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O&M Acceleration Program

Resource Toolkit

A Program of the New York Power Authority

Resource Toolkit

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Published summer 2016. First edition.

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Introduction: BuildSmart NY and OMAP

BuildSmart NY began with the signing of Executive Order 88 (EO 88) issued by Governor Andrew Cuomo on December 28, 2012. The primary goal of EO 88 is to achieve a 20 percent improvement in the energy efficiency performance of state government buildings by April 2020, while advancing economic growth, environmental protection, and energy security.

EO 88 designates the New York Power Authority (NYPA) to coordinate compliance and guide New York State Agencies and Authorities (State Agencies) to EO 88's 20 percent target. NYPA is the largest state public power organization in the nation and has a long history of supporting the advancement of energy efficiency in government facilities.

In order to understand the critical role that operations and maintenance (O&M) programs have towards achieving energy efficiency, NYPA created the **Operations and Maintenance Acceleration Program (OMAP)** to help State Agencies comply with the requirements of this order. As part of BuildSmart NY, OMAP is a suite of resources and services designed to assist State Agencies with the best practice for energy efficiency into their current O&M programs.

OMAP has four interrelated components as shown in the figure below. With practical resources, project funding, streamlined contracts, and statewide recognition – each program component is carefully designed to help advance EO 88. The Operations and Maintenance Resource Toolkit (Resource Toolkit) is a pillar of OMAP that is designed to help State Agencies expedite and enhance their O&M efforts.

The Toolkit can provide ideas for projects that can be submitted to the Grant Competition for consideration

The Maintenance Contracts can help implement ideas from the Toolkit Resource

RESOURCE TOOLKIT

GRANT COMPETITION

MAINTENANCE CONTRACTS

FACILITY STAR RECOGNITION

Projects awarded Grants can be recognized through Facility Star

Projects utilizing Maintenance Contracts can be recognized through Facility Star

OMAP's Four Interrelated Components

Defining the Resource Toolkit

As the lead implementer of BuildSmart NY, NYPA provides strategic and technical guidance to State Agencies to facilitate the establishment of effective O&M plans to maintain peak operating efficiency.

A BuildSmart NY publication, the Resource Toolkit, is intended to assist State Agencies in the development and implementation of effective, energy-focused O&M programs in the buildings they manage. It is designed to build upon the EO 88 Final O&M Plans that each State Agency has already developed in accordance with BuildSmart NY requirements.

The Resource Toolkit provides basic guidance on how facility managers can create and maintain a successful O&M program. It also includes detailed maintenance Work Plans, with recommended frequencies for State Agencies to incorporate into their Computerized Maintenance Management Systems (CMMS), to support in-house maintenance programs, or procure the services of qualified outside service contractors.

An effective O&M program will: ensure the equipment is operating at peak efficiency; the equipment life is extended to its maximum potential; and the facility experiences a minimum amount of equipment downtime. It is important to note that building portfolios vary from unit to unit, and as such, different facility managers will find different sections of this toolkit particularly useful.

Successful O&M programs can be developed using a three-phase process:

The Maintenance Planning & Development Process
PHASE I
Provides guidance that supports the development of an equipment maintenance framework.
This includes: the equipment selection process; equipment inventory development; selecting the correct type of maintenance service; and the Work Plan development and scheduling process.

Service Maintenance Contract Development & Execution
PHASE II
Offers an overview of the contract development process. It provides a step-by-step procedure for how to create the terms and conditions, and how to go out for a bid to secure a qualified contractor that will successfully support a maintenance service contract.

Continuous Program Monitoring & Compliance
PHASE III
Provides suggestions for maintaining O&M program compliance by creating and utilizing Key Performance Indicators (KPI).

Each phase is defined more fully in the following sections, followed by an appendix with additional tools and resources.

The Maintenance Planning & Development Process

PHASE I

Typical Objectives of an Operations & Maintenance Program

To start phase one, facility managers should have discussions around creating the appropriate objectives for their particular O&M Program. Doing so helps to ensure that their efforts are working toward a strategic and cohesive mission.

NYPA provides the following examples of common objectives that are often used within facility O&M programs:

1. Maximize maintenance standards at the lowest cost, highest quality, and within optimum safety standards: This statement is very broad, yet maintenance must have a proactive vision to help focus its activities.

2. Provide accurate equipment maintenance records: Providing accurate maintenance records enables an organization to correctly track equipment performance. For most State Agencies, this requires the appropriate utilization of a CMMS to track all the information. Whether or not a CMMS is used, all of the maintenance data must be accurately tracked.

3. Optimize maintenance resources: This includes eliminating waste through effective planning and scheduling of resources. Reactive maintenance programs can result in maintenance expenditure losses of nearly 30%. By optimizing maintenance resources, can reduce material and labor costs associated with O&M Programs.

4. Optimize capital equipment life: Implementing a preventive maintenance (PM) program per the Original Equipment Manufacturer (OEM) guidelines can maximize the equipment life. This is especially important for expensive generation equipment (i.e., chillers, boilers, etc.). Performing the correct type and frequency will maximize equipment life.

5. Minimize energy usage: Minimizing energy usage is a natural result of a en effective O&M program. Poorly maintained equipment uses more energy. Maintenance departments benefit from tracking their own energy usage as a KPI. Creating a successful energy best practices program starts with having detailed preventive and predictive maintenance schedules.

Defining these objectives will allow the facility to move forward with a focus on developing an O&M program that achieves these objectives.

Equipment Selection and Inventory Process

Once the objectives of the O&M Program are defined, the facility manager must identify the types of equipment to be included as part of their preventive maintenance (PM) program and create an equipment inventory.

The Equipment Inventory is a key component of any effective O&M program. Thorough and detailed equipment inventories enable a facility manager to track performance and maintenance costs for each piece of equipment.

Having a comprehensive and accurate Equipment Inventory is a basic, fundamental building block for all maintenance programs and ensure all critical equipment is being properly monitored. Equipment Inventories can be created with Excel spreadsheets or within a CMMS. It is important to have efficient procedures in place for the collection of relevant equipment information for long term tracking and planning.

An Equipment Inventory should include the following information:

- The equipment category/type, i.e. air handling unit, boiler, chiller, etc.
- A unique equipment tag number, which should be secured to the actual equipment as well.
- The location of the equipment.
- The area within the building or facility that the equipment serves/supports.

Having a comprehensive and accurate equipment inventory is a fundamental building block for all maintenance programs

- The item's nameplate data, i.e., the manufacturer, model and serial numbers, manufactured date, etc.
- Miscellaneous operating information, i.e. filter types and sizes, belt information, motor horsepower, fan capacity, etc.

A sample of an Equipment Inventory, which captures the above information, is highlighted in Table 1 on the following page.

Bldg, Room No.	Equip. Type	Equip. Tag	Location	Area Served	Manufact.	Model No.	Serial No.	Size, Cap., Misc. Info.
Bldg. 1, Room 201	Boiler, Package Steam	B-1	Bsmt MER Rm. 201	Bldg 1 & 2	Cleaver Brooks	CB 200–300	L-90917	Input: Gas = 12.553 MMBH; Oil = 89.5 GPH

Table 1: Sample Equipment Inventory Format

The Equipment Inventory may also be used to establish a parts inventory list that is used to ensure that critical parts are stored for emergency situations, and to create ordering notifications when inventory is exhausted or low. A comprehensive and accurate inventory will allow the facility to store the optimal volume of parts for just-in-time service responses, thus avoiding the excessive costs of maintaining inventory.

The following are suggested procedures that can be followed to successfully collect and organize equipment information:

1. **Obtain existing equipment lists from service contracts and/or the facility's CMMS.** Review the categories and locations along with the BMS graphics, if applicable, to determine if all existing equipment has been captured.

2. **Review as-built drawings and the schedules of all of the applicable spaces to establish a baseline of the existing equipment.**

3. **Obtain the floor plans that identify mechanical spaces.** Visit all mechanical spaces, including building rooftops, to ensure that the data collection in steps 1 and 2 are accurate. Add additional equipment that has been identified during this on-site survey process.

4. **Prepare forms for the collection of inventory information.** Review/revise the inventory collection form.

5. **Conduct the inventory tour through the applicable spaces.** Identify the space by room number and description. The equipment list shall identify each type of equipment with standardized nomenclature, labeling all similar items with identical names.

6. **Transfer the collected data to an Excel spreadsheet format or integrate within the facility's CMMS database, ideally using a mobile app.** Once the Equipment Inventory is entered into the CMMS, parts and equipment history can be managed and controlled in a more streamlined manner. For example, a life cycle cost analysis may be performed for high cost equipment to determine an effective capital replacement strategy. Having this streamlined information will provide a go-to resource for facility managers on all aspects of O&M planning.

Defining the Maintenance Services

With the Equipment Inventory process complete, facility managers will have the actionable information required for an energy-focused O&M program. Effective O&M programs can encompass a range of service options require a range of service options, depending on facility infrastructure or need. These services can be implemented as a standalone, or as part of a larger program.

Not all pieces of equipment are good candidates for preventive maintenance (PM). In some instances, run-to-fail may be a more cost efficient method as described in the below table. To determine if a piece of equipment should be included in a PM plan, the facility department should evaluate the cost of repairs versus replacement, how often maintenance is typically performed, and how critical the equipment is to core functions. level of the equipment.

The O&M service options and approaches are defined below, offering facility managers an opportunity to identify the service(s) that will be most applicable to their building portfolio and equipment needs.

