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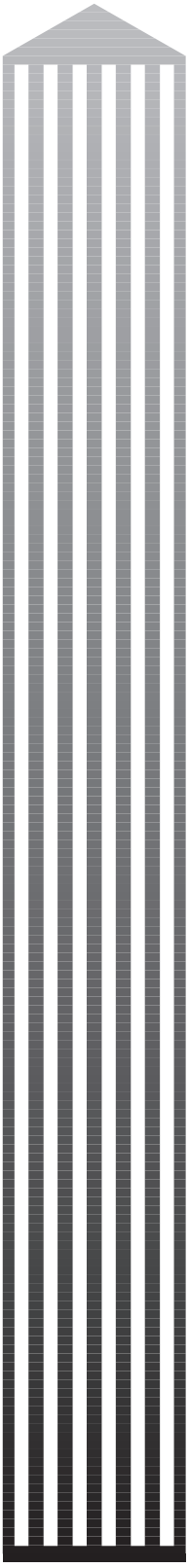

Operation and Maintenance Service Contracts

Guidelines for Obtaining Best-Practice Contracts for Commercial Buildings

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Operation and Maintenance Service Contracts

An overview of current trends and options, with guidelines for obtaining and managing the best contract for your building

Introduction

Frequently, building owners and managers outsource most if not all of the operation and maintenance (O&M) services for their building systems. Even large national companies and institutions with in-house O&M staffs often use outside service contractors to supplement their work.

Several factors contribute to increasing business opportunities for O&M service providers in retail and office buildings. These include:

- Growing interest in indoor air quality (IAQ) issues
- Americans with Disabilities Act
- Phaseout of CFC refrigerants
- Building owners' and managers' desire to reduce operating costs and assure reliability
- Building owners' and managers' desire to be environmentally responsible

The research required to design and obtain a good O&M service contract is often too confusing and time-consuming for the typical owner or manager to pursue. The purpose of this document is to provide clear information on service contract options and trends to commercial and retail building owners, facility managers, property managers, and chief building engineers.

The research and development of this document was conducted by Portland Energy Conservation Inc. (PECI) and funded by the Atmospheric Pollution Prevention Division of the U.S. Environmental Protection Agency (EPA) in cooperation with the U.S. Department of Energy (DOE). This document does not attempt to specify the exact legal language to use in a service contract; rather, it is a set of general guidelines. The main objective is to identify:

- What owners need to know to obtain a good service contract
- Ways to evaluate service providers
- Major service needs

Approximately 40% of all nonresidential buildings contract maintenance service for heating, ventilating, and air conditioning (HVAC) equipment. As third-party providers become more sophisticated in selling services, building owners and managers need to become better informed consumers.

- What the contract should include
- Ways to ensure that the contracted services are correctly performed

This paper focuses on service contracts for heating, ventilating, and air conditioning systems and equipment. The discussion is limited to contracts offered by firms whose service personnel work off site (as opposed to firms providing maintenance *management* services with key technical staff on site).

Survey and Definitions

What Is Operation and Maintenance?

Building O&M is the ongoing process of sustaining the performance of building systems according to design intent, the owner's or occupants' changing needs, and optimum efficiency levels. The O&M process helps sustain a building's overall profitability by addressing tenant comfort, equipment reliability, and efficient operation.

Efficient operation, in the context of O&M, refers to activities such as scheduling equipment and optimizing energy and comfort-control strategies so that equipment operates only to the degree needed to fulfill its intended function. Maintenance activities involve physically inspecting and caring for equipment. These O&M tasks, when performed systematically, increase reliability, reduce equipment degradation, and sustain energy efficiency.

In the absence of a sufficiently large and well trained in-house O&M staff, service contracts may be the only means of maintaining a building's mechanical systems in an organized, ongoing manner.

What Are the Various Types of Service Contracts?

In the maintenance service industry, there is no standard or set of definitions for the various kinds of service contracts. Each mechanical or maintenance service contractor puts together a unique package of contracts. The package often consists of three or four types of contracts, each presenting a different level of comprehensiveness.

In this document, four fundamental types of contract are defined: **full-coverage**, **full-labor**, **preventive-maintenance**, and **inspection contracts**. The newer concept of an end-use or end-results contract is also briefly discussed. The names used are based on industry literature and discussions with professionals in the field. There can be many variations within a contract type, depending on owner needs and contractor willingness to modify or customize service offerings.

Most of the contract types discussed below can encompass either the entire mechanical system or just one piece of major equipment such as a chiller. Also, owners may have more than one type of contract in place at any given time.

Full-Coverage Service Contract

A full-coverage service contract provides 100% coverage of labor, parts, and materials as well as emergency service. Owners may purchase this type of contract for all of their building equipment or for only the most critical equipment, depending on their needs. This type of contract should always include comprehensive preventive maintenance for the covered equipment and systems.

If it is not already included in the contract, for an additional fee the owner can purchase repair and replacement coverage (sometimes called a "breakdown" insurance policy) for the covered equipment. This makes the con-

tractor completely responsible for the equipment. When repair and replacement coverage is part of the agreement, it is to the contractor's advantage to perform rigorous preventive maintenance on schedule, since they must replace the equipment if it fails prematurely.

Full-coverage contracts are usually the most comprehensive and the most expensive type of agreement in the short term. In the long term, however, such a contract may prove to be the most cost-effective, depending on the owner's overall O&M objectives. Major advantages of full-coverage contracts are ease of budgeting and the fact that most if not all of the risk is carried by the contractor. However, if the contractor is not reputable or underestimates the requirements of the equipment to be insured, they may do only enough preventive maintenance to keep the equipment barely running until the end of the contract period. Also, if a company underbids the work in order to win the contract, they may attempt to break the contract early if they foresee a high probability of one or more catastrophic failures occurring before the end of the contract.

Full-Labor Service Contract

A full-labor service contract covers 100% of the labor to repair, replace, and maintain most mechanical equipment. The owner is required to purchase all equipment and parts. Although preventive maintenance and operation may be part of the agreement, actual installation of major plant equipment such as a centrifugal chillers, boilers, and large air compressors is typically excluded from the contract. Risk and warranty issues usually preclude anyone but the manufacturer installing these types of equipment. Methods of dealing with emergency calls may also vary. The cost of emergency calls may be factored into the original contract, or the contractor may agree to respond to an emergency within a set number of hours with the owner paying for the emergency labor as a separate item. Some preventive maintenance services are often included in the agreement along with minor materials such as belts, grease, and filters.

This is the second most expensive contract regarding short-term impact on the maintenance budget. This type of contract is usually advantageous only for owners of very large buildings or multiple properties who can buy in bulk and therefore obtain equipment, parts, and materials at reduced cost. For owners of small to medium-size buildings, cost control and budgeting becomes more complicated with this type of contract, in which labor is the only constant. Because they are responsible only for providing labor, the contractor's risk is less with this type of contract than with a full-coverage contract.

Preventive-Maintenance Service Contract

The preventive-maintenance (PM) contract is generally purchased for a fixed fee and includes a number of scheduled and rigorous activities such as changing belts and filters, cleaning indoor and outdoor coils, lubricating motors and bearings, cleaning and maintaining cooling towers, testing control functions and calibration, and painting for corrosion control. Generally

the contractor provides the materials as part of the contract. This type contract is popular with owners and is widely sold. The contract may or may not include arrangements regarding repairs or emergency calls.

