THE CONSULTANT

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Chairman's Corner

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If there is anything destructively stupid that can be thought of to be done, someone will eventually want to do it.

Such is the situation today with regard to "broadband over power lines" in which high speed data would be carried by unshielded power line wires. Energized with the RF of high speed data signals, those wires would act as long-wire antennas and send out broad spectrum electromagnetic interference far and wide.

Even a low-power, peanut whistle ham radio transmitter connected to just thirty feet of wire can be used to establish communication contacts over distances measured in hundreds of miles. In my teens, I did this myself with a one-tube, 6CL6, transmitter that I built in a coffee can. It worked because electromagnetic signals can really travel!

Clearly, there is money backing the underlying plans and tragically, money could in the end win out. In effect, in this writer's view, we and the electromagnetic spectrum are under attack.

Please visit http://www.arrl.org/tis/info/HTML/plc/ to see the American Radio Relay League's site for more information on the subject.

Meetings

January 2006

7:00 PM, Wednesday, January 4, the first Wednesday of the month.

Briarcliffe College, 1055 Stewart Avenue, Bethpage, NY.

Topic: "Effective Marketing and Sales for the Consultant"

Speakers: Mr. David Pinkowitz
DCP Marketing Services LLC, Melville, NY.
www.dcpmarketing.com
"The role of marketing is to develop strategies and messages and to communicate them frequently to prospects. Effective marketing must build awareness, develop relationships, and generate sales leads. Effective marketing results in the prospect contacting the consultant at the unknown time when they are ready to buy."

Mr. Mark Bullock
Real Business Vision, Northport, NY
Business Coaching and Consulting
www.RealBusinessVision.com
"Get this if nothing else - BE PRESENT, to the conversation and to them. Press the pause button on your desire to problem solve until you know, they know, you understand them, and what they want."

The above quotes were taken from their respective handouts, which contain more information and advice. The websites tell us more about their respective businesses. Mark's website tells us about the role of a coach in helping us to work ON our business instead of just IN it. To realize the vision that we had when we started it - before we got bogged down in its demands.

At the December meeting we elected officers for 2006.

Chairman - John Dunn
First Vice Chairman - Jerry Brown
Second Vice Chairman - Sam Sadinsky
Treasurer - Dave Rost
Secretary - Dick LaRosa

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Carbon Dioxide Sequestration ----- Carl E. Schwab

Introduction:
In a previous newsletter article the universal presence of methane gas or CH_4 was discussed. But there is another gas, carbon dioxide, that occurs whenever we combust any of the hydrocarbons or coal. CO_2 along with CH_4 have been identified by many members of the political and technical communities as the culprits which cause global warming. What we want to discuss here is technical means to keep the CO_2 from going into the atmosphere when we burn hydrocarbons and coal.

Two not-so-unconnected problems:
Problem 1 is that the US, India and China have tremendous energy reserves in the form of coal, and burning this coal generates tremendous amounts of CO_2 that are simply released into the atmosphere.

Problem 2 is that the oil-pumping industry needs tremendous amounts of CO_2 for enhanced oil recovery (EOR).

A Thought: After completion of EOR, can this CO_2 simply be left stored in the earth rather than in the atmosphere? In this way we get some good use of the CO_2 before we sequester it. In this case the CO_2 is sequestered deep into the ground and hopefully for thousands of years. First let’s revisit some old ideas.

Revisiting Old Ideas:
We have been burning coal for more than 200 years. For several decades steel mills have used coal massively in the manufacture of steel. What has evolved more as a convenience and also an improvement in efficiency was the idea of gasification of coal to produce gas that could be piped around the plant and burned as a generally convenient, cleaner energy source. Two such gases are **producer gas** and **water gas**. Frequently manufacturing plants manufactured **producer gas** or **water gas** for their own use. The primary difference between the two is that **producer gas** has about 50 percent nitrogen while **water gas** has very little or no nitrogen.

