

Modular Central Cooling Plants

The Mission Critical arena is abuzz with containerization and modularization solutions of IT space. Now we are seeing many of the other supporting electrical and mechanical technologies within the data center topography also undergoing this evolution. If we look back into recent history, other than packaged back-up generators, the computer room industry saw virtually no “packaged” or containerized systems until the mid-2000’s. It was at that point in time when packaged chilled water plants began to show up on several data center sites around the country. Although the concept of “packaged” cooling plants is still considered relatively new to the data center industry, it has actually been around for over 15 years and packaged pumping systems trace their origin back to the early 1970’s. It is seen by many that the day when the entire data center is modularized, is not far off.

Why is this an important subject to discuss today? The relevance is that this industry trend is growing and will be here for the foreseeable future. There are some drawbacks to modularization that are easy to point out for any given application. However, the benefits of modularization to the developers and owners of data space are compelling enough to drive the industry in this direction. This trend is no longer ignored by large segments of the industry. Many owners now realize the obvious benefits of modular and containerized systems and often drive this solution from the top down. They are seeing lower initial cost, speed to market, scalable allocation of capital expenditure (Capex) resources, and, in most cases, verifiable operating efficiencies. We are beginning to see this trend not only in enterprise data centers but also in co-location and managed properties as well. The trend seems to be on the increase but there is no clear path of where this will all lead in the future. It is also safe to say that for the most part, competing ideas and concepts regarding the modularization of data center space have not had sufficient time to prove or disprove individual viability in the marketplace.

In the case of packaged chilled water systems and packaged pumping systems (often used in air cooled chilled water applications), the technologies have been proven over the past fifteen years. Adaptation in the mission critical world has been relatively quick since the mid 2000’s. The major reasons for adaptation by the data center industry are as follows:

1) Lower first cost

In general, packaging lowers the initial cost of central chilled water plants when comparing same efficiency and quality to a traditional “stick built” chiller plant. Modularization (packaging) is a logical progression of what happened in the industry many years ago. Chillers themselves had to be field assembled in the 1950’s and 1960’s. At that time the chiller manufacturers began to package their chiller technology to lower field related assembly costs and the uncertainty of costs due to errors made during chiller assembly made in the field by contractors who did the field assembly. Factory packaging also had the net effect of increasing product reliability, and time needed to make a central plant fully operational. This trend was fully implemented by all the manufacturers by the mid 1970’s except on the very largest chillers which were too big to transport over the road and cumbersome to handle at the job site in one piece. The evolutionary trend seen in chillers in the last century is analogous to the trend seen today in chilled water plant packaging.

2) Scalability

Capex is always a consideration in building a data center. The question is, why spend dollars on a complete build-out when you do not have to? Why not spend the money on systems and equipment as it is needed and not before? Modular chilled water plants allow this possibility. Although it will be necessary to rough in future chilled water and power feeds ahead of time, the cost of these are relatively inexpensive when compared to purchasing all of the chilled water components in the plant itself.

3) Speed to market

Time is money! This is especially true in data centers. The quicker the data center can be brought on line, the quicker it starts to generate revenue. Unlike conventional plants, modular plants are built simultaneously off site, reducing project delivery time.

4) Single source responsibility

Owners like the idea of having only one source to design and build their central plant. The design and construction portions are completely integrated to the extent that if there is a problem, the supplier can quickly identify the source of the problem, without dispute, and fix it quickly without having to get multiple disciplines involved. This ultimately saves time and money allowing the data center to come on line faster than would have been the case.

5) Energy Efficiency

The modular manufacturers have the same technology available to them that engineers and contractors designing and building conventional plants do. However, modular plants have similarities between themselves that carry over from design to design. The process tends to be much more repetitive than conventional stick built plants, and can be validated through factory testing.

6) Factory Testing

A benefit that is only offered by certain vendors of packaged plants is in-house pre-commissioning through factory testing.

Even though chillers and sometimes pumps are tested at factory test stands for capacity and efficiency, the tests are most often done only at full load with other operating load points tested to a much lesser degree. Although the chiller is the heart of the chilled water system and single most expensive component and biggest energy consumer within the system, it does not drive total plant efficiency by itself. Other factors such as plant configuration, pump selection, piping design, and component control have a lot to do with the energy efficiency of the system over the entire load spectrum. Factory testing of the entire system validates performance and identifies deficiencies.

- First, the owner and engineer can see system performance over a spectrum of many operating points. A guarantee can be placed on the performance of each point with penalties accruing back to the owner if they are missed. The owner now knows that the tonnage and efficiency paid for is attained. To

ensure accurate measurement of parameters, the measurement equipment (electrical meters, flow meters and temperature sensors) must be certified by the applicable test agency, NIST.

- Second, faulty chillers, pumps, controls valve operators and the like can be identified quickly and replaced at the factory. Even after factory testing, we often see components fail on chillers when put into operation within the system for one reason or another. Factory testing of the system exposes many of these deficiencies and component failures when the system is run through a spectrum of load points.
- Third, control sequences and failure sequences can all be observed with the owner, engineer, commissioning agent, and construction manager present at the factory witness test. If changes need to be made, this can be done in relatively quick order by factory personnel and observed by the team the following day if necessary.

Packaged modular central cooling plants are still a minority of the market. The trend is growing and, is a matter of “when, not if” you will want to consider a modular concept as a cooling plant solution.