The main advantage of this type of contract is that it is initially less expensive than either the full-service or full-labor contract and provides the owner with an agreement that focuses on quality preventive maintenance. However, budgeting and cost control regarding emergencies, repairs, and replacements is more difficult because these activities are often done on a time-and-materials basis. With this type of contract the owner takes on most of the risk. Without a clear understanding of PM requirements, an owner could end up with a contract that provides either too much or too little. For example, if the building is in a particularly dirty environment, the outdoor cooling coils may need to be cleaned two or three times during the cooling season instead of just once at the beginning of the season. It is important to understand how much preventive maintenance is enough to realize the full benefit of this type of contract.

Inspection Service Contract

An inspection contract, also known in the industry as a "fly-by" contract, is purchased by the owner for a fixed annual fee and includes a fixed number of periodic inspections. Inspection activities are much less rigorous than preventive maintenance. Simple tasks such as changing a dirty filter or replacing a broken belt are performed routinely, but for the most part inspection means looking to see if anything is broken or is about to break and reporting it to the owner. The contract may or may not require that a limited number of materials (belts, grease, filters, etc.) be provided by the contractor, and it may or may not include an agreement regarding other service or emergency calls.

In the short-term perspective, this is the least expensive type of contract. It may also be the least effective—it's not always a moneymaker for the contractor but is viewed as a way to maintain a relationship with the customer. A contractor who has this "foot in the door" arrangement is more likely to be called when a breakdown or emergency arises. They can then bill on a time-and-materials basis. Low cost is the main advantage to this contract, which is most appropriate for smaller buildings with simple mechanical systems.

End-Results Contracting

End-results or end-use contracting is the newest concept in service contracting and is not yet widely available. The outside contractor takes over all of the operational risk for a particular end result, such as comfort. In this case, comfort is the product being bought and sold. The owner and contractor agree on a definition for comfort and a way to measure the results. For example, comfort might be defined as maintaining the space temperature throughout the building from 72° to 74° F for 95% of the annual occupied hours. The contract payment schedule is based on how well the contractor achieves the agreed-upon objectives.

Buyer Beware

Owners and managers need to be aware that some contractors' preventive maintenance programs more closely resemble the inspection service contract described on this page. Not all PM service contracts are equally rigorous. When obtaining bids, compare the level of service each agreement promises as well as the price.

This type of contract may be appropriate for owners who have sensitive customers or critical operational needs that depend on maintaining a certain level of comfort or environmental quality for optimum productivity. How risk is shared between the owner and contractor depends on the type or number of end results purchased. If comfort defined by dry-bulb temperature is the only end result required, then the owner takes on the risk for ameliorating other problems such as indoor air quality, humidity, and energy use issues. Maximum contract price is tied to the amount and complexity of the end results purchased.

Who Are the Providers?

A variety of contractors offer maintenance service agreements to owners of commercial buildings and retail facilities:

- Mechanical contractors and full-service mechanical contractors
- Maintenance service contractors
- National maintenance service firms (consolidators)
- Specialized service contractors
- Manufacturers
- Maintenance management firms

Mechanical Contractors

Mechanical contractors install, repair, and perform O&M on all types of mechanical equipment, including controls. Firms known as full-service mechanical contractors design systems as well as installing and servicing them. Both types of firms may also distribute manufacturers' HVAC equipment and control systems. Service contracts generally make up anywhere from 10% to 25% of their business.

Maintenance Service Contractors

Maintenance service contractors offer a broad range of services such as janitorial activities, lighting maintenance, and preventive HVAC maintenance, including installation and repair of equipment. Their offerings may also include infrared scanning, ultrasonic testing and eddy current testing. These firms generally do not sell equipment. Service makes up the major share of their business. They are hired primarily by owners who outsource most if not all of their building services. These firms may have HVAC technicians who are responsible for several different buildings. Janitorial crews, however, generally are not responsible for multiple buildings. Profits for these firms generally depend on the number and size of the janitorial and maintenance service contracts they sell.

National Maintenance Service Firms

There are two types of national maintenance service firms. One type serves mainly large retail chains and owners of multiple buildings. This type qualifies mechanical contracting businesses throughout the country as subcontractors. The qualified subcontractors are then considered part of the firm's

national service team. The number of subcontractors in a particular region or metropolitan area depends on the number of contracts the firm has in that area. The firm usually does not own any of its mechanical subcontractors. However, the firm itself may also be a full-service mechanical contractor with its own designers, installers, and service technicians.

The second type of firm, known in the industry as consolidators, is currently buying up mechanical contracting firms nationwide. At this time there are only a small number of consolidators, but each may own several hundred small to medium-size mechanical contracting firms. Although many of their current customers are residential, some such firms are beginning to include light-commercial buildings as part of their market. For the most part, the responsibility for service contract delivery remains with the local mechanical contractor. In some cases, the national service firm prefers to keep a low profile, allowing the acquired mechanical contracting business to keep its original name and making few changes in how business is conducted. Most if not all of these consolidators are publicly traded on the stock market. How beneficial this consolidation effort will be for the commercial and retail building customers remains to be seen.

Specialized Service Contractors

Specialized service contractors provide the narrowest scope of O&M services. They generally sell, install, repair, and service a particular type of equipment such as controls, refrigeration, water treatment, or electrical equipment. Their service is often limited to the specific technology they sell and may be far less important as a bottom-line moneymaker than sales of equipment. However, because these firms are very specialized and proficient in the technology and service they sell, owners and managers often purchase these service agreements to supplement in-house staff work.

Manufacturers

Manufacturers of HVAC equipment such as chillers, boilers, package units, fan systems, and energy management control systems (EMS or EMCS) often provide maintenance service contracts or agreements for the equipment they manufacture. Many of them also have the capability to provide maintenance for all other systems in the building, including controls. Owners and managers often use the manufacture's service contract for a particular piece of equipment or system such as a large chiller, boiler or EMS to supplement the work of in-house staff.

Maintenance Management Firms

Maintenance management firms usually provide full-time, on-site staff. They may provide just the key management staff, such as the facility manager and chief operating engineer, or a complete team of key personnel plus all technicians, including carpenters and painters. They are capturing the outsourcing business of owners who determine that such an approach is less expensive than maintaining an in-house staff. These firms base a large

portion of their business on O&M management and service. An emerging motivator for installing this kind of arrangement is the amount of savings generated from improved O&M practices. The specific type of contract these firms require is not discussed in this document.

Obtaining a Best-Practice O&M Service Contract

Although there are a variety of service contractors, each with its own marketing techniques and service contract packages, the buyer and user of these services can shape the service delivery process by remaining active in obtaining, developing, and overseeing the contract. The following section discusses several topics building owners and managers need to consider when evaluating or upgrading a current maintenance service contract or obtaining a new one. Not all of the suggestions are relevant to every situation. Owners and managers should choose what is most relevant to their needs and objectives to obtain the most suitable contract. A best-practice service contract is the result of informed owners and managers asking the right questions; having reasonable expectations; setting up easy ways to track information; establishing continuity; demonstrating interest; and including clear, enforceable language in the contract.

Appendix A contains an 8-Step Action Plan for obtaining a best-practice O&M service contract.

