CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

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Title: Effective use of the waste gas emitted from ammonia production plant in Syria

Version: 01
Date: 31/01/2010

A.2. Description of the project activity:

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General Fertilizer Company (hereafter called "GFC") which was established in 1967 is a unique and state-owned chemical complex in Homs which is the third biggest city in Syria. GFC have started the operation in 1972 and mainly manufactures ammonia (production capacity: 1,000 ton/day), urea (production capacity: 1,050 ton/day), nitric acid (production capacity: 280 ton/day), sulphuric acid (production capacity: 1,700 ton/day), phosphoric acid (production capacity: 580 ton/day) double superphosphate (production capacity: 1,450 ton/day) made from phosphoric acid and calcium sulphate (production capacity: 4,500 ton/day) as a by-product.

In GFC, off gas purged from the ammonia plant (hereafter called "ammonia-plant off gas (AOG)") which is combustible gas containing methane and hydrogen, has been released to the atmosphere without flaring, recovery or any other treatments. The regulations in Syria do not prohibit such current practice.

GFC had tried several times to utilize such off gas, but failed at each time of trial.

The purpose of the proposed project is to efficiently utilize all amount of generated ammonia-plant off gas as an alternative fuel to the current natural gas consumption. AOG is captured and used for as the boiler fuel displacing one of two boilers which have fed production processes within GFC with steam. A displaced natural gas boiler will be left as

Furthermore, an DeNOx unit will be installed to reduce NOx in exhaust gas from the AOG boiler.

The project activity is expected to contribute to the sustainable development locally or country as a whole as follows:

- Avoidance of the offensive odor due to ammonia;
- Employment creation (as construction and operation);
- New technology installation, technology transfer for monitoring to be employed by the project activity, and capacity building for QA/QC;
- Awareness-raising activity for environment and climate change in Syria where there are currently few CDM projects; and
- Stabilization for marketable price of fertilizers in agricultural host country Syria.

A.3. Project participants:

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Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Syrian Arab Republic (host)	**General Fertilizer Company (G.F.C.)** [owner and operator of the ammonia plant]	No
Japan	**Shimizu Corporation** [developer and co-financer of this CDM project]	No
Japan	**Osumi Co., Ltd** [coordinator of this CDM project]	No
Japan	**Climate Experts Ltd.** [CDM adviser]	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

>>

Syrian Arab Republic

A.4.1.2. Region/State/Province etc.:

>>

Homs city

A.4.1.3. City/Town/Community etc.:

>>

Kattina, Homs

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

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Homs city is located approximately 160 km north of Damascus (about midway between Damascus and Aleppo).

GFC is located on a south-west suburb area about 10 km from Homs city center and is located on an industrial park. (Physical location of G.F.C: latitude 34° 39' 14"north/longitude 36° 37' 37"east)

Figure 1: Location of Homs City, Syrian Arab Republic

Figure 2: Location of GFC (Kattina, Homs)

A.4.2. Category(ies) of project activity:

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Category 5: Chemical industries.

A.4.3. Technology to be employed by the project activity:

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Ammonia is manufactured from natural gas. Ammonia production process is as the following;

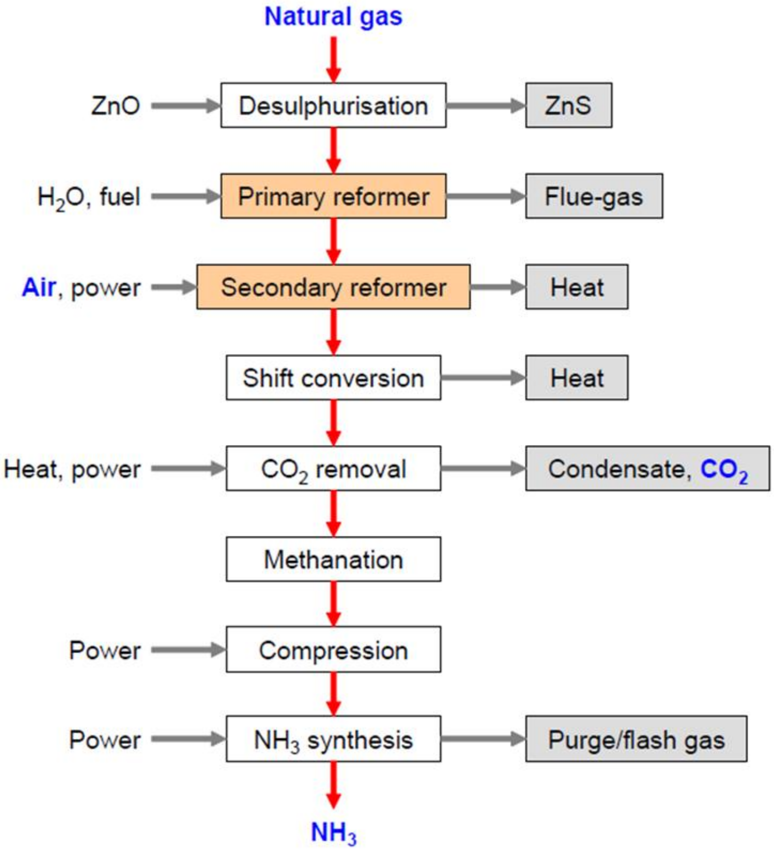

Figure 3: Ammonia production process flow[1]

De-sulphurisation

The catalyst used in the steam reforming process is highly sensitive to any sulphur compounds. So the sulphur compounds are hydrogenated to H_2S, typically using a cobalt molybdenum catalyst, and then finally adsorbed on pelletised zinc oxide (R = alkyl group):

[1] EIPPC (European Integrated Pollution Prevention and Control Bureau) Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals-Ammonia, Acids and Fertilizers (2007), Brussels, Belgium. August 2007 (available at http://ec.europa.eu/environment/ippc/brefs/lvic_bref_0907.pdf).

$$R\text{-}SH + H_2 \rightarrow H_2S + RH$$

$$H_2S + ZnO \rightarrow ZnS + H_2O$$

Primary reforming

Natural gas after the desulphuriser is mixed with steam and the preheated mixture enters the primary reformer at a temperature in the range of 400–600 °C and is converted to the hydrogen through catalyst containing nickel:

$$CH_4 + H_2O \rightarrow CO + 3H_2$$

Secondary reforming

In the secondary reforming process, air is fed for the purpose of adding the nitrogen required for the synthesis and completing the conversion of the hydrocarbon feed. In this process, most of remaining methane is converted down to a residual content:

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Shift conversion

CO contained in the process gas from the secondary reformer is converted in the shift section to CO_2 and H_2:

$$CO + H_2O \rightarrow CO_2 + H_2$$

CO_2 removal

This process step removes the CO_2 from the reaction gas and the quantity corresponds to nearly all the carbon introduced as feed gas into the overall process. The CO_2 is removed in a chemical or physical absorption process.

Methanation

The small amounts of CO and CO_2, remaining in the synthesis gas, can poison the ammonia synthesis catalyst and must be removed usually by conversion to CH_4 by hydrogenation:

$$CO + 3H_2 \rightarrow CH_4 + H_2O$$

Compression

Hydrogen and nitrogen gained through above-mentioned processes show a molar ratio of 3 to 1. Argon and methane in small amounts are contained as remaining contents. The synthesis gas is compressed to the required level for ammonia synthesis.

NH_3 synthesis

The synthesis of ammonia takes place on an catalyst (containing Fe_3O_4) at pressures usually in the range of 100–250 bar and at temperatures of between 350 and 550 °C:

$$N_2 + 3H_2 \rightarrow 2NH_3$$

Conversion rate of the synthesis gas to ammonia is low, due to unfavourable equilibrium conditions. The unreacted gas is recycled after removing the ammonia formed. Fresh synthesis gas is supplemented in the loop. Conventional reforming with methanation as the final purification step produces a synthesis gas containing unreacted gases and inerts (methane and argon).

The accumulation of these inerts prevent this reaction. In order to prevent the accumulation of these inerts, a constant rate of the loop gas is continuously purged to outside of the loop.

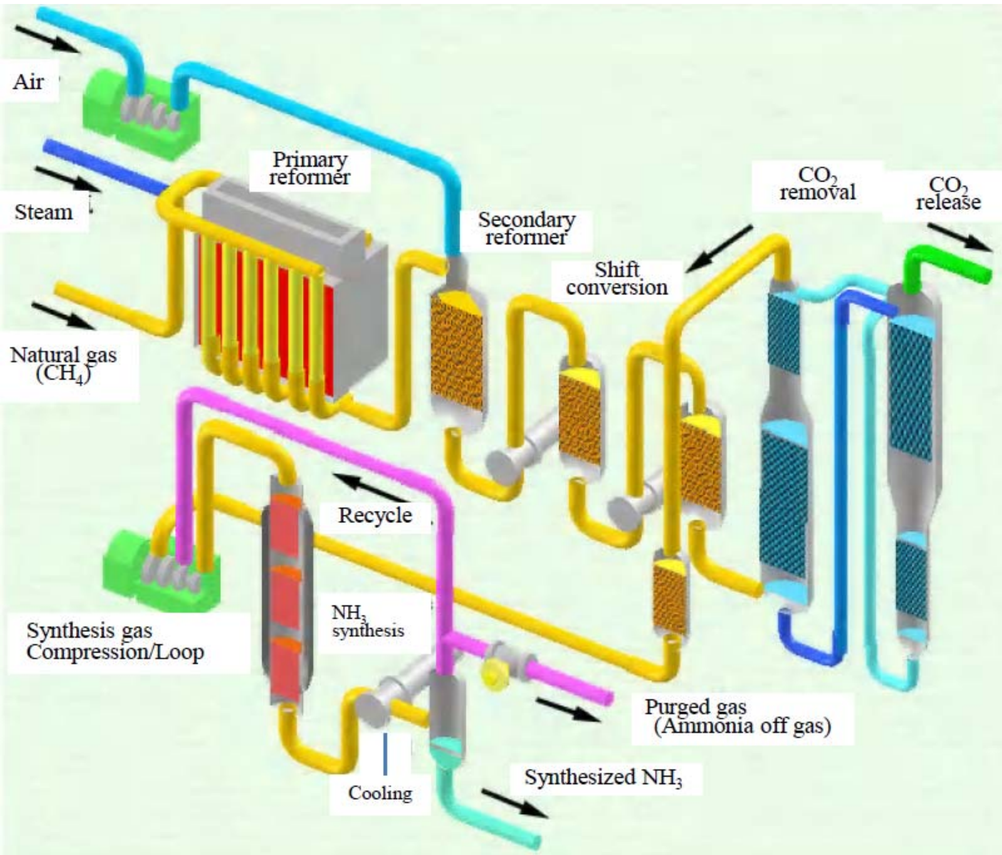

Figure 4: Ammonia plant diagram[2]

In GFC, ammonia-plant off gas purged from the ammonia plant, which is combustible gas containing methane and hydrogen, has been released to the atmosphere without flaring, recovery or any other treatments. The regulations in Syria do not prohibit current practice to release the off gas.

