JCM Project Design Document Form

A. Project description

A.1. Title of the JCM project

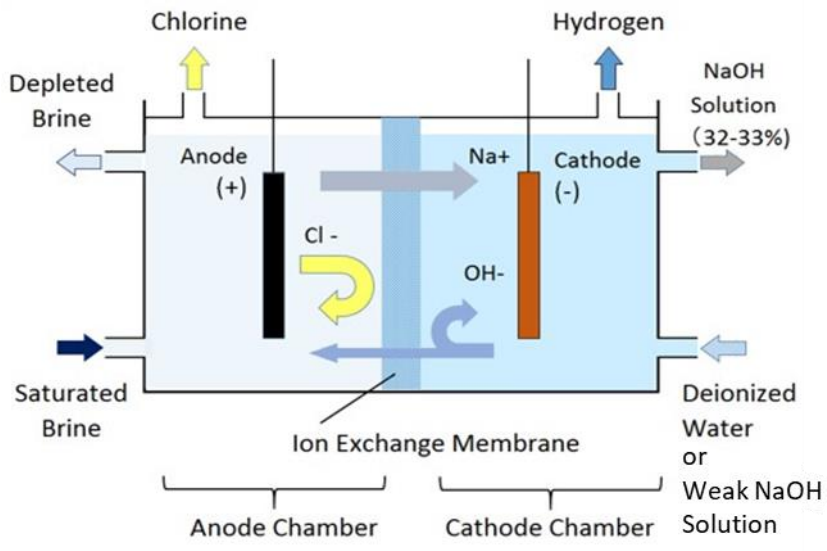
Introduction of High Efficiency Ion Exchange Membrane Electrolyzer in Caustic Soda Production Plant

A.2. General description of project and applied technologies and/or measures

The Phrapradaeng Factory of AGC Chemicals (Thailand) Co, Ltd., produces caustic soda and chlorine by running production facilities where ion exchange membrane electrolyzers are in operation. One of these facilities, called "MTA-5", was built in 1990. In this project, a new production facility "MTA-9" is constructed in a new land within the Phrapradaeng Factory, where two high efficient electrolyzers are newly installed. These new electrolyzers replace the production function of the existing 20 electrolyzers in MTA-5, which reduces the power consumption and CO_2 emissions by the facility.

The production process of caustic soda (NaOH) and chlorine (Cl_2) requires a decomposition of brine (NaCl) through ion exchange membrane electrolyzer as the following formula and figure indicate.

$$2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$$



Ion Exchange Membrane Electrolyzer (Schema)

The project electrolyzer “nx-BiTAC” is designed to make improvements in electrodes and inner structures. It also adopts finer meshes in anode and cathode for a homogeneous distribution of electric current, and optimal inner structures for a uniform concentration of supplied brine, so that these technological improvements contribute to a reduction in resistance. The membranes installed between anode and cathode compartments of the project electrolyzer are also designed to lower resistance by improving their polymer composition. These reductions of resistance in the project electrolyzer and membrane lessen the energy loss and power consumption per unit in the production process, which results in CO_2 emission reductions.

A.3. Location of project, including coordinates

Country	The Kingdom of Thailand
Region/State/Province etc.:	Samut Prakarn
City/Town/Community etc:	202 Moo 1, Suksawasdi Road (Km. 17), Tambol Pak KlongBang Plakod Amphur Prasamutjedi
Latitude, longitude	13°36'45.8"N, 100°32'55.9"E

A.4. Name of project participants

The Kingdom of Thailand	AGC Chemicals (Thailand) Co, Ltd.
Japan	AGC Inc.

A.5. Duration

Starting date of project operation	25/01/2019
Expected operational lifetime of project	8 years

A.6. Contribution from Japan

The proposed project was partially supported by the Ministry of the Environment, Japan through the Financing Program 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. The production process of NaOH and Cl_2 with Ion Exchange Membrane (IEM) Process was licensed and technically transferred by Japanese company AGC Inc. to AGC Chemicals (Thailand) Co, Ltd., and updated IEM Electrolyzer, named nx-BiTAC, was supplied by tkUCE-Japan who manufactured in Okayama and Fujisawa. The specific operation manual (including training of nx-BiTAC installation / re-membrane work) was transferred from tkUCE-Japan to AGC Chemicals (Thailand) Co, Ltd. as well.

