

Technology of Oil and Gas Forum

Tripoli, Libya 2010



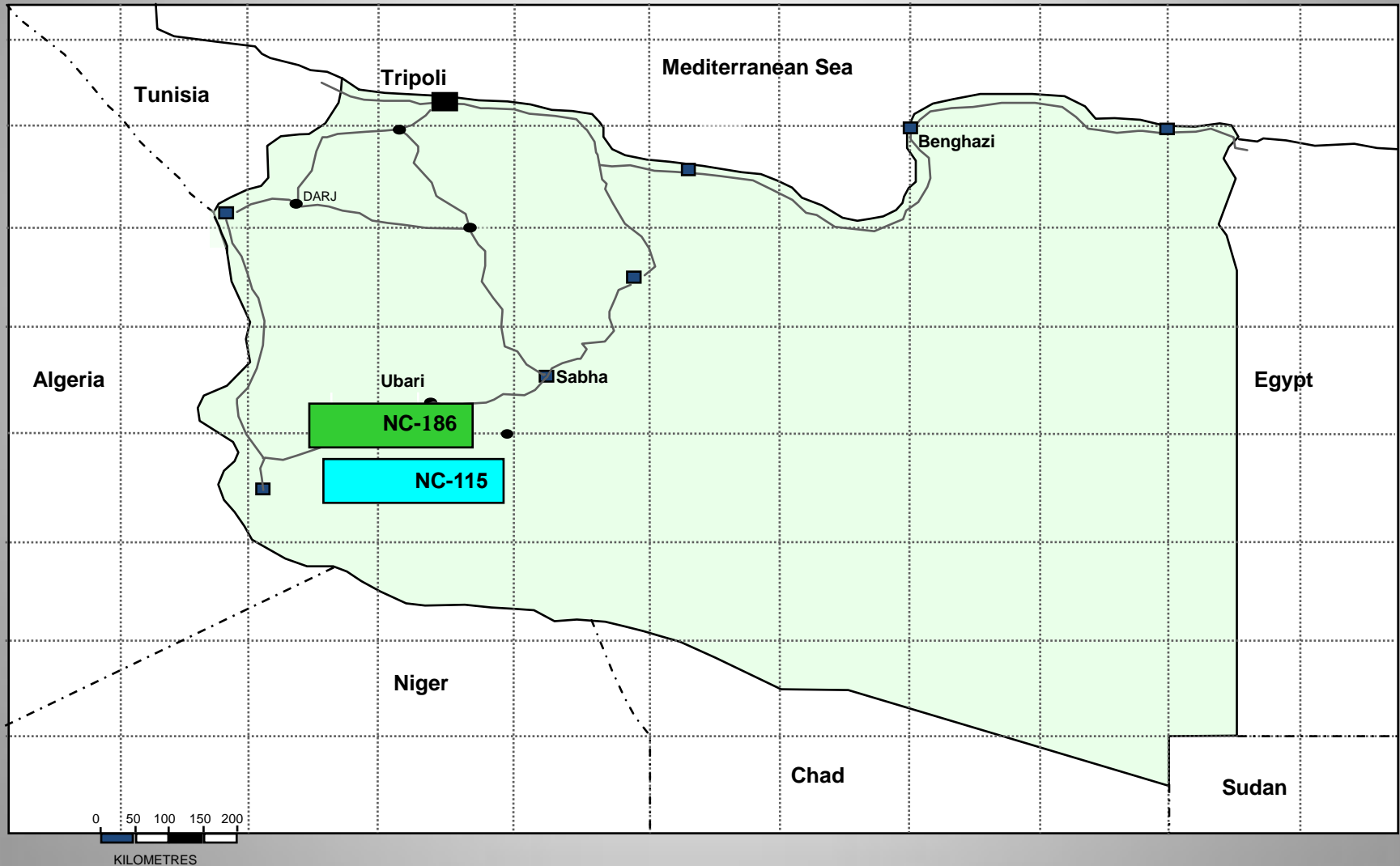
AKAKUS OIL OPERATIONS- LIBYA Gas Utilization & Flare Emission Reduction Project

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Project Location



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Introduction

Main Activities:

- Exploration, drilling and oil production from two main concessions:
- NC-115 (8 fields and three main GOSP's) total production 230,000 bbl/day.
- NC-186 (6 fields and one GOSP) total production 130,000 bbl/day.

