

## Demystifying HVAC

# Replacing an HVAC System By Ron Prager (Avoiding the pitfalls)

It has been said that nothing lasts forever. I mean some things seem to last forever like grade school plays and root canals, but just about anything you can think of lasts for a finite period of time. HVAC equipment is no exception. Much like an automobile, sooner or later the cost of operating and maintaining the equipment becomes prohibitive, the equipment becomes unreliable, or it just plain falls apart. When you replace a unit, what you replace it with, who performs the work, and the method you use to replace it, are the subject of this article and can make the facilities manager's job a dream or a nightmare.

There are basically two types of replacement projects. These are proactive replacements and reactive replacements.

### **Proactive:**

On a typical proactive replacement project, you have pre-selected a site as a candidate for new equipment. You know the store is profitable, the equipment is eighteen years



old, and your maintenance contractor has advised you that the condenser coils are rotting away. You have time to order high efficiency equipment with a four week lead time from your national account vendor. You obtain estimates for the installation work and the contractor files an application with the local building department. The job is scheduled and coordinated with the landlord and the store, and everything goes like clockwork.

*This unit is a perfect candidate for a proactive replacement project.*

### **Reactive:**

A typical reactive replacement is akin to fighting a major fire. It usually starts as a service request for a store being too hot or too cold. You dispatch a service contractor who determines that the unit in question has a burned out compressor. The machine is 15 years old and the condenser coils are no longer efficient. The service contractor tells you that even if you want to throw your money away by installing a new compressor in this piece of junk, he won't warranty the new compressor because he knows it's going to be running high head pressure as a result of the condition of

the condenser coils. He also tells you there is a pile of rust under the burners in the heating section. It has taken two days for you to learn all of this and by now the store manager and the district manager are screaming about the temperature of the store. You ask the contractor how quickly he can replace the unit and how much will it cost. The contractor tells you he will work up a price. You tell him you want a high efficiency unit made by a well respected manufacturer.



*This relatively new unit was stripped by vandals for the scrap value of the copper coils. An excellent example of a reactive replacement candidate.*

Two days later, the contractor calls to tell you that there is nothing available locally in a high efficiency unit made by any of the manufacturers you specified, but he can get you a Goodman and install it in three days when his crane company has an opening. Of course you must let him know right now or he can't guarantee the date or if the unit will still be in stock. You ask if he figured to pull permits and he tells you that would add three weeks to the process. He suggests that he can replace the unit and pull permits after the fact, but if the landlord stops the job he's not going to be responsible. By now you figure the district manager is bad mouthing you to the regional VP of operations and you weigh that against not sleeping well for three weeks until the permits are approved. You tell the contractor to pull the trigger and think about your life as a facility manager.

In a perfect world, all of our replacement work would be proactive. In our world, the best you can do is to set up a proactive program to limit the number of reactive replacements you are faced with, and work up a strategy with industry partners to deal with the reactive replacements while meeting your equipment specifications, and landlord criteria with a minimum of down time. Some of the planning you do with respect to a proactive program will help you deal with emergency replacements as well.

## **The Plan and Implementation**

### **1. Create and maintain an equipment inventory.**

In order to manage replacement of your HVAC systems, you need to create an accurate database of what equipment you own, and develop a rating system so that you have a method of comparing the condition of all of your units in a non-subjective manner. We also find it helpful to list a replacement year next to each unit in the database. Typically, your table would look something like this.

Site #	Address	City	State	Make	Model	Serial	Type	Age	Condition	Replace Date
123	12 Main St	Dallas	TX	Carrier	50DP016	1797G35127	Gas RTU	10	3	2012

You may also want to include additional information such as type of control system, unit number, heating capacity, cooling capacity, etc. Some managers also add the lease expiration date and the available options to this table as well.

**2. Develop a rating system.**

A rating system must be developed that allows the facility manager to consistently compare the condition of equipment being evaluated in different geographic areas by different technicians. This may be as simple as rating a unit’s condition from one to five. It may require the technician to rate the condition of each component in each unit and total the scores to obtain a score for each unit. You may want to weight the scores of some components heavier than others. For example, double the heat exchanger and condenser coil scores because these items greatly influence how desperately a unit must be replaced. The method you use to rate the units is far less important than making certain you use the same method for all units. This rating or scoring should be performed by your maintenance provider on an annual basis as part of their regular PM scope of work.

