JCM Validation Report Form

A. Summary of validation

A.1. General Information

Title of the project	Installation of High Efficiency Air Conditioning System and Chillers in Semiconductor Factory
Reference number	TH003
Third-party entity (TPE)	Japan Quality Assurance Organization (JQA) (TPE-TH-003)
Project participant contracting the TPE	Sony Semiconductor Manufacturing Corporation
Date of completion of this report	22/03/2018

A.2 Conclusion of validation

Overall validation opinion	☒ Positive ☐ Negative

A.3. Overview of final validation conclusion

Only when all of the checkboxes are checked, overall validation opinion is positive.

Item	Validation requirements	No CAR or CL remaining
Project design document form	The TPE determines whether the PDD was completed using the latest version of the PDD forms appropriate to the type of project and drafted in line with the Guidelines for Developing the Joint Crediting Mechanism (JCM) Project Design Document, Monitoring Plan and Monitoring Report.	☒
Project description	The description of the proposed JCM project in the PDD is accurate, complete, and provides comprehension of the proposed JCM project.	☒
Application of approved JCM methodology (ies)	The project is eligible for applying applied methodology and that the applied version is valid at the time of submission of the proposed JCM project for validation.	☒
Emission sources and calculation of emission reductions	All relevant GHG emission sources covered in the methodology are addressed for the purpose of calculating project emissions and reference emissions for the proposed JCM project.	☒
	The values for project specific parameters to be fixed *ex ante* listed in the Monitoring Plan Sheet are appropriate, if applicable.	☒
Environmental impact assessment	The project participants conducted an environmental impact assessment, if required by the Kingdom of Thailand, in line with Thai procedures.	☒
Local stakeholder	The project participants have completed a local stakeholder consultation process and that due steps were taken to engage	☒

Item	Validation requirements	No CAR or CL remaining
consultation	stakeholders and solicit comments for the proposed project.	
Monitoring	The description of the Monitoring Plan (Monitoring Plan Sheet and Monitoring Structure Sheet) is based on the approved methodology and/or Guidelines for Developing the Joint Crediting Mechanism (JCM) Project Design Document, Monitoring Plan, and Monitoring Report. The monitoring points for measurement are appropriate, as well as whether the types of equipment to be installed are appropriate if necessary.	☒
Public inputs	All inputs on the PDD of the proposed JCM project submitted in line with the Project Cycle Procedure are taken into due account by the project participants.	☒
Modalities of communications	The corporate identity of all project participants and a focal point, as well as the personal identities, including specimen signatures and employment status, of their authorized signatories are included in the MoC.	☒
	The MoC has been correctly completed and duly authorized.	☒
Avoidance of double registration	The proposed JCM project is not registered under other international climate mitigation mechanisms.	☒
Start of operation	The start of the operating date of the proposed JCM project does not predate January 1, 2013.	☒

Authorised signatory:	Mr. ☒	Ms. ☐
Last name: Asada	First name: Sumio	
Title: Senior Executive		
Specimen sig [redacted]		Date: 22/03/2018

B. Validation team and other experts

	Name	Company	Function*	Scheme competence*	Technical competence*	On-site visit
Mr. ☒ Ms. ☐	Tadashi Yoshida	External individual	Team leader	☒	Authorized	☒
Mr. ☒ Ms. ☐	Koichiro Tanabe	JQA	Internal Reviewer	☒	Authorized	☐

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 validation, findings, and conclusion based on reporting requirements

C.1. Project design document form

<Means of validation>

The PDD form was checked and confirmed as complete in accordance with the JCM Guidelines for Developing Project Design Document and Monitoring Report (JCM_TH_GL_PDD_MR_ver02.0). The latest version of the JCM PDD form (JCM_TH_F_PDD_ver02.0) is used for the PDD of the proposed project (Version 1.0 dated 06/11/2017 for First edition and Version 2.0 dated 20/02/2018 for Second edition). The validation was conducted on the first edition of the PDD.

<Findings>

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

No issue was raised to the requirement.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

JQA concludes that the PDD is completed using the valid version of the PDD form and drafted in line with the JCM Guidelines for Developing Project Design Document and Monitoring Report.

C.2. Project description

<Means of validation>

The purpose of the proposed project is to reduce CO_2 emissions from electricity consumption in the new clean room for Large Scale Integration (LSI) and image sensor manufacturing by newly installing high-efficiency centrifugal chillers and swirling induction type air conditioners. The proposed project is implemented at Sony Device Technology (Thailand) Co., Ltd. located in Bangkadi Industrial Park in the Kingdom of Thailand. The project air-conditioning system does not mix the air in the room and cools only the room's lower layer air and hence the cooling capacity becomes smaller compared to the reference system. Air flow rate also can be set lower than that of the reference system, which reduces power consumption of the fan motor. In addition, the project chiller equipped with an inverter contributes to energy saving through the control of rotation speed of compressor motor of the chiller and further continuously regulates its cooling capacity for the air-conditioning system with chilled water. As a result, the energy saving of about 46%, i.e., the annual emission reductions of 3,744 tCO_2/y, would be expected by the implementation of the proposed project.

