KSEng Inc. dba

KSENGINEERS

Mechanical Engineering Consultants & Energy Engineers

To Whom it mat concern at: **docket@energy.state.ca.us**

An hour ago I was informed of this submittal stage dead line of 5 PM today. In an hour I have to catch a plane. To get my comments in I use my TES testimony that I have used on another occasion. I cannot adjust it now specifically to this case right now. Please accept this as my comment to: "Load Management Standards: Proposed Standards Comments" docket number "08-DR-01"

However, I would like to voice my disagreement with the statement made on page 48 of your report:

Commissioners expressed support for the concept, but indicated that there may be no need for a standard to address their market penetration at this time. With all customers moving toward at least TOU rates under AMI, the value of such technologies to customers would appear to be increasingly attractive.

Commissioners are totally misinformed by stating that there may be no need for a standard to address their market penetration at this time. Where have they been the last 15 years since TES was totally neglected and is in such a low state that manufacturers can hardly survive? TOU rates have been going in the directions to squash any TES potentials. Please read my testimony.

Sincerely,

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TES TESTIMONY

SUMMARY

My name is Klaus Schiess and I am president of KSEngineers, a one man engineering firm which I started in 1987. I am a totally independent engineer with decades of energy and energy cost savings experience. I have no affiliation with any manufacturer and have always guarded my independence. I have also worked on two other continents and have always thought that America is at the forefront of everything. I took like fish to water when TES started to make inroads in the early eighties. Yes, this is the answer to electricity storage. Then something happened that is still a mystery to me.

From my white hair, you can see that I cannot have any selfish long term plans by trying to improve the conditions for or promote Thermal Energy Storage. It is purely that I am frustrated that this technology is not at the forefront of our energy policy. If I can make a slight difference even at this late stage, it would give me personal satisfaction that I may have contributed my little share to something that benefits society and helps the environment.

1. HISTORY

Personal History

My whole professional career seemed to evolve around the recurring theme of demand shifting applications.

My first job after graduating was in Switzerland working for Escher Wyss in the early sixties, a leading hydraulic turbine manufacturer who just started developing pump turbines for the then upcoming potential market for pump storage systems. Switzerland is known for its pump storage systems that pump water up the Alps during the night to let it come down during the day when the grid peaks. Overall efficiencies can reach 80%.

Then later in South Africa, which has no oil or natural gas resources and in addition was boycotted during that time, was forced to solely rely on coal fired electrical power plants. Therefore, even heating was electric resistance heating. I designed the largest hot water storage system in the country for a metallurgical laboratory complex in 1976, which required a lot of outside air. Thus on a cold winter morning the demand rose to such levels that the electrical design engineer had a fit and we resolved the issue by spreading the load over 24 hours to bring down the peak demand utilizing a hot water storage tank.

When I came to the USA in 1978 I was enthused to see that thermal energy storage for cooling started to make its entry. Electrical load shifting was right up my alley and I soon got involved with energy conservation and Thermal Energy Storage (TES) for cooling. I was convinced that within two decades there would hardly be a chiller-based air conditioning system built in the USA without applying this relatively simple technology.

Millions are spent on finding a battery that can store large amounts of electrical energy. Until such time as somebody invents such a battery it is obvious that America with the

high air conditioning loads is the ideal place for TES, produce the “coolth” at night when it is cheap and the grid load is low and cool the buildings with the stored cooling energy during the day. It is a nearly 100% efficient process and the energy is stored right at the site where it is produced and used up, relieving the electrical distribution system at the same time.

In the eighties the utilties fully supported this new approach with rebate programs and promotional material. I was soon involved in feasibility studies that looked at TES for new projects and retrofit projects. As each project is usually unique, it was necessary that consulting engineers should become involved and familiar with all TES technologies, which are basically split into three categories.

2. TYPES OF TES

Chilled water storage

The idea is to store chilled water, which requires large but relatively cheap tanks. Various ways were developed to ensure that a constant temperature difference could be maintained. In the end a vertical tank utilizing the stratification effect became the most economical method. As there is no phase change of the cooling media is involved it is called sensible heat only.

