METHODOLOGY ELEMENT ASSESSMENT REPORT: REDUCTION OF GHG EMISSIONS IN PROPYLENE OXIDE PRODUCTION

FINAL

Document Prepared By RINA Services S.p.A. (RINA)

Methodology Element Title	Reduction of GHG emissions in Propylene Oxide production	
Version	04	
Methodology Element Category	Methodology	Yes
	Methodology Revision	
	Module	
	Tool	
Sectoral Scope(s)	5	

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Client	South Pole Carbon (Thailand) Co., Ltd.
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Summary:

RINA Services S.p.A. (RINA), commissioned by SouthPole Carbon (Thailand) Co., Ltd., has performed the first assessment of the proposed VCS methodology "Reduction of GHG emissions in Propylene Oxide production", with regard to the relevant requirements for VCS activities.

The Methodology Element provides procedures for monitoring and calculating emission reductions associated with the manufacture of propylene oxide through HPPO process against the baseline practice of conventional Chlorohydrin Process.

The methodology assessment process consists of an independent third-party review of the new Methodology Element to confirm that the Methodology Element is consistent with relevant VCS rules and procedures. The assessment of the new Methodology Element is done through a double-approval process, according to the VCS Standard, and is necessary to provide assurance to stakeholders of the quality of the new Methodology Element.

The methodology assessment was conducted using the VCS Standard, v3.3 and the VCS Methodology Approval Process, Version 3.4 as the criteria. Additionally, RINA followed guidance in the VCS Program Guide, Version 3.4 and applied its professional judgment in assessing the proposed methodology.

Based on the desk review of the VCS ME published for commenting by the project developer in the VCS website (Methodology version 00 of 05-September-2012) and subsequent onsite visit conducted by the ME assessment team, 03 Corrective Action Requests (CARs) and 08 Clarification Requests (CLs) were identified and communicated to the methodology developer by Draft assessment report version 0.1 dated 19-November-2012. The methodology developer could sufficiently resolve all the CARs and CLs and submitted a revised Methodology element "Reduction of GHG emissions in Propylene Oxide production", version 03 of 16-January-2013 prior to proceeding with the Final assessment report. The list of CARs and CLs raised and its resolution is available as part of this report in Table 2 of section 4.

RINA confirmed in its 1st assessment report version 1.2 dated 21-February-2013, that the proposed Methodology element "Reduction of GHG emissions in Propylene Oxide production" is consistent with relevant VCS rules and procedures based on the ME, version 03 of 16-January-2013. As communicated by VCSA through email dated 27-June-2013, under the double approval process by which new methodologies are approved under the VCS Program, Bureau Veritas Certification Holding SAS (BVCH) was retained by VCSA to conduct the 2nd assessment of the proposed new Methodology Element. The Methodology element documentation was revised as a result of the second assessment. VCSA forwarded the revised methodology element version 04 dated 01-May-2013 and the assessment report from the 2nd VVB, version 01 of 22-May-2013 through the aforesaid email. RINA reviewed this revised methodology

element version 04 dated 01-May-2013 and the second assessment report version 01 of 22-May-2013 issued by Bureau Veritas Certification Holding SAS (BVCH) and confirm that the editorial changes made are appropriate.

In conclusion, it is RINA's opinion that the Methodology element "Reduction of GHG emissions in Propylene Oxide production", as described in the ME version 04 dated 01-May-2013, meets all relevant VCS requirements as mentioned above. Hence RINA confirms that the Methodology Element is consistent with relevant VCS rules and procedures.

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Abbreviations

BE	Baseline Emissions
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CH_4	Methane
CHP	Cumene Hydroperoxide
CHPO	Chlorohydrin Process
CL	Clarification Request
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CRT	Coordination and Technical Control Staff
DCI	Certification Division of RINA Services Spa
EB	Executive Board
EIA	Environmental Impact assessment
ER	Emission Reductions
FAR	Forward Action Request
GHG(s)	Greenhouse gas(es)
GWP	Global Warming Potential
HP	Hydrogen Peroxide
HPPO	Hydrogen Peroxide – based PO technology
IPCC	Intergovernmental Panel on Climate Change
ME	Methodology Element
MoV	Means of Verification
MP	Monitoring Plan
MR	Monitoring Report
MHMCL	MTP-HPPO Manufacturing Co. Ltd.
NGO	Non-governmental Organization
ODA	Official Development Assistance
PD	Project Document
PE	Project Emission
PO	Propylene oxide
PU and I	Process Utilities and Instrumentation
Ref.	Document Reference
RINA	RINA Services Spa
SPCTCL	South Pole Carbon Thailand) Co., Ltd
SS(s)	Sectoral Scope(s)
UNFCCC	United Nations Framework Convention on Climate Change
US	United States of America
VCS	Verified Carbon Standard
VCU	Verified Carbon Units
VVB	Validation and Verification Body

1 INTRODUCTION

South Pole Carbon (Thailand) Co., Ltd., has commissioned RINA to carry out the Verified Carbon Standard (VCS) methodology element (ME) assessment process for the proposed VCS Methodology Element titled “Reduction of GHG emissions in Propylene Oxide production”.

This report provides a description of the steps involved in conducting the first methodology assessment as part of the VCS double-approval process and summarizes the findings of the first methodology assessment, performed on the basis of prescribed VCS criteria.

1.1 Objective

The objective of the methodology element assessment is to have an independent evaluation of a methodology element by a Validation and Verification Body against the VCS requirements, on the basis of the VCS ME published for commenting by the project developer in the VCS website. In particular, the eligibility criteria, baseline approach, additionality, methodology boundary, approach for calculating baseline emissions, methodology emissions and emission reductions, leakage, monitoring, data and parameters, adherence to the Methodology-level principles of the VCS Program are assessed in order to confirm that the ME, as documented, is sound and reasonable and meets the identified criteria. Assessment of ME is a requirement for all VCS ME and is seen as necessary to provide assurance to stakeholders of the quality of the ME and its intended use by project developers and generation of verified carbon units (VCUs).

1.2 Scope and Criteria

The methodology assessment scope is to review the ME against the VCS criteria. The methodology assessment was conducted using the VCS Standard, v3.3 and the VCS Methodology Approval Process, Version 3.4 as the criteria. Additionally, RINA followed guidance in the VCS Program Guide, Version 3.4 and applied its professional judgment in assessing the proposed methodology.

This assessment is not meant to provide any consultancy towards the project developers. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the proposed methodology element.

1.3 Summary Description of the Methodology Element

The ME is applicable to project activities that involve synthesis of propylene oxide using Hydrogen Peroxide-based Propylene Oxide (HPPO) Technology which is able to reduce GHG emissions and waste generation during PO synthesis when compared to other processes. The GHG emission reductions are owing to usage of lesser GHG intensive reagents and reduced process energy requirements. In this methodology, the GHG emissions produced by different chemical manufacturing processes using different reagents are being compared, hence comparison of emissions that occur in the facility and emissions due to reagent production are also taken into account (for both baseline and project processes) between three classes of emissions:

- Up-stream emissions: include emission sources linked to the production of reagents being used in the process;

- Process emissions: represent emission sources located within the project facility and associated to the transformation of reagents into the product at the manufacturing site. Process emissions include energy consumption as well as emissions associated with product and waste treatments;

- Down stream emissions: As the product is the same in both the baseline and project scenarios, down-stream emissions would be the same in both cases and have therefore not been considered. Thus this methodology proposes to consider only the up-stream and process emissions.

The ME provides procedures for establishing the project boundary, determining the baseline scenario, demonstrating additionality, monitoring fuel consumption and other relevant parameters, and finally, quantifying baseline and project emissions and total emission reductions.

2 ASSESSMENT APPROACH

2.1 Method and Criteria

Assessment of the methodology element was conducted using RINA procedures in line with the requirements specified in the VCS Requirements, applying standard auditing techniques. The assessment of the methodology was on the basis of the VCS standard version 3.3 and the VCS Methodology Approval Process, Version 3.4 as the criteria. Additionally, RINA followed guidance in the VCS program guide version 3.4and prepared the report on Methodology assessment report template version 3.0 of 19/10/2011.

The assessment of the methodology element consisted of the following three phases:

- Desk review;
- On-site assessment:
- The resolution of outstanding issues and the issuance of the final first assessment report.

The following sections outline each step in more detail:

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2.2 Document Review

The VCS-Methodology Element “Reduction of GHG emissions in Propylene Oxide production”, version 03 of 16/01/2013 and the previous version 02 of 19/12/2012, version 01 of 08/12/2012, version 00 of 05/09/2012 /01/, the VCS-PD for the proposed project activity “Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd.” in Thailand, Version 02 of 16/01/2013and previous version 01 dated 19/12/2012, version 00 of 05/09/2012 /02/, the Emissions Reductions calculation sheet for the proposed VCS project activity “Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd.” in Thailand, version 01 of 19/12/2012 and the previous version 00 of 30/07/2012 provided in the form of a spreadsheet titled “ER calculation-19122012.xlsx” /03/, were verified as part of the assessment of the methodology element.

The following table lists the documentation that was reviewed during the assessment process:

/01/	SPCTCL: VCS-Methodology Element "Reduction of GHG emissions in Propylene Oxide production", version 03 of 16/01/2013 SPCTCL: VCS-Methodology Element "Reduction of GHG emissions in Propylene Oxide production", version 02 of 19/12/2012 SPCTCL: VCS-Methodology Element "Reduction of GHG emissions in Propylene Oxide production", version 01 of 08/12/2012 SPCTCL: VCS-Methodology Element "Reduction of GHG emissions in Propylene Oxide production", version 00 of 05/09/2012.
/02/	SPCTCL: VCS-PD for project activity "Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd." in Thailand, version 02 of 16/01/2013 SPCTCL: VCS-PD for project activity "Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd." in Thailand, version 01 of 19/12/2012 SPCTCL: VCS-PD for project activity "Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd." in Thailand, version 00 of 05/09/2012
/03/	SPCTCL: Emissions Reductions calculation sheet titled "ER calculation-19122012.xlsx" for the VCS project activity " Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd." in Thailand, version 01 of 19/12/2012 SPCTCL: Emissions Reductions calculation sheet titled "ER calculation-30072012.xlsx" for the VCS project activity " Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd." in Thailand, of 30/07/2012", received on 12/09/2012
/04/	VCS Association: VCS Standard, VCS version 3, Requirements document , v3.3 of 04/10/2012.
/05/	VCS Association: VCS Progarm Guide, VCS version 3 Requirements document , v3.4 of 04/10/2012.
/06/	VCS Association: VCS methodology approval process, VCS version 3 Procedural document , v3.4 of 04/10/2012.
/07/	VCS Association: VCS Methodology assessment report template version 3.0 of 19/10/2011.
/08/	VCS Association: List of VVBs as available at weblinlk https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?Tab=VVBs&a=1, in English retrieved on 22/10/2012
/09/	CDM Executive Board: List of DOEs as available at weblink http://cdm.unfccc.int/DOE/list/index.html, in English retrieved on 22/10/2012
/10/	VCS Association: VCS Methodology template version 3.2 of 04/10/2012.
/11/	MHMCL: Presentation on HPPO process overview, presented to the assessment team during onsite visit on 06/11/2012
/12/	Nexant: Chem systems program – Hydrogen Peroxide 07/08-3 of May 2009 submitted on 08/11/2012
/13/	Nexant: Chem systems program – Propylene Oxide 07/08-6 of November 2008 submitted on 08/11/2012
/14/	Dow Deutschland Inc., Stade, Federal Republic of Germany: Basic information on Propylene Oxide submitted on 08/11/2012
/15/	Marcos Nogueira César: Review 2009-4, Propylene oxide by the BASF-DOW HPPO Process of December 2009 submitted on 08/11/2012
/16/	CDM Executive Board: Methodological tool "Tool for the demonstration and assessment of additionality", Version 06.1.0, dated 13/09/2012 CDM Executive Board: Methodological tool "Tool for the demonstration and assessment of additionality", Version 07.0.0, dated 23/11/2012.
/17/	CDM Executive Board: Methodological tool "Tool to calculate baseline, project and/or leakage

	emissions from electricity consumption", Version 01, dated 16/05/2008
/18/	CDM Executive Board: Methodological tool "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", Version 02, dated 02/08/2008
/19/	Multilateral Investment Guarantee Agency: Environmental Guidelines for Chlor-Alkali Industry, available at weblink http://www.miga.org/documents/ChlorAlkali.pdf in English, retrieved on 12/11/2012
/20/	Dow Chemical Co., Ltd. Website: Giving location of the MTP HPPO Manufacturing Co., Ltd available at http://www.dow.com/thailand/locations/ in English, retrieved on 12/11/2012.
/21/	VCS Association: Weblink - http://v-c-s.org/methodologies/reduction-ghg-emissions-propylene-oxide-production giving the details of publication of the proposed ME for public comments , in English, retrieved on 07/01/2013.
/22/	VCS Association: VCS website giving the list of approved methodologies and the methodologies under development available at weblink http://v-c-s.org/ in English, retrieved on 07/01/2013
/23/	Gold Standard Foundation: GS website giving the list of approved methodologies and the methodologies under development available at weblink http://www.cdmgoldstandard.org/project-certification/gs-methodologies in English, retrieved on 07/01/2013
/24/	CDM Executive Board: CDM website giving the list of approved methodologies and the methodologies under development available at weblink http://cdm.unfccc.int/methodologies/index.html in English, retrieved on 07/01/2013

2.3 Interviews

On 06-November-2012 and 07-November-2012, RINA visited the MTP HPPO Manufacturing Co., Ltd, based on which the Methodology is being developed, located at postal address P.O.Box 71, Banchang Post Office, Rayong Province 21130, Thailand /20/ to resolve questions and issues identified during the document review and to perform interviews with relevant process specialists.