The proposed project is implemented by Sony Device Technology (Thailand) Co., Ltd. from Kingdom of Thailand and Sony Semiconductor Manufacturing Corporation from Japan. The commissioning of the project facilities was completed on 29/03/2017 and the starting date of the monitoring activity was set to be 01/04/2017. The expected operational lifetime of the project is 8 years, which is based on the legal durable years for the manufacturing facilities of electronic parts, device and/or circuit issued by Ministry of Finance, Japan.

The proposed project was partially supported by the Ministry of Environment (MOE), Japan through the Financing Programme for JCM model projects, which provided financial support of less than half of the initial investment for the projects in order to acquire JCM credits. As for the technology transfer, Sony Semiconductor Manufacturing Corporation has conducted OJT training on the operation and maintenance of the project facilities during the initial installation. Maintenance support by the manufacturers will be also available upon request.

JQA has assessed the PDD and the supporting documents through the desk review and on-site assessment conducted on 01/02/2018 to validate the requirements about accuracy and completeness of the project description. The details of the persons interviewed and documents reviewed are provided in Section E of this report.

Regarding the purpose of the proposed project and clean room, JQA raised CL 01 and this issue was resolved as explained in "Findings".

<Findings>

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

CL 01:

The main purpose of the proposed project in A.2 of the PDD is not clearly described.

Resolution of CL 01 by the PPs:

The purpose of the JCM project is now clearly stated in A.2 of the revised PDD as follows: "This project newly installs a high efficiency Centrifugal Chillers and Swirling Induction type air-conditioning system for a newly constructed clean room (6,250 m^2) to reduce CO_2 emissions from electricity consumption in the refurbishment of LSI (Large Scale Integration) and image sensor manufacturing plant at Bangkadi Industrial Park." It is confirmed through the review of the revised PDD and the interview with the PPs that the purpose of the proposed project is clearly described in A.2 of the revised PDD. Thus, CL 01 is closed.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

JQA concludes that the description of the proposed project in the revised PDD complies with the supporting documents and information obtained through the desk review, on-site visit and the interview with the PPs, and the description is accurate and complete.

C.3. Application of approved methodology(ies)

<Means of validation>

The approved methodologies JCM_TH_AM003_ver01.0 "Energy Saving by Introduction of High Efficiency Inverter Type Centrifugal Chiller" and JCM_TH_AM006_ ver01.0 "Installation of Displacement Ventilation Air Conditioning Unit in the Cleanroom of Semiconductor Manufacturing Factory" are applied to the proposed project. The methodologies were approved by the JC on 21/08/2017 (JC3, Annex 6 and 8) and valid at the time of the validation.

JQA has assessed whether the selected methodologies are applicable to the proposed project. The project applicability was checked against five eligibility criteria in TH_AM003 and four eligibility criteria in TH_AM006. The steps taken to validate each eligibility criterion and the conclusion about its applicability to the proposed project are summarized in the following tables:

[TH_AM003]

Eligibility criteria	Descriptions specified in the methodology	Project information	Assessment and conclusion

<table>
<tr>
<td>Criterion 1</td>
<td>Project chiller is an inverter type centrifugal chiller with a capacity which is less than or equals to 1,500 USRt.
* 1 USRt = 3.52 kW</td>
<td>The three installed chillers are the model “ETI-50” made by Mitsubishi Heavy Industries, Ltd. The project chillers are a centrifugal type with the capacity of 500 USRt each.</td>
<td>It is confirmed through the review of the manufacturer’s specification provided by the PPs, on-site visit and the interview with the PPs that the model of chiller is “ETI-50” which is a centrifugal type with a capacity of 500 USRt. Hence, JQA concludes that the Criterion 1 is satisfied.</td>
</tr>
<tr>
<td>Criterion 2</td>
<td>COP for project chiller i calculated under the standardizing temperature conditions* ($COP_{PJ,tc,i}$) is more than the threshold COP values set in the table below. (“x” in the table represents cooling capacity per unit.)
<table>
<tr><td>Cooling capacity per unit (USRt)</td><td>300≤x ≤450</td><td>450<x ≤550</td><td>550<x ≤825</td><td>825<x ≤1,500</td></tr>
<tr><td>Threshold COP value</td><td>5.59</td><td>5.69</td><td>5.85</td><td>6.06</td></tr>
</table>
$COP_{PJ,tc,i}$ is calculated by altering the temperature conditions of COP of project chiller i ($COP_{PJ,i}$) from the project specific conditions to the standardizing conditions. $COP_{PJ,i}$ is derived from specifications prepared for the quotation or factory acceptance test data by manufacturer.

[equation to calculate $COP_{PJ,tc,i}$]
$COP_{PJ,tc,i} = COP_{PJ,i} \times [(T_{cooling\text{-}out,i} - T_{chilled\text{-}out,i} + TD_{chilled} + TD_{cooling}) \div (37 - 7 + TD_{chilled} + TD_{cooling})]$

$COP_{PJ,tc,i}$: COP of project chiller i calculated under the standardizing temperature conditions* [-]
$COP_{PJ,i}$: COP of project chiller i under the project specific conditions [-]
$T_{cooling\text{-}out,i}$: Output cooling water temperature of project chiller i set under the project specific</td>
<td>The COP of chiller 1, 2&3 ($COP_{PJ,tc,i}$) was calculated under the standardizing temperature conditions in the chiller inspection records provided by the manufacturer. It is 6.15 (chiller 1), 6.59 (chiller 2&3) and is more than 5.69 in the table on the left.