Service	Definition	Appropriate Application
Run-to-Failure Maintenance	The simplest maintenance strategy is to execute "Run to Failure Maintenance" (Run-to-Fail). In this strategy, assets are deliberately allowed to operate until they break down, at which point reactive maintenance is performed. No maintenance, including preventive maintenance, is performed on the asset until there is a failure event. However, a plan is in place ahead of the failure so that the asset can be fixed without causing any production issues.	Run-to-failure maintenance makes sense when the total cost of repairing equipment after breakdown is less than the cost of performing other types of maintenance on the equipment beforehand. For example, if a customer has a machine that is involved in a continuous, 24/7 production process, shutting it down for monthly maintenance would stop production and create the same disruption as if a customer had just let it break down (which might happen one time a year. In this case, it makes sense to simply repair it when it breaks.
Critical Equipment Repair Response	Critical Equipment Repair Response is a process that identifies those pieces of equipment within a facility that are critical to its function. Although all facility equipment is important, certain pieces, such as a life safety emergency generators, must be in operating condition at all times, either by function or per code. Within these critical pieces of equipment are those components that are vital to its operation.	These types of equipment should be labeled as Tier 1 (top priority) maintenance and should be completed as a priority within the maintenance planning process. For example, the equipment's maintenance should receive priority over all non-critical equipment (Tier 2). It is also important to have spare parts in stock for equipment that falls under this definition.
Preventive Maintenance Service	Preventive Maintenance programs are designed to provide the care necessary to lengthen the life of facility equipment and reduce the frequency of breakdowns and replacements.	This is the most common type of maintenance, and should be used as the default for equipment that does not clearly fall within any of the other types of service.
Predictive Maintenance	The aim of Predictive Maintenance is first to predict when equipment failure might occur, and secondly, to prevent the occurrence of the failure by performing maintenance. Monitoring for future failures allows maintenance to be prepared before the failure occurs. Ideally, Predictive Maintenance allows the maintenance frequency to be as low as possible in order to prevent unplanned reactive maintenance without incurring costs associated with doing too much preventive maintenance.	This type of maintenance is suited for critical facility functions where the loss of the equipment for even brief periods may be catastrophic.

Maintenance Service Types

Creating a Work Plan & Schedule

As a next step in the O&M planning process, facility managers should evaluate each piece of equipment individually to identify what type of maintenance practices are best for each. Reviewing the manufacturer guidelines and warranty conditions can assist with identifying the type of maintenance tasks that should be performed.

The facility manager should evaluate past service records and interview facility staff to identify the Work Plan that would best support the facility's requirements for the facility. The facility manager should incorporate the following information when crafting the Work Plan:

1. Industry best practices

2. Standards and objectives based on the facility staff's experience

  a. Review of equipment failures

  b. Review of actual life cycle analyses

  c. Review of unscheduled downtime for critical equipment

3. Manufacturer's recommendations

  a. Operations and Maintenance Manuals

  b. System Commissioning Reports

  c. Past Facility Reviews, Needs Assessments

4. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Standard 180 (Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems)

5. International Standardization Organization,

> Use Manufacturer Guidelines and Warranty Conditions to identify the types of maintenance tasks to be performed along with work frequency

Standard ISO 50001 (Energy Management Standard)

6. Local facility staff requests

If the Work Plan tasks are to be performed in-house, the task descriptions and frequencies may be transferred to the facility's CMMS so that it overlays with the Equipment Inventory outlined earlier.

If the facility decides to obtain the services of a contractor, the Work Plan is a key component for the service contract and helps guide the contract development process. Including bidding, execution and documentation of the contract, and compliance of the service contract agreement terms and conditions.

Examples of comprehensive Work Plans for different types of equipment can be found in Appendix C.

Service Maintenance Contract Development & Execution

PHASE II

Mapping the Contract Development Process

With a better understanding of the O&M services needed, the facility senior leadership should evaluate if the required Work Plan is within the capabilities of the on-site maintenance staff. If not, the facility may require the expertise and resources of service contract providers.

Once O&M needs are identified, facility managers will be ready to initiate the contract development process for O&M tasks requiring outside service providers. This process encompasses the development, review, and revision of all maintenance service contracts. Generally, these contracts will also address energy conservation, preventive maintenance requirements and equipment repairs that may be beyond the scope and expertise of the on-site maintenance staff.

It is important to note that preparation and planning for the development of new and renewal service contracts must be strategically planned well in advance of a current service contract's expiration. Replacement contract submittal due dates should be established based on the contract processing time required by each State Agencies' administrative office. In some cases, given the state procurement process, the draft Work Plan must be prepared up to nine months prior to the desired start date. The amount of lead times are based on New York State Procurement Law requirements and processes that a contract must go through before it is advertised for bid, submitted to and approved by the New York State Office of the State Comptroller (OSC), and then awarded to the contractor.

Preparation and planning for the development of a service contract must be performed well in advance of the current contract expiration. Consider preparing the Work Plan up to nine months prior to the desired contract start date

As such, preparation of an updated maintenance contract spreadsheet that lists contract expiration dates would be considered a best practice for each State Agency, facility or service contract analyst. The list can then be distributed to all responsible parties on a quarterly basis to begin the contract development process, allowing sufficient time for the development process prior to the submittal deadline.

These procedures include several titles and roles that typically exist within facility O&M departments, but specific roles and titles will likely vary by location. These roles are listed in Appendix A.

The following procedures shall enable a facility to effectively manage the contract development program:

1. **The onsite Facility Service Contract Analyst (FSCA),** in coordination with the Business Office Service Contract Analyst (BOSCA), will develop a Contract List set to expire in the next fifteen months, or any new contracts that have been requested by a facility. This final contract list should be distributed to the Program Manager-O&M (PM-O&M) responsible for the service contracts.

2. **The PM-O&M should review the Contract List,** and prioritize the contracts for development of new contracts, or renewal of existing contracts.

3. **The Facility Project Engineer,** in coordination with the onsite facility staff, will review the equipment lists and preventive maintenance tasks for any necessary revisions. A review of the scope of work for any necessary revisions will also be performed.

4. **A standard boilerplate document** should be developed for each equipment system to ensure consistency between the respective facilities. The boilerplate includes:

   a. Standard language to be included in every contract for the "Contractor General Responsibilities" and "General Requirements for All Service Visits" sections; and

   b. A standard outline format for the PM tasks, equipment list and schedule matrix.

5. **The FSCA** should begin the development of the new contract Work Plan using the standard boilerplate documents developed and then approved by Business Office Service Contract Analyst (BOSCA).

6. If revisions are to be made to the standard boilerplate and/or outline format, the **BOSCA** must approve the revision and the new boilerplate/outline format should be distributed to each facility contract office.

7. **The FSCA** should distribute the draft contract Work Plan to the PM-O&M, or designee, for review and approval. If necessary, planning and review meeting(s) should be scheduled with the facility staff.

8. Upon facility approval of the draft contract Work Plan, the FSCA should develop a **Contract Bid Quote Form** using the standard boilerplate that was developed and approved by the facility manager.

9. The Contract Bid Quote Form should be developed by using the appropriate format for the equipment system contract bidding: **Full Warranty Maintenance or Preventive Maintenance.** The Quote Form should contain:

   a. Building Description

   b. Equipment Description

   c. Bid Unit Quantity

   d. Service Frequency (number of required visits per contract year for preventive maintenance; or the number of months per year for full warranty contracts)

   e. The annual cost for the service

   f. The full contract cost for each item, depending on the length of the contract term

   g. A Time and Material Allowance section that will include: material allowance per contract year, number of labor hours for straight time and overtime per contract year and number of training hours per contract year

10. **The FSCA should forward the facility approved** Work Plan draft and Bid Quote Form to BOSCA for peer review.

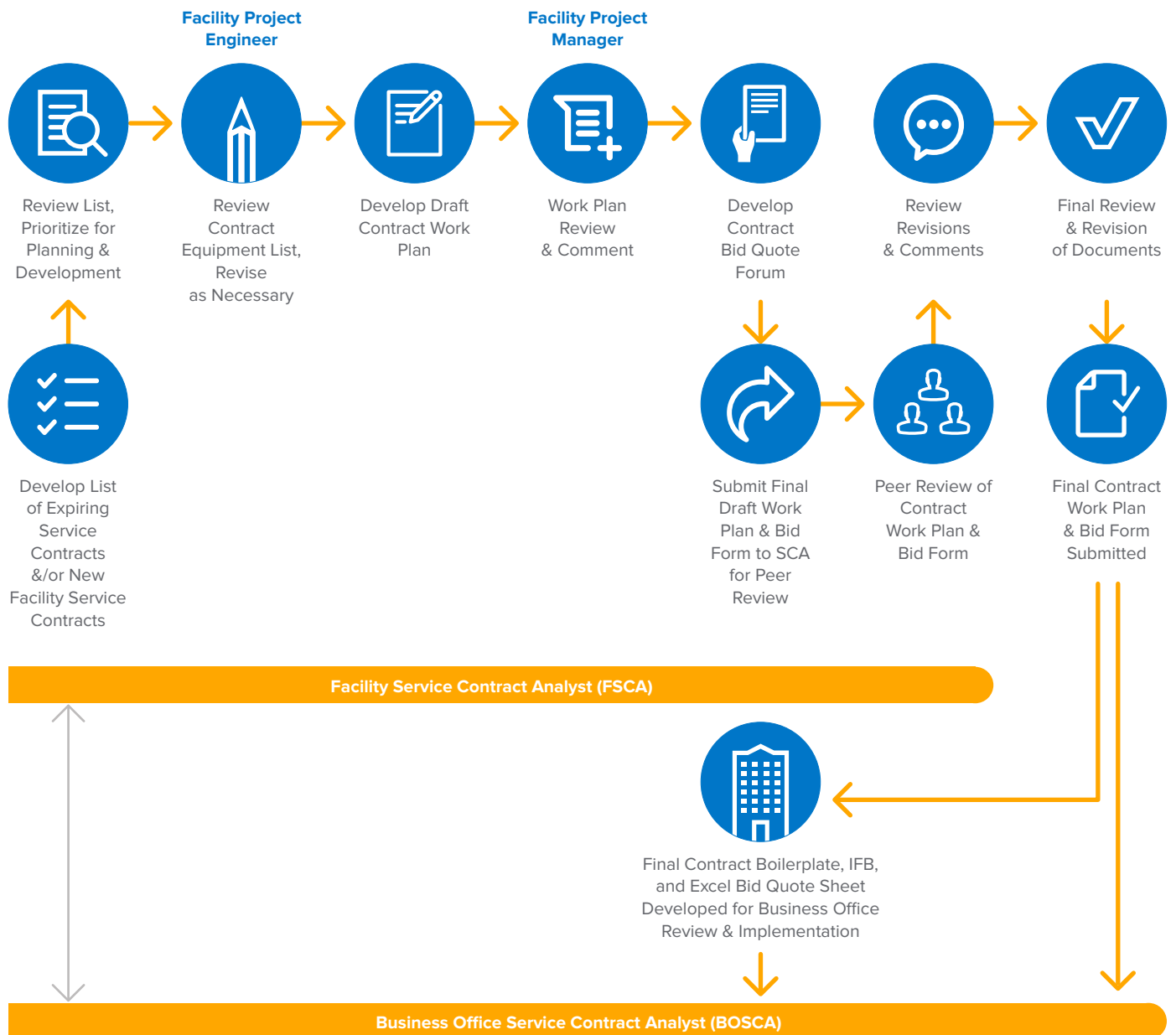11. **The BOSCA should peer review the contract Work Plan draft for:**

    a. Consistency with appropriate equipment system contract boilerplate and outline format

    b. A comparison to the current contract Work Plan, maintenance tasks, and equipment list; any variation or revision to the new contract Work Plan draft, and/or equipment list, will be noted during the peer review for confirmation of the change(s)

c. Review of the schedule matrix to ensure consistency between the equipment maintenance service scheduling of tasks and the Work Plan tasks

d. Consistency with appropriate contract bid format (i.e., full warranty or preventive maintenance)

e. Comparison of the bid quote form list of building/item description (equipment); bid unit and service frequency to the contract Work Plan preventive maintenance tasks; equipment list; and schedule matrix

f. Any variation/changes will be noted during the peer review for confirmation of the change(s)

12. The BOSCA should return the peer-reviewed contract Work Plan draft and bid quote sheet with attached revisions/comments to the **FSCA for review and comment.**

13. The FSCA should review the peer-reviewed contract Work Plan draft and bid quote sheet. The FSCA should respond to the revisions/comments included on the peer-reviewed documents and return to the PM-O&M for a second peer review and/or final revision of the document(s).