The key personnel interviewed and the main topics of the interviews are summarized in the table below.

	Date	Name and Role	Organization	Topic
/a/	06/11/2012 and 07/11/2012	Sandeep Kanda Tech. Portfolio Director	SPCTCL	Design of Methodology Element, ME adherence to VCS requirements.
/b/	06/11/2012 and 07/11/2012	Patrick Buergi Head of Advisory	SPCTCL	Design of Methodology Element, ME adherence to VCS requirements.
/c/	06/11/2012 and 07/11/2012	Patana Surawatanapongs Business Development Manager (Thailand)	SPCTCL	Design of Methodology Element, ME adherence to VCS requirements.
/d/	06/11/2012 and 07/11/2012	Pornpimon. R PO Operation Leader	MHMCL	Overview of production of PO using HPPO process, Reagent receipt, Storage, Production, Waste treatment, Disposal, Storage of Final product and

				Shipment.
/e/	07/11/2012	Chaiwut, Atthawethworawuth Government Affairs Manager	MHMCL	Statutory requirements Permits, International operations.
/f/	07/11/2012	Tawee Sakulkoakiet PU and I Production Leader	MHMCL	Waste Treatment and monitoring.
/g/	07/11/2012	Orladda Molasartsatorn PU and I Operation Leader	MHMCL	Utilities supply and monitoring.

2.4 Use of VCS-Approved Expert

A VCS-approved expert was not retained for the purposes of this methodology assessment. In accordance with the VCS Standard, a VCS-approved expert is not necessary for non-AFOLU ME assessments where a standardized method is not applied. However the technical expert, being part of the assessment team possess vast experience in Chlor-alkali-Chlorohydrin process.

2.5 Resolution of Any Material Discrepancy

The objective of this phase of the assessment of the methodology element is to resolve any outstanding issues which need to be clarified for RINA's positive conclusion on the structure and content of the methodology element.

To guarantee transparency an assessment protocol has been customized for the project. The protocol shows in a transparent manner the requirements, means of assessment and the results from assessing the identified criteria. The assessment protocol consists of two tables; the different columns in these tables are described in the figure below (see Figure 1). The completed assessment protocol is enclosed in section 4 of this report.

A corrective action request (CAR) is raised if one of the following occurs:

- The methodology has mistakes that will influence the ability of the methodology to assess project activity to achieve real, measurable additional emission reductions.
- The VCS requirements have not been met.
- There is a risk that the emission reductions cannot be monitored or calculated.

A clarification request (CL) is raised if information is insufficient or not clear enough to determine whether the applicable VCS requirements have been met.
CARs and CLs identified are included in the assessment protocol in section 4 of this report.

Figure 1 Assessment protocol tables

Assessment Protocol, Table 1 - Requirement checklist				
Checklist Question	**Ref.**	**MoV**	**Comments**	**Conclusion**
The various	Makes	Explain how	The	For CAR and CL see

requirements are linked to checklist questions the project should meet. The checklist is organized in fourteen different sections as categorized in methodology element assessment report.	reference to documents where the answer to the checklist question or item is found.	conformance with the checklist question is investigated. Examples are document review (DR), interview or any other follow-up actions (I), cross checking (CC) with available information relating to projects, (N/A) means not applicable.	discussion on how the conclusion is arrived at and the conclusion on the compliance with checklist question so far.	the definitions above. OK is used if the information and evidence provided is adequate to demonstrate compliance with VCS requirements.

Assessment Protocol, Table 2 - Resolution of Corrective Action Requests and Clarification			
Corrective action requests and/or clarification requests	**Reference to Table 2**	**Response by project participants**	**Assessment Conclusion**
The CAR and/or CLs raised in table 2 are repeated here.	Reference to the checklist question number in Table 2 where the CAR or CL is explained.	The responses given by the project participants to address the CARs and/or CLs.	The assessment team's assessment and final conclusion of the CARs and/or CLs.

2.6 Internal Quality Control

All the revisions of the methodology element assessment report before being submitted to the client were subjected to an independent internal technical review to confirm that all assessment activities had been completed according to the pertinent RINA instructions and VCS requirements.
The technical review was performed by a technical reviewer(s) qualified in accordance with RINA's qualification scheme for GHG validation and verification.

The Methodology element assessment team and the technical reviewers consist of the following personnel:

Role	Last Name	First Name	Country
Team Leader / Validator	Arokiasamy	Cyril Augustus	India
Technical expert	Venkatrama	Ramani	India
Technical Reviewer	Raghavan Nair	Reghu Kumar	India
Technical Reviewer	Valoroso	Rita	Italy

3 ASSESSMENT FINDINGS

3.1 Applicability Conditions

The applicability conditions are considered appropriate to the ME as it is applicable only when established that Chlorohydrin-Chlor-Alkali process is the baseline. Further the ME is applicable only

to green field projects where PO (Propylene Oxide) is the only output, no co-products are allowed, and no by-products more than 10% as compared to the PO output are allowed. This is accepted to be appropriate as only then the project applying this methodology would have an output comparable to Chlorohydrin-Chlor-Alkali process /13/.

The methodology could be applied to a project happening in any part of the world; baseline emissions are calculated based on specific local conditions accounting for the fuel types and resource availability. Since no default values are used and it is left to be determined at project level, the chosen geographical area of applicability of this methodology is acceptable and gives opportunity for comparing alternate technologies available globally.

Methodology uses project method to determine additionality and the crediting baseline. The latest version of Tool for the demonstration and assessment of additionality has been referred by the ME for determining the additionality of the project activity. Hence the ME excludes, those classes of project activities that it can be reasonably assumed will be implemented without the intervention created by the carbon market.

The ME details applicability conditions to specify the project activities to which it applies and has established criteria that describe the conditions under which the ME can (and cannot) be applied. The ME also demands project's compliance to applicability conditions set out in tools used by the methodology. Hence RINA confirms that the applicability conditions of the methodology are sufficient to establish whether the methodology could be applied to a proposed project activity.

3.2 Project Boundary

The spatial extent of the project boundary encompasses the upstream emissions from reagents, PO manufacturing plant from reagents admission to the treatment of by-products and waste from process. The project boundary encompasses also the project electricity system(s) and Heat/steam generation system that the PO plant is connected to. The spatial extent of the project electricity system consists of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. This is similar for the spatial extent of the steam system also.

ME has transparently given the schematic diagram of the geographical extent of the baseline scenario and the project scenario. A table indicating the greenhouse gases included in or excluded from the project boundary along with the justification of doing so is also available. The information in the ME is consistent with the study reports /11/-/15/, review of the VCS-PD /02/ and emission reduction calculation sheet /03/ for project activity "Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd." in Thailand confirmed by the onsite visit carried out by the assessment team and the interview had with the representatives of the process plant for which the methodology is being developed.

The ME establishes criteria and procedures for describing the project boundary and identifying and assessing GHG sources relevant to the project and baseline scenarios. Justification for GHG sources included or excluded has been provided. The ME covers GHG sources that are controlled by the project proponent, related to the project or affected by the project (leakage). The GHG sources identified for the project have been compared with those identified in the baseline scenario,

to ensure equivalency and consistency. Hence RINA confirms that the project boundary as detailed in the ME is sufficient to establish the geographical extent of a proposed project activity.

3.3 Procedure for Determining the Baseline Scenario

The ME uses project method to determine baseline scenario and has established the following four steps:

1. Identification of plausible alternative scenarios – Any globally available alternatives which could deliver equivalent outputs or services that have been implemented previously or are currently being introduced in the relevant country/region are considered plausible alternatives, this includes (but not limited to):
   P1: The project activity without carbon revenues;
   P2: A plant with comparable capacity using the Chlorohydrin process (Lime or Chlor-Alkali);
   P3: A plant with comparable capacity using any other commercially available technology.

2. Check consistency with mandatory applicable laws and regulations

3. Barrier analysis – Apply Step 3 of the latest version of the "Tool for demonstration and assessment of additionality" agreed by the CDM Executive Board, to identify and eliminate scenarios that face prohibitive barriers.

4. Economic attractiveness – If more than one alternative remains at the end of step 3, apply Step 2 of the latest approved version of the "Tool for the demonstration and assessment of Additionality" and compare the economic attractiveness without revenues from carbon credits for all alternatives that are remaining.

The Methodology has established criteria and procedures for identifying alternative baseline scenarios and determining the most plausible scenario, taking into account the identified GHG sources, existing and alternative project technologies providing equivalent output or services to the project, data availability, reliability and limitations and other relevant information concerning present or future conditions, such as legislative, technical, economic, socio-cultural, environmental, geographic, site-specific and temporal assumptions or projections. Hence RINA confirms that the procedure for determining baseline scenario as detailed in the ME is sufficient to meet the intent.

3.4 Procedure for Demonstrating Additionality

The ME uses project method to determine additionality and requires additionality of the project activity to be demonstrated and assessed using the latest version of the "Tool for the demonstration and assessment of additionality" agreed by the CDM Executive Board, which is available on the UNFCCC CDM website. While demonstrating the additionality of the proposed project activity, the Project Owner shall consider the different project alternatives as per the baseline identification section.

This meets the requirements as set out in paragraph 4.6.3 to 4.6.5 of the VCS standard version 3.3 /04/. Hence RINA confirms that the procedure for determining additionality of the project as detailed in the ME is sufficient to meet the requirement as stated in the VCS standard /04/.

3.5 Baseline Emissions

Baseline emissions (BE_y) is a sum of Emissions associated with the baseline reagents ($BE_{Upstream,y}$) for the production of PO, (tCO_2), this is considered upstream emission due to production of baseline reagents, and ; Emissions due to energy usage ($BE_{Process,y}$) heat, electricity, etc., for transforming the baseline reagents into the final product (PO) and also for waste and by-products treatment (tCO_2) considered as baseline emissions due to production on site.

Hence

$BE_y = BE_{Upstream,y} + BE_{Process,y}$.

$BE_{Upstream,y}$ is calculated as

$BE_{Upstream,y} = be_{Chlor\text{-}Alkali,y} \times PO_y$

Where:

$be_{Chlor\text{-}Alkali,y}$ is the Quantity of CO_2 emitted from Chlor-Alkali production per unit of PO (tons)

PO_y is the Quantity of PO produced in year y (tons)

Propylene is common reagent in both baseline and project scenario, hence not considered, this is consistent with the GHG sources as available in section 3.2 of this report (project boundary). Other reagents used in baseline process are Chloro-alkali (Chlorine and Sodium Hydroxide). The most common Chlor-Alkali process involves the electrolysis of aqueous sodium chloride (brine) in a membrane cell (owing to lower emissions) /19/. The process Chloro-Alkali produces both Cl_2 and NaOH, Hence energy consumption per ton/Cl_2 includes Sodium hydroxide produced and used in the baseline process as reagent. It can be noted that the equation 3 in the methodology has been presented in terms of Chlorine and PO. Therefore, the energy consumption too is linked to Chlorine. The justification has been included in the methodology for clarity, thus the equation becomes

$be_{Chlor\text{-}Alkali,y}$ is calculated to be $be_{Chlor\text{-}Alkali,y} = (71/58) \times ec_{Chlor\text{-}Alkali,y} \times EF_{EL,y}$.

