Advice to Grad Students and Other Aspiring Energy Managers

By **Bill Holmes, P.E.** October 19, 2012 03:16:24 pm

As a future energy manager you need to listen to the views of all involved and separate fact – physics, good science and engineering – from misinformation, myth, hype and sales pressure.

The following is taken from an email I sent to the graduate students taking the Industrial Assessment and Improvement Class, IEM 5953, at Oklahoma State University during the fall term of 2011. The professor was Bill Kolarik, PhD, PE, CEM, the long-time head of the School of Industrial Engineering and Management and the DOE Industrial Assessment Center at OSU. Bill has a wealth of both theoretical and practical experience, has worked with many owners, industrial plants and energy systems during his career, and is a dedicated teacher. I was taking classes toward my PhD and doing research on energy monitoring. The class had taken a tour of a large central plant containing chillers, boilers, cooling towers, air compressors, pumps, heat exchangers and more. For most, it was their first exposure to some of this equipment. My email and advice:

Students, the mechanical plant tour last week was a great experience for all of us. I always learn something when visiting a different facility. Very impressive and well run. You can often, but not always, get a pretty accurate feel for how systems are being run by the cleanliness and general condition of mechanical and electrical equipment rooms. I was really impressed by the condition of the equipment that in some cases was more than 60 years old.

There is a lot of pressure from manufacturers, lobbyists, utility companies and government programs to replace old equipment with new, more efficient equipment under the guise of saving energy. Selling equipment is how many in this field make their money. It is often the easiest solution; particularly for those with inadequate technical backgrounds. But replacing large equipment may have a long payback, is often not the best solution and may not be attractive to industry and others who are in business to make a profit, as Dr. Kolarik has pointed out more than once. Some of the older equipment has essentially an indefinite life if properly maintained and rebuilt as required. And the assumption that newer, more efficient equipment automatically saves energy is not necessarily valid. I have produced tremendous savings over the years though good management, proper control and good maintenance of existing equipment. I have always found the people factor much more important than the technology. Each system must be evaluated individually using accurate data. I believe that capital projects should be the last place to look not the first as is practiced by most in this field.

The main reason I am writing this is to point out that one of your most important roles as energy engineers and managers will be to listen to the views of all involved and separate fact – physics, good science and engineering – from misinformation, myth, hype and sales pressure. You will have the engineering training while most of the people you will be dealing with will not. You will need to gain the practical and real-world field experience; that is very important. But then you will need to develop enough confidence to be unafraid to ask questions of the various people you will encounter. Learn everything you can – both the right and the wrong ways from others; what to do and what not to do.

I remember as a young engineer being in groups of experienced contractors or operators or control people, asking a question when something didn't make sense, having them all look at me like I was a complete idiot and then finding out that they often didn't really know. They may have been doing things

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Author Bio

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Bill Holmes, P.E. founded Holmes Energy LLC www.holmesenergy.com and developed the AutoPilot Monitoring-Based Commissioning (MBCx) System in 1979. He has a B.S. and M.S. in mechanical engineering and has done additional coursework and research for his PhD. He is a former Purdue professor and taught for several years in the Continuing Education in Energy Management Program at the University of Wisconsin.

Bill has produced savings from 20% to, in a few projects, more than 50% from low-cost, no-cost changes in management, operation, maintenance and control alone in all types of facilities including Industrial Plants owned by Fortune 500 Companies.

He is the recipient of a DOE Award for Energy Innovation and was the Indiana Energy

one way for their whole career and it may have kept the systems running but very inefficiently. They didn't really know. That wasn't their training. They had little or no information or feedback on efficiency, but more importantly, they often had zero incentive to keep systems running at the lowest energy cost. They were just there to install it, keep it running and fix it when it broke; that was how they made their money, that was their incentive.

In thinking back over all of the people I have worked with in all of the projects over nearly 40 years, I recently realized that I have never encountered a single operating, maintenance or control technician, or electrical or mechanical contractor with adequate training in how to run energy systems efficiently; not a single one. I realize that may be hard for many to believe but it is true. Chiller people may know a lot about chillers, same with air compressor or temperature controls technicians, but their training is often limited and it is not uncommon for them to tell you things that are completely wrong. And they may sound very confident when they tell you; similar to an auto mechanic or a plumber. They may not realize where their expertise stops. People in the field often know little theory and people in design offices may have little actual field experience. They are different skill sets. But it takes both for a successful project.