Developing Objectives

The questions below help to formulate O&M objectives, determine if a service contract is needed, and if so, what type is most appropriate:

- Is the building fully owner-occupied?
- How long does the owner intend to own the building?
- Is the building single-tenant or multi-tenant?
- How sensitive are tenant's or owner's operations to a consistent building environment?
- What are the lease arrangements regarding mechanical systems?
  - Is the owner fully responsible for all the O&M for the building or are the tenants partially responsible?
  - How extensive are the tenant's responsibilities?
- How complex are the systems?
- How old is the equipment?
- If there is building staff, how capable are they and do they have time to perform good preventive maintenance?

Below are a few scenarios that may emerge from considering the questions above.

If an owner intends to sell the building with in a year or two, an expensive, comprehensive service contract may not be appropriate. However, a contract that ensures proper short-term maintenance, with the objective of increasing or at least maintaining the property value, may be cost-effective. During the "due diligence" process, buyers learn about the condition of the building systems. A well operated, well maintained building with good energy savings will bring a higher price, often recouping the cost of a service agreement.

If tenants are responsible for taking care of the equipment serving their area, the owner may choose not to have a service contract of any type. On the other hand, the owner may require that the tenants carry inspection or PM contracts as part of the lease agreement. The owner may even specify which service provider is to be hired. This helps ensure that the mechanical equipment is not allowed to deteriorate, leaving the owner with expensive repairs after the tenants leave.

For an owner who occupies the building, has a long-term commitment to the property, and has complex systems without the support of an expert in-house maintenance staff, a comprehensive agreement such as a full-coverage contract may be most effective. In this case, the owner's objectives may include providing a high level of comfort, ensuring equipment reliability, operating the building as efficiently as possible to reduce energy costs, and avoiding premature equipment failures.

Measurable Objectives

In any type of contract, measurable objectives are an important management tool. Measurable objectives help track how well the contractor is achieving the desired results. They also help the contractor understand where improvement is needed. Some owners and contractors use a report-card system to track progress. For example, if one objective is to reduce the number of comfort complaints from between 15 and 20 per month to between 0 and 3 per month, the owner may set up a system to track the number of comfort complaints following the placement of the service contract. The owner may then rate the contractor's progress toward meeting the objective at an agreed-upon time interval, such as monthly or quarterly.

The end-results contract discussed on page 5 is based primarily on measurable results.

Once O&M objectives are established and the basic type of contract is agreed on, the owner and contractor can negotiate modifications and additions during the bidding and selection process.

Screening the Contractors

Building owners and managers often hire service contractors based on recommendations by their peers. This approach may save time, but in the long run it may not reduce risk or save money. A better way to find a contractor who fits the particular needs of your building is to select several candidates and rigorously screen them before requesting bids. The screening process may seem time-consuming, but it greatly reduces the risk of costly problems after the contract is signed. During the screening processes, ask the following questions:

- Will the contractor do a thorough assessment of the building systems before signing the contract?
- Will the contractor modify the basic contract to fit the requirements of your building systems?

- Does the contractor have supporting documentation showing how various tasks are performed? For example, the contractor should have a policy/procedures manual defining each O&M task, such as checking refrigeration pressures, and describing the methods used for accomplishing the task. Ask to see the manual.
- Does the contractor have a database of PM tasks recommended either by manufacturer or other reputable sources?
- Will the contractor provide a detailed service plan as part of the contract, stating what services will be performed, at what frequency, and the time it takes to complete the service?
- Will the contractor use only environmentally safe products when servicing the building?
- Will the contractor provide an itemized list of hourly rates for labor by skill level, charges for travel, and cost of parts for each service performed?
- Does the contractor have a maximum response time for emergencies (usually four hours)?
- Will the contractor provide references from a one-year customer, a three-year customer and two customers of five or more years? Check the references.
- Does the contractor have several customers who have contracted with them for five or more years?

With regard to service technicians (employees), ask:

- Will the contractor commit the same two or three technicians continuously to the maintenance of the building?
- What is the level of skill of the service technicians who will perform the work for the building?
- Will the contractor have capable service technicians available 24 hours per day, 365 days per year?
- Is the contractor willing to provide resumes for the primary technicians assigned to the buildings?
- What is the employee turnover rate?
- Are the technicians CFC-certified and do they have all other required state and local licenses?
- What qualifications and training are they required to have ?
- Are they factory-trained on your building's brand of equipment and control system?
- Can they use your building's brand of EMS to troubleshoot problems?
- Are the technicians able to use the trending capabilities of the building's EMS to track data?
- Do they have access to and the ability to use state-of-the-art tools such as portable dataloggers for measuring variables and troubleshooting operational problems?
- Are they required to wear clean company uniforms with name tags?

To help clarify and organize information during the screening process, Appendix B presents a sample form that contains the questions listed above.

Also ask:

- What percent of the contractor's business is maintenance service?
- How long have they been in business?
- How many trucks do they have?
- Are their test instruments calibrated at least annually, and are their calibration methods in accordance with those of the Bureau of National Standards?

Checking the potential contractor's credit or D&B rating can also be informative.

Obtaining Bids and Selecting a Contractor

Because no two building systems are alike and no two service contractors are alike in the way they provide or price services, it is important for the customer to take control and specify what is wanted. The following section discusses some general methods that help to identify the O&M requirements for building systems and to "level the playing field" for bidders.

Once the screening process is complete, invite two to four potential contractors to do a thorough assessment of the facility. If possible conduct a "walk-through" of the facility with all bidders in attendance. That way, all potential bidders hear any questions that come up, along with the responses. Allow contractors to review a set of building documentation including mechanical drawings, control strategies, sequences of operation, and O&M manuals. This helps them understand how the building is supposed to perform and be maintained. Also, clearly communicate your objectives for a service contract.

After completing the assessments and the group walk-through, have each contractor submit a detailed scope-of-work proposal that includes all the O&M tasks for each piece of equipment, needed repairs, replacements, and suggested upgrades. Using the information gained from each response, put together a more detailed specification spelling out all the requirements to be included in the contract, along with the requirements for documenting and reporting information. This method levels the playing field, providing each contractor with the same information for bidding purposes. It demonstrates at the outset the owner's or manager's interest in, understanding of, and commitment to getting the best possible contract for a reasonable price, and it prevents contractors from downgrading service in order to provide a lower bid. (See the section below titled "*What to Include in a Best-Practice Service Contract.*")

The next step is to have each contractor give a final bid based on the new specifications. To avoid any surprises, the final bids should specify clearly all applicable requirements and conditions from both the contractor's and owner's side.

The above method of obtaining bids may be modified to fit the size and type of facility and the expertise of the owner or building staff. For a large,

complex facility, a building owner or manager may want to hire a third party—such as a consulting engineer *with practical hands-on field experience*—to do the building assessment and help draw up the basic scope of work for the bid. However, this does not necessarily preclude contractors' assessments. Many contractors, especially when bidding on a large facility, will want to do their own assessment to understand the age and condition of the equipment they will be servicing. For a smaller or less complicated facility, the owner, the manager, or an expert building operator may be able to do the assessment and draw up a specification without calling on a third party. Manufacturers' O&M manuals are good sources for identifying the specific tasks needed for each piece of equipment. The main objective is to give all the contractors the same information and requirements in order to get the most cost-effective contract, whether it's for several building systems or just one major piece of equipment.