14. Upon completion of final contract document revisions, the finalized contract Work Plan draft and **Bid Quote Form will be submitted to the BOSCA.**

15. The BOSCA should develop the Contract Boilerplate, Invitation for Bid, and Excel Bid Quote Sheet, and notify the FSCA that the documents are ready for review and submission to the facility business office.

Program Manager: Operations & Maintenance (PM-O&M)

Facility Project Engineer

Facility Project Manager

Review List, Prioritize for Planning & Development

Review Contract Equipment List, Revise as Necessary

Develop Draft Contract Work Plan

Work Plan Review & Comment

Develop Contract Bid Quote Forum

Review Revisions & Comments

Final Review & Revision of Documents

Develop List of Expiring Service Contracts &/or New Facility Service Contracts

Submit Final Draft Work Plan & Bid Form to SCA for Peer Review

Peer Review of Contract Work Plan & Bid Form

Final Contract Work Plan & Bid Form Submitted

Facility Service Contract Analyst (FSCA)

Final Contract Boilerplate, IFB, and Excel Bid Quote Sheet Developed for Business Office Review & Implementation

Business Office Service Contract Analyst (BOSCA)

Maintenance Service Contract Development Procedural Flowchart

Establishing Contract Terms and Conditions

Service contracts are predominantly comprised of standard terms and conditions, unrelated to the actual tasks that need to be performed. These terms and conditions are common to all service contracts in order to comply with New York State, a specific State Agency, and local Facility procurement rules and regulations.

Defining the details of service terms and conditions is a precise process that will require legal counsel in nearly all cases. Facility managers should consult with their procurement department to fully understand the terms and conditions of any particular contract.

In brief, common O&M service contract terms and conditions for consideration are outlined below:

1. Contractor general responsibilities and requirements

    a. General contract scope of work

    b. Contractor experience, licenses, and certifications required

    c. Times of operation

    d. Definitions of facility straight time and overtime

    e. Mandatory regular meetings on site, without additional compensation

    f. Site contacts and reporting details

    g. Safety and environmental responsibility

    h. Facility risk assessment

2. Preventive maintenance service

    a. Task details

    b. Frequencies

    c. Service ticket

3. Repair maintenance service

    a. Repair procedures: scheduled and emergency

    b. Emergency response times: call-in and onsite response

    c. Time and material Proposal form and documentation

4. Equipment list

    a. Description of equipment

    b. Location of equipment and area served

    c. Schedule matrix

    d. Tasks and month to be performed

Service contracts generally adhere to the following structure:

1. Cover sheet, table of contents

2. Signature page

3. NYS Standard Clauses: Office of State Comptroller Procurement Requirements

    a. Legal conditions of the agreement

    b. Contract term definitions

    c. Conditions of termination

    d. Procurement lobbying act

    e. Vendor responsibility review

    f. Confidentiality

    g. Force majeure protection

    h. Correspondence contacts

4. State Agency specific clauses
   a. Compliance documentation requirements

5. Facility specific clauses
   a. Security procedures: key access, secure areas, escorts, etc.
   b. Safety: confined spaces, lockout/tagout, personal protection, evacuation, fire protection, etc.
   c. Environmental: spill prevention, hazard communication, reporting
   d. HIPAA Confidentiality, as required

6. Minority and Women Business Entity (MBE/WBE Requirements)

7. Budget
   a. Detail of budget breakdown by unit costs
   b. Schedule of values over the contract period
   c. Travel time compensation for emergency response
   d. Invoice requirements and form
   e. Contact information
   f. Payment methods

8. Insurance and Indemnification Requirements
   a. Insurance requirements
   b. Workers' compensation requirements
   c. Prevailing wage compliance

9. Amendment Form, as required

PREPARE THE BID DOCUMENTS & BIDDING PROCESS

Once the contract has been finalized, facility managers will be ready to begin the bidding process.

The format of the bid documents will reflect the type of service contract to be pursued. In some cases, a single lump sum to provide maintenance services to a diverse group and a large quantity of equipment is preferable. Alternatively, bids may request unit pricing to determine the cost to perform a single service on a piece of equipment.

In both cases, the following items should be incorporated in the unit cost or lump sum:

1. **Material required to perform the task**
2. **Labor required to perform the task**
3. **Labor required to travel to and from the site**
4. **Labor required to mobilize to and from the equipment location**
5. **Company standard overhead, as a percentage**
6. **Company profit, as a percentage**

The bid documents should be formatted to provide the facility manager with the unit costs and total costs to perform each specific service. The below table is a suggested bid document format.

Equipment	Quantity	Service	Frequency	Unit Cost	Annual Cost QUANTITY x FREQUENCY x UNIT COST
Pump	10 (pumps)	Quarterly Preventive Maintenance	4 (per year)	$50	**$2,000** 10 x 4 x 50

Table 2: Sample Bid Form Document

BIDDING PROCESS

Effective oversight of the bidding process provides long-term value by increasing bid competitiveness and improving understanding of service costs.

Specific bidding considerations include budgetary cost estimates, bidders list, and a bidder walk-through. These elements of the bidding process ensure that a streamlined and legally-sound workflow is created, and these elements are described in more detail in the following sections.

The format in Table 2 (page 6) will allow the facility manager to evaluate this specific unit cost ($50.00) to perform this specific service (Quarterly Preventive Maintenance Service).

The Bid Documents should be formatted to help make the project work function most effective. The following standard elements are recommended:

1. General scope of work and general terms and conditions

2. Event dates of the sequence for bidding, including the corresponding forms:
a. Mandatory pre-bid conference and site visit
b. Return of pre-bid conference/site visit registration form
c. Receipt of questions from potential bidders
d. Questions/answers responses sent
e. Proposal submission/no bid due date and time
f. Bid responses to bidders
g. Pre-contract award meeting
h. Anticipated contract start/end dates

3. Contact and directions for the bid steps and Information for bid submission

4. Mandatory documents and responses:
a. New York State, State Agency, and facility bidding and procurement requirements
b. Publication of a request for bids in the contract reporter
c. Vendor responsibility requirements
d. MBE/WBE requirements
e. Prevailing wage statement
f. Term of contract and cost escalations
g. Liquidated damages, if required

5. Method of determination of award:
a. Low bid/quote
b. Prime response/proposal
c. Points to review in the award process
d. Right to negotiate bid unit costs, prior to contract award

6. Bid form:
a. Equipment itemized by type and quantity
b. Unit costs required per service per piece of equipment
c. Estimated or actual cost escalations for term of contract
d. Material markups for emergency services
e. Labor rates (straight time and overtime) for emergency services
f. Final full cost of the contract calculation

CREATE BUDGETARY COST ESTIMATES

An estimate of final contract costs should be prepared prior to the bidding process to inform budgetary requirements. The facility manager should be consulted when preparing service cost estimates.

When the bids are received, the unit cost and the total contract cost from the lowest, qualified bidder should be compared with initial cost estimates to determine whether bid estimates are reasonable. If an individual unit cost is unreasonably higher or lower than the estimate, the potential contractor should explain their rationale for their proposed unit cost.

For unit cost bids lower than anticipated, the price should be confirmed with the proposer, along with an affirmation they will honor their proposed cost after contract award. The potential contractor should be asked if they have made a mistake and if they will honor their proposed cost if they are awarded the contract.

For unit cost bids higher than anticipated, the proposer can be asked to negotiate their unit cost to within the range of the predetermined cost estimate. The proposer should be required to provide an explanation of their calculated time required to perform the specified task.

ESTABLISH BIDDERS LIST & CONDUCT WALKTHROUGH

Potential bidders are able to access the bidding process through the notices appearing in the New York State Contract Reporter, a New York State contract publication. In addition, it is beneficial for each State Agency or facility to create a list of potential qualified bidders.

Through the facility manager's industry experience and contacts, a bidders list should be developed by the State Agency or Facility Service Contract Manager for each type of service and, if necessary, updated on a regional basis. The list may be used to obtain the necessary number of qualified bidders to ensure that a competitive bid process is maintained and results in securing several qualified bid proposals.

BIDDER WALK-THROUGH

To assist potential bidders in understanding the condition of the equipment, facility, and equipment access, a mandatory bidder walk-through should be held. The mandatory walk-through eliminates complaints and misunderstandings by contractor estimators after contracts are awarded. A bidder signature sheet should be required to document the walk-through attendance.

The facility should escort the potential bidders to as many equipment locations that would be considered representative of the facility and the equipment list of the service contract. Prior to the start of the walk-through, the facility representative should briefly summarize the scope of work, services required, and the type of tour that will be conducted.

> Require a mandatory bid walk-through to eliminate potential complaints and misunderstandings that can occur after the contract is awarded

During the bidder walk-through, all bidders have an opportunity to observe the equipment, preferably while in operation. If the bidders have any questions, they must submit them in writing after the walk-through. To avoid the appearance of impropriety, there should not be any information provided to any individual contractors during the walk-through that is not made available to the entire group.

