Star Energy Partnership in Natural Gas STAR Program

Methane Expo 2013 - Vancouver
Why Methane?

Every greenhouse gas has a global warming potential (GWP)—the measure of its ability to trap heat in the atmosphere relative to CO₂. Methane is referred to as a potent greenhouse gas because it has a GWP of 21. This means that methane is 21 times more powerful than CO₂ at trapping heat in the atmosphere over a 100-year period.

President RI’s Executive Order To Reduce Greenhouse Gas Emission at 26% before 2020

Why is Reducing Methane Emissions Important?

Oil and natural gas operations are the largest human-made source of methane emissions in the United States and the second largest human-made source of methane emissions globally. Given methane’s role as both a potent greenhouse gas and clean energy source, reducing these emissions can have significant environmental and economic benefits.

Decrees of Minister of ESDM / Director General of Oil & Gas to secure Flaring Reduction by 30% per annum to achieve ZERO in 2025

Overall national commitment
Reduce GHG emissions by 26% through domestic effort and 41% with international support by 2020 (from BAU baseline)

Gas flaring objective
To achieve zero flared gas in 2025
Process Philosophy – Methane Source

477 bopd
39 bcpd
7.925 mmscfd

1,227 bopd
145 bcpd
14.043 mmscfd

673 bopd
1,146 bcppd

953 bopd
Export: 37.060 mmscfd

Data from: April 01, 2012 DPR
Partnership

Term of Reference for the

Global Methane Initiative

Signature: ____________________________
Bambang Dwiyanto
Head of Agency of Research and Development for Energy and Mineral Resources
Ministry of Energy and Mineral Resources of Republic Indonesia

Date: ____________________________
29 April 2011

NATURAL GAS STAR PROGRAM: MEMORANDUM OF UNDERSTANDING FOR INTERNATIONAL OPERATIONS

This is a voluntary agreement between Star Energy (Kalah) Ltd and the U.S. Environmental Protection Agency (EPA) for the purpose of reducing methane releases to the atmosphere by implementing cost-effective emission reduction technologies and practices.

Authorized Company Representative: Arin Hamam, Vice President Oil & Gas Operations
Signature: ____________________________
Date: May 23, 2011

Dina Kraiger, Director, Climate Change Division, U.S. Environmental Protection Agency
Signature: ____________________________
Date: ____________________________

Partner’s Designated Natural Gas STAR Implementation Manager:
Wahyu Wiraksana
Name: ____________________________
Title: Sr. Manager Operations
Arwana Barito Pacific, Star Energy Tower 8th-11th floor, Letyend S. Parman Street, Kav. 62-63
City/State: West Jakarta / DKI Jakarta
Zip Code/Postal Code: 11410
Country: Indonesia
Telephone: (62-21) 532 58 28
Fax: (62-21) 530 79 28
E-mail: wahuny.wiraksana@starenergy.co.id

Under the Methane to Markets Initiative, The Natural Gas STAR Program is a flexible, non-regulatory, and voluntary partnership between the EPA and the international oil and natural gas industry aimed at facilitating and accounting for cost-effective methane emission reductions worldwide.
Star Energy’s Involvement

- Measurement Study Objectives Formulation (end of 2011)
  - Identified and evaluated opportunities to reduce methane emissions
    - Venting
    - Fugitive
    - Flare efficiency

- Measurement Study was Conducted
  - KRA & KF (February 2012)
  - KN FSO (September 2012)

- Attended GMI workshop & study tour at Denver, Colorado (April 2012)

- Co-Hosted 2nd Asia Pacific GMI workshop with Pertamina EP, SPE, and GGFR (September 2012)
# Measurement Study Result

## KF Platform Emission Source

<table>
<thead>
<tr>
<th>Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Fugitives</td>
<td>5%</td>
</tr>
<tr>
<td>Reciprocating Comp. Packing</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Centrifugal Comp. Seal</td>
<td>2%</td>
</tr>
<tr>
<td>Flare</td>
<td>93%</td>
</tr>
</tbody>
</table>