Producer Gas: When a limited supply of air is led through white-hot coke, the latter undergoes partial oxidation to carbon monoxide. Sufficient heat is set free to permit the process to be self-sustaining. In practice, the air is forced into the base of a furnace with the aid of a jet of steam. The burning of the coke is accompanied by a reaction between it and the steam, resulting in hydrogen being produced along with carbon monoxide. Thus the gases rising out of the fuel bed are, in diminishing proportions; nitrogen, carbon monoxide, hydrogen, and carbon dioxide. This mixture, called **producer gas**, is combustible and is used directly for industrial heating and to drive gas engines for power.
The chemical reaction for **producer gas** and **water gas** is

$$C+H_2O \longrightarrow CO+H_2 \quad -33.1\ \text{Kcal}$$

Water Gas: Essentially a mixture of hydrogen and carbon monoxide, this gas is manufactured commercially by blowing steam through white-hot coke or anthracite. See equation above. The coke is first set on fire in a brick-lined cylindrical structure. It is brought to vigorous combustion by blowing in air for about 10 minutes. The resulting gas, mostly CO_2 and N_2, is vented to the atmosphere. Then steam is substituted for the air, and the resulting water gas collected and stored in a Holder Tank for convenient use.

The interaction (see the equation above), as the negative sign indicates, takes place with absorption of heat. Hence, at the end of a few minutes, the coke becomes too cool. It is then necessary to turn off the steam and to turn the air on again, and so on alternately. The mixture of carbon monoxide (40 to 50 percent), and hydrogen (45 to 50 percent), containing some carbon dioxide (3 to 7 percent), nitrogen (1 to 5 percent), and oxygen (1 percent), is known as **water gas**. It is almost wholly combustible, burning with a blue flame, and is used as a source of heat and, by driving internal combustion engines, to furnish power.

If both air and steam are driven together through the burning coke, the air enables the coke to burn continuously, and a fuel that is a cross between **producer gas** and **water gas** is obtained. This continuous operation was desired by some companies. If oxygen is available at the site, it may be substituted for the air to continuously produce **water gas**.

In 1923, in Germany, a patent was granted for the **Fischer-Tropsch process** for producing gas from coal to manufacture synthetic gasoline. The gas in this case was water gas and consisted mainly of carbon monoxide, CO, about 35 percent, and hydrogen, H_2, about 50 percent. The end product found application as replacement for gasoline from petroleum.

In the late 1930s both Germany and England had perfected coal gasification methods, **Bergius process**, to produce gasoline, and in particular aviation fuel. Both England and Germany were heavily dependent on coal as a source for synthetic fuels throughout WWII.

Coal gas: Gasification of coal has been used to provide isolated Midwestern towns with several luxuries such as coal brickets for cooking, coal gas to be used for lighting of streets and homes. By products were tar, benzene and distillates. With the advent of Edison's electrical generators, the towns switched to electric power for street and home lighting. The gas in this case was about 50 percent H_2 and 40 percent CH_4.

Nowadays, gasification of coal is getting a LOT of interest in regards to reducing CO_2 into the atmosphere. The current technology is called **IGCC (Integrated Gasification Combined Cycle)** power generation. This addresses **Problem 1** above, how to burn coal and NOT put CO_2 into the atmosphere.

IGCC:
The heart of **IGCC** is the gasification of coal. Now this is certainly not new. My old college chemistry textbook described a process for manufacturing something called **coal gas** described above. Basically that process consisted of heating coal to 1300C in an airtight retort that drove off all volatile elements leaving only carbon in the form of coke that was then formed into briquettes. The **IGCC** process starts with a similar process where the gases driven off are collected as raw **syngas**. When you gasify coal, you don't actually burn it. You heat it to about 1150°C in a sealed chamber. Along with adding some steam, you inject a bit of oxygen (not air), but not enough to allow the coal to burst into flames. Instead, the coal breaks down into its chemical molecular blocks and numerous chemical reactions occur in the gasifier. The resulting gas is combusted to drive a gas turbine, which in turn drives an electrical generator to produce electrical power. The gases exhausted from the turbine are quite hot and have considerable energy that can further be extracted by using it to heat steam that in turn drives a steam turbine, which drives a second generator of electrical power. The flue gases from the steam generation are mostly water vapor and are clean. The combined electrical output from the generators is the plant output.

