F-CDM-DEV-METH ver 01

CDM: Form for submission of requests for deviation from methodology
(Version 01)
(To be used by the DOE, for requesting a deviation)

Name of the entity (DOE) submitting this form	RINA Services S.p.A.
Title of the project activity	Pesqueiro Energia Small Hydroelectric Project (PESHP) - UNFCCC Ref. 0242
Title of methodology	"Tool to calculate the emission factor for an electricity system"
Title/Subject (give a short title or specify the subject of your submission, maximum 200 characters)	Deviation from the "*Tool to calculate the emission factor for an electricity system*" to allow the use of alternative weights based on the intermittent and non-dispatchable nature of power a project applying AMS-I.D.
Attach draft CDM-PDD of project activity	☐ Yes, is attached.
Date and signature for the DOE	11/10/2001, Paolo Teramo, [signature]

Description of the request for deviation

Please use the space below to describe the deviation and substantiate the reason for requesting a deviation from approved methodologies (validation/registration stage).

On October 22nd, 2010 the Request for Revision SSC_486 was submitted to the Small Scale Working Group (SSC WG)[1]. The request aimed at proposing new weights for build and operating margins while calculating the combined margin for small hydropower plants during their second crediting period, owing to their intermittent and non-dispatchable nature.

In January, 2011, the SSC WG provided forwarded the issue to the attention of the Meth Panel, since based on the information previously submitted the panel could not draw a conclusion[2]. Also it was informed that the matter should be addressed as a revision of the "*Tool to calculate the emission factor for an electricity system*". Yet, the SSC WG requested that the following additional information should be provided:

- *A definition of run-of-the-river hydro plant (dispatchable/intermittent vs. non-dispatchable / non-intermittent) would be required;*
- *Further elaboration about the impact on the grid by run-of-the-river hydro vs. wind/solar project*

[1] http://cdm.unfccc.int/UserManagement/FileStorage/IUG93F0ERO41CXW5KYJATQMPHSDLN7
[2] http://cdm.unfccc.int/UserManagement/FileStorage/R7FAOMQLZN0GE9PC6KTUX31Y2BWI5V

activities, justifying that the same OM/BM weights could be applied for all these cases.

From the additional information sent to the SSC WG, the following excerpts are worth recalling. Concerning the definition of run-of-river hydro power plants, the explanation provided by International Energy Agency (IEA, 2004)[3] is as follows:

"Run-of-river plants produce electricity according to the flow of water in the river it has been built in. Water is shored at low head hydroelectric plants and channeled through turbines using the natural force of the river flow. Seasonal variations determine the water level in the river and thus the strength of the water flow and its implicit available energy."

Besides, as pointed out by IEA (2008) in another report entitled "*Empowering Variable Renewable Options for Flexible Electricity Systems*", small hydropower plants can also be listed as an intermittent source of electricity. In its report, the agency equals small hydropower plants to other sources such as wind and solar, as highlighted in the two excerpts presented below:

"A number of renewable electricity technologies, such as wind, wave, tidal, solar, and run-of-river hydro share a characteristic that distinguishes them from conventional power plants: their output varies according to the availability of the resource.

(…)

"Variable types. Var-RE power plants rely on resources that fluctuate on the timescale of seconds to days, and do not include some form of integrated storage. Such technologies include wind power, wave and tidal power, run-of-river hydropower, and solar photovoltaics (PV). Output from such plants fluctuates upwards and downwards according to the resource: the wind, cloud cover, rain, waves, tide, etc. Such technologies are often referred to as intermittent (…)"

In connection with the second request for additional information made by the SSC WG, it is worth to recall information provided regarding Brazilian typical grid resources. The studies conducted by the Energy Research Company (from Portuguese *Empresa de Pesquisa Energética* – EPE) foresee an increase in the electricity demand in Brazil in the order of 3,300 MW[4] per year. EPE is the responsible for envisaging the future scenarios of the Brazilian energy market in order to subsidize the Brazilian Energy Ministry. According to Brazilian Electricity Regulatory Agency[5], as of August 2011, Brazil possesses 2.467 power plants in operation summing up 118,402MW of installed capacity. From this total, 67.5% of the electricity generation comes from large hydropower plants with an average installed capacity over 400MW per plant[6]. Therefore, for the specific case of Pesqueiro SHPP (12.4 MW of installed capacity), the project's capacity value is lower than that of a typical grid resource which may influence the build margin.