[Calculation result for chiller 1]
6.15 = 6.15 x [(37 - 7 + 1.5 + 1.5) ÷ (37 – 7 + 1.5 + 1.5)]

[Calculation result for chiller 2 and 3]
6.59 = 8.37 x [(37 - 14 + 1.5 + 1.5) ÷ (37 – 7 + 1.5 + 1.5)]

The value (6.15) is used not only for chiller1 but also for chiller 2&3 since the three project chillers are the exactly same</td>
<td>It is confirmed through the review of the manufacturer’s specification provided by the PPs, on-site visit and the interview with the PPs that the COP of ETI-50 is 6.15 for chiller 1and 6.59 for chillers 2 & 3, higher than the threshold COP of 5.69 for 500 USRt cooling capacity class. Hence, JQA concludes that the Criterion 2 is satisfied.</td>
</tr>
</table>

	conditions [degree Celsius] $T_{chilled-out,i}$: Output chilled water temperature of project chiller *i* set under the project specific conditions [degree Celsius] $TD_{cooling}$: Temperature difference between condensing temperature of refrigerant and output cooling water temperature 1.5 degree Celsius set as a default value [degree Celsius] $TD_{chilled}$: Temperature difference between evaporating temperature of refrigerant and output chilled water temperature, 1.5 degree Celsius set as a default value [degree Celsius] *The standardizing temperature conditions to calculate $COP_{PJ,tc,i}$ Chilled water: Output 7 Degree Celsius Input 12 Degree Celsius Cooling water: Output 37 Degree Celsius Input 32 Degree Celsius	model with the capacity of 500 USRt each. The value is more conservative and ensures net emission reductions of the proposed project.	
Criterion 3	Periodical check is planned more than one (1) time annually.	An annual inspection, including washing of the tubes, is carried out by the manufacturer and a maintenance report is provided.	It is confirmed through the review of Letter of Consent and Annual maintenance service report provided by the PPs and the interview with the PPs that the chiller is checked annually by the manufacturer. Hence, JQA concludes that the Criterion 3 is satisfied.

Criterion 4	Ozone Depletion Potential (ODP) of the refrigerant used for project chiller is zero.	The refrigerant type of the project chiller is "ASAHIKLIN AK-134a (HFC-134)" by AGC Chemicals, whose ODP is zero.	It is confirmed through the review of specification of refrigerant and the interview with the PPs that the refrigerant used for chiller is "ASAHIKLIN AK-134a (HFC-134)" of which ODP is zero. Hence, JQA concludes that the Criterion 4 is satisfied.
Criterion 5	A plan for prevention of releasing refrigerant used for project chiller is prepared. In the case of replacing the existing chiller with the project chiller, a plan for prevention of releasing refrigerant used in the existing chiller to the air (e.g. re-use of the equipment) is prepared. Execution of this plan is checked at the time of verification, in order to confirm that refrigerant used for the existing one replaced by the project is prevented from being released to the air.	To prevent the release of refrigerants into the atmosphere due to the project, at the time of chiller removal, the project owner plans to collect the refrigerants from the project chiller removed by using a refrigerant recovery machine and ensure the storage of the collected refrigerants. A letter of consent on not releasing refrigerants used for the project chiller was prepared by the participants from both sides.	It is confirmed through the review of Letter of Consent provided by the PPs and the interview with the PPs that the collection of refrigerant from the project chiller at the time of removal is appropriately processed by the outsourced manufacturer, according to Guideline on CFC recovery issued by INFREP. Hence, JQA concludes that the Criterion 5 is satisfied.

[TH_AM006]

Eligibility criteria	Descriptions specified in the methodology	Project information	Assessment and conclusion

Criterion 1	Displacement ventilation air conditioning unit, whose specification of velocity of the discharged air is designed to be more than 0.5 m/s and equals to or less than 1.0 m/s, is installed in the cleanroom of semiconductor plant.	The velocity of discharged air in this air conditioning system is set at 0.83 m/s.	It is confirmed through the review of the relevant document and the interview with the PPs that the velocity of discharged air by the displacement ventilation air conditioning unit is set to be 0.83 m/s to keep a proper discharge pressure in the clean room. Hence, JQA concludes that the Criterion 1 is satisfied.
Criterion 2	The project displacement ventilation air conditioning unit is constituted of at least cooling coil, HEPA (high efficiency particular air) or ULPA (ultra low penetration air) filter and air supply fan in one unit.	HEPA is adopted in Class 10,000 areas with a cooling coil and air supply fan while ULPA is adopted in Class 1,000 areas with a cooling coil and air supply fan.	It is confirmed through the review of the relevant documents and the interview with the PPs that HEPA is used in Class 10,000 areas with a cooling coil and air supply fan, while ULPA is used in Class 1,000 areas with a cooling coil and air supply fan. Hence, JQA concludes that the Criterion 2 is satisfied.
Criterion 3	The project displacement ventilation air conditioning unit is designed to meet the threshold values of Class 6 or class 7 of airborne particulate cleanliness class set by ISO 14644-1:2015.	Class 6 and Class 7 are adopted in the cleanroom.	It is confirmed through the review of the design drawings of the clean room for class 6 and class 7 and the interview with the PPs that the displacement ventilation air conditioning unit is designed to meet the threshold values of Class 6 and Class 7 based on ISO 14644-1:2015. Hence, JQA concludes that the Criterion 3 is satisfied.
Criterion 4	The project displacement ventilation air conditioning unit only supplies cooled air.	Only a cold water coil is installed in this system so only cooled air is supplied.	It is confirmed through the review of the design drawing of air conditioning system and the interview with the PPs that the displacement ventilation air conditioning unit only supplies air cooled by the chilled water. Hence, JQA concludes that the Criterion 4 is satisfied.