B. Application of an approved methodology(ies)

B.1. Selection of methodology(ies)

Selected approved methodology No.	JCM_TH_AM015
Version number	Ver01.0

B.2. Explanation of how the project meets eligibility criteria of the approved methodology

<table>
<tr><th>Eligibility criteria</th><th>Descriptions specified in the methodology</th><th>Project information</th></tr>
<tr><td>Criterion 1</td><td>Bipolar electrolyzer(s), which employs an ion-exchange membrane technology, is installed in the manufacturing process of caustic soda.</td><td>The proposed project installs two bipolar electrolyzers which employ ion exchange membrane in the chlor-alkali manufacturing process of Phrapradaeng Factory producing caustic soda and chlorine.</td></tr>
<tr><td>Criterion 2</td><td>SEC value of project electrolyzer under the standard conditions, 32% NaOH and 90 degrees Celsius is less than threshold SEC value set in the table below under the standard conditions, 32% NaOH and 90 degrees Celsius;

<table>
<tr><th>CD (Current density) [kA/m^2]</th><th>Threshold SEC value of the electrolyzer [kWh (DC)/t-NaOH]</th></tr>
<tr><td>4.0 ≤ CD < 4.5</td><td>2,013</td></tr>
<tr><td>4.5 ≤ CD < 5.0</td><td>2,038</td></tr>
<tr><td>5.0 ≤ CD < 5.5</td><td>2,061</td></tr>
<tr><td>5.5 ≤ CD < 6.0</td><td>2,086</td></tr>
<tr><td>6.0 ≤ CD < 6.5</td><td>2,110</td></tr>
</table>

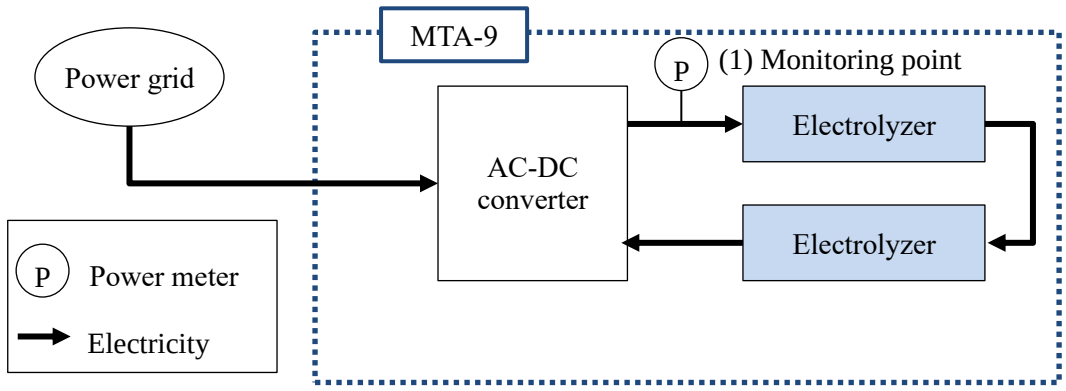
SEC value of project electrolyzer is derived from performance guaranteed value provided by manufacturer.</td><td>The SEC value of the project electolyzer guaranteed by the manufacturer is 1,979 kWh (DC)/t-NaOH when CD is 5.79 kA/m^2 and is less than the corresponding threshold SEC value.</td></tr>
</table>

C. Calculation of emission reductions

C.1. All emission sources and their associated greenhouse gases relevant to the JCM project

Reference emissions	
Emission sources	GHG type
Power consumption of reference electrolyzer	CO_2
Project emissions	
Emission sources	GHG type
Power consumption of project electrolyzer	CO_2

C.2. Figure of all emission sources and monitoring points relevant to the JCM project



Monitored data used for credit issuance are kept and archived for two years after the final issuance of credits.