With a gasification plant, separating CO_2 from the rest of the synthetic-gas stream is a straightforward chemistry project that requires little added expense. It is not to be confused with removing CO_2 from a conventional coal burning stack.

Syngas, What is it?
Syngas in the raw form, consists of about 30% to 50% methane; about 40% to 60% hydrogen; and variously up to about 10% of ethane, butane, and propane.
In some cases the products are sold separately i.e. the CH_4, H_2, ethane, butane and propane are filtered out. It is frequently profitable to filter out the methane and sell it separately. The remaining gas is used to fire the gas turbine.

So that is the first part, **problem 1**, consume coal with minimum of CO_2 that is captured and generate clean electrical power. Now the second part, **problem 2**, is what to do with the CO_2?

Serendipity would dictate that we simply use this CO_2 to flood oil fields to promote the recovery of oil. First let's examine the Phase State Pressure-Temperature curve for CO_2. Next let's see how well CO_2 can be moved by pipeline.

CO_2 Pressure-Temperature Curve:

The gram molecular weight of CO_2 is 12+16+16=44 gm. As gases go, it is heavy. In the liquid state it is heavier than water, which is heavier than oil. CO_2 has a **CRITICAL TEMPERATURE** of 31 degrees Celsius, a **CRITICAL PRESSURE** of 71 atm and a **TRIPLE POINT** at -56.7 degrees Celsius and pressure of 5.3 atm. Between 0 Celsius and 20 degrees Celsius, the vapor pressure varies from 35.4 to 56.5 atm. In the liquid state, the CO_2 is denser than water (20% heavier) and hence sinks to the bottom (lowest point) of the well bore and remains there forever.

(A 10-meter water depth produces a 1 atm pressure difference. Also 1 bar = 1 atm.)

Efficiency of Transmission:
Using pipelines to move CO_2 is quite efficient. Depending upon the pipeline, the pressure can be high enough to pump the CO_2 in either gaseous or occasionally in a liquid state. Most often the best efficiency is obtained with the CO_2 in the gaseous state at high pressure. Moving CO_2 is only troublesome if sufficient moisture (H_2O) is present to cause ice plugs in winter operations.

EOR operations:
More than 1000 miles of pipeline are used currently to flood oil wells with CO_2 to flush the residual oil to a pool for pumping. Currently, this is done mainly in West Texas. This is not a rigorous description of an oil field but it is not too far off the mark. Let us assume we have an area of say 70 square miles situated over an oil bearing rock layer at say a depth of 6000 feet below the surface. If this is a good bearing formation then the field will be drilled with about 10 wells per square mile. Now there are regulations about where the drilling sites can be located relative to each other and placement becomes as much of an art as it is a science. Pumped over a period of say 20 years this field will be "pumped out" to the extent that production has fallen to say 20 percent of the original flow rates. But historical fact is that some 50 percent of the oil is still in the rock formation.

For the past many decades the oil production business has sought endless ways to somehow reach that remaining 50 percent. Acid washes have been used to loosen the oil from the rock. In some instances live steam has been forced down adjacent well sites to soften and drive oil towards the pumping well. Water flooding had been used, again flooding down adjacent sites to force the residual oil towards the pumping well. Most successful of recent years is the use of liquid CO_2. This is called **EOR, Enhanced Oil Recovery.**

In our hypothetical 70 square mile field, **EOR** engineer(s) would survey the field and the production records of the about 700 wells drilled. From this information and experience they would determine which wells would be used for injecting CO_2 and which ones would be used for oil production. A source point for the 70 square mile area would be selected and a CO_2 pipeline terminal installed. From this terminus, tertiary lines would connect to the selected injection wells.