During the bidder question/answer period, questions should be collected and responses developed. At the end of the question/answer period, the facility representative should distribute these written questions and answers to all bidders who participated in the walk-through. It is critical that each bidder has the same information before calculating their final bids.

Award Process

Once proposals are received and tabulated, the facility manager should evaluate the contractor's qualifications and proposed unit costs. The analysis should compare the proposed unit costs with industry standards. Where necessary, the facility manager should suggest points of negotiation to reduce overall costs.

The low bidder qualifications should be investigated and references interviewed to ensure the agreement is being made with a qualified contractor

During this review process, it is suggested that the facility manager validate the proposed costs to determine if they are reasonable. If a lump sum cost is provided and not formatted properly to conduct a reasonableness-of-cost review, then it should not be accepted.

As necessary, low bidder qualifications should be investigated and references interviewed to ensure the agreement is being made with a qualified contractor. Questions to be asked should be based on the specific industry and trade the contractor works in.

The questions and responses from each specific reference should be documented and included in the contract file to substantiate acceptance or rejection of the low bidder.

The contract award process should generally involve the following two meetings:

1. Pre-Award Bidder Meeting; and
2. Contract Kick-off Meeting

The importance of both meetings are explained in the following sections.

PRE-AWARD BIDDER MEETING

In certain instances, there are remaining questions regarding the proposed costs or the ability of the bidder to satisfactorily perform the required tasks.

When necessary, a pre-award meeting should be held with the facility staff and the contractor representatives. The pre-award meeting should be conducted to ensure that the terms and conditions of the agreement are understood by the potential contractor and the facility staff to assure that the bidder can meet them.

In some cases, an open discussion should lead to an understanding that the bidder is either not capable of performing the contract requirements or the meeting serves to reassure the facility that the contractor is aware of all conditions and are able to meet all expectations.

The discussion of the pre-award meeting should be documented using meeting minutes and then distributed to all meeting participants.

Pre-award meetings help ensure all parties understand the service agreement's terms and conditions

CONTRACT KICK-OFF MEETING

After all questions are satisfactorily answered, the contracting entity should award the contract in writing to the successful bidder. In coordination with the start date of the contract, the contracting entity should schedule a Contract Kick-off Meeting. The Kick-off Meeting introduces the facility staff to the contractor staff and establishes basic facility protocols within the terms of the contract.

The following items are common topics to discuss during the Kick-off Meeting:

1 Introductions of the significant participants of each party

2 Emergency contacts of each party, for routine and emergency communication

3 Technician and facility supervisors' names and contact information

4 Technician cross-training: ensuring multiple technicians have a basic understanding of facility layout and equipment to be served

5 Point of contact: billing, administration, T&M requests

6 Certifications, licenses, and OSHA 10 compliance: All technicians' information should be submitted to the facility for reference

7 Facility security and safety policies: sign-in procedures, facility IDs, fire alarms, evacuations, tool policy, client safety, escorts, safety data sheets, waste handling, lockout/tagout policy, confined space policy, etc.

8 Equipment in contract

9 Preventive maintenance tasks required

10 Preventive maintenance task schedule

11 Maintenance checklists/service tickets

12 Time & material request procedures (proposals and emergencies)

13 Spare parts/equipment storage

14 Invoicing procedures: invoice format, service tickets, certified payroll

15 Next meeting/project meetings

Continuous Program Monitoring & Compliance

PHASE III

Service Contract or In-House Compliance

The maintenance program does not end with the awarding of a service contract, or completing the work using in-house maintenance staff. Successful program execution requires monitoring and compliance check-ins throughout the duration of the O&M program.

To ensure O&M program quality, program managers may employ a variety of monitoring strategies and processes, some of which include:

- Create a compliance policy and identify/assign a qualified internal staff member (i.e., Service Contract Manager) to ensure maintenance task completion, documentation of work performed, and validation of quality service in accordance with the manufacturer's requirements.

- Ensure that Maintenance Service Tickets or Checklists are required to be completed and submitted to confirm that maintenance tasks have been satisfactorily completed. The Maintenance Service Tickets or Checklists should be required for payment of contractor invoices or before the in-house work is shown as complete in the facility CMMS.

- Evaluate compliance with contract terms and conditions through a review of the Maintenance Service Tickets and field-level quality control verification.

To maximize the benefits of O&M programs, program managers should seek to share information about their maintenance work and key program updates. Possible means of achieving this information sharing include:

- Establish a network of other managers with periodic (quarterly, semi-annual, or annual) meetings or other communications to share State Agency-wide experiences and lessons learned, such as PM tasks, bidder lists, compliance methods, etc.

- Create a newsletter used to inform the statewide facility staff of specific and general information to celebrate high quality maintenance programs, and share best practices.

For programs that utilize service contracts, it is important to establish ongoing communications with contractors to ensure effective provision of service by taking the following steps:

- Establish monthly progress meetings with the facility staff and the contractor to track the progress of scheduled work and emergency projects, and review overall contractor performance. If progress meetings do not resolve poor contractor performance, compliance meetings are conducted, perhaps ultimately leading to the termination of a contract.

- Facility managers must provide firm directions, create clear lines of communication, and define specific protocols during regular progress meetings.

- All meetings should be followed immediately with meeting minutes to document the discussions, as a record of responsibilities, and to confirm expected deliverables and associated dates. If the facility determines that the contract should be terminated for cause, the monthly meeting minutes may be used as supporting documentation.

Establishing monthly progress meetings with service providers, and creating clear lines of communication between contractors and facility staff will help ensure services are provided effectively and in accordance with facility protocols.

Develop Key Performance Indicators to Monitor Compliance

Key Performance Indicators, also referred to as KPIs, can help facilities define and measure progress toward O&M objectives while tracking and maintaining pre-established performance metrics. The KPIs are quantifiable measurements defined before launching an O&M program that reflect the critical success factors of an organization.

Whatever KPIs a State Agency decides to select, they must be quantifiable and reflect the goals of the facility's organization. These KPIs will help benchmark, track, and improve the performance of a State Agency's overall facilities O&M program. Developing these KPIs helps ensure that facility managers issue contracts that deliver impactful outcomes, or effectively manage in-house preventive maintenance (PM) when outside contracts are not utilized.

Organizations typically utilize KPIs, not only as a performance management tool, but also as an incentive. The KPIs give everyone on the team more clarity of what is important and what actions they need to focus on in order to achieve overall success and to manage performance. In this case, KPIs will ensure that everyone is moving in the same direction to guarantee that the facilities staff is focused on meeting or exceeding those KPIs. The KPIs can also be utilized as an incentive.

> KPIs will help benchmark, track, and improve the performance of a State Agency's overall facility's O&M program

State Agencies should consider posting the KPIs throughout the facility offices: in the lunchroom, on the walls of the conference room, and on the company intranet. It highlights the target for each KPI, and documents the progress towards that target. In most cases the facility staff will be motivated to achieve those KPI targets if the objectives are presented in a positive manner.

KPIs are usually long-term considerations. The definition of what they are and how they are measured do not often change. The State Agencies should develop KPI's that become ingrained in the culture of the facility's community. While challenging, this approach presents an opportunity for each department to connect its operation to the State Agency's overall goal.

Selected performance indicators will be the key to the continuous improvement process, hence why they are referred to as KPIs.

How to Identify and Select the Appropriate KPIs

When selecting realistic KPIs, it is critical to limit them to those factors that are essential to the State Agency's ability to reach its goals. It is also important to keep the number of KPIs relatively small across the organization to help keep attention focused on achieving the same realistic goals.

During the development process, KPIs should be integrated and interdependent in order to provide an overall perspective on the facility's goals and specific objectives. During the process of developing KPIs, the following should be taken into consideration:

- Make the objectives clear in order to focus and bring the total facilities organization together. Senior management must clearly articulate the overall vision.

- Maintenance is a core business function, as it includes assets (equipment) and/or facility labor. It is important that the identified KPIs pull together all components of the facility's organization as a whole.

- Focus on critical success factors for each of the processes, recognizing there will be important variables to consider.

- Use KPIs to track facility performance trends and to highlight progress and potential issues/deficiencies.

- Industry standard KPIs can assist organizations in creating facility specific indicators, and help facility managers assess their performance

A Decision Matrix can be utilized as a roadmap to help guide an organization through the O&M KPI identification and development process, and ultimately create KPIs that are effective in managing the performance of your O&M program

Keeping the program objectives in mind help assure the development of a good operation and maintenance (OM) performance indicator system.

NYPA has included a list of the typical KPIs that are utilized to track the performance of a facility in Appendix B.

The Decision Matrix can be found in Appendix B, page 33.

Next Steps

The main objective of this document is to help facilities design strong O&M programs which will maintain energy savings over time. The OMAP Toolkit serves as a roadmap to enable facility managers to effectively implement energy-saving O&M practices.

From potential project funding, to recognition for achievements – OMAP is intended to serve as a resource and pathway for a more energy efficient New York. With a framework provided to simplify the O&M contract procurement process, facility managers will be better positioned to achieve the goals set forth in EO 88.

NYPA, continuing its role as a trusted advisor, is available to help implement the aforementioned plans and programs.

