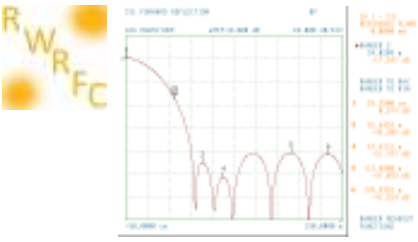


Testing of a Large Warehouse Facility

This Facility incorporates over 3000 Tons
Of Centravac Chillers and 10,000 Amperes
Of Electrical Distribution

This test was for several of the larger systems:

September 23, 2010

Dear Customer (just like you),
Thank you and your staff for the tremendous opportunity to visit with you and your Journeyman Electrician Mr. Jason. Present for the testing that day was Mr. Andy Matovitch of ARM Electrical Service, and myself along with Mr. Jason. Mr. Matovitch is a Master Electrician and I am a former heavy electrics Electrician. We concentrated our work today in the electrical room behind the Welding Shop. This is certainly not any ordinary electrical room. With three 4,000 Ampere Pressure Bolted Mains contactor services from Siemens Group, this was an impressive representative array of your ten total electrical services. I believe that your systems include three, 3,000 Ampere and Seven, 4,000 ampere systems, each is fed with a 2500kVA sub-station type oil filled transformer on underground feeders.

Andy and I appreciate your taking time from your day to speak with us on several occasions about the work we performed. It is our goal that we provide you the most comprehensive services, and solutions, and that we conform to your specific needs as well as all safety requirements at all times.

We were able to speak about several areas of concern to you during our conversations. The primary focus of today's testing was to measure the service that feeds main chillers 2 and 3. This is a 4,000 Ampere system that only feeds these two machines. We also spoke about Transient Voltage Surge Suppression (TVSS), Power consumption/maintenance Metering Systems, and Grounding. I will touch on these topics throughout the document in various lights.

The Power Factor testing on the chiller service was full of very good data and though it is very representative of the typical response of systems of this type. We agreed that Andy and I should return on Friday night, October 1st, 2010 for the purpose of collecting additional data on this system, and the chiller 1 combined service. The data collected so far represents a run load of about fifty percent capacity on the two units.

So that I can feel you have a bit of a better understanding about these areas, I have included a short passage of instructional information below for you. After this training primer, I include the separately attached report about the testing that you were so kind to allow me to perform. If my information below is too elementary, please forgive me as I try to bring these discussions up from the basic.

Of particular interest in our testing is the ability to quantify the Real Dollars that the implementation of Power Factor Correction provides. The additional topics of TVSS, Metering and enhanced Ground systems testing and augmentation are also designed to assist you with saving dollars on the plant operation through maintenance and damage avoidance. Where the TVSS and Grounding are involved, the Life Safety of your personnel are also enhanced from reduced danger from shock and burn hazards due to lightning and power line Utility problems. TVSS enhances equipment longevity and increases up time. I hope that you will see that with this depth of testing for Power Factor Correction, the data assists me in evaluating the level of Real Dollars to be saved with the Utility, and puts me on the spot for accuracy and not ambiguity. I apologize for the long form of this letter however, there is much that I want to be sure that I explain to you.

Understanding The Problem:

Voltage & Amperage Are Out Of Alignment

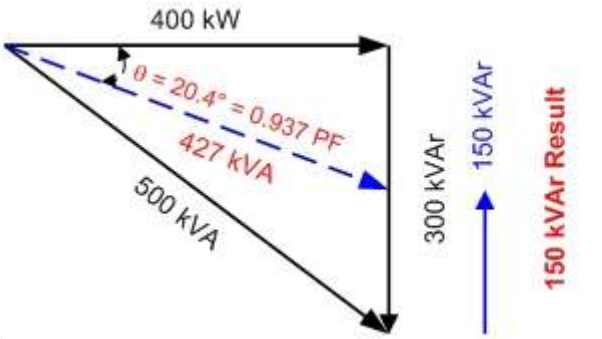
I have developed a testing methodology where existing electrical loads are analyzed for usage of electrical power in the forms of Kilowatts (KW), kilo-Volt-Amperes (kVA), Volt-Amperes-reactive (VAR) and Displacement Power Factor (DPF). These four acronyms are the basic building blocks that the various Utilities use to determine your electrical bills.

