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IMPACT OF CHILLER IN FACILITY MANAGEMENT (Hard Service-Property Maintenance Management)

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ABSTRACT

Facility manager, who must familiarize the primary decisive factor of chiller, and it amenities him to sort out chillers issues earlier, whose promotions & planning of chillers that aid to his HVAC squad solve chiller's hurdle without barriers. But a non HVAC background facility manager constantly depends on a chiller specialist in order to enrich his know-how. The chiller maintenance mission is a team effort making synchronization & mutual aid amid the facility maintenance work forces of other than HVAC employees and HVAC employees, so it is most vital to a Facility manager to understand the parts & types of a chiller for his day to day approaching chiller, emergency chiller service and carry out the planned preventive maintenance (PPM) tasks of chiller. For understanding the economic evolution of chiller system, a facility manager needs to be acquainted the refrigerants and its uses at chiller along with calculating chiller efficiency. In order to prepare the check list activities for carrying out the chiller's Planned Preventive tasks daily to avoid raising many numbers of break down (reactive) maintenance tasks ,a facility manager must be discussed with chiller technicians, analyze various chillers reports including AMC(Annual Maintenance contract) reports and daily log sheets etc, and it leads to fewer addiction of outsourcing . The EQ (emotional intelligence), which creates ego to a facility manager who is ill-equipped the fundamental concepts chiller & unwilling to learn a chiller tasks. As a result it is unavoidable to a facility manager to equip himself to enrich his knowledge in chiller to become a participative leadership.

KEY WORDS: Chiller, Check list, EQ (emotional intelligence), Facility Manager, HVAC, Planned preventive maintenance (PPM), Refrigerants,

1. INTRODUCTION

While execution the trouble shoot of chiller tasks in facility management it is necessary for IQ (Intelligent quotient) of chiller technician and EQ (emotional intelligence) of Facility manager because of lacking of chiller trouble shooting IQ to Facility manager that leads to build great relationship with chiller technicians / chiller team, it (IQ) is non verbal process in the forms of Facility manager's thinking and influence connects with his colloquies.

Furthermore rather than a good facility manager/supervisor, a dire Facility manager/ supervisor can take a good chiller staffs, but he roots the superlative employees to take off and the leftovers to loss all motivation due to his futile emotional intelligence attitude and who destroys everything from team moral. As a result a good chiller / HVAC technician, who leaves out from his dire facility

manager / supervisor not from bad jobs because a dire boss generates panic and makes work drudgery.

And all the facility managers are not good leaders, because a good leader can build people up but dire facility manager pull down and the facility managers are always competing with their subordinates due to their sense of self. Hence a facility manager will become a leader to execute the facility management task without any issues.

Consequently, a facility manager other than HVAC locale, if he has ability to learn the fundamental concepts of the chiller and its functions, it shall help him to lead a site without any issues and even his reliance to others also lessen.

2. CHILLERS – WHAT ARE THEY

1 "A chiller is a heat transfer device that uses refrigeration system to remove heat from a process load and transfers the heat to the environment. Chillers may also be

seen as cooling machines of choice to condition industrial, commercial, and institutional facilities”¹.

All the buildings need air conditioning and the smaller buildings that can be occupied by “units”, however a building reaches certain extent due to cost –effective, it is necessitated to use of centralized system.

1a“Centralized systems use “chillers” which are basically giant A/C units but they work slightly differently because of their size.”^{1a}.

Moreover, at large, the chillers are located either in basement or in roof a building, and the air cooled chillers, which are located roof top, but the basement chiller which are used to be the “cooler chiller”. And all the buildings engender unwanted heat which needs to be removed for keeping the building occupants and electrical, mechanical equipments at analogous temperature, and it can be done by the chillers only.

For making cool to the buildings 2“to discard the unwanted heat into the atmosphere which is picked up into the building and the water cooled chillers normally uses “Cooling Tower “whereas “air cooler chillers” blows air across their condenser, much like an A/C unit, to disperse the unwanted heat into the atmosphere”²., and the industrial chillers, which are also used to move heat from one premises to another premises.

And so, In order to understand the basic criteria of facility management of chiller tasks execution, a facility manager must realize the central observable fact of chiller as it helps to him to analysis issues earlier and understand the technical criterion, which is communal by a chiller technician; otherwise the facility manager always depends on the chiller specialist of his site even for single & simple issue. Hence it is essential to know the facility manager the sort of chiller and their functioning

3. TYPES OF CHILLER

A well experienced Facility manager, who has other than HVAC locale, must be familiarize the elemental criterion of the chiller sort that helps to understand to solve the chiller issues earlier along with his HVAC colloquies and make acquainted chiller vernacular / lingo, and it facilitates to the facility manager constantly keeping at top of his list eventhough who has various anxiety at his site.

