in the project activity as per LoA:

Project Participant: Araputanga Centrais Elétricas S.A.
Barão de Melgaço, 2350 – room 11
Cuiabá
Mato Grosso
Brazil

Contact Person Mr. Jaime Monteiro Brennand
jaime@brennandenergia.com.br

Project Participant: Arapucel Indiavaí S.A.
Barão de Melgaço, 2350 – room 11
Cuiabá
Mato Grosso
Brazil

Contact Person Mr. Jaime Monteiro Brennand
jaime@brennandenergia.com.br

Project Participant: Arapucel Ombreiras S.A.
Barão de Melgaço, 2350 – room 11
Cuiabá
Mato Grosso
Brazil

Contact Person Mr. Jaime Monteiro Brennand
jaime@brennandenergia.com.br

1.3.4. Project Location

The project is located on 3 sites near Araputanga and Jauru Cities, at the Jauru River (Paraguay River basin), state of Mato Grosso, in the Midwest of Brazil (latitude 15° 02' 47" South and longitude 58° 45' 09" West to SHP Alto Jauru; latitude 15° 15' 49" South and longitude 58° 43' 12" West to SHP Indiavaí; latitude 15° 02' 23" South and longitude 58° 44' 03" West to SHP Ombreiras).

1.3.5. Technical Project Description

The three facilities of the Arapucel run-of-river projects involve the following installations:

- SHP Alto Jauru – two Vatech Francis turbines with an installed capacity of **21.96** MW;
- SHP Indiavaí – four Vatech Francis turbines with an installed capacity of 28 MW;
- SHP Ombreiras – two Alstom Kaplan – Type S turbines with an installed capacity of 26 MW.

The project uses water from the Jauru River (part of Paraguay basin) to generate electricity. It contains also low level diversion dams (reservoir areas 0.14 km², 0.38 km² and 2.9 km², respectively). The key data submitted within the PDD are given in the table 1-2 mentioned below.

Table 1-2: Technical and operational data

SHP Alto Jauru

Turbines	
Type	Vatech Francis – horizontal axis
Quantity	2
RPM	257
Power (MW)	21.96
Nominal Liquid Head (m)	44.70
Generators	
Type	Toshiba synchronous
Quantity	2
Frequency (Hz)	60
Nominal Power (MW)	10
Voltage (kV)	13.8

SHP Indiavaí

Turbines	
Type	Vatech Francis – horizontal axis
Quantity	4
RPM	257
Power (MW)	28
Nominal Liquid Head (m)	32.10
Generators	
Type	Toshiba synchronous
Quantity	2
Frequency (Hz)	60
Voltage (kV)	13.8

SHP Ombreiras

Turbines	
Type	Alstom Kaplan – Type S
Quantity	2
RPM	300
Power (MW)	26
Nominal Liquid Head (m)	31.92
Generators	
Type	Alston – SOH 333/59/24
Nominal Power (MW)	13

The emission reductions are a result of the displacement of conventional generated energy in the Brazilian interconnected grid.

2. VERIFICATION TEAM

The Verification Team was led by:

- **Rainer Winter.** He works at TÜV NORD CERT GmbH as ISO 9001 and ISO 14001 Auditor, as an environmental verifier for EMAS, and as a DEHSt-appointed emission verifier in the framework of the EU-ETS. Mr. Winter has been appointed as JI/CDM assessor and is in charge of the TÜV NORD JI/CDM CP.

For this verification he was assisted by:

- **Maria Carolina Crisci Coelho,** BRTÜV-Brazil (TÜVNORD-Brazil), Mrs. Coelho is ISO 14001 Auditor and Product Manager for CDM Services for BRTÜV. She is an appointed expert of TÜV NORD JI/CDM certification program.

The final verification report is verified by:

- **Eric Krupp.** He works at TÜV NORD as an approved emission verifier within the European Emission Trading Scheme. Mr. Krupp is an authorized JI/CDM assessor and deputy head of the JI/CDM Certification Program of TÜV NORD.

As a trainee **Ms. Katja Beyer** took part in the verification of the project. She is an environmental scientist and works for the TÜV NORD CERT GmbH.

3. METHODOLOGY

The verification of the project was carried out from January to August 2007:

Preparations: *From 2007-01-02 to 2007-01-13*

On-site verification: *2007-01-15 and 2007-01-16*

Reporting: *From 2007-01-17 to 2007-08-03*

The verification consisted of the following steps:

- A desk review of the Monitoring Report^{/MR/} submitted by the client and additional supporting documents with the use of a customised verification protocol^{/CPM/} according to the Validation and Verification Manual^{/VVM/},
- On-Site assessment,
- Background investigation and follow-up interviews with personnel of the project developer and its contractors,
- Verification reporting.

