JCM Verification Report Form

A. Summary of verification

A.1. General Information

Title of the project	Introduction of 3.4MW Rooftop Solar Power System to Air-conditioning Parts Factories
Reference number	TH005
Monitoring period	From 01/12/2017 to 31/12/2018
Date of completion of the monitoring report	18/06/2019
Third-party entity (TPE)	Lloyd's Register Quality Assurance Limited (LRQA)
Project participant contracting the TPE	Sharp Energy Solutions Corporation
Date of completion of this report	24/07/2019

A.2 Conclusion of verification and level of assurance

Overall verification opinion	☒ Positive ☐ Negative
☒ Unqualified opinion	Based on the process and procedure conducted, *Lloyd's Register Quality Assurance Limited (LRQA)* (TPE's name) provides reasonable assurance that the emission reductions for *Introduction of 3.4MW Rooftop Solar Power System to Air-conditioning Parts Factories* (project name) ✓ Are free of material errors and are a fair representation of the GHG data and information, and ✓ Are prepared in line with the related JCM rules, procedure, guidelines, forms and other relevant documents
(If overall verification opinion is negative, please check below and state its reasons.) ☐ Qualified Opinion ☐ Adverse opinion ☐ Disclaimer	<State the reasons> Not applicable

A.3. Overview of the verification results

Item	Verification requirements	No CAR or CL remaining
The project implementation with the eligibility criteria of the applied methodology	The TPE determines the conformity of the actual project and its operation with the eligibility criteria of the applied methodology.	☒
The project implementation against the registered PDD or any approved revised PDD	The TPE assesses the status of the actual project and its operation with the registered/validated PDD or any approved revised PDD.	☒
Calibration frequency and correction of measured values with related requirements	If monitoring Option C is selected, the TPE determines whether the measuring equipments have been properly calibrated in line with the monitoring plan and whether measured values are properly corrected, where necessary, to calculate emission reductions in line with the PDD and Monitoring Guidelines.	☒
Data and calculation of GHG emission reductions	The TPE assesses the data and calculations of GHG emission reductions achieved by/resulting from the project by the application of the selected approved methodology.	☒
Avoidance of double registration	The TPE determines whether the project is not registered under other international climate mitigation mechanisms.	☒
Post registration changes	The TPE determines whether there are post registration changes from the registered PDD and/or methodology which prevent the use of the applied methodology.	☒

Authorised signatory:	Mr. ☒	Ms. ☐
Last name: Chiba	First name: Michiaki	
Title: Climate Change Manager - Asia & Pacific		
Specimen signature: [redacted]		Date: 24/07/2019

B. Verification team and other experts

	Name	Company	Function*	Scheme competence*	Technical competence*	On-site visit
Mr. ☒ Ms. ☐	Michiaki Chiba	LRQA Ltd.	Team leader	☒	Technical competence authorised	☒
Mr. ☐ Ms. ☒	Kamiga Sukkeaw	LRQA Thailand	Host country expert	☐	N/A	☒
Mr. ☒ Ms. ☐	Stewart Niu	LRQA China	Internal reviewer	☒	N/A	☐
Mr. ☐ Ms. ☐				☐		☐

Please specify the following for each item.

* *Function: Indicate the role of the personnel in the validation activity such as team leader, team member, technical expert, or internal reviewer.*

* *Scheme competence: Check the boxes if the personnel have sufficient knowledge on the JCM.*

* *Technical competence: Indicate if the personnel have sufficient technical competence related to the project under validation.*

C. Means of verification, findings and conclusions based on reporting requirements

C.1. Compliance of the project implementation and operation with the eligibility criteria of the applied methodology

<Means of verification>

LRQA has determined during the verification process that the actual implementation and operation of the project has been conducted in conformance with the eligibility criteria of the applied methodology.

The project applied the approved methodology: JCM_TH_AM001_ver01.0 "Introduction of Solar PV System, Ver 01.0".