**3. Due diligence.**

There is nothing that will make you look quite as foolish as replacing the HVAC equipment at a site and having the site close six months later. Developing an equipment inventory and rating the replacement hierarchy gives you a list of possible replacement candidates and allows you to evaluate your exposure with respect to possible emergency replacements, but before you consider replacing a unit some tough questions need to be asked. Lease term and profitability of the store come to mind immediately.

Obviously, what you spent on repairs in previous years has an effect on the replacement hierarchy, but how does this factor in?

Where the condition of the equipment is equal, conventional thinking is to replace the units on the sites where you have historically spent the most on repairs. This is not necessarily the correct methodology. Let’s say you have a thirteen year old unit where you replaced two compressors and a heat exchanger over the past three years at a total cost of \$10,000.00. You think to yourself that this one is the gift that keeps on giving and getting rid of it is certainly justified. Actually, you need to look closely at the condition report to see what condition the condenser coils are in. If the coils are in fair to good condition, what are the chances you will have to put significant dollars into this unit over the next year? You have already replaced most of the major components. You probably would be better off

replacing a thirteen year old unit in similar condition that you spent \$1500.00 repairing over the last three years. This unit is operating with thirteen year old compressors and heat exchangers and stands a good chance of becoming a liability.

You also need to factor in geographic location, utility rates, and visibility of the store. Geographic location has an effect on the number of hours the unit operates each year. This will influence the wear and tear on the old unit as well as the return on investment if you install a new more efficient unit. Utility rates will also affect the return on investment because the higher the rates, the greater the difference in operating cost between the existing unit and the new higher efficiency unit. The visibility factor is political in nature. All things being equal, would you rather replace the equipment on your Michigan Avenue, Chicago location, or the store in an outlet center in Lake George, New York?

There is one more due diligence item that is often overlooked. You should make an effort to evaluate if the existing system served the needs of the store appropriately prior to replacing it. Discuss the existing system with the store manager and your service contractor, and review the service history. Was the store heated and cooled adequately? Was there adequate access to the equipment? Were excessive filter changes required because the return grilles were undersized? Were there ongoing leak issues because the unit was not pitched properly? Were there particular areas of the store that were always warmer or cooler than the rest of the space? Has the lighting load in the store changed drastically? Do you want to upgrade the current control system? The time to deal with these issues is when you are replacing the system, rather than having someone ask how you spent all this money without correcting the old issues.

Later on in this article, we will list some of the special conditions that cause significant increases in replacement costs. Even prior to obtaining estimated replacement costs, due diligence dictates that if you have knowledge of them, you factor in some of these special conditions when considering a replacement candidate. For example, there are some landlords who have disallowed the use of curb adapters on their buildings. This rule can effectively double the installation cost on a small unit. Another example would be the added cost in the southeast due to new code requirements resulting from recent hurricanes.

#### **4. Justifying proactive replacement.**

So now you have created your replacement wish list based upon equipment condition and you have boiled it down to the sites that you know should be replaced this year. The next challenge is building a bullet-proof case logically and financially.

##### **Proactive replacement is advantageous for the following reasons:**

- Cost of installation work is lower.
- There is sufficient time to get competitive bids.

- There is sufficient time to procure the equipment you want with the factory installed options you require.
- Work can be scheduled when it has the least impact on store operations.
- Costs can be budgeted.
- Work can be filed with the authority having jurisdiction.
- Work can be coordinated more easily with landlord, neighbors, and roofer.
- There is time to evaluate the deficiencies of the existing system.
- There is time to order a unit charged with R410A rather than R22.

Of course, with the exception of lower installation cost, very little of the above is going to impress the number crunchers who hold the purse strings.

One of the most important things you can do to support your case is to track and chart your repair costs versus equipment age. This will present a very vivid picture of how repair costs climb as equipment ages. You should also mine some of your old data with respect to the average age of equipment that had to be replaced reactively in the past because it could no longer be repaired.