Thus, a facility manager must know the types of chillers and their functioning for easily carrying out the chiller troubles in facility management.

5“The chillers can be mostly classified as “**absorption chillers** and “**refrigerant compression chillers**”.

In **absorption chiller** “**natural gas or steam**”, which are used as heat sources for creating refrigeration or cooling effect whereas in the **Refrigerant compression chiller** practices mechanical compression through it components such as a compressor, an evaporator, a condenser and a valve metering system.

Further the **refrigerant compression chiller** is categorized in two main types such as,

“**Air cooled chiller**”, wherein air condenser is cooled by utilizing water, where as in “**water cooled chiller** “water

condenser is cooler by water resource, it is located within building only, and use cooling tower also. Normally the **water cooled chiller** that rejects water’s heat from condenser when it is fixed near a pond or river. The **air cooled chiller** is planned for outdoor rather than indoor for installation and operation eventhough the cooling medium on the condenser is to be air instead of water.

In **air cooled chiller**, there is rejection of heat to atmosphere by mechanical, which means circulation of outdoor air by a fan directly through the machine’s condenser, and there is no need for “cooling tower” however in **water cooler chiller**, air rejects heat to atmosphere by the cooling tower only”⁵

Moreover, It is indispensable to the facility manager to know the glowing well-known of the compressor and its working principles as the chiller is further classified depending on compression method of the refrigerant in its vapor phase such as, “**reciprocating, centrifugal, rotary screw and rotary scroll type** and the absorption chiller and the vapour compression chiller are other types of the chiller, which are using in facility management.

Accordingly, an account of having wide knowledge/skill to execute too much tasks to solve various issues in a site, the facility manager views about the planning and listening, promotion of the chiller, which leads good foundation to execute the chiller tasks in successful manner, and non HVAC back ground facility manager, who must understand the fundamental criteria of types of chiller and their working principles, that helps him to understand the HVAC verbal communication.

4. HOW A CHILLER WORKS & IMPORTANT PARTS OF CHILLER

It is obligatory to the facility manager, who plans the chiller tasks properly otherwise / unless who has to face lot of issues on account of many vital facilities role react to occupant call for only, and it should be resolved at the earliest and that if the facility manager is more familiar in the basic principles of chiller works, it shall guide him rarely / seldom take as much time to plan the chiller strategically .And it must help to improve the chiller service procedure

Two Circuits

5“**In chiller system s, there are two main circuits** such as a **refrigeration circuit** and a **fluid circuit**.

The **refrigerant circuit** is most technical part of how chiller works, and it is made up of four components, such as compressor, the condenser, the evaporator and the expression valve, it removes heat from the process fluid., and “the **principle of Thermodynamics**” which is used to move heat from one area to another nevertheless if heat at chiller is taken from the fluid which is being chilled and transferred to the ambient air. But the fluid circuit is typically compressed fluid reservoir, a pump filters, and heat exchangers, and it carries the process fluid around the object being cooled.

The **refrigerant circuit** is made up of four components: the compressor, the condenser, the expansion valve and the

evaporator. The refrigerant circuit removes heat from the process fluid.

The fluid circuit is typically compressed fluid reservoir, a pump filters, and heat exchanger. The fluid circuit carries the process fluid around the object being cooled.

The refrigerant circuit is the most technical part of how chiller works. The refrigeration cycle uses **the principles of thermodynamics** to efficiency move heat from one area to another, and in the case of chillers, heat is taken from the fluid being chilled and transferred to the ambient air.

The compressor -The refrigeration cycle begins with the compressor that takes low pressure low temperature refrigerant in gas and compresses it into a high -pressure high temperature gas.

The condenser -This gas then flows through coils in the condenser. Whilst in the condenser, air or water will flow over the coils and remove heat from the refrigerant .As the refrigerant loses heat it will begin to condense until all of the gas has condensed into liquid

The Expansion valve_After leaving the condenser, the liquid goes through the expansion valve. The expansion valve restricts the flow of refrigerant. When the high -pressure liquid goes through the expansion valve the evaporator

The Evaporator-The Evaporator is where the refrigerant starts evaporating back into a gas. When the refrigerant evaporates it gets very cold and absorbs a lot of heat. It is in the evaporator that the process fluid will interact with the cold refrigerant .Heat is removed from the fluid and transferred to the refrigerant. The refrigerant will then enter the compressor and the cycle begins again.”⁵