LRQA assessed by means of an on-site visit that the physical features of the project are in place and that the PPs have operated the project as per the eligibility criteria of the applied methodology. The steps taken to verify each eligibility criterion and the conclusions about implementation of the project are summarised as below.

Criterion 1: The project installs solar PV system(s).

Justification in the PDD: The solar PV systems are installed on to the rooftops of factories in Rayong Province.

Steps taken for assessment: The verification team assessed the project documentation, technical specification, the test and commissioning reports, and conducted physical on site assessment.
Conclusion: The verification team confirmed that the project installed rooftop solar PV systems at the factories of subsidiary companies of SNC Former Public Co., Ltd. (SNC) and the criterion is met.

Criterion 2: The solar PV system is connected to the internal power grid of the project site and/or to the grid for displacing grid electricity and/or captive electricity at the project site.
Justification in the PDD: The solar PV systems are connected to the internal power grids of the project sites (each of factories) for displacing grid electricity at the project sites.
Steps taken for assessment: The verification team assessed the electricity diagram and conducted physical on site assessment.
Conclusion: The verification team confirmed that the project solar PV systems are connected to the internal electricity supply systems of the factories of subsidiary companies of SNC. The electricity supply systems are connected to the public power grid system and no captive electricity is used in the project sites. The project was confirmed to displace consumption of grid electricity. The systems to prevent reverse power flow from the project solar PV systems to the public power grid systems have been installed and the electricity generated by the project solar PV systems is only consumed at the project sites. The criterion is met by the project.

Criterion 3: The PV modules have obtained a certification of design qualifications (IEC 61215, IEC 61646 or IEC 62108) and safety qualification (IEC 61730-1 and IEC 61730-2).
Justification in the PDD: The PV modules installed in the project have been certified for IEC 61215, IEC 61730-1 and IEC 61730-2.
Steps taken for assessment: The verification team reviewed the technical specification, certificates of design qualifications and safety qualification, the test and commissioning reports, and conducted physical on site assessment.
Conclusion: The verification team confirmed that the PV modules of the project solar PV system have obtained the certificates in compliance with the international standards IEC61215, IEC61730-1 and IEC61730-2 as appropriate. The criterion was therefore fulfilled.

Criterion 4: The equipment to monitor output power of the solar PV system and irradiance is installed at the project site.
Justification in the PDD: Electricity meters and pyranometers have been installed at the project sites to monitor output power and irradiance respectively.
Steps taken for assessment: The verification team assessed the technical specification, the test and commissioning reports, and conducted physical on site assessment.

Conclusion: The verification team confirmed that the monitoring equipment has been installed for output power of the solar PV systems as well as irradiance at the project sites. Thus the criterion was confirmed as satisfied by the project.

The verification team confirmed that the eligibility conditions are satisfied by the project by reviewing the supporting documents and the on site assessment.
The details of the persons interviewed and the documents reviewed are shown in the Section F of this report.

<Findings>

Please state if CARs, CLs, or FARs are raised, and how they are resolved.

No issue was raised to the requirements of this section.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

The verification team confirmed that the project has been implemented in conformity with the eligibility criteria of the applied methodology.

C.2. Assessment of the project implementation against the registered PDD or any approved revised PDD

<Means of verification>

The project installed rooftop solar power systems with the total generating capacity of 3.4 MW at air-conditioning parts factories in Rayong Province, Thailand.
The project is implemented by SNC of Thailand and Sharp Energy Solutions Corporation of Japan (the PPs) utilizing the crystalline silicon photovoltaic (PV) modules of Sharp Corporation of Japan (Models ND-AH315 and ND-RA260). Sharp's PV modules are well known for high durability, adhering to the company standard which is more stringent than Japan Industrial Standard or International Electrotechnical Commission Standards.
The solar power systems are implemented to 6 factories owned by subsidiary companies of SNC, SNC Pyongsan Evolution Company Limited (SPEC), Infinity Parts Co., Ltd., (IPC), Ultimate Parts Company Limited (UMP) and SNC Creativity Anthology Company Limited (SCAN).
All the electricity produced by the project is supplied to 6 factories displacing electricity generation by fossil-fuel based power plants, contributing to greenhouse gas (GHG) emissions reduction in Thailand.
The start date of project operation is on 01/12/2017 and the expected operational lifetime of the project is for 10 years.
The project receives financial support for JCM model projects from the Ministry of the Environment, Japan (MOEJ).