Where:

$ec_{Chlor\text{-}Alkali,y}$ is the Energy consumption per ton of Cl_2 production (MWh/tCl_2) this value is to be determined at the project level, using Independent third party report.

$EF_{EL,y}$ is the Emission factor for electricity generation in year y (tCO_2/MWh) calculated as per the requirements of the latest CDM "Tool to calculate the emission factor for an electricity system"
71/58 is the Ratio between the molecular weights of Cl_2 and C_3H_6O (mass units/mass units)

Emissions due to energy usage ($BE_{Process,y}$) heat, electricity, etc., for transforming the baseline reagents into the final product (PO) and treatment of waste generated out of the process is calculated as under:

$BE_{Process,y} = BE_{heat,y} + BE_{Electricity,y} + BE_{Waste,y}$

Where $BE_{heat,y}$ is calculated to be

$BE_{heat,y} = SSC_{CHPO} \times PO_y \times EF_{Steam,y}$

Where:

$BE_{Heat,y}$ is the Emissions due to thermal energy (heat/steam) for transforming the baseline reagents into the final product (PO) and also for waste treatment (tCO_2)

SSC_{CHPO} is the Specific thermal energy consumption ratio in the PO production through CHPO process (TJ/tonne of PO); this value is to be determined at the project level, using Independent third party report.

$EF_{Steam,y}$ is the Emission factor for thermal energy generation in year y (tCO_2/TJ) is calculated as:

$EF_{Steam,y} = EF_{CO2,i.y} / \eta_{Boiler,y}$

Where:

$EF_{CO2,i.y}$ is the Weighted average CO_2 emission factor of fuel type i in year y (tCO_2/TJ) calculated as per the CDM "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

$\eta_{Boiler,y}$ is the Efficiency of the steam generating system calculated as per the CDM "Tool to determine the baseline efficiency of thermal or electric energy generation systems" .

$BE_{elec,y}$ is the Emissions due to electrical energy for transforming the baseline reagents into the final product (PO) and also for waste treatment (tCO_2) calculated as:

$BE_{elec,,y} = SEC_{CHPO} \times PO_y \times EF_{El,y}$

Where:

SEC_{CHPO} is the Specific electrical energy consumption ratio in the PO production through CHPO process (MWh/tonne of PO) sourced from Independent third party report

$EF_{El,y}$ is the Emission factor for electricity generation in year y (tCO_2/MWh) calculated as per the requirements of the latest CDM "Tool to calculate the emission factor for an electricity system"

$BE_{Waste,y}$ is the Emissions due to treatment of waste products (tCO_2), calculated as:

$BE_{Waste,y} = (44/12) \times (CA_{Waste,\ Baseline}) + FC_{i,Baseline,} \times COEF_{,i}$

Where

$CA_{Waste,\ Baseline}$ is the carbon amount in the waste stream derived from the carbon amount in the Propylene feed, PO and by-products in the baseline (tonnes). The carbon amount in the waste

stream and fuel combusted in the incinerator is presented in terms of PO output. Values are to be justified at project level.

(44/12) is the ratio between the molecular weights of CO_2 and Carbon (mass units/mass units)

$FC_{i,Baseline}$ is the Quantity of fuel type i combusted in the incinerator in the baseline (mass or volume unit/year) sourced from Independent third party report.

$COEF_{,i}$ is the CO_2 emission coefficient of fuel type i (tCO_2/mass or volume unit) calculated as per the requirements of the CDM tool "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

If credible data to estimate the emissions linked to waste and by-products is not available, the project proponents may neglect calculation of baseline emissions due to the same. The assessment team accepted the same as it is conservative. However, monitoring and accounting emissions due to waste treatment in the project activity is mandatory and is included in the monitoring plan of the methodology.

Calculation of baseline emissions is in line with the publicly available technical literature /13//15//19/ and interviews performed during the site visit. All the values (parameters to be monitored and not monitored) are to be determined at the project level using approved CDM tools and independent third party reports as referred in the ME. Hence RINA confirms that the procedure for determining baseline emissions in the ME is sufficient and would result in a conservative estimates.

3.6 Project Emissions

Project emissions is the summation of emissions associated with the production of project reagents for the production of PO, (tCO_2), emissions due to energy usage (heat, electricity etc.) for transforming the project reagents into the final product (PO) and waste treatment (tCO_2)

Hence

$PE_{,y} = PE_{Upstream,y} + PE_{Process,y}$.

The reagents used in the project process are Propylene and Hydrogen Peroxide. Propylene is common reagent in both baseline and project scenarios, hence not considered. This is conservative as the amount of Propylene required in the baseline CHPO process is slightly higher as compared to the HPPO process /13/. Since the epoxidation reaction is carried out in solvents, the emissions associated with the use (make-up) of solvent is considered.

Hence $PE_{Upstream,y}$ is calculated as

$PE_{Upstream,y} = PE_{Upstream,H2O2,y} + PE_{Upstream,\ Solvent,y}$

$PE_{Upstream,H2O2,y} = (34/58) \times pe_{HP} \times PO_y$

Where

(34/58) is the Ratio between the molecular weights of H_2O_2 and C_3H_6O (mass units/mass units)

pe_{HP} is the Quantity of CO_2 that would be emitted per ton of H_2O_2 (tCO_2/ tH_2O_2) sourced from independent third party report, the concentration of H_2O_2 is considered on 100% basis.

PO_y is the Quantity of PO produced in year y (tons)

$PE_{Upstream, Solvent,y}$ is the emissions associated with the use (make-up) of solvent is calculated as:

$PE_{Upstream, Solvent,y} = pe_{Sol} \times sol_y \times PO_y$

Where

pe_{Sol} is the Quantity of CO_2 that would be emitted per ton of Solvent (tCO_2/ ton of Solvent)

sol_y is the Quantity of solvent (tons) required per ton of PO, sourced from the design details of the project and for ex-post calculation instead of specific (sol_y) the total solvent consumption ($Sol_{,y}$) is a monitoring parameter.

PO_y is the Quantity of PO produced (tons)

The process emissions arise due to energy usage (heat, electricity, etc.) for transforming the reagents into the final product, by-products and also for waste treatment, hence calculated as:

$PE_{Process,y} = PE_{heat,y} + PE_{Electricity,y} + PE_{Waste, y}$

$PE_{heat,y}$ is calculated to be

$PE_{heat,y} = SSC_{HPPO} \times PO_y \times EF_{Steam,y}$

Where:

SSC_{HPPO} is the Specific thermal energy consumption ratio in the PO production through HPPO process (TJ/ton of PO), sourced from the design details of the project and for ex-post calculation instead of specific (SSC_{HPPO}) the total steam consumption ($SC_{HPPO, y}$) is a monitoring parameter.

$EF_{Steam,y}$ is the Emission factor for thermal energy generation in year y (tCO_2/TJ) is calculated as in the baseline scenario.

$PE_{elec,y}$ is calculated to be

$PE_{elec,,y} = SEC_{HPPO} \times PO_y \times EF_{El,y}$

Where:

SEC_{HPPO} is the Specific electrical energy consumption ratio in the PO production through HPPO process (MWh/tonne of PO) sourced from the design details of the project and for ex-post calculation instead of specific (SEC_{HPPO}) the total electricity consumption ($EC_{HPPO, y}$) is a monitoring parameter.

$EF_{EI,y}$ is the Emission factor for electricity generation in year y (tCO_2/MWh) is calculated as in the baseline scenario.

$PE_{Waste,y}$ is calculated to be

$$PE_{Waste,y} = (44/12) \times (CA_{Waste,y}) + FC_{i,y}, \times COEF_{,I,y}$$

Where

$CA_{Waste,y}$ is the Carbon amount in the waste stream derived from the carbon amount in the Propylene feed, Solvent, PO and by-products during year y of the crediting period (tons). Calculation of $CA_{Waste,y}$ is detailed below.

(44/12) is the ratio between the molecular weights of CO_2 and Carbon (mass units/mass units)

$FC_{i,y}$ is the Quantity of fuel type i combusted in the incinerator during the year y (mass or volume unit/year) to be sourced as described in the CDM "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

$COEF_{,i}$ is the CO_2 emission coefficient of fuel type i (tCO_2/mass or volume unit) calculated as per the requirements of the CDM tool "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
The carbon amount in the waste stream shall be calculated as a difference between the carbon amount (CA) in the feed and the carbon amount in product and byproduct. The carbon amount in a product is a function of respective carbon fraction and the quantity this is calculated as:

$$CA_{Waste,y} = CA_{Propylene,y} + CA_{Solvent,y} – (CA_{PO,y} + CA_{Byproduct,y})$$

$$CA_{Waste,y} =(36/42) \times Q_{Propylene,y} + (12/32) \times Sol_{y} – (36/58) \times PO_{,y} – (36/76) \times Q_{Byproduct,y}$$

Calculation of baseline emissions is in line with the publicly available technical literature /12//13//15/ and the technical presentation /11/ and the interview had during the site visit. All the values (parameters to be monitored and not monitored) are to be determined at the project level using approved CDM tools, independent third party reports and ex-post monitoring and measurement as referred in the ME. Hence RINA confirms that the procedure for determining project emissions in the ME is sufficient and would result in a conservative estimate.

3.7 Leakage

Leakage is not considered in the ME, since upstream emissions due to use of reagents are accounted under project emissions and post production, the product (PO) is comparable to the PO derived out of any other process including Chloro-hydrin process. As discussed with the project

implementation team, there could be emissions owing to construction of the facility, these emissions are ignored as they are expected to be same for baseline and project. RINA considered this appropriate as the difference, if any, would be insignificant against the emission reductions envisaged from the project.

3.8 Quantification of Net GHG Emission Reductions and/or Removals

Emission reductions are calculated as a the net difference between the baseline emissions (BEy) and the Project emissions (PEy) including Leakage (LEy), hence represented as:

$ER_y = BE_y – PE_y - LEy$

In case there is a retrofit in the plant, implemented during crediting period, having an effect on the energy (steam and/or electricity) consumption of the project activity, the project proponents shall submit a deviation on how such retrofit is monitored to estimate its effect on emission reduction.

Thus the methodology establishes criteria and procedures for quantifying GHG emissions for the selected GHG sources, separately for the project and baseline scenarios. The methodology is also transparent on the criteria and procedures for quantifying net GHG emission, quantified as the difference between the GHG emissions between from GHG sources relevant for the project and those relevant for the baseline scenario. RINA confirms that the procedure for determining Emission reductions given in the ME is sufficient and would result in a conservative estimate.

3.9 Monitoring

The methodology element describes the all the data and parameters to be reported, including sources of data and units of measurement. Methodology ensures that conservative values shall be selected that ensure that the quantification does not lead to an overestimation of net GHG emission reductions. Metric tons have been used as the unit of measure and the quantity of GHG has been given in tons of CO_2e. Each of the data and parameter that shall be available at the time of validation and the ex-post monitoring parameters and its compliance to the requirements of VCS rules are discussed in the following section. Hence RINA confirms that the monitoring procedure as given in the ME is sufficient and would ensure that the quantification does not lead to an overestimation of net GHG emission reductions.

3.10 Data and Parameters

Following are the Data and Parameters to be made available at Validation:

1. $ec_{Chlor\text{-}Alkali,\ y}$ the Energy consumption per ton of Cl_2 production ($MWh/tCl_{2)}$ The membrane cell process is the preferred process for new plants. Thus, it is assumed that production of Chlor-Alkali in the baseline plant is through membrane cell process /19/.

2. SSC_{CHPO} the Specific thermal energy consumption ratio in the PO production through CHPO process (TJ/ton of PO). Steam consumption is to be converted conservatively into energy terms using enthalpy values and accounting for any condensate return.

3. SEC_{CHPO} the Specific electrical energy consumption ratio in the PO production through CHPO process (MWh/ton of PO).

4. pe_{HP} the Quantity of CO_2 that would be emitted per ton of H_2O_2 (tCO_2/ tH_2O_2).

5. pe_{Sol} the Quantity of CO_2 that would be emitted per ton of Methanol (tCO_2/ ton of Methanol Solvent).

6. $ca_{Waste, Baseline}$ the Carbon amount in the waste stream combusted in the incinerator in the baseline per ton of PO(tC/ ton of PO).

7. $fc_{i,Baseline}$ the Quantity of fuel type i combusted in the incinerator in the baseline per ton of PO (mass or volume unit in baseline per ton of PO).

   All the above values are required to be sourced from Independent third party report from industry wide recognized technology analysis consultants.