6“**Power unit** is either mounted directly to the chiller or it can be separated and mounted to the wall of the plant room with power cables running between them and the purpose of the power unit is to control the flow of the electrical power to the chiller. These usually contain a starter, circuit breaks, speed controller and power monitoring equipment. **The controls unit** is typically mounted on the chiller. Its purpose is to monitor the various aspects of the chillers of performance and control these by making adjustments. The controls unit will generate alarms for the engineering teams and safely shut the system down to prevent damage to the unit. **BMS** connections are also usually present to allow remote control and monitoring also usually present to allow remote control and monitoring. **Water boxes** are mounted to the evaporators and also the condensers of water cooled chillers .The purpose of the water box is to direct flow as well as to segregate the entrance and exit. Depending on the number of passes in the evaporator and condenser, water boxes may have 1-2 flanged entrance or exit holes or they can be completely capped and just redirect flow back into next pass.”⁶

Thus it is indispensable to understand the components of chillers to the chiller operator , Ac technician, Site engineer and facility manager because in general a facility manager having other than AC back ground with blind spot of the chiller , who always depend on the chiller expert/ technician of the site or supervisor . Most of the supervisors

know the fundamental criteria of the chillers and do not know how to trouble shoot the chiller issues and it is also pathogenic condition to AC technicians, who are to be carrying out the split & window AC s services and their planned preventive programs, they never be trained to learn the chiller works, they are also never come forward to carry out chiller works due to scare about the chiller. So it is duty of the facility manager to train the general Ac technicians becoming chiller technician to carry out the facility management tasks without any issues.

As a result, the familiarity of working principles of the chiller components to the facility manager, it helps not only collect informations & data’s, but also to analyze them and turn them in decision and actionable changes to improve the chiller results, whilst the HVAC team carrying out to solve a issue at a chiller along with the facility manager, besides it helps to Facility manager to delegate power to HVAV team.

5. CHILLER MAINTENANCE

The precise daily log has been providing the day today chiller in service conditions, and it helps earlier detection of anomalous condition of the chiller, hence apt sort of checks need to be including in the chiller maintenance programs.

For carrying out the chiller maintenance program, a team is needed to constitute by HVAC section/ department, eventhough the planned preventive tasks are being carried out by the respective technicians separately, and this team needs to act upon following functions periodically such as,

Check the chiller starter and controls before starting the winter season, check panel dirty condition & moving conditions of linkage, overload setting & working condition, tightness of all wire and check all contacts for pitting & corrosion along with safeties and controls all work .

Besides, this team inspects periodically the compressor too along with signs of overheating, oil leaks, and motor terminal pitting corrosion, crankcase heater working status, compressor oil level & oil filter.

Moreover the team acquires the conditions of chiller, whilst carrying out the filter, Oil, refrigerant analysis as per manufacturer guidance of the respective chiller, and it helps to schedule corrective action if necessary. In addition, the team has to check in service temperature & pressure with evaluating the conditions of full refrigerant charge of chiller.

5a Eddy current testing

It is a mandatory method of preventive maintenance to identify the chiller working at its optimal level and it helps to identify problems early to prevent unforeseen repairs.

It is designed to

7“Detect identify and locate signs of weakening in the condenser evaporator tubes, before any leaks or failures occur. Depending on the size, each chiller can contain hundreds of evaporator tubes that are constantly dealing with day – to-day mechanical stress. Overtime, moister build up in chillers can release acids that from corrosion and rust build up on the equipments. Small rust particles can escape and grow inside the chillers condenser tubes. This often triggers ruptures and

cracks that can lead to potentially dangerous leaks that are costly to repair.”⁷

Therefore it is carried out by trained technician for 02 to 03 days at intervals 03 to 05 years, who runs a small electric current through each chiller tubes for analyzing current flow and it helps to correct the repair of major breakdown.

5b Maintenance Schedule:

“For preventing the chiller break downs, the predetermined maintenance actions are carried out at regular time intervals, and the primary goal is to prevent the chiller equipments failures before it actually occurs, and that it includes inspection, adjustments, and regular service and planned shut downs”⁸

Thus, a standard Maintenance schedule aids to enhance the existence of chiller, and lessen the necessitate of part repair / replacement.