Every device that consumes electrical power does so with parameters that encompass most of these factors. If we are able to manage or manipulate the usage of these parameters, we can manage your total electrical consumption, and your bill, in order to help you meet company mandated goals.

Many consultants that promote Green Technologies will come in and recommend the typical additions or changes of electronic lighting, skylights, and ultra efficient toothbrushes and while these items will assist you in saving dollars, the un-sung hero of energy saving is Power Factor Correction. These savings are quantified in longer equipment life, longer maintenance intervals of large motors, minimized heating of transformer cores, and lower KVA, DPF and Demand Charges. All of these things translate in to real dollar savings. The Utility companies have used this little known to the public technology for decades, only to their advantage. It is a simple technology that places capacitors on to the power line to correct problems with the inductances placed on the system by motors, most ballasted lighting and transformers. This correction technology allows the Utility to make the best use of existing infrastructure so that it can carry greater capacity and make more money. In the realm of the end user of power such as yourself, it is this same Power Factor Correction (internally applied) that also allows you to maximize the capacities of transformers and generators PLUS the added advantage of managing the aforementioned 4 acronyms that dictate your bill. The generator aspect is important too because there is savings in fuel consumption that accompanies this technology. The bottom line is that I have never met a motor than I can not make run cooler, last longer and cost less to operate. The variable is the Return On Investment.

The chart below will help you understand the Einstein version of influence of Power Factor Correction. The math involved is called Vector Addition. If resistance is the horizontal line, and the motor load is the lower part of the triangle, the Power Factor Correction that is applied is opposite the polar value of the lower triangle. This minimizes the total usage to as close to the pure resistance value as possible which minimizes your costs.

The math can be a bit steep for many people. The other following charts makes the concept easier to understand.



300 kVAr required by loads
150 kVAr power factor capacitor added
150 kVAr result

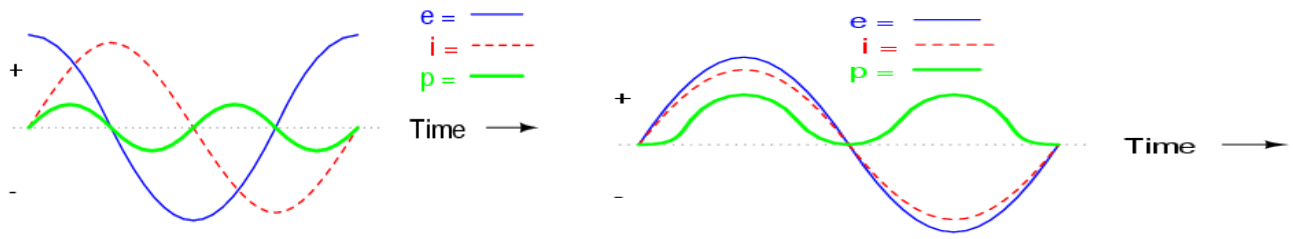
$$kVA_{new} = \sqrt{(400^2 + 150^2)} = 427kVA$$

$$PF = \frac{400}{427} x100 = 93.7\%$$

$$\theta = COS^{-1}(PF) = COS^{-1}(0.937) = 20.4°$$

Vector math causes the charts below to happen. All electrical devices use electricity in a predictable way. The blue sine wave represents the Voltage and the Amperage is red. Power Factor and kVA are expressed by a number.

A perfect Power Factor is expressed by a value of 1.00PF. This perfection is reserved for incandescent light bulbs and resistive heaters. They are a pure resistance with no capacitive or inductive reactance as an operating component. Motors on the other hand have a large quantity of inductance. This inductance causes the motor to operate at a Power Factor that is less than the perfect expression of 1.00PF. Motors can have a wide range of PF that spans from the .2 range to .9. Looking at the left chart, you can see that when reading from left to right, the Amperage wave occurs after the Voltage wave. This is called "Lagging" power. The greater the Lag, the lower or worse, the PF expression. The right hand chart shows a corrected circuit and the Amperage and the Voltage run in sync with each other. This is a much higher PF closer to 1.00PF or "Unity".



