

Monroe A. Miller, Jr.
19 Big Spruce Lane
Waynesville, NC 28786
September 4, 2010
(Rev. a, 9/9/2010)

[**Editors Note:** One (1) major correction, several typing corrections, some updates, and deletion of questions and answers regarding an Adsorption Chiller system].

Supplement - What is known about the FLS HCC Design at this point in time.

This paper will not conform to any conventional style. It will be part Time-Line , part based on subject, part open questions, part comment, all in no particular order.

At the top level, it has been very difficult, if not impossible, to determine any aspects of the solar design presented by FLS to HCC at this time. Rose Johnson has refused to provide any information. As far as I can determine, no member of the Board of Trustees has knowledge of either the FLS design or contract details. All of that is being handled and negotiated by Rose Johnson.

According to the document, “Solar Developer Proposal For: Haywood Community College Creative Arts Building Solar Systems”, there are three (3) systems and five (5) options involved.

- Solar Water Heating System, and Solar Heating/Cooling System (i.e. Solar Thermal),
- Photovoltaic System,
- Both Solar Water Heating System, and Solar Heating/Cooling System and Photovoltaic System,
- Solar Water Heating System, and Solar Heating/Cooling System and 50 Ton Absorption Chiller and Back-Up Generator,
- Both Solar Water Heating System, and Solar Heating/Cooling System and Photovoltaic System, and 50 Ton Absorption Chiller and Back-Up Generator.

Photovoltaic System.

The Photovoltaic System was the easiest to flush out. Based on a conversation I had with Frank Marshall on 8/13/2010, he indicated that FLS was to own all of the solar equipment on the roof of the Creative Arts Building. Also, the public utilities commission prevents FLS from selling electrical power to customers, therefore, FLS is connecting to the grid and selling power to Progress Energy (or some electric utility company). Frank Marshall indicated the peak power generation capability will be 109 KW. The only income HCC will receive from this aspect of the project will be lease revenue for equipment on the roof. It is not known what that lease revenue will be.

It was suggested by a renowned consultant in the solar industry that after 6 years, HCC would have an option to purchase the solar equipment for this project after 6 years for a purchase price of approximately 30% of the original price, and at that point, realize a direct energy savings. That would be by disconnecting from the grid and purchasing an inverter, battery storage system, whatever. It is not known where HCC will get the funding at this time to make this purchase.

Solar Water Heating System.

Most hidden, at this point, is a Solar Water Heating System. This is pretty standard, and from the Design Specifications, those panels occupy about one half the area of one of the buildings. The FLS website offers multiple examples of installations with Photovoltaic and Solar Hot Water Heating Systems. It is typical that Hot Water Heating Systems are leased at a fixed amount per year or lifetime. It is not known if this will be part of the metered delivered BTU's (in therms, which is \$1.200 for the first year, going up to \$1.918 for year 20). **[The PSNC (the NG supplier for Haywood Co) rate schedule from their website shows the facilities charge as well as the energy charge for various types of customers. Based on these published rates the solar thermal energy would be more expensive than natural gas energy in year 1.]**

Michael Nicklas and Innovative Design.

Evidently, HCC did not have a choice with this architect, but was selected by some government agency. HCC chose the architect. It was brought to my attention that this is not a standard Design / Build type of arrangement that one would normally enter into, if this were a regular corporation seeking a thermal design. Rather, it is the architect that designs the project, in this case, Michael Nicklas, one of a handful of architects capable of doing a solar thermal design. That's right, this system has been designed by an architect. When bidders are asked to bid on this project, they are presumably given a little latitude in the design, but by and large, this is what will be built.

[At the conclusion of the latest Board of Trustees meeting on 9/2/2010, one board member brought me over to Mr. Smathers, the lawyer for HCC, to see what it took for me to look at the FLS design. He indicated I would have to sign a non-disclosure agreement. I indicated I would not be signing any non-disclosure agreement].

There is only one (1) documented instance that I have been able to determine where Rose Johnson has divulged information about this design outside the normal bidding process, and that is found in the Buildings & Grounds Committee Report on July 16, 2010, where Rose Johnson made a call to Bill Guiney, the program director for Johnson Controls Renewable Energy Division. In that report, there was reference to **adsorption** and **absorption** systems. [There is a difference between **adsorption** and **absorption** systems, covered later]. Guiney said this was an absorption system. He also referred to "the design of collectors is such that it is easy to replace the individual tubes and they are fairly inexpensive technology". [There are two general types of collectors - black flat panel, and evacuated tubes, again covered later].

It was on September 2nd, when I received a call from the COO of Vanir Energy, Steve Hunter, in Sacramento, CA., that he indicated that Vanir had exclusivity on selling ADSorptive Chillers in the state of North Carolina, that I finally deduced that FLS had to be using an Absorptive Chiller.

When I originally went to HCC and asked to review the Solar Design, I was presented with two items:

- A very large set of architectural drawings of the building, with only two pages indicating any hint of a solar system (a page with what looked like embedded water pipes in the floor for heating and cooling, and a page showing solar panels on the roof, no indication if they were water or photovoltaic).
- A book with some boiler plate requirements for general electrical equipment, again, nothing related to solar.

