

HydroFlame Steam + Flue Gas Generator

By

Jim Landry

HydroFlame Technologies, LLC

Baton Rouge, LA, U.S.A.

jelandry@hydroflametechnologies.com

hydroflametechnologies.com

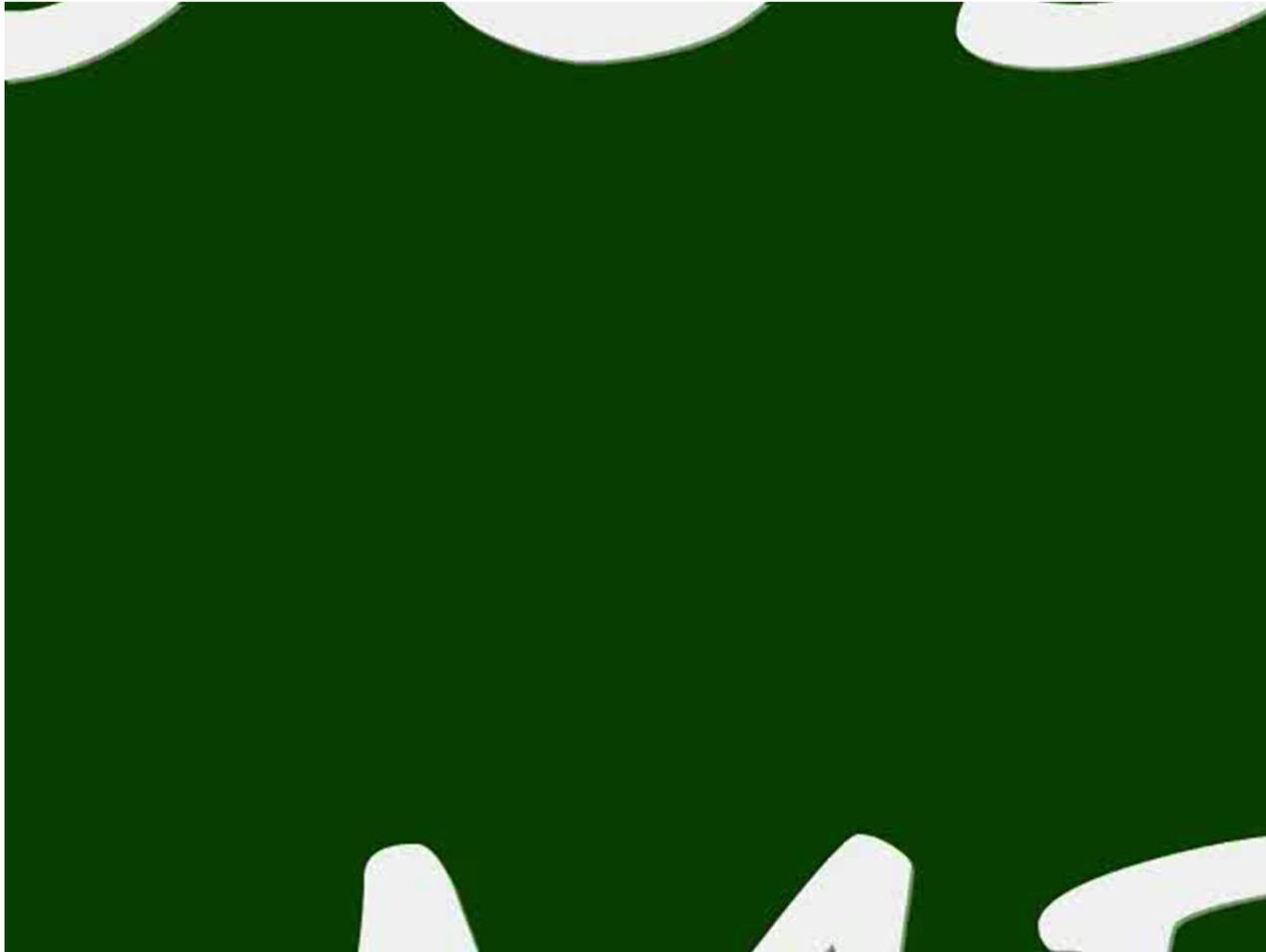
Outline

- The HydroFlame Concept
- HydroFlame Process Development
- Impact
- Potential Applications
- Economics
- HydroFlame Team

The HydroFlame Concept

- The high-intensity flame is always surrounded by a rotating body of water. Hence the name “HydroFlame”.
- The hydrodynamic stability of the rotating body of water and the aerodynamic stability of the flame complement each other.
- The result is an elegant solution to an age-old problem of *combustion containment*.