Appendices

Table of Contents

APPENDIX A: PROGRAM TEAM

Below is a list of recommended roles that could help
with the implementation of O&M programs:

- Facility Manager
- Facility Maintenance Specialist
- Service Contract Manager
- Facility Project Engineer
- Facility Service Contract Analyst
- Business Office Service Contract Analyst (BOSCA)
- Program Manager-O&M (PM-O&M)

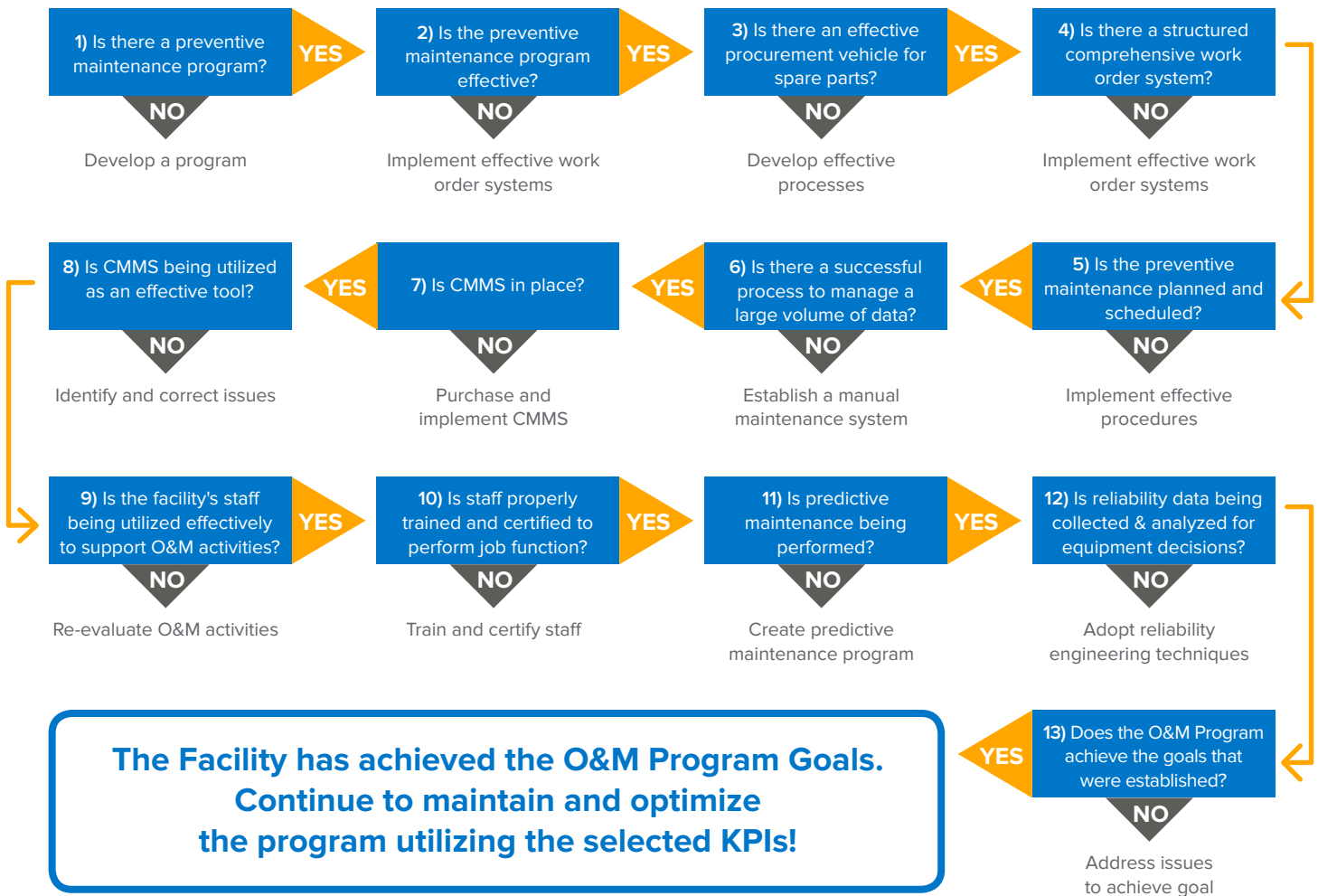# APPENDIX B: A ROADMAP FOR THE DEVELOPMENT OF KEY PERFORMANCE INDICIATORS

The following roadmap should be used to identify appropriate Key Performance Indicators (KPIs) for the facility. Diagram A summarizes the roadmap.

How to Use this Roadmap:
The objective is to get through question No. 13, and be able to answer "Yes" to all thirteen questions. If all 13 of these questions receive an affirmative response, it indicates an effective O&M program is in place. The pages following the roadmap provide additional details to understand each question, and recommended KPIs to help facilities achieve and maintain O&M program milestones.

Beginning with the first box in the Decision Matrix, assess whether your facility or organization is effectively implementing this task. If you can answer yes then you can go to the next question. If no, then execute the appropriate steps to ensure a "yes" answer can be reached to move to the next question. Create KPIs along the way so the facility can monitor their success. Some recommended KPIs are provided so you can monitor and ensure a "yes" answer can be maintained.

DIAGRAM A: INITIATION PROGRAM DECISION MATRIX

1) Is there a preventive maintenance program?	YES →	**2)** Is the preventive maintenance program effective?	YES →	**3)** Is there an effective procurement vehicle for spare parts?	YES →	**4)** Is there a structured comprehensive work order system?
NO ↓		NO ↓		NO ↓		NO ↓
Develop a program		Implement effective work order systems		Develop effective processes		Implement effective work order systems

8) Is CMMS being utilized as an effective tool?	← YES	**7)** Is CMMS in place?	← YES	**6)** Is there a successful process to manage a large volume of data?	← YES	**5)** Is the preventive maintenance planned and scheduled?
NO ↓		NO ↓		NO ↓		NO ↓
Identify and correct issues		Purchase and implement CMMS		Establish a manual maintenance system		Implement effective procedures

9) Is the facility's staff being utilized effectively to support O&M activities?	YES →	**10)** Is staff properly trained and certified to perform job function?	YES →	**11)** Is predictive maintenance being performed?	YES →	**12)** Is reliability data being collected & analyzed for equipment decisions?
NO ↓		NO ↓		NO ↓		NO ↓
Re-evaluate O&M activities		Train and certify staff		Create predictive maintenance program		Adopt reliability engineering techniques

The Facility has achieved the O&M Program Goals. Continue to maintain and optimize the program utilizing the selected KPIs!

← YES **13)** Does the O&M Program achieve the goals that were established?

NO ↓

Address issues to achieve goal

1) Is there a preventive maintenance program?

The preventive maintenance program is the core of any strategy to improve the O&M of equipment. All of the equipment, as outlined within the equipment inventory list, must be covered under a comprehensive and cost-effective preventive maintenance program. The program should be evaluated to ensure that proper maintenance is scheduled at appropriate intervals for each piece of equipment. The maintenance should include cleaning, inspections, adjustments, lubrication, and repair or replacement of failed parts. The overall objective is to ensure that a program is in place that reduces, and eventually eliminates, unplanned maintenance.

2) Is the preventive maintenance program effective?

There are several KPIs that can be utilized to determine the effectiveness of an O&M program. Typically, the effectiveness is determined by quantifying the level of unplanned equipment maintenance. This can be referred to as reactive maintenance, or any equipment repair or maintenance that is performed as a result of a breakdown or unplanned service. In order to move forward and answer "Yes" to the above question, the following KPIs should be achieved.

Note: Although we provide industry standard benchmarks, most organizations prefer create their own benchmarks which are established at the start of the O&M program, and adjusted periodically as the program is implemented.

KPI No. 1: Equipment Downtime Caused by Breakdowns	
Formula: Downtime from Breakdown / Total Downtime	**Benchmark:** N/A

Defining the KPI:
Highlights the impact that the preventive maintenance program has on the facility. It focuses on what the preventive maintenance program is designed to eliminate. This KPI takes the total downtime caused by the breakdown of a piece of equipment, and expresses it in a percentage of downtime. It indicates whether the breakdown (unplanned downtime) is actually an issue.

KPI No. 2: Emergency (Unplanned Work) Man Hours	
Formula: Manhours on Emergency Work / Total Manhours Worked	**Benchmark:** < 20%

Defining the KPI:
Highlights the labor resources being dedicated to breakdowns. When the level of labor usage to address equipment emergencies or breakdown issues is high, then the productivity rates are low. This indicator, expressed as a percentage, may be used to examine the resource by trade. It is useful for assessing if too much maintenance labor is being used to address emergency or breakdown work.

KPI No. 3: Cost of Breakdown (Emergency) Repairs	
Formula: Direct Cost of Breakdown Repairs / Total Direct Cost of Maintenance	**Benchmark:** N/A

Defining the KPI:
Highlights the impact that breakdown or emergency work is having on the facility's O&M budget. It can be utilized to justify improvements in the preventive maintenance program when the percentage of maintenance dollars on breakdown repairs is known. This percentage is calculated by taking the direct cost of maintenance for all breakdown (emergency) repairs and dividing it by the total of the direct maintenance cost. Note: These costs should include labor, materials, rental equipment, contractors, and any other direct maintenance cost. This indicator can be calculated at different levels (i.e., maintenance department, trade level, equipment level).

KPI No. 4: Preventive Maintenance Compliance

Formula: Preventive Maintenance Tasks Completed / Preventive Maintenance Tasks Scheduled

Benchmark: > 95%

Defining the KPI:
Assesses the number of preventive maintenance tasks scheduled compared to the number of preventive maintenance tasks completed. Typically compiled at the conclusion of a week or month, it is useful for highlighting the effectiveness of existing preventive maintenance programs. Effectiveness may be hindered by the failure to complete the tasks that are scheduled due to lack of available resources. This is one of the major KPIs that effectively measures the compliance that a facilities organization has with its preventive maintenance program.

KPI No. 5: Preventive Maintenance Estimates Compliance

Formula: Estimated Preventive Maintenance Task Cost / Actual Preventive Maintenance Task Cost

Benchmark: 0.9 to 1.1

Defining the KPI:
Compares the estimates of labor and material costs for preventive maintenance tasks with the actual costs to perform the tasks. This measure points to the accuracy of the preventive maintenance task estimates. If they are not monitored, then the overall accuracy of the estimated labor and materials required to perform the preventive maintenance tasks will be inaccurate, which can create unknown budgetary issues.

KPI No. 6: Breakdowns From Inadequate / Lack of Proper Preventive Maintenance

Formula: No. of Breakdowns That Should Have Been Prevented / Total No. of Breakdowns

Benchmark: < 20%

Defining the KPI:
Assesses the main cause for breakdowns and investigates whether those causes should have been detected as part of the preventive maintenance program. This indicator evaluates the preventive maintenance task, and the thoroughness of the individual performing the task. The resulting percentage indicates the opportunity for improvement by upgrading or modifying the preventive maintenance program.

KPI No. 7: Preventive Maintenance Efficiency

Formula: Total No. of Work Orders Generated from Preventive Maintenance Inspections / Total No. of Work Orders Generated

Benchmark: N/A

Defining the KPI:
Assesses the amount of work generated from the preventive maintenance program. While completing the inspection, the individual will uncover components or equipment showing signs of wear, or impending failure. The individual will create a work order to correct the issue before a breakdown occurs. Some work should be generated from these preventive maintenance inspections; otherwise, the preventive maintenance tasks are probably being carried out too frequently. It is viewed as effective if the majority of the work orders are identified through the preventive maintenance program. The formula shows that efficiency is measured by dividing the total number of work orders generated from the preventive maintenance program by the total number of work orders submitted. This is typically done on a monthly basis.