Regarding the periodical check of chiller, JQA raised CL 03 and this issue was resolved as

explained in “Findings”.

<Findings>

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

CL 03:

As for Criterion 3 of TH_AM003, any letter of consent for periodical check and maintenance is to be provided.

Resolution of CL 03 by the PPs :

The PPs provided Letter of consent, Preventive Maintenance Control Plan and Annual maintenance service report for chiller for TPE’s review. It is confirmed through the review of these documents and the interview with the PPs that the annual check and maintenance of chiller have been appropriately conducted according to the schedule of Preventive Maintenance Control Plan prepared by the PP. Thus, CL 03 is closed.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

JQA concludes that the proposed project is eligible for applying the valid version of the approved methodologies TH_AM003_ver01.0 and TH_AM006_ver01.0 and all eligibility criteria have been met by the proposed project.

C.4. Emission sources and calculation of emission reductions

<Means of validation>

The proposed project aims to reduce CO_2 emission from electricity consumption in the clean room of the semiconductor plant by installing high-efficiency centrifugal chiller and swirling induction type air-conditioning system. Both reference emissions and project emissions are sourced from electricity consumption by reference chiller/mixing ventilation air-conditioning unit and project chiller/displacement ventilation air-conditioning unit, respectively.

[TH_AM003]

The emission reductions achieved by the introduction of centrifugal chiller equipped with inverter are calculated by the following procedures.

Reference emissions for chiller are calculated by multiplying electricity consumption of project chiller, ratio of COPs of reference/project chillers, and CO_2 emission factor for consumed electricity. The COP of reference chiller ($COP_{RE,i}$) is conservatively set using a

default value of 5.69 for the cooling capacity of 500 USRt, as per TH_AM003. The COP of project chiller under the standardizing temperature conditions ($COP_{PJ,tc,i}$) is calculated using the $COP_{PJ,i}$ given by the manufacturer's test data. Thus, the reference emissions for chiller are calculated by Equation (1):

$$REp = \sum(EC_{PJ,i,p} \times COP_{PJ,tc,i} / COP_{RE,i} \times EF_{elec}) \quad \text{---------- (1)}$$

Where:

RE_p : Reference emissions during the period *p* [tCO_2/p]
$EC_{PJ,i,p}$: Power consumption of project chiller *i* during the period *p* [MWh/p]
$COP_{PJ,tc,i}$: COP of project chiller *i* calculated under the standardizing temperature conditions [-]
$COP_{RE,i}$: COP of reference chiller *i* under the standardizing temperature conditions [-]
EF_{elec} : CO_2 emission factor for consumed electricity [tCO_2/MWh]

Project emissions are calculated by Equation (2), based on the power consumption of project chiller and CO_2 emission factor for consumed electricity.

$$PE_p = \sum(EC_{PJ,i,p} \times EF_{elec}) \quad \text{---------- (2)}$$

Where:

PE_p : Project emissions during the period *p* [tCO_2/p]
$EC_{PJ,i,p}$: Power consumption of project chiller *i* during the period *p* [MWh/p]
EF_{elec} : CO_2 emission factor for consumed electricity [tCO_2/MWh]

Thus, the GHG emission reductions during the period *p* are calculated by Equation (3), in line with the approved methodology:

$$ERp = REp - PEp \quad \text{---------- (3)}$$

The annual value of the emission reductions by chiller is calculated as follows:

$$ERp = REp - PEp$$
$$= \sum(EC_{PJ,i,p} \times COP_{PJ,tc,i} / COP_{RE,i} \times EF_{elec}) - \sum(EC_{PJ,i,p} \times EF_{elec})$$
$$= (2{,}288 \times 3 \times 6.15/5.69 \times 0.5664) - (2{,}288 \times 3 \times 0.5664)$$
$$= 314.30$$

[TH_AM006]

The emission reductions achieved by the introduction of displacement ventilation air-

conditioning system are calculated by the following procedures.

Reference emissions for the mixing ventilation air conditioning units are calculated by multiplying electricity consumption of the project displacement ventilation air conditioning unit, ratio of motive power of reference mixing ventilation air conditioning unit and motive power of project displacement ventilation air conditioning unit, and CO_2 emission factor for consumed electricity. Thus, the reference emissions for mixing ventilation air conditioning units are calculated by Equation (4):

$$REp = \sum\sum\sum(EC_{PJ,DV,i,j,k,p} \times L_{RE,j,k} / L_{PJ,j,k} \times EF_{elec,k})$$
$$= \sum\sum\sum(EC_{PJ,DV,i,j,k,p} \times (P_{d,RE,j,k} \times AFR_{RE,j,k}) / (P_{d,PJ,j,k} \times AFR_{PJ,j,k}) \times EF_{elec,k}$$
---------- (4)

Where:

RE_p : Reference emissions during the period *p* [tCO_2/p]