Currently in GFC, high-pressure steam—for main production process of GFC—is generated by two natural gas boilers[3]. These boilers are constantly operated in parallel and generate high-pressure steam used for some steam utility lines by reducing the compression.

[2] http://chemeng.on.coocan.jp/resource/an_home.html.
[3] For 1 unit, Steam pressure: 40bar. Rated output steam：60t/hr. Design capacity for natural gas combustion: 5,000 Nm^3/hr.

In order to utilize the ammonia-plant off gas for high pressure steam generation, new installation of a high efficient boiler is needed, because the net calorific value of the ammonia-plant off gas is considerably lower than that of natural gas. As a result, it is impossible just to modify the existing boilers (*e.g.* by changing burner) to generate high pressure. Furthermore, a DeNOx unit will be installed for the purpose of reducing NOx in exhaust gas from the AOG boiler.A high-efficient boiler to be employed by the project activity specifically designed to burn flue gas with ammonia is the type as shown below:

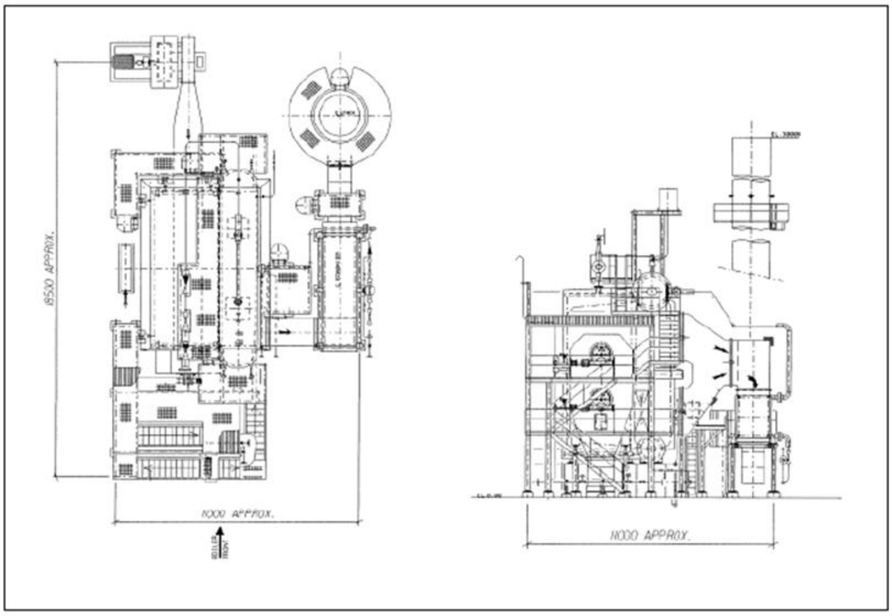

Figure 5: Appearance of through flow type boiler

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

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Ex ante estimation for GHG emission reductions during the crediting period is as follows;

Year (Month)	Annual estimation of emission reductions in tonnes of CO_2 e
2011(Jan.-Dec.)	85,343
2012(Jan.-Dec.)	85,343
2013(Jan.-Dec.)	85,343
2014(Jan.-Dec.)	85,343
2015(Jan.-Dec.)	85,343
2016(Jan.-Dec.)	85,343
2017(Jan.-Dec.)	85,343
2018(Jan.-Dec.)	85,343

2019(Jan.-Dec.)	85,343
2020(Jan.-Dec.)	85,343
Total estimated reductions (tonnes of CO_2 e)	853,430
Total number of crediting years	10 years
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	85,343

A.4.5. Public funding of the project activity:

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The project will not utilize any official funding from Annex I countries.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

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The proposed project is based on submitting a new baseline and monitoring methodology.

“Effective use of the waste gas emitted from ammonia production plant” (ver. 1)
currently submitted as a new methodology.

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

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The applicability conditions specified in the proposed methodology (*italic in a box*) and the explanation whether the conditions are applicable to the proposed project activity are as follows:

*(1) The project activity collects and utilizes all of the ammonia-plant off gas (AOG) which has been released to atmosphere without recovery or flaring at an existing ammonia production plant before implementation of the project. It shall be demonstrated by direct measurements of the energy content and the amount of the AOG produced for at least three years prior to the start of the project activity;*The proposed project collects and utilizes all of the ammonia-plant off gas (AOG) which has been released to atmosphere without recovery or flaring at an existing ammonia production plant before implementation of the project. And it will be demonstrated by direct measurements of the energy content and the amount of the AOG produced for at least three years prior to the start of the project activity.

*(2) Regulations of the host country on volume, concentration, chemical composition or others of the ammonia-plant off gas (AOG) do not prohibit the current practice to release AOG without flaring, recovery or other treatment prior to implementation of the project activity;*Regulations of Syria on volume, concentration, chemical composition or others of the ammonia-plant off gas (AOG) do not prohibit the current practice to release the ammonia-plant off gas (AOG) without flaring, recovery or other treatment prior to implementation of the project activity;

(3) The project activity does not increase the lifetime of the boiler existent prior to the project activity during the crediting period (i.e., emission reductions are only accounted up only to the end of the lifetime of the boiler existent prior to the project activity). The options specified in the latest guideline “Treatment of the lifetime of plants and equipment in proposed new baseline methodologies” are applieds for the assessment of the lifetime;

The remaining operational lifetime of the natural gas boiler existent prior to the project activity is much longer than the crediting period.

(4) The proposed project activity does not result in integrated process change for the chemical complex.

The proposed project activity does not result in integrated process change for GFC. A portion of natural gas which is the fuel for process steam is only displaced by the ammonia-plant off gas.

(5) The project activity utilizes the ammonia-plant off gas (AOG) only for steam generation by an AOG-specific new boiler in the ammonia-plant without mixing with other fuels to replace internal fuel use for this purpose. The total of the steam demand in the facility is not affected or reduced by the project activity; and

The proposed project activity utilizes the ammonia-plant off gas for steam generation to replace internal fuel use for this purpose.

The proposed project utilizes the ammonia-plant off gas (AOG) only for steam generation by an AOG-specific new boiler in the ammonia-plant without mixing with other fuels to replace internal fuel use for this purpose. The total of the steam demand in the facility will not be affected or reduced by the project activity

(6) AOG that is released from abnormal operation (e.g., in the case of emergencies, shut down) of the plant shall not be accounted for emission reductions.

For this project, AOG that is released from abnormal operation (e.g., in the case of emergencies, shut down) of the plant is not accounted for emission reductions.

The additional applicability conditions specified in the proposed methodology (italic in a box) and the explanation whether the conditions are applicable to the proposed project activity are as follows:

This methodology is not applicable to the case where an industrial facility captures and utilizes a portion of AOG in the absence of the project activity;

The proposed project utilizes all amount of AOG emitted by the ammonia plant.

The project activity may clear off ammonia from AOG before its utilization as a fuel and/or install De-NOx equipment from exhaust gas from the AOG-fueled boiler;

For this project, a De-NOx equipment will be newly installed to deduce NOx emissions in the exhaust gas from the AOG-fueled boiler. So, it is not needed to clear off ammonia from AOG before its utilization.

The methodology is only applicable when the continuation of total atmospheric release of AOG without flaring, recovery or other treatment is provided to be the most plausible baseline scenario;

For the project activity, the most plausible baseline scenario is considered to be the continuation of total atmospheric release of AOG without flaring, recovery or other treatment. As for the demonstration, please see Section B.4 and B.5 in this PDD.

The above analysis explains the project fully meets the applicability conditions of the proposed methodology.

B.3. Description of the sources and gases included in the project boundary:

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The proposed project aims to install equipment to collect all of the AOG (except for the case of emergency) and use it as a single fuel (not mixing with other fuels) for steam generation in a new boiler specifically designed for AOG. It replaces an exiting boiler which uses a fossil fuel although the replaced one may be kept as it is for back-up purposes. Then, In order to meet NOx regulation, a DeNOx equipment will be introduced to collect ammonia from it and/or to clean the exhaust gas as shown.

As shown in figure 6, the spatial extent of the project boundary covers the site of the project activity where the ammonia-plant off gas is captured (within ammonia plant for this project) and the recovered ammonia-plant off gas are used as the boiler fuel in GFC.