Applying the proper amount of Power Factor correction brings the Amperage wave in to time alignment with the Voltage. This minimizes your consumption and minimizes your bill.

kVA:
You can not have a good discussion about Power Factor without understanding the difference between KW and kVA. The typical motor, just like the incandescent light bulb has a resistance value. This resistive value consumes the portion of the electrical energy that is expressed and measured in Kilowatts (KW), also called "Real Power".

This value is not able to be altered assuming a constant load on the motor. The kVA is the inductive part that creates the magnetism that runs the motor.

This kVA value is the wasted energy or the "Apparent Power". Power Factor Correction minimizes the amount of wasted kVA that a motor uses. While not all of the kVA can be eliminated due to electro-mechanical constraints that the motor has, about 70% to 90% of the kVA can be removed from the equation and this is where the savings starts.

A higher Power Factor is directly tied to a lowered kVA. A lowered kVA when compared to the actual Real Power of the motor in KW means a lower Demand Charge from the Utility. Under many tariff's the lower demand charge is the majority of your savings however due to meter technology being somewhat inexact, there are benefits to the associated lowering of KW usage also. These all will come more in to play when your Utility starts to charge for poor Power Factor, and KVARH or reactive hours of consumption, just like KW consumption, if they don't already.

The results of Properly Applied Power Factor Correction are measureable and predictable through mathematics but suffice to say that this very olde technology works. There are a large number of companies in the field of Power Factor Correction that will make wild claims as to percentages of savings and they will tout various methods that they use to perform this magic. These claims may exceed 20% in dollars. Unfortunately the vast majority of these companies are selling nothing more than snake oil. This is unfortunate because these companies give the art of Power Factor Correction a bad name. In any applied science or trade, the improper application, will never give a good result. Many of these companies will claim to know what they are doing, and few of the actually will. Savings of between 2% and 12% are typical. Heavy motor load sites will yield savings more toward the high end.

A Short Primer:
It is anticipated that in 2011 many more Utilities will begin charging penalties for your consumption of electricity that is considered to be "out of tolerance" from the stand point of Power Factor, and Demand factor. These newly installed electronic meters are doing more than studying your usage.

Presently, the Utilities get to charge you for this total usage with their old style mechanical meters from a simple increase measured in your actual consumption along with a peak usage indication. For example, 1 Horse Power is 746 Watts.

The actual consumption that the power company measures due to increased inductive "losses" or usage above the resistive value can range from 800 Watts to over 1,000 Watts. There is clearly a 7 percent to over a 20 percent waste of electricity from this inductive or VAR factor failure.

To make matters worse, the installation of the new "Electronic" usage meters allows the power utility to track your usage by time and also allows them to monitor your 4 acronyms including Demand and Power Factor excess usage from these motors and other inductive devices with greater accuracy. Penalties will soon be assessed potentially based on gross usage, power factor, demand factor and time of day.

Approaches:
There are a few best ways to approach Power Factor Correction and there are about a dozen wrong ways. One of the worst offenders is the method where a fixed value capacitor, a one size box fits all solution that is wired to your main panel is typically not the way to go in this field. Some companies will install a large capacitor on to the electrical service through a circuit breaker and call this good. The truth is that this method only works in your favor about 20% of the time and only under specific conditions. They will tell you that the capacitor sits there not doing anything until it has something to correct. This is simply not true. The new electronic meters register this capacitive reactance as it would any other reactive load and if present to excess, will levy penalties of use to your bill.

The Individual Device Approach:
While it is true that individual Power Factor Correction of each motor or user of power to a near perfect value minimizes the effects of wire losses and phase angle errors within a device, a properly designed electrical system will exhibit less than 2 percent wiring losses internally within the building. Direct application of Power Factor Correction directly to a motor will dramatically reduce the kVA and will slightly reduce KW losses due to the resistance of the circuit wiring. Direct application of fixed value correction capacitors will only work on constant load motors like pumps, single compressors, or fans, and will not work on multi stage devices like chillers unless one corrector package is applied per compressor and one package is applied per fan. There are cases where this is the front line approach to saving you real dollars and there are times where this is the secondary approach.