Ice Storage

An alternative way is to utilize the latent heat effect of a phase change of liquid to solid. As water is abundantly available and in addition has the highest phase change energy requirements of any liquid it is a good opportunity to make ice at night and then melt it during the day to cool the building. Ice storage however introduces new aspects such as an ice machine is required involving temperatures about 10 degrees below freezing.

Various methods of ice making developed such as ice harvesting, encapsulated ice or ice freezing on coils or tubes or even on plastic panels that originated from the solar heating industry.

Eutectic Salt

A mixture of substances were developed to try to get the benefit of the two above described systems into one, meaning that ice making chillers and the lower temperatures could be avoided yet the benefit of the latent heat principle could be reaped. Transphase developed the eutectic salt system with a melting/freezing temperature of 47 degrees. Therefore, normal chilled water chillers could be used and the storage tanks became considerably smaller than for chilled water due to the latent heat storage of the eutectic salt.

4. THE HAYDAYS OF TES

In 1983 I moved to San Diego and took like a fish to water. SDG&E and other California utilities heavily promoted TES with sharing in costs for feasibility studies

Late 1980s were the "heydays" of TES for the following reasons:

Rate schedules were favorable for TES by differentiating between day time and night time energy costs

On peak demand charges reached $25/KW

Even a special Super-TOU rate was created by SCE to promote TES which introduced a 4 hour on-peak window to keep storage capacities lower and with it initial project costs.

Utilities provided Rebates up to $300/KW shifted

Utilities offered free or 50% assistance for TES studies

Utilities offered special TES Seminars

EPRI developed "COOLAID" software for Utilities to explore and to assist in the evaluation and design. I was personally involved with assisting with the development of that DOS based computer software.

KSEngineers had a high ratio of feasibility studies actually developing into projects, some of them under my design.

5. THE DECLINE OF TES

After a few years the interest and assistance of the utilities started to wane. There were unfortunately some teething problems and especially one particular manufacturer caused a lot of damage to the industry when those systems did not perform and large lawsuits were filed that could have dampened any enthusiasm for the utilities to stay involved with TES.

There was also the impression given that the trend of the electric rates was going towards Real Time Pricing (RTP). Metering technology would facilitate this methodology of charging customers rates that were a true reflection of the real cost to produce the power.

KSEngineers was actually commissioned to do a study on the effect of RTP on TES. PG&E had a test site where this experimental rate was applied. As a result I published a paper, which was also presented at one of the annual World Energy Congresses. **"The Effect or Real Time Pricing on TES"** published in 1995 is actually today still totally up to date. The conclusions reached were that RTP would greatly promote the feasibility of TES perhaps even more so than the normal time-of-use (TOU) rate structures.

With the onset of deregulation or the split into electricity providers and transporters a definite trend became evident in the fact that rate schedules started to eliminate the difference between on peak and off peak charges per KWH as well as lower the demand charges. The rebates disappeared and it seemed everybody started to lose interest in demand shifting.

Representing the building owners, engineering consultants and designers are on the receiving end of rate structures, and we have to provide tools to calculate and predict the costs of any changes that a project would yield. This is no easy task because there are so many different utilities with each one having their own numerous rate schedules that as an outsider are difficult to explain. The impression is gained that rate design is a special breed of calculators that cannot see the forest for the trees, or I would even go further, they cannot see the beach for the grains of sand.

Again, as an outsider to the thinking process of utilities I could not decide if the rate and incentive designers knew what the changes they made did to TES, whether they actually cared or may be if it was intentional.

Reasons for the decline and why TES could not sustain itself.

No investor will risk capital if there is not a potential to get rewarded for the effort. One of the major problems is that TES does not save energy at the site or very little but it saves at the source. The source and the distribution are in the hands of the utilities. Electricity is a monopoly that is regulated by a public commission.