Following are the Data and Parameters to be Monitored:

1. POy the Final quantity of PO produced in year y (tons) to be sourced from plant records measured with Flow-rate meters, mass meters and cross-checked with stock verification records. The data shall be continuously monitored and aggregate recording at least monthly, to calculate emission reduction. Meters should be calibrated regularly according to manufacturer's guidelines or national standards.

2. Sol_y the Quantity of make-up methanol solvent used in year y (tons) to be sourced from plant records measured with Flow-rate meters, mass meters and cross-checked with stock verification records. The data shall be continuously monitored and aggregate recording at least monthly, to calculate emission reduction. Meters should be calibrated regularly according to manufacturer's guidelines or national standards.

3. $EF_{EL,y}$ the Emission factor for electricity generation in year y (tCO_2/MWh), to be calculated using procedures in the latest approved version of the 'Tool to calculate the emission factor for an electricity system'.

4. $EF_{CO2, I, y}$ the Weighted average CO_2 emission factor of fuel type i in year (tCO_2/TJ) to be calculated using procedures in the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

5. $\eta_{Boiler,y}$ the Efficiency of the steam generating system to be determined as described in the "Tool to determine the baseline efficiency of thermal or electric energy generation systems".

6. $SC_{HPPO, y}$ the Thermal energy consumption in the PO production through HPPO process in year y to be sourced from plant records. This parameter should be determined as the difference of the enthalpy of the process heat (steam) supplied to PO production process in the project method, minus the enthalpy of the feed-water, the boiler blow-down and any condensate return. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure. The data shall be continuously monitored and aggregate recording at least monthly, to

calculate emission reduction. Meters should be calibrated regularly according to manufacturer's guidelines or national standards.

7. $EC_{HPPO,\ y}$ the Electrical energy consumption in the PO production through HPPO process in year y (MWh) to be sourced from plant records. Electrical consumption is to be monitored continuously aggregate recording at least monthly. The average specific electrical energy consumption to be calculated based on PO production. Meters should be calibrated regularly according to manufacturer's guidelines or national standards.

8. $Q_{Propylene,y}$ the Quantity of propylene used in year y (tons) sourced from plant records measured with Flow-rate meters, mass meters and cross-checked with stock verification records. The data shall be continuously monitored and aggregate recording at least monthly, to calculate emission reduction. Meters should be calibrated regularly according to manufacturer's guidelines or national standards.

9. $Q_{By\text{-}product,y}$ the Quantity of by-product produced in year y (tons) sourced from plant records measured with Flow-rate meters, mass meters and cross-checked with stock verification records. The data shall be continuously monitored and aggregate recording at least monthly, to calculate emission reduction. Meters should be calibrated regularly according to manufacturer's guidelines or national standards.

10. $FC_{i,y}$ the Quantity of fuel type i combusted in the incinerator during the year y (mass or volume unit/year). To be determined as described in the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

11. $COEF_{i,y}$ the CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit). To be determined as described in the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

The ME has identified all the data and parameters necessary and is consistent with the procedures and calculations as available in the ME to determine emission reductions. ME has also established criteria and procedures for monitoring, which includes, the Purpose of monitoring, monitoring procedures, including measurement and calculation approaches, Procedures for managing data quality and Monitoring frequency and measurement procedures. Hence RINA confirms that all the data and parameter to be made available at validation and the data and parameters to be monitored have been sufficiently captured in the ME and consistent with applicable VCS rules.

3.11 Use of Tools/Modules

For additionality demonstration and for elimination of alternatives not feasible, this methodology refers to the latest approved version of the CDM "Tool for the demonstration and assessment of additionality"

For parts of baseline and project emission calculations this methodology refers to elements of the latest approved version of the following CDM tools:

- Tool to calculate baseline, project and/or leakage emissions from electricity consumption;

- Tool to determine the baseline efficiency of thermal or electric energy generation systems;
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion.

The ME does not refer to any module.

RINA confirms that as detailed in section 3.3, 3.4 and 3.10 of this report, the tools referred above are used appropriately within the methodology element.

3.12 Adherence to the Project Principles of the VCS Program

RINA confirms that the proposed ME is developed in accordance with the requirements of VCS and adequately addresses the principles of relevance, completeness, consistency, accuracy, transparency, and conservativeness and will ensure that GHG-related information related to a project applying this ME is a true and fair account.

3.13 Relationship to Approved or Pending Methodologies

RINA verified VCS, CDM and GS websites /22/-/24/, currently there is no approved or pending methodology under the VCS Program or an approved GHG program that could reasonably be revised to meet the objective of the proposed methodology. The methods of estimation of Baseline emissions, project emissions and emission reductions used in the ME are similar to a few approved CDM methodologies, however totally unrelated. Hence RINA confirms requirement of the proposed ME to meet the objective.

3.14 Stakeholder Comments

In accordance with the VCS requirement, the methodology was open for public comment from 3-October-2012 until 1- November -2012. No stakeholder comments were received for the proposed ME /21/.

4 RESOLUTION OF CORRECTIVE ACTION REQUESTS AND CLARIFICATION REQUESTS

ASSESSMENT PROTOCOL

TABLE 1 REQUIREMENTS CHECKLIST

Checklist Question		Reference	MoV[1]	Comments	Conclusion
1.Title and description of Methodology Element (ME)					
1.1	Does the methodology title clearly enable the reader to identify the	/01/	DR/I	The title of the methodology is Reduction of GHG emissions in Propylene Oxide production, version 00, dated 05-September-2012.	OK

[1] MoV: DR document review, I interview, CC cross checking

Checklist Question		Reference	MoV[1]	Comments	Conclusion
	unique VCS methodology? Is there an indication of a revision number and the date of the revision?			Relevant and consistent throughout the ME. Moreover, the title clearly enable third person to identify the unique VCS methodology and hence accepted.	
1.2	Does the ME comply with the applicable requirements for completing the VCS-ME (latest version available)?	/01/ /06/	DR/ CC	*Version 3.3 of the methodology approval process has been used to prepare the methodology; a more recent version is available. ME developer is requested to clarify the appropriateness of using the version 3.3 of the methodology approval process document and its consistency with extant VCS rules.*	~~CL1~~ OK
1.3.	Does the VCS-ME comply with the template available (latest version)?	/01/ /10/	DR/ CC	*Version 3.1 has been used to prepare the methodology; a more recent version is available. The ME developer is requested to clarify the appropriateness of using the version 3.1 of the methodology template and its consistency with extant VCS rules.*	~~CL1~~ OK
1.4	Does the VCS-ME contain an accurate description and provide the reader with a clear understanding of the precise nature of the ME? How was this assessed? Does the ME state which type of method standardized method or a project method is used to determine additionality and/or the crediting baseline for each?	/01/ /02/ /11/ /12/ /13/ /14/ /15/	DR/ CC/ I	The ME is applicable to project activities that involve synthesis of propylene oxide using Hydrogen Peroxide-based Propylene Oxide (HPPO) Technology which is able to reduce GHG emissions and waste generation during PO synthesis when compared to Chloro-hydrin process and others processes where the output is only propylene oxide. The GHG emission reductions are owing to usage of lesser GHG intensive reagents and reduced process energy requirements. As the product is the same in both the baseline and project scenarios, down-stream emissions would be the same in both cases and have therefore not been considered. Thus this methodology proposes to consider only the up-stream and process emissions, which include heat, electricity requirements for the process and the energy requirement for waste treatment. ME explicitly states that the project method is used to determine additionality and the crediting baseline.	~~CL2~~ OK

Checklist Question		Reference	MoV[1]	Comments	Conclusion
				The ME description is not transparent on possible use of solvent in the process. The ME developer is requested to correct the ME as appropriate and submit evidences. *The ME mentions the baseline process to be Chlorohydrin process and Chlorohydrin- Chloro – Alkali process at a few places, ME developer is requested to keep this consistent throughout the ME.* *Evidences are required in support of statements made in project description, especially on* *1. the propylene oxide production statistics through various methods.* *2. the methods available to produce PO as the only product (may include by-products such as in the case of project activity)* *3. that the process Hydrogen Peroxide-based Propylene Oxide (HPPO) Technology will be able to reduce GHG emissions and waste generation during PO synthesis when compared to other processes by submitting evidences in support of assumptions made in the VCS-PD for project activity "Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd." in Thailand.* *4. that the process based on HPPO technology will result in GHG emission reductions owing to usage of lesser GHG intensive reagents and reduced process energy requirements by submitting evidences in support of assumptions made in the VCS-PD for project activity*	

Checklist Question		Reference	MoV[1]	Comments	Conclusion
				"Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd." in Thailand. *ME developer to clarify why an existing CDM / any VCS approved GHG program energy efficiency methodology cannot be directly or with revisions used in place of this ME. Also please clarify on how the ME could fall under sectoral scope 1, given that the ME does not involve energy generation, nor does it happen at an energy generation plant.*	
A.	**Applicability Conditions**				
A.1.	Does the ME transparently mention to which it applies and has established criteria that describe the conditions under which the methodology can (and cannot, if appropriate) be applied? Is the methodology applicable for all types of project like scale, Greenfield, capacity addition, retrofit and projects at different sites and grouped projects?	/01/ /04/	DR/ CC/ I	ME is not transparent on who will own the credits resulting from the project activity and how it avoids double counting as it involves a sort of life cycle analysis. However this is accepted and not raised as an issue as the reagents used in HPPO process and the output are available in open market and the emission factors for heat, electricity and waste treatment are arrived from appropriate and latest tools as prescribed by CDM. 1. *ME developer is requested justification on why processes producing co-products are not included?* 2. *ME developer is requested to provide justification on why by-products are not to be more than 10% of the PO output? ME Developer is requested to clarify whether it includes water (or any other waste) which may or may not be used or sold and generated during the reaction as evident in the ME.* 3. *ME developer is requested to make it transparent and justify on whether PO output refers to the final marketable product only? If so what*	~~CL3~~ OK

Checklist Question		Reference	MoV[1]	Comments	Conclusion
				about PO being an intermediate and consumed within the same project facility for synthesis of other compounds? ME is not transparent on how it would ensure that the product PO is identical in physical and chemical properties in comparison to PO produced by other methods and more so by the Chlorohydrin-Chlor-Alkali process. It is understood over discussion with the experts from MHMCL that the impurities present in the final product (whatsoever level) may vary with PO derived out of any other process including Chloro-hydrin process, ME developer is requested to clarify how this does not affect the commercial use of PO from HPPO process against PO from any other method 4. *ME Developer is requested to further make it transparent in the ME on what is a co-product and what is a by-product. The guideline for the Project owner to differentiate is not transparent.* 5. *The applicability of the ME is not transparent on the requirement of the project's ability to measure input; output and energy input and clearly differentiating (signal to noise ratio) it from the other operations in the facility and other activities not part of this project activity. The ME is not transparent on how the process improvements done during the crediting period and the other energy efficiency activities which may be carried out in the facility during the crediting*	

Checklist Question		Reference	MoV[1]	Comments	Conclusion
				period are isolated and measured? ME is not transparent on isolated measurement and monitoring of energy consumption due to shared facilities such as waste water treatment for example in a complex producing multiple products / intermediaries. 6. *The ME is not transparent on whether it is applicable for all types of project like scale, Greenfield, capacity addition, retrofit and projects at different sites and grouped projects.* 7. *ME is not transparent on how it would ensure that the output is only from this route of production, when there are more than one method of producing PO in the same facility.*	
A.2.	Does the ME refer to any tool or module? Does the ME refer to any applicability conditions set out in tools or modules used?	/01/ /04/ /16/ /17/ /18/	DR/I	The ME refers to the latest version of the following tools: Tool for the demonstration and assessment of additionality for determining the additionality of the project activity Tool to calculate baseline, project and/or leakage emissions from electricity consumption, and Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion, for baseline and project emission calculations as appropriate The ME does not refer to any module.	~~OK~~ OK
A.3.	How does the ME excludes, those classes of project activities that it can be reasonably assumed will be implemented without the intervention created by the carbon market?	/01/ /16/	DR/I	The latest version of Tool for the demonstration and assessment of additionality has been referred by the ME for determining the additionality of the project activity.	OK

