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ENERGY MANAGEMENT IN A REFRIGERATION PLANT AN END USERS PERSPECTIVE

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Energy Management is not something new to the Industrial Refrigeration world. Spending most of my career to date as an End User I have learned this. As technology improved so did the ability to provide better Energy Management. When I say Energy Management I mean the amount of Electricity required to perform the services needed (refrigeration) which provides the transfer of heat from the products and services we produce to the atmosphere.

Each Refrigeration system is different, very rare are there two that are identical. Each having their own characteristics and unique operating requirements. This poses a challenge to the Operating Engineer as he or she needs to understand the products or space they are cooling, the temperature ranges available, how much time they have to cool the area or product along with the equipment they are operating.

The Refrigeration equipment is the beginning stage of Energy Management. Having the correct equipment to do the "work" required is critical. Over time the production process may change, the Refrigeration equipment needs to be able to adapt to this change. Many times the Refrigeration equipment will need to be modified or upgraded to accommodate the increased volume, change in process or simply due to age.

When selecting new Refrigeration equipment keep Energy Management in mind. Work with your service contractor, the equipment manufacture or both. They will be extremely valuable in helping the Operating Engineer maintain a good Energy Management program.

Before I get too far into Refrigeration equipment I believe it is important to start with the Operating Engineer (Operator). Qualified and knowledgeable persons should be the only ones to start/stop or make adjustments to the Ammonia Refrigeration system. The Industrial Refrigeration industry puts a tremendous amount of attention and focus on safety, "*Keep It In The Pipe*" is a great motto! With Safety taking the lead, Energy Management follow's a close second.

Having a "qualified" operator means the persons has years of operating experience, training in regards to the safe and efficient operations of an ammonia refrigeration system or both. Even though the mechanical equipment is critical to a good Energy Management program it is worth nothing unless it is operated correctly. So, with that being said, make sure to send your Operating Engineers to training classes. Whether it is Operator Safety, Equipment specific or a more advanced Energy Management course continued training will pay for itself in the long run.

Moving from the Operating Engineer to the Refrigeration equipment is next. Compressors are considered the heart of any Refrigeration system as they are sometimes referred to as the "Prime Mover". The compressor is the single largest user of Energy in an Ammonia Refrigeration system. Having the right compressor for the job at hand is critical; wasting Horse Power is wasting Energy. In today's world of Controls and VFD/VSD's we can achieve great savings by slowing down the compressors motor (rpm) while keeping the compressor itself within the optimum working range.

The compressor control system is critical to a good Energy Management program. Allowing more compressors to be online at a time than is needed is a tremendous waste of Energy. Utilizing a compressor control system will help an Operating Engineer use the right amount of compressor during any given time of the process to effectively manage Energy Efficiency in the engine room. Starting and stopping frequently is also a large waste of Energy; compressor controls can help to manage both.

Following the flow of ammonia we move on to the Condenser. Here is another BIG opportunity for Energy savings; controlling head pressure. Now, the condenser isn't the only piece of equipment that influences head pressure, but it does have the biggest impact on it. The closer you are able to keep your suction and discharge or head pressure the less work your compressor has to perform. This is not always the easiest thing to accomplish since you will need to worry about Hot Gas pressure for defrosting Evaporators. Also,

many Compressor manufactures have a minimum head pressure requirement to ensure the oil remains in the separator and not out into the system.

As with any component within a Refrigeration system, size does matter. Having the proper tonnage available will help manage head pressure especially in the hot summer months. During winter months, when the outdoor temperature falls, extra Condenser capacity can be isolated (make sure you follow the manufactures guidelines and your own Standard Operating Procedures) from the system and be ready for the next heat wave.

Variable Frequency Drives (VFD's) are another great application for Condenser fans. Connected to the overall Refrigeration control system, these VFD's can monitor head pressure and either slow the fan's down or speed them up depending on the circumstances. Keeping the head pressure from fluctuating too much will help to reduce the horse power usage of the compressors and therefore right back to the bottom line, Energy Savings.