The market is too small or too small to afford an effective lobby. Chiller manufacturers associated themselves with certain manufacturers of TES equipment but the real reason was not to boost TES, it was more to not miss out in marketing and selling of chillers.

But the fact was that it got difficult to develop projects that had an acceptable pay back period. By 1994 a collaborate of concerned professionals in the energy conservation industry was formed to try to stem this trend. We all could not understand why this proven effective demand shifting opportunity started to become a wall flower and was not invited to dance anymore.

6. CALIFORNIA ENERGY COMMISSION

The collaborative worked out a white paper that the CEC published as their report that clearly defined all the benefits of TES to the State and to the Nation. Some of the main statements are repeated here:

In 1995 the CEC stated and confirmed that:

“TES is an energy technology offering compelling energy, environmental, diversity, and economical development benefits to California.” (CEC TES Systems Report P500-95-005 Page 51)

"TES is the best tool a commercial facility manager has for managing power costs under Real-Time Pricing, which the California Public Utilities Commission has proposed as the dominant type of pricing in a deregulated competitive electricity industry." (CEC TES Systems Report P500-95-005 Page 6)

The report estimates all the potential savings in reducing California's peak demand and the associated pollution reduction. Clearly it was concluded that TES benefits the State and the Nation. Certain legislation was past that required utilities to encourage demand shifting opportunities.

That was 1995. We are now going into 2009. What has happened? Why have we wasted 15 years of valuable time to utilize the "best battery money can buy"?

7. RELIABILITY OF TES SYSTEMS

7.1 Technical Reliability

Like with any energy conservation measure it takes some input to achieve savings. Unfortunately with mechanical things it is not quite as easy as changing a light bulb. Chillers have to run now at night but with our vastly improved control technology with remote warnings etc. things have become a lot more user friendly than just ten or twenty years ago.

I have personally designed TES projects of all three types chilled water, ice storage and eutectic salt systems that are still in use today after nearly 20 years of operation. Many of them are still in operation today. I try to stay in touch with "my children" but owners change or operators change and they then deal with their own advisers if any.

There have been some problems with some installations but they really had nothing to do with the technology. It was sometimes bad quality control, bad designs, and neglected maintenance or control sequences being changed. But that happens to any machinery. TES is a technology that works and if maintained and controlled properly delivers what it is planned to do.

Over the years I have had many trouble shooting consultations, they were mainly due to human lack of interest or misconceptions. But again this happens in any technical field. Right now I am in the process to provide consulting advice on what to do for two ice systems that are still operating but may need to be replaced with new, abandon them and replace with new chillers or try to hang on until the TES renaissance is happening.

3.2 Economical Reliability

Like with any energy conservation and energy cost savings measure there is no free lunch. It takes upfront cost to achieve savings. It is always a compromise.

The past history of the utilities in guaranteeing the economical long term feasibility to invest in TES has been badly shaken by the mere fact that the rates have smothered the economical reliability of TES. The disappearance of incentives also contributed to the fact that the TES market slowed down considerably. The savings potential was just too little for investing in new TES projects or even retrofits.

Owners are discouraged when they find out that rate structures have changed in such a manner that the savings are progressively reduced. As an example, about two years ago SDG&E switched the on-peak demand charge from approximately $12 down to $5, but at the same time increase the NTR demand from $5 to $12. Nobody realized this except a TES expert. I had to inform the owners that as a result the monthly summer savings potential has been reduced by $2,000 for a TES system of about 1,500 ton-hours. Why? The new highest demand now that gets hit with the $12 demand charge is the 15 minute interval just before the on-peak period. The shift that was originally worth $12 has now been de-rated to $5.

In an attempt to reduce this damage and salvage some of the savings potential, completely new control methodology has to be introduced. In stead of on-peak shaving, which shuts down chillers at a certain time, a control strategy has now to be implemented which makes use of load leveling techniques. This is a much more complicated process as the building electrical load profile comes into play with the TES sharing cooling with the chillers at the same time.