Final bids should be evaluated according to how well they meet the owner's specifications and price. If all the contractors are provided with the same information, prices should not vary significantly. Knowing the potential contractor's hourly rate for the various levels of service (including overtime and emergency service) helps the owner evaluate the cost of the task work. However, the total price of some contracts will also reflect the contractor's attempt to anticipate conditions a contractor has little control over, such as the weather and the possibility of frequent equipment breakdowns. Price is discussed in more detail in the section below titled *"What Should a Best-Practice Service Contract Cost?"*

Before a final selection, the owner or manager should consider visiting the contractor's place of business to see how organized and professional it is. Giving the right answers to the screening questions and writing a good bid doesn't mean the contractor isn't working out of his or her garage. Some managers even suggest sitting with the dispatcher for an hour or two to get to know the volume of demand for service and how customer needs are met.

What to Include in a Best-Practice Service Contract

Not all of the requirement discussed here are appropriate for every type of contract. However, most of them will apply to owners of larger and more complex facilities that depend on outside service contractors to operate and maintain their buildings.

Documenting, Tracking, and Reporting Requirements

It is important for the building owner or manager to develop requirements for what information is to be reported, how it is to be reported, and who is to receive the reports, invoices, and documentation. Specify clear channels of communication and documentation requirements. Owners and managers should consider the following when hiring a contractor and developing the contract specifications:

- Require that log cards be placed at each piece of equipment with space for noting the date of last service and any new parts that were installed. This gives new technicians and in-house staff a quick understanding of the service status for each piece of equipment. Insist on legible handwriting.
- For companies using handheld electronic recording devices, require either that a copy of the data be entered in the on-site computer or that a hard copy be sent to the maintenance office in a timely manner.
- If the facility has a CMMS, require the contractor to enter the service data into the software after each service call. Also, if a bar-coded PM system is in place, require the contractor to use the bar-coding system to track PM work.
- Require that the service technician sign a log when entering and leaving the facility. This gives the person responsible for authorizing payment a way to track actual hours spent in the building. Some owners and managers require the service technician not only to sign a log, but also to report to them upon entering and leaving the facility.
- Require a forms-based service ticket. This includes a complete task sheet listing the equipment serviced and explaining exactly what was done for every scheduled service call along with recommendations for improvements, repairs, and replacements. At minimum, one copy should remain with the owner or manager (preferably in a ring binder) and one with the contractor. This gives a more detailed history of the service performed on the equipment than the log card but doesn't necessarily replace the need for a log card system.
- Require that measurements, such as motor amps and volts, temperatures, and pressures, be taken and documented for each piece of equipment, either on the equipment's log card or on a separate service sheet. The purpose of gathering this data is to observe how the measurements change over time, thus helping to predict or reveal problems affecting efficiency and reliability. It also helps both owner and contractor under-

stand and justify replacements, repairs, or adjustments. If an electronic handheld recording device is used to capture the information, make sure the contractor provides a copy of the data to the owner or manager for review.

- Request that the technician report any safety hazards or possible environmental quality problems directly to the owner/manager.
- Require that a copy of any test analysis results, such as oil analysis, water treatment analysis, or boiler combustion analysis, be provided to the building owner/manager for review.
- Have clear billing and payment criteria stated in the contract. Such criteria might include the following:
  - The technician performing the service must sign the service invoice.
  - The technician must clearly describe each task including labor time, travel charges, and replacement parts, if any. Require legible handwriting.
  - Any electronically acquired data must be made available to the building staff and owner either as hard copy or on a site-based computer.
  - All old parts must be turned in at a designated place or to a designated person.
  - The building name, number, or ID must be included on the service invoice.
  - The contractor must provide a separate bill for additional work performed at the time of the regular PM visit. Also, the contractor must obtain prior approval for work if the cost exceeds a specified dollar amount.
  - Bills must be received within a specified time limit (such as 90 days), after which they will not be paid.

Appendix B contains a sample format for a list of charges.

Even if a contract specifies that the owner will pay the total contract amount in twelve monthly payments, several of the above criteria would still be valid and useful.

The Facility O&M Service Plan

Require that the contractor submit a facility O&M service plan and schedule as part of the contract. The plan should be based on the building owner's needs and the building's design documentation. It should contain the equipment list and the operating and maintenance tasks for each system or piece of equipment along with the service schedule. The plan may be more or less detailed depending on the size and complexity of the building systems. Consider including a combination of the following items:

- A list of important data to be tracked over time (such as chiller performance) and analysis of that data. For example, require that the chiller kW per ton for a given condition be tracked and reported over time.
- A list of the tasks that target efficient operation of building equipment (See the section titled *"Adding the "O" to an O&M Service Contract."*)

Appendix B contains a sample service plan for a chiller.

- An O&M service plan for each piece of equipment: the tasks to be performed; the frequency (such as quarterly, semiannually, annually); and the expected time needed to perform them.
- Annual startup and shutdown plan for the cooling and heating systems with a list of the tasks to be included in each process.
- A list of tests to be performed only as often as equipment performance indicates a need, for example, an eddy current test.
- A list of times (provided by the owner) when equipment must not be shut off.

A comprehensive service plan often incorporates most of the items listed above for the piece of equipment it addresses.

Adding the "O" to an O&M Service Contract

Most companies providing HVAC service contracts focus on the maintenance or care of equipment and systems. In fact, the industry usually refers to the service contract as a "maintenance" service contract. However, recent studies show that actual equipment operation accounts for most of the energy waste or energy savings. No matter how well the HVAC system and equipment is cared for, if it is operated poorly or operated when it could be shut down, the result is energy waste, possible premature failure, and lost dollars. Building owners and managers need to insist on requirements that address the operating issues as well as the maintenance issues in service contracts.

Peter Herzog, in his book Energy-Efficient Operation of Buildings*, defines energy-efficient operation as operating an energy-consuming device so that it uses only as much energy as it needs to fulfill its intended function.*

The following is a list of tasks that specifically address efficient operation:

- Periodically check the following schedules to ensure that equipment is operating only as much as needed to fulfill its intended function:
  - Time-of-day (TOD) schedules, holiday schedules, and start-stop time optimization strategies set by the EMS; mechanical time clocks, and programmable thermostats for HVAC equipment
  - Lighting TOD schedules and sweep schedules as compared to HVAC schedules
  - Setup and setback temperatures
  - Space temperature setpoint schedules
  - Reset schedules such as supply air, chilled water, and heating water
  - Lockout schedules for economizers, chillers, boilers, etc.
  - Freeze protection setpoints

Make sure that:

- Deadbands or lockout temperatures are properly set to keep cooling and heating from occurring simultaneously unless it's part of the design intent for the building.
- Sensors critical to efficient operation are calibrated more than once per year, including sensors used as control signals such as outside air, supply air, and mixed air sensors.