The Whole Building Approach:
An appropriate solution for variable load conditions is a single variable correction device that is traded under the name Eaton AutoVAR. This is traditionally a custom designed device that is wired on to a large service. For large continuous or fixed loads, a Fixed value Power Factor Correction device can be used for maximum savings. In either case, a custom manufactured and properly sized unit will always be selected for you in order to maximize your savings.

These indoor or weatherproof units will mount in a convenient location and in many cases be wired in to the main generator transfer switch.

This will allow the saving in electricity to apply to both the utility and the emergency generator's use of Diesel or LPG fuel. If for example we are able to save you 12 percent in utility charges, we anticipate a savings of about 8% in fuel to apply.

This is due to non-linearity's in the conversion of fuel to electrical power which is dependent on the size of the generator and where you are in the power usage curve of the alternator. Please advise me of any and all generation systems on this property as they may play in to a specific system design or concern. I am aware of a Diesel Fire Pump but no other generation devices.

Knowledge Is Power:
The key to successful savings of real dollars is the proper application of the Power Factor Technology. This requires trained personnel and appropriate testing equipment. This combination of experience and equipment will develop an appropriate bank of testing data that can be examined for trends of use, special conditions of use, and a topic that is all too often avoided or ignored.

Harmonic Distortion is a highly destructive condition that can cause your consumptive bill to rise, systems to heat up, damage to occur and costs to rise from use, metering errors, and short life spans. The real dollars are saved when a competent technician arrives at your site and performs a critical battery of tests, compiles the data, evaluates the data and makes a specific recommendation for your facility that are custom designed for you.

If Harmonic Distortion is not taken in to account, problems can be amplified and damage can be accelerated. You can see that Harmonic Distortion accounts for ¼ or more of the data portion of this report.

Follow Up Services:
After installation, there should also be a courtesy afternoon of monitoring and graphing just like the original assessment to insure that your new AutoVAR or Fixed Capacitive system is set up properly and is tracking the loads of the building such as lights, compressors, and fans, as they cycle on and off. The AutoVAR unit automatically adds or removes banks of capacitors as needed depending on the Power Factor of the building in any 60 second window of time. The power sample is adjustable in time length for optimum savings. The Fixed VAR solution is similarly tested and a report is generated for you. It is important to also mention that after the installation of an AutoVAR system, that there are still small bits of savings that can be reaped, and vice versa depending which type of system is installed first. This first horse or cart will be determined by your trained technician and discussed with you. Once the AutoVAR or Fixed solution is installed and a track record of savings established, it is important to evaluate whether saving an additional .5 to 2 Percent in building wiring and motor losses is relevant. A whole building solution will resolve the information that the utility utilizes for your billing. Application of smaller fixed correction units on specific target loads can minimize panel, circuit breaker, and fuse heating, which translates in to even lower kW and kVA usage.

If at a later date you feel that a facility can benefit from an additional 1 to 2 Percent savings due to new legislation or compliance regulations, we can continue to survey the facility and suggest these additional changes. Air conditioners and chiller pumps are simple to apply fixed solutions to as they are installed after the run contactor.

Metering with the Power Xpert:
You can not manage what you can not measure
We discussed that incorporating a full metering system in the 2260 version of the Power Xpert can not only give you the ability to instantly monitor the usage and consumption of the store but to be able to use the Xpert as a diagnostic tool and perhaps give you the ability to re-coupe dollars from the Utility in the event of an electrical mishap. With the Xpert installed you can set alarm points for nearly every measurement that the meter is capable of performing. These alarm points are able to Email you in the event some problem that may occur and can be observed from ANY computer with an ability to hop on the Internet. The Power Xpert allows you to manage your usage. This is important because if you can not monitor your usage you can not manage it.

Transient Voltage Surge Suppression (TVSS):
AutoVAR and Fixed capacitor units offer a modicum of surge arresting ability. The nature of parallel mounted capacitors offer some surge arresting ability. While not a touted feature of the units as a service, it is undoubtedly a factor from the operation of the unit but is not a substitute for a properly designed TVSS system. For service disconnects the size of the units in this facility, special attention must be paid to the sheer Ampacity and ability to route destructive lighting and other primary line system maladies directly in to the building. At service sizes of 3,000 and 4,000 Amperes, it is not uncommon to sustain inrush damage currents of between 100,000 and 200,000 pulse Amperes. This level of current as well as the carrier Voltages of well over 1,000 Volts AC can destroy everything in the path from the electronic trip circuit breaker protection systems, to delicate picker/packer systems and other numerical controls and computers. With 277/480 systems a clamping Voltage of around 750 VAC RMS is not uncommon. Though it is debatable what the most appropriate clamping Voltage is and whether this is a RMS or Peak value, the fact remains that these are critical devices and with this, their placement physically and electrically are a dynamic consideration to their effectiveness.