Production history:

- December 1996 the early production started with 50,000 bbl/day (EPF).
- December 1997 the main GOSP in NC-115 A was Commissioned.
- October 1998, the 2.7 MMbbls capacity storage terminal including the 720 KM transmission pipeline were put in operation.
- End of 1999 the first gas compression package was put in operation for feeding two power generation units with fuel gas
- During 2001,02& 03 all satellite fields were connected to the main GOSP's @ NC115
- The early production started @ NC186 in 2004 (EPF), the power demand had increased and accordingly the power units were increased to 4 units with two units operating on gas and other two units operating on treated crude oil.
- During 2005 all satellite fields were connected to the main GOSP A NC-186.

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GAS UTILISATION PROJECT STRATEGY

INITIATIVE FOR REDUCTION IN GAS FLARING

- In Jan 2005 AOO achieved ISO 14001 certification with the requirement to gradually minimize the gas flaring. Accordingly several options were explored to achieve the optimum process scenario in terms of utilizing the produced gases for power generation and hydrocarbon recovery.
- In 2006 the Gas Utilization feasibility study was finalized with a recommendation to implement the project in two phases:
- **Phase I:**
 - In this phase the VRU packages were introduced to treat the low pressure tank gas. This was the first installation in Libya, which was focused on flare reduction of Tank vapor/ gas by recovering the condensate and diverting the remaining gas to the main plant compression system. The Project was completed in late 2008 .
 - By installing the VRU and splitting the existing compression systems into two independent trains the fuel gas had increased to allow four power generation units to operate on Gas and maximizing the condensate recovery thereby reduce flaring.
 - Awarded Vapor Recovery Units design and Fabrication to Hy-Bon Engineering, a company with 55 years experience in this field.

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NC-115 Location



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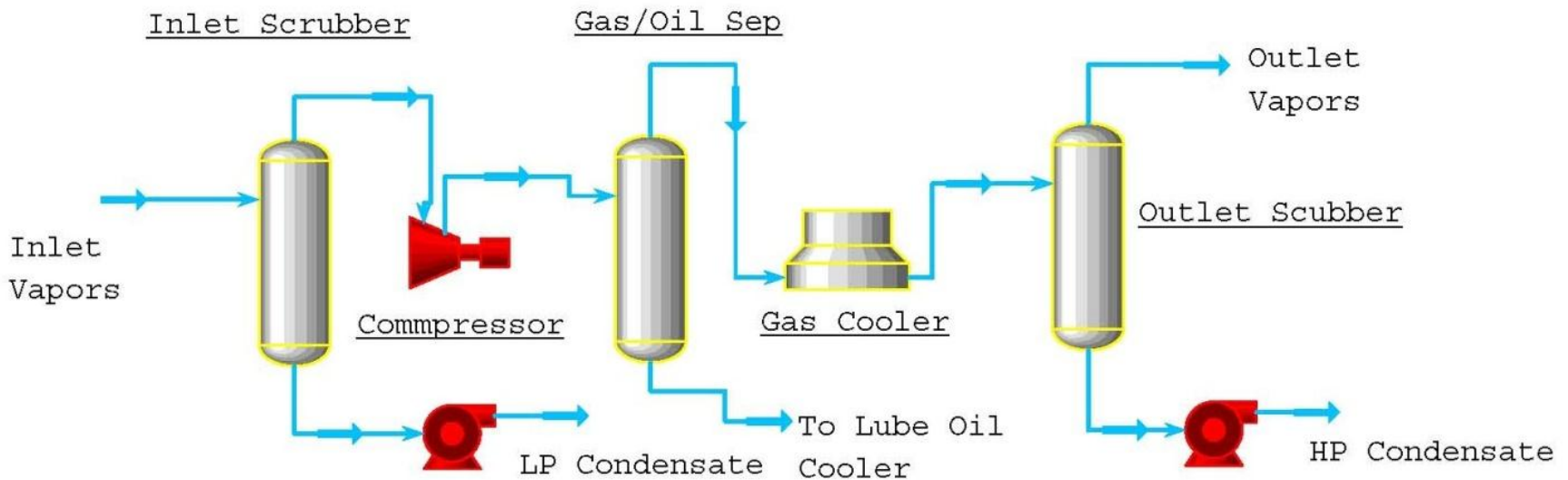
NC-186 Location