- Heating and cooling equipment, including resistance heating, is staging on and off in an optimal manner.
- Air conditioning compressors are loading and unloading properly and efficiently.
- Boilers are firing optimally (low, medium, and high fire)
- All adjustable-speed drives are functioning optimally and the minimum rpm setpoint does not inhibit turn-down.
- Air and water economizers are functioning so as to take full advantage of free cooling.
- Capacity strategies are optimized for cooling tower operation.
- HVAC equipment has staggered start times to help reduce the peak demand (i.e., all or numerous motors should not start simultaneously at either morning startup or upon restoring power after a power outage).
- Any soft-start strategies are working properly to reduce in-rush currents and peak demand.
- Morning warm-up, pre-cool, and night purge strategies are working appropriately.
- Optimum start and coast-down strategies are functioning properly.
- Unoccupied spaces have heating and cooling equipment turned off or setpoints at or exceeding the typical setbacks and setups for the building.
- Control strategies and schedules that are easily overridden or circumvented are periodically checked and returned to their normal operating mode if appropriate.

In order to diagnose operating problems successfully, a service contractor must be able to measure and track the various parameters that indicate proper operation. Service technicians must either be trained to use the building's EMS to trend points that reveal operating problems or have (and know how to use) portable dataloggers as one of their diagnostic tools. It is not cost-effective to have a technician stay for hours in a building or put in expensive overtime to observe operating strategies. For buildings where EMS is unavailable or inadequate, there are several types of dataloggers on the market that capture information over time and that use accompanying software packages analyze it.

A building containing an energy management control system (EMS) may have a separate service contract specifically for the control system. In that case, the EMS service contract rather than the general HVAC service contract should cover several of the operating ("O") tasks described here.

Calibration Requirements

Instrument Calibration

A service contract should include a section requiring that the contractor's test instruments have up-to-date and valid calibration documentation. This may be in the form of a certificate from the manufacturer. If the instruments used to measure variables, check sensor calibration, or troubleshoot problems are not calibrated on a regular basis, test instrument errors could cause energy inefficiency and comfort problems as well as wasted troubleshooting time.

Instrument calibration may be performed by companies or government agencies that regularly calibrate similar instruments or by the instrument's manufacturer. In either case, some form of documentation stating that the instrument was calibrated at a certain date is usually provided. The building owner or manager may request that a copy of the documentation be attached to the contract on an annual basis.

Equipment Calibration

Periodic calibration checks are among the most important PM tasks for ensuring that equipment and systems are performing optimally. Any sensors or instruments calibrated by the contractor should have a calibration label identifying the contractor, the technician performing the calibration, and the date of calibration.

Certifications and Safety Requirements

CFC Certification and Requirements

Appendix B contains a sample of a Contractor Refrigerant Policy Agreement.

The Federal Clean Air Act of 1990 contains requirements regarding venting, recovery, recycling, and replacement of chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and other refrigerants used in air conditioning and refrigeration systems. In order to assure compliance, some owners require service contractors to sign a refrigerant policy agreement. This agreement may be modified to include additional requirements.

The owner should also consider requiring the contractor to track refrigerants on the site, including current inventory, equipment leaks, and leakage rates. Also, in the event of a refrigerant changeout, require the contractor to issue a credit for the old refrigerant of at least 75% of the current wholesale market price.

Materials Safety Data Sheets

As part of the contract, require the contractor to provide copies of Material Safety Data Sheets (MSDS) prior to bringing to the site any chemical required for performing a service task. Clearly state that unless the contractor receives written approval from the owner, any chemicals brought on site shall be removed by the contractor, along with any waste associated with them, and that hazardous chemicals shall not be put into the owner's waste stream.

Contract Cancellation, Protocols, and General Considerations

The following section discusses several further contract considerations, including what might constitute a contract cancellation and protocols for the contractor's technicians to follow when on the building site.

Contract Cancellation

A service contract should clearly state what would constitute grounds for cancellation of the contract and the time interval after which the cancellation would be effective. A cancellation clause motivates the contractor to meet the owner's requirements. Some owners reserve the right to cancel any service contract, without listing any reasons, thirty days after written notification. Others list examples of violations that would be considered serious enough to cause cancellation. These might include:

- Failure to respond to an emergency within the contracted time period
- Poor conduct on the part of the service technician
- Failure to perform the contracted PM tasks adequately or in a timely manner
- Interference with the owner's operations or personnel

Cancellations of full-service contracts that include repair and replacement coverage may be more complicated from both the owner's and the contractor's position. It is advisable to have some language in the contract that prevents either party from bearing the full economic brunt of a cancellation. For example, if an owner decides to cancel a three-year contract two years early and the contractor has just installed and paid for a substantial piece of mechanical equipment, the contractor should be fairly compensated by the owner for that piece of equipment. On the other hand, if the contractor decides to cancel the contract early, the owner should reserve the right to have a third party do an assessment of the system (at the contractor's expense) to determine whether there are any major problems. The outgoing contractor should then correct the problems before leaving. The economics in both cases should be based, in part, on the time remaining on the contract as compared to the original length of the contract.

Protocols

A service contract should spell out the protocols to be followed regarding security issues and use of building facilities. The following is a list of suggested topics for inclusion:

- Special security or access areas
- Use of restrooms, kitchens, cafeterias, and employee lounges
- Designated smoking areas
- Staging areas for installation work and storage areas for ladders and tools
- Parking requirements
- Special safety requirements
- Lock-out/tag-out (LO/TO) requirements. Require the contractor to provide a copy of his LO/TO program or to use the owner's LO/TO program.
- Recycling requirements.

General Contract Considerations

The following is a list of some general contract requirements:

- State that the contractor cannot under any circumstances subcontract the work to another firm. Or, if the arrangement allows the primary contractor to use subcontractors, require a list of all subcontractors and specify that they must abide by all contract requirements.
- Require the service contractor to pay the bill when they fail to respond to an emergency within the agreed-on time period (under normal seasonal conditions), causing the owner to call in another firm to handle the problem.
- Require the contractor to sign for any keys to the building. If the contractor is given a grand master key, consider having them agree to re-key the building at their own expense if the master key is lost.
- Require a copy of the contractor's safety/accident records for the past two years. This should include the number of "lost day cases" for that period. (Preferably, the number of LDCs should be very low in proportion to the size of the contracting firm.)
- Require that the contractor provide all personal protective equipment (PPE) such as harnesses, hardhats, safety glasses, and breathing protection, and that the service personnel are all trained and qualified in their use.
- Require evidence that the contracting firm holds regular safety meetings with its staff technicians.

Require that the contractor also provide:

- At least minimum liability insurance and proof of coverage.
- A copy of the performance bond (if required).
- Workmen's compensation coverage limits and proof of coverage.

What Should a Best-Practice Service Contract Cost?

Contract prices can range from under $300 to several thousands of dollars per year depending on the contract type and the custom features added to meet the owner's objectives. To lessen the price discrepancies among bids, owners and managers must supply each potential bidder with the same information. A method for doing this is discussed in the section titled "*Obtaining and Selecting a Best-Practice Service Contract.*"

Service contract prices also vary depending on the type and condition of building equipment, hours of operation (24 hours per day vs 10 hours per day), owner's budget constraints, and regional location. Because of the many variables, standard pricing is generally nonexistent except for inspection-only contracts. Even with inspection-only contracts, the size of the building and amount of equipment included for inspection will sometimes alter the price of the standard contract.