8. FEASIBILITY

TES projects are totally dependent on a favorable rate structure or incentives in the form of rebates or tax credits. Hospitals, schools, universities, office buildings, manufacturing facilities all use chilled water systems that make a TES system feasible if and only if: SHOW ME THE MONEY. That applies for new projects but even the retrofit market could contribute tremendously to a State wide reduction in peak demand loads.

I have been named the “Moses of TES” as at one ASHREA conference I gave a presentation where I introduced “The Ten Commandments of TES”. Here the first two.

First Commandment of TES:

There shall be a Rate Schedule that makes the extra effort and cost to implement a TES project economically feasible.

Second Commandment of TES:

There shall be some financial incentive in form of rebates or tax credits to make TES economically feasible.

Basically, it has to be realized that TES is intricately linked to rates and incentives that can make it feasible or not. Or alternatively it is the rates that can kill a good thing. The same thing is being realized in the electrical solar industry where it is found that photo voltaic projects do not realize sufficient savings because the high non-time related demand charge is hitting the bill in the morning before the sun can produce sufficient power.

9 PAST PROBLEMS WITH THE UTILITIES

9.1 The infatuation of the utilities with demand response programs

In recent years it has become more than apparent that the utilities are very much interested in shifting demand during peak periods. Energy conservation measures obviously contribute to it but it is not enough. Unnecessary loads need to be turned off. And of course attempt to try to shift load from on-peak to off-peak. Well, as it is, the giant economical rechargeable battery does not exist yet. In the mean time there is the storage of potential energy (pump storage systems) and thermal energy storage systems that do a good job all over the world.

The utilities are offering programs that reward demand shifting but only during the time that it suits the utilities. That means only during the time that the grid is in trouble.

The public is now offered programs via aggregators that reward the user if they reduce load in any fashion during the peak period but only if the grid is in trouble . If, however, the user has found a successful demand shifting measure and thinks that is a good idea to do it permanently, then hey wait a minute! The utilities will punish you for doing something good all the time. No, we want you to shift only when it suits utility. So the program only rewards the shift is achieved against the load profile of the five previous workdays.
This is a contradiction in itself unless there are other motives involved that are generally not known. Until I know what they are I maintain that:

Demand response programs are like taking a pill when you get a headache. Do PLS like TES and you won't get a headache.

It got so far that account representatives of a utility went around their customers who still had functional TES systems and advised them to use them only as a demand response program.

9.2 Experience with Demand Response Marketing

KSEngineers has been employed by an aggregator to assist in finding demand response opportunities with potential clients that show interest in signing up. A visit to the facility usually ended up in finding relatively little to do without some heavy investment. The result usually was that it is not worth the trouble. My experience so far is that it is going to be very difficult to sign up enough reliable load shift.

However, what I found is that there is plenty of opportunity to do some real load shifting on a permanent basis if some improvements are made however they needed some experienced engineering to develop. The moment we talked about them, there was interest but who is going to pay for the project development and the feasibility thereof?

Funds for Technical Assistance (TA) reports were not available anymore. The latest development is that the client cannot chose their own engineer or consultant to do any TA work, it has to be done by a utility selected consultant. Therefore, I as an independent consultant cannot provide the same services for free, on the contrary I am now forced to compete against free services. I have lost many potential jobs because of that.

9.3 The sad cases of this Engineer having to nix TES Projects

9.3.1 Prison

A prison located in desert climate proposed to add a chilled water storage tank of considerable size to shift of close to 1000 KW from on-peak to off-peak KSEngineers was appointed to evaluate the proposal from an ESCO company.

KSEngineers soon discovered that this was a typical proposal to get a project going with very flimsy cost savings calculations. The rates at the time did not even have any difference between on-peak and off-peak. The utility promised to adjust the rate structure once the project was implemented and offered a 2 cents/KWh difference with no demand charges. The incentives were not really worth talking about.

Now if you are well versed in this business, you are going to laugh out loudly.