Usually, the maintenance schedule, which encloses some indispensable steps to optimize the chiller recital, they are such as

- ❖ Quarterly inspect the chiller
- ❖ Check refrigerant leaks routinely
- ❖ Substantiate compressor operating pressure are within reasonable range
- ❖ Check all motors Voltage & Amps, electrical starters, contactors and relay.
- ❖ Check all hot gases and UN loader operations
- ❖ To reach maximum efficiency, use superheat and sub cooling temperature reading and
- ❖ Line readings from discharge lines should also be obtained”⁹

Therefore, an expert HVAC Engineer having well acquainted of chiller task can easily outline the chiller maintenance schedule without any inaccuracy, and it must be necessary to be reviewed now and then. But, All inexperienced Facility manager/ site engineer always depends on the know-how person, and a site engineer having other than HVAC back ground may be faced numerous troubles to outline the chiller maintenance schedule, it leads to inaccuracy also. Normally, the schedule is prepared for every twelve months; the check list is blood stream to chiller maintenance schedule, it aids to distinguish the conditions of chiller.

And (10) “The check list is a listing of comprehensive key or appropriate actions or steps which are taken in specific order, and it is different from check sheet”¹⁰ 11 “that presents a sequence of steps or events that is marked off (checked off) by the user, specific order or as the anticipated events occur”¹¹

And so, a facility manager, who keeps in his psyche whilst get reading the chiller schedule below converse the check list points, and it leads to goodwill to the building owner and contractors

12 “The maintenance of chiller schedule contains,

- ✓ Daily maintenance check list,
- ✓ Monthly maintenance check list
- ✓ Semi-annually check list

- ✓ Annual maintenance check list.
- ✓ It is more essential to comprise the below mentioned description in **daily maintenance check list** such as,

Chiller use & sequence (turn off or sequence unnecessary chillers)

Over all Visual inspection (complete overall inspection to be sure all equipment is operating and that safety systems are in placed)

Check set points (check all set points for proper setting and function).

Besides, for **monthly maintenance check list** needs to adjoin following portrayal for instance,

Evaporator and condenser coil fouling (asses evaporator and condenser coil fouling as needed)

Compressor motor temperature (check temperature per manufacture’s specification)

Leak testing (conduct leak testing on all compressor fitting, oil pump joints and fittings and relief valves)

Check insulation (check insulation for condition and appropriateness)

Control Operations (verify proper control function of Hot gas bypass & liquid injection)

Furthermore, we should prepare the **semiannually maintenance check list** also that contains depiction such as, Check chiller lock out points (check setting for manufacture’s specification)

In annual maintenance check list, the facility management squad of HVAC must include beneath referred description such as,

Compressor Motor & Assembly (check all alignments to specification . check all seals and provide lubrication wherever necessary)

Compressor Oil system (Conduct analysis on oil & change as necessary, check oil pump & seals , check oil heater & thermostat , check all strainers , valves etc.

Electrical connections (Check all electrical connections and terminals for contact and tightness)

Water flow (Assess proper water flow in evaporator and condenser) and

Check refrigerant level and condition (Record amounts and address leakage issues)”¹²

5c Chiller maintenance check list – (protecting the chiller)

Chiller maintenance is vital mitigate the risk of down time, and it extends the life span of the chiller and providing peace mind to Facility manager at the site, while executing of day today tasks.

12 “In general, the check lists of chiller maintenance those bestow,

Day today basics to keep the chiller running smoothly, the ideas about best practice for chiller maintenance, when to check the chiller’s refrigerant circuit and Permits a facility manager & HVAC engineer to select the planned preventive maintenance service provider.

And it is duty of a facility manager to permit a “F –Gas” certified employee to work on temperature control equipments in any invasive way, and an at extent level on a day to day basis in the interest of keeping the chiller on running, the facility manager / HVAC Engineer of the respective site can depute either an A/C technician or a chiller technician.

6. DAY TODAY APPROACH TO CHILLER

An Experienced chiller technician deputizes to carry out the chiller maintenance tasks every day, who usually check sounds / vibration of chillers and investigate if the cause for the sound is not immediately apparent. And it is also responsibility to him for carrying out the visual check, the debris near the chiller areas including loose components on the chiller such as thermal insulation and fluid leaks, excessive condensation. Furthermore, it is instant to inform a chiller expert by the chiller technician through his facility manager / Ac engineer, whilst observing fault codes displaying on chiller, and HVAC engineer does not delegate to check to one person either, because the chiller issues can quickly develop in to serious fault and that from the Daily log sheet of the chiller, FM manager /HVAC engineer can easily understand the working status / conditions / setting of the chiller. Besides the HVAC engineer should train AC technicians to carry out to run the basic checks on chillers.