Because of the amount of risk that the contractor bears, pricing for the full-service contract and full-labor contract is considerably more complicated than for other types. The price for these contracts usually goes up as risk to the contractor increases. The risk is highest for the full-service contractor offering breakdown insurance if equipment is middle-aged or old, is in a dirty environment, has received little to no maintenance, or operates at longer than average runtimes. The contractor also gambles on the weather. If the cooling, heating and swing seasons are average for the area, the contractor usually does well for the term of the contract. However, if cooling seasons are hotter than usual or heating seasons are colder than usual, the contractor may see substantially reduced profits over the term of a full-service contract.

For a typical mechanical contractor providing journey-level service, hourly rates vary from approximately $35.00 to $90.00 per hour depending on the region of the country and size of the community. EMS technicians and other specialists may be billed out at higher rates than the typical HVAC service technicians serving the same area. Keep in mind that, regardless of type, most contracts have a minimum gross margin of 50% (contract cost times two).

Buyer Beware

Because so many variables are involved in pricing a service contract, owners and manager should beware of contractors claiming to have a standard price for different levels of service.

Tips for managing and Overseeing a Best-Practice Service Contract

Once a service contractor is selected and the work begins, it is important for an owner or manager to provide some oversight. The following activities help to successfully manage a service contract.

1. Communication

- Establish clear lines of communication and specific protocols to follow regarding emergency service, after-hours service, *and regular PM visits.*
- Set up a feedback system for contractor performance.
  - Periodically review with the contractor any measurable objectives that are part of the contract.
  - Use a quarterly report card as part of the feedback system. (Refer to page 10, "*Measurable Objectives.*")
  - Let contractors know when they are doing a good job.

2. Documentation and Review

- Periodically review the contract document. Over time, there is a tendency to forget some of the requirements contained in the contract.
- Designate a notebook for contractor-gathered data. Require the contractor to leave a copy in the notebook of any performance data or documentation gathered during service calls. This provides the owner, manager, and building staff with a history of equipment performance.
- Periodically review and analyze with the contractor any performance data on equipment the contractor is required to track. This ensures that the contractor is obtaining and recording the correct data and that equipment is performing optimally. Have the technician responsible for gathering the data participate in the analysis.
- Keep all building documentation (drawings, manufacturers' O&M manuals, sequences of operation, etc.) on site, in one location, and readily available to the contractor for reference.

3. Spot Checks

- Periodic spot checks of mechanical equipment after PM visits will ensure that the work contracted for is being performed. Spot checks may be done with or without the contractor present. Document the findings. Take photographs if necessary. Also note whether the PM log card is properly filled out. Is it legible and understandable?
- If in-house staff are available, have them periodically oversee the contractor's work.
- Do periodic spot checks of the contractor's trucks. The state of the contractor's own equipment and supplies may reflect how well the contractor maintains clients' equipment. A disorganized and dirty service vehicle may indicate a problem with a particular service technician or with the contractor's business in general.

APPENDIX

AN 8-STEP ACTION PLAN FOR OBTAINING A BEST-PRACTICE SERVICE CONTRACT

An outline of the recommended steps for choosing, obtaining, and managing the best contract for your building

1. Develop objectives for an O&M service contract, such as:

- Provide maximum comfort for building occupants.
- Improve operating efficiency of mechanical plant (boilers, chillers, cooling towers, etc.).
- Apply preventive maintenance procedures to reduce chances of premature equipment failures.
- Improve operating efficiency of all mechanical systems (reduce energy waste).
- Augment the in-house staff's work so their time can be used more effectively.
- Provide for periodic inspection of building systems to avoid emergency breakdown situations.

The objectives for a service contract often dictate the type of contract that is most appropriate. It is important to understand all of the objectives prior to the screening process and to clearly communicate the objectives to the contractors throughout the screening, bidding, and selection processes. Also, include a detailed description of the measurable objectives and the methods used for tracking these objectives.

2. Develop and apply a screening process.

The screening process may be more or less rigorous depending on the owner's objectives and the size, number, and complexity of the facilities involved.

3. Have all building documentation available in one place. Include:

- Mechanical and electrical drawings
- Equipment list
- Test, Adjusting, and Balance Report
- Control system documentation
- Sequences of operation and control strategies (warm-up, optimum start, night purge, etc.)

4. ***Select two to four potential contractors and obtain initial proposals based on each contractor's building assessments.***

   During the contractors' assessment process, communicate the objectives and expectations for the O&M service contract and allow each contractor to study the building documentation.

5. ***Develop the major contract requirements using the contractors' initial proposals.***

   Make sure to include the requirements for documentation and reporting. Contract requirements may also be developed by competent in-house staff or a third party.

6. ***Obtain final bids from the potential contractors based on the owner-developed requirements.***

7. ***Select the contractor and develop the final contract language and service plan.***

8. ***Manage and oversee the contracts and documentation.***

   Periodically review the entire contract. Build in a feedback process.

APPENDIX

Sample Forms, Plans, and Agreements

Suggested content that can be edited and adapted to meet specific needs and objectives

This appendix contains samples of the following:

I. Contractor Screening Form

II. Itemized List of Charges

III. Service Plan for a Centrifugal Chiller

IV. Contractor's Hazardous Materials/Refrigerant Policy Agreement

I. Contractor Screening Form

Some of the questions in this form may be more important than others, depending on the owner's or manager's objectives for a service contract, the size of the facility, and the complexity of the equipment. Check marks, yes/no answers, or scores are placed in the columns under the names of the companies being rated. When using a scoring system, weights of importance may be assigned using the column titled "Weight Factor." A blank sheet is also provided for additional user-specific items.

	WEIGHT FACTOR	COMPANY	COMPANY	COMPANY	COMPANY	COMMENTS
Will the contractor do a thorough assessment of the building systems before signing the contract?						
Will the contractor modify the basic contract to fit the requirements of your building systems?						
Does the contractor have supporting documentation showing how various tasks are performed? For example, the contractor should have a policy/ procedures manual defining each O&M task, such as checking refrigeration pressures, and describing the methods used for accomplishing the task. Ask to see the manual.						
Does the contractor have a database of PM tasks recommended either by the manufacturer or other reputable sources?						
Will the contractor provide a detailed service plan as part of the contract, stating what services will be performed, at what frequency, and the time it takes to complete the service?						
Will the contractor use only environmentally safe products when servicing the building?						
Will the contractor provide an itemized list of hourly rates for labor by skill level, charges for travel, and cost of parts for each service performed?						
Does the contractor have a maximum response time for emergencies (usually four hours)?						
Will the contractor provide references from a one-year customer, a three-year customer and two customers of five or more years? Check the references.						
Does the contractor have several customers who have contracted with them for five or more years?						

CONTRACTOR SCREENING FORM
(continued)

	WEIGHT FACTOR	COMPANY	COMPANY	COMPANY	COMPANY	COMMENTS
With regard to service technicians (employees), ask:						
Will the contractor commit the same two or three technicians continuously to the maintenance of the building?						
What is the level of skill of service technicians who will perform the work for the building?						
Will the contractor have capable service technicians available 24 hours per day, 365 days per year?						
Is the contractor willing to provide resumes for the primary technicians assigned to the buildings?						
What is the employee turnover rate?						
Are the technicians CFC-certified and do they have all other required state and local licenses?						
What qualifications and training are they required to have?						
Are they factory-trained on your building's brand of equipment and control system?						
Can they use your building's brand of EMS to troubleshoot problems?						
Are the technicians able to use the trending capabilities of the building's EMS to track data?						
Do they have access to and the ability to use state-of-the-art tools such as portable dataloggers for measuring variables and troubleshooting operational problems?						
Are they required to wear clean company uniforms with name tags?						
Also ask:						
What percentage of the contractor's business is maintenance service?						
How long have they been in business?						
How many trucks do they have?						
Are their test instruments calibrated at least annually, and are their calibration methods in accordance with those of the Bureau of National Standards?						