Any excess wire length, wire sizes, fuse selections, and circuit breaker characteristics, all affect the effectiveness of these TVSS devices. Lightning and other problems can manifest themselves throughout a system before the TVSS device which may be placed just microseconds too far away either physically or inductively can be effective.

For systems such as these I recommend 300kA surge units in a 277/480 Wye configuration. These units also incorporate strike counters to indicate whether the device has performed a safety operation. These devices would utilize fused disconnects from Siemens and will bolt directly in to the main frame buss systems. TVSS of this size uses 100 Ampere, dual element, time delay fuses as these fuses have the lowest series inductance of any fuse, stay together the longest, exhibit the toughest burn times to clear and failure, and just hang in there right up to a fatal fault of the Surge Device in which case, clearing the 100 Amp fuse is a 2 second event and makes a glorious noise. I would also like to discuss what is distributed among the sub system panels for what I refer to as Slave TVSS. For the slave units, I often incorporate a model of TVSS in the Eaton CVX family.

These are available in 208 as well as 480 Volt classes and in 50kA and 100kA capacities with indicator LED's for signs of operation and failure mode. These units are often attached (unfortunately) with 20 and 30 Ampere motor type circuit breakers.

Motor type resilient circuit breakers have a lower inrush inductance and survive massive amounts of current better than the standard types of resettable disconnection means. A data sheet on both the large format SPD and smaller format CVX units will be supplied to you for inspection.

Grounding:

This is a very touchy topic that often brings about screeching and loud debate amongst the most learned of persons. I do profess to be one of these learned fellows and would like to have an opportunity to discuss this topic further with you as you mentioned to me that you often take indescribable damage to the systems in the building with no clear source. I offer several downloads to you for inspection about the subject and art of grounding.
http://www.radioworksrfconsulting.com/download.htm
This is one of my web sites that contains a number of articles on grounding and while specifically written for the Broadcasting world, these theories have been translated for use by myself and others of my team for the Cellular, Cable TV, Fiber NOC, Emergency Operations Centers, Hospitals, and other critical nature locations where failure and electrocution of the staff is simply not an option. On quick glance, I see that a great amount of detail was put in to the design of the grounding appurtenances here at the distribution center, but there are some critical errors that arise as well and the hidden questions of buried rings, halo's and driven rod depths along with water well points and other Utility company references. Please feel free to download any and all information from my alternate web site as well as those in the appendices of the articles for an absolutely diametric learning experience. This is another topic that I enjoy discussing. The goal of successful lighting protection has three steps. Avoid the strike, Minimize the strike, Control the directivity of the strike. The success of the last step is to have transformed the hundreds of thousands of Volts and unknown Amperage to only hundreds of Volts at hundreds of thousands of Amperes. This success is usually seen when Cathode Ray Tube type computer monitors turn strange colors and have to be de-gaussed.

ROI, The biggest Bang For The Buck:
When comparing various Green Solutions, the Return On Investment is the key to proceeding. The other popular players in the Green Game are Photo Voltaic (PV) and Wind Turbine Power. The cost of both of these technologies need to be broken down in two phases. The cost of the PV panels, or Wind Turbine, the method of storing the energy, and the conversion of the energy stored in to something that can be used such as electricity.

It is no secret that PV and Wind are pretty expensive to purchase and install. The real consideration to them both is how to store the energy. The most common mode is battery technology. Storage of the recovered energy in the form of Direct Current means owning and maintaining large banks of batteries. Battery technology runs the gamut of wet technology and newer AGM and Gel. No matter which you select based on price and longevity, the next consideration is to convert the DC in to AC so that it can be used by most site equipment.

