Southern Methodist University

Geothermal Laboratory

"Bringing The Earth's Energy Into Your Community"

Geothermal Energy and Waste Heat to Power:

Utilizing Oil and Gas Plays

Energy Production with Mixed Hydrocarbons and Geopressured Integrated Hybrid Systems

March 13-14, 2013 Conference, SMU Campus, Dallas, TX

TAS®

economic. clean. energy.

“Nonconventional” geothermal power

- Unique and successful set of project developments:
  - utilization of co-produced fluids
  - geo-pressured hybrid technology including waste heat to power
  - increasing technology transfer to the oil and gas industry
- First commercial use of ORC on “un-separated mixed hydrocarbons” - mid-stream oil production facility in CA
- Developing geopressured hybrid geothermal
  - low-moderate temperature geo-pressured fluids
  - recover the waste heat from the engine exhaust and jacket water
  - from burning entrained naturally occurring solution gas assets

“Un-separated mixed hydrocarbons”

- “Major’s” Problem statement:
  - Develop a waste heat recovery project
  - Using binary turbine technology
  - Convert waste heat into electricity
  - Hydrocarbon-water-multi-phase
  - Prior to separation
  - Mid-stream processing facility

“Un-separated mixed hydrocarbons”

Constituent	C #
Methane	C-1
Ethane	C-2
Propane	C-3
Natural Gas Fraction	
Butanes	C-4
Pentanes	C-5
Hexanes	C-6
Gasoline Fraction	
Heptanes	C-7
Octanes	C-8
Nonanes	C-9
Gasoline Fraction	
Decanes	C-10
Undecanes	C-11
Dodecanes	C-12
Kerosene Fraction	
Tridecanes	C-13
Tetradecanes	C-14

Constituent	
Oxygen/Argon	O2 / Ar
Nitrogen	N2
Carbon Dioxide	CO2
Carbon Monoxide	CO
Methane	C-1
Ethane	C-2
Propane	C-3
Iso-Butane	C-4
N-Butane	C-4
Neo Pentane	C-5
Iso-Pentane	C-5
N-Pentane	C-5
Hexanes Plus	C-6 (+)
*** Hydrogen	H_2
Hydrogen Sulfide	H_2S

Vapor Flow Rates		Total	MSCFD
			lb/hr
	Gas		MSCFD
			lb/hr
	Steam		BSPD
			lb/hr

Physical Data

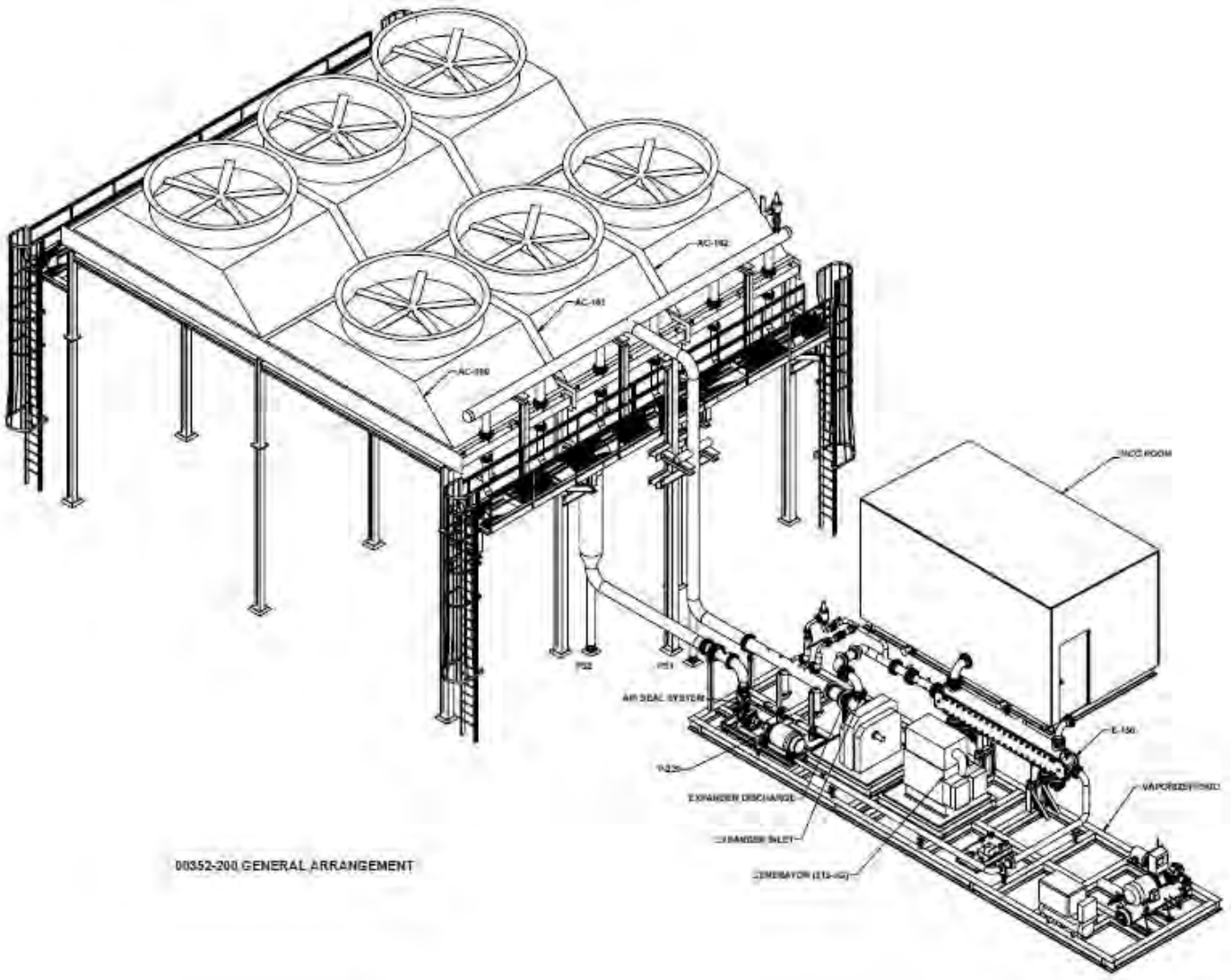
BTU cu.ft. ideal =
BTU cu.ft. real =
BTU/lb, ideal =
(Density) Sp. Gr. Ideal =
(Density) Sp. Gr. Real =
Density lbm/(1000 ft³) =