CONTRACTOR SCREENING FORM
(continued)

	WEIGHT FACTOR	COMPANY	COMPANY	COMPANY	COMPANY	COMMENTS

II. Itemized List of Charges

The following is a sample list of charges included in a service invoice. The technician performing the work fills out the service invoice and submits it to the contract-designated person before leaving the site.

DESCRIPTION	SKILL LEVEL	RATE	HOURS	TOTAL
Seasonal chiller startup regular time	Journey-level mechanic	$ 45	40	$ 1,800
Premium time		$ 65	0	$ —
Seasonal chiller startup regular time	Helper	$ 35	20	$ 700
Premium time		$ 55	0	$ —
Travel		$ 30	1	$ 30
			61	$ 2,530
Parts (see attached list)				$ 500
TOTAL				**$ 3,030**

COMMENTS:
Startup tasks completed as listed on attached sheet including tube cleaning and program changes for leaving chilled-water reset.

III. Service Plan for a Centrifugal Chiller

The following pages contain a sample preventive maintenance (PM) service plan for a centrifugal chiller along with a list of tasks for seasonal startup and shutdown. The plan includes tasks for both the outside service contractor (X) and the in-house staff (O). Both the service contractor and the owner had input into this plan. This demonstrates only one type of planning format. Some contractors or owners may want to have separate task sheets based on frequency of service such as monthly, quarterly, or annually. As part of a best-practice service contract, each system and piece of equipment should have a service plan similar to the one shown here.

When the plan is complete, the last two columns should be completely filled out with the time needed for each task shown in the frequency column (e.g., monthly, quarterly) as well as the "Time Required" column. Including the completion times in the frequency column makes it easier for the owner to reconcile the PM visit records to the invoices. The owner or manager may or may not want to include the task completion times for in-house staff.

Operating parameters, such as setpoints, reset schedules, lockouts, etc., should also be listed in the service plan for each piece of equipment. In a case where the EMS controls the equipment at a level beyond the enable/disable function, the service plan for the EMS should also contain the operating parameters for all controlled equipment as well as space temperature setpoints, set-backs, and setups.

For equipment requiring seasonal startup and shutdown, the owner or manager should consider having the semiannual PM tasks coincide with these events. This avoids extra trip charges and the cost of performing tasks more often than necessary. For some equipment it may be appropriate to remove the semiannual column as long as the tasks are accomplished as part of the startup and shutdown procedures.

CHILLER PM SERVICE PLAN

DESCRIPTION	MONTHLY	QUARTERLY	SEMIANNUALLY	ANNUALLY	AS REQ'D BY PERFORMANCE	TIME REQ'D	SKILL LEVEL REQUIRED
I. COMPRESSOR							
A. Performance Evaluation (Log conditions and analyze. Submit copy to FM.)	O						Journey
B. Motor							
• Meg. windings (See note on page B-9.)			X .75			0.75	Journey
• Ampere balance (within 10%)		X .25				0.25	Journey
• Terminal check (tight connection; clean.)				X .50		0.50	Helper
• Motor cooling (Check temperatures.)		X .25				0.25	Journey
C. Lubrication System							
• Oil lines temperatures	O						Helper
• Water (refrigerant) coolant temperature	O						Helper
• Oil cooler strainer (water)				X			
• Oil cooler solenoid operation		X					
• Oil analysis			X				
• Oil appearance	O						
• Oil filter change					X		
D. Vane Operation							
• Compressor loads:							
- Operate manual switch.		X					
- Record motor amps.		X					
• Compressor unloads							
- Operate manual switch.		X					
- Record motor amps.		X					
E. Internal Compressor Check					X		
II. CONTROLS							
A. Operating Controls							
• Check LRT settings and operation.			X				
• Check vane control setting and operation.			X				
• Verify motor load limit control.			X				
• Verify load balance operation.			X				
• Check oil pump contactor.			X				
• Check soft-start settings and function.							
• Check chilled water reset settings and function. OSA = 75 ºF / LCHW = 44 ºF, OSA = 60 ºF / LCHW = 55 ºF			X				
• Check chiller lockout setpoint = 55 ºF			X				

CHILLER PM SERVICE PLAN
(continued)

DESCRIPTION	MONTHLY	QUARTERLY	SEMIANNUALLY	ANNUALLY	AS REQ'D BY PERFORMANCE	TIME REQ'D	SKILL LEVEL REQUIRED
B. Protective Controls Test operation of:							
• Alarm relay		X					
• Pump interlocks		X					
• Hot and cold oil temperature switches		X					
• Surgeguard relays		X					
• High and low pressure switches		X					
• High suction temperature switches		X					
• High discharge temperature switch		X					
• Low pressure override switch		X					
• Oil pump pressure differential switch		X					
• Oil pump safety timer		X					
• Oil pump time delay switch		X					
• System monitor timer		X					
• Vane closed switch		X					
III. CONDENSER							
A. Performance Evaluation (Log conditions and analyze. Submit copy to FM)	O						
B. Water Quality (Test.)		X					
C. Condenser Tubes (Clean.)				X			
D. Eddy Current Test – Tube Wall Thickness					X		
E. Seasonal Protection					X		
F. Check Setpoints:							
• Cond. water = 70 ºF							
• Bypass = 60 ºF							
IV. EVAPORATOR							
A. Performance Evaluation (Log conditions and analyze. Submit copy to FM)	O						
B. Water Quality (Test.)		X					
C. Evaporator tubes (Clean as required.)				X			
D. Eddy Current Test– Tube Watt Thickness (as req'd)					X		
E. Seasonal Protection					X		
V. EXPANSION VALVES							
A. Performance Evaluation (superheat control)		X					

CHILLER PM SERVICE PLAN
(continued)

DESCRIPTION	MONTHLY	QUARTERLY	SEMIANNUALLY	ANNUALLY	AS REQ'D BY PERFORMANCE	TIME REQ'D	SKILL LEVEL REQUIRED
VI. COMPRESSOR-CHILLER UNIT							
A. Performance Evaluation (Log conditions and analyze. Submit copy to FM)	O						
B. Leak Test							
• Compressor fittings and terminal		X					
• Piping fittings		X					
• Oil pump joints and fittings		X					
• Vessel relief valves		X					
C. Vibration Isolation Test					X		
D. General Appearance							
• Paint				X			
• Insulation				X			
VII. STARTER(S)							
A. Contactors (Examine hardware and operation.)		X					
B. Overload Setting and Trip (Verify.)		X					
C. Electrical Connections (Test.)		X					
D. Pump Down Control (Verify operation.)		X					
VIII. OPTIONAL CONTROLS							
A. Hot Gas Bypass Controls (Verify operation.)		X					
B. Liquid Injection Controls (Verify operation.)		X					
C. Pump Down Control (Verify operation.)		X					
TOTAL HOURS							

KEY

O — Performed by in-house staff

X— Performed by service contractor

Note:
Some centrifugal chillers use power factor capacitors, and some use surge capacitors. The capacitor may be installed out of sight in the compressor motor terminal box. In all cases, capacitors must be disconnected from the circuit to obtain a useful megger reading. Failure to do so will produce a low reading. When handling electrical components is required, only fully qualified electrical technicians should attempt service.