Summary of gases and sources included in the project boundary, and justification/explanation where gases and sources are not included are as follows;

	Source	Gas	Included?	Justification/Explanation
Baseline	Emissions as the ammonia-plant off gas (AOG) without flaring or any other disposal	CH_4	Yes	The major source of emissions in the baseline
		N_2O	No.	Little N_2O is contained in ammonia-plant off gas. Exclusion of this gas is conservative.
		CO_2	No	CO_2 [5]is not utilized both for the baseline scenario and the project activity (common emissions).
	Baseline fuel burning for the boiler (equivalent to the thermal output which is displaced by the ammonia-plant off gas.)	CO_2	Yes	The major source of emissions in the baseline For this project, the baseline fuel is natural gas.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative
Project activity	Combustion and utilization of ammonia-plant off gas by the project activity	CO_2	Yes	The major source of emissions (CO_2 emissions from CO_2 contained in ammonia-plant off gas prior to burning are excluded.)
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

[5] Little CO_2 is contained in ammonia off gas because CO_2 is removed not to prevent NH_3 synthesis.

	Emissions from electricity use for an ammonia absorber (for the purpose of avoiding NOx generation)	CO_2	Yes	Maybe an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

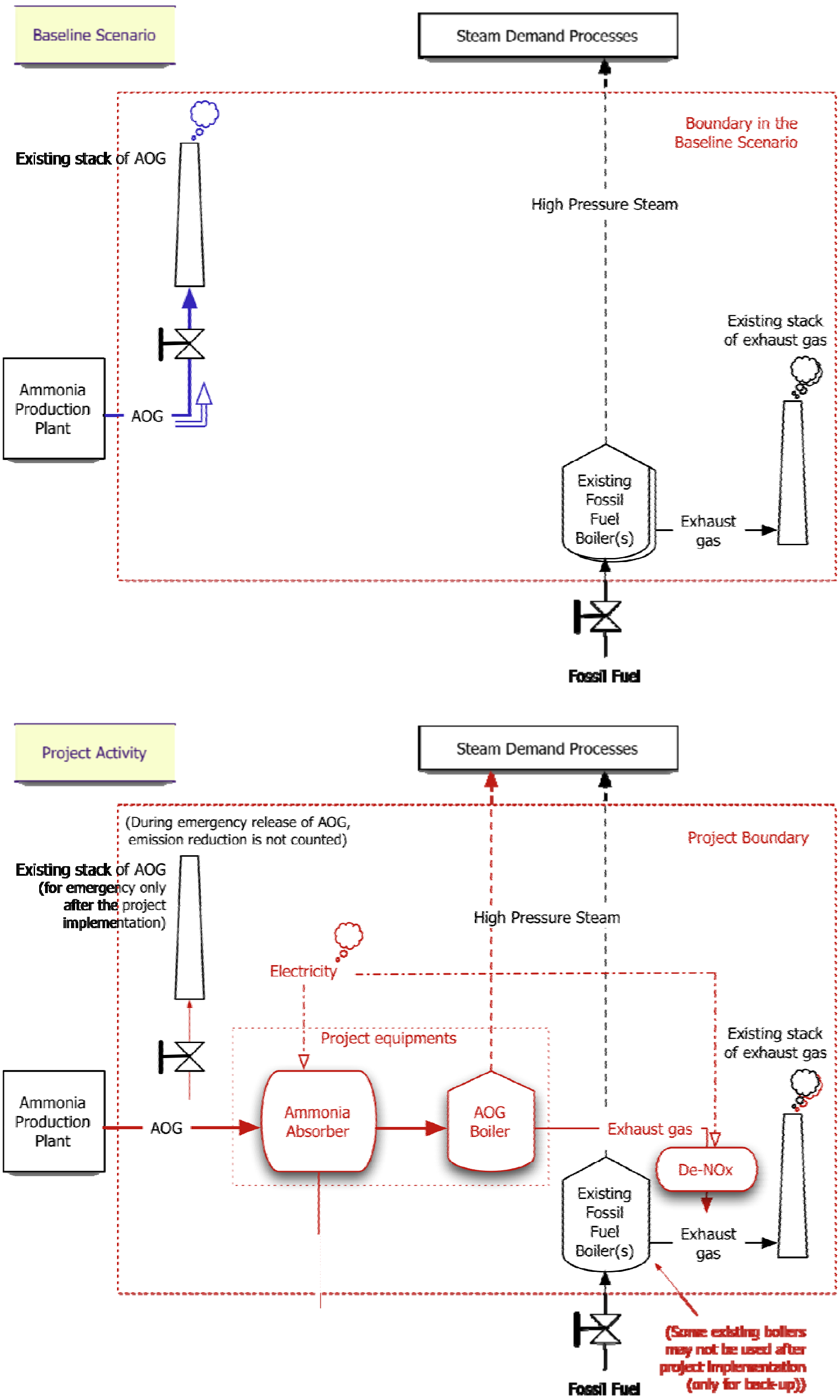

Figure 6: Project boundary

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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The proposed methodology requires four steps to identify the baseline scenario. Each step is traced as follows:

Step 1: Identification of alternative scenarios

In identifying baseline scenario alternatives, the elements of the project activity are divided into two components as follows;

(a) treatment/utilization of the ammonia-plant off gas (AOG), and
(b) heat supply for the steam generation.

Alternatives for (a) treatment/utilization of the off gas in the absence of the project activity, *i.e.*, the scenario relevant for estimating baseline emissions, to be analysed should include, *inter alia*:

AOG1: The project activity (i.e. capture of ammonia-plant off gas and its use for steam generation in an AOG-specific boiler not being mixing with other fuels) undertaken without being registered as a CDM project activity;

AOG2: Capturing AOG and using it for steam or power generation with a boiler by mixing it with other fuels;

AOG3: Continuation of current practice (i.e., release of the ammonia-plant off gas to the atmosphere without recovery and flaring) during the entire crediting period;

AOG4: (Partial) capture of the ammonia-plant off gas and flaring it;

AOG5: (Partial) capture of the ammonia-plant off gas for energy use other than steam generation at the chemical complex;

AOG6: (Partial) capture of the ammonia-plant off gas for feedstock use at the chemical complex;

AOG7: (Partial) capture of the ammonia-plant off gas for sale.

For (b) heat supply for the steam generation, the realistic and credible alternative(s) may include, *inter alia*:

HS1: The project activity (i.e. capture of ammonia-plant off gas and its use for steam generation) undertaken without being registered as a CDM project activity;

HS2: Continuation of the current practice of using the existing fossil fuel;

HS3: Change of the current fossil fuel with another fuel.

Step 2: Eliminate alternatives that are not complying with applicable laws and regulations

The option AOG3 is eliminated in this step because the NOx regulation does not allow to combust off gas with highly concentrated ammonia.

All the above alternatives identified above except for AOG3 are in compliance with all applicable legal and regulatory requirements.

Step 3: Eliminate alternatives that face prohibitive barriers

Scenarios that face prohibitive barriers should be eliminated by applying step 3 of the latest version of the "Tool for demonstration assessment and of additionality" agreed by the CDM Executive Board as well as the elements shown in the following additionality section of the methodology.

The following discussion will show whether the identified barriers from step 3 of the latest version of the "Tool for demonstration assessment and of additionality" will prevent the implementation of the baseline scenario alternatives presented from step 2 above:

AOG1: The project activity (*i.e*. capture of ammonia-plant off gas and its use for steam generation in an AOG-specific boiler not being mixing with other fuels) undertaken without being registered as a CDM project activity;

Currently in GFC, high-pressure steam—for main production process of GFC—is generated by two natural gas boilers. These boilers are constantly operated in parallel and generate high-pressure steam used for some steam utility lines by reducing the compression.

In order to utilize the ammonia-plant off gas for high pressure steam generation, new installation of a high efficient boiler is needed, because the net calorific value of the ammonia-plant off gas is considerably lower than that of natural gas. As a result, it is impossible just to modify the existing boilers (*e.g*. by changing burner) to generate high pressure. Furthermore, an ammonia absorber is installed for the purpose of removing ammonia contained in the ammonia-plant off gas before using it as boiler fuel. In case of burning the fuel gas containing ammonia, regulation on NOx emissions will not be met due to highly concentrated fuel NOx.

For the proposed project activity, GFC cannot access to the original manufacturer (Kellogg Ltd., UK) as Syria has politically isolated. Therefore, severe technological barrier is found. The technology to utilize ammonia-plant off gas is the "first-of-this-country" in Syria. We see that this option would face prohibitive barriers due to prevailing practice in Syria.

Moreover, the host company GFC is state-owned company and does not have any intension to improve the energy efficiency due to the lack of economical incentives to do so.

In reality, the World Bank undertook a comprehensive study of the GFC in 1990.[6] It identified many measures in a priority order. However, most of such measures have not yet realized. For the proposed

[6] "Syria: Energy Efficiency in the Fertilizer Sector" (June 1990) by Energy Efficiency and Strategy Unit, Industry and Energy Department, The World Bank (Report No. 115/90).

project activity, although it is rated “3” among prioritized measures rated as “1A, 2A, 1B, 2B, 1C, or 3”.

In addition, GFC tried several times to recover/utilize the AOG, but every trial was failed as shown below.

Furthermore, reform of steam lines is not substantively available to GFC for utility of low pressure steam generated by the existing boiler using the ammonia-plant off gas as fuel, because this method needs considerable initial investment costs such as large scale retrofits and takes considerable shutdown time.

Therefore, AOG1 would NOT be realized as the probable baseline scenario.

AOG2: Capturing AOG and using it for steam or power generation with a boiler by mixing it with other fuels;

As for new installation of a boiler for mixing AOG with the natural gas, it would NOT be realized as the probable baseline scenario.