KPI No. 8: Overdue Preventive Maintenance Tasks

Formula: No. Preventive Maintenances Past Due / No. of Preventive Maintenances Currently Active

Benchmark: < 5%

Defining the KPI:
Assesses the number of preventive maintenance tasks that are not being completed on schedule. This indicator can be utilized to identify concerning trends and forecast problems. Monitoring this indicator on a weekly basis allows the facility to maintain a proactive approach to managing preventive maintenance tasks.

KPI No. 9: Percentage of Overtime (OT)

Formula: Hours of Overtime Worked / Total Hours Worked

Benchmark: < 5%

Defining the KPI:
Although not a direct indicator, high overtime percentages can indicate an ineffective preventive maintenance program. It can help monitor the amount of emergency / breakdown work that requires overtime to complete. This can be an important indicator given that overtime comes at a higher cost, which can impact a facility budget.

3) Is there an effective procurement vehicle for spare parts in place?

Maintenance materials (i.e. parts, equipment, etc.) can be the largest maintenance support function that contributes to poor maintenance efficiency and effectiveness. It often becomes one of the main causes of equipment downtime. However, technological advances have allowed companies to provide automated inventory management services that help maintenance departments streamline inventory control, reduce carrying costs, and expedite the material ordering process to reduce equipment downtime.

Maintenance, Repair and Overhaul (MRO) spare parts account for an average of 50 percent of a facility's maintenance budget. It is the second most important function in maintenance management (behind preventive maintenance). KPIs for this effort are designed to ensure proper management of the facility's storehouse and procurement functions.

KPI No. 11: Stores Annual Turns	
Formula: Total Annual Amount of Stores Usage / Total Inventory Valuation	**Benchmark:** 1.0 to 2.0 turns
Defining the KPI: Determines the number of times each year the dollar value of the inventory is actually used. Although there are some spare parts that will not be used in a given year, many will show several turns in a year. This indicator (expressed in number of turns) is almost an industry standard as a benchmark, and indicates whether an organization has too large of an inventory on hand. The indicator can be used to compare different organizations because the inventory goal (benchmark) is similar for most organization types.	

KPI No. 12: Service Level of Stores	
Formula: Total No. of Orders Filled on Demand / Total No. of Orders Requested	**Benchmark:** 90% to 97%
Defining the KPI: Represents the percentage of time that the storehouse was able to fill maintenance requests for spare parts. This indicator is becoming a standard benchmark to compare the performance of a facility's storehouse. A higher percentage reflects better performance of the storehouse and purchasing groups in meeting the needs that the facilities have in satisfying the work orders in a timely manner. Performance lower than 90 percent will contribute to delays in work, and percentages higher than 97 percent suggest that the store is carrying too many spare parts.	

KPI No. 13: Percentage of Single Line Item Purchase Orders (PO)

Formula: Total No. of Single Line Item PO's / Total No. of PO's	**Benchmark:** N/A

Defining the KPI:
Every organization has a cost of processing a purchase order. This indicator highlights the opportunity to gain purchase processing efficiencies by consolidating line items and reducing the total number of purchase orders. It is also valuable for determining whether the purchasing function is reactive or proactive. A higher number indicates a more reactive maintenance department, whereas a lower number can indicate a proactive maintenance department with forecasted demands. Each organization should have its own personal benchmark to compare against.

KPI No. 14: Percentage of Maintenance Work Orders Waiting on Parts

Formula: No. of Maintenance Work Orders Awaiting Parts / Total No. of Open Work Orders	**Benchmark:** Low Percentage

Defining the KPI:
Highlights the impact the storehouse and purchasing function have on the execution of maintenance activities. The higher the percentage, the more maintenance work that is being placed on hold by the lack of being able to secure spare parts. This is a good indicator to use when trying to identify where work execution is an issue.

KPI No. 15: Inactive Stock Showing No Movement in Last 12 Months

Formula: Inactive Stock Line Items / Total Stock Line Items	**Benchmark:** < 5%

Defining the KPI:
Used to find spare parts that are no longer needed. These items may have been purchased as spare parts for equipment that is no longer used, or has been replaced. It is useful for highlighting opportunities to reduce the overall inventory valuation.

4) Is there a structured and comprehensive work order system?

The work flow process is the information system for the facilities organization. Without recording all the details on a work order, the facility does not have data to perform any meaningful analysis on their operating practices, policies, and procedures for the equipment it is maintaining. Without an effective work order system, it becomes challenging to plan and schedule maintenance activities. The following KPIs can monitor the work flow system, and the planning and scheduling activities associated with it.

KPI No. 16: Total Maintenance Labor Reported to a Work Order	
Formula: Maintenance Labor Costs on Work Orders / Total Maintenance Labor Costs	**Benchmark:** 100%

Defining the KPI:
Checks the accuracy of the maintenance labor reporting, as it compares the maintenance department labor records to the accounting labor records for the same time period. This will allow the maintenance staff to determine if there are gaps in their recording of data. The KPI, as a %, can be calculated on a weekly or monthly basis, and tracked over a rolling 12-month period to observe accuracy trends.

If below < 100%: then some of the labor costs are not being posted to the Work Order
If above > 100%: then some labor is being overcharged or over-recorded

KPI No. 17: Total Maintenance Material Costs Reported to a Work Order	
Formula: Maintenance Material Costs on Work Orders / Total Maintenance Material Costs	**Benchmark:** 100%

Defining the KPI:
Similar to the maintenance labor indicator above, it highlights the accuracy of the reporting of material costs.

KPI No. 18: Total Maintenance Contract Costs Reported to a Work Order

Formula: Maintenance Contractor on Work Orders / Total Maintenance Contract Costs	Benchmark: 100%

Defining the KPI:
Tracks the accuracy of the maintenance contractor reporting. It compares the maintenance contractor records to the accounting contractor records (purchase orders) for the same time period. This indicator is essential for any organization that wants data accuracy. The data can also be used to monitor contractor usage and effectiveness. If the contractor charges to perform certain tasks, the in-house labor costs then begins to escalate to perform the same work, then a decision may be made to bring this particular work back in-house.

KPI No. 19: Maintenance Labor & Material Costs Charged to a Standing or Blanket Work Order

Formula: Maintenance Labor or Material Costs Charged to a Standing Work Order / Total Maintenance Labor or Material Costs	Benchmark: N/A

Defining the KPI:
Checks the amount of maintenance labor or maintenance materials charged to a standing work order. This indicator prevents excessive charging to a blanket work order. When a percentage of labor or materials charged to a blanket work order is high, then much of an organizations ability to manage data is lost. It can be used to identify when a facility starts to develop the poor habits of taking short cuts on data collection. The KPI, as a percentage, can be calculated on a weekly or monthly basis, and tracked over a rolling 12-month period to observe accuracy trends.

KPI No. 20: Percentage of Work Distribution by Type of Work Order

Formula: Total Charges (labor, materials, contractor) of the Type of Work / Total Charges for All Types of Work	Benchmark: 20% Emergency 40% Preventive 40% Corrective

Defining the KPI:
Monitors the work distribution within the maintenance organization. This shows the focus of the organization and where most of the resources are being consumed. While the terminology may differ, a typical series of categories may be emergency, preventive, and corrective work orders--additional categories may also be added. It closely analyzes trends and identifies potential issues, and allows the maintenance department to take corrective actions to ensure that there is a balanced work distribution. There is versatility in utilizing the format of this KPI to examine labor, material, or contractor costs.

5) Is preventive maintenance planned and scheduled?

Once the work order system is being utilized to the organization's satisfaction, then the facility's work can be planned and scheduled for maximum efficiency and effectiveness. The organization must be focused on increasing efficiencies through better planning, scheduling, and coordination of resources. The following KPIs will help an organization evaluate and control how effective an organization is in planning and scheduling maintenance.

KPI No. 21: Percentage of Maintenance Work Orders Planned	
Formula: Maintenance Work Orders Planned / Total Work Orders Received	**Benchmark:** N/A

Defining the KPI:
Monitors the amount of maintenance work being planned. When the work is unplanned, there are logistical delays getting the equipment shut down, organizing the labor resources, finding and delivering all of the spare parts, and coordinating with contractors. All of this increases the downtime of the equipment. This KPI should not be 100 percent, given that it is not necessary to plan all maintenance functions, but each organization will have a specific benchmark for the proper number of jobs that need to be planned. It should be monitored on a monthly basis, and charted on a rolling 12-month period. Too low of a percentage may indicate a lack of disciplined planning, but the results should be carefully understood and interpreted before coming to conclusions about what the KPI results mean. Note: A similar KPI can be used to monitor the amount of labor and material costs that are planned versus unplanned.

KPI No. 22: Schedule Compliance	
Formula: Maintenance Hours Scheduled / Total Maintenance Hours Worked	**Benchmark:** > 95%

Defining the KPI:
The focus is on hours that were scheduled versus those that actually worked. This KPI shows whether the scheduling process was effective. This is valuable for ensuring the proper level of maintenance that is being worked as scheduled. Although the goal is to achieve 100 percent, some trades may have a lower percentage of scheduled compliance for acceptable reasons. This KPI will provide the organization with an understanding of how the scheduling of preventive maintenance can be improved and identify how it is impacting the organization. The KPI should be tracked on a weekly basis, and charted over a 12-month period.

KPI No. 23: Overtime Percentage

Formula: Total Overtime Hours Worked / Total Hours Worked

Benchmark: ≤ 5%

Defining the KPI:

In some cases overtime is worked in response to improper planning and scheduling. Furthermore, many organizations work a high level of overtime to compensate for a shortage of labor resources. Excessive overtime can have an impact on workforce efficiency. This KPI can be utilized to track overtime amounts and ensure that no excessive maintenance overtime is being expended.