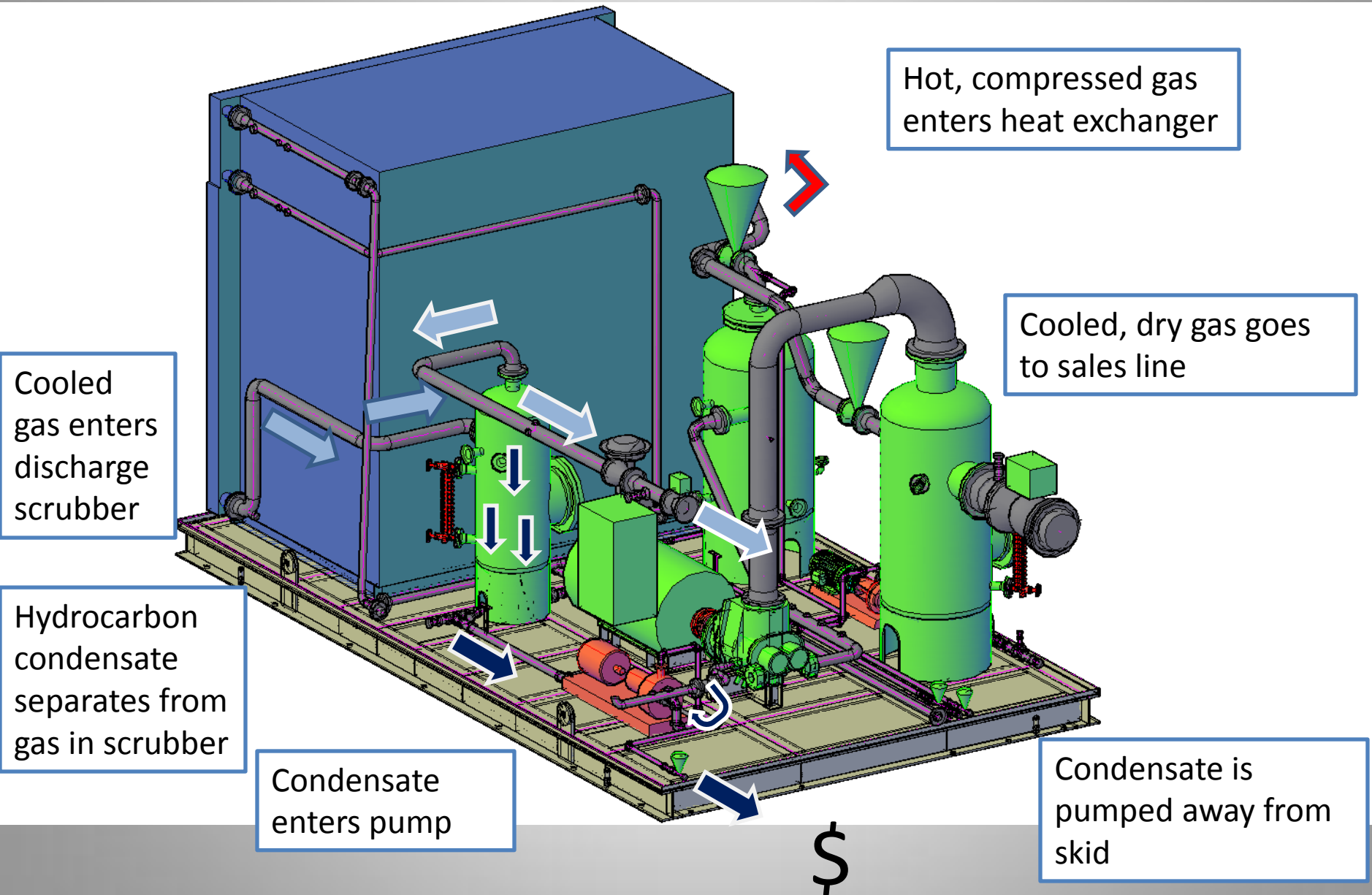
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VRU – Flow Diagram