AOG3: Continuation of current practice (*i.e.*, release of the ammonia-plant off gas to the atmosphere without recovery);

This option is not prevented by any barriers.
Then, as for remaining lifetime of the existing boiler (to be replaced in the project activity), it would be longer than the crediting period because of the manufacture’s information on the technical lifetime of boiler. Later, it will be validated by the verifier.

AOG5: (Partial) capture of the ammonia-plant off gas for energy use other than steam generation at the chemical complex;

For this option, it is considerable to use the ammonia-plant off gas as fuel of the primary reformer in the ammonia plant. However it would technologically face prohibitive barriers in Syria. It is required for utilization for fuel of the primary reformer to apply a burner which fits to the chamber capacity/configuration of the primary reformer and calorie of the fuel. It is impossible to apply other burner, because it leads to damage the chamber.

There are no practiced hands who have such special technique/technical know-how and can operate/maintain safely in Syria. In addition, there are no specialized institutions which can give training in Syria.

Although GFC had tried with the cooperation of a British technology in past years, it could not be put into practice because of inappropriately-designed. Furthermore, GFC has not been able to obtain collaboration from US which had a technical know-how in this technical field because of economic sanction. GFC has not been able to obtain from other developed countries until now. Chronological efforts to utilize the ammonia-plant off gas are following table.

Date	Contact	Problem and Countermeasure
1988	Kellogg	The fuel is switched from naphtha to the natural gas by the design of the Kellogg Ltd. - UK

		Premixed combustion with the purge gas was planned at first. a) The back pressure of fuel gas system rises when the purge gas is mixed with the natural gas and the purge gas doesn't flow into the fuel gas system. b) The control of the combustion air is imperfect. c) The flame pattern of the natural gas combustion is not good either.
1988–	GFC	a) By making the purge gas high-pressure forcibly, the mixed gas was made and burnt. b) Because the possibility that the flame pattern deteriorated further and the catalyst tube is damaged was high, the mixed gas discontinued premixed combustion. c) Moreover, the combustion air cannot be controlled. d) There are a lot of bottlenecks in the ammonia plant. GFC had been examining the improvement plan of bottlenecks, but they were not able to be solved the problem. (The response of Kellogg Ltd. - UK at the early stage to this problem was "Abnormality cannot be found to our design.")
May 31, 1995	From KTI	KTI conducts the study to decrease the pressure of Fuel Gas System. "Process And Mechanical Study on How To Decrease The Pressure Drop In The Fuel Gas System Of The Primary Reformer of the 1000 MT/D Ammonia Plant At Homs – Syria prepared for General Fertilizer Company by Kinetics Technology International S.p.A."
2003	GFC Kellogg	GFC and Kellogg started a joint research toward solving the problem.
Mar. 18, 2003	To Kellogg	GFC requested the following to Kellogg. "Request for studying and finding solutions for bottlenecks in Ammonia plant (1000 m/t daily)" GFC presents six most big problems, and request the use of the purge gas as the one.
Apr. 2, 2003	From Kellogg	FAX of GFC on February 24 (Fuel Gas System problems) is answered as follows. "We have made a preliminary review of the flue gas system and cannot see anything abnormal in our design."
June 28, 2003	To JOHN ZINK	GFC requested the following to JOHN ZINK. "Problem of increasing the pressure of fuel gas arch burners related to primary reformer 101 B- asking for sending your expert of burners working (serviceman)"
Sep. 10, 2003	From Foure Lagadec CEAMAG	FL/CEAMAG has described various Bottlenecks that relates to Arch Burners and Cooling Water Loop as a result of the site investigation in "REPORT OF MISSION AT GFC HOMS SYRIA 1000 MTPD AMMONIA PLANT". The use of the purge gas has been described in the report as follows. "Due to the high pressure of purge gas (# 8kg/cm2), pressure of natural gas has to be increased up to 10 kg/cm2 to find equilibrium for mixing. At this pressure level the flame gets again very difficult adjust."

Sep. 12, 2003	From JOHN ZINK	ZHON ZINK reports on result of the site investigation (Subject: Arch Burner of Ammonia Reformer) as follows. A diameter of the pipeline and pressure of the natural gas and the purge gas, the burner tile and gas tips, a calorie of the fuel gas and a remaining heat temperature, and various problems of the flame pattern etc. are pointed out.
Sep. 29, 2003	To China National Bluestar Corp.	GFC explained a current problem of operating rates, and conferred on the offer of the Financial loan for solving the problem.
Apr. 2, 2004	From Kellogg	In FAX from Kellogg Ltd. – UK (Subject: KELLOGG Ammonia plant Re-vamp study - Proposal Ref: E3940), the discontinuance of cooperation is described as follows. “We regret to inform you that we are unable to reach agreement on this and regretfully Kellogg shall not be proceeding with this contract on the basis of your fax.”

AOG6: (Partial) capture of the ammonia-plant off gas for feedstock use at the chemical complex;

For this option, it is considerable to use the hydrogen content of the ammonia-plant off gas as for resource of ammonia in the process of ammonia synthesis. However it would technologically face prohibitive barriers in Syria. Because it is required to separate only hydrogen from the ammonia-plant off gas applying membrane separation method which is an advanced technology and can now only be installed in a few developed countries.

AOG7: (Partial) capture of the ammonia-plant off gas for sale;

This option would realistically face prohibitive barriers in Syria.

For the ammonia-plant off gas for sale, it has no attraction for buyers because it is required to remove ammonia for use as fuel. Therefore, this option is not realistically considerable.

For heat supply for the steam generation (b), the realistic and credible alternative(s) may include, *inter alia*:

HS1: The project activity (i.e. capture of ammonia-plant off gas and its use for steam generation) undertaken without being registered as a CDM project activity;

As already mentioned in AOG1, this option would face prohibitive barriers due to prevailing practice in Syria.

HS2: Continuation of the current practice of using the existing fossil fuel;

This option is not prevented by any barriers.

HS3: Change of the current fossil fuel with another fuel.

GFC have used a small amount of heavy oil, because the boiler for heavy oil had been already installed many years ago. It is possible for GFC to change the existing natural gas for steam generation to heavy oil which has been used for other purpose. However, GFC can get natural gas at rock-bottom prices under the shadow of the national preference policy. The price of heavy oil is almost same as the one of natural gas. Furthermore, it is apprehended to introduce air pollution by using heavy oil. Therefore, this option is not feasible and eliminated in this step.

As a result of the assessment against the barriers as discussed above, alternatives AOG1, AOG2, AOG4, AOG5, AOG6, AOG7, HS1 and HS3 are eliminated, and alternatives AOG3, HS2 remain.
Therefore, it is concluded that the baseline alternative chosen for the Project is the continuation of the current practice (Alternative AOG3 and HS2).

Step 4: Compare economic attractiveness of remaining alternatives

This step is not needed to consider.

Therefore, it is concluded that the baseline alternative chosen for the Project is the continuation of the current practice (Alternative AOG3 and HS2).

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

>>
As explained about the possibility of AOG1 in the previous section, the project activity would not be realized in the absence of CDM.

The date when ordering of equipment will be commenced (October 1, 2010) is considered as the starting date of the project activity and it was later than the starting date of the validation (to be expected June 1, 2010).

Furthermore, prior to the starting date of validation, there had been the following progress.

- Feasibility Study by Shimizu Corporation,
- Project Idea Note was submitted by Shimizu Corporation and it was officially accepted by Syrian DNA,
- MOU with Ministry of industry in Syria.

Therefore, it can be considered that project proponents had taken the project as a CDM project prior to implementation of project. In conclusion, the continuation of the current situation is considered as the baseline scenario and therefore the proposed CDM project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

>>

Followings are mathematical formulas (specified in the proposed methodology) to calculate project emissions, baseline emissions and the associated emission reductions for the case where the baseline scenario is the continuation of current practiced.

Project Emissions:

The amount of project emissions (with the ceiling) is given by

$$PE_y = PE_{AOG,y} + PE_{EL,y} \quad (1)$$

where:

PE_y = Project emissions in year y (tCO_2/yr)

$PE_{AOG,y}$ = Project emissions from ammonia-plant off gas combustion for fuel in year y (tCO_2/yr)

$PE_{EL,y}$ = Project emissions from electricity consumption for removing ammonia contained in the ammonia-plant off gas in year y (tCO_2/yr)

Project emissions include

1.– CO_2 emissions due to burning the ammonia-plant off gas (AOG) for fuel, and
2.– CO_2 emissions due to electricity consumption for removing ammonia contained in the AOG and for removing NOx from exhaust gas with additional De-NOx equipment, if any.

The project emissions is represented as:

$$\begin{aligned} PE_y &= PE_{AOG,y} + PE_{EL,y} \\ &= Q_{AOG,y} \times EF_{CO2,AOG,y} + \left(EC_{AA,y} + EC_{DeNOx,y}\right) \times CEF_{EL} \\ &= Q_{AOG,y} \times EF_{CO2,AOG,y} + \left(EC_{DeNOx,y}\right) \times CEF_{EL} \end{aligned} \quad (2)$$

Because, for this project, ammonia absorber will not installed.

where

PE_y : Project emissions in a reporting interval y (tCO_2e/reporting interval).

$PE_{AOG,y}$: Project emissions from ammonia-plant off gas (AOG) combustion for fuel in a reporting interval y (tCO_2/reporting interval).

$PE_{EL,y}$: Project emissions from electricity consumption for removing ammonia contained in the ammonia-plant off gas (AOG) and for removing NOx with De-NOx equipment, if any, in a reporting interval y (tCO_2/reporting interval).