This requires inverter technology. This contraption of PV, Wind, Batteries and Inverters has a typical life span of 15 to 25 years and unfortunately has a payback rate that is very similar.

If either of these technologies is selected for use in a given location, Power Factor Correction must also be applied. Remembering that if you save 2% to 12% in the operating usage and/or cost of your consumption, you will increase the capacity of the PV or Wind system by the same amount. In actuality, the Inverter technology does not care if the load is in KW or kVA. It is all overhead to the unit and savings equals straight savings and enhanced capacity. Because of this, Power Factor Corrective technology is the key companion to any Green Energy Initiative.

The Testing Regimen:
Testing of a 277/480 VAC service buss such as this can be quite hazardous and we incorporate the appropriate safety apparatus when we work.

The specialized Fluke metering system and companion laptop were set up and testing of the system in the WYE or Phase to Neutral mode began first. This is a mixed use system and though primarily connected for Delta configurations, WYE type testing reveals any unbalances in distributed load and other related anomalies that the building may have that strict Delta testing will miss every time. During the set up of these tests, we made every attempt to conform with the corporate safety protocols of arc and flash protective personal equipment. Due to the limited amount of testing time, we were still able to gather a significant amount of data.

Testing covers screen shot transfers of pertinent data displayed as well as fully embedded graphics. This data includes Voltages, Current, Vector Analysis, Harmonic Distortion, Neutral/Ground deviation differential, Wattage, VA, Power Factor and Displacement Power Factor. Once this testing is completed and stored, the apparatus is cleared and a full regimen of testing commences in the Delta Mode.

Power Factor Correction is typically only applied in the Delta configuration and is appropriate for nearly 99% of applications. The advent of also performing the full testing regimen in the WYE mode insures that I leave no stone un-turned.

The Evaluation And Results:
In observing the two chillers, they are distinctly different in their start up and operational characteristics.

The smaller unit exhibits a 20 second tapered duration high amperage inrush event that draws 2300 inrush Amperes while the larger unit seems to pull only around 1900 inrush Amperes but it does so for a 40 second tapered duration. While significant, these currents have little effect on the total demand charges. Because of the electronic meters now installed, lightning quick recording reflexes never miss a trick for KW consumption all the way down to a tenth of a second duration so while these multi-megawatt class consumptions are high, the requisite 15 minute applied rolling window for averaging smoothes these numbers out quite well. Again, analysis of your tariff information will allow us to determine the contributory effect of these types of inrush draws on your total billing package.

Even though the high rates of draw ramp up and back down over the 20 second and 40 second windows, these time frames are only two to four percent of the 15 minute window which keep the contributions to the demand charges low. I look forward to additional testing of the chillers and in particular chiller 3. Data presented shows that this unit has a pulsed power draw during operation that is quite unusual. At random intervals, this unit pulses about 35KW and 50kVA for about a 2 second duration of each pulse. These consumptive pulsed draws are confirmed in the full gamut of the testing data that was taken prior to the full run up of both units. This data might want to be shared with Trane as it may be an indicator if a problem manifesting itself with this unit. This pulsing was not evident during the twin unit run up and was likely buried in the overall massive numbers. Individual testing of this unit will be performed at our next visit as a course of the protocol for motor direct AutoVAR evaluations, and that next run of data should also be submitted for analysis by Trane. Regardless of the status of that outcome from the pulsing, this type of annual or semiannual maintenance testing can be very proactive in tracking the health of large format devices such as the chillers. Though quite large, the chillers are non noteworthy as any eye opening events are concerned. They exhibited extremely low Total Harmonic Distortion levels in both the Voltage and Amperage modes and are quite correctable as far a Power Factor is concerned. Installation of the AutoVAR's on to the chillers will require that they be fully shut down as this is a direct connection to the inbound wiring to the wall mounted control devices for the motors.