Although it is difficult to calculate the cost of equipment downtime, a case can be made for the number of customers lost when a store is down for an extended period of time. Your marketing people should be able to tell you how much is spent in advertising and marketing to gain a new customer. Most equipment manufacturers can help you to predict your return on investment when replacing an existing piece of equipment. They will factor in the projected decrease in utility costs due to lower usage and demand, as well as the decrease in repair costs over the life of the unit and calculate your return on investment. You should also be able to prove the savings in actual installation costs derived from purchasing and replacing a unit during the off-season, based upon a schedule and a competitive bid versus the cost of replacing a unit on an emergency basis. Keep in mind that we are not just talking about rooftop unit replacements where the process of replacing equipment has a minimal effect on store operations. Think about the situation where you are forced to replace a chilled water air handler hanging above the ceiling of a store and because it failed, the work, including removing a substantial portion of ceiling, must be performed between Thanksgiving and Christmas. Now put a price on it.



### **5. Creating the Specification.**

It does not matter if you are dealing with a proactive or a reactive replacement project; someone has to develop a scope of work for the project. You can have this work scope created by a design professional as boiler plate. You can outsource it to a management company. You can develop it yourself, if you have the knowledge and want to take on the liability, or you can allow the contractor to provide the work

*Installing a new HVAC unit inside an occupied store can be challenging.*

scope in his proposal. I would recommend one of the first two options. This is probably a good time to address the subject of liability. We have been discussing replacement of air conditioning equipment as if you were buying a new car. What



is actually being discussed is a very specialized area of construction work. We are talking about lifting and moving heavy loads and removing and placing these loads on a structure while it is occupied. In addition to the structural and rigging operations, the process involves natural gas piping and 460 Volt electrical work. Lastly, the seal between the

*Rigging operations can become extremely complex*

HVAC unit and the roof is part of the waterproof envelope that protects your store interior and your merchandise from water damage. There is a lot of potential for events to occur with serious consequences. Accidents and mistakes do not happen frequently thank goodness, but they do happen, and the repercussions can be extremely expensive. It is imperative that your scope of work clearly spells out what work is to be performed, who is responsible for each part of the work and who is responsible for coordination. It must state your requirements for licensed trades and filing of permits, and the fact that you take no responsibility for supervision of the actual work. Proof of workman's compensation and liability insurance are paramount. Here is a list of items that should be addressed in your work scope:

- Contractor must visit site prior to submitting a quotation.
- Structural review must be performed.
- Design of replacement work.
- Curb adapters and structural work.
- Work to be performed on premium time.
- Payment terms.
- Permits must be pulled prior to start of work.
- Work must be coordinated with store management and landlord.
- Rigging operations must be coordinated with landlord and other tenants.
- Installation must meet new codes.
- Coordination with fire suppression and fire alarm companies.
- Percentage of store that can be left without cooling or heat at any time.
- Roofing requirements including dealing with a bonded roof.
- Who is specifying and purchasing the equipment.
- Estimated start date and time to completion.

- Electrical work performed by licensed contractor and filed.
- Gas piping performed by licensed contractor and filed.
- Licensed Master Rigger on site where required.
- Street closing permits where required.
- Condensate piping and disposal.
- Recovery of refrigerant from existing systems and disposal thereof.
- Removal and disposal of old equipment and trash.
- Line of sight issues.
- Sheet metal work.
- Controls and EMS system tie in.
- Cleaning existing duct work.
- General construction work. (If unit is located within the store.)
- Commissioning and test and balance work.
- Equipment warranty and labor warranty.

## **6. Selecting the equipment.**

There are many choices to be made with respect to the actual equipment being installed. If you have a national account with a major manufacturer you will probably decide to work with that manufacturer. If you don't have a national account you may still prefer a particular brand, or you may allow contractors to bid on any of the four major national brands. You also need to determine if you want to purchase the equipment and curb adapter yourself or if you want the installing contractor to make the purchase. Direct purchase gives you control over exactly what is being purchased and what options and accessories are included. The cost of the equipment may be slightly lower than if the contractor purchased the equipment, however you are now taking on additional responsibility. You now become responsible for ordering the correct equipment and having it delivered. This can become more complicated than it sounds. If you choose the direct purchase route, my recommendation is never to attempt to have an equipment delivery meet a contractor's crane on site. This does not usually work out well and crane time is extremely expensive. Equipment should be delivered to a rigger's storage yard with provision for offloading the equipment at the time of arrival. You also will need to require the contractor to inspect the shipment for obvious damage prior to accepting and offloading the equipment.