3.1. Verification Protocol

In order to ensure transparency and consideration of all relevant assessment criteria, a verification protocol was used. The protocol shows, in a transparent manner, criteria and requirements, means and results of verification. The verification protocol serves the following purposes:

- It organises, details and clarifies the requirements a CDM project is expected to meet;
- It ensures a transparent verification process where the independent entity will document how a particular requirement has been proved and the result of the verification.

The applied verification protocol consists of two Periodic Verification Checklists: Table 1 (Data Management System/Controls); Table 2 (GHG calculation procedures and management control testing / Detailed audit testing of residual risk areas and random testing) as described in figure 3-1.

The completed verification protocol is enclosed in the annex to this report.

Periodic Verification Checklist**Table 1: Data Management Systems/Controls**

Expectations for GHG data management system/controls	Comments	Draft Concl.	Final Concl.
<i>The project operator's data management system/controls are assessed to identify reporting risks and to assess the data management system's/control's ability to mitigate reporting risks. The GHG data management system/controls are assessed against the expectations detailed in the table.</i>	<i>Description of circumstances and further commendation to the conclusion.</i>	<i>This is either acceptable based on review of MR and supporting Documents (OK), or a Corrective Action Request (CAR) of risk or non-compliance with stated requirements. The corrective action requests are numbered and presented to the client in the Draft Verification report. The Initial Verification has additional Forward Action Requests (FAR). FAR indicates essential risks for further periodic verifications</i>	<i>CARs and CRs raised in the Draft Conclusion have to be closed or resolved. The final conclusion determines the final statement. FARs could remain in this section as they are subject in the next consecutive verification.</i>

Periodic Verification Checklist**Table 2: GHG calculation procedures and management control testing / Detailed audit testing of residual risk areas and random testing**

Identification of potential reporting risk	Identification, assessment and testing of management controls	Areas of residual risks	Additional verification testing performed	Conclusions and Areas Requiring Improvement (including Forward Action Requests)
The following potential risks were identified and divided and structured according to the possible areas of occurrence.	The potential risks of raw data generation have been identified in the course of the monitoring system implementation. The following measures were taken in order to minimize the corresponding risks. The following measures are implemented:	Despite the measures implemented in order to reduce the occurrence probability the following residual risks remain and have to be addressed in the course of every verification.	The additional verification testing performed is described. Testing may include: • Sample cross checking of manual transfers of data • Recalculation • Spreadsheet 'walk throughs' to check links and equations • Inspection of calibration and maintenance records for key equipment • Check sampling analysis results Discussions with process engineers who have detailed knowledge of process uncertainty/error bands.	Having investigated the residual risks, the conclusions should be noted here. Errors and uncertainties are highlighted.

Figure 3-1 : Verification protocol tables

3.2. Review of Documentation

The following documents were reviewed:

- the last revision of the PDD including the monitoring plan,
- the draft monitoring report
- the last revision of the monitoring report, including the claimed emission reductions for the project,
- the last revision of the validation report.

- relevant documents of the management system

Other supporting documents, such as technical drawings, manuals of equipment suppliers, performance records, meter readings, installation and calibration documents and business data were also reviewed.

3.3. On-site assessment

The assessment performed during the verification enabled the verifier to arrive at a conclusion regarding the readiness of the project to generate high quality emission reductions. As such, it was indispensable to carry out an inspection on site in order to verify that the project is implemented in accordance with the applicable criteria. Furthermore the on-site assessment is necessary to check the monitoring data with respect to accuracy to ensure the calculation of emission reductions.

- The on-site assessment included an investigation of whether all relevant equipment is installed and works as anticipated.
- The operating staff was interviewed and observed in order to check the risks of inappropriate operation and data collection procedures.
- Information processes for generating, aggregating and reporting the selected monitored parameters were reviewed.
- Metering equipment was checked and positions of counters were recorded in order to prepare for the next periodic verification.
- The project operator has provided evidence that all metering equipment was duly calibrated.
- The monitoring processes, routines and documentations were audited to check their proper application.
- The monitoring data were checked via spot sample on the level of the meter recordings.

Before and during the on-site visit on 2007-01-15 and 2007-01-16 the verification team of TÜV NORD JI/CDM CP performed interviews with the project participants to confirm selected information and to resolve issues identified in the document review.

Representatives of Araputanga Centrais Elétricas S.A. and Ecoinvest Consult (project consultant) including the operational staff of the plant were interviewed. The main topics of the interviews are summarised in Table 3-1.