In the **EOR** operation, the strategy is to flood well locations that surround one oil production well with water first, then CO_2 injected to establish a moving vertical layer that forces the oil ahead of it towards the production well selected.

Why this works?
Experience has shown that the un-recovered oil resides about midway between former production well locations i.e. about half of the oil originally available is left in patches scattered between the drilled well sites.

So the strategy is to establish this moving wall of water backed up by CO_2, which because of relative densities pushes the residual oil towards a desired pump-out well site.

EOR experience has shown that the oil field will not only increase its production rate but may extend its life up to 15 years. In the contiguous United States, in 2005, there is little new production. The bulk of current production results from EOR operations.

But what do you do if the conditions are such that after EOR operations the CO_2 does not want to sequester (long term store) in the now-abandoned well? The circumstances that will allow the CO_2 to sequester are well understood and if it will not store, then (just as at the current time) simply vent it to the atmosphere.

Alternative Storage Well:

Since the art of well drilling is advanced, we can seek out sites for well locations that are to be used only for CO_2 storage. Geologists refer to these as brine aquifers (not to be confused with the fresh water aquifers as here on Long Island). They have become brine (salty) aquifers because the water has been stationary for hundreds of years and allowed to dissolve the salts in the surrounding rock layer. If you have a good, isolated formation with an impermeable cap rock as a lid to keep CO_2 from escaping upward, then the gas should stay down there indefinitely. The bigger question is how much CO_2 could be put in these brine formations? Some rough calculations done in the 1990s came up with some very large capacities – as much as 50,000 billion tons of CO_2! That would be enough to entomb every last ounce of projected CO_2 emissions for centuries!

Conclusion:
Carbon dioxide occurs whenever we combust any of the hydrocarbons and, in particular, coal. CO_2 is not a pollutant but actually a gas vitally needed for support of life, but too much CO_2 along with CH_4 in the atmosphere have been identified by many in the political and technical communities as the culprits causing global warming. What we have discussed here are technical means of keeping the CO_2 from going into the atmosphere when we burn hydrocarbons and coal. Sequestering CO_2 by deep burial into the earth has been suggested and indeed it seems likely to be a cost-effective method of preventing the CO_2 release into the atmosphere. Much of the cost for developing this technology will be borne by the US and US-owned companies, but even if India and China are getting a 'free ride', the world may gain.

Hurricane Suppression ---- Dr. Richard LaRosa, sealevelcontrol.com.

INTRODUCTION

The November 2005 Newsletter described a system of forced upwelling of cold bottom water on the Atlantic Ocean side of the Antilles Islands chain. The cold water is mixed with the warm surface water entering the Caribbean Sea via the shallow passages between the Antilles Islands. This reduces the surface temperature of the Caribbean Sea and the Gulf of Mexico below the critical value required for hurricane formation and intensification.

REDUCED SYSTEM SIZE

The November system size was estimated by requiring the cooling to balance the net radiation input (solar minus long-wave) to an arbitrarily-chosen area. The new estimate eliminates this arbitrary choice, and is obtained as follows: About $30 \times 10^6\ m^3 s^{-1}$ flows into the Caribbean Sea via the Antilles passages. Mixing less than $1.2 \times 10^6\ m^3 s^{-1}$ of 4.5°C bottom water with the surface water can reduce the surface temperature about 3.5°C, enough to prevent the formation and intensification of hurricanes. The cooled surface water passes from the Caribbean Sea into the Gulf of Mexico, and from there it is carried into the Atlantic Ocean by the Florida Current. Most of this water circulates around the North Atlantic Subtropical Gyre and achieves a long-term cooling of the entire Atlantic Ocean. Therefore the full 3.5°C reduction in surface temperature may not be required. The exact pumping rate depends on the system configuration, and this is presently undergoing change. In any event, the requirement is a lot less than the pumping rate reported in November.