Taking into account the additional information, briefly summarized here, the Meth Panel (MP), at its 50th meeting, decided not to revise the methodological tool[7]. However, in their final answer, the MP suggested that the revision of weights could be made individually for each CDM Project Activity, considering its particularities. The PPs would like to clarify that to the best of their understanding different OM/BM weights are generically applicable to solar/wind power plants, due to their intermittent and non-dispatchable nature without any further elaboration. To the best of the PPs understanding, as discussed above, run-of-river hydro power plants have by definition the same nature. Actually as in the case of the Pesqueiro SHHP the intermittent and non-dispatchable nature is at least as evident as a few

[3] **International Energy Agency - IEA** (2004): Variability of Wind Power and Other Renewables, Management options and strategies.

[4] BRAZIL. Ministry of Mines and Energy / Energy Research Company. **Ten Year Expansion Plan 2019: Summary.** Brasília: MME/EPE, 2010 p.23. Available at http://www.epe.gov.br/PDEE/20101129_2.pdf.

[5] Brazilian Electricity Regulatory Agency ANEEL (from *Portuguese Agência Nacional de Energia Elétrica*)

[6] ANEEL – Brazilian Electricity Regulatory Agency. Generation Database (BIG): Brazil´s Installed Capacity. Available at http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp.

[7] http://cdm.unfccc.int/Panels/meth/meeting/11/050/mp50_an12.pdf

registered CDM wind power plants (examples below were supplied during the requests for clarification and review).

In light with the examples and recommendations provided by the Meth Panel, a request for deviation which is going to be applied to the renewal of the crediting period of "*Pesqueiro Energia Small Hydroelectric Project*" is submitted to attention of the Meth Panel, addressing the point of view presented by the panel as further discussed below.

The answer provided by the MP argues that depending on the availability of the resource (*i.e., river flow in the case of run-of-river hydropower plants*), the plant could be able to "save" the resource and use it for electricity generation during the peak hours. Besides, differently from small hydropower plants and biomass power plants, wind power plants cannot choose when to generate electricity since they can only be operational in the exact moment when the resource is available.

However, two aspects shall also be considered. Run-of-river hydropower plants have very limited "water saving" capabilities. Additionally, the river flow greatly varies throughout the year. In this sense, the example given by the MP for small hydropower plants could only be observed, if possible at all, if the river flow is considered constant throughout the years.

In hydropower projects variations in the river flow is widely observed between the years. Consequently it makes difficult to predict the possible electricity generation by the plant, consequently saving water in the reservoir. With the purpose of exemplifying this variation, values of the Natural Affluent Energy (from the Portuguese *Energia Natural Afluente - ENA*), published by ONS were used[8].

The *ENA* represents the amount of water flowing into the reservoir that is available to electricity generation. The *ENA* is expressed in a percentage over the Long Term Average (from the Portuguese *Média de Longo Termo - MLT*) registered and is directly connected to the amount of rain feeding the river flow[9].

The chart below is the *ENA* of the south region of Brazil, where the project is located. Data from 2000 to 2010 was used. An important aspect to highlight from the below figure is that within a year, the availability of water varies significantly. As it can be observed, there is not a clear pattern that makes feasible for the project owner to predict electricity generation.