Table 3-1 Interviewed persons and interview topics

Interviewed Persons / Entities	Interview topics
1. Project & Operations Personnel, Brennand Energia 2. Consultant, Ecoinvest	- General aspects of the project - Project design and implementation - Commissioning - Technical equipment and operation - Performance of the project - Monitoring and measurement equipment - Calibration procedures - Quality management system - Involved personnel and responsibilities - Training and practice of the operational personnel - Implementation of the monitoring plan - Monitoring data management - Data uncertainty and residual risks - GHG calculation - Procedural aspects of the verification - SHP Operations - Maintenance - Automation - Environmental

3.4. Resolution of Forward and Corrective Action Requests

Nonconformities raised during the verification can either be seen as a non-fulfilment of criteria ensuring the proper implementation of a project or were a risk to deliver high quality emission reductions is identified.

Corrective Action Requests (CARs) are issued, where:

- there is a clear deviation concerning to the above mentioned applicable criteria (esp. the monitoring plan).
- requirements set by the monitoring plan or qualifications in a validation opinion have not been met; or
- there is a risk that the project would not be able to deliver emission reductions.

Forward Action Requests (FAR) indicates essential risks for further periodic verifications. Forward Action Requests are issued, where:

- the actual status requires a special focus on this item for the next consecutive verification, or
- an adjustment of the monitoring plan is recommended.



The verification team may also use the term Clarification Request (CR), which would be issued where:

- Additional information is needed to fully clarify an issue.

4. VERIFICATION FINDINGS

In the following paragraphs the findings from the desk review of the monitoring report, the PDD and other supporting documents, as well as from the on-site assessment and the interviews are summarised.

The summary of CAR, FAR and CR issued are shown in Table 4-1:

Table 4-1: Summary of CAR, FAR and CR

Verification topic	No. of CAR	No. of FAR	No. of CR
Completeness of Monitoring	0	0	0
Accuracy of emission reduction calculations	2	0	0
Quality of evidence to determine emission reductions	0	0	0
Management system and quality assurance	0	2	0
SUM	2	2	0

For an in depth evaluation of all verification items it should be referred to the verification protocols (see Annex).

4.1. Periodic Verification Findings

4.1.1. Project Implementation

The project has been implemented as described in the PDD ^{/PDD/}.

4.1.2. Completeness of Monitoring

The reporting procedures reflect the requirements of the monitoring plan. All relevant data is collected continuously and stored during the whole monitoring period. The used meter equipment is state of the art and adequate for measuring the electricity generation. The generated electricity is monitored by the power plants as well as by CEMAT, the buyer/distributor of electricity. Thereby a cross-check of the meter readings of the SHP plants and the receipts submitted once a month by CEMAT is possible.

During the verification process no significant lacks of evidence were detected.

In the registered PDD it is stated, that the “proportion of data to be monitored” is not applicable (see D.2.1.3.) as this data can not be monitored in portions. Nevertheless the PP has decided – to make it more consistent with the applied methodology – to put the value of 100 % instead of “n. a.” in the corresponding table of the monitoring report. The actual monitoring practice is not influenced by this adaptation.

4.1.3. Accuracy of Emission Reduction Calculations

The emission factor (EF_y) is calculated in line with the methodology ACM0002 version 5 as well as with the monitoring plan in the registered PDD. EF_y is calculated ex-post for each year in which the emission reduction occurs as combined margin, i.e. a combination of operating margin and build margin.

According to the MP and the applied methodology the parameters that have to be measured and calculated are the electricity supplied to the grid and the emission factor, respectively. The chosen grid emission factor calculation was ex-post. The factor was checked by the assigned DOE during the verification of the project activity. The calculations of the emission reductions were checked by the verification team using own spreadsheets. These calculations have shown the same results as given in the monitoring report ^{/MR/}.

The electricity meters used are well known and state of the art. All measured data is collected continuously during the whole monitoring period.

The energy meters are specified by the energy distribution company and approved by National System Operator and CCEE. The measurements are controlled in real

time through a Digital System and by the Electric Energy Operational Center (located at Cuiabá city) through satellites.

All the energy from the three SHP plants goes to CEMAT central meter. The quantity of energy generation considered to be invoiced to the PCHs is from CEMAT meters. At the end of every month, CEMAT sends an Energy Generation Report to Brennand Energia Group (Araputanga Centrais Elétricas S.A., Arapucel Indiavaí S.A. and Arapucel Ombreiras S.A. controller) and Brennand Energia Group compares the CEMAT's Report with its own Report for the authorization of the payment.

Till 2005, the SHP plants were maintenance and operated by Alstom. After this year, Brennand Energia Group assumed it.

Nevertheless the following CARs and FARs have been raised:

CAR 1: Divergent values between the draft monitoring report (ver.01 - 2006/12/31) and the calculation spreadsheets for the emission reduction calculation (based on the mass memories and invoices) were found which were provided to the DOE for the verification. A review of the documents was required.

CAR 2: The emission factor has to be updated annually for the year in which actual project generation and associated emission reductions occur, because of the ex-post utilization of EF calculation.