$Q_{AOG,y}$: Net heat quantity of the ammonia-plant off gas (AOG) after removing ammonia that would be used in a reporting interval *y* by the project activity (GJ/duration of interval).

$EF_{CO2,AOG,y}$: CO_2 emission factor of the ammonia-plant off gas (AOG) after removing ammonia in a reporting interval *y* calculated based on the composition of the AOG (tCO_2/MJ). To obtain a rate for this parameter, Option A (based on chemical component) specified in the latest version of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"[7] is applied.

$EC_{AA,y}$: Quantity of electricity consumed for removing ammonia from AOG with ammonia absorber in a reporting interval *y* (MWh/reporting interval).

$EC_{DeNOx,y}$: Quantity of electricity consumed by DeNOx equipment in a reporting interval *y* (MWh/reporting interval).

CEF_{EL} : CO_2 emission factor of electricity consumed in the latest year at the time of validation (tCO_2/MWh). A fixed value can be used as far as the grid electricity is used as per the section of "Determination of the emission factor for electricity generation" specified in "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"[8].

Leakages:

No leakage effects need to be accounted under the proposed methodology.

Baseline Emissions:

The amount of baseline emissions (with the ceiling) is given by

The baseline emissions is represented as:

$$\begin{aligned} BE_y &= MD_{project,y} \times GWP_{CH4} + FF_{BL\_fuel,y} \times EF_{CO2,BL\_fuel} \\ &= MD_{project,y} \times GWP_{CH4} + \left(\eta_{PJ\_boiler,y} / \eta_{BL\_boiler}\right) \times Q_{AOG,y} \times EF_{CO2,BL\_fuel} \\ &= Vol^{CR}{}_{AOG,y} \times w_{CH4,y} \times \rho_{CH4} \times GWP_{CH4} + \left(1/\eta_{BL\_boiler}\right) \times Q_{project,y} \times EF_{CO2,BL\_fuel} \end{aligned} \quad (3)$$

with

$$MD_{project,y} = Vol^{CR}{}_{AOG,y} \times w_{CH4,y} \times \rho_{CH4} \quad (4)$$

$$Vol^{CR}{}_{AOG,y} = \min\left[Vol_{AOG,y} / Prod_{AM,y},\ \langle Vol / Prod \rangle_{hist}\right] \times Prod_{AM,y} \quad (5)$$

[7] See http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf.

[8] See http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf.

$$Q_{\mathrm{AOG},y} = Vol_{\mathrm{AOG},y} \times NCV_{\mathrm{AOG},y} \quad (6)$$

$$\eta_{\mathrm{PJ\_boiler},y} = Q_{\mathrm{project},y} / Q_{\mathrm{AOG},y} \quad (7)$$

where

BE_y : Baseline emissions in a reporting interval *y* (tCO_2e/reporting interval).

$MD_{\mathrm{project},y}$: The amount of methane in the AOG (tCH_4/reporting interval) that would have been combusted by the project activity in an interval *y* (monitored and recorded daily). This is calculated in (2) as a conservative method.

GWP_{CH4} : Global Warming Potential of methane (for the first commitment period, GWP_{CH4} is 21) (tCO_2e/tCH_4).

$FF_{\mathrm{CO2,BL\_fuel},y}$: The amount of baseline fossil fuel which would be used in the replaced baseline boiler (GJ/reporting interval). This is calculated by using $\eta_{\mathrm{BL\_boiler}}$ and $Q_{\mathrm{project},y}$ as shown in (3): $FF_{\mathrm{CO2,BL\_fuel},y} = \left(1/\eta_{\mathrm{BL\_boiler}}\right) \times Q_{\mathrm{project},y}$.

$EF_{\mathrm{CO2,BL\_fuel}}$: CO_2 emission factor of the baseline fuel that would be combusted for steam generation in the absence of the project (tCO_2/GJ). If multiple fuels are used in the baseline, the lowest CO_2 emission factor is applied.

$Q_{\mathrm{AOG},y}$: Net heat quantity of the ammonia-plant off gas (AOG) after removing ammonia that would be used in a reporting interval *y* by the project activity (GJ/reporting interval).

$\eta_{\mathrm{BL\_boiler}}$: Net efficiency of steam generation for the boiler used in the absence of the project (no dimension; fixed value measured prior to implementation of the project activity). To obtain a rate for this parameter, Option C, D, E or F specified in "Tool to determine the baseline efficiency of thermal or electric energy generation systems"[9] is applied.

$\eta_{\mathrm{PJ\_boiler},y}$: Net efficiency of steam generation for the boiler used by the project activity (no dimension; fixed value measured after implementation of the project activity in reporting interval *y*). This parameter is not expressed in the final expression of (3), thus not to be monitored.

$Prod_{\mathrm{AM},y}$: Production of ammonia in a reporting interval *y* (tNH_3/reporting interval).

$Vol_{\mathrm{AOG},y}$: Total volume of ammonia-plant off gas (AOG) after removing ammonia used by the project activity in an interval *y* (Nm^3/reporting interval). The AOG flow (after removing ammonia) is measured continuously and corrected to the standard condition.

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[9] See http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v1.pdf.

$Vol^{CR}_{AOG,y}$: Corrected total volume of ammonia-plant off gas (AOG) with a cap set by historical emission intensity of AOG per NH_3 production in a reporting interval y (Nm^3/reporting interval) as defined in eq. (3).

$\langle Vol/Prod \rangle_{hist}$: The cap set for the volume of AOG per unit of ammonia production. It is defined as the historical weighted average of annual amount of AOG per unit of ammonia production during the latest 3 years before implementation of the project (Nm^3/tNH_3) (fixed value to be determined before implementation of the project).

$w_{CH4,y}$: Mean methane fraction in the ammonia-plant off gas (AOG) after removing ammonia in the project scenario in a reporting interval y (m^3CH_4/m^3AOG).

ρ_{CH4} : Methane density (tCH_4/m^3CH_4) in the standard condition.

$NCV_{AOG,y}$: Net calorific value (energy content) of the ammonia-plant off gas (AOG) after removing ammonia in an interval y (MJ/m^3) in a reporting interval y.

$Q_{project,y}$: Net quantity of heat (steam) generated from firing AOG in a reporting interval y (GJ/reporting interval).

[Note] The notation "y" above should be read as the interval (notably monitoring interval). If y is recognized as some period like a year, it shall be noted that the notation $A_y \times B_y$ is NOT the product of the aggregated values BUT the aggregation of the product specified in each monitoring interval, *i.e.*, $A_y \times B_y = \sum_{interval} (A_{interval} \times B_{interval}) \neq \left(\sum_{interval} A_{interval} \right) \times \left(\sum_{interval} B_{interval} \right)$.

The emission intensity of AOG is capped in the baseline emission calculation as shown in (4).

Emission Reductions:

The amount of emission reductions is given by

$$ER_y = BE_y - PE_y \quad (8)$$

Where:

ER_y Emission reductions in a year y (tCO_2e/yr)

BE_y Baseline emissions in a year y (tCO_2e/yr)

PE_y Project emissions in a year y (tCO_2/yr)

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	*Regulatory requirements relating to ammonia-plant off gas(AOG)*

Data unit:	--
Description:	Regulatory requirements relating to ammonia-plant off gas(AOG)
Source of data used:	Publicly available information of the host country's regulatory requirements related to ammonia production plant.
Value applied:	There are currently no regulations concerning utilization and flaring or other treatment of ammonia-plant off gas in Syria.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on information obtained from the host country DNA, it has been confirmed that the host country has no legislation concerning utilization and flaring or other treatment of ammonia-plant off gas
Any comment:	Conditions of the regulation shall be checked, *e.g.*, on volume, concentration, chemical composition or others. Relevant regulations for ammonia-plant off gas (AOG) utilization project activities shall be updated at renewal of each credit period. Project participants should explain how regulations are translated into that amount of gas.

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of CH_4
Source of data used:	IPCC (Second Assessment Report for the first commitment period)
Value applied:	21 tCO_2e/tCH_4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Specified in the proposed methodology.
Any comment:	No.

Data / Parameter:	ρ_{CH4}
Data unit:	tCH_4/m^3CH_4
Description:	Methane density in the standard condition.
Source of data used:	ACM0001 ver09.1
Value applied:	0.0007168 tCH_4/m^3CH_4 at standard temperature and pressure (0 degree Celsius and 1,013 bar)
Justification of the choice of data or description of	Specified in the proposed methodology

measurement methods and procedures actually applied :	
Any comment:	No.

Data / Parameter:	$CEF_{EL,y}$
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor of electricity consumed by DeNOx equipment
Source of data used:	Grid supplier data, reliable official publications. Or relevant fuel and power generation data if power is supplied by in-house power system.
Value applied:	For now, 1.3 tCO_2/MWh is set for this parameter based on “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” version01
Justification of the choice of data or description of measurement methods and procedures actually applied :	For now, the ex-ante value for this parameter is set as 1.3 in conservative manner. Receive data calculated based on the “Tool to calculate project emissions from electricity consumption” from the host DNA. If the grid emission factor cannot be obtained, receive the data required for calculation and calculate based on the said tool. If data cannot be acquired, use the default value of 1.3.
Any comment:	No.