Under any circumstances you will have to decide what options and accessories you require based on geographic location, company culture and the needs of the particular project. I have included a list of things to consider below. Keep in mind that factory installed options will usually be less expensive than field installed accessories because field labor is less efficient and more expensive than assembly line labor.

### **What to order:**

- High efficiency or standard efficiency. (High efficiency is preferred unless you will occupy the space for a very limited time.)

- Refrigerant 22 or refrigerant 410A. (Most retailers are switching over to 410A due to the phase out of R22.)
- Outdoor air economizer or motorized outdoor air damper. (Outdoor air economizers are normally the preferred option other than in the deep south where their usefulness is outweighed by the problems they cause.)
- Factory mounted disconnect switches. (You will usually find it less expensive to order this option rather than having the contractor field furnish and install them.)
- Motor and drive options. (These must be determined based upon the resistance of the existing air distribution system.)
- Power exhaust accessories. (If the store is located in a geographic area where you expect to be able to take advantage of economizer operation for a significant number of hours, you should go with this option. I personally specify power exhaust on all rooftop units with a capacity of 7.5 tons or more.)
- Coated condenser coils. (If the store is on an island or within ½ mile of a large body of salt water this is a must. There are other geographic areas where this is a good idea as well.)
- Unit mounted smoke detectors. (This is usually a good idea as existing duct mounted detectors are usually mounted in an areas that is impossible to access.)
- Hinged access doors. (This eliminates some of the damage HVAC techs do to the roof membrane and speeds up the service process.)
- Low ambient controls and winter start controls . (These allow compressor operation at reduced outdoor temperatures without the unit suffering damage and or nuisance trip-outs. Most RTU's today come with this feature as standard, but it is a required option on split systems in most areas of the country.)
- Hail Guards. (This one is a crap shoot. Where is the store and how likely is it that it will see a hail storm with the wind blowing the wrong way?)
- Convenience receptacles. (My personal opinion is that you are better off having these furnished and installed by the electrical contractor.)
- Dehumidification cycle. (If the product you sell is sensitive to high humidity this may be a desirable option in certain geographic areas.)
- Demand ventilation. (Depending on utility rates this may be very desirable as current code requirements are such that up to 35% of your equipment operating hours may be due to the need to condition outdoor air brought in for ventilation purposes.)

## **7. Selecting the contractor.**

I'm not even going to attempt to tell you how to select the appropriate contractor to perform a replacement job. I will say to go with someone you trust and trust the expertise of the contractor you select, but don't be afraid to ask questions. By asking questions, you accomplish three things. First of all, you will gain expertise. Second, you may remind the contractor of some detail he has neglected to deal with. Third, you will let the contractor know that you are involved and



*Field conditions must be verified*

watching. Once again, this work is more like construction than it is HVAC repair. If you don't think you are capable of managing a replacement project, hire someone to manage it. It will probably be money well spent. Another thing to keep in mind is that a contractor who is good at repair and maintenance of HVAC systems is not necessarily good at replacement work. He may be excellent at replacement work, but

that is not necessarily the case as the skill sets, subcontractor network, and coordination capabilities are not the same. Lastly, don't ever accept a bid from a contractor who can't prove that he actually visited the site and inspected the field conditions. Unless you can verify that he knows what he is bidding on, you may be heading down a very dangerous road.

## **8. Performing the work.**

Now you have selected a contractor, verified his insurance and had him execute a hold harmless agreement. You have provided the contractor with equipment specifications and dimensioned cuts of the equipment and curb adapters you will be ordering. The contractor visits the site and signs off on the cuts, agreeing that the equipment you are ordering is correct for the site in question. You place an order with the manufacturer and arrange for the equipment to be delivered to a rigger's yard chosen by the contractor. The contractor hires an Engineer who performs a structural review and prepares a plan. The contractor submits the plan to the local building department with an application for a permit to perform the work shown on the plan. The plans are approved and permit is issued. The equipment arrives at the rigger's yard, and the rigger, acting for the contractor, verifies model numbers and voltage and inspects for any visible damage. The contractor meets with the property manager and the store manager to coordinate and schedule the work. If a separate rigging permit or street closing permit is required, this may state the time and date the work must be performed. Otherwise, the property manager will determine during what hours you will be allowed to set up a crane in the parking lot or will be allowed to work within the occupied store.