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Tank Gas- Vapor Recovery Units

| Location | Processed Tank Gas MMSCFD | VRU Recovered Condensate | Additional recovered condensate |
|----------|---------------------------|--------------------------|---------------------------------|
| NC-115 | 4 | 1200 blls/day@ 60 psig | 1750 blls /day @ 150 psig |
| NC-186 | 2 | 275 blls/day@ 60 psig | 1121 blls/day @ 250 psig |

| Location | No of VRU | Pay back time | Co2 emission reduction |
|----------|-----------|---------------|------------------------|
| NC-115 | 3 | 3 months | 866 tons/day |
| NC-186 | 2 | 8 months | 406 tons/day |

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- Volume of recovered condensate is dependent upon volume of gas and gas composition.
- As the gas is cooled after compression (typically to 7° C above ambient temperature) the hydrocarbon liquids condense. This condensate can be captured in a vessel and delivered via pipeline or truck for further processing.
- One beneficial use is to “spike” (blend) the condensate into the crude oil stream. This serves to lighten the crude oil and increase the API gravity of the crude. This would involve pumping the condensate to the pressure of the crude oil pipeline. The condensate will blend with the crude oil, and depending upon the length of the line, virtually all flashing will be eliminated as the condensate is absorbed into the crude oil.
- This condensate can also be taken away via tanker truck. In this scenario, the condensate is taken from the compressor discharge scrubber via pump or pressure flow to an atmospheric pressure vessel. Any gas that flashes in this vessel can be taken back to the suction of the compressor. The recovered liquids will stabilize and can be put into a truck.
- In some cases, the installation may be close enough to a Natural Gas Liquids plant to pump the condensate from the discharge scrubber, via pipeline, for further refinement of the liquids.

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Tank Gas Composition

| | <u>NC-186 % mole</u> | <u>NC-115 % mole</u> |
|---------------|----------------------|----------------------|
| • Nitrogen | 0.04 | 0.04 |
| • CO2 | 0.66 | 0.90 |
| • C1 Methane | 1.16 | 0.97 |
| • C2 Ethane | 6.33 | 5.10 |
| • C3 Propane | 2.94 | 19.22 |
| • C4 Butanes | 5.84 | 32.50 |
| • C5 Pentanes | 14.45 | 20.00 |
| • C6 Hexane | 5.31 | 5.40 |
| • C7 Heptanes | 3.50 | 2.82 |
| • C7+ | 3.98 | 6.15 |
| • H2O | 16.38 | 6.90 |