The HydroFlame Concept



Combustion flame in the air core of rotating body of water

Seeing is believing...



Flame Temperature in the combustion chamber: $\approx 2500^{\circ}\text{F}$

Exterior wall temperature of the combustion chamber: $< 120^{\circ}\text{F}$

HydroFlame Process Development

Present Model Operating in Baton Rouge:

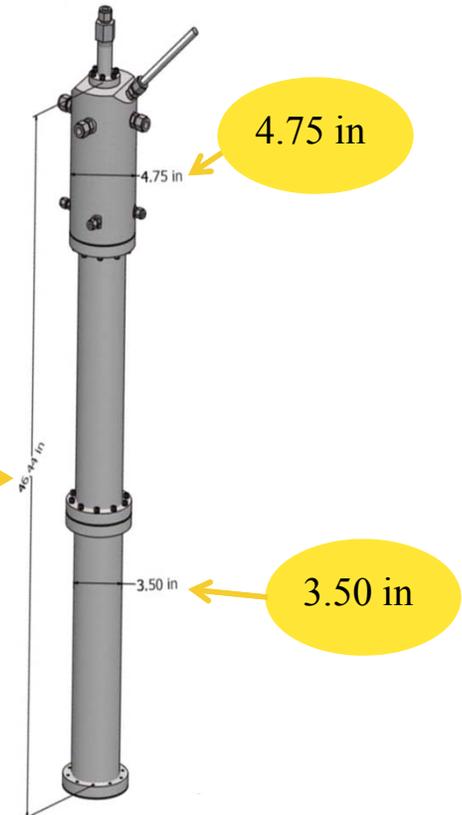
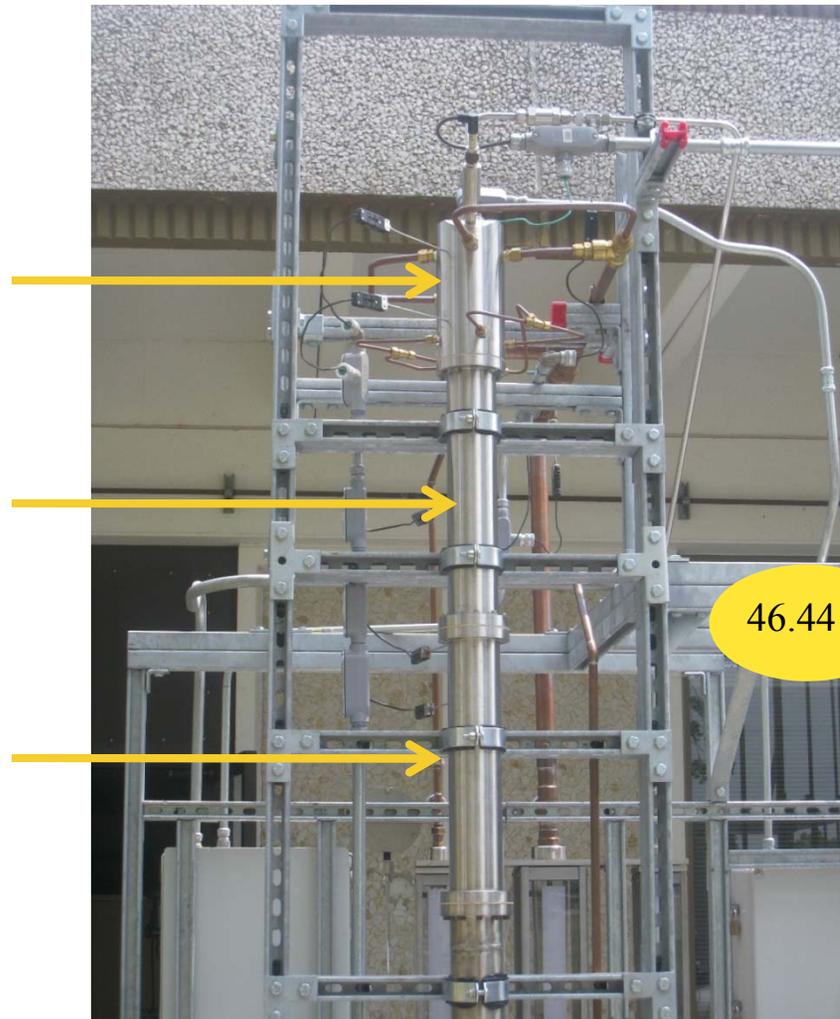
- Design capacity: 1 MMBtu/hr at 100 psig
- Successfully operated at 1.75 MMBtu/h capacity at 110 psig & 300°F steam temp.
- 2.5 gpm water flow (68 BPD)
- 11 CFM of methane at operating conditions
- 110 CFM of compressed air at operating conditions
- Flow models to determine hydrodynamics
- Study of combustion aerodynamics using “transparent” combustion chamber
- Videos