The values had been corrected and a new revision of CDM Monitoring Report was emitted (version 04, 31/July/2007).

4.1.4. Quality of Evidence to Determine Emission Reductions

The key parameter power output was measured by calibrated meters. CEMAT, the electricity buyer/distributor provided the power meter records (monthly wise) of the total amount of sold electricity. Furthermore CEMAT is responsible for the calibration. It has to be noted that from the year 2006 on the project participant takes part in the free market and CEMAT is operating as distributor of the generated electricity.

The verification team got access to all relevant documentation regarding the monitoring of the emission reduction calculation, like:

- Technical data of the measuring equipment
- meter readings by the CEMAT,
- calibration reports,
- Measurement devices stock list
- calculation spreadsheets
- Internet based power generation data (Chamber of Commercialization of Electric Energy /CCEE/).

All these documentation were checked and found to be consistent and of high quality. Furthermore all needed information is traceable and appropriately archived.

All used parameters were of sufficient and appropriate quality to assure an accurate monitoring.

It could be evidenced that the whole monitoring system was fully operational during the entire monitoring period.

4.1.5. Management System and Quality Assurance

The meters (main and back up meter) located in the substation Jauru, make the measurements of electricity generation from the three power plants delivered to the grid. These measures are calibrated by CEMAT - Centrais Elétricas Matogrossenses S.A.

There are in each plants, meters that are calibrated by CEMAT, - Centrais Elétricas Matogrossenses S.A.

Additional one meter is installed in each power plant. They can detect any problems (like water shortage, materials inside the turbines, meter inaccuracy, etc) and if necessary the plant personnel can put in action.

However, two FARs has been raised for necessary improvement of data control:

FAR 1: It is necessary to improve the control of external data (mass memory received from CEMAT) to keep the integrity of this information with measured data.

FAR 2: The improvement of internal controls of information regarding the electricity generation values for attainment of carbon credits is necessary. An internal control and validation of the launchings in spread sheets must be considered.

4.1.6. Summary of Findings and Conclusions

Topic	#					
Completeness of monitoring	-	Classification	☐ CAR	☐ FAR	☐ CR	☒ None
		Findings	-			
		Corrective Action	-			
		Conclusion	☐ To be checked during next periodic verification ☐ Appropriate action was taken ☐ MR was corrected correspondingly ☐ Appropriate action was not taken ☒ The project complies with the requirements			

Accuracy of emission reduction calculations	CAR 1, CAR 2,	Classification	☒ CAR	☐ FAR	☐ CR	☐ None
		Findings	CAR 1 : Divergent values between the draft monitoring report (ver.01 - 2006/12/31) and the calculation spreadsheets for the emission reduction calculation (based on the mass memories and invoices) were found which were provided to the DOE for the verification. A review of the documents was required. CAR 2: The emission factor has to be updated annually for the year in which actual project generation and associated emission reduction occur, because of the ex-post utilization of EF calculation (cp. ACM0002 v. 5).			
		Corrective Action	CAR 1, CAR 2: The values had been corrected and a new revision of CDM Monitoring Report was emitted (Document version number: 04, 31/July/2007). Also the annually emission factors are included.			
		Conclusion	☐ To be checked during next periodic verification ☐ Appropriate action was taken ☒ MR was corrected correspondingly ☐ Appropriate action was not taken ☐ The project complies with the requirements			

Quality of evidence to determine emission reductions	-	Classification	☐ CAR	☐ FAR	☐ CR	☒ None
		Findings	-			
		Corrective Action	-			
		Conclusion	☐ To be checked du-ring next periodic verification ☐ Appropriate action was taken ☐ MR was corrected correspondingly ☐ Appropriate action was not taken ☒ The project complies with the requirements			
Management system and quality assurance	FAR 1, FAR 2	Classification	☐ CAR	☒ FAR	☐ CR	☐ None
		Findings	FAR 1: It is necessary to improve the control of external data (mass memory received from CEMAT) to keep the integrity of this information with measured data. FAR 2: The improvement of internal controls of information regarding the electricity generation values for attainment of carbon credits is necessary. An internal control and validation of the launchings in spreadsheets must be considered.			
		Corrective Action	-			
		Conclusion	☒ To be checked during next periodic verification ☐ Appropriate action was taken ☐ MR was corrected correspondingly ☐ Appropriate action was not taken ☐ The project complies with the requirements			