C.3. Estimated emissions reductions in each year

Year	Estimated Reference emissions (tCO_2e)	Estimated Project Emissions (tCO_2e)	Estimated Emission Reductions (tCO_2e)
2013	-	-	-
2014	-	-	-
2015	-	-	-
2016	-	-	-
2017	-	-	-
2018	-	-	-
2019	45,691.83	43,348.10	2,343
2020	48,907.68	46,398.99	2,508
2021	48,907.68	46,398.99	2,508
2022	48,907.68	46,398.99	2,508

2023	48,907.68	46,398.99	2,508
2024	48,907.68	46,398.99	2,508
2025	48,907.68	46,398.99	2,508
2026	48,907.68	46,398.99	2,508
2027	3,215.85	3,050.89	164
2028	-	-	-
2029	-	-	-
2030	-	-	-
Total (tCO_2e)			20,063

D. Environmental impact assessment	
Legal requirement of environmental impact assessment for the proposed project	Yes See section "F. References"

E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

A local stakeholder consultation has been conducted on 28 November, 2018. The participants are listed in the table below.

The list of participants to the meeting has been consulted to the JCM secretariat of the Thai side (TGO: Thailand Greenhouse Gas Management Organization), and the local stakeholders to be invited have been fixed. The project participants sent invitation letters to those stakeholders to notify them of convening the local stakeholder consultation meeting. The schedule and participants of the meeting are provided below.

Date: 28 November 2018
Venue: Phrapradaeng Factory of AGC Chemicals (Thailand) Co, Ltd.
Time: 10:00-12:00

Agenda:
1. Opening remarks
2. Introduction about AGC Chemicals (Thailand) Co, Ltd. and AGC Inc.
3. Project overview, and introduced technology and facility
4. Questions and answers
5. Plant tour

6. Closing

Participants:

[Local stakeholders]

No.	Organization	Position
1	TGO	Manager (Review and Monitoring Office)
2		Manager (Review and Monitoring Office)
3		Technical Officer (Review and Monitoring Office)

[Project participants]

No.	Organization	Position
1	AGC Chemicals (Thailand) Co, Ltd.	Executive Director, Chief Technical Officer (CTO)
2		Director, Factory Manager
3		Division Manager, Production Division
4		Division Manager, Maintenance Division
5		Department Manager, Administration Division

A summary of the received comments and consideration of those comments are provided in Section E.2.

E.2. Summary of comments received and their consideration

Stakeholders	Comments received	Consideration of comments received
TGO	Is MTA-9 constructed in a new land, or where MTA-5 stands? Is there a capacity extension in output level by starting operation of MTA-9?	The construction of MTA-9 takes place in a new land. MTA-5 had been in operation until MTA-9 started operation on 8 November 2018. The output level does not change. No further action is needed.
TGO	What is the difference between conventional and project	The conventional technology may be n-BiTAC, but the project

	technology?	electrolyzer adopts nx-BiTAC. One of the differences is the number of contact points between cathode mesh and frame: about 10,000 points/electrolyzer for n-BiTAC and 100,000 points/electrolyzer for nx-BiTAC. The increase in the contact points decreases IR-drop, and achieves homogeneous distribution of electric current and less energy consumption. No further action is needed.
TGO	How can the project technology reduce electricity usage and greenhouse gas emission?	Reduction of electricity usage comes from the new design of electrolyzer and membrane that increases the conductivity. No further action is needed.
TGO	Is there a captive power generator in project site?	Yes, but it is intended only for emergency situation. The power generation capacity is too small to be used for operating electrolyzers. No further action is needed.
TGO	The electrolyzer consumes DC-power that must be converted from AC by using rectifier. Losses from the conversion will not be accounted if the project monitors DC and directly uses the value for calculation of GHG emission reduction.	This issue will be discussed during the development of methodology. No further action is needed.

F. References

Doc.no. TorSor 1009.8/ 2366

Reference lists to support descriptions in the PDD, if any.

Annex
N/A

Revision history of PDD		
Version	Date	Contents revised
01.0	16/02/2022	First edition