The verification team assessed the Monitoring Report (MR) that consists of Monitoring Report Sheet (MRS) parts of the Monitoring Spreadsheet and the supporting documents, conducted a physical site visit to assess the status of the actual project and its operation in accordance with the registered PDD. No revision to the registered PDD was requested.
The verification team determined through the verification process that the implementation and operation of the project has been in accordance with the description contained in the registered PDD. The verification team, by means of a desk review and an on-site visit, assessed that:
- all physical features of the JCM project described in the registered PDD are in place, and
- the PPs have operated the JCM project as per the registered PDD.
The MR follows the Monitoring Plan (MP) of the registered PDD that has been established based on the approved methodology. The parameter to be monitored ex-post is EGi,p the total quantity of the electricity generated by the project solar PV system i during the period p (in MWh/p). Total eight electricity meters are installed to directly and continuously measure electricity supply from six factory buildings, i.e. SPEC1, SPEC2, SPEC3, SPEC4, SCAN2 and SCAN3 (two electricity meters are installed to the buildings of SPEC2 and SCAN3).
The roles and responsibilities of the persons are described in the Monitoring Structure Sheet (MSS) in accordance with the requirements of the applied methodology. There was no change in the organizational structure during the monitoring period.

Through the processes taken, CAR 2 and CAR 3 were raised as the resolution detailed below.
The details of the persons interviewed and the documents reviewed are shown in the Section F of this report.

<Findings>

Please state if CARs, CLs, or FARs are raised, and how they are resolved.

Grade / Ref: CAR 2
Nature of the issue raised: The PPs were required to provide revised monitoring procedures that address:
1) The assigned personnel to the roles indicated in the MSS of the registered MP,
2) Details of the monitoring activities to collect, process and report the data,
3) Cross checking procedures of data collected from the different sources,
4) Staff training, and
5) Keeping data/records
Nature of responses provided by the PPs: The PPs provided the revised monitoring procedures for review by the verification team.
Assessment of the responses: The verification team reviewed the revised monitoring procedures with supporting records of the implementation and confirmed the relevant elements have been addressed incorporating improvements identified over the first monitoring period.

The CAR was closed.

Grade / Ref: CAR 3
Nature of the issue raised: Identification of the cluster controllers and electricity meters was not indicated in a consistent manner on site for the Meter 02-1 and Meter 02-2 installed to SPEC2 factory.
Nature of responses provided by the PPs: The PPs corrected the on site indication of electricity meters and provided records for review by the verification team.
Assessment of the responses: The verification team reviewed the records of correction implemented by the PPs to the on site indication of the electricity meters and confirmed those are consistent with the respective PV generation sources and the cluster controllers.
The CAR was closed.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

The verification team confirmed that the project was implemented and operated in accordance with the registered PDD and no revision to the same was requested for the monitoring period.

C.3. Compliance of calibration frequency and correction of measured values with related requirements

<Means of verification>

The parameter No. (1) EGi,p applies the monitoring Option C and the monitoring of the parameter uses inverters (main) and electricity meters (secondary) as the measuring equipment. The electricity meters are calibrated according to IEC 62053-22 (class 0.2s) every 5 years in accordance with the registered MP. The meters were calibrated in November to December 2016 and those remain valid during the monitoring period. No correction was required to the measured values to calculate emission reductions in line with the PDD and Monitoring Guidelines during the monitoring period.
The verification team confirmed that the procedures for cross checking data from the main inverter sources and that from the electricity meters have been clarified in the revised monitoring procedures as mentioned in the resolution of CAR 2 in the above Section C.2.
The details of the persons interviewed and the documents reviewed are shown in the Section F of this report.