$EC_{PJ,DV,i,j,k,p}$: Amount of power consumption by the project displacement ventilation air conditioning unit *i* in clean room *j* of the project factory *k* during the period *p* [MWh/p]

$P_{d,RE,j,k}$: Discharge pressure of reference mixing ventilation air conditioning unit(s) supplying air to clean room *j* in the project factory *k* [Pa]

$P_{d,PJ,j,k}$: Discharge pressure of project displacement ventilation air conditioning unit(s) supplying air to clean room *j* in the project factory *k* [Pa]

$AFR_{RE,j,k}$: Airflow rate of reference mixing ventilation air conditioning unit(s) supplying air to clean room *j* in the project factory *k* [m^3/s]

$AFR_{PJ,j,k}$: Airflow rate of project displacement ventilation air conditioning unit(s) supplying air to clean room *j* in the project factory *k* [m^3/s]

$EF_{elec,k}$: CO_2 emission factor for consumed electricity in the project factory *k* [tCO_2/MWh]

Project emissions are calculated by Equation (5), based on the power consumption of displacement ventilation air conditioning unit and CO_2 emission factor for consumed electricity.

$$PE_p = \sum\sum\sum(EC_{PJ,DV,i,j,k,p} \times EF_{elec,k}) \quad \text{---------- (5)}$$

Where:

PE_p : Project emissions during the period *p* [tCO_2/p]

$EC_{PJ,DV,i,j,k,p}$: Amount of power consumption by the project displacement ventilation air conditioning unit *i* in clean room *j* of the project factory *k* during the period

p [MWh/p]

$EF_{elec,k}$: CO_2 emission factor for consumed electricity in the project factory *k* [tCO_2/MWh]

Since the emissions from power consumption by reference/ project outdoor-air processing unit(s) and by reference/ project exhaust fan(s) are considered to be equal, these emissions are not included in the calculation of reference/ project emissions.

When summing up the reduction of CO_2 emission from electricity consumption by the installation of project displacement ventilation air conditioning unit and chillers, the annual emission reductions of the proposed project are 3,744 tCO_2 and the sum of the emission reductions for the period of 2017 - 2025 is estimated to be 29,950 tCO_2.

Here, the electricity consumed by the proposed project is supplied only from the Provincial Electricity Authority (PEA) of the national grid. Therefore, the most recent value of CO_2 emission factor of grid electricity available at the time of validation, i.e., 0.5664 tCO_2/MWh in 2016, is used to calculate emission reductions, which is sourced from "Grid Emission Factor of Thailand", endorsed by Thailand Greenhouse Gas Management Organization.

It is confirmed through the review of relevant documents and on-site assessment that all GHG emission sources specified by the applied methodologies are identified, and the reference emissions, project emissions and emission reductions in the PDD (ver. 2.0) and Monitoring Plan Sheet are correctly calculated, in accordance with the approved methodologies.

Regarding the values of electricity consumption for chiller and CO_2 emission factor of the grid, JQA raised CAR 02 and CAR 04 and these issues were resolved as explained in "Findings".

<Findings>

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

CAR 02:

The calculation process of $EC_{PJ,i,p}$ for the value of 858 MWh/p in MPS (input_separate) of TH_AM003 is to be explained.

Resolution of CAR 02 by the PPs :

The estimated value of $EC_{PJ,i,p}$ for chiller is calculated as follows:

$EC_{PJ,i,p}$ = 2 x 143 kW x 8,000 hrs /1,000 = 2,288 MWh/y

Where:

2 : Number of compressor installed in chiller

143 kW : Rated electricity consumption of chiller

8,000 hrs : Expected annual operation time

1,000 : Conversion factor from kW to MW

The initial value of electricity consumption for chiller has been appropriately corrected based on the expected annual operation of designed semiconductor production lines. It is confirmed through the review of the manufacturer's specification, on-site visit and the interview with the PPs that the value of annual electricity consumption ($EC_{PJ,i,p}$) for chiller is correctly calculated in the revised MPS(input_separate) sheet. Thus, CAR 02 is closed.

CAR 04:

Most recent grid emission factor (i.e. 2016) is to be applied to the calculation of electricity consumption, in accordance with the methodology.

Resolution of CAR 04 by the PPs :

The value of electricity consumption has been corrected using the most recent grid emission factor (2016) sourced from Grid Emission Factor of Thailand. It is confirmed through the review of the revised PDD and MPS that the value of electricity consumption for displacement ventilation air conditioning unit chiller is correctly re-calculated using the most recent grid emission factor, i.e., 0.5664 tCO_2/MWh for year 2016. Thus, CAR 04 is closed.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

JQA confirms that all emission sources and GHG types for the proposed project are appropriately identified. JQA concludes that the values of electricity consumption to be monitored *ex-post* in the MPS are correctly estimated and the values of the project-specific parameters to be fixed *ex-ante* are also appropriately selected. As a result, the GHG emission reductions per year are correctly calculated using appropriate parameters and data.