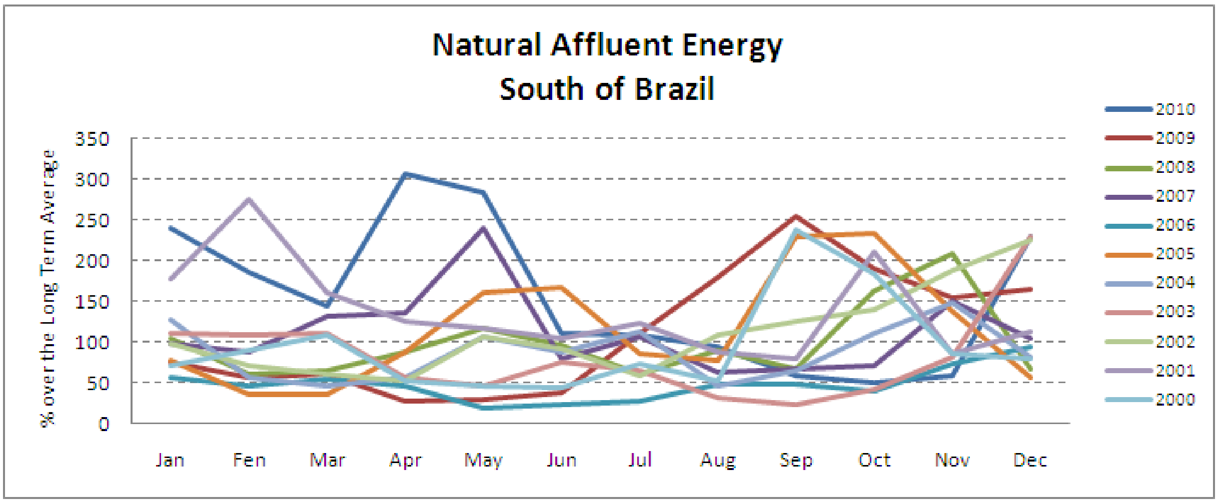

Figure 1 – Natural Affluent Energy in the south region of Brazil from 2000 to 2010.

Additionally, diverse from what is stated by the MP, not always small hydropower plants can continuously generate electricity. It must also be considered that in some exceptional years, there also may be some periods in which the river flow is not sufficient to run the plant. See historical yearly and

[8] Data used is available at http://www.ons.org.br/historico/energia_natural_afluente.aspx.
[9] Available at http://www.abradee.com.br/glossario_conteudo.asp.

monthly variation in the river flow compared to the long term, 1930 to 2005 averages, in the two following figures, stressing the intermittent character of the hydropower potential[10].

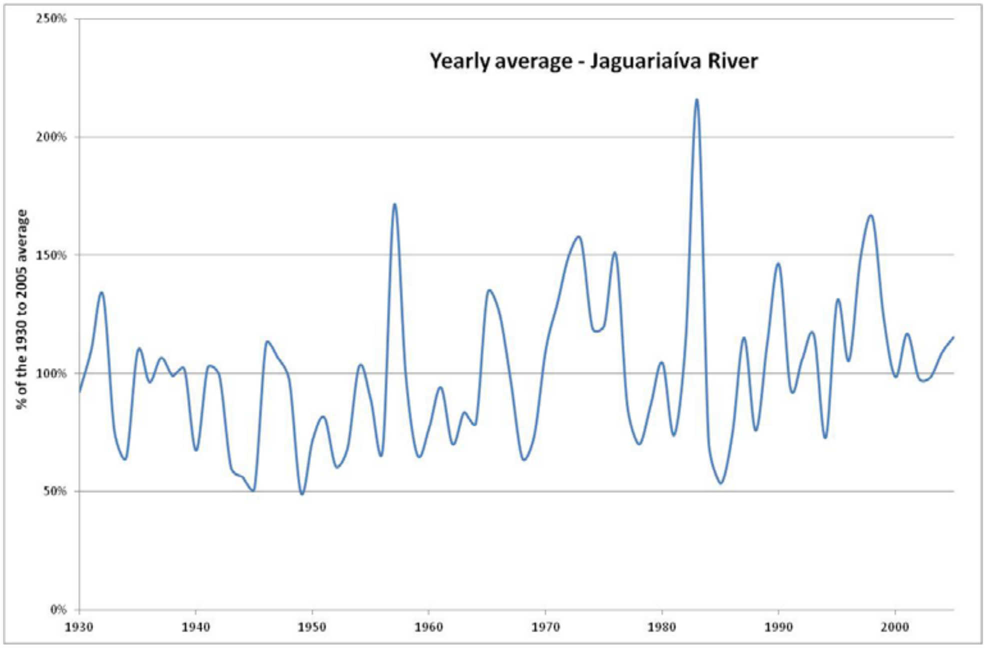

Figure 2 – Yearly variation compared to the long term (1930-2005) average.