Checklist Question		Reference	MoV[1]	Comments	Conclusion
A.4.	What is the geographical area to which the ME applies? How it is determined that it is conservative to apply data by considering the same factors across the geographical area chosen?	/01/ /04/	DR/ CC/ I	*The ME mentions that the project may take place in any geographic region of the world; ME developer to clarify whether it implies that it includes baseline emissions from all countries? If so, how it is determined that it is conservative to apply data by considering the same factors across the geographical area chosen?*	~~CL4~~ OK
B.	**Project boundary**				
B.1.	Does the ME establish criteria and procedures for describing the project boundary and identifying and assessing GHG sources, sinks and reservoirs relevant to the project and baseline scenarios? Is the justification for GHG sources, sinks and reservoirs included or excluded provided?	/01/ /04/	DR/ CC/ I	*ME developer is requested to justify and provide evidence in support for eliminating of N_2O and CH_4 in project emission and that it is conservative.* *The ME is not transparent on the emissions which may arise due to the possible use of solvent. The ME is not transparent on project emissions due to combustions of low boils and other waste gases generated and disposed from the HPPO process.*	~~CAR1~~ OK
B.2.	Does the methodology set out criteria and procedures for identifying and assessing GHG sources, sinks and reservoirs that are controlled by the project proponent, related to the project or affected by the project (i.e., leakage)?	/01/ /04/	DR/I	Leakage is not considered in the ME, upstream emissions due to use of reagents are accounted under project emissions and post production, the product as such (PO) is comparable to the PO derived out of any other process including Chloro-hydrin process. Hence considered appropriate. However please refer to section A.1 above	~~CL3~~ OK
B.3.	Does the ME where necessary, explain and apply additional criteria for identifying relevant baseline GHG sources, sinks and reservoirs? Does the ME compare the GHG sources, sinks and reservoirs	/01/ /04/	DR/I	Yes, the ME allows the project owner to choose to consider or not to consider the baseline and project emissions due to waste treatment if it is demonstrated that the waste generation in the HPPO process is lesser in quantity and carbon intensity as compared to baseline.	~~CAR1~~ OK

Checklist Question		Reference	MoV[1]	Comments	Conclusion
	identified for the project with those identified in the baseline scenario, to ensure equivalency and consistency?			However please refer to section B.1 above	
C.	**Procedure for determining the Baseline Scenario**				
C.1.	Does the ME determine criteria and procedures for identifying alternative baseline scenarios and determining the most plausible scenario?	/01/ /04/	DR/ CC/ I	*The ME considers the global PO production and considers any technology contributing to 1% of global PO production is to be a commercially plausible technology. However ME also mentions that alternatives giving equivalent output or services to be considered, thus inconsistent. Also, there is a chance that a project plant's capacity is less than that of 1% of global production. ME developer is requested to clarify the above.* *ME developer is requested to justify the logic behind considering 1% of global PO production statistics to be alternative available on commercial scale.* *The ME is not transparent on how it is conservative and appropriate to consider only processes of equivalent output and services to be alternatives to the project activity. ME developer to clarify whether the equivalent output refers to a range of comparable output, in terms of quality and quantity.* *The ME considers the plants (alternatives) giving equivalent output at the time of investment decision, the project developer is requested to clarify why the plants under implementation is not considered.*	~~CL5~~ OK
C.2	Is there any specific guidance, including the methodological tools has been applied?	/01/ /04/	DR	The baseline is established in three steps, Step 1 being identification of plausible alternatives. Step 2 being compliance to rules and regulations and the Step 3 being barrier analysis as per step 3 of additionality tool. *The ME developer is requested to justify why it does not give the option*	~~CL6~~ OK

Checklist Question		Reference	MoV[1]	Comments	Conclusion
				to the project developer to choose Step 2 of the additionality tool	
C.3.	How does the criteria take in to account the following: 1) The identified GHG sources, sinks and reservoirs. 2) Existing and alternative project types, activities and technologies providing equivalent type and level of activity of products or services to the project. 3) Data availability, reliability and limitations. 4) Other relevant information concerning present or future conditions, such as legislative, technical, economic, socio-cultural, environmental, geographic, site-specific and temporal assumptions or projections.	/01/, /04/	DR	The ME does not determine the baseline. It is to be determined at project level. However, this methodology is not applicable if Chlorohydrin-Chlor-Alkali process is not identified as the baseline.	OK
D.	**Procedure for demonstrating additionality**				
D.1.	In reference to paragraph 4.6.2 of the VCS standard, V3.3 what is the method adopted in the ME? Is it appropriate and complete?	/01/ /04/, /16/	DR	The additionality of the project activity is to be demonstrated using the latest version of the "Tool for the demonstration and assessment of additionality" agreed by the CDM Executive Board. Considering the different project alternatives as per the baseline identification section.	OK
E.	**Quantification of GHG emission reductions and removals**				
E.1	**Baseline emissions**				
E.1.1	Is the ME transparent and clear to the reader on the steps and equations applied to calculate the	/01/	DR/ CC/ I	Yes, Baseline emissions (BE_y) is a sum of Emissions associated with the baseline reagents ($BE_{Upstream,y}$) for the production of PO, (tCO_2), this is considered upstream emission due	OK

Checklist Question		Reference	MoV[1]	Comments	Conclusion
	baseline emissions?			to production of baseline reagents, and ; Emissions due to energy usage ($BE_{Process,y}$) heat, electricity, etc., for transforming the baseline reagents into the final product (PO) and also for waste and by-products treatment (tCO_2) considered as baseline emissions due to production on site. Hence $BE_y = BE_{Upstream,y} + BE_{Process,y}$.	
E.1.2	What are the components of baseline emissions? Is it appropriate and conservative?	/01/	DR/ CC/ I	$BE_y = BE_{Upstream,y} + BE_{Process,y}$. $BE_{Upstream,y}$ is calculated to be: $BE_{Upstream,y} = be_{Chlor\text{-}Alkali} \times PO_y$ Where: $be_{Chlor\text{-}Alkali,\ y}$ is the Quantity of CO_2 emitted from Chlor-Alkali production per unit of PO (tonnes) PO_y is the Quantity of PO produced in year y (tonnes) $be_{Chlor\text{-}Alkali}$ is calculated to be : $be_{Chlor\text{-}Alkali} = (71/58) \times ec_{Chlor\text{-}Alkali} \times EF_{EL,y}$. Where: $ec_{Chlor\text{-}Alkali,\ y}$ is the Energy consumption per ton of Cl_2 production (MWh/tCl_2) $EF_{EL,y}$ is the Emission factor for electricity generation in year y (tCO_2/MWh) calculated as per the requirements of the CDM "Tool to calculate the emission factor for an electricity system" 71/58 is the Ratio between the molecular weights of Cl_2 and C_3H_6O (mass units/mass units) Propylene is common reagent in both baseline and project scenarios, hence not considered, the other reagents used in baseline process are Chlorine and Sodium Hydroxide, among the process available to produce Chlorine and sodium hydroxide Membrane cell process is the least energy intensive, hence the	~~CL7~~ OK

Checklist Question		Reference	MoV[1]	Comments	Conclusion
				specific energy use for this process being 2.2MWh/ton is considered. Hence the equation becomes $be_{Chlor\text{-}Alkali}$=(71/58) x 2.2 MWh/ton x $EF_{EL,y.}$ *The ME is not transparent on the units for the value 2.2 used in equation 4 of ME.* *The process Chloro-Alkali produces both Cl_2 and NaOH, Hence energy consumption per ton/Cl_2 includes Sodium hydroxide produced and used in the baseline process as reagent. However this information is not transparent in the ME.* $BE_{Process,y}$ = $BE_{heat,y}$ + $BE_{Electricity,y}$ + $BE_{Waste,y}$ $BE_{heat,y}$ is calculated to be $BE_{heat,y} = SSC_{CHPO} \times PO_y \times EF_{Steam,y}$ Where: SSC_{CHPO} is the Specific thermal energy consumption ratio in the PO production through CHPO process (TJ/tonne of PO), value to be determined at the project level, using Independent third party report. $EF_{Steam,y}$ is the Emission factor for thermal energy generation in year y (tCO_2/TJ) is calculated as $EF_{Steam,y} = EF_{CO2,i.y} / \eta_{Boiler,y}$ Where: $EF_{CO2,i.y}$ is the Weighted average CO_2 emission factor of fuel type i in year y (tCO_2/TJ) calculated as per the CDM “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”. $\eta_{Boiler,y}$ is the Efficiency of the steam generating system calculated as per the CDM “Tool to determine the baseline efficiency of thermal or electric energy generation systems” .	

Checklist Question		Reference	MoV[1]	Comments	Conclusion
				However the use of this tool is not captured in section 1 of the ME. $BE_{elec,y}$ is calculated to be $BE_{elec,,y} = SEC_{CHPO} \times PO_y \times EF_{El,y}$ Where: SEC_{CHPO} is the Specific electrical energy consumption ratio in the PO production through CHPO process (MWh/tonne of PO) sourced from Independent third party report $EF_{El,y}$ is the Emission factor for electricity generation in year y (tCO_2/MWh) $BE_{Waste,y}$ is calculated to be $BE_{Waste,y} = (44/12) \times (CA_{Waste,\ Baseline}) + FC_{i,Baseline,} \times COEF_{,i}$ Where $CA_{Waste,\ Baseline}$ is the carbon amount in the waste stream derived from the carbon amount in the Propylene feed, PO and by-products in the baseline (tonnes). The carbon amount in the waste stream and fuel combusted in the incinerator is presented in terms of PO output. (44/12) is the ratio between the molecular weights of CO_2 and Carbon (mass units/mass units) $FC_{i,Baseline}$ is the Quantity of fuel type i combusted in the incinerator in the baseline (mass or volume unit/year) sourced from Independent third party report. $COEF_{,i}$ is the CO_2 emission coefficient of fuel type i (tCO_2/mass or volume unit) calculated as per the requirements of the CDM tool "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" For simplification, and as a conservative approach, the emissions linked to waste and by-products may be neglected, if credible data to estimate the same is	

Checklist Question		Reference	MoV[1]	Comments	Conclusion
				not available.	
E.1.3	Is there any assumption or use of default value? How it is determined to be conservative and appropriate across projects to which this ME is applicable? How uncertainty in estimates is properly addressed?	/01/, /19/	DR/ CC/ I	*The ME developer is requested to explain why only the value for* $ec_{Chlor\text{-}Alkali,\ y}$ *(Energy consumption per ton of* Cl_2 *production (MWh/t*Cl_2*)) is provided while all other values are to be justified at project level.* *The ME developer is requested to justify on how the value used 2.2MWh/t*Cl_2 *is conservative and appropriate across projects to which this ME is applicable and also detail on how the uncertainty in estimates is addressed.*	~~CL7~~ OK
E.2	**Project emissions**				
E.2.1	Is the ME transparent and clear to the reader on the steps and equations applied to calculate the project emissions?	/01/	DR/ CC/ I	Yes, project emissions is a sum of Emissions associated with the project reagents for the production of PO, (tCO_2) and Emissions due to energy usage (heat, electricity etc.) for transforming the project reagents into the final product (PO) and also for waste treatment (tCO_2) Hence $PE_{,y} = PE_{Upstream,y} + PE_{Process,y.}$	OK
E.2.2	What are the components of project emissions? Is it appropriate and conservative?	/01/	DR/ CC/ I	The reagents used in the project process are Propylene and Hydrogen Peroxide. Propylene is common reagent in both baseline and project scenarios, hence not considered, However *ME developer is requested to submit evidence that the specific consumption of propylene used in the baseline process and the project activity are equal or conservative.* Hence *project emissions upstream have been limited to Hydrogen Peroxide. As observed during onsite visit substantial amount of solvent (Methanol) is being used in the process; however the upstream emissions due to the same have not been considered, ME Developer is requested to clarify this.* $PE_{Upstream,y}$ is calculated to be	~~CAR2~~ ~~CAR1~~ OK

Checklist Question		Reference	MoV[1]	Comments	Conclusion
				$PE_{Upstream,y} = (34/58) \times pe_{HP} \times PO_y$ Where (34/58) is the Ratio between the molecular weights of H_2O_2 and C_3H_6O (mass units/mass units) pe_{HP} is the Quantity of CO_2 that would be emitted per ton of H_2O_2 (tCO_2/ tH_2O_2) sourced from independent third party report. However *ME Developer is requested to clarify on how this would be estimated as the Project Owner could source hydrogen peroxide from a different source at a different concentration for instance.* PO_y is the Quantity of PO produced (tonnes) $PE_{Process,y} = PE_{heat,y} + PE_{Electricity,y} + PE_{Waste,y}$ $PE_{heat,y}$ is calculated to be $PE_{heat,y} = SSC_{HPPO} \times PO_y \times EF_{Steam,y}$ Where: SSC_{HPPO} is the Specific thermal energy consumption ratio in the PO production through HPPO process (TJ/tonne of PO), *the method of calculating SSC_{HPPO} is not transparent in the ME.* $EF_{Steam,y}$ is the Emission factor for thermal energy generation in year y (tCO_2/TJ) is calculated as in the baseline scenario $PE_{elec,y}$ is calculated to be $PE_{elec,,y} = SEC_{HPPO} \times PO_y \times EF_{El,y}$ Where: SEC_{HPPO} is the Specific electrical energy consumption ratio in the PO production through HPPO process (MWh/tonne of PO) *the method of calculating SEC_{HPPO} is not transparent in the ME.*	