It was brought to my attention that there exists a set of requirements (a bid proposal) and a completely independent set of drawings specifically defining every aspect of the solar system. There is an outside shed attached to one of the buildings that contains all of the solar thermal equipment (not on the roof, but on the ground, attached to the building), which contains the Absorption chiller and a 15,000 gallon pressurized water tank. **[During the Public Hearing, there was discussion of using electricity to power the chiller, in the event that solar hot water was not sufficient. Natural Gas would be more efficient, however.]**

There were three (3) company's bidding on this project. One company had proposed a much higher efficiency system and eventually no-bid, another company bid only on the solar thermal but not the photovoltaic, and the third was FLS, who bid the whole thing.

Here's one of my problems.

I was invited to attend the opening of the bids for the general contractors, which I recall to be on 8/13,10, the day I spoke to Frank Marshall. (It doesn't matter, I was invited to attend whenever it was).

When the three bidders for the solar design presented their bids, it was under closed session, with only some of the Board of Trustees attending along with Rose Johnson. Each bidder had one (1) hour to present the bid.

Michael Nicklas created both sets of drawings for each portion of this entire project, the building construction and the solar construction. Michael Nicklas **has been paid** nearly \$3/4 M (\$700,000) for his work thus far on this project. [Where is this money coming from, I asked a Board of Trustee member? "It is out of pocket from HCC. We plan to get re-paid when the \$12M loan is approved", he said.]

So here is the problem: **Why was I allowed to view the opening up the bids for the general contractor and not allowed to view the opening up the bids for the solar portion, if all of this comes from the same taxpayer funded revenue/loan?**

Adsorption vs. Absorption Chillers.

This is interesting, yet a little complicated. There are two currently available types of chillers today, i.e., turn hot water into chilled water. There are pro's and con's with each.

The **adsorption chiller** uses **lithium-bromide** to hold the refrigerant, water, and the **adsorption chiller** uses **silica gel** to hold the refrigerant, water.

Adsorption Pro's

- Silica gel is non-toxic. It is in the crystal package you find when you open a new piece of electronic equipment. It usually says "Do not swallow".
- It's efficiency is much higher at lower hot water input temperatures.

Adsorption Con's

- Units are more expensive for the smaller systems. Nicklas has called for a 50 ton chiller.

Absorption Pro's

- More economical for the smaller systems.