5. PROJECT SCORECARD

Risk Areas		Conclusions			Summary of findings and comments
		Baseline Emissions	Project Emissions	Calculated Emission Reductions	
Completeness	Source coverage/ boundary definition	✓	✓	✓	All relevant sources are covered by the monitoring plan. The project boundaries are defined correctly and transparently.
Accuracy	Physical Measurement and Analysis	✓	✓	✓	The measurement of data was carried out with calibrated meters. Accurate evidences were provided for each meter.
	Data calculations	✓	✓	CAR 1 CAR 2	Two CARs were raised regarding inconsistencies between the provided values for ER calculation in the monitoring report and the calculation spreadsheets and the calculation of the grid emission factor. All relevant documents and calculations were corrected in the revised Monitoring Report and associated documents.
	Data management & reporting	✓	✓	FAR 1 FAR 2	Two FARs must be considered during next verification regarding the improvement of internal as well as external control of the data, utilized for the ER calculation.
Consistency	Changes in the project	✓	✓	✓	The project has been implemented as described in the PDD.



6. VERIFICATION STATEMENT

Araputanga Centrais Elétricas S.A. has commissioned the TÜV NORD JI/CDM Certification Program to carry out the 1st periodic verification of the project: “ARAPutanga Centrais ELétricas S. A. - ARAPUCEL – Small Hydroelectric Power Plants Project”, with regard to the relevant requirements for CDM project activities. The project reduces GHG emissions by displacement of conventional generated electricity in the Brazilian interconnected grid by renewable power from a hydro power plant.

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As a result of this periodic verification, the verifier confirms that:

- all operations of the project are implemented and installed as planned and described in the validated PDD,
- the monitoring plan is accordance with the applied approved CDM methodology,
- the installed equipment essential for generating emission reductions runs reliable and is calibrated appropriately,
- the monitoring system is in place and fully functional. The project is ready to generate GHG emission reductions.

As the result of the 1st periodic verification, the verifier confirms that the GHG emission reductions are calculated without material misstatements in a conservative and appropriate manner. TÜV NORD JI/CDM CP herewith confirms that the project has achieved emission reductions in the above mentioned reporting period as follows:

Baseline emissions:	432,630	t CO _{2eq}
Project emissions:	0	t CO _{2eq}
Emission reductions:	432,630	t CO _{2eq}

Essen, 2007-09-06

A handwritten signature in black ink, appearing to read 'R. Winter'.

Rainer Winter

TÜV NORD JI/CDM Certification Program

Verification Team Leader

7. REFERENCES

Table 7-1: Documents provided by the project proponent

Reference	Document
/ALO/	Physic/chemistry analysis of Lubricative oil Date: 2006/12/26 - Company Laboril - Samples: B261206063-00018, B261206062-00017, B261206061-00016, B261206060-00015
/CAL/	Excel – Calculation sheets provided by the project participant / consultant
/CSA/	Contract of supply authorization: AFI-314.1 – to Physic/Chemistry and chromatographic analyses to transforming of 138 KV. Supplier Brastrafo do Brasil Ltda.
/CVM/	Calibration Certificate Actaris do Medidor SL 7000 nº de série 36008987 de 14/06/2005 Calibration Certificate Actaris do Medidor SL 7000 nº de série 36008988 de 14/06/2005 Calibration Certificate Actaris do Medidor SL 7000 nº de série 36008989 de 14/06/2005 Calibration Certificate Actaris do Medidor SL 7000 nº de série 36008990 de 14/06/2005 Calibration Certificate Actaris do Medidor SL 7000 nº de série 36008991 de 14/06/2005 Calibration Certificate Actaris do Medidor SL 7000 nº de série 36008992 de 14/06/2005
/ECP/	Environmental Control Plan - SHP Ombreiras
/FDM1/	Functional diagram of the measurements (until June 2005) – slide 1
/FDM2/	Functional diagram of the measurements (from June 2005) – slide 2
/JMR/	Joint Meter Readings Spread sheets of memory of mass Referring to the years of 2002 until 2006 –(Measurements CEMAT)
/MC/	Meter Calibration Q1000 Type SM 3050 Schlumberger serial number 97B935415 e TAG 26.339.099 : Certificate number: DIMCI 0951/2003 de 10/07/2003 Certificate number DIMCI 2014/2005 de 08/11/2005