Checklist Question		Reference	MoV[1]	Comments	Conclusion
				$EF_{El,y}$ is the Emission factor for electricity generation in year y (tCO_2/MWh) is calculated as in the baseline scenario $PE_{Waste,y}$ is calculated to be $PE_{Waste,y}$ = (44/12) x ($CA_{Waste,y}$) + $FC_{i,y}$, x $COEF_{,I,y}$ Where $CA_{Waste,y}$ is the Carbon amount in the waste stream derived from the carbon amount in the Propylene feed, PO and by-products during year y of the crediting period (tonnes), by Ultimate analysis of PO and by-products, however *the ME is not transparent on who would conduct this analysis. Also the ME is not transparent on how the carbon amount in solvent make-up is taken in to account* (44/12) is the ratio between the molecular weights of CO_2 and Carbon (mass units/mass units) $FC_{i,y}$ is the Quantity of fuel type i combusted in the incinerator during the year y (mass or volume unit/year) to be sourced as described in the CDM "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" $COEF_{,i}$ is the CO_2 emission coefficient of fuel type i (tCO_2/mass or volume unit) calculated as per the requirements of the CDM tool "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" For simplification, the emissions associated with treatment of waste coming out of the project process may be excluded if it can be demonstrated that waste generation is lesser in quantity and carbon intensity as compared to baseline and assuming that the fossil fuel consumed in the incinerator is the	

Checklist Question		Reference	MoV[1]	Comments	Conclusion
				same as in the baseline. However *the ME is not transparent on whether the non-availability of credible data to estimate baseline emissions linked to waste could be a reason for not considering the Project emissions due to carbon amount in waste.* Also, please refer to section B.1	
E.2.3	Is there any assumption or use of default value? How it is determined to be conservative and appropriate across projects to which this ME is applicable? How uncertainty in estimates is properly addressed?	/01/	DR/ CC/ I	No, all the values used in project emissions are to be determined at project level	OK
E.3	**Leakage**				
E.3.1	Is leakage to be determined and the project activity? How it is accepted?	/01/	DR/ CC/ I	Leakage is not considered in the ME; please refer to section B.2 above.	~~CL3~~ OK
E.4	**Emission reductions**				
E.4.1	Is the ME transparent and clear to the reader on the steps and equations applied to calculate the Emission reductions?	/01/	DR/ CC/ I	Yes, However please refer to section E.1, E2 and E3 above	~~CAR 2~~ ~~CL 7~~ OK
E.4.2	Is the ME transparent on emission reduction calculations for ex-ante and ex-post scenarios?	/01/	DR/ CC/ I	Yes, However please refer to section E.1, E2 and E3 above	~~CAR 2~~ ~~CL 7~~ OK
E.4.3	Is it appropriate and consistent with the calculation of baseline, project and leakage emissions discussed above?	/01/	DR/ CC/ I	Yes, However please refer to section E.1, E2 and E3 above	~~CAR 2~~ ~~CL 7~~ OK
F.	**Monitoring**				
F.1	**Data and Parameters available at Validation**				

Checklist Question		Reference	MoV[1]	Comments	Conclusion
F.1.1	Does the ME contain the list of all parameters to be available at the time of validation? Is the ME transparent on necessity of documenting Parameters as required by applicable tools?	/01/	DR/ CC/ I	*Please refer to section E above.* *$ec_{Chlor\text{-}Alkali,\ y}$ is the Energy consumption per ton of Cl_2 production (MWh/tCl_2) is not available as a parameter available at Validation, ME developer is requested justification.* *The parameter $SC_{HPPO,\ y}$ mentions that the process heat (steam) supplied to PO production process in the baseline method, ME developer is requested clarification.* *ME mentions specific energy consumption(s) to be sourced from independent third party report. ME developer to justify on why the ME cannot give default values.* *ME developer to clarify on why the ME does not permit to accept historical data from the project owner, in case it is available and credible.* *ME is not transparent on what could be the source of data for the third party report and guideline on selection of such a third party.* *ME is not transparent on necessity of documenting Parameters as required by applicable CDM tools*	~~CL8~~ OK
F.1.2	Which default data have been selected and applied? Are the values used conservative? How it is ensured that the quantification does not lead to an overestimation of net GHG emission reductions or removals?	/01/	DR/ CC/ I	*Please refer to section E.1.3*	~~CL8~~ OK
F.2	**Monitoring plan : Data and Parameters monitored**				
F.2.1	Does the ME contain the list of all parameters required to be monitored? Is the ME transparent	/01/	DR/ CC/ I	*Please refer to section E above.* *Amount of waste and amount of by-products not included as monitoring parameters, also it is not clear on why the ME requires and how CA by*	~~CAR3~~ OK

Checklist Question		Reference	MoV[1]	Comments	Conclusion
	on necessity of documenting Parameters as required by applicable tools?			*products and CA waste can be monitored continuously.* *ME is not transparent on necessity of documenting Parameters as required by applicable CDM tools*	
F.2.2	Is the ME transparent on the : 1) Purpose of monitoring. 2) Monitoring procedures, including estimation, modeling, measurement or calculation approaches. 3) Procedures for managing data quality 4) Monitoring frequency and measurement procedures	/01/	DR/ CC/ I	*The ME is not transparent on the purpose of monitoring for each parameter, especially for $SC_{HPPO,\ y}$ and $EC_{HPPO,\ y}$.* *ME is not transparent on the recording frequencies of the parameters to be monitored.*	~~CAR3~~ OK
G.	**Reference and other information**				
G.1	Is the ME transparent on all the references and other information used in the ME as applicable?	/01/ /16/ /17/ /18/ /19/	DR/I	Yes, the ME refers to the CDM tools as discussed above. The value $ec_{Chlor\text{-}Alkali,\ y}$ the Energy consumption per ton of Cl_2 production (MWh/tCl_2) has been sourced from the website http://www.miga.org/documents/ChlorAlkali.pdf transparent in the ME. *$\eta_{Boiler,y}$ is the Efficiency of the steam generating system calculated as per the CDM "Tool to determine the baseline efficiency of thermal or electric energy generation systems" . However the use of this tool is not captured in section 1 of the ME.*	~~CL7~~ OK

TABLE 2: RESOLUTION OF CORRECTIVE ACTION REQUESTS AND CLARIFICATION REQUESTS

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
CAR 1 1. ME developer is requested to justify and provide evidence in support for eliminating of N_2O and CH_4 in project emission and that it is conservative.	B.1, E.2.2	1. The methodology does not include N_2O and CH_4 in baseline as well as project emissions. Though there could be CH4 and N2O emissions due to combustion of fuels during the production of baseline/project reagents, steam & electricity generation and incineration of waste, nevertheless, it will be a minor emission source (Please also refer to other approved CDM methodologies: ACM0002, AM0018 etc.). Further, since these emissions are higher in the baseline therefore the exclusion is conservative.	1. Given that the basis of the methodology is that there is reduced energy consumption in the project activity against the baseline practice, the explanation given by the ME developer is sufficient, hence accepted.
The ME is not transparent on the emissions which may arise due to the possible use of solvent. The ME is not transparent on project emissions due to combustions of low boils and other waste gases generated and disposed from the HPPO process.		2. The methodology has been revised to account for the possible use of methanol as solvent (make-up) in the project emissions. The incineration of the waste accounts for project emissions due to combustions of low boils and other waste gases generated and disposed from the HPPO process.	2. The ME has been revised appropriately and consistent with the response here, hence accepted CAR 1 is closed.
CAR2 1. ME developer is requested to submit evidence that the specific consumption of propylene used in the baseline process and the project activity are equal or conservative.	E.2.2	1. The amount of Propylene required in the baseline CHPO process is slightly higher as compared to the HPPO process. However, for simplicity and conservativeness, the specific consumption of propylene used in the baseline process and the	1. Verified Nexant report, consistent with the response. Hence accepted.

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
		project activity are considered to be equal. Please refer to the attached Nexant report (page 74-76) on Propylene Oxide as evidence.	
2. Project emissions upstream have been limited to Hydrogen Peroxide. As observed during onsite visit substantial amount of solvent (Methanol) is being used in the process; however the upstream emissions due to the same have not been considered, ME Developer is requested to clarify this .		2. The methodology has been revised to account for the usage of methanol as solvent in the process. The emissions associated with the make-up methanol (replenishment of methanol lost) are now included as part of upstream emissions.	2. The ME has been revised appropriately and consistent with the response here, hence accepted
3. pe_{HP} is the Quantity of CO_2 that would be emitted per ton of H_2O_2 (tCO_2/ tH_2O_2) sourced from independent third party report. However ME developer is requested to clarify on how this would be estimated as the project owner could source hydrogen peroxide from a different source at a different concentration for instance.		3. It can be noted that H2O2 is one of the key reagent apart from propylene in the HPPO process. A H2O2 facility is usually associated with the HPPO facility as transporting large quantities of H2O2 over a long distance is prohibitory. Therefore the source remains fixed. Also owing to contractual relationship the concentration too is not expected to vary. 2nd response Please refer to the submitted Nexant report, as per the same, the amount of H2O2 (100% basis) required is 0.6021 tons per ton of PO to be produced. Hence for 430 kilotons per annum of PO,	3. Justification is accepted, however the ME developer is requested to submit evidences in support of the statements made here. 2nd response: ME developer's response is appropriate and consistent with the nexant report and the interview had during site visit, hence accepted.

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
		the amount of H2O2 would translate to around 30 tons per hour. Transporting such quantities of H2O2 will have commercial risks thereby prohibitory. A co-located H2O2 plant avoids the transport costs and inherent safety issues (Page 49, Nexant report).	
4. The method of calculating SSC_{HPPO} is not transparent in the ME.		4. For ex-ante estimation of project emissions owing to steam consumption the presentation has been made in terms of specific steam consumption (SSC_{HPPO}) and thereby linking it to PO production (TJ/ton of PO). For ex-post calculation instead of specific the total steam consumption ($SC_{HPPO, y}$) is a monitoring parameter. 2nd response The methodology has been revised for further clarity. The following sentence has been included: For ex-post calculation instead of specific (SSC_{HPPO}) the total steam consumption ($SC_{HPPO, y}$) is a monitoring parameter.	4. This is not transparent in the ME. 2nd response: The ME has been revised appropriately, hence accepted.
5. The method of calculating SEC_{HPPO} is not transparent in the ME.		5. Similar to the above explanation for specific steam consumption (SSC_{HPPO}) the specific electricity consumption (SEC_{HPPO}) too is for ex-ante estimation (MWh/ton of PO). For ex-post the electricity consumption ($EC_{HPPO, y}$) is monitored.	5. This is not transparent in the ME.