<Findings>

Please state if CARs, CLs, or FARs are raised, and how they are resolved.

No issue was raised to the requirements of this section.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

The verification team confirmed that the measuring equipment applied for the parameter satisfied the requirements of the MP concerning the regular calibration and no correction was required to the measured values during the monitoring period.

C.4. Assessment of data and calculation of GHG emission reductions

<Means of verification> The MR is developed using the MRS applied to the registered JCM project that is confirmed fulfilment of the requirements of the MRS of the applied methodology. LRQA has determined that: 1. a complete set of data for the specified monitoring period is available, 2. information provided in the MR has been cross-checked with other sources such as plant log books, inventories, purchase records, laboratory analysis, 3. calculations of reference emissions (REs) and project emissions (PEs), as appropriate, have been carried out in accordance with the formulae and methods described in the MP and the applied methodology, 4. any assumptions used in emission calculations have been justified, and 5. appropriate emission factors, default values and other reference values have been correctly applied. The project supplies electricity generated by solar PV systems installed on the rooftops of the factory buildings for the self-consumption and displaces electricity purchased from the public power grid system. The source of GHG emissions is consumption of grid electricity and CO2 emissions in the reference scenario are considered to determine the reference emissions (REs), while the project emissions (PEs) is assumed to be zero for the solar PV system in accordance with the applied methodology. The REs are determined as a product of total electricity generation (sum of measured data for six factory buildings) and the default reference CO2 emission factor of the applied methodology at 0.319 t-CO2/MWh. The GHG emission reductions during the monitoring period (each for year 2017 and 2018) are calculated as: ERp = REp - PEp = REs = Σ _i EG_i,p x EF_RE From 01/12/2017 to 31/12/2017 85.72 x 0.319 tCO2/MWh = 27.3 tCO2e. From 01/01/2018 to 31/12/2018 2,138.61 x 0.319 tCO2/MWh = 682.2 tCO2e. The verification team assessed the reported data with documented evidence and by means of on site visit. Achieved electricity generation in first monitoring period of 13 months (396 days) is 2,224.33 MWh in total, that is 2,050.20 MWh (2,224.33 MWh x 365/396) in a year and 55.4 % of ex-

ante estimate in PDD of 3,698.10 MWh. The project site is applied functions to prevent reverse electricity flow to the connected public power grid systems that have interrupted utilising capacity of the project solar PV systems as designed. Under the current conditions, electricity generation of project solar PV systems is stopped when electricity consumption of specified building areas is low or less than electricity supply from the solar PV systems, and the power demand is met by import of grid electricity. Electricity consumption of each factory included in the project fluctuates depending on the production level of product components being manufactured by seasons and years. The PPs expect increase of electricity consumption in the future years along with the planned expansion and optimising of the production facilities.

Through the processes taken, CAR 1 was raised as the resolution detailed below.

The details of the persons interviewed and the documents reviewed are shown in the Section F of this report.

Parameters	Monitored values	Method to check values in the monitoring report with sources
EGi,p (2017)	85.72 MWh/p	Assessment was conducted based on records of monitored data and on site assessment.
EGi,p (2018)	2,138.61 MWh/p	Assessment was conducted based on records of monitored data and on site assessment.

<Findings>

Please state if CARs, CLs, or FARs are raised, and how they are resolved.

Grade / Ref: CAR 1

Nature of the issue raised: The monitored data for the parameter EGi,p was not substantiated with the evidence. The PPs were required to provide relevant evidence that clearly presents the monitored data and the calculation processes for each factory over the monitoring period.

Nature of responses provided by the PPs: The PPs provided supporting evidence for the monitored data and revised MRS to apply conservative calculation where sufficient evidence was not available.

