ENERGY DEVICE MEASUREMENT and VERIFICATION REPORT

Advanced Combustion Technologies
Hydrogen Energy System: HydroQube

Measurement and Verification:
Hydrogen Energy System (Validation test 1)

Test Site:

Advanced Combustion Technologies
80 West Easy Street
Simi Valley, Ca, U.S.A.

Report by:

James Beach, CEM
Witnessed by: James Beach

- Certified Energy Manager, Association of Energy Engineers
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Test Dates:

Nov. 4th and 5th 2015

Executive Summary

Overview of Current Prototype Systems in Place

- Dates of preliminary prototype demonstration set up as outlined below Nov.4th and 5th, 2015
- Data collected from manufacturers' design specifications
- Data collected from owner/developer
- Brief description of the present situation
- Initial findings, observations and assessment of the performance of prototype demonstration system's output or equipment

Brief Description of the System *(As observed while operating at ACT Advanced Combustion Technologies in Simi Valley, California)*

Upon arrival at the office the system was reviewed with me and then presented to me in the shop area where it was set up, connected and ready to operate.

We began an inspection with an overall description of the operational purpose of each piece of equipment in the system. After installing electrical meters the HydroQube/Generator was started and ran for a few minutes then stopped and inspected after a brief explanation of its operation parameters plus gauges and monitoring devices.

For a more thorough inspection and minor adjustment/repair we opened the generator to find nothing inside but its standard windings. The vacuum pump was also taken apart and inspected, found to be normal except the seals were worn and replaced at that time. The new replacement carbon monoxide cylinder was observed completely sealed from Air Gas the supplier then opened and installed in my presence. The HHO generators were as you see from the following photographs a clear type plastic and inside only the plates for electrolysis plus the water. All interconnected components were purged before the demo. The second day, the three phase generator had been disconnected from the panel and from the electrolyzer, running only on the power supply fed by the generator itself which was running off the gas from the one electrolyzer and the carbon monoxide only. At that time, it also powered the electric heaters drawing the appropriate amperage. The second day part of the windings failed in the generator so even though it ran itself generating its own gas at that time it produced a reduced amount of heat from the electric heaters as seen in the thermography report.

In addition, another separate and independent device, the Hydro Electric Generator was observed to use one liter of the HHO gas, ignited, using a spark plug and sending a water column 50 feet high into the air. Nothing else was attached, producing approximately 1,000 PSI.

All of this was videoed and or photographed part of which is presented in this document plus the additional information and videos are available upon request.

Table of Contents

I. **Introduction**

- Brief description of equipment – type of generator usage, hours of operation, style built, etc.
- Breakdown of energy (electricity and fuel) consumption is in chart form:

Objectives of test:

- To quantify the energy production of the HydroQube prototype system with a view that will meet performance and financial criteria and take into consideration technical and operational advantages and/or limitations.
- Confirm specifically the amount of energy input required to run the 10kWh Generator.

Input Power: total input power was measured at: 2.3KW



Input Three Phase Power Supply Starting	Input Single Phase Power Supply Running	Actual Amperage Disconnected from Grid	HHO Flow Rate To Run the Generator	Generation Full Design And Potential Observed Total	CO Flow Rate
.733 KW	.550 KW	.550 KW	40LPM/5.6KW	67LPM/9.6KW	1.2KW

Notes: as to why 3 phase verses single phase. The generator was started while utilizing 3 phase grid power which was then disconnected to continue to run on the single phase power supply provided by the generator itself.

Output Power: **Total Output Power was measured at 10 kW**

Unit No.	Generator (KW)		Carbon Monoxide		Vacuum PUMP		2 Electric Heaters	
	Design	**Measured**		**Measured**	**Design**	**Actual**	**ºF**	**KW**
1	10KW	10KW		10LPM or 1.2KW	350 watts	300/350 Watts		4
2								4

Output Power KW	Design	Actual	2 4KW Electric Heaters	Design BTUs/Hour	Actual BTUs
10KW	10KW	10/11 KW	8/9 KW Total	15,354	

II. Methodology and Instrumentation

- Instrumentation table (see example below)
- Detailed devices installed and measurement procedure
- Pictures and Diagrams showing the readout locations of the installed instruments

Sequence of Operation for HydroQube Energy System
(1st and 2nd Mode)

The System consists of a natural gas converted electrical generator, power supply electrolyzer, bubbler, mixing chamber, CO cylinder, and pressure tank. The System shall be monitored and logged. When in electrical mode energy usage shall be presented on a graph and will be available for further energy load analysis. (All suggested set points and settings are adjustable).