Recommendations:

Chillers:

Based on the data presented and the knowledge that these machines were only running at one half capacity, I did get to watch the start up characteristics and though I do not like to forecast or guess with authority, the Power Factor corrections that would be utilized are 350kVAr for chiller 2 and 400kVAr for chiller 3. These numbers are however a bit on the light side based on the name plate ratings and observed Power Factor and total VAR responses during start up. As I said, though I do not like to guess and we will be back for individual unit testing, I would anticipate that chiller 2 will wind up with a recommendation of 450kVAr and chiller 3 will likely require 500kVAr for Power Factor Correction measures but we will see. The harmonics are amazingly low and any need for Harmonic Suppression is simply not a thought which helps dramatically to keep the costs of the AutoVAR's low. These devices will need to be installed in close proximity to the chiller starter/controllers. Each AutoVAR in this case will contain an internal circuit breaker for a means of disconnection and safety for maintenance and protection which minimizes the installation foot print and costs in materials and labor.

Metering:
You have a Siemens branded metering system installed in to each mains service. I do not believe that these meters are a part of a facility wide monitoring system. These units appear to lack the ability to analyzer Harmonic Distortion. These Siemens units are good front panel systems and are optically interrogatable but need to be connectable on to your data transport systems. We offer several types of metering packages and know that a quality metering system will divulge the usage parameters of the service in question. You also get total Harmonic Distortion analysis, event alarms, event alarm Email, and networking ability.

We can set these metering systems up for your use to either ride the existing in building LAN systems, or we can make power monitoring a network of its own on either wired CAT5-RJ45 hardwire systems, or in these types of facilities, I prefer Radio Frequency link based connectivity in the 900mHz band as it is robust enough to deal with the concrete and steel infrastructure with minimal installation costs. This RF link connectivity promotes electrical isolation between the services and data recorders thusly minimizing other errant paths of conductivity and destruction.

Power monitoring and alarm reporting is also useful in minimizing consumption costs. Once trends are established for various systems, comparisons can be seen between days, weeks and months of a system to observe trends. Alarm points can be set to alert the operator of potential problems that can trigger a maintenance cycle before a partially shorted motor winding, or transformer becomes a show stopper at an inopportune moment. Electrical failures can often be predicted and do not have to be the show stoppers that they try to be. Another key feature to alarm based Email reporting is spike, sag and brown out event wave form recording. The best example is that on a clear day your take a primary line strike that enters the system at nearly 1,649 VAC RMS. This would have a peak value of around 3,000 VAC. A week later the “B” side chilled water pump fails. From the run log, this pump was running when the email went out about this spike in the system. You can go back in to the log of the software and pull the PDF of the event that the system recorded, perform the repair, and often hand the charges to the Utility for reimbursement as you can prove that “They” did this to you.

When installing a Power Xpert, I typically recommend that it be in place for 30 to 60 days with the first 30 days of evaluative metering to be performed and at the 30 day mark, the AutoVAR would be ordered and run its course for manufacturing and delivery. This gives an additional 30 days to develop the usage trends of the facility prior to the Power Factor corrections. At the time of delivery of the AutoVAR, the difference in consumption and Demand Factor will become apparent within minutes of turning the AutoVAR on. As for a cost of any Power Xpert system, it is safe to say that over 90% of individual Xpert installations cost under $9,500.00. Because you would have 10 systems reporting in, I would recommend the advanced monitoring software package. The advantage to Power Expert and related systems is that there are no continuing license agreement fees and life time support comes with the software from the manufacturer.

Power Factor:
In previous discussions the notion that I can remove between 70% and 90% of the waste kVA consumed in a facility plays the largest role in taming the Demand Factor figure included in the Utility bills. Because the Demand factor is made up of this relatively high KW to kVA ratio the proximal waste usage calls for correction values that are quite high. For this discussion only the chiller 2 and 3 service is considered. From the preliminary data, this service is a candidate for motor direct Power factor Correction.

The Trane Centra-Vac systems are fully modulated chiller systems that operate on a complex system of part winding bump, roll and start operation. These controlled systems are delicate to Power Factor correct as the motor is actually quite delicate and the location and type of Power Factor Correction system must be carefully laid out. I need to ask that I be put in touch with the Trane representative in order to insure that I recommend the proper system for each chiller.

Trane often publishes a document for each model that outlines the maximum amount of capacitance that can be applied either in microfarads (uF) or in kVAr. In either case, these maximum levels cannot be exceeded.

These chillers have a range of operation in power Factor in the .8 region. This is not uncommon and the Total Harmonic distortion is well under 2% for both the Voltage and Amperage modes which is another sign of very high quality motor systems. The recommendation to go motor (system) direct is driven by the line loss recoverability for maximum savings.