Assessment of the responses: The verification team reviewed the supporting evidence and revised MRS, and confirmed that the data reported in the revised MR is supported by evidence and conservative calculation has been applied in comparison with the back-up data. The revision resulted in decrease of total ERs during the monitoring period by 1 tCO2e.

The CAR was closed.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.
The verification team confirmed that appropriate methods and formulae for calculating REs and PEs have been followed. The verification team is of the opinion that all assumptions, emissions factors and default values that were applied in calculations have been justified.

C.5. Assessment of avoidance of double registration

<Means of verification>
The verification team assessed and confirmed relevance of the written confirmation from the PPs that the project is not registered under the other international climate mitigation mechanisms.
The team, in addition to the interviews with the PPs, checked publicly accessible information of Clean Development Mechanism (CDM), Joint Implementation (JI), Verified Carbon Standard (VCS) and Gold Standard (GS) and found no identical project as the registered JCM project in terms of the name of entities, applied technology, scale and the location. The result of researches confirmed that the project was not registered under the other international climate mitigation mechanisms than JCM and it will not result in a double counting of GHG emission reductions.
CAR 4 was raised through the verification process that resolution details are as below.
The details of the persons interviewed and the documents reviewed are shown in the Section F of this report.
<Findings>
Please state if CARs, CLs, or FARs are raised, and how they are resolved.
Grade / Ref: CAR 4
Nature of the issue raised: A written confirmation had not been submitted by the PPs on no double registration of the project with the other international climate mitigation mechanism than JCM over the monitoring period.
Nature of responses provided by the PPs: The PPs submitted the declaration on avoidance of double registration dated 22/03/2019.
Assessment of the responses: The verification team confirmed a written confirmation on avoidance of double registration was submitted by the PPs as required.
The CAR was closed.
<Conclusion based on reporting requirements>
Please state conclusion based on reporting requirements.
The verification team confirmed that the project is not registered under other international climate mitigation programs.

C.6. Post registration changes

<Means of verification>

The verification team assessed the project documentation and through the on site visit and confirmed that there was no post registration change from the registered PDD or the approved methodology.

<Findings>

Please state if CARs, CLs, or FARs are raised, and how they are resolved.

No issue was raised to the requirements of this section.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

The verification through the verification processes determined that there was no post registration change from the registered PDD or approved methodology which prevent from use of the applied methodology.

D. Assessment of response to remaining issues

An assessment of response to the remaining issues including FARs from the validation and/or previous verification period, if appropriate

No FAR was issued in the validation and this is the first verification of the project.

E. Verified amount of emission reductions achieved

Year	Verified Reference Emissions (tCO_2e)	Verified Project Emissions (tCO_2e)	Verified Emission Reductions (tCO_2e)
2013			
2014			
2015			
2016			
2017	27.3	0	27
2018	682.2	0	682
2019			
2020			
2021			
2022			
2023			
2024			
2025			
2026			
2027			
2028			
2029			
2030			
Total (tCO_2e)			709

F. List of interviewees and documents received

F.1. List of interviewees

SNC Pyongsan Evolution Company Limited (SPEC)

Somchai Ngamkitcharoenlap, Managing Director

Pipat Poisen, Manager

Wassana Srikhat, Engineering

Sharp Energy Solutions Corporation

Hiroya Ota, Supervisor, Global New Business Promotion Division, Project Business Unit

Sharp Solar Solution Asia Co., Ltd.