9.3.2 Large University

A large technical university had already done the design for a large chilled water storage tank under their baseball field. It was a $7million project. KSEngineers was required to do a peer review. I soon discovered that the rates onto which the feasibility study was based had changed considerably and that the 6 year proposed simple pay-back period had now changed to about 25 years. The University decided to shelf that project. The main reason was that a NTD charge had been silently added as well as a ratchet clause of a year that alone nixed the first years' savings.

When I called up the utility and asked them if they were in the business of providing $800,000 rebate for a 25 year payback TES system they said no way of course. When I told them that with their rate change they had done that and just killed the project, the account rep told me that she would have to talk to her supervisor.

T appears that those rate designers could not see the Relationship between NTD and On-peak demand. It appears that rate designers have no clue what they are doing to the outside world. They just see their own world and bottom line rules. They can't see the

forest for the trees, no a tree is a good thing, they are worse, they cannot see the beach for sand grains**.**

9.3.3 Gas cooling SCE nixes hybrid project (City of West Covina)

KSEngineers developed a unique project for a police station in a City in SCE territory that involved utilizing a gas engine driven chiller that would produce cooling during on-peak periods. But at the same time we could also use it as a generator in case of a power failure. As this was going to be an experimental project the manufacturer guaranteed that after one year of close monitoring, the City could either buy the unit that was to be installed for free or give it back.

Now it is a known fact that it is a lot easier to implement a hybrid system in a utility territory that is served by a "Gas & Electric". I did not know that I would land up in a hot political battle between two sides consisting of the mayor and some council members and some councilors under the leadership of an employee of SCE who managed to squash the project. I was verbally attacked at the City Council meeting by that account representative of SCE when I suggested that as an employee of SCE he should recuse himself from voting.

10. WHAT DOES IT TAKE TO ESTABLISH TES AS A PERMANENT LOAD SHIFTING APPLICATION

Rate Design Research:

Provide a rate schedule that guarantees the demand charges and the on-peak off-peak difference for at least 10 years but guarantees the utilities the necessary income that other rate schedules provide. May be California needs a "Green Rate Schedule" that promotes TES, Solar Power and Wind Power.

The rates can go up and down with the market conditions but **the differences** must stay constant. This needs cooperation with the major utilities and probably government input to achieve cooperation

Incentives, Rebates and Tax Breaks

If the rate schedule is made attractive enough, no further financial incentives like rebates etc. are needed after a few years of kick starting the process again with rebates or tax breaks.

Education

Some State sponsored institution must offer educational programs to educate the potential investors and the engineers necessary to produce feasibility studies and eventually design and implement the project.

11. A DECADE OF PERSONAL FRUSTRATION BY PERHAPS AN IDEALIST

Ten years ago I gave a presentation at the Western Conference of the Association of Energy Engineers at Long Beach and called it: "TES at the Crossroads". I then followed it up with an article that got published in the AEE's "Strategic Planning for Energy and the Environment" (Vol 18, No. 4 – 1999). It gives my thoughts at what should be done to follow what the California Energy Commission report reported and with its publication attempts to contribute to the welfare of the State of California.

Personally, I do not understand what the reasons are that we as progressive Americans have let things slide so badly that this needed demand management opportunity has been neglected if perhaps not kept on the backburner on purpose. We have a public utility commission that has to keep a watchful eye on the monopoly of the electrical supply to the State.

After witnessing the trend in rate design and the flipping of on-peak demand with non-time related (NTD) demand charges one cannot help to come to the conclusion that the rate design is so grossly self indulgent that they have no idea what they are doing to any of the industries like TES or the photovoltaic and wind power industries even perhaps gas cooling. These demand management opportunities need a rate schedule to make them economically feasible.
Here are my perhaps naïve thoughts on what is needed:

A simple rate structure, preferably state wide to ensure that these industries can overcome the initial capital investment and allow economically feasible projects. The rates must reflect the difference in cost between on-peak and off-peak Of course the rates may vary up and down according to the market, but the difference must be guaranteed for at least a 10 year period.

If Real Time Pricing reflects the real cost of electricity to be produced then let it be RTP and as far as I can gather from my past experience, TES will have a chance to flourish and make the contribution to society it should have done already for decades.