CHILLER PM SERVICE PLAN *(continued)*

STARTUP AND SHUTDOWN PROCEDURES

The cooling season startup and shutdown tasks are performed by a journey-level technician with the assistance of a helper-level technician.

A. Cooling season startup preparation and inspection

The following tasks prepare your unit for cooling duties with reliability, safety and efficiency:

1. Pressurizing the unit and conducting a leak check
2. Checking refrigerant and oil levels
3. Checking oil sump and purge oil heaters and temperatures
4. Checking and testing all operating and safety controls
5. Checking the starter operation
6. Starting the chilled water pump
7. Starting the condenser water pump and cooling tower
8. Starting the chiller and calibrating controls
9. Checking purge unit operation
10. Logging operating conditions after system and unit stabilize
11. Reviewing operating procedures and owner's log with operator
12. Checking auxiliary equipment operation

TOTAL HOURS TO COMPLETE: ☐

B. Annual equipment shutdown inspection and PM

The following tasks are performed once each year during a shutdown period in order to properly evaluate your equipment status and prepare your unit for the next cooling season:

1. Inspecting the **compressor motor assembly** and performing the following tasks:
   - Recording voltages
   - Megging and recording motor winding resistance
   - Lubricating open motor
   - Checking the alignment on open motor drive units
   - Checking the coupling
   - Checking seals
   - Checking inlet vane operator and linkage; lubricating where required
2. Inspecting the **compressor oil system** and performing the following tasks:
   - Changing oil, oil filter, and dryer
   - Conducting analysis on oil and oil filter at an independent laboratory
   - Checking oil pump, seal, and motor
   - Cleaning the dirt leg
   - Checking heater and thermostat
   - Checking all other oil system components including cooler, strainer, and solenoid valve where applicable
3. Inspecting the **motor starter** and performing the following tasks:
   - Running diagnostic check
   - Cleaning contacts or recommending replacement
   - Checking linkage

CHILLER PM SERVICE PLAN *(continued)*

- Megging motor
- Checking all terminals and tightening connections
- Checking overloads, dash pot oil, and calibrating
- Cleaning or replacing air filter where required
- Dry-running starter (or before startup); checking status lights

4. Inspecting the **control panel** and performing the following tasks:
   - Running diagnostic check of Micro Control Panel
   - Checking safety shutdown operation
   - Checking all terminals and tightening connections
   - Checking display data accuracy and setpoints
5. Inspecting the **purge unit** and performing the following tasks:
   - Inspecting the operation of the unit
   - Changing oil
   - Changing filter dryer
   - Cleaning orifice in the liquid feedline to coil
   - Cleaning the foul gas strainer
   - Cleaning solenoid valves
   - Cleaning purge drum, checking and cleaning float valve; replacing gaskets
   - Checking heater operation
   - Checking all other components for proper condition and operation; recording pressure control setpoint
6. Inspecting the **condenser** and performing the following tasks:
   - Checking the water flow
   - Checking flow switch operation
   - Removing condenser head and inspecting end sheets
   - Mechanically brush-cleaning condenser water tube
7. Inspecting the **cooler** and performing the following tasks:
   - Checking the water flow
   - Checking flow switch operation
   - Checking refrigerant level
8. Inspecting the **system** and performing the following tasks:
   - Conducting a leak check and identifying leak sources
   - Adding refrigerant as required (10% maximum included)
   - Recording condition of sight glasses
   - Checking the refrigerant cycle to verify the proper operating balance
   - Checking condenser water and chilled water heat transfer
9. **General items** to be included:
   - Repairing insulation removed for inspection and maintenance procedures
   - Cleaning equipment and surrounding area upon completion of work
   - Consulting with the operator
   - Reporting deficiencies and repairs required

TOTAL HOURS TO COMPLETE: ☐

IV. Contractor's Hazardous Materials/ Refrigerant Policy Agreement

Hazardous Materials Policy Agreement:

The contractor agrees to use/provide only environmentally safe products while doing business with (Company Name) _____, its subsidiaries, affiliates and employees in fulfillment of this contract; to describe in detail any products it shall use or provide, including necessary specifications indicating that the products meet with all requirements of law; to dispose of any material considered to be "hazardous" under any federal, state, or local statute, regulation, rule or ordinance in a lawful and environmentally safe manner; and to indemnify and hold harmless (Company Name) _____ from any loss, damages or liabilities incurred as a result of use by or on behalf of (Company Name) _____ of such products.

The contractor shall provide to the facility owner or manager *and* post in a conspicuous location all applicable Material Safety Data Sheets.

Refrigerant Policy Agreement:

I, _____, do hereby acknowledge that all of our service technicians have received training on venting, recovery, recycling, and replacement of chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and other refrigerants used in air conditioning and refrigerant systems, units, and small appliances, and have taken and passed an EPA-approved test appropriate for the equipment that they service and/or dispose of.

I agree that all of our service technicians will follow procedures for servicing, repairing, and disposing of any and all refrigerant-containing devices, units, and systems as outlined by company policy and federal, state, and local laws and regulations now in effect or hereinafter enacted which pertain to the Federal Clean Air Act of 1990.

I am aware of the significant harm to the earth's atmosphere caused by venting refrigerants into the air. We agree not to willfully vent refrigerants into the air under any circumstances.

I understand that our organization will be held responsible and liable if I or any of our service technicians willfully violate the Federal Clean Air Act of 1990 regarding venting of refrigerants and that we are liable for any and all fines associated with violations (currently up to $25,000 per occurrence). Any unintentional venting will be documented in accordance with company policy.

I understand that if we willfully violate the Clean Air Act of 1990, we will fully protect, indemnify, hold harmless, and defend (Company Name) _____ from and against any and all liability regarding the handling, venting, and/or disposal of any and all refrigerants.

We also agree to provide a copy of the Federal Certification numbers for all our service technicians. Should any certifications be revoked, we will notify (Company Name) _____ immediately.

Signed _____

Printed Name _____

Company Name _____

Date _____

Technician Name _____ Certification No._____

CONTRACTOR'S HAZARDOUS MATERIALS/ REFRIGERANT POLICY AGREEMENT

(continued)

Use space below and back if needed to complete technician information.

CONTRACTOR'S HAZARDOUS MATERIALS/ REFRIGERANT POLICY AGREEMENT
(continued)

Use space below if needed to complete technician information.

APPENDIX

List of Acronyms and Bibliography

List of Acronyms

CFC Chlorofluorocarbons

CMMS Computerized Maintenance Management System

D&B Dun & Bradstreet

EMS Energy Management System

HCFC Hydrochlorofluorocarbons

HVAC Heating, Ventilating, and Air Conditioning

LO/TO Lock-out/Tag-out

MSDS Material Safety Data Sheets

O&M Operation & Maintenance

PM Preventive Maintenance

TAB Testing, Adjusting, and Balancing

TOD Time-of-Day

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