Data / Parameter:	$\eta_{BL,boiler}$
Data unit:	–
Description:	Net efficiency of steam generation for the boiler in the absence of the project
Source of data used:	Tool to determine the baseline efficiency of thermal or electric energy generation systems
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	For now, this parameter is set based on historical rough data$_r$. For this project, option B “Establish a load-efficiency function based on measurements and a regression analysis” will be selected. The efficiency tests shall be conducted following the guidance provided in relevant national/international standards,6 such as ASME PTC-6 or IEC 60953-3, ASME PTC-4 or BS 845 or EN 12952-15 etc., preferably using direct methods (i.e., dividing the net output by the sum of all inputs). All measurements will be conducted immediately after scheduled preventive maintenance has been undertaken and under favorable operation conditions. During the measurement campaign, the load should be varied over the whole operational range or the rated capacity of the energy generation system. The

	efficiency of the system will then be determined at different steady-state conditions. Document the monitoring procedures and results transparently. The tests will be conducted by an independent entity such as the equipment supplier, sectoral experts/consultants etc. and the results of the efficiency tests shall be validated by the DOE.
Any comment:	No.

Data / Parameter:	$\langle Vol/Prod \rangle_{\text{hist}}$
Data unit:	Nm^3/tNH_3
Description:	Cap set for the volume of AOG per unit of ammonia production
Source of data used:	Historical (annual) data of AOG volume and ammonia production for the latest 3 years prior to the validation
Value applied:	209.76 Nm^3/tNH_3 For now, this parameter is set based on the design capacity for ammonia production (1000tNH_3/day) and the design value for the AOG gas flow (8740Nm^3/hr).
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is defined as the historical weighted average of annual amount of AOG per unit of ammonia production during the latest 3 years before implementation of the project (Nm^3/tNH_3). Calculated by historical record of these data. In case direct measured historical data are not available, calculation based on mass/energy-balance approach using historical data can be applied. For this case, statistically conservative estimation within the 95% confidence level shall be maintained.
Any comment:	Fixed value measured prior to implementation of the project activity.

B.6.3. Ex-ante calculation of emission reductions:

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We estimate the emission reductions for ammonia production of 320,000 ton/yr run at the existing design capacity of the ammonia plant (1,000ton/day* 320day/yr=320,000 ton/yr).

As described in equation (2) of Section B6.1, the emissions due to project activity is calculated by

$$PE_y = PE_{\text{AOG},y} + PE_{\text{EL},y}$$

$$= Q_{\text{AOG},y} \times EF_{\text{CO2,AOG},y} + \left(EC_{\text{DeNOx},y}\right) \times CEF_{\text{EL}}$$

And, as described in equation (5) of Section B6.1, the amount of baseline emissions is calculated by

$$BE_y = MD_{project,y} * GWP_{CH4} + Q_{AOG,y} * (\varepsilon_{PJboiler}/\varepsilon_{BLboiler}) * EF_{CO2,BL\ fuel} /1000$$
$$= AOG_{total,y} * w_{CH4,y} * D_{CH4} * GWP_{CH4}$$
$$+ AOG_{total,y} * NCV_{AOG,y} * Q_{project,y} /(Q_{AOG,y}) /\varepsilon_{BLboiler} * EF_{CO2,BL\ fuel} /1000$$

$$\begin{aligned} BE_y &= MD_{\mathrm{project},y} \times GWP_{\mathrm{CH4}} + FF_{\mathrm{BL\_fuel},y} \times EF_{\mathrm{CO2,BL\_fuel}} \\ &= MD_{\mathrm{project},y} \times GWP_{\mathrm{CH4}} + \left(\eta_{\mathrm{PJ\_boiler},y} / \eta_{\mathrm{BL\_boiler}}\right) \times Q_{\mathrm{AOG},y} \times EF_{\mathrm{CO2,BL\_fuel}} \\ &= Vol^{\mathrm{CR}}{}_{\mathrm{AOG},y} \times w_{\mathrm{CH4},y} \times \rho_{\mathrm{CH4}} \times GWP_{\mathrm{CH4}} + \left(1/\eta_{\mathrm{BL\_boiler}}\right) \times Q_{\mathrm{project},y} \times EF_{\mathrm{CO2,BL\_fuel}} \end{aligned}$$

with

$$MD_{\mathrm{project},y} = Vol^{\mathrm{CR}}{}_{\mathrm{AOG},y} \times w_{\mathrm{CH4},y} \times \rho_{\mathrm{CH4}}$$

$$Vol^{\mathrm{CR}}{}_{\mathrm{AOG},y} = \min\left[Vol_{\mathrm{AOG},y} / Prod_{\mathrm{AM},y},\ \langle Vol / Prod \rangle_{\mathrm{hist}}\right] \times Prod_{\mathrm{AM},y}$$

$$Q_{\mathrm{AOG},y} = Vol_{\mathrm{AOG},y} \times NCV_{\mathrm{AOG},y}$$
$$\eta_{\mathrm{PJ\_boiler},y} = Q_{\mathrm{project},y} / Q_{\mathrm{AOG},y}$$

As a result, the amount of emission reductions is calculated by

$$ER_y = BE_y - PE_y$$

Ex-ante estimation of emission reductions and values applied for parameters are shown as the following table;

Parameter		Estimated Value	Unit
OH	Operation hours	7680	hr/yr
$MD_{project,y}$	The amount of methane in the AOG that would have been combusted by the project activity	2790.61	tCH_4/yr
GWP_{CH4}	Global Warming Potential of methane	21	tCO_2e/tCH_4
$FF_{CO2,BL\_fuel,y}$	The amount of baseline fossil fuel which would be used in the replaced baseline boiler	618000	GJ/yr
EF_{CO2,BL_fuel}	CO_2 emission factor of the baseline fuel that would be combusted for steam generation in the absence of the project .	0.056	tCO_2/GJ
$Q_{AOG,y}$	Net heat quantity of the ammonia-plant off gas (AOG) after removing ammonia that would be used by the project activity	618000	GJ/yr
h_{BL_boiler}	Net efficiency of steam generation for the boiler used in the absence of the project	0.800	-

$h_{PJ\_boiler,y}$	Net efficiency of steam generation for the boiler used by the project activity	0.800	-
$Prod_{AM,y}$	Production of ammonia	320000	tNH_3/yr
$Vol_{AOG,y}$	Total volume of ammonia-plant off gas (AOG) used by the project activity.	67123200	Nm^3/yr
$Vol^{CR}_{AOG,y}$	Corrected total volume of ammonia-plant off gas (AOG) with a cap set by historical emission intensity of AOG per NH_3 production	67123200	Nm_3/yr
$(Vol/Prod)_{hist}$	The cap set for the volume of AOG per unit of ammonia production.	209.76	Nm^3/tNH_3
$w_{CH4,y}$	Mean methane fraction in the ammonia-plant off gas (AOG) after removing ammonia in the project scenario	0.0580	m^3CH_4/m^3AOG
r_{CH4}	Methane density in the standard condition.	0.0007168	tCH_4/m^3CH_4
$NCV_{AOG,y}$	Net calorific value (energy content) of the ammonia-plant off gas (AOG)	0.00920	GJ/Nm^3
$Q_{project,y}$	Net quantity of heat (steam) generated from firing AOG	494400	GJ/yr
$EF_{CO2,AOG,y}$:	CO_2 emission factor of the ammonia-plant off gas (AOG) calculated based on the composition of the AOG	0.0095	tCO_2/GJ
$EC_{DeNOx,y}$	Quantity of electricity consumed by DeNOx equipment	1536	MWh/yr
CEF_{EL}	CO_2 emission factor of electricity consumed in the latest year at the time of validation	1.3	tCO_2/MWh
BE_y	Baseline emissions	93211	tCO_2e/yr
PE_y	Project emissions	7868	tCO_2/yr
$PE_{AOG,y}$	Project emissions from ammonia-plant off gas (AOG) combustion for fuel	5871	tCO_2/yr
$PE_{EL,y}$	Project emissions from electricity consumption for removing NOx with De-NOx equipment	1997	tCO_2/yr
ER_y	Emissiom reduction	85343	tCO_2e/yr

B.6.4 Summary of the ex-ante estimation of emission reductions:

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Ex ante estimation during the crediting period is given as follows:

Year (Month)	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2 e)
2011(Jan.-Dec.)	7,868	93,211	0	85,343

2012(Jan.-Dec.)	7,868	93,211	0	85,343
2013(Jan.-Dec.)	7,868	93,211	0	85,343
2014(Jan.-Dec.)	7,868	93,211	0	85,343
2015(Jan.-Dec.)	7,868	93,211	0	85,343
2016(Jan.-Dec.)	7,868	93,211	0	85,343
2017(Jan.-Dec.)	7,868	93,211	0	85,343
2018(Jan.-Dec.)	7,868	93,211	0	85,343
2019(Jan.-Dec.)	7,868	93,211	0	85,343
2020(Jan.-Dec.)	7,868	93,211	0	85,343
Total (tonnes of CO_2 e)	78,680	932,110	0	853,430

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1. Data and parameters monitored:

Data / Parameter:	$Prod_{AM,y}$
Data unit:	tNH_3/reporting interval
Description:	Production of ammonia in a reporting interval *y*
Source of data used:	Flow meter for the produced ammonia
Value of data applied for the purpose of calculating expected emission reductions	320000tNH_3/yr
Description of measurement methods and procedures to be applied:	Monitoring conditions as follows; ● Measuring device : Flow meter ● Measuring period : Continuously ● Recording frequency : Daily
QA/QC procedures to be applied:	Checked against the sales record.
Any comment:	The correction is by setting a cap for its intensity per ammonia

Data / Parameter:	*VolAOG,y*
Data unit:	Nm^3/ reporting duration of interval

Description:	Total volume of amount of ammonia-plant off gas (AOG) used by the project activity in an interval a reporting interval y
Source of data used:	Flow meter with normalizing function
Value of data applied for the purpose of calculating expected emission reductions	67123200Nm^3/yr
Description of measurement methods and procedures to be applied:	This parameter is calculated as follows; $Vol_{AOG,y}= Vol_{AOG,i}* OH_y$ Where; $Vol_{AOG,i}$: Total volume of ammonia-plant off gas used after an ammonia absorber [Nm_3/hr] For now, 8740 Nm^3/hr is applied for this parameter based on the design value which the ammonia plant is run at the design capacity (Ammonia production capacity: 1,000tonNH_3/day). OH_y : Operating hours of the ammonia plant in a year y [hr] For now, 7,680 hr (320day/yr*24hr/day) is applied for this parameter on the assumption that the ammonia plant is run at the yearly maximum operation. Monitoring conditions as follows; ● Measuring device : Orifice (Differential pressure) flow meter with normalizing function ● Measuring point: Inlet of the ammonia-plant off gas boiler ● Measuring period : Continuously ● Recording frequency : Daily ●
QA/QC procedures to be applied:	Flow meters should be subject to a regular maintenance and testing regime (including caribration) to ensure accuracy according to according to relevant industry standards or or the manufacturer's requirement.
Any comment:	No.

