Eagle Ford Operations

Marathon Oil Corporation
Dual Fuel Concept

- Substitute Natural Gas for Diesel Fuel
  - Economics
    - Diesel is ~10x the cost of natural gas on an MMBTU (energy-equivalent) basis.
    - Large spend category
  - Environmental Stewardship
    - Emissions Reduction
    - Trucking Reduction
  - Explore and Test Technology to advance Marathon’s Eagle Ford Operations
Dual Fuel
Considerations and Challenges

- Land
  - Lease Terms
  - Permits
  - Pipeline Route

- Internal Communication
  - Division Order, Land, Law, Accounting, Measurement, Drilling, and Regulatory

- Safety
- Supply
- Rig Schedule
- Economics
**Dual Fuel**

*Supply Options*

- LNG, CNG, Pipeline
  - Lack of Infrastructure and Supply
  - Commercial Terms
- Wellhead Gas
  - Eagle Ford gas is high in C4+ content which can result in pre-detonation
  - Requires pre-conditioning
Dual Fuel
Implementation Concept

Existing Well Location

From CDP or well
~1000 psig

Test Separator

Gas Meter

PCV

Tie-in

Oil Meter

LCV

Tie-in

Oil to Flowline

H₂S scrubber

Gas to Flowline

Pilot-operated ESD valve

Gas Meter

Pilot-operated ESD valve

635 psig

PCV

Small gas-diaphragm Injection pump

PCV

~100 psig

Pad Drilling Location

DieSEL/Electric Gen-sets
(retro-fitted with dual-fuel gas blending system)

Gas Fuel Manifold

5 drilling rigs with gas blending systems
4 membrane skids
8 months from concept to pilot

Marathon Oil Corporation
Dual Fuel

Membrane Technology

- Pressurized gas provides the driving force for heavy component permeation
- Passive operation with 99% reliability
- Operates at ambient temperature
- No upstream dehydration required
- Heavy components removed from gas are contained in a low pressure “permeate” vapor stream
- Combust permeate stream of recycle if location is near a central facility
Dual Fuel

Gas Blending

- Computer Controlled
  - Manages supply
    - Diesel is throttled back as gas is blended.
  - Up to 70% fuel replacement
  - Accepts LNG, CNG, Pipeline, and Field Gas
    - 900-1250 BTU
    - <10 PPM H2S
  - 30 – 40 psi supply to inlet manifold
  - Proven Technology
    - Failure modes and response
Membrane Skid
Membrane Skid

PLC
Dual Fuel

Fuel Savings

Projected Daily Savings

- Pilot Program
- 20% Diesel Replacement
- 30% Diesel Replacement
- 40% Diesel Replacement
- 50% Diesel Replacement
- 60% Diesel Replacement
- 70% Diesel Replacement

Savings / Day

Diesel Price

Marathon Oil Corporation
Dual Fuel
Profit and Loss

Purchased Gas: 60% Replace/Condition
Free Gas: 60% Replace/Condition
Free Gas: 40% Replace/Unconditioned
Purchased Gas: 40% Replace/Unconditioned

Profit / Loss

Time

Marathon Oil Corporation
Lessons Learned, Going Forward

- Well Head gas is a viable solution
  - Eagle Ford gas provides challenges

- Equipment Uptime
  - Production upsets
  - Weather impacts

- Manpower Requirements
  - Long term “route” scenario

- Schedule Success
  - Viable locations, “set” rig schedule

- Expand and Drive Up Performance
  - Frac fleet and Compression sites

The Learning Cycle
You don’t just learn by doing... you need to think about what you did and improve on it!
Questions?

Dual Fuel – A Lease Use Approach

AADE Symposium – Feb 2014 – Tulsa, OK.