C.5. Environmental impact assessment

<Means of validation>

The purpose of the proposed project is to reduce CO_2 emissions from electricity consumption in the new clean room of semiconductor plant by newly installing high-efficiency centrifugal chillers and displacement ventilation air conditioning unit. An Environmental

Impact Assessment (EIA) is not required because the proposed project only gives a limited level of environmental impact within the factory. Hence, the stakeholders identified are also limited to public organization and staff members of Sony Device Technology (Thailand) Co., Ltd. and Sony Corporate Services (Japan) Corporation. According to the EIA Guidebook for Japanese Companies in Overseas Business Development, published by Institute for Global Environmental Strategies (IGES) on March 2015, there is no stipulation which requires EIA assessment to such kind of the technology implementation. Therefore, JQA confirms that EIA is not required.

<Findings>

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

No issue was raised to the requirement.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

JQA concludes that the proposed project does not require the EIA. The implementation of the project is in line with the regulations in the Kingdom of Thailand and the requirements of the JCM.

C.6. Local stakeholder consultation

<Means of validation>

The PPs conducted a local stakeholder consultation at Sony Device Technology (Thailand) Co., Ltd. on 22/11/2016. Prior to the meeting, the invitation letter by email was delivered to the stakeholders on 06/10/2016.

The list of the participants for Local Stakeholders' Consultation Meeting is as follows:

- Thailand Greenhouse Gas Management Organization
- Sony Device Technology (Thailand) Co., Ltd.
- Sony Corporate Services (Japan) Corporation

As Sony Device Technology (Thailand) Co., Ltd. is located in Bangkadi Industrial Park, there is no residence near the project site. Therefore, the representative of the residents is not included in the participants. The local stakeholders provided positive comments for the proposed project. No negative issues that require actions to be taken by the PPs were raised through the consultation. It is confirmed through the review of the relevant documents and the interview with the PPs that the stakeholder consultation process was appropriately addressed to collect stakeholders' opinions on the project. The summary of the comments

received in the consultation and due account of all comments taken by the PPs are fully described in the PDD.

<Findings>

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

No issue was raised to the requirement.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

JQA concludes that the PPs have completed a local stakeholder consultation process and invited comments on the proposed project from the local stakeholders. The summary of the comments received is provided in the PDD in a complete manner and the PPs have taken due account of all the comments received and described this process in the PDD.

C.7. Monitoring

<Means of validation>

The Monitoring Plan consists of the Monitoring Plan Sheet and Monitoring Structure Sheet which comply with the approved Methodologies JCM_TH_AM003_ver01.0 and TH_AM006_ ver01.0. Two monitoring parameters, i.e., power consumption of project displacement ventilation air conditioning unit ($EC_{PJ,DV,i,j,k,p}$) and power consumption of project chiller ($EC_{PJ,i,p}$) during the period *p*, are measured by electricity meter. The monitoring points of power consumption for displacement ventilation air conditioning unit and chiller are located at the right position, respectively. The measured data is automatically transmitted to the server at Sony Device Technology (Thailand) Co., Ltd. for recording.

The power consumption is continuously monitored and monthly checked for aggregation. The electricity meter is calibrated by the manufacturer at the time of factory shipment, and the performance of meter is guaranteed by the manufacturer for ten years without a calibration.

All monitored data which are required for verification and issuance will be kept and archived electronically for two years after the final issuance of the credits.

The roles and responsibilities of the personnel are described in Monitoring Structure Sheet. The monitoring structure consists of General Manager (stationed in Japan), Person-in-charge of the Project (stationed in Japan), General Manager (stationed in Thailand) and Person-in-charge of the Project (stationed in Thailand). General Manager (stationed in Japan) is responsible for project management and Person-in-charge of the Project (stationed in Japan) is responsible for facilities including reporting preparations, equipment adjustments and

monitoring. General Manager and Person-in-charge of the Project in Thailand are responsible for equipment management and data collection, respectively.

It is confirmed through the review of the relevant documents, on-site visit and the interview with the PPs that the monitoring plan complies with the requirements of the approved methodologies and the PPs will be able to implement the monitoring activity appropriately according to the monitoring plan.

Regarding the stream line of chilled water, the archiving procedure of data and calibration frequency of electricity meter, JQA raised CAR 01, CAR 03 and CL 02 and these issues were resolved as explained in "Findings".

<Findings>

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

CAR 01:

The stream line of chilled return water is not illustrated in C.2 of the PDD.

Resolution of CAR 01 by the PPs:

The stream line of chilled return water is added in the revised PDD. It is confirmed through the review of the revised PDD that the stream line of chilled return water is appropriately illustrated in the figure of the monitoring system. Thus, CAR 01 is closed.

CAR 03:

No description on the archiving procedures of data is included in Monitoring Plan Sheet (PDD GL para. 26).

Resolution of CAR 03 by the PPs:

The description “The data monitored and required for verification and issuance will be kept and archived electronically for two years after the final issuance of credits” is provided in the MPS(input) sheet. It is confirmed through the review of the revised MPS(input) sheet that the description on the archiving procedures of data is appropriately provided. Thus, CAR 03 is closed.

CL 02:

The calibration frequency of electricity meter is not clearly described.

Resolution of CL 02 by the PPs:

The description “The electrical power meter is calibrated by the manufacturer at the time

of factory shipment, and the performance of meter is guaranteed by the manufacturer for ten years without a calibration" is provided in the MPS(input) sheet. It is confirmed through the review of the revised MPS(input) sheet and manufacturer's specification of electricity meter that the calibration of electricity meter is not required for ten years after the calibration at the time of shipment. Thus, CL 02 is closed.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

JQA concludes that the description of Monitoring Plan is based on the approved methodologies and JCM Guidelines for Developing Project Design Document and Monitoring Report, and the monitoring points as well as monitoring equipment for measurement are also appropriate. Thus, the PPs have demonstrated feasibility of the monitoring structure and their abilities to implement the monitoring activity appropriately.