It is always to keep in mind by a Facility manager such as

“Planned downtime is better than preventive down time”

Hence a facility manager needs to find the time to perform slightly more through investigation of the chiller, and it is most preferably to Week, but monthly without fail. By planning this ahead time, the facility manager will able to identify the defects of the chiller earlier .In general , the chiller checking starts from take out the side panel of the chiller unit , and in addition to daily routine tasks , needs to inspect for debris inside the chiller also . It is more important to isolate the chiller unit for the electrical supply before continuing the checks, and whilst the chiller unit is made of safe, it is time to chiller technician checking the fixing and fastening on the chiller unit, ensuring tightly secured also. Further the chiller technician must check fluid leaking at all pipe work of chiller. In case the chiller technician finds unfastened secured and seeping on chiller, he shall be tightening them without delay, and inform to expert about leaking .It is unavoidable to the certified engineer, who is going to undertake tasks on the refrigerant circuit of chiller to check log sheets since date of last check or commissioning along with general surrounding of the chiller such as Ambient temperature. Then, the engineer, who should check the three main components of the chiller such as, **CHILLER COPRESSOR, CHILLER EVAPORATOR AND COOLED.**

The **compressor** acts as pump for unit ‘s refrigerant around the system by using difference in pressure to move the

liquid through system , and HVAC engineer or Facility manager must check the key things at compressor such as, oil level and pressure, the discharge temperature & pressure, the suction temperature & pressure and current voltage & current levels.

And in **chiller evaporator** the HVAC engineer needs to check fluid or air inlet temperature & pressure, fluid or air outlet temperature & pressure, refrigeration & outlet temperature and insulation condition because of taking heat observed from building at compressor and that the checking of compressor slightly be varied based on the types of chillers .

Besides it is duty to check by HVAC engineer regarding “**cooled**” also, who has to check air intake and exhaust temperature, refrigeration inlet and out let temperature, fan motor currents, noise and vibration and condenser coil condition.

Glycol dosing & water treatment & Leak testing (refrigerant)

Glycol/ anti – freeze prevents the fluid freezing inside the chiller because it handles temperature below Zero, and mismanagement leads to cause freezing of water for damaging pipe works at chiller, so needs to use the specially manufactured glycol rather than generic glycol for avoiding corrosion at pipe works. Consuming excellent quality of water for chiller water treatment is necessary to avoid corroding at pipe works/equipment failure at chiller. The leak test /refrigerant leak test ensures the chiller circuit whether it hermetically sealed (complete airtight) or not”¹²

Therefore facility manager gets the peace in his mind when the outcome of daily routine checks or the refrigeration circuit checks only.

7. CHILLERS PPM (Planned Preventive Maintenance)

¹³ “The Planned PM is necessary for execution chiller tasks properly, and it facilitates to identify the issues of a chiller earlier and resolves with in stipulated time. The check list points/ activity of ppm is more vital / important due to whilst going through it by a HVAC supervisor or Engineer as a part of execution tasks after the PPM tasks carrying out by technicians as per scheduled , they can effortlessly identify the operational conditions of the chiller.

In general, the check list is prepared by a chiller expert only after chat with relevant HVAC supervisors or HVAC engineer , and exclude apt check list point leads the cause ruthless smash up to the chiller . Hence it is indispensable for more awareness whilst preparing the chiller check list.

Typically ,the PPM planer is scheduled for Day , Weekly ,Monthly Quarterly (every 03 months) , Half yearly (6 months) and yearly wises , and it depends on the manpower , number of chillers existing at a site. The Annual Maintenance (AMC) is being carried out by the respective chiller manufacture company’s human resources as per AM contract, which is executed amid the chiller manufacturer company and the client/ owner of the property.

And after execution of Planned preventive tasks by the chiller technicians, it is obligatory to psychiatry them

without failure by the Facility Manager who may insist the report from HVAC Engineer in case he feels displeasure, and it is essential to the HVAC engineer who sustains every part of the chiller allied credentials appropriately”¹³

8. EMERGENCY CHILLER SERVICES

Either a Hvac tech / chiller technician needs to convey the information earlier to respective Hvac engineer /supervisors, while who is on duty after receiving a issue / compliant about the chiller, and the supervisor immediately needs to rush the chiller premises to collect necessary details for diagnosing the issue.

The respective duty engineer / HVAC engineer first observes what indicators or codes comp up on the diagnostic read outs (if the chiller has), and further needs to check such as,

14”is the pump circulating the water? What is temperature?

When did the go off line, and has this happened before, if so, when

Is the chiller running and not cooling or just at all

And after collecting / getting accuracy informations “if the chiller runs,

It is necessary to measure the antifreeze concentration at chiller by **refract meter**, and in case of the chiller does not have/use antifreeze then inspect the water quality and that the freeze point may be different for same percentage incase ethylene or propylene glycol uses in chiller.

And the HVAC engineer finds the **chiller is not running**, who looks for diagnostic display panel that directs to begin checking and to check power status & control power from the transformer along with check all fuses also.