Laksamee Tippayawat, Manager, Engineering Department

F.2. List of documents received

Category A documents (documents prepared by the PPs) - Monitoring report dated 07/03/2019 - Revised monitoring report dated 18/06/2019 - Calculation spreadsheet - Specification of main equipment - PEA grid connection permission - EPC Contract for design, engineer, procure, construct, test and commissioning dated 19/09/2016 - DC Cable Route and Cable Raceway - Aluminum Rail Plan of Mounting Structure - Single Line Diagram VAC and VDC Distribution Board - Communication Diagram - Monitoring Diagram - EDMI Mk6E Advanced Three Phase Electronic Revenue Meter Specifications - KIPP & ZONEN Pyranometers Specifications - Commissioning report for 3.432 MWp dc PV Solar Roof System in SNC PYONGSAN EVOLUTION CO., LTD (Rayong Province,Thailand) Date: 25 to 28 April 2017, Sharp Solar Solution Asia Co., Ltd. - Certificate of IEC 61215, IEC 61730-1 and IEC 61730-2 issued by TUV Rheinland dated 18/08/2016 - Certificate of IEC 61215, IEC 61730-1 and IEC 61730-2 issued by VDE Testing and Certification Institute dated 31/10/2013 - Relaying and Metering Diagram SPEC1 - Relaying and Metering Diagram SPEC2 - Relaying and Metering Diagram SPEC3 - Relaying and Metering Diagram SPEC4 - Relaying and Metering Diagram SCAN2 - Relaying and Metering Diagram SCAN3 - Technical information – Measurement accuracy for PV Inverter Sunny Boy and Sunny Mini Central, SMA - Manufacturer’s recommendation for calibration frequency of electricity meter - Declaration on avoidance of double registration dated 22/03/2019

- Review of the monitoring system and data sources
- JCM Monitoring Procedure dated 14/06/2019
- Raw data and summary of electricity generation
- Records of correction of on site indication of electricity meters for SPEC2
- Records of staff training

Category B documents (other documents referenced)
- Registered PDD Version 03.0 dated 24/04/2018 with the Monitoring Spreadsheet
- Validation report for the project dated 26/07/2018
- JCM_TH_AM001_ver01.0 Installation of Solar PV Systems
- Additional Information to the Proposed Methodology “Installation of Solar PV System”
- JCM Project Cycle Procedure JCM_TH_PCP_ver02.0
- JCM Guidelines for Validation and Verification JCM_TH_GL_VV_ver01.0
- JCM Guidelines for Developing PDD and MR JCM_TH_GL_PDD_MR_ver02.0
- JCM Glossary of Terms JCM_TH_Glossary_ver01.0
- JCM Verification Report Form JCM_TH_F_Vrf_Rep_ver02.0
- Verification report for JCM project No. TH001
- Proposed and registered projects under CDM, VCS, Gold Standard, and the other international schemes
- IEC 62053-22:2003, Electricity metering equipment (ac) - Particular requirements. Part 22: Static meters for active energy (classes 0,2 S and 0,5 S)
- APLMF Economy Report Thailand, Central Bureau of Weights and Measures
- Weights and Measures Act B.E. 2542 (1999)

Annex Certificates or curricula vitae of TPE's verification team members, technical experts and internal technical reviewers

Please attach certificates or curricula vitae of TPE's validation team members, technical experts and internal technical reviewers.

Certificate of Appointment is attached to this report.

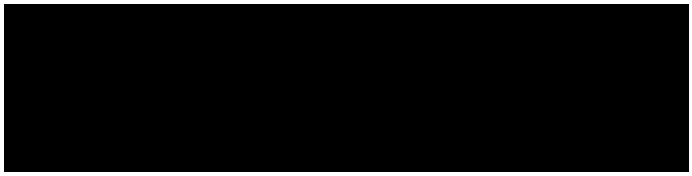
Joint Crediting Mechanism Certificate of Appointment

Title of Project: Introduction of 3.4MW Rooftop Solar Power System to Air-conditioning Parts Factories (Ref# TH005)
Verification for the first monitoring period: 01/12/2017 - 31/12/2018

We hereby certify that the following personnel have engaged in the verification process that has fully satisfied the competence requirements of the verification of the JCM project.

Name of Person	Assigned Roles
Michiaki Chiba	Team Leader
Kamiga Sukkeaw	Host Country Expert
Stewart Niu	Technical Reviewer

Signed by



Michiaki Chiba
Climate Change Manager – Asia & Pacific
08/03/2019