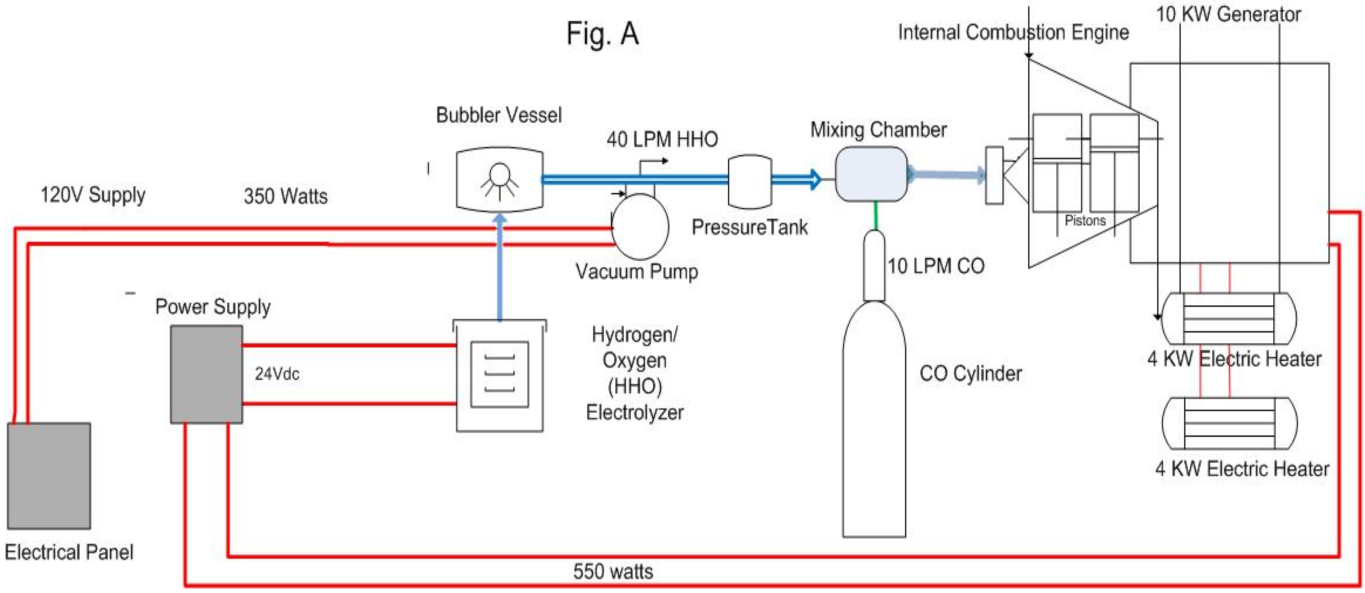
Standard Mode

The electrical generator shall run continuously and the unit is controlled as follows:
With the system in the standard electrical mode it shall be energized to maintain a standard load and water will be introduced when necessary and recycled when possible.

Demand Reduction Mode

The electrical generator runs and when a predetermined demand load is approached associated zone set points may be adjusted and the respective capacity is temporarily converted to the local grid load reduction is achieved then the capacity shall be energized to maintain the original load. Then the system will revert back to demand reduction mode whenever the predetermined demand is approached again. During this mode water is controlled with load and utilized when appropriate.