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
		2nd response The methodology has been revised for further clarity. The following sentence has been included: For ex-post calculation instead of specific (SEC_{HPPO}) the total electricity consumption ($EC_{HPPO, y}$) is a monitoring parameter.	2nd response: The ME has been revised appropriately, hence accepted.
6. $CA_{Waste,y}$ is the Carbon amount in the waste stream derived from the carbon amount in the Propylene feed, PO and by-products during year y of the crediting period (tonnes), by Ultimate analysis of PO and by-products, however the ME is not transparent on who would conduct this analysis. Also the ME is not transparent on how the carbon amount in solvent make-up is taken in to account		6. The methodology has been revised addressing the concern raised. Also the carbon amount in the solvent has been inducted in the equation. Further the monitoring parameters have been revised to arrive at the carbon quantum in the waste stream. 2nd response The methodology has been revised for further clarity. The carbon amount in the waste stream ($CA_{waste,y}$) derived from the carbon amount in the solvent has also been included.	6. The ME has been revised appropriately, however, this is not transparent in the explanation of $CA_{waste,y}$ below equation 16 of the revised ME. 2nd response: ME has been edited appropriately, hence accepted.
7. ME is not transparent on whether the non-availability of credible data to estimate baseline emissions linked to waste could be a reason for not considering the Project emissions due to carbon amount in waste.		7. The methodology accounts for the emissions arising from waste.	7. OK, this explanation is given under process emissions in baseline, hence may be neglected, not considering the same is conservative. Methodology however accounts for emissions arising from waste in the project scenario, conservative hence accepted. CAR 2 is closed.
CAR3 Amount of waste and	F.2.1	1. The methodology has	1. Revision is appropriate,

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
amount of by-products not included as monitoring parameters, also it is not clear on why the ME requires and how CA by products and CA waste can be monitored continuously.	F.2.2	been revised addressing the concern raised. The monitoring parameters have been revised to arrive at the carbon quantum. 2nd response The methodology has been revised for further clarity. With methanol as the solvent the only byproduct is Monopropyleneglycol.	however the ME developer is requested to confirm whether there would be only one by product in this process. 2nd response ME has been edited appropriately, hence accepted
ME is not transparent on necessity of documenting Parameters as required by applicable CDM tools		2. The relevant parameters as required by the tools applied/referred have been included in the methodology. Further this is in line with the other approved CDM methodologies wherein reference to the tools is given as the tools provide various options and are subject to revisions. Nevertheless, the methodology has been revised to include the applicability conditions of the tools applied.	2. The ME has been appropriately revised, hence accepted.
The ME is not transparent on the purpose of monitoring for each parameter, especially for $SC_{HPPO,y}$ and $EC_{HPPO,y}$		3. As explained earlier, although for ex-ante estimation of emission reduction the specific steam and electricity consumption values have been used, for ex-post the monitored values corresponding to $SC_{HPPO,y}$ and $EC_{HPPO,y}$ will be used. 2nd response The methodology has been revised for further clarity. It has been indicated that for ex-post calculation instead of	3. This is not transparent in the ME. 2nd response ME has been appropriately revised, hence accepted.

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
		specific ($SSC_{HPPO,}$ SEC_{HPPO}) the total steam/electricity consumption ($SC_{HPPO,\ y,}$ $EC_{HPPO,\ y}$) is a monitoring parameter respectively. 4. The revised methodology includes the recording frequencies of the parameters to be monitored.	4. Revision is complete, hence accepted. CAR3 is closed.
ME is not transparent on the recording frequencies of the parameters to be monitored.			
CL 1 Version 3.3 of the methodology approval process has been used to prepare the methodology; a more recent version is available. ME developer is requested to clarify the appropriateness of using the version 3.3 of the methodology approval process document and its consistency with extant VCS rules.	1.2, 1.3	1. There is no change in the methodology owing to the update to version 3.4 of the methodology approval process.	1. Cross checked with the revised ME. Response is appropriate, hence accepted.
Version 3.1 has been used to prepare the methodology; a more recent version is available. The ME developer is requested to clarify the appropriateness of using the version 3.1 of the methodology template and its consistency with extant VCS rules.		2. There is no change in the methodology owing to this update. Nevertheless, the methodology has been upgraded using the latest available methodology template version 3.2.	2. ME has been revised appropriately, hence accepted. CL1 is closed.
CL2 1. The ME description is not transparent on possible use of solvent in the process. The ME developer is requested to correct the ME as	1.4	1. Please refer to response provided in CAR-2 (2).	1. Please refer to evaluation of CAR-2 (2). However ME developer is requested to confirm whether Methanol is the only solvent which could be used or the ME should be modified to accept on any other alternate solvent

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
appropriate and submit evidences.		2nd response Please refer to the submitted Nexant report (page 50). The process has been designed using Methanol as the solvent.	is used in the process. 2nd response Response is consistent with nexant report and the PDD has been revised to make this transparent, hence accepted.
2. The ME mentions the baseline process to be Chlorohydrin process and Chlorohydrin- Chloro – Alkali process in a few places, ME developer is requested to keep this consistent throughout the ME.		2. The methodology explicitly presents in the applicability conditions and the baseline determination too that the baseline process is Chlorohydrin-Chlor-Alkali process.	2. ME is revised appropriately, hence accepted.
3. Evidences are required in support of statements made in project description, especially on a. the propylene oxide production statistics through various methods. b. the methods available to produce PO as the only product (may include by-products such as in the case of project activity)		3. The supporting evidences for the statements are being submitted herewith: - Nexant report on Propylene Oxide, PERP 07/08-6. - SRI report on PO by the BASF-DOW process.	3. The evidence submitted supports the statement made in project description, hence accepted. Point 3. (a)-(b) closed.
c. that the process Hydrogen Peroxide-based Propylene Oxide (HPPO) Technology will be able to reduce GHG emissions and waste generation during PO synthesis when compared to other processes by submitting evidences		2nd response The revised PD and ER calculation sheets are being submitted herewith.	ME developer is requested to submit the revised PDD and ER calculation sheets and its evidences for cross check. 2nd response VCS PD dated 09-December-2012 and ER sheet dated 19-December -2012 are submitted. The input values used have

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
in support of assumptions made in the VCS-PD for project activity "Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd." in Thailand.			been justified and the Project is able to achieve significant emission reductions. Emissions due to fossil fuel firing in the project waste incinerator has not been considered as the low boils from the methanol distillation column is used as a fuel in incinerator and is already accounted under PE waste, hence accepted. It is to be noted that detailed validation of all these parameters used in the VCS-PD and ER sheet have not been carried out as it is not part of the ME assessment.
d. that the process based on HPPO technology will result in GHG emission reductions owing to usage of lesser GHG intensive reagents and reduced process energy requirements by submitting evidences in support of assumptions made in the VCS-PD for project activity "Reduction of GHG Emissions in Propylene Oxide Production at MTP HPPO Manufacturing Co., Ltd." in Thailand.		2nd response The revised PD and ER calculation sheets along with evidences for cross-check are being submitted herewith.	ME developer is requested to submit the revised PDD and ER calculation sheets and its evidences for cross check. 2nd response: VCS PD dated 09-December-2012 and ER sheet dated 19-December -2012 are submitted. The input values used have been justified. Upstream emissions due to use of Methanol has been considered as zero as it is likely to originate from renewable source. This assumption has been accepted as the maximum CO_2 emissions due to production of methanol as detailed in table 3.12 of Chapter 3 of 2006, IPCC guidelines for National Greenhouse Gas Inventories is 5.285 tCO_2/tMethanol and still the project reduces emissions

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
			compared to baseline levels. hence accepted. It is to be noted that detailed validation of all these parameters used in the VCS-PD and ER sheet have not been carried out as it is not part of the ME assessment.
4. ME developer to clarify why an existing CDM / any VCS approved GHG program energy efficiency methodology cannot be directly or with revisions used in place of this ME. Also please clarify on how the ME could fall under sectoral scope 1, given that the ME does not involve energy generation, nor does it happen at an energy generation plant.		4. The existing CDM and VCS methodologies have been checked and none have been found to fully address the GHG emissions and emission reduction calculations associated with the project activity. Sectoral scope 1 has been removed.	4. Cross checked VCS, CDM and GS websites, consistent with response, hence accepted. CL 2 is closed
CL3 1. ME developer is requested justification on why processes producing co-products are not included?	A.1, B.2, E.3.1	1. The processes producing co-products are not included for the reason that the output intended from the project activity is only PO.	1. Accepted as it is the same as in baseline scenario.
2. ME developer is requested to provide justification on why by-products are not to be more than 10% of the PO output? ME Developer is requested to clarify whether it includes water (or any other by-product) which may or may not be used or sold and generated during the		2. The quantification has been done intentionally as at times the distinction between by-products and co-products is difficult. Further, it has been clarified that water is neither considered as a co-product nor by-product.	2. OK, justification provided is consistent with the interview had with the process owner during site visit, hence accepted. ME has been revised appropriately, hence accepted.

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
reaction as evident in the ME.			
3. ME developer is requested to make it transparent and justify on whether PO output refers to the final marketable product only? If so what about PO being an intermediate and consumed within the same project facility for synthesis of other compounds? ME is not transparent on how it would ensure that the product PO is identical in physical and chemical properties in comparison to PO produced by other methods and more so by the Chlorohydrin-Chlor-Alkali process. It is understood over discussion with the experts from MHMCL that the impurities present in the final product (whatsoever level) may vary with PO derived out of any other process including Chloro-hydrin process, ME developer is requested to clarify how this does not affect the commercial use of PO from HPPO process against PO from any other method		3. PO output refers to the final output as no intermediate is taken out and is rather put back into the system or comes out as waste or by-product. Further all the emissions are accounted to the final PO output. Regarding the various technologies for PO manufacturing please refer to the submitted Nexant report on PO. 2nd response For further clarity, the methodology has been revised. The monitoring plan now refers to the final quantity of PO produced.	3. ME is not transparent that PO output refers to the final output only The nexant report clarifies the various technologies for PO manufacturing and do not differentiate between them on final product. Further at the project level, the ME ensures that only processes of equivalent output and services are to be considered as alternatives to the project activity, which ensures that PO from baseline process and the project activities are equivalent and have same applications. 2nd response ME has been appropriately revised, hence accepted.
4. ME Developer is requested to further make it transparent in		4. The methodology already defines the co-product and by-product	4. The definition for co-product and by-product is available in the ME, also a

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
the ME on what is a co-product and what is a by-product. The guideline for the Project owner to differentiate is not transparent.		and various examples of PO technologies which give co-products have been included.	10% limit is given to differentiate, hence accepted.
5. The applicability of the ME is not transparent on the requirement of the project's ability to measure input; output and energy input and clearly differentiating (signal to noise ratio) it from the other operations in the facility and other activities not part of this project activity? The ME is not transparent on how the process improvements done during the crediting period and the other energy efficiency activities which may be carried out in the facility during the crediting period are isolated and measured? ME is not transparent on isolated measurement and monitoring of energy consumption due to shared facilities such as waste water treatment for example in a complex producing multiple products /intermediaries.		5. To address the concern of signal to noise ratio, the following note has been included in the methodology: 'In case there is a retrofit in the plant, implemented during crediting period, having an effect on the energy (steam and/or electricity) consumption of the project activity, the project proponents should submit a deviation on how such retrofit is monitored to estimate its effect on emission reduction.' This kind of approach has been indicated in the approved CDM methodology AM0018.	5. This condition may not be sufficient, because this may be acceptable during crediting period of the project activity, but an energy efficiency measure could be included in the project design itself. For instance if incinerators are used in the baseline and the project activity. Waste heat recovery in the project incinerator could be included by design itself (not post registration of project activity). The energy saving here is not due to process change. Hence it becomes important to know whether the baseline incinerator also has a waste heat recovery unit, going in to such details would complicate the issue. Hence it is important that the ME makes it clear on the project's ability to measure input; output and energy input and clearly differentiating (signal to noise ratio) it from the other operations in the facility and other activities not part of this project activity Also the response is not transparent on the query requiring isolated measurement and monitoring of energy consumption due to shared facilities such as waste water treatment for example in a complex producing

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
			multiple products /intermediaries.
		2nd response It can be noted that the baseline is based on independent third party report from industry wide recognized technology analysis consultants. These information sources are likely to get updated based on the current scenario prevalent in the sector. Further, for the project activity, measures which are part of the initial design would result in appropriate change in the specific energy consumption. Moreover, the monitoring parameters clearly spell out that the energy consumption through HPPO process is to be monitored. Site specific details/deviations (if any) are supposed to get addressed during validation/verification.	2nd response Explanation given by the ME developer is consistent with the interview had during site visit. Hence accepted.
6. The ME is not transparent on whether it is applicable for all types of project like scale, Greenfield, capacity addition, retrofit and projects at different sites and grouped projects.		6. The methodology is applicable to only Greenfield projects. This has also been included as an eligibility criterion.	6. ME has been revised appropriately, hence accepted.
7. ME is not transparent on how it would ensure that the output is only from this route of production, when there are more than		7. Please refer to earlier response; the methodology is only applicable to Greenfield projects.	7. Accepted as this is to be ensured at project level. The ME as such is clear that it is applicable only for green field projects.