Data / Parameter:	Chemical composition of AOG
Data unit:	Vol. %
Description:	Chemical composition of the ammonia-plant off gas (AOG) in an interval *y*.
Source of data used:	Laboratory componential analysis.
Value of data applied for the purpose of calculating expected emission reductions	Not needed.
Description of measurement methods	Laboratory analysis of the ammonia-plant off gas (AOG) using gas-chromatography.

and procedures to be applied:	To obtain a rate for this parameter, Option A (based on chemical component) specified in the latest version of “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” is applied.
QA/QC procedures to be applied:	Check the consistency of the data by comparing the data from previous days/months/years.
Any comment:	Methane component is used for calculation of $w_{CH4,y}$, hydro-carbon components, H_2 components and others are used to calculate $EF_{AOG,y}$ and $NCV_{AOG,y}$.

Data / Parameter:	$w_{CH4,y}$
Data unit:	m^3CH_4/m^3AOG
Description:	Methane fraction in the ammonia-plant off gas in the project scenario in a reporting intervaly
Source of data used:	Specified in the data of chemical composition of AOG as the methane component.
Value of data applied for the purpose of calculating expected emission reductions	5.8% For now, this parameter is set based on historical data.
Description of measurement methods and procedures to be applied:	This parameter is analyzed by gas-chromatography in GFC’s laboratory. ●
QA/QC procedures to be applied:	Check the consistency of the data by comparing the data from previous days/months/years.
Any comment:	No.

Data / Parameter:	T_y
Data unit:	°C
Description:	Temperature of the ammonia-plant off gas (simultaneously with $Vol_{AOG,y}$) in a reporting interval y
Source of data used:	Temperature sensor
Value of data applied for the purpose of calculating expected emission reductions	Not applicable
Description of measurement methods and procedures to be applied:	Monitoring conditions as follows; ● Measuring device : Thermo-couple ● Measuring point: Inlet of the ammonia-plant off gas boiler ● Measuring period : Continuously

QA/QC procedures to be applied:	Temperature sensor should be subject to a regular maintenance and testing regime (including caribration) to ensure accuracy according to relevant industry standards or or the manufacturer's requirement.
Any comment:	To convert the ammonia-plant off gas volume to the one in the normal condition.

Data / Parameter:	P_y
Data unit:	Pa
Description:	Pressure of the ammonia-plant off gas (simultaneously with $Vol_{AOG,y}$) in a reporting interval *y*
Source of data used:	Pressure transmitter
Value of data applied for the purpose of calculating expected emission reductions	Not applicable
Description of measurement methods and procedures to be applied:	Monitoring conditions as follows; ● Measuring device : Pressure transmitter ● Measuring point: Inlet of the ammonia-plant off gas boiler ● Measuring period : Continuously
QA/QC procedures to be applied:	Pressure transmitter should be subject to a regular maintenance and testing regime (including caribration) to ensure accuracy according to relevant industry standards or or the manufacturer's requirement.
Any comment:	To convert the ammonia-plant off gas volume to the one in the normal condition.

Data / Parameter:	$NCV_{AOG,y}$
Data unit:	GJ /Nm^3 /reporting interval
Description:	Net calorific value (energy content) of the ammonia-plant off gas after removing ammonia in a reporting interval *y*
Source of data used:	Calculated based on the chemical composition of AOG from laboratory analysis
Value of data applied for the purpose of calculating expected emission reductions	0.00940.00920 GJ /Nm^3

Description of measurement methods and procedures to be applied:	For now, this parameter is set based on historical records of the GFC's laboratory analysis. Monitoring conditions for laboratory componential analysis as follows; ● Sampling point for the ammonia-plant off gas：Inlet of the ammonia-plant off gas boiler ● Measuring frequency：Every 8 hours
QA/QC procedures to be applied:	● Laboratory componential analysis will be carried out by GFC's laboratory based on DIN. ● Check the consistency of the data by comparing the data with those for previous days/months/years.
Any comment:	No.

Data / Parameter:	$EF_{CO2,BLfuel}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of the baseline fuel type (natural gas for this project) that would be combusted to generate steam in the absence of the project in a reporting *y*
Source of data used:	Ingredient label provided by the natural gas supplier
Value of data applied for the purpose of calculating expected emission reductions	0.0056 tCO_2/GJ
Description of measurement methods and procedures to be applied:	For now, this parameter is set based on historical ingredient labels by the natural gas supplier (General Company for Trans and Investment of Gas). This parameter will be monthly monitored after the project starts and will be set as the ex-post value based on ingredient labels by the natural gas supplier (General Company for Trans and Investment of Gas). The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated.
QA/QC procedures to be applied:	Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements.
Any comment:	No.

Data / Parameter:	$EF_{CO2,AOG,y}$
Data unit:	tCO_2/GJ

Description:	CO_2 emission factor of the ammonia-plant off gas in a reporting *y*
Source of data used:	Calculated by laboratory componential analysis record
Value of data applied for the purpose of calculating expected emission reductions	0.0095 tCO_2/GJ
Description of measurement methods and procedures to be applied:	For now, this parameter is set based on historical records of the GFC's laboratory analysis based on chemical formula for oxidization (combustion). To obtain a rate for this parameter, Option A (based on chemical component) specified in the latest version of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" is applied.. Monitoring conditions for laboratory componential analysis as follows; ● Sampling point for the ammonia-plant off gas：Inlet of the ammonia-plant off gas boiler ● Measuring frequency：Every 8 hours
QA/QC procedures to be applied:	● Laboratory componential analysis will be carried out by GFC's laboratory based on DIN. ● Check the consistency of the measurements by comparing the measurement results with measurements from previous years
Any comment:	No.

Data / Parameter:	$EC_{DeNOx,y}$
Data unit:	MWh/ reporting interval
Description:	Quantity of electricity consumed by De-NOx equipment in a reporting interval *y*
Source of data used:	Electricity meter
Value of data applied for the purpose of calculating expected emission reductions	1536MWh /yr
Description of measurement methods and procedures to be applied:	This parameter is calculated as follows; $EC_{DeNOx,y} = EC_{DeNOx,i} * OH_y$ Where; $EC_{DeNOx,i}$: Average quantity of electricity consumed by De-NOx equipment [MWh/hr] For now, 0.2MWh/hr is applied for this parameter based on the maker hearing of the ammonia absorber. OH_y : Operating hours of the ammonia plant in a year y [hr] For now, 7,680 hr (320day/yr*24hr/day) is applied for this parameter on the assumption that the ammonia plant is run at the yearly maximum operation.

	Monitoring conditions as follows; ● Measuring device : Electricity meter ● Measuring period : Continuously ● Recording frequency : Daily
QA/QC procedures to be applied:	Regular maintenance and testing regime.
Any comment:	Only aggregated value for the period of verification (typically one year) counts.

Data / Parameter:	$Q_{project,y}$
Data unit:	GJ/duration of interval
Description:	Net quantity of heat generated from firing project fuel in a reporting *y* In case of steam, this is expressed as difference in energy content of the steam supplied to the recipient plant and feed water to the boiler. The enthalpy of feed water to the boiler takes into account the enthalpy of condensate returned to the boiler (if any) and any other waste heat recovery (including economiser, blow down heat recovery etc). In case of hot water generator, this is expressed as difference in energy content of the hot water supply and return from the recipient plant(s) to the element process of cogeneration plant.
Source of data used:	Actual measurement records
Value of data applied for the purpose of calculating expected emission reductions	494400 GJ/yr
Description of measurement methods and procedures to be applied:	Heat generation is determined as the enthalpy of the steam or hot water generated by the boiler(s) minus the enthalpy of the feed-water. The enthalpy of feed water to the boiler takes into account the enthalpy of condensate returned to the boiler (if any) and any other waste heat recovery (including economiser, blow down heat recovery etc). It should be noted that no additional fuel outside the boiler or the hot water generator should be combusted to heat the feed water. 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. This parameter is calculated as follows; $Q_{project,y} = Q_{project,i} * OH_y$

	Where; $Q_{project,i}$: Average net quantity of heat generated from firing project fuel [GJ/hr] For now, 64.375GJ/hr is applied for this parameter on the assumption that $\varepsilon_{PJboiler}$ is equal to 0.8. OH_y : Operating hours of the ammonia plant in a year y [hr] For now, 7,680 hr (320day/yr*24hr/day) is applied for this parameter on the assumption that the ammonia plant is run at the yearly maximum operation. Monitoring conditions as follows; ● Measuring device For steam: Orifice flow meter (Differential pressure) /Thermo-couple/Pressure transmitter For feed water: Volume flow meter with temperature sensor ● Measuring period : Continuously ● Recording frequency : Daily (to be aggregated yearly)
QA/QC procedures to be applied:	● The consistency of metered net heat generation should be cross-checked by comparing the measurement results with measurements from previous years
Any comment:	No.