Then, it is necessary to note any codes listed on the chiller by the HVAC engineer who looks up the reason in the chiller’s troubleshooting manual (now days most of the new chiller units have diagnostic codes or alarm codes to view) but at latest type of chiller now day having a computer worth of information built into memory .

Besides , If the issue continues (chiller not running) it is indispensable for the HVAC engineer to find the electrical diagram of its control and high voltage circuits, and this is mainly needful for older chiller which is not equipped with built-in diagnostics.

Generally, this is because of open condition somewhere at control circuit, and the HVAC engineer needs to find it through electrical diagram. The HVAC engineer needs to start at the power side of the transformer and check wire by wire,

The situation wherein the HVAC engineer does not have access to the electrical diagram, or the chiller locates at where who can’t not read model numbers or any diagnostic indicators lights or codes, always start at the control transformer and follow the control power wire path, the Hvac engineer finds the power side, and with a good voltmeter, trace the power wire from safety to safety. Eventually the control power will come to the compressor or pump contactor

coil. In case the engineer finds an open condition he must determine why. It could be anything from low pressure to a broken compressor control module.

Usually chillers have two unique safeties, **one** is water flow switch, that can be hidden in the water piping and not be visible. **The second safety** is a freeze stat control is basically a backup thermostat, which ensures the supply water temperature does not get too cold.

Furthermore the HVAC engineer needs to make visual inspection of the chiller electrical panel , water piping , and pump tank system , who may able to observe obvious problems such as burned or broken wire , the water pump not running , water valves shut off , and improper system water temperature.

Wherein the HVAC engineer finds safety tripped, does not to reset it until he has his gauges on the compressor and oil pump (if applicable). Strap temperature probes on the suction, discharge, and liquid lines. Place an amp meter on the high voltage leg of the compressor before you start system .Reset the safety. Then watch all the pressure, temperature and amperages at the same time. It is not an easy task to the HVAC engineer, but it must be carried out with in the five minutes.

And the HVAC engineer finds the chiller is running, who installs gauges and temperature probes and begin to take readings.

9. COMMON CHILLER TROUBLE SHOOTING PROBLEMS

Based on the chiller reading, the HVAC engineer or an experienced chiller technician can trouble shoot some common problems such as,

Low pressure trip: it is caused due to low refrigerant, power assembly broken capillary, low or not water flow, clogged water filter or screen, antifreeze or mud coating the tubes of the evaporator casing poor efficiency.

High pressure trip: it is because of water cooled condenser has poor or no flow; water cooled condenser has mineral build up due to poor water quality (**very common**); air cooled condenser is blocked with debris or has a fan not working; chilled water tank temperature is very high (over 80F plus)

Oil failure trip: it can be caused by either low super heat, low oil (due to a refrigerant leak), or oil pump damage

Freeze stat: it is due to poor water flow or the thermostat is set too low.

Blown fuses or starter trips: This is due to shorted or over-amped motor, compressor or wires

System running but not reaching thermostat set point: it is due to evaporator internally iced up, anti freeze breakdown causing poor heat exchange; system load is too great for chiller to handle.

Proof flow: this is because of either flow or pressure switches in water circuit are suffering from low or no flow , blocked water filer ,water valve shut off , water piping too small , flow switch paddle broken (**very common**)”¹⁴

These are common, nevertheless indeed not all troubles that can cause a chiller to go offline, and it is forever paramount to remain “up –to-date” on chiller technology through training and that the entire major chiller manufacturer’s offers troubleshooting seminars/ workshops. It is necessary to the facility manager allowing the field service technicians should avail themselves of them

It is the duty of a facility manager to implement a new technique, whilst execution of facility management tasks to identify the defects earlier, and **thermal imaging** is one of such a vital method

And15 “**Thermal imaging** is a technology that is used to identify refrigerant gas leak at chiller caused by wear or damage which is undetected by other maintenance methods, and the leaks at the chiller find quickly and efficiently through a thermal imaging camera.

In traditional methods the gas leak was detected by using of sniffers, but in thermal imaging technique, the visual output of camera allows users to see any exit point of the gas , automatically supplying evidence –based reports on gas escapes .

Besides, it is used as preventive maintenance tool to identify potential refrigerant gas escapes, and it helps to improve the reliability of facility chillers and extend the life cycle of a critical building asset.