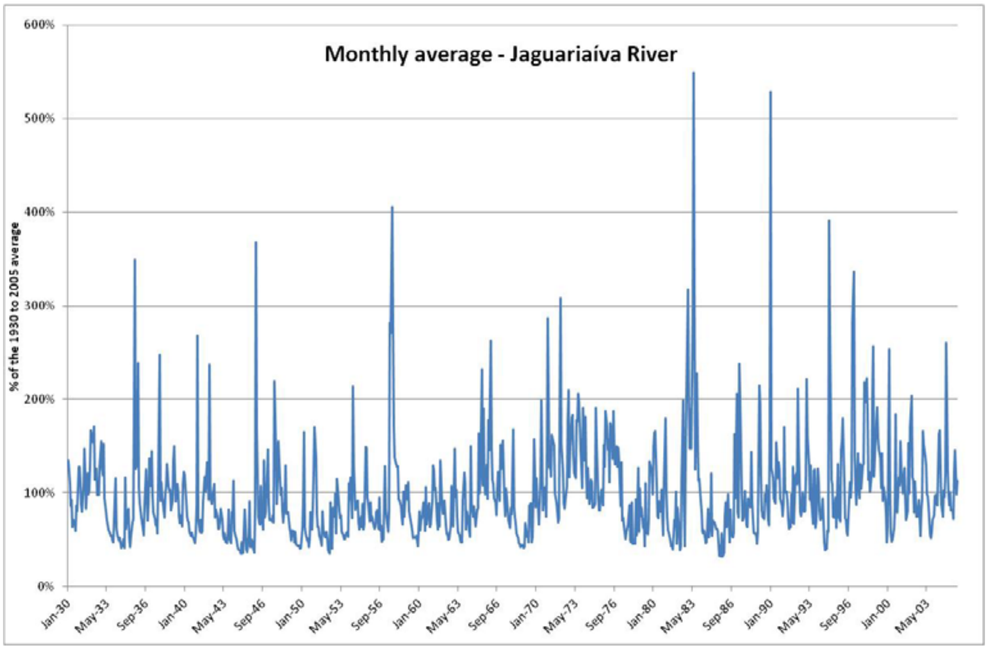

Figure 3 – Yearly variation compared to the long term (1930-2005) average.

Moreover, some wind power plants may also generate electricity continuously throughout the year. This can be seen by the observing the electricity generation of three registered CDM wind power plants project activities as presented in the figure below.

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[10] Source: retrieved on July 2011 from the Hydrological Information System, Brazilian National Water Agency (http://www2.ana.gov.br/Paginas/servicos/informacoeshidrologicas/redehidro.aspx).

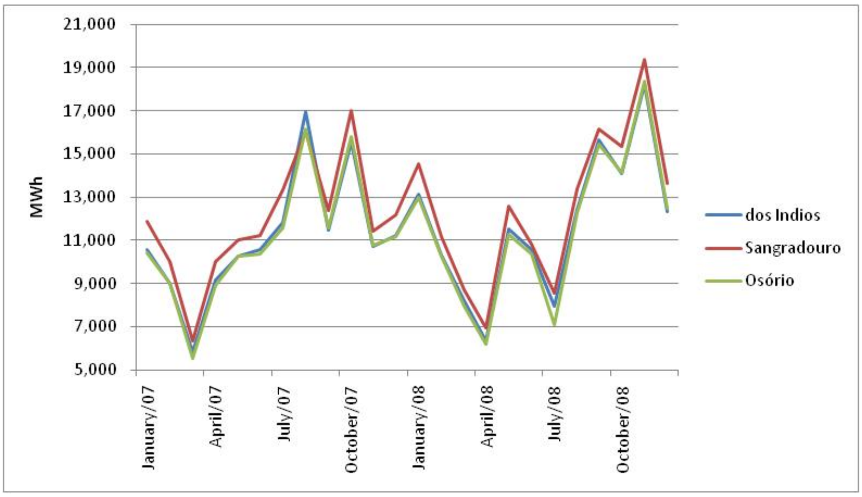


Figure 4 - CDM project activity monitored monthly power generation in MWh, Osório, Sangradouro and Dos Indios Wind Power Plants (Source: UNFCCC)

In fact, the project generation profile is very similar to the profile of three other wind power plants. As it can be seen from the figure below, Pesqueiro Small Hydro Power Plant generates electricity throughout the year significantly varying its electricity output within a year.