Fig. A



Details of the equipment, their ages and; description of controls, type and number of generators/heaters and operating times

Description	Qty	Rated kW or gallons	Operating hours design	Operating hours actual
generator	1	10 kw	24/7	1/2 hour
CO tank	1	1.2KW	24/7	1/2 hour
electric heater	2	4kw ea.	24/7	1/2 hour

III. Data Analysis and Findings

- November 4th and 5th, 2015
- Energy consumption and the methodology used to establish it
- The energy efficiency index defined as the amount of electrical energy consumed compared to output of electrical energy.
- Description of systems or equipment tested plus their capacities and ratings, design and operating conditions, equipment, etc, including information such as the type of systems, and number of auxiliary equipment, etc.
- Findings and observations

	Design	Measured		Measured	Design	Actual	OF	Measured
1	2							

Input Three Phase Power Supply	Input Single Phase Power Supply	Actual Amperage Disconnected from Grid	HHO Flow Rate While Running the Generator	Generation Design And Observed	CO Flow Rate
.733 KW	.550 KW	.550 KW	40 LPM	80 LPM	10 LPM

IV. Conclusion

The generator was further inspected again found to be a standard natural gas model, only the intake was modified on the generator to accept the HHO/CO gas mixture and throttle it appropriately. See pictures for further clarification. The vacuum pump remained hooked to the grid through the measured wall outlet and pulled the name plate amps/ watts or less. Nothing else was connected to the equipment inside or out. When using the three face power supply it was at .733 kilowatts as expected running both electrolyzers, which were running the generator. The generator will also run on a single electrolyzer and its own single phase power supply.

In summary, the water and CO are the only fuel raw materials and many other more plentiful and less expensive gases can be used in place of the CO to modify the burn of the HHO gas produced in the electrolyzer unit, such as biogas, waste gas, natural gas, methane, etc.. This replacement of CO with natural gas can make it cost effective because of the inefficiency of the gas generator in its present configuration it isn't. The electrolyzer is very efficient at producing HHO gas and utilizing this gas in a device such as the Hydro Electric Generator would be more cost effective.

This system is described below:

This has the potential to be up to 3 times more efficient than running a natural gas generator, if not also for the fact that there will be less ancillaries and less capital cost.

Next prototype will consist of 2-3 cubes powering a 50kWH generator.

In my opinion the engineering required is not groundbreaking, this is entirely feasible to engineer and make a second phase prototype.

See section V for more information.

Identified/Calculated Energy Production Measures

With the cost of CO at .72 per cu. ft. it makes the system uneconomical. Cheaper input gases can be found, but were not available for the demonstration. The CO is used to buffer the temperature and modify the rate of the burn down. CO cost .72 per cu.ft. is several times higher than natural gas with less KWH.

Power Measurement

Details of the electrical load profile of generator illustrated with the following recorded

- Electric load (kW) profile over at least one half hour
  8 KW Electric Radiant Heaters and 550w single Phase Power Supply
- Electric input (kW) profile of 350 watt vacuum pump
- Carbon Monoxide input 10 LPM

Measurement and Verification

After monitoring and recording input KW and output KW, plus heater production, CO LPM, and thermal temperature energy and power use.

Estimation of Energy Values:

Estimated generator output power = 10KW

Note: As per additional Independent report of the ACT Cell rating is as follows: For a power input of 1650 Watts (1.65 KWH) the ACT Cell has a potential output of 9.6 KWH (Please see the Independent Report of the ACT Cell) by Helton Appendices #1

V. Next Steps with Hydro Electric Generator (Validation Test 2)

The Hydro Electric Generator will directly utilize the expansive pressure from HHO developed in the special electrolysis process to force a fluid (water, hydraulic oil, etc.) into a Parker Denison or similar rotary vane pump that is attached to a generator. This will be many times more efficient then burning the gas in a conventional generator engine, it will also be virtually pollution free and self-sustaining. As illustrated below, the Hydro Electric Generator reached an approximate instantaneous pressure of 1000 PSI and generated a water column of 50 ft.

VI. Appendices

Information of significant importance, which cannot be presented as a part of the text report (because of number of pages, quality/quantity of presentation, etc.)

The appendices include:

- Patents and drawings of the equipment
- Details of instrumentation used – parameters monitored and duration of monitoring for each parameter for additional 3rd party testing
- Additional measurement and verification (M&V) plan for monitoring and verifying energy for ACT system
- /Spreadsheets/Videos containing the raw measurement data available upon request

General Notes to the Report

- Documentation – All numbers related to the results are supported by additional collaboration and test performed by other reports showing how they were derived. This includes all energy readings.
- All calculations in the reports checked for mathematical accuracy.
- Consistent units used in all parts of the reports where practical.
- All graphs and plots are properly labeled and show the dates when the readings were taken.
- Examples shown serve as a guide; actual tables show more detailed information where possible.