Dew Point (Water Content) Calculation.
ASTM D 1142
(14.7 psia 60°F Base)

C-H-O-N-S

% Carbon =
% Hydrogen =
% Oxygen =
% Nitrogen =
% Sulfur =
Total =

“Un-separated mixed hydrocarbons”



“Un-separated mixed hydrocarbons”

“Un-separated mixed hydrocarbons”

“Un-separated mixed hydrocarbons”

“Geopressured Hybrid”

- Been there – Done that….
  - Late 1980s, Ben Holt Co. designed, built, and operated a demo plant
  - Pleasant Bayou geopressured resource
- The power plant operated successfully…
  - Electricity could be generated from geopressured resources
  - With high reliability, using standard materials of construction
- Using a hybrid cycle…
  - Electricity generated by burning entrained gas in engines
  - heat from the gas engine exhaust supplements heat from the brine
  - improve efficiency of the binary cycle
- The project was co-funded by the U.S. Department of Energy and the Electric Power Research Institute.

“Geopressured Hybrid”

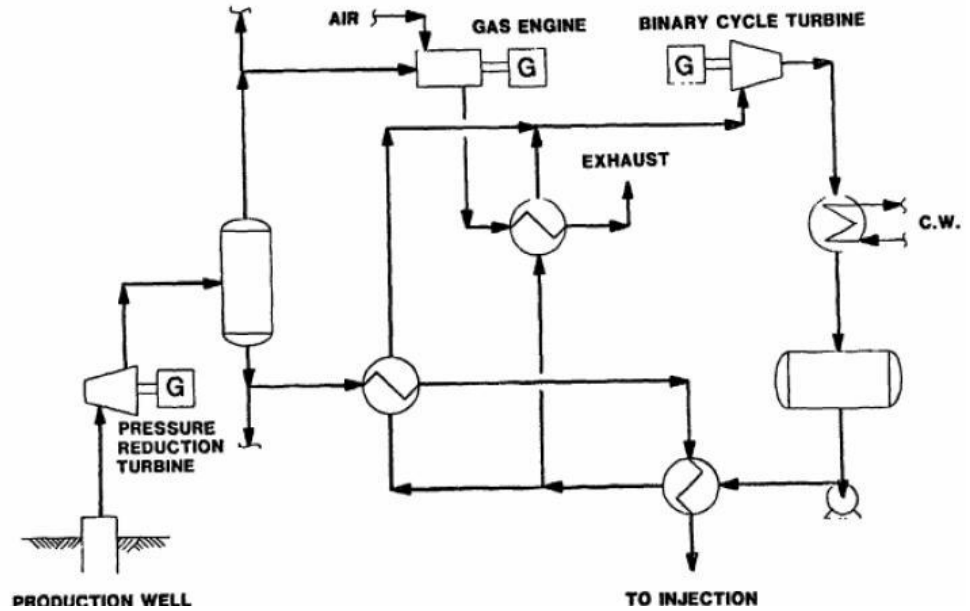
SUCCESS!!!

- Nominal 1.0 MW hybrid cycle (10,000 BPD)
- Multiple energy streams - running on brine and gas

*The hybrid cycle power plant demonstrated that **there are no technical obstacles** to electricity generation.*

*The hybrid power system demonstration at Pleasant Bayou **was successful in all respects.***

“Geopressured Hybrid”



“Geopressured Integrated Hybrid”

TAS ENERGY – Developments in the Gulf Coast Region…

- Binary w/ “Un-separated mixed hydrocarbons” HEX
- Recover waste heat from engine exhaust & jacket water
- Substantial efficiency improvements
- **Nominal 3.5 MW** Integrated Hybrid Cycle (25,000 BPD)

Conclusion

Generating electricity from multiple energy streams

- Reduces overall project expenses
- Reduces or eliminates CO2 emissions
- Decreases operator dependency on the local grid
- May qualify for Renewable Energy Credits
- Combining surface & reservoir sources of thermal energy maximizes the opportunity for Return on Investment.

Questions

Thank You!

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