The power draw on a chiller is quite high and there are line and wire losses that can be recovered by dropping the total amount of Amperage that is heating up the systems. With a dramatic drop in the waste kVA of 70 percent to 90 percent and in this case nearly 200kVA, this will likely play a dramatic role in the reduction of your tariff charges that Corey Clive will work on with you as a separate part of this evaluation. Initially and subject to confirmation during the upcoming testing event scheduled for Friday night, October, 1st, 2010, my recommendations are to install a standard model AutoVAR on chiller 2 that has a correction value of 350kVAr, and for chiller 3, a correction value of 400kVAr. Because the Total Harmonic Distortion is so low in both the Voltage and Amperage modes, non-harmonically-suppressed systems can be utilized. Another advent of the AutoVAR is that they is programmable for time delay of action. Typically a delay of 3 minutes is used on start up and a cease command can be applied from the chiller controller to end the Power Factor Correction just before cessation of operation of the chiller to insure that voltage spikes are other capacitor related items are avoided.

This unit would mount on a available wall space or rack and for safety a means of disconnection is contained within each AutoVAR unit should the unit ever require repairs.

The Savings:
We ask you to share with us the last 12 months electrical bills from each service that we test. We will evaluate the information contained on them and in the event that the Utility does not openly give you the required data such as actual KW, kVA, PF and other reactive measurements, we will ask you to give us permission to speak directly with the Utility about your usage.

Once we pull up your billing matrix tariff, we will be able to fully compare the methodology of your billing matrix structure to the data that we have already taken during the testing. Corey is quite good at the analysis of these tariff's and how they relate to the usage, demand factor calculations and other considerations. We maintain that a savings of typically 2 to 12 percent can be achieved with the Return on Investment of between 24 and 36 months. With such a large savings to be recovered in the kVA category, this spills over in to a .5% to 2% reduction in your over all KW usage. While the math involved is pure and there are absolutes in the calculations, the reality to this is that when you have the 20% kVA overage or greater that this facility exhibits, removing 70% to 90% of this kVA will couple in to the reduction of this small fraction of KW usage which will assist in recovery of the Return On Investment.

The application of appropriate Power Factor Correction does also play a small direct part in the reduction of straight KW usage from the fine tuning action of the AutoVAR when applied to the building as an entity just like applying a fixed value capacitor directly to a motor to accomplish the same thing, only in this case the motor has a life of its own and the AutoVAR continuously adjusts to compensate for this action.

Testing for a typical location of your size generally has a cost per service bank of between $2,500.00 and $3,500.00, which includes the visit, testing, evaluation and recommendation of equipment.

The electrical contractor, and of course your staff will play a large role in the evaluations of the various installation costs as they typically vary quite a bit from location type to location type. A rebate is available when systems are purchased and a credit is applied to the system purchase price. Installation typically only takes one day per system with no system shut down and the largest cost of the installation other than labor is the cost of the disconnection means.

The cost of a typical installation in these circumstances often runs around $3,500.00 per AutoVAR, and includes the materials. (subject to modification for parts availability) We typically refer the installation to your favorite electrical contractor as you have a tremendous working relationship with them and those costs are variable which are difficult for us to quote. The cost of the AutoVAR is predictable as is the shipping. Installation costs of Metering systems and TVSS can be incorporated to the price of the AutoVAR installations and often rounds out a day and can occasionally extend in to a second day. Package installation pricing from our group is of course available once our hand picked Electrician has had an opportunity to walk each job.

Recurring Maintenance Testing:
As a part of our commitment to you to insure that the product we recommend will continue to work well for you, we recommend that you ask us to return (for a charge) to re-evaluate your systems or in the case of facilities where you have installed Power Xperts, we should look over your data from each location by calling each metering site up on the Internet. This way, we can evaluate the performance of each AutoVAR no matter if it is a single tiered or multi-tiered installation. We want you to know that we value your business and are here to help you grow.

If you have any questions about this letter please feel free to call my office at any time. Corey would like to discuss the possibility of applying for grants with you to assist in the costs of these systems.

Thank you,
Gary A. Minker

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