

Concurrent Technologies Corporation

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Prepared For

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Laboratory
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Concurrent Technologies Rapid Technology Assessment – Langson Energy

BOTTOM LINE UP FRONT

The Langson Energy concept employs routinely available technologies to extract energy from natural gas pipelines as the pressure is let down from normal transmission line pressures to end-use pressures. While the Langson Energy approach uses a rotary helical screw, turbine technologies can be used as well. There is a very large amount of available energy in the pressure let-down approach. A conservative estimate is that over 6 GW could be available for Air Force use if ~ 10% of the available flow were to be tapped. The cost to implement such a system should be modest, but requires further study. Aside from the theoretical power available, the seminal issue is how close do production pipelines come to domestic Air Force Bases – do they traverse government property? If they do and let-down stations are on the base, the potential for ease of capturing the power is very high. As a very preliminary assessment, if 20,000 cfm of gas passes by Tinker AFB, with let-downs from 600-200 psi, then potentially 40 MW of continuous power is available. If the Air Force owned the assets with an operator operating the assets, it could have extremely low-cost power with ROIs measured in months.

RECOMMENDATION: The Air Force should rapidly pursue this technical capability. Specifically it should:

- Expand the study to evaluate natural gas pipelines traversing or passing near to Air Force facilities and bases to determine power available
- Work with the gas and electrical utilities to understand how a long-term, mutually beneficial relationship can be generated
- Ascertain the most favorable acquisition strategy for the Air Force

RAPID TECHNOLOGY ASSESSMENT (RTA)

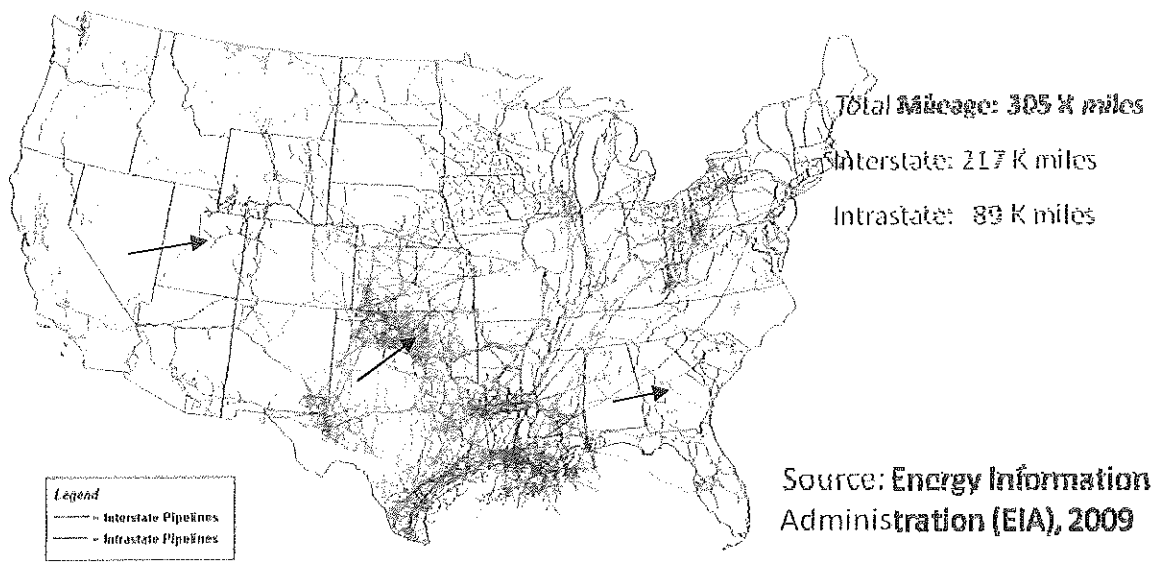
PURPOSE OF ASSESSMENT: To ascertain if replacing step-down throttling valve systems with an expander cycle engine to convert the let-down energy to electricity makes technical and economic sense.

COMPANY INFORMATION:

1. Earth Care Energy has a license to market and manufacture this device in most domestic and global markets. Ken Haney is the CEO of the licensee (Earthcare Energy: www.earthcareenergy.com) and can be reached at (832) 731-0104.
2. Langson Energy has a specific technological approach to extracting gas pressure energy from natural gas let-down stations through an expander cycle versus throttle valve.
 - a. The specific technology is a helical screw type technology
 - b. This technology is routinely used in high-volume gas compressors
 - c. The natural gas expands through the helical screw turning the screws
 - d. The rotational energy is used to drive an alternator (not defined)
 - e. The concept was invented by Richard Langson.