B.7.2. Description of the monitoring plan:

>>

GFC will bear full responsibility for project operation and management (monitoring, facilities operation and maintenance, accounting, subcontracting, personnel affairs, reporting, etc.).
GFC has been operating some chemical plants including the ammonia production plant since the commissioning of these plants and has sufficient and well-experienced staff. In order to ensure the successful operation of the project and the creditability and verifiability of the CERs achieved, the project will have a well-defined management and operational system, and Japanese project participants will support GFC for the monitoring.

An illustrative scheme of the operational and management structure is as follows:

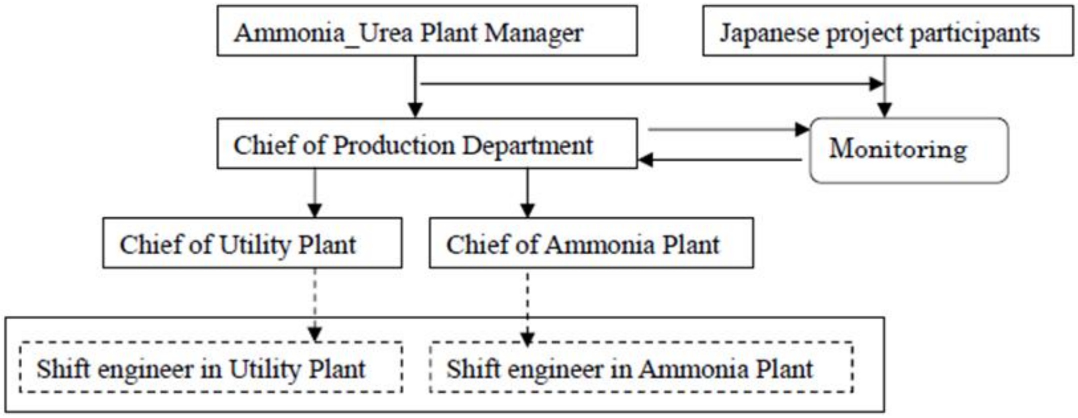

Figure 7:Monitoring Organization in GFC

Departments connected to the monitoring are as follows;

- Ammonia-Urea Plant Manager is responsible for preparation of the monitoring report.
- Chief of Production Department is responsible for maintenance of monitoring instruments including calibration
- Chief of Production Department is also responsible for filing the recorded data.

In the project, quality control and quality assurance will be carried out by the following methods.

- Management will prepare written procedures for operating facilities. Written procedures, containing daily work contents, periodic maintenance methods and judgment criteria, etc., will be compiled according to appropriate formats.
- Management will check reports from operating personnel and determine there are no problems according to the procedures. If problems are found in such checks, management will implement the appropriate countermeasures with appropriate timing.
- Management will everyday file and store reports from monitoring engineer according to the procedures.
- In the event of accidents (including malfunction of measuring equipments/logging system, abnormality of the ammonia plant, the ammonia-plant off gas boiler and the ammonia absorber), management will ascertain the causes, implement and instruct countermeasures to the operating personnel.
- In cases of emergency (including malfunction of measuring equipments/logging system, abnormality of the ammonia plant/the ammonia-plant off gas boiler/NH_3 absorber), operating personnel will take stopgap measures and implement countermeasures according to instructions from management.
- Measuring instruments will be periodically and appropriately calibrated according to the procedures. Calibration timing and methods will be in accordance with “relevant industry standards or the manufacturer’s requirement”.
- The logging data and all reports printed out from the system are kept during the credit period plus 2 years.
- Measured data will also be subject to audit by government agencies in the host country. Where appropriate, the internal audit will be conducted and the monitoring data is periodically checked.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

>>

Name/Entity of the application of the baseline and monitoring methodologies:

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Mr. Minoru Hirao
Osumi Co., Ltd
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Dr. Naoki Matsuo and Mr. Kunihiro Ueno
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n_matsuo@climate-experts.info

Completion date:

31/1/20010

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
01/10/2010 (The day ordering of equipment will be commenced)

C.1.2. Expected operational lifetime of the project activity:

>>
20 years

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

>>
01/01/2011 or the date of registration, whichever is later

C.2.1.2. Length of the first crediting period:

>>
10 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
N/A

C.2.2.2. Length:

>>
N/A

SECTION D. Environmental impacts

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D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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The proposed project is to efficiently use ammonia-plant off gas which has been released to the atmosphere without flaring and any other treatments. And ammonia contained in the ammonia-plant off gas is removed before use it as fuel. The ammonia-plant off gas after removing ammonia is clean energy.

Environmental impacts of waste gas, wastewater, solid waste and noises etc. of the proposed CDM project are briefly analyzed as below:

Waste gas

There almost never impact due to waste gas after burning as follows;

- SOx: There is no sulphur content in the ammonia-plant off gas.
- NOx: Before fuel use of the ammonia-plant off gas, ammonia is removed by an ammonia absorber. Net calorific value of the ammonia-plant off gas used for this project is considerably lower than the natural gas. NOx emissions due to burning the ammonia-plant off gas is equivalent to the one for the natural gas or lower than it.

Waste water

There is no waste water, because total amount of the recovered ammonia are used.

Solid waste

There is no solid waste due to the project implementation.

Noise/vibration

The noise is generated by operating ammonia-plant off gas boiler and an ammonia absorber, but there is no significant impact to the nearby communities, because these installation points are far out of the communities.

As noted above, no trans-boundary impacts are expected.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

For now, the Environmental Impact Assessment (EIA) is not necessary for these project activities under the law in Syria.

However, NOx is measured to ensure compliance with environmental regulations. There are no other environmental indicators and sustainable development indicators to be required for monitoring by the host government or local authorities.

SECTION E. Stakeholders' comments

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E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

E.2. Summary of the comments received:

>>

E.3. Report on how due account was taken of any comments received:

>>

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project will not utilize any official funding from Annex I countries.

Annex 3

BASELINE INFORMATION

Parameters used to estimate emission reductions

Parameter		Estimated Value	Unit
OH	Operation hours	7680	hr/yr
$MD_{project,y}$	The amount of methane in the AOG that would have been combusted by the project activity	2790.61	tCH_4/yr
GWP_{CH4}	Global Warming Potential of methane	21	tCO_2e/tCH_4
$FF_{CO2,BL\_fuel,y}$	The amount of baseline fossil fuel which would be used in the replaced baseline boiler	618000	GJ/yr
EF_{CO2,BL_fuel}	CO_2 emission factor of the baseline fuel that would be combusted for steam generation in the absence of the project .	0.056	tCO_2/GJ
$Q_{AOG,y}$	Net heat quantity of the ammonia-plant off gas (AOG) after removing ammonia that would be used by the project activity	618000	GJ/yr
h_{BL_boiler}	Net efficiency of steam generation for the boiler used in the absence of the project	0.800	-
$h_{PJ\_boiler,y}$	Net efficiency of steam generation for the boiler used by the project activity	0.800	-
$Prod_{AM,y}$	Production of ammonia	320000	tNH_3/yr
$Vol_{AOG,y}$	Total volume of ammonia-plant off gas (AOG) used by the project activity.	67123200	Nm^3/yr
$Vol^{CR}_{AOG,y}$	Corrected total volume of ammonia-plant off gas (AOG) with a cap set by historical emission intensity of AOG per NH_3 production	67123200	Nm_3/yr
$(Vol/Prod)_{hist}$	The cap set for the volume of AOG per unit of ammonia production.	209.76	Nm^3/tNH_3
$w_{CH4,y}$	Mean methane fraction in the ammonia-plant off gas (AOG) after removing ammonia in the project scenario	0.0580	m^3CH_4/m^3AOG
r_{CH4}	Methane density in the standard condition.	0.0007168	tCH_4/m^3CH_4
$NCV_{AOG,y}$	Net calorific value (energy content) of the ammonia-plant off gas (AOG)	0.00920	GJ/Nm^3
$Q_{project,y}$	Net quantity of heat (steam) generated from firing AOG	494400	GJ/yr
$EF_{CO2,AOG,y}$:	CO_2 emission factor of the ammonia-plant off gas (AOG) calculated based on the composition of the AOG	0.0095	tCO_2/GJ
$EC_{DeNOx,y}$	Quantity of electricity consumed by DeNOx equipment	1536	MWh/yr

CEF_{EL}	CO_2 emission factor of electricity consumed in the latest year at the time of validation	1.3	tCO_2/MWh

Representative example of natural gas composition

	Composition [vol %]	Molecular weight [g/22.4L]	Net calorific value [MJ/kmol]
CH_4	90.15	16	802
C_2H_6	4.75	30	1429
C_3H_8	1	44	2043
n-C_4H_{10}	0.1	58	2654
CO_2	0.5	44	
N_2	3.5	28	
Total	100		814

Representative example of ammonia-plant off gas composition

	Composition (Before- an ammonia absorber) [vol %]	Net calorific value [kJ/Nm^3]
CH_4	5.8	35804
H_2	66	10760
NH_3	2.8	
N_2	22.7	
Ar+0_2	2.7	
Total	100.0	

Annex 4

MONITORING INFORMATION

ammonia-plant off gas flow measurement:
Orifice flow meter is used to measure this important parameter. Differential pressure is measured with differential pressure transmitters. The flow rate is converted to the one at the normal conditions by temperature and pressure measured by temperature and pressure transmitters.

Continuous analysis of the methane content in the ammonia-plant off gas:
The Project employs Non-Dispersive Infrared photometry system (NDIR) to measure the concentration of CH_4 at outlet of an ammonia absorber which is the key parameter of the Project. NDIR will have measurement range of 0-20 %

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