HydroFlame 1 MMBtu/hr Unit

Combustion chamber

Heat transfer zone – provides additional space for the combustion flame

Spray quench zone – generates high quality steam (> 80%)



HydroFlame 1 MMBtu/hr Unit in Operation

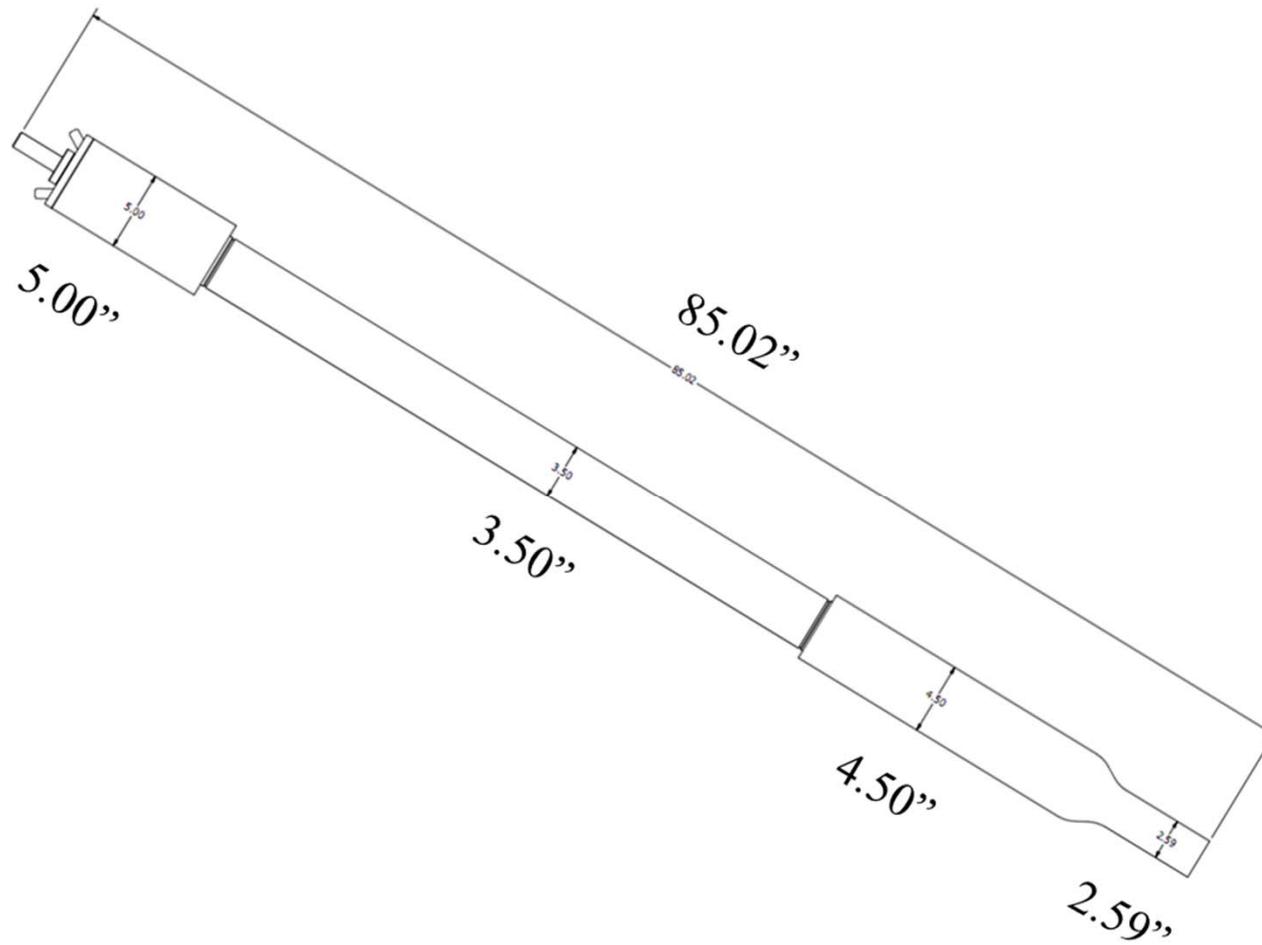


Development of 5 MMBtu/hr Unit

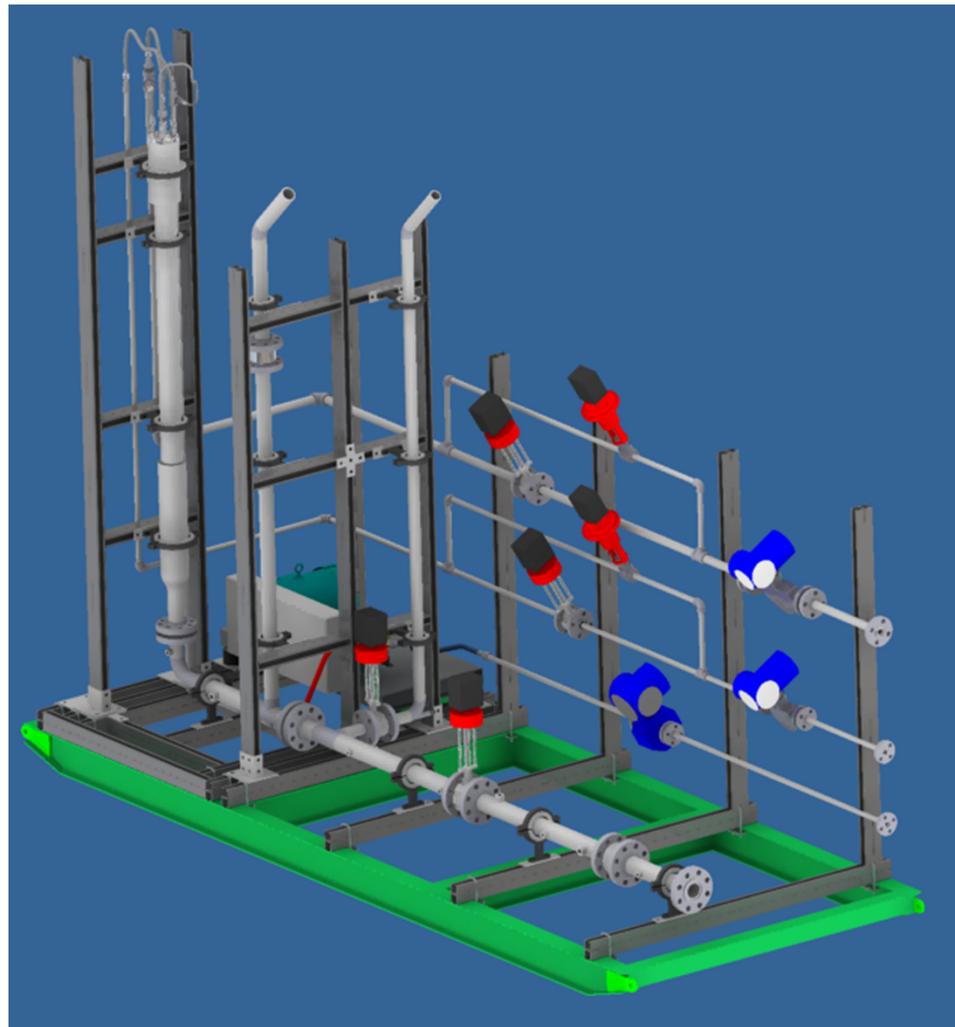
Field Test Unit

- 5 MMBtu/hr at design pressure of 750 psi
- 8.77 GPM water flow (300 BPD)
 - Water formed with the combustion of natural gas is recovered as injection steam, hence, less feed water is required.
- 82.43 SCFM of methane
- 785.5 SCFM of air
- Initial test on surface to be followed by a downhole test