12. CONCLUSION

Dear CPUC:

Google talks of developing a smart electrical grid. Everybody is starting to realize that something has to be done. TES uses electricity on a site when it suits the grid. It relieves the grid during peak time. What more do you want, the storage is happening right there at the site. It does not only even out the load profile, it also helps to improve the efficiency of the grid. Just like, I am sure you agree, it is a lot easier to drive at night when there is no traffic.

Now is the time to act and make up the time lost. It is in your power. Rate design is not rocket science, it just needs the will from all parties for it to be done.

13. APPENDIX

Copy of the article "TES at the Crossroads" on following page:

THERMAL ENERGY STORAGE (TES) AT THE CROSSROADS

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INTRODUCTION

Thermal Energy Storage (TES) or off-peak cooling as the technology is also called is at a crossroads. Deregulation will bring dramatic changes to electrical rate structures that will impact TES more than any other load management technology. Predictions from crystal ball gazers vary from one extreme to the other. Some say that the industry is going to die, others expect a rapid take off. Generally, most experts predict that deregulation will bring higher on-peak costs

and lower off-peak costs. If this is true then TES is not only going to survive but actually prosper.

The progress and popularity of TES has been much slower than expected. Although the technology is nothing new and uncomplicated in itself, it is surprising how many problems have clouded the success stories. In this paper we postulate that with a paradigm shift in the pricing of electricity from the “off peak” / “on peak” universe to a real time, the stage is set for TES to finally payoff through demand shifting resulting in significant cost savings.

TES CHALLENGES

The focus of most industry research in recent years has been on operating strategies and in designing control sequences. For instance, in the "Background" paragraph of the work statement for 1054-TRP of ASHRAE's Technical Committee TC 6.9 the following statement appears:

"THE REAL NEED IS TO DEVELOP A COMPREHENSIVE SYSTEM FOR ACCURATELY DESCRIBING AND PROPERLY SELECTING AN OPERATING STRATEGY FOR A GIVEN SYSTEM."

This statement of industry leaders in this field of technology brings to our attention the fact that we are in need of more information. The root cause of the problem is a lack of communications between various entities to implement TES solutions. Each party has its own agenda and along the way they often lose sight of the fundamental objective.

TES Playing Fields

There are many variables which affect TES systems. Each TES system is an entirely separate entity due to its size, type of equipment, load characteristics, discharge characteristics and rate schedule.

* **Rate Schedule:** The "first commandment" for TES systems: Thou shall have a rate schedule that allows to save energy costs by using TES. Without a rate schedule that differentiates between on-peak and off-peak rates whether it be in the form of energy costs or demand costs, a mixture of the two or just plain real time pricing, there is seldom justification for making plant operation more difficult with additional equipment and a multitude of control sequences.

  Utilities have created rate schedules that compensate them for the actual costs to produce electricity under the watchful eyes of some commission

representing the public. The utilities overall electrical load profile will dictate the rules and rates under which TES operates to achieve savings that benefit the user. Therefore, TES systems are subjected to on-peak windows ranging from 4 hours to 14 hours to suit the requirements of the utility. There are on-peak, mid-peak and off-peak hours, demand charges and even maximum or non-time demand charges. To complicate matters even more there are ratchets and tier systems.

* **Load Profiles:** In most TES applications the load profile varies considerably from season to season and usually on a daily basis as well. The load shape also varies from project to project. As mentioned above, the customary approach has been to satisfy peak conditions and the job is done. TES has to adjust to every variable for optimal performance, resulting in more complex control strategies. Especially partial storage systems need closer attention to ensure that the storage capacity is not depleted too early, i.e. before the end of the on-peak demand period.

TES Team Players

* **HVAC engineers** are used to design for peak conditions and assume that the system will function at any load lower than that. It is considered to be the problem of the operator to tweak out maximum efficiency from the system. Therefore, engineers think their job is done.

* **Manufacturers** deliver the product, if it satisfies design conditions, job is done.