Our guide was very nice and anxious to help us. But I don't know if you noticed that he had very strong opinions on politics, gas, oil, wind power, etc., along with facts on the power plant. He said his training was as an electrician, which doesn't mean his isn't a very knowledgeable guy in other areas. But I picked up two things he said where he was out of his element and would have been better off just saying “I don't know.” You are the engineers and you are expected to know the science and the physics where people in the field most likely will not.

I asked our guide if they ran the cooling towers at an 85 F return water temperature in the extreme summer heat (over 110 F). He said no, they ran them at 70 degrees. Most towers are designed to run with a 10 degree differential between supply and return temperature, as are chillers; normally 85 degree water is produced by the towers and returned as inlet water to the chillers. At full load the chiller will send 95 degree F water back to the towers. I have seen some with a 15 degree delta but for normal HVAC systems and chillers, 10 degrees is the standard. Anyway, in any case, the return water temperature is limited by the laws of physics; that is not arbitrary.

One of my college classmates has been a tower expert for 40 years and I have worked with him on many of my projects. The rule-of-thumb is that the coldest water a cooling tower can make is 10 degrees above the outdoor wet-bulb temperature. This is called the “approach” temperature. I looked up the wet-bulb temperature for a hot summer day in Oklahoma City, actually a “design day,” one that may be used to size cooling equipment, and it is 74 F. The dry-bulb is 97 F. The coldest water the tower can produce on a design day is around 85 degrees, certainly not 70.

What I was told by our guide is impossible but he is not the only one who has been taught that the cooler you can run the return temperature from the towers, the more efficient the chiller will run and less energy it will use. The first thing that probably 80% of every chiller service technician that I have worked with does when they go into a chiller room is override whatever is controlling the tower return water temperature, crank it down as low as it goes and tell me it will save energy. Not true. It wastes energy. What it does is cause the tower fans, whether they are 40 hp or 200 hp, to run 100% of the time trying to achieve a temperature that is impossible according to the laws of physics instead of running 20% or 30% of the time, whatever the load on the chiller requires to maintain an 85 F return temperature. I have monitored many chillers and towers and continuously running a 50 hp or 100 hp motor on a tower fan to save 20-30 kW on a chiller makes no sense.

Not picking on our guide but he also gave some other opinions including that converting steam systems to hot water would not save much energy due to pumping costs. But each case requires analysis. Every situation is unique. Buildings are not like automobiles where they can make hundreds or thousands of identical cars. I have converted steam systems to hot water with huge savings. When you may only need 80 or 90 degree hot water in certain systems at certain times of the year, using medium-pressure steam at 400 degrees to make it is very inefficient, with tremendous heat losses and associated costs. With all of the huge older equipment at his particular plant it may not make sense to convert it, but in many other cases it offers a tremendous opportunity.

Understanding that you must question and determine the validity of what you see and hear is one of the most important things you need to learn if you are to work in the energy efficiency field. It was often the single most important service I provided for my clients and it is never ending. Many people will fight to the death defending something that is totally wrong. And once corrected, many of them will change it back to the way it was before at the first opportunity. I once found a contractor piping a boiler backwards, actually one that I was converting from steam to hot water. When I pointed it out as politely as I could he said, “I've been piping boilers this way for 30 years.” Luckily I had a boiler piping handbook with me. When I showed it to him he said, “I guess I've been doing it wrong for 30 years.” True story.

I happen to believe that along with education, using actual data is the most essential step to correcting this situation. Kind of like the piping handbook. It is a little easier to help educate when you have the facts to support you. Although at this large facility there was some extensive instrumentation, that is often not the case. Even if there is data on temperatures, pressures, flows, etc., many if not most operators have almost no data available to them on system performance, efficiencies or operating costs. I can absolutely guarantee you that our tour guide had never seen the utility bills for the total

Manager of the Year in 1990. He has published numerous papers and been making presentations on his projects and methods for more than 25 years. Bill is a sculptor, a writer and a regular contributor to Sustainable Plant.

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facility. I encourage you to learn all you can about energy monitoring and information systems and find ways to provide both real-time and historical energy, efficiency, cost, emissions and other data to operators, engineers and others involved with the energy systems to allow them to operate the systems at optimum performance levels.

I hope this helps you a little. Good luck in your careers in this exciting field!

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