KPI No. 24: Planning Compliance

Formula: Total Hours Estimated on Scheduled Preventive Maintenance Work Orders / Total Hours Charged to Scheduled Preventive Maintenance Work Orders

Benchmark: 1.0

Defining the KPI:

Checks the accuracy of the estimates for the preventive maintenance work that is on the weekly schedule. This KPI is important for organizations that are moving toward an integrated scheduling program in which the maintenance and operations schedules are combined. In organizations where schedule integration is not an issue, this KPI still has some impact on the operations schedule. It is valuable for ensuring accuracy of the preventive maintenance schedule.

KPI No. 25: Work Orders Completed Within +/- 20% of Planned Labor Hour OR Material Cost

Formula: Number of Work Orders Completed Greater than 20% of Estimated Material or Labor / Total Number of Maintenance Work Orders

Benchmark: ≤ 10%

(1 out of every 10 Work Orders having 20% greater actual material cost or labor hours than original budget)

Defining the KPI:

Used to check the accuracy of the labor hour or material cost estimates for the work being completed. This KPI can be set-up to track work order actual labor hours against planned OR the work orders actual material cost versus planned.

This KPI can be a useful tool for monitoring the lack of skills or performance from the planner, supervisor, and/or trades team. The KPI tracks problems that impact the estimates of a planned task. Most organizations start with a goal of ≤ 10% and gradually adjust the KPI towards 0% as the accuracy of planned versus actual improves.

KPI No. 26: Work Orders Overdue	
Formula: Work Orders Overdue / Total Work Orders	**Benchmark:** The lower the percentage the better, with a goal of 0 percent

Defining the KPI:
Checks the timeliness of Work Order Completion. The goal is typically to complete the work order within 2 to 4 weeks of being issued. This KPI is valuable for ensuring the timely services of the maintenance department and maintaining a good customer service rating.

6) Is a CMMS in place? If so, is the system being utilized as an effective tool?

A Computer Maintenance Management Software (CMMS) is a user-friendly software tool that can be utilized to perform functions in support of the management and tracking of O&M programs. The information gathered in the system is intended to help maintenance workers perform their tasks more effectively and help management make informed decisions. The CMMS packages may be used by any organization that must perform maintenance on equipment, assets and property.

The CMMS can produce status reports and documents that provide the analytics that assess various O&M activities. We typically find that several reasons cause the CMMS to be an ineffective tool after installation. The most common reasons include:

- Poorly configured system
- Lack of maintenance dedication
- Incomplete implementation of the system
- Lack of end user training
- Lack of sufficient resources (labor) to maintain the CMMS
- Inaccurate data
- Not utilizing the data for analysis
- Poor "buy-in" from the organization

The work order process, as previously discussed, is an important feature of the CMMS as it collects all of the labor, material, contractor, and preventive maintenance that are recorded for a piece of equipment. The collected information is stored in a database called the Equipment History. It is from here that all of the data is extracted to create the various reports required to manage the equipment. A fully operating CMMS is needed if any useful data is to be collected and analyzed. The following KPIs can be used to help ensure a successful data collection and management program is employed.

KPI No. 27: Percentage of Maintenance Labor, Material or Contractor Costs

Formula: Total Maintenance Labor, Material, or Contractor Costs in CMMS / Total Maintenance Labor, Material or Contractor Costs from Accounting	**Benchmark:** Goal to achieve 100 Percent

Defining the KPI:
Compares the maintenance labor, material or contractor costs captured in the CMMS to the maintenance labor, material and contractor costs in the accounting system. This KPI ensures that all costs are being recorded correctly. The resulting percentage is the degree of accuracy of the data in the CMMS. If the percent is above 100 percent, then the maintenance staff is overbilling. If the percent is below 100 percent, then the CMMS is not capturing all of the costs. This KPI allows the organization to track the accuracy of its labor, material or contractor charges that are being inputted into the CMMS.

KPI No. 28: Percentage of Equipment Coverage by the CMMS

Formula: Total Quantity of Equipment in CMMS / Total Quantity of Equipment on Campus / in Building	**Benchmark:** Goal to achieve 100 Percent

Defining the KPI:
Evaluates how many pieces of equipment are in the CMMS. The CMMS should cover all equipment (first, second and third tier). If equipment is missing, the costs are typically charged to a standing work order, and the information is unusable for data analytics, equipment troubleshooting, or life cycle costing. All equipment that requires preventive maintenance must be entered into the CMMS. This KPI is required for any organization that wants to have complete accuracy of the maintenance data and being able to charge all costs and repair information to the appropriate equipment history. It is an important tool that ensures complete equipment coverage.

KPI No. 29: Percentage of Stores Coverage by CMMS

Formula: Total Quantity of Parts in CMMS / Total Quantity of Parts on Campus	**Benchmark:** Goal to achieve 100 percent

Defining the KPI:
Evaluates the extent to which inventory and spare parts are covered by the CMMS. Although this information may be challenging to collect, it is a good indicator for an organization that wants to ensure accuracy of the inventory and procurement data, and being able to charge the parts cost to the appropriate equipment history.

KPI No. 30: Percentage of Preventive Maintenance Coverage by CMMS

Formula: Total Quantity of Preventive Maintenance Tasks / Total Quantity of Equipment Items Multiplied by 3

Benchmark: The goal is 100 percent or higher

Defining the KPI:
Evaluates the level of preventive maintenance coverage that has been placed in the CMMS. By reviewing the total number of equipment items and comparing it to the average number of preventive maintenance tasks for an equipment item, a goal can be identified. By comparing the number of preventive maintenance tasks to this number, the facility's department may obtain an estimated level of coverage. A piece of equipment can have several types of task intervals (daily, weekly, monthly, quarterly, semi-annual, annual, therefore the total quantity of equipment items is multiplied by three). This KPI provides a theoretical check on preventive maintenance coverage in a CMMS.

KPI No. 31: Percentage of Maintenance Information Recorded at the Equipment Level

Formula: Total Maintenance Costs Charged to Individual Equipment / Total Maintenance Cost from Accounting

Benchmark: N/A

Defining the KPI:
Evaluates the cost information that is recorded at the equipment level compared to untracked cost information. This KPI is useful for identifying how much of the maintenance cost cannot be traced to a specific equipment item for data analysis, equipment troubleshooting, or life cycle costing. The resulting percentage is the cost that is traceable to an equipment item. The other costs are most likely charged to standing work orders or go unrecorded. It is a valuable KPI for ensuring complete cost accuracy.

KPI No. 32: Supervisory Staffing Ratio

Formula: No. of Maintenance FTEs / No. of Supervisors

Benchmark: 8:1 to 12:1

Defining the KPI:
Monitors the span of control for a front-line maintenance supervisor. In a typical organization, the average ratio is 1 supervisor for every 8 to 12 maintenance workers. Some organizations have tried to extend the ratio, but it can result in inefficient supervision and wasted labor productivity that will result in greater cost. If the number is less than 8, there is not sufficient work to justify a supervisor. The exception to this is when the total number of maintenance staff is less than 8. This KPI is valuable for any organization focused on ensuring proper supervisory levels for the maintenance organization.

KPI No. 33: Percentage of Maintenance Support to Direct Maintenance Costs

Formula: Total No. of Maintenance Overhead Personnel / Total Hourly Maintenance Personnel

Benchmark: 3:1 to 5:1

Defining the KPI:
Utilized to monitor the support personnel required for the maintenance staff. In a traditional facilities organization, the proper ratio is 1 support person for every 3 to 5 hourly maintenance workers. Some organizations have been able to justify extending the ratio to 5 to 1 by applying CMMS data collection and analysis techniques. However, an improperly configured CMMS will be difficult to manage, and could in fact lower the ratio. Any ratio over 5 can result in ineffective staffing. For example, it is likely more economical for an organization to pay a maintenance clerk to enter information into the CMMS than it is to pay a maintenance worker to perform this job function. This KPI is valued for organizations that want to ensure they have proper levels of support for the maintenance organization.

7) Are the facilities staff being utilized effectively to support O&M activities?

Many organizations face a shortage of qualified maintenance workers that are responsible for performing much of the technical "hands-on" work that needs to be performed on the equipment. In fact, it is common that equipment does not operate correctly because it does not receive the proper attention that is required to maintain the equipment at peak operating efficiencies. In order to solve this issue, organizations typically involve the operators in activities such as start-up activities, cleaning, routine lubrication, preventive maintenance, and data collection. Involving the operators in preventive maintenance activities should be monitored. The following KPIs can be used to track this.

KPI No. 34: Percentage of PMs Performed by Operators

Formula: Hours of Preventive Maintenance Performed by Operator / Total Preventive Maintenance Hours

Benchmark: Range between 20 percent and 40 percent of the preventive maintenance Workload

Defining the KPI:
Evaluates the preventive maintenance program and what percentage of the work is being performed by the building operators. This KPI ensures that some of the preventive maintenance tasks are being performed by the operator, and is irrelevant if an organization's operators and maintenance workers are one in the same. The resulting percentage shows the amount of preventive maintenance work being performed by the operators. This KPI is valuable for organizations that want to ensure there is operational involvement in the preventive maintenance program.

KPI No. 35: Availability of Maintenance Resources

Formula: Hours of Preventive Maintenance Activities Performed by Operators This year / Hours of Preventive Maintenance Activities Performed by Operators Previous year

Benchmark: ≥ previous year percent

Defining the KPI:
Evaluates the increased maintenance resource available due to the operator's activities. This KPI should demonstrate the positive impact by involving operators in the preventive maintenance work. It is best to use monthly totals, and trend the indicator over a 12-month window. The KPI is useful for highlighting the change in operator involvement in preventive maintenance activities.

KPI No. 36: Percentage of Operators Time Spent on Equipment Improvement Activities

Formula: Hours of Equipment Improvement Performed by Operators / Total Hours Worked by Operators

Benchmark: TBD

Defining the KPI:
Evaluates the percentage of time the operators spend on equipment improvement activities and compares it to the operator's total time. The result can be trended over time to show the level of involvement of the operators in equipment improvement activities. When calculating this KPI it is ideal to use a monthly total and then trend over a 12-month period. This KPI is useful for highlighting the level of involvement in equipment improvement activities. It helps to ensure that the improvement activities are consistent, and prevents the program from losing ground.

8) Is staff properly trained / certified to perform their job function?

The training and education of today's maintenance workforce is becoming a major challenge that needs to be addressed. The current workforce for many State Agencies are aging, and the skills of those entering the workforce require proper training to adequately replace those who are retiring. Training and re-training will be essential if the technical skills required to operate and maintain the newer, high-tech equipment is being installed in new buildings and major renovation projects. The O&M of these technology-advanced boilers, chillers, and HVAC controls is leaving a significant need for the training of staff.