C.8. Modalities of Communication

<Means of validation>

The MoC was provided to JQA for review on 19/01/2018, in the valid form (JCM_TH_F_MoC_ver01.0) at the time of validation, in which Sony Semiconductor Manufacturing Corporation is nominated as the focal point. The MoC was signed by the authorized representatives of Sony Device Technology (Thailand) Co., Ltd. on 21/11/2017 and by the authorized representatives of Sony Semiconductor Manufacturing Corporation on 22/11/2017, along with the contact details.

JQA has checked the personal identities including specimen signatures and employment status of the authorized signatories directly through the interview with the PPs during on-site assessment. Primary authorized signatory of Sony Semiconductor Manufacturing Corporation is Mr. Koki Oitori, Project Manager, and alternate authorized signatory is Mr. Yoshiyuki Nishimura, Senior Manager. Primary authorized signatory of Sony Device Technology (Thailand) Co., Ltd. is Mr. Chiaki Nomura, Executive Director, and alternate authorized signatory is Mr. Yoshiro Fujiyama, General Manager.

It is confirmed that all corporate and personal details including specimen signatures and the information in the MoC are valid and accurate as requested in the JCM Guidelines for Validation and Verification.

<Findings>

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

No issue was raised to the requirement.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

JQA concludes that the MoC is completed using the valid version of the form, and the information and the specimen signature of the PPs provided in the MoC are correct and sufficient, in compliance with the requirements of the JCM Guidelines. It is demonstrated that the MoC is correctly completed and dully authorized.

C.9. Avoidance of double registration

<Means of validation>

The representative of focal point entity in the MoC, Mr. Koki Oitori, Project Manager of Sony Semiconductor Manufacturing Corporation, declares that the proposed project is not registered under any other international climate mitigation mechanism other than the JCM. It is confirmed through the check of the relevant website (e.g. UNFCCC website, etc.) that the proposed project is not registered under any other international climate mitigation mechanisms in terms of the name of entity, applied technology, scale and location. Thus, it can be concluded that the proposed project will not result in double counting of GHG emission reductions.

<Findings>

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

No issue was raised to the requirement.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

JQA concludes that the proposed project is not registered under any other international climate mitigation mechanisms and hence will not result in double counting of GHG emission reductions.

C.10. Start of operation

<Means of validation>

For the proposed project, the commissioning of the project facilities was completed on 29/03/2017 and the starting date of monitoring activity was set as 01/04/2017. It is confirmed through the review of relevant documents, on-site assessment and the interview with the PPs that the starting date of the proposed project given in the PDD, 01/04/2017, is correct.

<Findings>

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

No issue was raised to the requirement.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

JQA concludes that the starting date of project operation is set as 01/04/2017 and does not predate 01/01/2013 as required by the Guideline of the JCM project.

C.11. Other issues

<Means of validation>

No more issues are raised in the validation of the proposed project.

<Findings>

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

Not applicable.

<Conclusion based on reporting requirements>

Please state conclusion based on reporting requirements.

Not applicable.

D. Information on public inputs

D.1. Summary of public inputs

In line with the JCM Project Cycle Procedure, the PDD was made publicly available for 30 days from 17/02/2018 to 18/03/2018 to invite public comments on the following JCM website: https://www.jcm.go.jp/th-jp/i1nformation/257

No public comments were received.

D.2. Summary of how inputs received have been taken into account by the project participants

Not applicable.

E. List of interviewees and documents received

E.1. List of interviewees

- Hironori Sakamoto, Managing Director, Sony Device Technology (Thailand) Co., Ltd.
- Yoshiro Fujiyama, Executive Director, Sony Device Technology (Thailand) Co., Ltd.
- Chiaki Nomura, Executive Director, Sony Device Technology (Thailand) Co., Ltd.
- Rapin Pensook, Executive Director, Sony Device Technology (Thailand) Co., Ltd.
- Apirome Puangchareanpor, Assistant General Manager, Sony Device Technology (Thailand) Co., Ltd.
- Somya Nathomtong, Assistant General Manager, Sony Device Technology (Thailand) Co., Ltd.
- Manattida Temiyakul, Sony Device Technology (Thailand) Co., Ltd.
- Chihiro Kudo, General Manager, Sony Technology (Thailand) Co, Ltd.
- Hirotoshi Kikuchi, Assistant Manager, Sony Technology (Thailand) Co, Ltd.
- Nobutaka Kawashita, Senior General Manager, Sony Semiconductor Manufacturing Corporation
- Takeshi Yamada, Manager, Sony Semiconductor Manufacturing Corporation
- Kazuyuki Amano, Sony Semiconductor Manufacturing Corporation
- Yasuhiro Takemura, Senior Manager, E-Square Inc.
- Kenichi Uchida, Manager, E-Square Inc.