Schematic of 5 MMBtu/hr Unit



5 MMBtu/hr Tool Setup for Surface Operation



Impact of HydroFlame Technology

1. Reduced heat losses when compared to OTSG
 - OTSG heat losses: > 20%
 - HF steam generator heat losses: negligible (<5%)
2. Reduced water treatment required as opposed to OTSG
3. Heavy oil production from reservoirs at any depth
 - Current technology, Once Through Steam Generator (OTSG), is limited to depths shallower than 2500 ft.
 - 95% of the heavy oil in the world are located at depths greater than 2500 ft.*

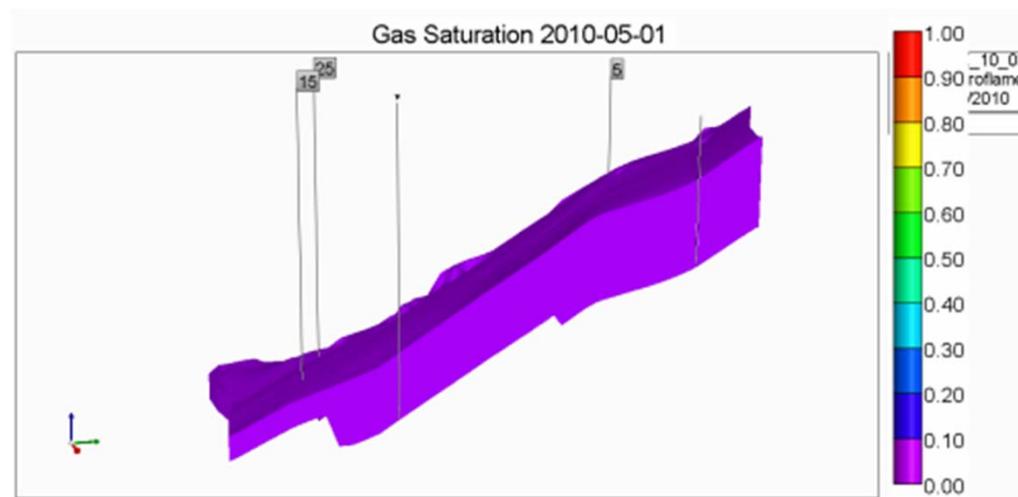
*Source: R. F. Meyer, E. D. Attanasi, P. A. Freeman, Heavy Oil and Natural Bitumen Resources in Geological Basins of the World, USGS Open File-Report 2007-1084.

Impact of HydroFlame Technology

4. Heavy oil production from offshore reservoirs & from under the Alaskan permafrost
5. Reduction in greenhouse gas emissions
 - Flue gases from combustion are injected downhole into the reservoir along with the steam.
6. Pressure maintenance in oil reservoirs due to flue gas injection, resulting in higher oil recoveries.
7. High heat transfer rates and compact design result in less footprint on land.

Plans

- Field test of the 5 MMBtu/hr HF unit in September, 2010.



Evaluation prior to field test - Reservoir simulation of steam + gas injection using a thermal simulator software. (Recovery: 77,432 bbls in 2 years)

- Upscale of the HF tool – Design and Fabrication of 10 MMBtu/hr HF unit and 25 MMBtu/hr HF unit.

Potential Applications

- Direct Contact Thermal Softener for produced water treatment
- Oxycombustion (CO₂ flooding of light oil reservoirs and CO₂ sequestration, liquid waste incineration)
- Hydrogen + Oxygen Combustion
- Power Generation
- Removal of hydrate plugs in subsea wells

Economics

Heavy oil production from one well:

	Day Rate	Monthly Rate	Yearly Rate
Number of barrels of production	40.00		
Price of the oil	75.00		
Gross production	3,000.00	91,250.00	1,095,000.00
Less discount for heavy oil (20%)	600.00	18,250.00	219,000.00
Royalty to be paid (25%)	750.00	22,812.50	273,750.00
Net production value	1,650.00	50,187.50	602,250.00
Production sharing percentage (50%)	825.00	25,093.75	301,125.00

HydroFlame Team