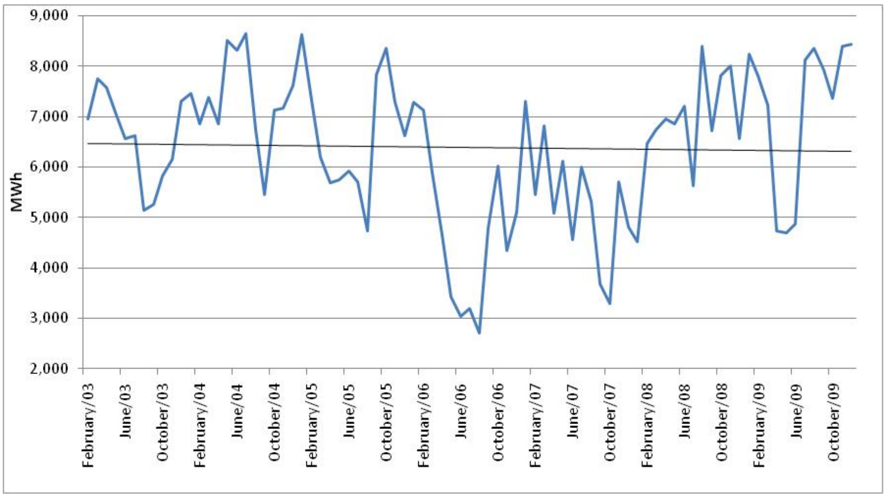


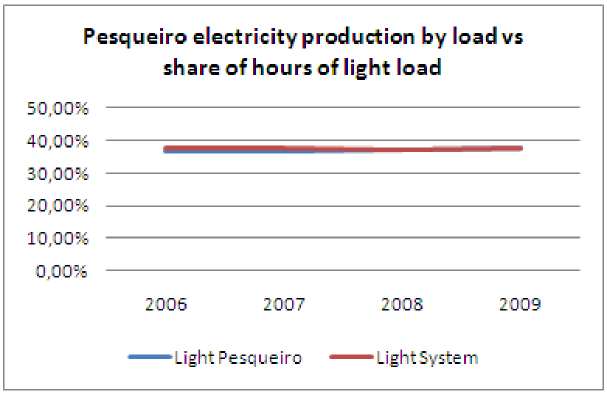
Figure 5 - CDM project activity monitored monthly power generation in MWh, Pesqueiro SHPP (Source: UNFCCC)

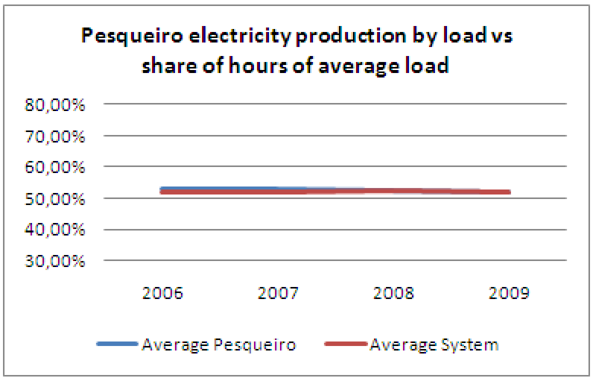
Small Hydropower Plant Pesqueiro possesses a small reservoir which allows the plant to store water for approximately five hours. Taking this information into account the MP inferred that the plant could shift its generation to the peak hours. However, it shall be noted that this assumption (generating electricity only during the peak hours) would only be reasonable it the river flow is considered to be constant and stable throughout the day, week and year, which is not.

Moreover, comparing the actual generation data from the plant and the load of the system for the most recent years, it can be seen that the generation by the plant matches the load profile of the system (~37% of electricity generation during low consumption periods; ~53% of electricity generation during average consumption period; ~10% of electricity generation during peak load periods). This evidences that the reservoir is not used to save water to favor electricity generation in the peak hours. On the contrary, whenever the resource (i.e. water) is available, the plant is operational and generates electricity.

The figure below presents data from 2006. According to CCEE the Load Threshold means the classification of the hours of the month according to the load profile defined by ONS, which may be: Light (low consumption period), Average (average consumption period) and Heavy (peak load period).

Information from 2007, 2008 and 2009 is also available and results in the same profile.





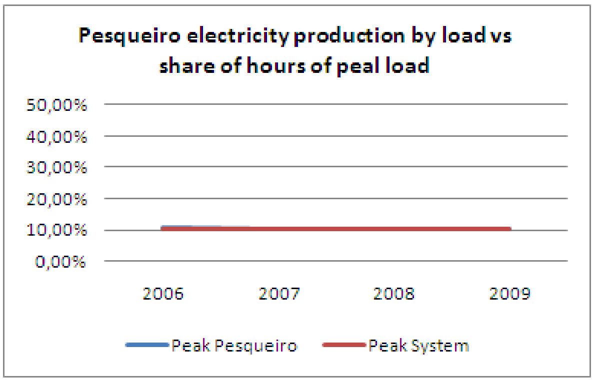


Figure 6 - Pesqueiro electricity production by load vs Share of hours in each load thresholds of the system from 2006 to 2009.