*Crane arrival at the jobsite*

The date is set, the rigger loads the trucks and the contractor disconnects the power and gas from half of your existing units during the afternoon prior to the day the lift is scheduled. At 5:00 AM on the day of the lift, it's raining

buckets. The contractor is worried that if he removes the existing units there will be water damage to the store interior. The rigger is willing to lift in the rain, but if there is any lightning, he will have to lower the boom and stop the job. Someone is going to be eating some labor and some crane time, or the contractor is going to need to think outside the box. Make sure you are not the party responsible for making the decisions or paying the additional costs in this scenario.

The contractor lucks out and the rain stops. The existing units are removed from the roof, one at a time, and the existing duct drops are vacuumed out. The duct connections to the existing roof curbs are inspected and new gaskets are applied to the existing curbs and duct flanges. A crew on the ground recovers the



*Equipment arriving on site*

refrigerant from the old units and uncrates the new units. A curb adapter is lifted to the roof and set in place on the existing curb. The problem is the adapter does not fit the existing curb. The contractor is melting down because he knows he signed off on the adapter cuts and now they are wrong. He has already disconnected half the store and

one unit is already on the ground. This could be a disaster.

However, his luck is holding and one of his mechanics notices that the curb adapter is actually designed for one of the other units being replaced. The real issue is that someone marked the adapter with the wrong unit number. The correct adapter is lifted into place and secured to the existing curb. A crew begins to connect the electrical power and gas piping to the new unit and the next unit is lifted from the roof. Once the new units are started, the balance of the old units

are disconnected, removed and replaced. The crane sets all of the old units and all of the debris on the rigger's trucks and they are disposed of by the rigger. Over the next two days, the contractor performs the permanent electrical, condensate piping, controls and natural gas installation, installs any accessories and commissions the equipment. A certified test and balance contractor is brought in to adjust the blower drives and



*Completed Installation*

minimum damper positions. The contractor calls the mechanical inspector for a final inspection. He takes pictures of the completed work and delivers the pictures, the building department sign-off and his invoice to you along with a list of the new model and serial numbers of the equipment now installed on your roof. See how easy that was?

## 9. Chipping away at the issues:

By now, you know you want a proactive replacement program and you have a pretty good idea of how to set it up and justify it. Depending upon corporate culture, maybe it will fly and maybe it won't. You also know what needs to be included in an equipment specification and a work scope. We all know that there are going to be emergency replacements, and these last two items apply to the reactive as well as the proactive replacements. The major issue faced by every facility manager is how to obtain the equipment he or she wants, have it installed quickly, meet all codes and due diligence requirements, and do all of this at a reasonable price. This is not an easy task, nor is it always possible.



Let's start with code requirements and due diligence. I don't care how long it takes to get a unit installed, you can't knowingly violate code and you must perform your due diligence. You might risk losing your job because it took three weeks to get a unit replaced, but you won't risk your liberty. Should an accident occur and someone is hurt or killed on a job where you

knowingly violated the building code, you risk facing criminal charges and your company risks their insurer ducking any claim stemming from your illegal act.

The next hurdle is equipment availability. You can shorten lead time slightly by accepting field installed accessories in lieu of factory installed options. The real issue here is that manufacturers do not want to stock large quantities of equipment hoping that the equipment will be needed. There is a certain amount of what we'll call distributor stock available, but the deeper into the cooling season you go, the less possibility there is of finding the unit you need. You should develop a strategy with respect to what you are willing to give up and what items remain most important. What takes precedence; brand or high efficiency? Are you willing to buy an R22 unit rather than a R410A unit if you can get a high efficiency unit in a week? The trade-offs will vary with each situation. The first question you need to ask is how long will the permitting process take. This is non-negotiable and will set the time limit you have to obtain the equipment.

One of the best strategies you can employ is to discuss your anticipated needs with your national accounts partner or the company responsible for your service and maintenance. You can make some projections based upon your equipment inventory and condition table. Think out of the box and you may be able to negotiate a stocking arrangement based upon a pre-purchase or an agreement to purchase a minimum number of units. Once you have obtained the equipment and your contractor has approved permits, the emergency replacement follow the same path as the proactive replacement described above. The speed at which the actual work can be accomplished will depend upon your relationship with the HVAC contractor or the National HVAC management company and your combined luck.