The cooling water is pumped up from 1400 m depth instead of the 1600 m depth chosen in November. Also, a 10 m inside diameter has been chosen for the cold-water pipes, instead of the 2.74 m used in the November estimate. These changes, together with the reduced flow, result in less power required to lift the water against gravity and overcome pipe friction. However, the cold water must be distributed from very long perforated fabric hoses that are inflated by the discharge pressure of the pumps. Floats keep these hoses near the surface. Without this dispersion system, the discharge of each pumping station would form a plume of cold water that would sink before it could mix with the warm surface water. Therefore the OTEC (ocean thermal energy conversion) plants must supply additional power for dispersing the effluent.

If the pumping stations are distributed along the Atlantic Ocean perimeter of the Antilles chain with their perforated discharge hoses directed toward the inter-island passages, it is apparent that surface currents passing between the pumping stations may not be adequately cooled, while the current flowing near the discharge hoses is cooled too much and may sink too low to mix with the warm water that spreads out above it downstream. This must be analyzed, but it is anticipated that a pumping station must have no more than one 10-m-diameter cold-water pipe in order to reduce the concentration of its cold-water discharge.

PUMPING STATIONS

The cold-water pipe is suspended from a floating structures, which I initially called a barge. But a barge is flat-bottomed and has a large area at the water line. It is subjected to large vertical motion due to waves, and is impacted sidewise in storms. The deepwater offshore oil and gas industry overcomes this problem by using tension-leg platforms. Buoyancy is provided by submerged horizontal pontoons connected to an above-water platform by one or more vertical float chambers with comparatively small area at the water line. The structure is kept at a fixed height above the sea floor by deep sea moorings anchored to the bottom. The moorings might be vertical metal tubes with little elasticity, or chains and cables with computer-controlled automatic tensioning devices to hold them at a fixed location above the sea floor. These are well-suited for connection to pipelines from wells and distribution centers.

The problem with these tension-leg platforms is that the center of gravity is above the center of buoyancy. The moorings keep them from toppling over. The trade magazines show a post-Katrina photo of a rig with its three radial pontoons floating upside-down on top of the water, connected to the submerged platform by the inverted center column. The oil and gas industry can afford losses like this because it passes the cost onto the consumers who are in desperate need of the product. The hurricane suppression system, however, requires inherently stable structures.

The trial design envisions a submerged hull connected to at least one above-water hatch by a column whose cross section is just large enough to accommodate the hatch opening. The small column cross section minimizes the variation in buoyancy when waves pass over the hull. The submerged hull minimizes side slapping by storm waves. The hatch must be large enough to pass the largest piece of machinery on board. There must be an overhead trolley and large-enough horizontal passageway to move the component between its station and the hatchway. The heavy machinery must be installed near the bottom of the hull to lower the center of gravity. Part of the hull volume will be occupied by a pipe that connects the floor intake to the side discharge port via a 90-degree elbow. The pipe will be filled with water, so its volume has neutral buoyancy. The main cold-water pump will be axial flow with its rotor in the horizontal downstream leg of the elbow. This allows its shaft to come through the elbow wall and be driven by the OTEC turbine. Downstream from the main pump, some cold water will be diverted into the condenser heat exchanger whose back pressure will be overcome by another pump. This pump and several other pumps in the OTEC plant will be driven by electric motors so that the system can be started from outside electric power delivered by a service boat. Once the system is started, the motors can be powered by an alternator driven by the OTEC turbine.

One next step is to make tentative estimates of the various components to determine whether they are compatible with the submerged hull concept. Another is to prepare publications and presentations in order to elicit help and other participation from the marine industry and other communities. A short article in Sea Technology magazine should appear soon, and there is the possibility that a chapter written for a book on macroenginering (very large projects) may be published.