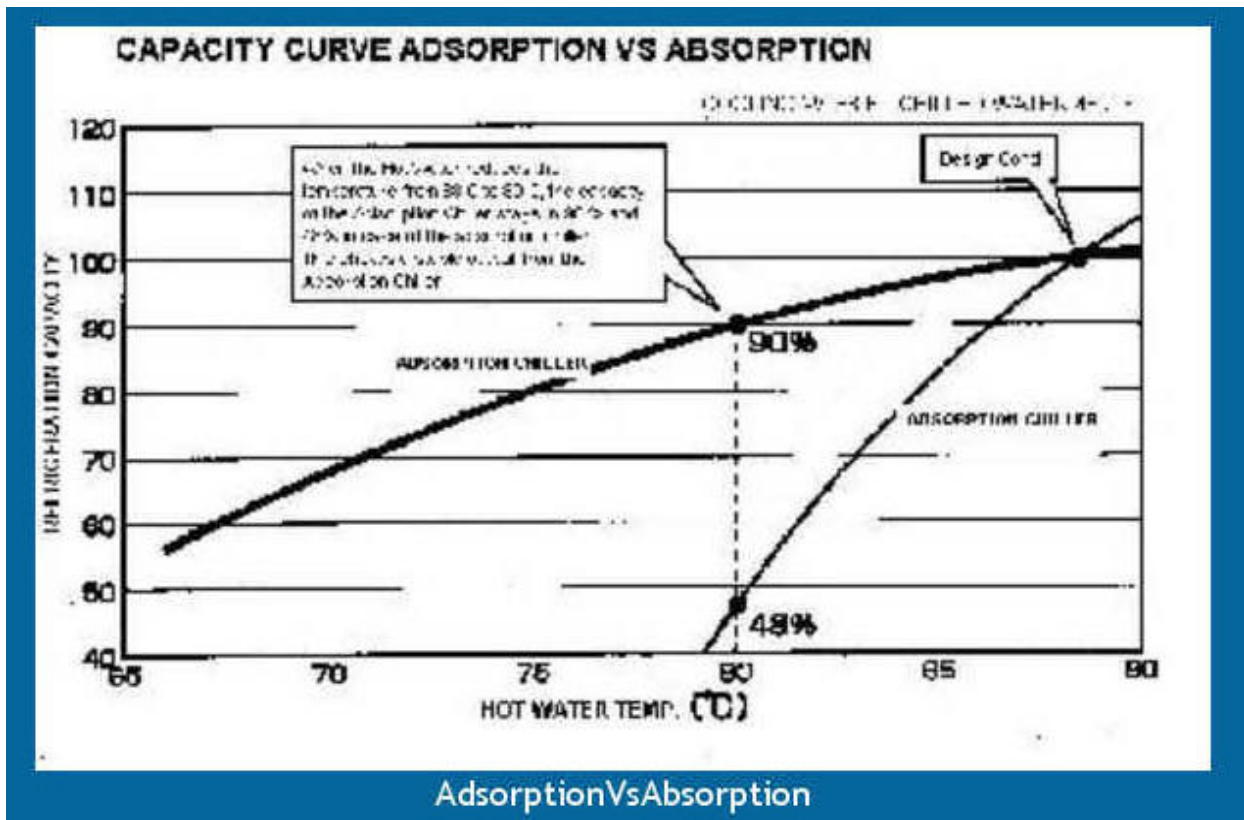
Absorption Con's

- Lithium Bromide is toxic and corrosive. There are additives that can be used to soften these problems.
- Lithium Bromide is expensive, (\$1,200/30 gal) and needs to be replaced periodically.
- Lower efficiency at (relatively) low input hot water temperatures.

When I mentioned what Dale Freudenberger, FLS President, said while quoted in the Smoky Mountain News article by Becky Johnson on 8/24/2010 to Steve Hunter, the COO from Vanir Energy -

“The fluid flowing through the solar thermal coils needs to be 154 degrees to power an absorption chiller, Freudenberger said. He claims it’s no problem achieving that temperature.” [154° F = 68° C].

we both said almost simultaneously, the efficiency of an absorption chiller at that temperature will be near zero (0%). See the graph below [re: greenchiller.biz]



The resolution on the graph is as best as I can get, but the top curve is for an Adsorptive chiller (90% at 80° C), and the one that drops off fast (48% at 80°C) is for an Absorptive chiller, the type specified by Michael Nicklas. At 68°C, towards the left end of the curve, it is left to your imagination what the efficiency will be.

Based on this graph, Mr. Freudenberger will have to tell Steve Hunter and me why this graph is wrong, or he will have to reconsider the input temperature to the chiller.

The Worlds Largest Adsorption Chiller Installation.

I'll bet you didn't know it but the worlds largest adsorption chiller installation is right in our back yard! It is the installation that Michael Nicklas used as a reference in his teleconference call on May 12th, at the HCC Creative Arts Building workshop held for the benefit of the County Commissioners (I recorded that meeting). In a subsequent newspaper article, Rose Johnson was quoted as saying : "A solar system installed at a Fletcher business ... didn't function as expected...". There had also been some rumors floating about that there had been some litigation involved with that installation.

I researched the installation to discover that it uses two (2) adsorptive chillers. [**Why would Michael Nicklas reference a site using adsorptive chillers when he specified an absorptive chiller?**] The warehouse was the old Steelcase manufacturing plant, now the Fletcher Business Park. It is 900,000 sq. ft. The system was installed by Vanir Energy. I called Steve Hunter, COO of Vanir and asked if I could take a look. He set it up so that several of the personnel would give me a tour and answer questions that I might have. The only condition was that I was not allowed to take any pictures.

I visited the plant Friday, September 3, 2010 at 11:00am, the time chosen so I could see the operation at near peak operation. Their personnel answered every direct question I had with a direct answer. They were incredibly forthcoming. I had called Tommy Cleveland of the North Carolina Solar Center, one of the experts referenced in Becky Johnson's article in the Smoky Mountain News on 8/24/2010 and asked if he had any questions, forward them to me, and I would see if they would answer those, as he knew little about the Fletcher installation. Vanir personnel answered every single question posed by Tommy Cleveland.

To me, this is kind of the way it should be.

This stonewalling by Johnson and FLS is simply not right. [The words "Not Right" were echoed to me by one of the Board of Trustee members]. Every possible **red flag** has gone up.

I wanted to verify the rumors about the litigation that had been floating about. They were surprised about that, and concerned that solar thermal might get a bad name. It turns out that there is no current or pending litigation, i.e., nothing to do with the operation of the solar thermal system there.

Vanir personnel then took me on a tour of the facility. 640 panels is a lot of panels on the roof. These were large panels. At noon, the output temperature was about 160° F (felt with his finger, he didn't bring the infrared thermometer). Confirmed with a digital reading below (160.1° F).

There was a single water cooling tower on the roof. The fluid is simply water. Excess heat from the panels is simply boiled off and vented.

There is a 27,000 insulated gallon tank. The tank retains enough heat at the end of the day to run the chillers for an early morning shift of ladies that do sewing in one part of the building.

There were two chillers, made in Japan, 180 ton and 120 ton. The larger chiller made a thumping sound, a flapper valve opening and closing about 1 / second.

During the last winter, there were about four days that heating of the building was run with natural gas.

I did not ask the question of how the water was kept from freezing in the winter.

I was impressed.

Summary

I have only scratched the surface of diving into this thing called Solar Thermal. Remember, I am only a casual observer. I do think that in order for this to be a system that the county can be proud of, we want to make sure that we give this a little bit more scrutiny at the beginning of this project, and not wait for any surprises that might pop up down the road a little. Perhaps if we all got together we can all ask Johnson nicely to open this thing up a little. We might all feel a little more comfortable in getting behind this project.

Monroe Miller