There is often a significant amount of damage to equipment, creating energy inefficiencies, because the O&M staff are unsure of how to operate and maintain the equipment as designed. Given that these needs exist, an organization needs to identify how their workforce is keeping pace with the changing equipment technologies. An evaluation of workforce skills should be performed using some of the following KPIs.

KPI No. 37: Training % Versus Total Facility Payroll	
Formula: Total Training Dollars / Total Facility Organization Payroll	**Benchmark:** 2.5% (54 hours per year) – per 2015 U.S. Training Industry Report)
Defining the KPI: Evaluates the actual average training dollars being spent per employee per year. It is useful for trending the training expenditures and ensuring that an appropriate level of training is being funded by the organization. It is useful for trending the training budget as the plant payroll increases or decreases, and ensure an appropriate level of training is budgeted.	

KPI No. 38: Annual Training Expenditures Per Employee	
Formula: No. of Facility Employees / Total Annual Facility Training Expenditure	**Benchmark:** $871 (per 2015 U.S. Training Industry Report for Service Industry)
Defining the KPI: Evaluates the actual average training expenditures being allocated per employee per year. Although "soft" skills training is important, technical training is equally important and often minimized. These skills are essential to improve O&M effectiveness.	

KPI No. 39: OSHA Recordable Injuries per 200,000 Labor Hours

Formula: No. of OSHA Recordable Accidents / 200,000 Labor Hours	**Benchmark:** Ratio (Goal: 0)

Defining the KPI:
Measures the number of OSHA recordable accidents per 200,000 labor hours worked. This safety KPI is standard in the United States, as all organizations are required to track this information in the same format.

KPI No. 40: Downtime Related to Operator Training

Formula: Total Downtime Related to Operator Training / Total Downtime (Hours)	**Benchmark:** TBD

Defining the KPI:
Examines the actual equipment downtime that is caused by the operators' skill deficiencies. Useful for tracking the hours of downtime caused by operational errors. However, it is better utilized by tracking the reduction in downtime hours once a training program has been implemented. It is then easier to calculate the ROI for training.

KPI No. 41: Downtime Related to Maintenance Training

Formula: Total Downtime Attributed to Maintenance Errors / Total Downtime	**Benchmark:** TBD

Defining the KPI:
Similar to the above, but it focuses on maintenance skill deficiencies. Useful for tracking the hours of downtime caused by maintenance errors. However, it is better utilized by tracking the reduction in downtime hours once a training program has been implemented. It is then easier to calculate the ROI for training.

KPI No. 42: Average Training Versus Payroll	
Formula: Total Training Dollars / Total Facilities Payroll	**Benchmark:** TBD

Defining the KPI:
Evaluates the actual average training dollars being invested on training compared to actual payroll. Utilized for trending the training budget as the payroll increases or decreases, the KPI ensures the proper level of training budget is set aside.

9) Is predictive maintenance being performed?

Predictive maintenance is the monitoring of equipment operating conditions to detect any signs of wear that is leading the equipment towards failure. The goal of the predictive maintenance program is to track the component wear with a methodology that ensures that any impending failures are detected. Once identified, the component wear is more closely tracked by measuring operating dynamics from one of these techniques: vibration analysis, thermography, ultrasonic, oil analysis, lubricant condition, wear particles. The idea is to replace the component before it reaches complete failure. Below are some of the key KPIs that can be used to determine if the predictive maintenance program is being implemented successfully.

KPI No. 43: Predictive Maintenance Activities as a Percent of Total Maintenance Activities	
Formula: Hours of Predictive Maintenance Activities / Total Maintenance Hours (Note: can also be done for costs)	**Benchmark:** TBD

Defining the KPI:
Examines the percentage of maintenance activities that are predictive compared to the other categories of maintenance work. It can be viewed by total hours or total dollars spent on maintenance. The resulting percentage can be trended over time to show the level of hours or costs invested in the predictive maintenance program. It is best to use a weekly total and then trend over a 12-month period. This KPI is useful for highlighting the level of predictive maintenance activities and ensuring that the predictive maintenance activities are consistent.

KPI No. 44: Decreased Maintenance Expenses Attributed to Predictive Maintenance Activities	
Formula: Current Maintenance Costs / Maintenance Costs Prior to Predictive Maintenance Program	**Benchmark:** TBD

Defining the KPI:
Evaluates the maintenance expense reduction for operating in a predictive mode compared to a reactive or preventive mode. These costs should be in the form of monthly expenditures. The result, which can be expressed as a percentage, can be trended over a rolling 12-month period, with the lowest and highest months displayed as the range. This KPI is valuable for developing and maintaining support for the predictive maintenance program. There is value in educating the greater organization about the financial benefits of a predictive maintenance program.

KPI No. 45: Decreased Breakdown Frequency	
Formula: Number of Equipment Breakdowns / Total Hours in Time Period	**Benchmark:** TBD

Defining the KPI:
Evaluates the Mean Time Between Failure calculation for selected critical equipment items. The effectiveness of the predictive maintenance program is determined by having fewer equipment breakdowns. For each piece of equipment, the number of breakdowns is divided by the time period, producing a mean time period between failures. This KPI highlights the impact that predictive maintenance activities have on equipment failures. As long as the ratio increases over time, the program is deemed effective.

10) Is reliability data being collected & analyzed for equipment decisions?

Reliability Centered Maintenance is a very forward-thinking approach to equipment reliability. It focuses on the optimization of the preventive and predictive maintenance programs to increase equipment efficiency while minimizing the related maintenance costs. Given that this approach is such an advanced maintenance technique, it is important to understand how it should be monitored. The following KPIs will help monitor the Reliability Centered Maintenance process.

KPI No. 46: Percentage of Repetitive Equipment Failures

Formula: No. of Repetitive Equipment Failures / Total No. of Equipment Failures

Benchmark: Trending downward

Defining the KPIs:

The result, as shown by percentage, represents the opportunity to reduce equipment failures through the Reliability Centered Maintenance process. The indicator should be tracked by individual equipment item, and is useful for highlighting potential opportunities for Reliability Centered Maintenance analysis in the area of repetitive equipment failures.

KPI No. 47: Percentage of Preventive Maintenance Program Activities Audited Annually for Effectiveness

Formula: No. of Maintenance Tasks Audited / Total Number of Maintenance Tasks

Benchmark: > 10%

Defining the KPIs:

Indicates the level of preventive maintenance tasks that are actually being compared to the equipment history and the root cause of breakdowns, insuring that the correct procedures are on the preventive maintenance tasks, and that they are only being performed at the correct frequency. This KPI ensures that the preventive maintenance program is being closely monitored.

KPI No. 48: Percentage of Predictive Maintenance Program Activities Audited Annually for Effectiveness

Formula: Number of Predictive Maintenance Tasks Audited / Total Number of Predictive Maintenance Tasks

Benchmark: > 10%

Defining the KPIs:

This percentage compares the number of predictive maintenance tasks that are being audited each year to the total number of predictive tasks. This KPI also ensures the predictive maintenance program is closely being monitored.

KPI No. 49: Extension of Equipment Life and Increased Mean Time Between Failures

Formula: Total No. of Equipment Breakdowns / Total Hours in Time Period Between Failures	**Benchmark:** If monitored by year, then decreases in the figure indicate the Reliability Centered Maintenance program is effective.

Defining the KPI:
This ratio examines the mean time between failures for each piece of equipment. The number of breakdowns should be divided by a specific time period, such as a full year (8,760 hrs) or the period of time since the equipment was installed. This ratio can highlight the impact that Reliability Centered Maintenance activities have on equipment failures. It is an important ratio to use in order to keep the Reliability Centered Maintenance program effective.

APPENDIX C: WORK PLAN TEMPLATES

Work Plans serve as a critical resource for facility managers in the implantation of a successful O&M Program. Facility managers should evaluate past service records to identify which Work Plan outline in the Resource Toolkit would best support their O&M Program.

Sample Work Plans include:

- Boiler Service Contract Work Plan
- Chiller Service Contract Work Plan
- Heating Ventilation and Air Conditioning System Service Contract Work Plan
- Building Management System Service Contract Work Plan
- Generator Service Contract Work Plan
- Elevator and Escalator Service Contract Work Plan
- Electrical System Service Contract Work Plan
- Water Treatment Service Contract Work Plan
- Fire, Smoke and Combination Damper Maintenance Work Plan

APPENDIX D: CASE STUDY

Service Contract Management – A State Agency's Success Story

The New York State Office of Mental Health (OMH) created a comprehensive facilities service contract management program in 2005. The program encompasses the following service contracts: Building Management Systems; Heating, Ventilation and Air Conditioning; Boilers; Chillers; Refrigeration Equipment; Emergency Generators; and Elevators. The OMH contract system includes 136 service contracts to support 28 campuses throughout New York.

The program was initiated by evaluating the specific needs of each facility, and identifying a cost-effective solution for providing successful preventive maintenance and repair services. The outcomes of this evaluation allowed the State Agency to create policies and procedures that created a very comprehensive program that closely aligns with the O&M Program elements that are described in this OMAP Toolkit.

These new processes, procedures, and templates were created and implemented to provide a very successful maintenance program for every campus across OMH. A few of these important enhancements included:

- Utilizing qualified engineering consultants to create the framework for this program.
- Converting existing full-warranty type service contracts to preventive maintenance with added provisions to address time and material repairs.

- The development of bid documents in compliance with the New York State legal requirements and procurement guidelines.
- Conducting service contract cost estimates, prior to the request for bids, to provide the facilities with a budgetary cost and a point of comparison of received bids.
- A review of the low bidder's qualifications (upon bid receipt) and proposed costs were completed to ensure the client is obtaining qualified services at the least cost.
- Identifying where the unit costs exceed industry standards.
- Assisting each campus' facility department with the management of the contract and ensures compliance with all terms and conditions of the contract.
- Reviewing proposals for time and material repairs submitted by the service contractors for reasonableness of cost and the proper scope of work. Alternatives are considered and recommended as appropriate.
- Recommending improvements and management strategies to the service contractor that reduce costs and improve overall service delivery.

As of 2016, the services contract management program has **documented a cost avoidance that exceeds $19 million.**

O&M Acceleration Program