Reference	Document
/MOM/	Maintenance and Operation Manual – MT – 020201-003
/MR/	Monitoring Report “ARAPUtanga Centrais ELétricas S.A - ARAPUCEL – Small Hydroelectric Power Plants Project (Brazil)” for the period 2002 September 01 to 2006 December 31, version 01 – 31 th December, 2006 Monitoring Report “ARAPUtanga Centrais ELétricas S.A - ARAPUCEL – Small Hydroelectric Power Plants Project (Brazil)” for the period 2002 September 01 to 2006 December 31, version 04 – 31 st July, 2007 Monitoring Report “ARAPUtanga Centrais ELétricas S.A - ARAPUCEL – Small Hydroelectric Power Plants Project (Brazil)” for the period 2002 September 01 to 2006 December 31, version 05 – 5 th September, 2007
/OL/	Official letter #001/SURH – COL/GO/2007 – Indiavaí Official letter #002/SURH – COL/GO/2007 – Jauru Official letter #003/SURH – COL/GO/2007 – Ombreiras
/OLI/	Operation License #1844/2007 validity: 2008/01/16 (SHP Indiavaí) Technician report #4093/CIE/SUIMIS/2007
/OLJ/	Operation license 1320/2006 validity: 2008/09/25 (SHP Jauru) Technician report #307/Coinf/SUIMIS/2006
/OLO/	Operation License #124/2006 validity: 2008/09/13 (SHP Ombreiras) Technician report #394/CIE/SUIMIS/2006
/PDD/	Final Project Design Document for CDM project “ARAPUtanga Centrais ELétricas S.A - ARAPUCEL – Small Hydroelectric Power Plants Project (Brazil)”, registered December 2006
/PO/	Procedure for maneuvers of operation of the supervisory one
/PPA/	Power Purchase Agreement
/PRADJ/	Plan of degraded areas recovery SHP Jauru – May 2006 – Protocol #120829/2006 Ictiofauna Report– Protocol # 177742/2006
/PRADO/	Plan of degraded areas recovery SHP Ombreiras – Protocol #121385/2006
/RMI/	Procedure of Reading of Measurement for Invoicing – ONS – 2001/07/23

Reference	Document
/RS/	Receipt of Sales – September' 2002 until January' 2005
/SC/	Supplier Contract TCI File, for documents management and organization - 10/01/2005
/SOSEm/	System of Operation in Emergency Situation
/VAL/	Validation Report “Araputanga Centrais Elétricas S.A. – ARAPUCEL – Small Hydroelectric Power Plants Project” issued by TÜV SÜD Industrie Service GmbH, dated 2006-06-13

Table 7-2: Background investigation and assessment documents

Reference	Document
/ACM/	ACM0002: Consolidated methodology for grid-connected electricity generation from renewable sources (version 5).
/CPM/	TÜV NORD JI / CDM CP Manual (incl. CP procedures and forms).
/KP/	Kyoto Protocol (1997)
/MA/	Decision 17/CP.7 (Marrakech Accords): Guidelines for the implementation of Article 12 of the Kyoto Protocol.
/VVM/	IETA, PCF Validation and Verification Manual (V. 4).

Table 7-3: List of interviewed persons

Reference		Name	Organisation / Function
/IM01/	☒ Mr. ☐ Ms.	A. Bonfim	Brennand Energy, operation director
/IM01/	☐ Mr. ☒ Ms.	K. M. Nagai	Ecoinvest, consultant
/IM01/	☒ Mr. ☐ Ms.	J. Sandoval	Brennand Energy, controller managment
/IM01/	☒ Mr.	J. Furlan	Brennand Energy, environment



Reference		Name	Organisation / Function
	☐ Ms.		engineer
/IM01/	☒ Mr. ☐ Ms.	J. C. Sampaio	Brennand Energy, civil engineer
/IM01/	☒ Mr. ☐ Ms.	A. Tadini	Brennand Energy, maintenance supervisor
/IM01/	☒ Mr. ☐ Ms.	L. Figueiredo	Brennand Energy, operator
/IM01/	☒ Mr. ☐ Ms.	E. Fernandes Suza	Brennand Energy, operator - technician in electrotechnical
/IM01/	☒ Mr. ☐ Ms.	R. Silva	Brennand Energy, operator
/IM01/	☒ Mr. ☐ Ms.	L. F. Negrão	Brennand Energy, automation supervisor



ANNEX

ANNEX: VERIFICATION PROTOCOL

TABLE A-1: DATA MANAGEMENT SYSTEM/CONTROLS

Expectations for GHG data management system/controls	Verifiers Comments	Draft Concl.	Final Concl.
1. Defined organisational structure, responsibilities and competencies			
1.1. Position and roles <i>Position and role of each person in the GHG data management process is clearly defined and implemented, from raw data generation to submission of the final data. Accountability of senior management must also be demonstrated.</i>	Brennad Energia Group is controller of Araputanga Centrais Elétricas S.A., Arapucel Indiavaí S.A. and Arapucel Ombreiras S.A.), so the company is responsible for: • Operating • Management • Data recording All responsibilities are clearly defined.	OK	OK
1.2. Responsibilities <i>Specific monitoring and reporting tasks and responsibilities are included in job descriptions or special instructions for employees.</i>	All responsibilities were clearly defined and formalized in the relevant procedures and documents which have been presented during the site visit. ECOINVEST CARBON is responsible for the monitoring report including the calculation of the emissions reductions based on the information received from Brennad Energia Group and following the monitoring plan indicated in the PDD.	OK	OK