Light – P = Pesqueiro electricity production during low consumption period; Average – P = Pesqueiro electricity production during; Average consumption period; Peak – P = Pesqueiro electricity production during peak load period; Light – S = Low consumption period share of hours; Average – S = Average consumption period share of hours; Peak – S = Peak load period share of hours

As per the argumentation presented above, it is evident that the Pesqueiro SHPP Project Activity has an intermittent and non-dispatchable nature fully comparable to wind power plants in the same region (Brazil) and the adoption of the corresponding weighting values (w_{OM} = 0.75 and w_{BM} = 0.25) not only reasonable but natural.

Please use the space below to describe and substantiate the assessment of the DOE that the deviation does not require an amendment to the approved methodology used by the proposed project activity.

During the 50th Meth Panel meeting the recommendation was provided:

... the Methodologies Panel recommends not to revise the "Tool to calculate the emission factor for an

electricity system", as no general conclusion can be drawn which applies to all run-of-river hydro power plants. However, hydro power plants may have different impacts on the share of the BM and OM depending on the specific circumstances, and a change to the ratio of OM/BM weights may be proposed for individual project activities through a deviation request. Therefore, considering this request for deviation is project specific, it is understood that no revision of the tool is required.	
Please use the space below to describe the impact of the deviation on the estimates of the emissions reductions for the proposed project activity with the use of approved methodology as existing and with the deviation. Please substantiate the estimations with relevant and verifiable data.	
The proposed deviation request is submitted in the context of the revalidation of Pesqueiro Energia Small Hydroelectricity Project. Emission Reductions by this CDM Project Activity are generated due to electricity generation by a Small Hydro Power Plant which is dispatched into Brazilian Interconnected Grid. Baseline emissions are determined multiplying electricity generated by the plant by the emission factor of the grid. Electricity to be generated during the second crediting period of the proposed CDM Project Activity is estimated considering the plant load factor as established by the Brazilian Electricity Regulatory Agency (form the Portuguese *Agência Nacional de Energia Elétrica* – ANEEL) – ANEEL Ordinance #325, dated August 13th, 2001. Trough this ordinance, ANEEL established that the plant is authorized to generated 80,942.4MW/year on average. This figure is used to estimate the future emission reductions by the plant during the second crediting period. For the purpose of estimate, the build margin and operating margin emission factors for the year 2009, which were published by the Brazilian DNA, are going to be used to describe the impact of the proposed deviation on the estimates of emission reductions for the proposed project activity. The numbers published by the Brazilian DNA for that year are: Build Margin (BM_{2009}) emission factor: 0.0794 tCO_2/MWh Operating Margin (OM_{2009}) emission factor: 0.2476 tCO_2/MWh The weighting for calculation of the combined margin during the second crediting period, as established by the latest version of the "*Tool to calculate the emission factor for an electricity system*" for projects other than wind and solar is w_{OM} = 0.25 and w_{BM} = 0.75. Considering these weights, the combined margin emission factor to be used while estimating the emission reductions by the proposed project activity is 0.1214 tCO_2/MWh. Consequently, the emission reductions by the project during its second crediting period are 9,830 tCO_2/year. If the proposed deviation request is deemed appropriate, the weights for estimating the combined margin would be w_{OM} = 0.75 and w_{BM} = 0.25. Using these weights, the result is that the combined margin emission factor is 0.2055 tCO_2/MWh, which results in an average emission reduction equal to 16,635 tCO_2/MWh.	
Link to the documentation made available at validation stage	http://cdm.unfccc.int/Projects/DB/DNV-CUK1137160660.09/view
If necessary, list attached files containing relevant information which is not available through the above link	---

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Version	Date	Nature of revision
01	EB 49, Annex 5 11 September 2009	Initial adoption. This form replaces the form included as part of the *Procedures for request for deviation to the Executive Board* (version 02, EB 24, Annex 30). This form should be used in conjunction with *Procedures for requests to the Executive Board for deviation from an approved methodology.*
Decision Class: Regulatory **Document Type**: Form **Business Function**: Methodology		