* The **Automatic Control Contractor** makes sure that the system functions according to the control modes that were specified. The control contractors are often in a tough situation, because they are expected to "fix" the system if there are any problems, commission it as they go along, smooth over any problems that may occur whether it is of their making or not. Control contractors know what to deliver and how to control, but they need to be told why. In other words they speak controls but do not necessarily "speak TES". If the three or four modes work that, hopefully, were specified, then job is done.

* The **Contractor** considers his job as done once all the equipment is installed.

* The **Owner** buys a complete system and expects that it will produce the savings as predicted or promised. Understandably the owner expects TES to work, just like replacing a light bulb with an energy efficient one.

* **Operators** are usually suspicious of something that makes their work more complex but they have to go along because it is expected of them. If

they are lucky they get a few hours of training from the control contractor. This is equivalent to learning to drive a car. After a few starts and stops you get your drivers license. Job is done.

With all these variables and players it is not surprising that after so many years of TES experience, industry societies are still attempting to *"develop a framework for describing and characterizing cool storage operating and control strategies"*. We have not yet even managed to clearly define "full storage". To some it means full shift of the whole daily load. To others, it means shift of all load during the on-peak demand period. Obviously with the on-peak windows varying from 4 hours to 14 hours these definitions can become blurred.

So what went wrong? Once you have a drivers license you are surely not considered a professional driver with experience in fuel economy and good road sense. In other words, I would like to plagiarize a well known proverb about happiness and change it to:

TES IS NOT A DESTINATION, BUT A WAY OF TRAVELING

DEREGULATION - Effect on TES

With deregulation it is inevitable that the concept of REAL TIME PRICING (RTP) is entering the electricity market. After having completed a TES study comparing time-of-use and real time pricing rate schedules this author presented a paper "The Effect of Real Time Pricing on TES Systems" at AEE and IDEA conventions. This article was also published in "Strategic Planning for Energy and the Environment" and was also accepted as a poster presentation at the MEGASTOCK conference in Sapporo, Japan in June 1997.

For the TES study with RTP I soon realized that calculations ideally have to be done on an hourly basis for each and every day. This is obviously a cumbersome approach with 8,760 hours a year and possibly the same number of hourly prices.

Since the study however, I have come to realize that RTP and deregulation could be a blessing in disguise for TES. The dark clouds on the horizon promise even more rate schedules created by the new ESCO, ESP companies who will now create new rate schedules to convince any potential client into believing that they are getting electricity at a better price than before or from their competitor. How is TES going to adjust to this flood of rate schedules and the new ground rules that complicate things even more?

Current Software is inadequate

The HVAC industry has been geared to designing the chiller capacity to satisfy peak conditions. All software programs in the HVAC field were developed to find the peak cooling load. It was later on when energy conservation became more important that computer programs were upgraded to include conditions on an hourly basis all year round. These programs have become quite sophisticated and thus more difficult to use. In my personal opinion the results are often too theoretical and sometimes when one studies the results more closely, old Hollywood comes to mind: "Any similarity with real life is purely coincidental".

Design engineers who had the courage to take TES more seriously prepared their own spreadsheet type of software to assist them in calculating energy and cost savings. From my personal experience it was the software this author developed that gave him the versatility to be effective in the application of TES. Some of these ideas were subsequently integrated into the COOLAID program developed by EPRI.

COOLAID was developed to assist utilities in analyzing and developing sufficient information to interest their clients to consider TES seriously. It is not known how many engineers used it eventually as their design tool. The input allows for hot days, workdays, cold days and non-work days. The operational sequence is only defined by the peak condition. For more accurate calculations it should be possible to input operational sequences for the other loads as well.

COOLAID is DOS based and may have become somewhat outdated in today's window based computer world. Some manufacturers developed their own software which, of course, is equipment and proprietary orientated.

The Department of Energy has developed various versions of DOE energy conservation programs. TES eventually found its way into the later versions but fails to adequately address TES application needs.