[illegible]

Expectations for GHG data management system/controls	Verifiers Comments	Draft Concl.	Final Concl.
2.2. Necessary Changes <i>Necessary changes to the monitoring plan are identified and changes are integrated in local procedures as necessary.</i>	No changes in the monitoring plan were identified.	OK	OK
3. Application of GHG determination methods			
3.1. Methods used <i>There are documented description of the methods used to determine GHG emissions and justification for the chosen methods. If applicable, procedures for capturing emissions from non-routine or exceptional events are in place and implemented.</i>	The methodology used is given in the validated monitoring plan according to the requirements of ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" - Version 5. The electricity exported to the grid is multiplied with the annually updated carbon emission factor (as per registered PDD) to result in the actual emissions reductions. During the on-site visit all relevant procedures according to the management and monitoring for the determination of the emission reductions of the CDM project were implemented and available.	OK	OK
3.2. Information/process flow <i>An information/process flow diagram, describing the entire process from raw data to reported totals is developed.</i>	The total energy generated by the hydropower plants, is given in monthly tables. The procedure for recording the power exported to the grid has been indicated in the Power Purchase Agreement between Brennand's and CEMAT until the end of 2005. There is an internal control system installed for the units, using a back-up system of the electricity exported to the grid. A daily control and a previous check of the meters are done by the maintenance staff as well as a manual registration of the data of the main meters. The internal data and the values invoiced are compared.	OK	OK

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Expectations for GHG data management system/controls	Verifiers Comments	Draft Concl.	Final Concl.
3.4. Data trails <i>Requirements for documented data trails are defined and implemented and all documentation are physically available.</i>	The requirements for documented data traceability are fulfilled and tested on a random sample basis during the site visit. Currently, there are two types of archives: electronic and paper, which are archived on Brennand office in Recife city. There is a backup in ribbon and hard drive (HD). For all data in paper, a company specialized in fillings, keeps digitalization and maintenance of the archive is being contracted. Currently, who archives the documents is TCI-File Company – Contract of 2005/01/10. However, the following FAR has been raised: Improvement of the control of external document (mass memory received from CEMAT) is necessary, for keeping the integrity of the information with the data of measurements of electricity generation, delivered to grid.	OK FAR 1	OK
4. Identification and maintenance of key process parameters			
4.1. Identification of key parameters <i>The key physical process parameters that are critical for the determination of GHG emissions (e.g. meters, sampling methods) are identified.</i>	The key parameter with significant influence on the calculation of emission reductions is the power output. This parameter was measured with calibrated meters.	OK	OK
4.2. Calibration/maintenance <i>Appropriate calibration/maintenance requirements are determined.</i>	The uploading station meter is calibrated by the CEMAT – Centrais Elétricas Matogrossenses S.A. Corresponding evidence was provided.	OK	OK
5. GHG Calculations			

Expectations for GHG data management system/controls	Verifiers Comments	Draft Concl.	Final Concl.
5.1. Use of estimates and default data <i>Where estimates or default data are used, these are validated and periodically evaluated to ensure their ongoing appropriateness and accuracy, particularly following changes to circumstances, equipment etc. The validation and periodic evaluation of this is documented.</i>	The key parameter power output (EGy) was measured. The emission factor has to be updated annually for the year in which actual project generation and associated emission reductions occur according to the ACM0002, because of the ex-post utilization of EF calculation as stated in the registered PDD.	CAR 2	OK
5.2. Guidance on checks and reviews <i>Guidance is provided on when, where and how checks and reviews are to be carried out, and what evidence needs to be documented. This includes spot checks by a second person not performing the calculations over manual data transfers, changes in assumptions and the overall reliability of the calculation processes.</i>	No internal audit was carried out. Nevertheless a comparison of both metering system meters was carried out in order to determine the accuracy, consistency and correctness of the measured values. CAR1: It was found divergent values in the draft monitoring report (ver.01 - 2006/12/31) in relation to the verifications carried through DOE on the basis of the mass memories presented and receipts of sales. A review of the calculations is required. The improvement of internal controls of information regarding the electricity generation values for attainment of carbon credits is necessary. An internal control and validation of the launchings in spreadsheets must be considered.	CAR 1 FAR 2	OK
5.3. Internal validation and verification <i>Internal verifications include the GHG data management systems, to ensure consistent application of calculation methods.</i> <i>Data reported from internal departments should be validated visibly (by signature or electronically) by an employee who is able to assess the accuracy and completeness of the data.</i>	Divergent values of generated electricity (EGy) were found within the used spread sheet to carry out the calculation of emission reductions and the invoices of CEMAT (cp. CAR1 mentioned in sec. 5.2). The relevant data for monitoring occurs only at the plant in-charge level. Responsible and competent personnel validate the transferred data to the owners. hence FAR 2	CAR 1 FAR 2	OK