As a result, the thermal imaging helps to reduce the chiller downtime. ‘15

10. ECONOMIC EVALUATIONS OF CHILLER SYSTEMS IN FACILITY MANAGEMENT

16“It is necessary to the Facility manager along with respective HVAC team, the following assessment tasks should be carried out to enable an appropriate conclusion to be reached, whilst selecting a chiller for a new application. First & foremost is to determine the functional and operational requirements by assessing the cooling load and load profiles including locations, hours of operations, number / type of occupants being used etc. Besides, the facility manager has to determine the required system configuration in items of number and plant capacity by taking into account the total capacity and operational requirement, reliability and maintenance consideration. And identify planning and environmental issues, in particular those that would prohibit the use of certain type of equipment or costly treatment or measures required to render the proposed equipment fit for use .i.e. **cooling load profile**.

The cooling load profile that is more important to select the right configuration of chillers, and helps to determine the type of chiller to use and that the multiple chiller configuration is a common method of meeting peak load in large installations, it allows facilities professional to stage their operation to match building loads whilst keeping the chillers operating at energy efficient loading. It also provides redundancy/ laying off for routine maintenance and equipment failure. For many typical facilities, sizing one chiller at one – third and another chiller at two – thirds of the

peak load enables the system to meet most cooling conditions at relatively high chiller part load efficiencies.

Minimum Number of Chillers:

A Well experienced facility manager who knows failure of some refrigerant equipments leads to serial financial loss beyond the equipment repair expense, so it is better to consider a multiple compressor system rather than single chiller, because multiple chiller offers operational flexibility, standby capacity and less disruptive maintenance however these advantages require an increase in cost and space.

And it is very essential to the facility manager to know the two ways of the installation of multiple chillers such as,

Symmetrical and asymmetrical

The key to decide symmetrical or unsymmetrical arrangement is dependent on the minimum anticipated load, where in symmetrical arrangement of chiller all chillers are sized for equal capacity but in asymmetrical arrangement one or more chillers may be of different sizes

Multiple Chiller Configurations

A **multiple chiller system** has two or more chillers connected by parallel or series piping to a common distribution system. **Series Arrangement:** In the series configuration with two chillers and each chiller is selected to produce half of the required cooling at the full system flow rate. Thus, half of the total design range is produced by each chiller. Load ratios other than 50/50 are possible, but this is by far the most common condition because of control problems with chillers at very small temperature differences. **Parallel Arrangement:** In the parallel arrangement, liquid to be chilled is divided among the liquid chillers; the multiple chilled streams are combined again in a common line after chilling. As the cooling load decreases, one unit may be shut down. Unless water flow is stopped through the inoperative chiller, the remaining unit(s) provide colder than design chilled liquid. The combined streams (included one from the idle chiller) then supply the chilled water at the design temperature in the common line. All units should be controlled by the combined leaving water temperature or by return water temperature. Chilled water temperature can be used to cycle one unit off when it drops below a capacity that can be matched by the remaining units. Note that in both, series or parallel arrangement, one unit should be shut down as soon as possible with the remaining unit(s) carrying the full load. This not only reduces the number of operating hours on a unit, but also reduces total power consumption because the COP tends to decrease below the full load value when unit load drops much below 50 %.

Operational Regimes:

It is necessitate keeping in mind to chiller team ,the cost efficient to operate a smaller capacity chiller at full load than a bigger capacity at part load , and microclimate conditions such as high humidity , tropic climate conditions are always favor the selection of air –cooled chillers rather than centrifugal chillers require cooling tower and make up water.

System maintenance and serviceability considerations

The facility manager along with his chiller team necessary to consider the maintenance requirement of different type of chiller, and it is necessitated to observe the use technologies, which are reliable and can stand long hours of continuous operation with minimum downtime along with minimum maintenance. Further the team considers the level of service and support, which can be provided by the manufacturer in the location, and the environmental planning constraints on the proposed plant location need to be considered along with great extent space (area / space) of quality of water availability because it should help to be installed type of chiller .

And whilst installation of chiller at noise sensitive area, it must be known to the facility management team of chiller that the screw chiller is the better choice at noise sensitive area rather than the reciprocating chillers create too much noisy due to reciprocating movements of the pistons, and the centrifugal compressor create series problem of high pitched complaint

It is necessary to observe of the team whether the HVAC design & selection must adhere statutory codes and regulations or not because of prohibiting of ammonia in some building , preventing of using legionella bacteria in cooling tower ,stoppage of air cooled machines (due to too much noise).

It is duty of the chiller team recommends to the facility manager maximum utilization of chiller with low cost consideration. Hence the team has to calculate first & foremost the initial cost (capital cost), which includes all necessary equipment costs with the cost to install the components and make system operational ,and the team further calculate the maintenance cost , recurring cost/ operating cost means actual operation of the system including energy & water usage, water – treatment chemicals , the maintenance cost are those requiring to keep system operational including routine servicing, replacement parts ,repairs , cleaning and disinfection and so on .