From the Condenser we move to Vessels. Depending on your system configuration you may have pumps or you may move Liquid Ammonia by pressure. Either way there are opportunities in regards to Energy Savings by managing the level(s) within the vessels. If your system uses pumps there are a few areas to help improve Energy management. Proper sizing is critical to ensure you are providing the correct amount of Liquid Ammonia to the Heat Exchanger or Evaporator. It is common to find overfeed systems, more ammonia is sent than is needed to ensure a "wetted coil". Cavitation of pumps is a major waste of Energy. Cavitation is typically caused by not enough Liquid Ammonia being sent to the suction side of the pump. This is called NPSH which is short for ***Net Positive Suction Head***. Cavitation will reduce the amount of Liquid Ammonia being sent to the Heat Exchanger or Evaporator and will reduce the ability to provide a "wetted coil" plus it will damage the pump over time. Using pressure (Transfer Vessels) to move Liquid Ammonia can also have an Energy Impact. Keeping levels within Manufactures

ranges will ensure the most efficient operation. If the Transfer Vessel is not allowed to "fill" to its proper level, more "dumps" are required to provide the same amount Of Liquid Ammonia to the Heat Exchangers or Evaporators.

As part of the discussion of Heat Exchangers and Evaporators we will include Expansion Devices which have a big impact on Energy Savings. Properly setting the expansion device to properly feed the correct amount of liquid ammonia to the Heat Exchanger or Evaporator can adversely affect the performance of the equipment. This poor performance turns into wasted dollars and cents every month.

Defrost can also play havoc on your Energy Bill every month. Too many Defrost schedules are a waste of Energy just as much as having not enough. Watch your coils go through a defrost a few times and ensure that the defrost is during the best time for the coil meaning there is not a huge layer of ice already built up or, on the other hand, no frost at all. Make sure the timing is correct. By this I mean the amount of pre and post bleed depending on the type of Heat Exchanger or Evaporator you are operating as well as the amount of time of the "Hot Gas" cycle.

Hot Gas pressure is another factor when it comes to an effective and Energy Efficient defrost. Having too much Hot Gas pressure will not allow the tube bundle the time to pick up the heat energy to effectively remove the frost/ice buildup within the scheduled cycle. Not having enough Hot Gas pressure is the direct opposite. The tube bundle will absorb all of the heat energy from the vapor but it will not be enough to melt the frost/ice within the time allotted for the Hot Gas portion of a defrost cycle. So, setting the correct Hot Gas pressure and timing, timing, timing (did I mention timing?) is critical for an Energy Efficient defrost. Some methods have been tested and proven to be even more efficient using warm liquid rather than Hot Gas for defrost, we will leave that for another paper.

As with Compressors and Condenser, VFD's can play a critical role in Energy Management with regards to Evaporators. Slowing down Fan Speed during none critical times will still help to control the temperature of the space or product while doing less "work" which equals Energy Usage. Couple this with a good controls package and you have a winning combination. As you slow the fan speed down you can also raise the suction pressure (as long as you still meet the demand of the space) which saves Compressor Horse Power.

These are only some of the basics of the equipment portion of Energy Management. More detail is available and should be considered especially during the selection of new equipment. The best time to plan for Energy Management is before the equipment is purchased because once you have it you are generally stuck with it. My favorite slogan is "***Use Your Resources***", in this case it means get involved. Work with your equipment manufacturers, operators, and contractors they can help optimize the savings for their specific product.

That is certainly not the end of the Energy Management story. There are many ways to track your Energy usage which is critical to a good Energy Management program. Start by contacting your Energy provider and find out about the rates that are charged and at what times of day/season they may be. Look at your Mass Energy Balance sheet, this will tell you what total Horse Power potential your system has. Track the Kilowatt Usage of your Refrigeration system which will help you find the best time(s) of the day to defrost or operate the most Horse Power without the huge penalties during Peak Time (Usually 6am to 8pm). Having this information at your fingertips will help prove the benefits regarding a good Energy Management program. Also, get involved on the production side of your business. Know the products you are dealing with, the heat load they produce and the amount of time you have to get the product to the correct temperature and how long you need to keep it there. Having all of this information is critical not only

to the Operating Engineer for proper operation of the system but also to maintain a good Energy Management program.

There is plenty of help if you are unsure of your abilities in regards to Energy Management. RETA has recently launched the CRES program. CRES stands for Certified Refrigeration Energy Specialist and is the 3rd certification that RETA currently offers. Having a CRES certified Operating Engineer on staff will certainly pay dividends when it comes to Energy Management and savings. Another opportunity is partnering with an Energy Management consultant. They will help you develop an Energy Management tracking system and offer guidance in regards to the efficient operation of your Ammonia Refrigeration system. They can also work with your Energy provider on your behalf to find ways to improve your Energy usage such as help with grant money should you wish to invest in Energy Savings related projects.