Expectations for GHG data management system/controls	Verifiers Comments	Draft Concl.	Final Concl.
<i>Supporting information on the data limitations, problems should also be included in the data trail.</i>	has been raised (cp. sec. 5.2)		
5.4. Data protection measures <i>Data protection measures for databases/spreadsheets should be in place (access restrictions and editor rights).</i>	The key parameters are being measured and recorded in the respective documents/ registers in electronic and in paper form by CEMAT. All software solutions are protected with standard PC protection measures and work within the limitation of user authorisation. CEMAT generates a monthly based report and sent this to Brennands. They check it with the invoices and the information passes to CCEE.	OK	OK
5.5. IT systems <i>IT systems used for GHG monitoring and reporting should be tested and documented.</i>	The IT system is based on standard PC solutions. All calculations necessary for purpose of emissions reduction monitoring can be done on the basis of MS – Excel (or comparable solutions).	OK	OK

Table A-2: Periodic Verification Checklist: GHG calculation procedures and management control testing / Detailed audit testing of residual risk areas and random testing

Identification of potential reporting risk	Identification, assessment and testing of management controls	Areas of residual risks	Additional verification testing performed	Conclusions and Areas Requiring Improvement (including <i>Forward Action Requests</i>)
Raw data generation				
• Installation of measuring equipment • Dysfunction of installed equipment • Maloperation by operational personnel • Downtimes of equipment • Exchange of equipment • Capacity additions • Change of technology	• Installation of modern and state of the art equipment • On line meter readings / independent counter-checks • Regular visual inspections of installed equipment • Only skilled and trained personnel operates the relevant equipment • Immediate exchange of dysfunctional equipment • Stand-by duty is organized • Training • Internal counterchecks	• Capacity additions • Inadequate installation / operation of the monitoring equipment • Inadequate exchange of equipment • Change of personnel • Undetected measurement errors	• Check of equipment • Check of technical data sheets • Site – visit • Counter-check of meter readings and commercial data	• OK

Identification of potential reporting risk	Identification, assessment and testing of management controls	Areas of residual risks	Additional verification testing performed	Conclusions and Areas Requiring Improvement (including <i>Forward Action Requests</i>)
Raw data collection				
• Metering records • Operational log sheets • Calibration and maintenance data • Accuracies • Manuals and other manufacturer data • Accounting records	• Exclusive installation and operation of duly calibrated equipment • Cross-check of data • Redundant manual meter readings • Appropriate archiving system • Appointment of competent external measurement institutes for calibration holding the corresponding accreditations • International as well as national calibration standards • Clear allocation of responsibilities	• Unintended usage of old data that has been revised • Incomplete documentation • Ex-post corrections of accounting records • Ambiguous sources of information	• Check of calibration records • Check of individual (raw data) figures	• Procedure defining the management and the monitoring activities was documented
Data aggregation				
• IT Systems	• Clear allocation of	• Manual data transfer	• Check of data	FAR 1 and FAR 2: An

Identification of potential reporting risk	Identification, assessment and testing of management controls	Areas of residual risks	Additional verification testing performed	Conclusions and Areas Requiring Improvement (including <i>Forward Action Requests</i>)
- Spread sheet programming - Manual data transmission - Data protection - Responsibilities	- responsibilities - Usage of standard software solutions (Spreadsheets) - Limited access to IT systems - Data protection procedures	- mistakes - Unintended change of spread sheet programming or data base entries - Problems caused by updating/upgrading or change of applied software	- aggregation - Counter-calculation	improvement of the external control of electricity generation data is required as well as an internal control for these data for utilization of the emission reduction calculation.
Other calculation parameters				
- Data sources - Emission factors - Accuracies	- Ex post calculation of base line - All used values and data sources applied are defined in the monitoring plan	No significant residual risks	No significant uncertainties or errors regarding the other calculation parameters were observed in the course of this verification.	CAR 2: The grid emission factor has to be updated annually.
Calculation Methods				

Identification of potential reporting risk	Identification, assessment and testing of management controls	Areas of residual risks	Additional verification testing performed	Conclusions and Areas Requiring Improvement (including <i>Forward Action Requests</i>)
- Calculation approach - Applied formulae - Lack of clarity in the monitoring plan	- Appropriate IT and archiving system - Usage tested Excel spreadsheets	The danger of miscalculation can only be minimized	Countercheck on the basis of own calculation	OK
Monitoring reporting				
- Data transfer to the author of the monitoring report - Issuance of the monitoring report	An experienced consultant is responsible for monitoring reporting	The danger of data transfer mistakes can only be minimized	Counter check with evidence provided	OK