E.2. List of documents received

1. PDD, ver. 1.0, 06/11/2017 and ver. 2.0, 20/02/2018
2. Monitoring Spreadsheet JCM_TH_AM003_ver01.0 and JCM_TH_AM006_ver01.0, 20/02/2018
3. JCM Modalities of Communication Statement Form (MoC) dated 22/11/2017
4. Approved Methodology JCM_TH_AM003_ver01.0, 21/08/2017, JC3, Annex 6
5. Monitoring Spreadsheet JCM_TH_AM003_ver01.0
6. Approved Methodology JCM_TH_AM006_ver01.0, 21/08/2017, JC3, Annex 8
7. Monitoring Spreadsheet JCM_TH_AM006_ver01.0
8. JCM Glossary of Terms (JCM_TH_Glossary_ver01.0)
9. JCM Project Cycle Procedure (JCM_TH_PCP_ver02.0)
10. JCM Modalities of Communication Statement Form (JCM_TH_F_MoC_ver01.0)
11. JCM Project Design Document Form (JCM_TH_F_PDD_ver02.0)
12. JCM Guidelines for Developing Project Design Document and Monitoring Report (JCM_TH_GL_PDD_MR_ver02.0)

13. JCM Guidelines for Validation and Verification (JCM_TH_GL_VV_ver01.0)
14. JCM Validation Report Form (JCM_TH_F_Val_Rep_ver01.0)
15. Project implementation plan for installation of high efficiency air conditioning system and Chillers in semiconductor factory
16. Layout of air conditioning units and chillers in the clean room of semiconductor plant
17. Profile of Sony Device Technology (Thailand) Co., Ltd.
18. Profile of Sony Semiconductor Manufacturing Corporation
19. Delivery and acceptance of construction work completion, dated 29/03/2017

20-1. Commissioning report of chiller (Model ETI-50)

20-2. Requirement of acceptance for clean room

21. Operational lifetime of the project (8 years)

22-1. Operation manual of chiller (ETI series) issued by Mitsubishi Heavy Industries, Ltd.

22-2. Operation manual of air conditioning unit (SWIT) issued by Nippon Floda Co.

23. Specification of chiller (ETI-50), including $COP_{PJ,i}$, $T_{cooling\text{-}out,i}$ and $T_{chilled\text{-}out,i}$

24-1. Specification of air conditioning unit (SWIT)

24-2. Design of air conditioning system

24-3. System of air conditioning unit (SWIT)

24-4. Characteristic of air conditioning unit (SWIT)

24-5. Flow rate vs. Differential pressure

25. Preventive Maintenance Control Plan, prepared by Sony Device Technology (Thailand) Co., Ltd.
26. Annual maintenance service report for chiller, issued by Mitsubishi Heavy Industries – Mahajak Air Conditioners Co., Ltd.
27. Specification of refrigerant “ASAHIKLIN AK-134a” (HFC-134)
28. Letter of Consent for maintenance of chiller, issued by Sony Device Technology (Thailand) Co., Ltd. and Sony Semiconductor Manufacturing Corporation, dated 18/12/2017
29. Monitoring system and monitoring points for measuring electricity consumption of air conditioning unit and chiller

30-1. Design of clean room for 1K

30-2. Design of clean room for 10K

30-3. Design of air conditioning system for clean room

30-4. ISO 14644-1

31-1. Environmental Impact Assessment in Thailand, Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment, August 2015

31-2. Thailand EIA Guidebook issued by IGES, March 2015

32-1. Agenda of local stakeholder consultation meeting held on 22/11/2016
32-2. Participant list of local stakeholder consultation meeting
32-3. Minutes of local stakeholder consultation meeting
32-4. Presentation materials used for the local stakeholder consultation meeting
32-5. Summary of comments received at the local stakeholder consultation meeting
33. Monitoring structure of the proposed project
34. Specification of electricity meter
35. Calibration frequency of electricity meter recommended by manufacturer
36. 2016 Grid Emission Factor of Thailand issued by Greenhouse Gas Management Organization

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

Statement of competence JQA

Name: Dr. Tadashi Yoshida

Qualified and authorized by Japan Quality Assurance Organization.

Function	Date of qualification
Validator	2014/12/22
Verifier	2014/12/22
Team leader	2014/12/22

Technical area within sectoral scopes	Date of qualification
TA 1.1. Thermal energy generation	2014/12/22
TA 1.2. Renewables	2014/12/22
TA 3.1. Energy demand	2014/12/22
TA 4.1. Cement and lime production	2015/11/12
TA 4.6. Other manufacturing industries	2014/12/22
TA 5.1. Chemical industry	2014/12/22
TA 10.1. Fugitive emissions from oil and gas	2014/12/22
TA 13.1. Solid waste and wastewater	2014/12/22
TA 14.1. Afforestation and reforestation	-

Statement of competence JQA

Name: Mr. Koichiro Tanabe

Qualified and authorized by Japan Quality Assurance Organization.

Function	Date of qualification
Validator	-
Verifier	2014/12/22
Team leader	2014/12/22

Technical area within sectoral scopes	Date of qualification
TA 1.1. Thermal energy generation	2014/12/22
TA 1.2. Renewables	2014/12/22
TA 3.1. Energy demand	2014/12/22
TA 4.1. Cement and lime production	-
TA 4.6. Other manufacturing industries	2014/12/22
TA 5.1. Chemical industry	2014/12/22
TA 10.1. Fugitive emissions from oil and gas	2014/12/22
TA 13.1. Solid waste and wastewater	2014/12/22
TA 14.1. Afforestation and reforestation	-