GREAT OPPORTUNITY

Deregulation forces new rules into the TES game. It is, therefore, time for a fundamentally new approach. What is the driving force that dominates studies, cost savings calculations, design and control sequences of TES? MONEY of course. TES must reduce operating costs. By using a totally new approach it is possible to reform TES strategies to be ready for the worst case scenario (given by RTP) and thus cater for any rate schedule that has thus far been developed.

If we accept the challenges which operators are facing, we must look at TES operating strategies on a daily basis with hourly increments (or even less if the rates so dictate) and everything will start to take on a new look. If we can develop a tool that allows us to calculate optimum performance on an hourly basis, every other rate schedule will fall into this mold. Actually, "conventional" rate schedules will then simplify calculations by being repetitive to some degree.

SOFTWARE BASED ON PRACTICALITY AND SIMPLICITY

If we have software that calculates the optimum method of producing the required cooling under given constraints of a load profile and rate structure, we can then derive the operational strategy for optimum savings for that day. The TES industry needs a software package that can be used by operators and engineers alike. Operators must be able to get a control sequence on a daily basis if RTP is involved.

KSEngineers intends to fill this gap and create an Off-peak Cooling Software for the 21st century. Deregulation provides the opportunity for us to define a new approach which satisfies future requirements and which at the same time corrects the deficiencies of the past. The intent is to develop a simple computer program for the TES industry that gives optimal control sequences for operators and at the same time provides the tool for the designers and engineers to evaluate TES projects. The program will be spreadsheet based which allows any control software to interface with control sequences input.

The basic concepts are not that difficult. Every system initially has certain inputs like chiller sizes, efficiencies, pumps etc. basically to define what it costs to produce one ton-hour of cooling. Part of this input is also the peak discharge performance of the TES system. This basic input will then be used to determine the cost to satisfy the cooling load at a given hour.

The program can be simply used on a daily basis or weekly or whichever is desired. For TES plants with RTP, the calculations will be done on a daily basis. For large TES systems on time-of-use rate schedules, it will also be done on a daily basis, especially if partial storage is involved.

For smaller systems the program should allow the operator to establish the best simple time clock type of controls. If the available controls are sophisticated enough, control sequences can then be based on whatever the existing controls can work with.

The program will facilitate simplification to allow reducing the 8,760 values to the accuracy that is desired. Design engineers can use the program to predict savings to any degree they wish to input. One can still do it on a monthly basis with four different typical daily load curves (as in COOLAID). The program will then automatically optimize the non-peak load profiles.

Time-of-use rate schedules with a window of on-peak demand charges will automatically develop a control sequence that will use the tank fully during the on-peak period because of the high cost per ton-hour during the on-peak period. If there is surplus capacity the program will automatically select the most cost effective shift of mid-peak load fully discharging the tank.

POSSIBILITY FOR ZERO COST ENERGY

At seminars on deregulation, zero cost energy during certain night hours is often discussed as a possibility. Even if this does not materialize, it certainly shows that very low cost electricity may be available for a few hours during the night.

This opens up a whole new world for the charging cycle of TES systems so far not even considered. Presently off-peak rates at night are constant. Chillers size was then selected to charge the system during the full off-peak period. With the possibility that another marked reduction could occur, say for five hours during the night, it may be economically feasible to increase chiller capacity to charge the system during those five hours instead of the customary use of the total off-peak period. In other words, the charging cycle can also be optimized to save energy cost using TES systems.

CONCLUSION

KSEngineers proposes to develop the tools for the TES industry that actually provides the operating strategy for operators in graphic form and, if needed, delivers system readable input for the automatic control system. Furthermore, the program will provide the designers and engineers with an analytical tool to estimate savings more accurately leading to better utilization of existing and future TES systems. With deregulation a reality in California and soon for the rest of the nation, it is imperative that the TES industry has the sophisticated tools available to respond to the vast and forever changing rate changes that will inevitably result from deregulation. Our solution does not only allow us to cope with the challenges of the future but also remedies the deficiencies of the past.

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