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
one method of producing PO in the same facility.			CL3 is closed.
CL4 The ME mentions that the project may take place in any geographic region of the world; ME developer to clarify whether it implies that it includes baseline emissions from all countries? If so, how it is determined that it is conservative to apply data by considering the same factors across the geographical area chosen?	A.4	The methodology could be applied to a project happening in any part of the world; nevertheless, baseline emissions are calculated based on specific local conditions accounting for the fuel types and resource availability. This ensures that conservative assumptions are taken while fixing the baseline parameters ex-ante ($SSC_{CHPO,}$ SEC_{CHPO}).	Since no default values are used and it is left to be determined at project level, the geographical area chosen is conservative. CL4 is closed.
CL5 1. The ME considers the global PO production and considers any technology contributing to 1% of global PO production are to be a commercially plausible technology. However ME also mentions that alternatives giving equivalent output services to be considered, thus inconsistent. Also, there is a chance that a project plant's capacity is less than that of 1% of global production. ME developer is requested to clarify the above.	C.1	1. It can be noted that the limit of 1% is set for identifying commercially plausible technology. Please refer to the attached Nexant report (Figure 1.1, page 1) for the PO capacity share by technology type. The common practice analysis carried out for the project accounts for the +/- 50% capacity for the project activity. Thus there is no inconsistency with regards to this issue. 2nd response The methodology has been revised to address the concern. The 1% clause has been deleted.	1. The query is on identification of alternatives and not on common practice. ME developer is requested to clarify this inconsistency. 2nd response ME has been appropriately revised, hence accepted.
2. ME developer is requested to justify the logic behind		2. It can be noted that the limit of 1% is set for identifying commercially	2. Verified Nexant report, consistent with ME's response. The information

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
considering 1% of global PO production statistics to be alternative available on commercial scale.		plausible technology. Please refer to the attached Nexant report (Figure 1.1, page 1) for the PO capacity share by technology type. The lowest share by CHP (Sumitomo) is 3.7%. Therefore setting the limit to 1% is still conservative and reasonable.	on PO processes is also available in public domain. Hence accepted.
3. The ME is not transparent on how it is conservative and appropriate to consider only processes of equivalent output and services to be alternatives to the project activity. ME developer to clarify whether the equivalent output refers to a range of comparable output, in terms of quality and quantity.		3. The only output intended is PO in terms of quality and quantity from the process (no co-products). For further clarity, the same has been included in the revised methodology.	3. As this ME is related to production of a process chemical, it is important that the project produces equivalent output as that of baseline scenario, hence accepted to have the same applications post production. Hence the revision done is appropriate.
4. The ME considers the plants (alternatives) giving equivalent output at the time of investment decision, the project developer is requested to clarify why the plants under implementation is not considered.		4. The methodology considers the plants (alternatives) giving equivalent output at the time of investment decision, the plants under implementation are not considered. This is in-line with the Additionality tool too, wherein, in the common practice analysis the following is indicated: 'Provide an analysis of any other activities that are **operational** and that are similar to the proposed project activity.' 2nd response The methodology has been revised to be in-line with paragraph 22 of the additionality tool version	4. Identification of alternatives is different from common practice analysis. Please see paragraph 22 of the additionality tool version 7.0.0, alternatives to be considered should be of "….comparable quality, properties and application areas as the proposed CDM project activity and that have been implemented previously or are currently being introduced in the relevant country/region" 2nd response ME has been appropriately revised, hence accepted.

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
		7.0.0.	CL5 is closed.
CL6 The ME developer is requested to justify why it does not give the option to the project developer to choose Step 2 of the additionality tool	C.2	The methodology has been revised to include step 2 of the Additionality tool for baseline scenario determination.	ME has been revised appropriately to include step 3 and step 2 to identify most plausible baseline scenarios. CL6 is closed.
CL7 1. The ME is not transparent on the units for the value 2.2 used in equation 4 of ME.	E.1.2, E.1.3, G.1	1. The units of the value 2.2 is MWh/ton of Chlorine, the same is also indicated in the methodology.	1. The units were MWh/ton and MWh/ton of Chlorine in the same sentence. This inconsistency had to be corrected and this was already discussed during onsite review. Anyway this is now deleted from the ME, hence accepted.
2. The process Chloro-Alkali produces both Cl_2 and NaOH, Hence energy consumption per ton/Cl_2 includes Sodium hydroxide produced and used in the baseline process as reagent. However this information is not transparent in the ME.		2. It can be noted that the equation 3 in the methodology has been presented in terms of Chlorine and PO. Therefore, the energy consumption too is linked to Chlorine. The justification has been included in the methodology for clarity.	2. ME has been revised appropriately, hence accepted.
3. $\eta_{Boiler,y}$ is the Efficiency of the steam generating system calculated as per the CDM "Tool to determine the baseline efficiency of thermal or electric energy generation systems" . However the use of this tool is not captured in section 1 of the ME.		3. The methodology has been revised to include the reference to the said tool in section 1.	3. Revision is complete hence accepted.
4. The ME developer is requested to explain why only the value for $ec_{Chlor\text{-}Alkali,y}$ (Energy consumption per ton of		4. It can be noted that chlor-alkali process involves electrolysis and is not as complex as compared to PO	4. This is not an acceptable justification as if it is not complex to determine the same then it is better it is justified at project level only.

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
Cl_2 production (MWh/tCl_2)) is provided while all other values are to be justified at project level.		production wherein steam and electricity is used in various intermediate processes, thereby leading to possibility of optimization. Thus the baseline parameters corresponding to steam and electricity ($SSC_{CHPO,}$ SEC_{CHPO}) have not been defined at the methodology level rather are to be justified at project level based on latest available information. 2nd response For further clarity, the methodology has been revised. The specific numbers pertaining to baseline chlor-alkali process will be defined at project level.	2nd response ME has been appropriately revised, hence accepted.
5. The ME developer is requested to justify on how the value used $2.2MWh/tCl_2$ is conservative and appropriate across projects to which this ME is applicable and also detail on how the uncertainty in estimates is addressed.		5. It has been clearly indicated in the methodology that of the two technologies for chlor-alkali process (diaphragm cell and membrane cell) the later is the preferred process for new plants and has lower energy consumption and conservatively the lower value of the range is to be used. 2nd response For further clarity, the methodology has been revised. The specific numbers pertaining to chlor-alkali process has been deleted.	5. Please refer to point 4 above. 2nd response ME has been appropriately revised, hence accepted. CL7 is closed.
CL8 1. $ec_{Chlor\text{-}Alkali,\ y}$ is the Energy consumption	F.1.1	1. The said parameter has now been included in	1. OK however please refer to CL8 point 4 and 5.

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
per ton of Cl_2 production (MWh/tCl_2) is not available as a parameter available at Validation, ME developer is requested justification.	F.1.2	section 9.1 of the revised methodology.	
2. The parameter $SC_{HPPO,y}$ mentions that the process heat (steam) supplied to PO production process in the baseline method, ME developer is requested clarification.		2. This is a typographical error and has been corrected. It should be read as project instead of baseline.	2. ME has been revised appropriately, hence accepted.
3. ME mentions specific energy consumption(s) to be sourced from independent third party report. ME developer to justify on why the ME cannot give default values.		3. As indicated earlier, since this methodology is applicable to Greenfield projects the data will be based on latest available independent third party report from industry wide recognized technology analysis consultants for baseline setting.	3. Justification is appropriate, ME has been revised for this change, hence accepted.
4. ME developer to clarify on why the ME does not permit to accept historical data from the project owner, in case it is available and credible.		4. As indicated earlier, since this methodology is applicable to Greenfield projects the data will be based on latest available independent third party report from industry wide recognized technology analysis consultants for baseline setting. 2nd response Capacity additions are not envisaged for such projects.	4. Capacity additions could also be considered as green field projects, ME developer is requested clarification. 2nd response ME has been revised to bring in clarity, hence accepted.
5. ME is not transparent on what could be the source of data for the third party report and guideline on selection of such a third party.		5. The methodology does not prescribe any particular source or guideline for the third party. However for further clarity it has been	5. Justification is appropriate, ME has been revised for this change, hence accepted.

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Assessment Conclusion
		included that the independent 3rd party should be an industry wide recognized technology analysis consultant. It will have to be assessed by the VVB at the time of project validation.	
6. ME is not transparent on necessity of documenting Parameters as required by applicable CDM tools		6. The parameters to be monitored as per the applied tool will depend upon the respective options chosen at project level. Thus only the tools have been mentioned rather than replicating the whole list from the applied tool. This is an accepted approach as can be seen from other approved CDM methodologies (e.g., ACM0002)	6. Consistent with the approach used in methodologies ACM0002, hence accepted. CL8 is closed.

5 ASSESSMENT CONCLUSION

RINA Services Spa (RINA) has performed the first assessment of the proposed Methodology Element "Reduction of GHG emissions in Propylene Oxide production", with regard to the relevant requirements for VCS. The Methodology Element provides procedures for monitoring and calculating emission reductions associated with the manufacture of propylene oxide through HPPO process against the baseline practice of conventional Chlorohydrin Process. The proposed methodology belongs to Sectoral Scope 5 – Chemical Industries.

The methodology assessment was conducted using the VCS Standard, v3.3 and the VCS Methodology Approval Process, Version 3.4 as the criteria. Additionally, RINA followed guidance in the VCS Program Guide, Version 3.4 and applied its professional judgment in assessing the proposed methodology. The reviews of the proposed Methodology element and the subsequent follow-up interviews have provided RINA with sufficient evidence to determine the fulfillment of the stated criteria.

By description of the proposed Methodology element, the ME is applicable to project activities that involve synthesis of propylene oxide using Hydrogen Peroxide-based Propylene Oxide (HPPO) Technology which is able to reduce GHG emissions and waste generation during PO synthesis when compared to other processes. The GHG emission reductions are owing to usage of lesser GHG intensive reagents and reduced process energy requirements. Hence would result in reduction of CO_2 emissions that are real, measurable and give long-term benefits to the mitigation of climate change.

The ME uses Project method to demonstrate additionality and crediting baseline. The methodology element establishes criteria and procedures for quantifying GHG emissions for the selected GHG sources, separately for the project and baseline scenarios. The methodology is also transparent on the criteria and procedures for quantifying net GHG emission, quantified as the difference between the GHG emissions between from GHG sources relevant for the project and those relevant for the baseline scenario. RINA verified VCS, CDM and GS websites, currently there is no approved or pending methodology under the VCS Program or an approved GHG program that could reasonably be revised to meet the objective of the proposed methodology.

RINA confirmed in its 1st assessment report version 1.2 dated 21-February-2013, that the proposed Methodology element "Reduction of GHG emissions in Propylene Oxide production" is consistent with relevant VCS rules and procedures based on the ME, version 03 of 16-January-2013. As communicated by VCSA through email dated 27-June-2013, under the double approval process by which new methodologies are approved under the VCS Program, Bureau Veritas Certification Holding SAS (BVCH) was retained by VCSA to conduct the 2nd assessment of the proposed new Methodology Element. The Methodology element documentation was revised as a result of the second assessment. VCSA forwarded the revised methodology element version 04 dated 01-May-2013 and the assessment report from the 2nd VVB, version 01 of 22-May-2013 through the aforesaid email. RINA reviewed this revised methodology element version 04 dated 01-May-2013 and the second assessment report version 01 of 22-May-2013 issued by Bureau Veritas Certification Holding SAS (BVCH) and confirm that the editorial changes made are appropriate.

In conclusion, it is RINA's opinion that the proposed Methodology element "Reduction of GHG emissions in Propylene Oxide production", as described in the ME, version 04 dated 01-May-2013, meets all relevant VCS requirements. RINA thus confirms that the Methodology Element is consistent with relevant VCS rules and procedures.

6 REPORT RECONCILIATION

RINA reviewed the revised methodology element version 04 dated 01-May-2013 (produced as a result of the second assessment) and the second assessment report version 01 of 22-May-2013 issued by Bureau Veritas Certification Holding SAS (BVCH). As confirmed by the 2nd VVB only a few minor editorial changes have been done to the Methodology Element. Since the changes made are appropriate and have no impact on the adopted approach, no sections of this report required reconciliation with the second assessment report. RINA has not made any changes to the 1st assessment report version 1.2 dated 21-February-2013 other than updating the assessment statement as required by VCS methodology approval process document , v3.4 of 04-October-2012 /06/.

7 EVIDENCE OF FULFILMENT OF VVB ELIGIBILITY REQUIREMENTS

RINA Services S.p.A. (RINA) is an DOE accredited by UNFCCC, reference number E-0037 /09/ and a VVB with VVB ID 005 /08/ accredited for sectoral scope 5. This being the first Methodology Assessment Report RINA is eligible under the VCS programme to perform assessments for the ME, which falls under sector 5.

8 SIGNATURE

Signed for and on behalf of:

Name of entity: *_RINA Services S.p.A_____*

Signature: __  _____

Name of signatory: *__Mr. Roberto Cavanna_____*

Date: *__27-June-2013_____*