**Total:** 184 ton / year

## KRA Platform Emission Source

<table>
<thead>
<tr>
<th>Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Fugitives</td>
<td>5%</td>
</tr>
<tr>
<td>Centrifugal Comp. Seal</td>
<td>2%</td>
</tr>
<tr>
<td>Flare</td>
<td>93%</td>
</tr>
</tbody>
</table>

**Total:** 143 ton / year
Indonesia’s Oil & Gas Contribution to Global Warming

Flaring and Venting in Indonesia

- 2009 estimates: 270-350 mmcf/d (2.8-3.6 bcm) is flared, i.e. ~10% of annual Indonesian consumption (36 bcm in 2009)
- Indonesia rank # 7-10
- Equivalent to ~10 mln tonnes of CO2 eq.
- Equal or greater amount of CO₂ directly vented during gas processing
- Combined CO₂ emissions would place Indonesia #5
- CH4 vented volumes are unknown
- Black Carbon emitted during flaring increases the warming effect of flaring
- $500 mln in lost revenues including lost government share

Indonesia venting and flaring adds 17 million tonnes CO₂ to atmosphere every year and wastes million dollars of energy resources.
Proposed Improvement (1)

Proposed Improvement:
Joule-Thomson Skid

Resources Required:
1. Accurate gas to flare measurement
2. Detail engineering complete with economic analysis
3. Compressor with high compression ratio

Resources Available:
1. Support from US EPA for engineering study
Proposed Improvement (2)

- Average gas to flare KF (2011): 23 MMSCF / month
- Potential Revenue Loss: USD 530K / month
- Gas to Flare Composition: Average Methane 58%

Proposed Improvement:
Flare Gas Recovery

Resources Required:
1. Accurate gas to flare measurement
2. Detail engineering complete with economic analysis
3. Compressor with high compression ratio

Resources Available:
1. Support from US EPA for engineering study
Emission Reduction Practices

Engine Starting System Retrofit

• Retrofit from natural gas starting system to air starting system – Successful Trial

• 3-5 cranking before engine running

• Benefits:
  – Reduce emission
  – Reduce interruption on gas export
  – Reduce water coning risk
First Steps in Global Methane Initiative Offshore Natuna Sea, Indonesia

Author Block: S. Ramadhana, M. Amar, Star Energy (kakap) Ltd

Abstract: Methane (CH₄) is the major component of natural gas. However, it's also the second most important manmade greenhouse gas (GHG) after carbon dioxide (CO₂). While methane is in the atmosphere for a shorter period of time and is emitted in smaller quantities than CO₂, its ability to trap heat in the atmosphere, which is called its "global warming potential," is 21 times greater than that of CO₂.

Star Energy is the first oil & gas company in Indonesia which supports the MIGAS Directorate General & Ministry of Environment's Global Methane Initiative (GMI) program under the auspices of US Environmental Protection Agency (US EPA). Star Energy and US EPA team had already conducted a series of emission measurements on Kakap offshore field production facilities (KF & KRA platforms) in February-March 2012 and on KN FSO in September 2012. The measurement shows that KF platform's emission reaches approximately 257,000 m³/year whilst KRA Platform emits approximately 200,000 m³/year and most of them are coming from flaring activities. The measurement results for KN FSO are still being assessed out with recent project changes.

Efforts on emission control have been focused on flare reduction on KF platform. The joint government-company Team is proposing to install JT process in KF to reduce flare emission. JT process' objective is simply to recover the methane gas to flare, compress it, flow it through JT valves, re-export the methane gas and recover the condensate. However, several technical challenges exist for implementing this pilot project, such as finding the right compressor to compress methane gas from near atmospheric pressure to gas system pressure of around 300 psig. Another challenge is how to accurately measure the recoverable methane gas rates in order to secure a viable economic assessment.
• Existing Air Receiver
  - Volume 106 cuft
  - Operating at 165 psig
Pertamina’s GHG Account

- Hulu: 9,056 juta ton CO$_2$e
- Refining: 15,421 juta ton CO$_2$e
- Marketing & Trading: 0.44 juta ton CO$_2$e

Total Emisi: 24,92 juta Ton CO$_2$e

Emission Reduction (ton Co2e/yr):

![Graph showing emission reduction from 2006 to 2015]