It is very challenging to the team to give accurate maintenance cost to the Facility manager because of existing of statistics/ data are very less, thus it is difficult to estimate accurately”¹⁶

11. CALCULATING CHILLER EFFICIENCY

It is basic or fundamental criteria to the facility manager to understand the efficiency of the chiller, because the chillers are one of the largest energy consumers within building along with big impact on operational costs, and it helps to monitor the chillers to assess the efficiency of the system and ensure optimal performance. it is calculated through COP

17“The coefficient of performance (COP) is ration of the refrigerant effect produced by the chiller against the amount of electrical energy that went into the machine to produce this, both units measured in KW (Kilowatts).

I.e. If the chiller produces 2,500KW of cooling by consuming 460 KW electrical power demand, The COP is 5.4KW i.e. $2,500 \text{ KW} / 460\text{KW}=5.4 \text{ KW}$ (for every 1KW of electricity chiller produces 5.4 KW cooling).This is metric calculation.”¹⁷

12. REFRIGERANTS

A well experienced facility manager with HVAC back ground along with chiller understanding know- how , who knows essential of refrigerant using in the chillers however other than HVACs back ground facility manger indispensable to study impact of refrigerants, unless otherwise who will face issues whilst execution facility management task , because

18 “Ammonia is highly efficient refrigerant but it creates health & safety issues, whilst using at public areas and the specially trained engineer requires for carefully designing and manufacturing the equipments. The capital costs are high. The HFO is the best substitute for widely using R132a refrigerant, but it is high cost of refrigerant with limited test quantity. However now days the refrigerants are in full scale commercial production and the price has fallen much more in line with that for HFCs, nevertheless HFOs cannot be used straight drop – in replacement for HFCs, relatively few designs changes requiring to make equipment and compatible . It is considered safe and non-toxic and it can be handled by engineers with the need for specialist training.

But in terms of performance, chiller test with HFOs at standard operating conditions have shown that , compared with R134a, a higher volume of HFO (around 23% more) has to be circulated to obtain same cooling capacity .Hence a slightly larger compressor must be used. After detailed testing and evaluation by the manufacture, an HFO version of the high efficacy Turbo miser chiller is now available, running on HFO123ze. The only changes to the design requires new seals, due to materials compatibly issues, and an update to control software.

Four Geoclima chillers operating on HFO123ze are currently installed in the UK and reported to be working well. Two are based on Turo miser oil – less magnetic levitations system”¹⁸

As a result in facility management, three principles which are top at facility manager list such as **listening, planning, and promoting** because it guides a facility manager puts foundation for building success of chillers issues in facility management

At a chiller maintenance juncture, a successful facility manager to collect necessary facts of the chillers for analyzing, and act on to increase services, manage costs, and be more efficient in dealing with chiller issues .Moreover an immature / inexperienced facility manager, whilst managing the chiller issues, who should take time for listening, and it leads delaying in decision making for actionable changes.

And in **planning**, a facility manager takes more strategic approach for solving chiller issues because the chiller planning takes focus and time, and a Well experienced facility manager having know – how knowledge of chiller, who has courage to delegate for making change from

“*managing the urgent chiller issues*” to “*managing the important chiller issues*”. Therefore simply firing by a facility manager in his chamber to his chiller team does not solve the chiller issues earlier due to who is an also paid to think rather than to get things done.

Promotion is guarantee/ ensures to give support to a chiller team to solve chiller issues at working site, and it is duty of a Facility manager, who has to provide all needful facilities at the earliest, it may be capital replacement money, staff, training, tools etc

Hence a facility manager, who overlays these principles in perfect manners while execution of chiller issues, he shall solve the chiller issues within stipulated time.

CONCLUSION

Facility management is interdisciplinary function and it is smoothly integrated workforce, locality and course of action with the use of technology for the efficient function to build environment. The buildings are more than just concrete and steel boxes, and each building has its unique set of conditions required to ensure the health, comfort and productivity of its

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occupants and most of the large building now day are conditioned by chiller which plays a critical role in creating the right environment.

As a result a facility manager headed by chiller team, who must have participative leadership quality and it helps to him active participation of every chiller squad members decision, which makes to solve the chiller issues earlier and it helps to each chiller technicians have an opportunity for them to exert their skills in order that they can also share their abilities in the team and a immature/ unskilled facility manager's certain fragile assessment of chiller shall be resolved by the team working hand in hand to come out with the best decision.

Hence a Facility manager must be a generalist rather than specialist for prompt learning and solve chiller issues as soon as possible and that who allows his colloquies to participate in the hard service decision making.