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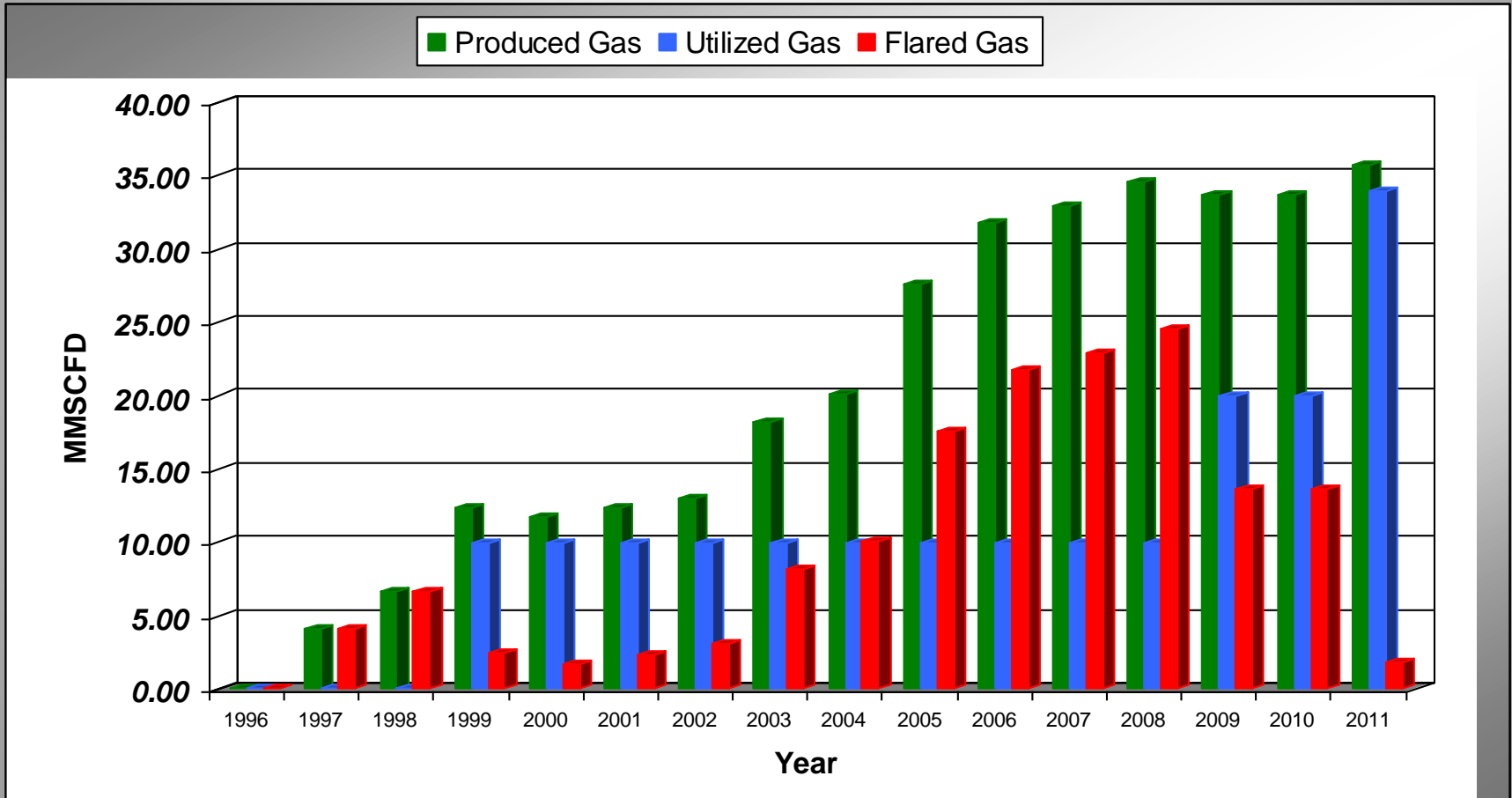
GAS UTILISATION PROJECT PHASE 2

- Phase II:
 - In this phase we will be able to utilize all high pressure gases produced at NC-115 and NC-186, by implementing two compression trains at NC-186, and the compressed gas from this concession will be transferred to NC-115 location via 30 km pipeline that will enhance our capability for power generation and supply fuel gas to other operators in the region.
 - The overall completion is scheduled by the end of 2010.
 - From the forecast analysis, we expect to achieve reduction in flaring of hydrocarbon gases to approximately 2.5 MMSCFD which will be a overall reduction of 83% compared with the gas that is being currently flared.

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Gas Production & Utilization



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Benefits:

Gas: The gas captured by the VRUs is directed to the suction of booster compressors that go to the turbines that generate electricity.

Condensate: Along with the gas being utilized the condensate is sent to the flash drum at the front of the system to be blended back into the crude oil.

Pollution: Less pollution to the atmosphere is always a benefit to any application. It is truly a waste to just burn these resources and pollute the planet in which we live.

Goal: The goal is to eliminate these flares completely. They would only be used in an upset situation. At that time all gas and condensate would be used for the purpose of making Akakus Oil more money and help clean up the environment at the same time.

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5. ECONOMICS

Recovered Vapors

| | | |
|---------------|---|--------------------------|
| Heating Value | - | 3080 Btu/ft ³ |
| Wobbe Number | - | 2289 Btu/ft ³ |
| Volume | - | 6.0 MMSCFD |

Condensate Production

| | | |
|--------|---|------------|
| Volume | - | 1475 bbl/d |
|--------|---|------------|

Valuation

Savings per Month (gas at a conservative worldwide rate of \$3 mscfd) - \$1,600,000

Savings per year - \$18,630,000

While not as easily estimable (due to spiking the condensate into the crude oil) it can be determined that the produced volume of condensate adds another \$2,655,000 per month (based on a conservative \$60/bbl rate) or \$31,860,000 per year to the Akakus bottom line.

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This is a picture of the flares at NC-115 before the VRU's were installed



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This is a picture of the flares at NC-115 after the VRU's were installed



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