BACKGROUND

1. There is considerable energy in the pressure let-down, presently operated through a very reliable throttle valve technology
2. The U.S. natural gas pipeline network is a highly integrated transmission grid
 - a. It is comprised of more than 210 natural gas pipeline systems;
 - b. 305,000 miles of interstate and intrastate transmission pipeline;
 - c. more than 1,400 compressor stations that maintain pressure on the network and ensure continuous forward movement of supplies;
 - d. more than 11,000 delivery points,
 - e. 5,000 receipt points, and
 - f. 1,400 interconnection points that provide for the transfer of natural gas throughout the United States.
 - g. The pipeline grid efficiently and safely moves more than 20 trillion cubic feet (Tcf) of natural gas annually.
 - h. Assuming a 100% pipeline duty factor, flow is 2.28×10^9 ft³/hr
 - i. See Figure below for objective view of the grid
 - j. Pipeline pressures are incommensurate with user requirements. Depending upon usage, most end users do not see pressures higher than a few psi. Domestic users will have pressures between .30 and 50 millibar at the meter, which reduces the pressure to ~21 millibar for domestic home use
 - k. Domestic use accounts for up to 40% of natural gas consumption in the US



Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System

3. Applying the let-down approach to DoD facilities

- a. Above is a map of the US natural gas pipeline network
- b. The (very approximate) locations of major USAF depots are indicated
- c. All depots appear to be near major interstate or intra-state pipelines
- d. Tinker AFB is near a maze of pipelines – this would be a natural location for a demonstration

4. Pipelines are comprised of 3 types: gathering, transmission and distribution

- a. Gathering – from wellhead to transmission ½" to (6" - 16") diameters
- b. Transmission – 16" – 48"
- c. Distribution – 6" – 16"
- d. Varying Pressures
 - i. 200 – 1500 psi transmission
 - ii. Lower pressures – down to inches of water at user
- e. Pressure is reduced using throttle valves

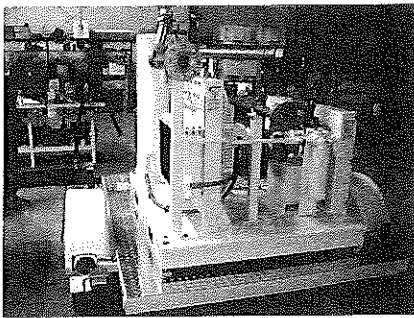
5. The throttle valve wastes all the energy of stored pressure

ANALYSIS AND ASSESSMENT

1. Langson Energy claims energy available according to the chart below

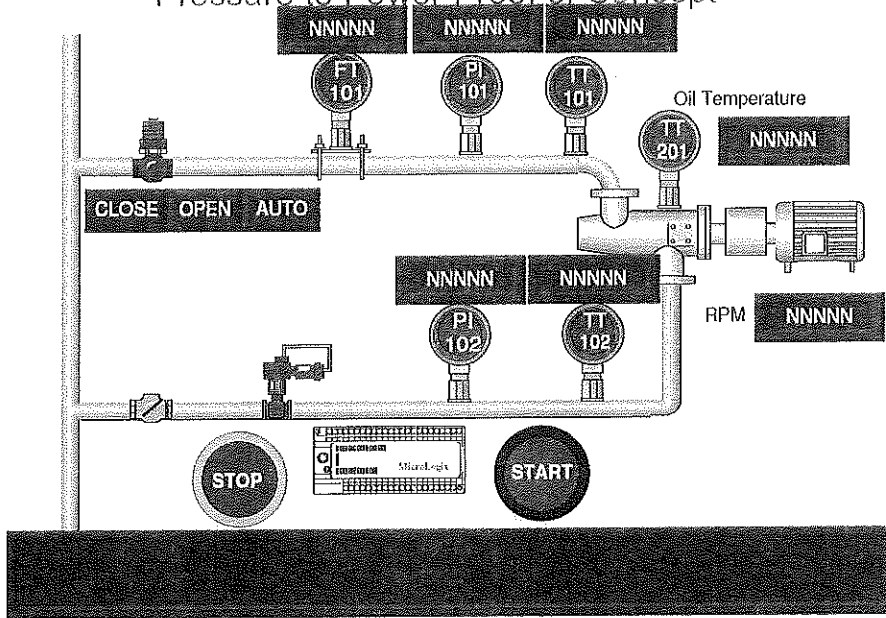
- a. The available energy is significant – the author has independently corroborated Langson's energy availability figures

- b. The values below appear to be at a 70% isentropic efficiency, probably realistic for helical screw
 - c. Large amounts of available energy ~13% of the combustion energy available from a combined cycle gas turbine can be gained from expanding the natural gas flow rate associated with the gas turbine and converting the expansion energy into electricity adding this energy to the total electricity produced by a combined cycle gas turbine.
2. Using the author's analysis and comparing to above graph (the graph is conservative)
- a. In units of $10^5 \text{ ft}^3/\text{hr}$, each of these units could produce 3.15 MW (100% isentropic expansion efficiency)
 - b. The total power available in going from 600 psi to 200 psi let-down is ~72 GW electric assuming reasonable system efficiencies (there may be more or less depending upon actual pressures and volumes)
 - c. The helical screw technology is ~80% efficient: this could theoretically yield ~53.7 GW of electrical power assuming a 93% efficient alternator for the entirety of the gas volume
 - d. Assuming 10% of the let-down stations are near a DOD facility, ~5.4 GW of power could be available to reduce electrical bills with helical screw technology.
3. Technical considerations
- a. The technical issues with this concept are straightforward engineering
4. Applicability to the DOD: This project has potentially very high applicability to the DOD in a domestic region – it may be feasible in some foreign countries. Specific utility is dependent upon gas supply, magnitude, etc. All of these need to be evaluated on a case-by-case basis.
5. TRL: at least 7, MRL at least 7, System Readiness Level: 5



15 kW trailer mounted unit

Pressure to Power Proof of Concept



Test unit human machine interface