

Valve Maintenance

Preparing for the Plant Outage

White Paper

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1.0 Executive Summary

As production and utility plant areas prepare for upcoming maintenance turnarounds (TAR), outages, and shut-downs, effective planning can save time and curtail expenses associated with the testing, repair, and replacement of control valves within the plant's total valve population. Effective planning is also a key component to smoothly managing both internal maintenance employees and externally contracted technicians that will be performing the work. Manpower resources make up a large portion of the total expenses associated with the outage so organization becomes just as important as those planning processes.

While outage employees will be required to document all valve repairs and their associated usage of parts and equipment, plant facility employees will eventually be required to update all equipment maintenance history records with that very repair and replacement information. Documenting "as-left" conditions in a post-outage report brings closure to the process and highlights performance issues that are found, which need to be addressed in the future.

In many cases, existing plant Preventive Maintenance (PM) programs have already identified or scheduled the repair of critical valves within the plant's valve population. That very PM program may depend on the utilization of an existing Computerized Maintenance Management System (CMMS). It can be helpful when scheduling work to be performed during the outage and reconciling its listing of poorly performing valves already identified. Another method used to identify control valves that need attention is to perform a "walk down" of the plant outage area. A walk down reduces the chance of missing or misidentifying the testing and repairs of those known "bad actors" and reviewing the valve population in this

manner can help prioritize or de-prioritize the repair or replacement of expensive valves during the outage over the less expensive valves. This is especially important when considering budget constraints and criticality rankings.

Long before the planned outage date, Facility, Maintenance, and/or Reliability Engineering have usually established an estimated budget that is dedicated to the testing, removal, and repair or replacement of problem valves. But the outage budget may or may not fall within the overall maintenance budget for the fiscal year. This fact can sometimes limit funding for the outage project and associated valve work especially if little to no "scope-creep" is planned for during the work event. As unplanned valve related problems are found and identified, decisions have to be made quickly about financing additional materials and resources required to resolve those problems. Making sure that some form of cost-overflow allowance is planned for within the budget can avert crisis management decisions.

Facilities, Maintenance, or Reliability Engineering along with an Operations representative usually begin the outage planning a minimum of six months before the scheduled outage date. They will be familiar with the preliminary budget allocation along with the preliminary equipment list which includes critical valves to be repaired or replaced. They will also set goals, milestones, and key performance indicators (KPI's) based upon what they believe can realistically be accomplished. In light of both budget and time constraints, there are many key components to planning, performing, completing, and reporting the valve work to be performed during a successful plant outage.

2.0 Walk Down Outage Area

Once the outage date(s) and period is firmly established and agreed upon by both Operations and Maintenance departments, the next step is determining what actual valve work needs to be accomplished during the outage. The walk down can be performed by a qualified area technician, planner, facility or reliability engineer, contractor outage manager (if used), and/or operations manager but this responsibility can vary depending on the company. Walking through the outage area and observing poorly performing valves, leaking flange connections, leaking stem seals and packing, noticeable air leaks, bad positioner air gauges, tubing damage, etc., is all part of the walk down action. Any of these abnormalities are documented as well as the valve manufacturer, serial number, valve type, size, positioner, actuator, photos of the tag, and the valve location description. Noting the valve location is very important for when the outage manager plans the actual work, so a detailed location description is necessary. The more quickly the valve technicians can move from valve-to-valve while keeping equipment and tool relocation distances to a minimum greatly improves efficiency. Valve-specific information should already be electronically stored and associated with the valve tag in the CMMS or other relational database software program but verification is still required. Sometimes valves, actuators, positioners, trim type, etc., are changed during regular maintenance and not properly documented or updated within the CMMS application. The walk down serves to remedy this problem. The CMMS information can even be updated after the walk down.

If outside valve maintenance personnel will be contracted to perform valve repair and/or replacement during the outage, additional data should be surveyed and included

with the walk down report. This survey data may include:

- Cafeteria and food and drink locations
- Safety, medical treatment and eyewash stations
- Parking locations
- Restroom locations
- Elevator locations, cranes / rigging availability and locations
- Gate or building entry and exit points
- Availability of loading/unloading docks and forklifts to move heavy valves and parts
- Storeroom location
- Electrical power availability and location of receptacles
- Compressed air availability and location of supply manifolds
- Waste receptacles and plan for waste removal
- Removal and disposal plan of hazardous materials or waste process material

Contract workers should not be expected or encouraged to walk around the facility in search of the above items in order to perform their work due to safety concerns. Getting contract maintenance personnel, equipment, tools, repair parts, etc., into the facility efficiently and familiar with both the worksite and job scope allows the work to begin quickly and without confusion. Including the survey information into the walk down report will assure this efficiency.

3.0 Walk-Down Report / Outage Kick off Meeting Prep / Preliminary Work List Creation

The walk down report is a vital part in establishing the scope of work to be performed during the outage. When the CMMS work tag list is compiled with the tag list and information gained from the walk down, a preliminary valve work scope can be developed in preparation of the kick off meeting. The walk down / outage kick off meeting prep report which has the compiled tag list can be used to review what parts are available and which ones must be ordered for the outage. This task is accomplished prior to the outage kick off meeting.

PM programs and their associated CMMS documentation along with normal everyday spare parts strategies, usually dictate to facilities to keep some valve replacement and repair parts on-hand. Many facilities desire to pull from their everyday repair/replacement inventory first for the outage and/or purchase repair/replacement parts in advance of the outage to hold within their stockrooms or storehouses. But some facilities will prefer to rely on contractor-supplied valve replacement and repair parts so usually a combination of each strategy is implemented. The required replacement valves list, critical valve repair list, and long-lead time specialty valves list can be

sent to procurement, planning, or contractor personnel for quoting and comment prior to the kick off meeting along with the walk-down report. Long lead-time parts such as special valve trim, exotic materials, specialty function valves, or large control valves can take up to 6 months to receive.

Once the quotes have been received back for parts and replacement valves from vendors (not including contractor supplied material and manpower), a preliminary work list of valves can be created. Historical CMMS data, outage experience, technician knowledge, and contractor information can all be utilized in determining average repair or replacement times required when reviewing the preliminary work list and planning the outage. An estimated total number of man-hours required to perform the work should be prepared for the kick off meeting. This information will be required when manpower resource utilization is planned, quoted, and finalized.



4.0 Create Outage Team

Establishing the core outage team prior to the kick-off meeting is important. The work scope helps determine which personnel will be necessary in order to be successful. The outage manager who, most likely has already been chosen by senior management will define the roles and responsibilities of the outage personnel prior to the kick-off meeting with additional responsibilities and/or personnel added or removed if required. The outage manager chooses the team members.

Outage team members can vary depending on the size and scope of the event and the skill sets required to accomplish the valve work defined within the job scope. Typical outage team members are shown in Table 1.

The names and cell phone numbers for each team member are necessary to make sure that there are no barriers to communication as issues come up before, during, and after the planned outage. Communication between all team members is vital especially when tools, people, materials, and equipment are moved around as the work progresses.

Table 1

Core Outage Team Members	
Onsite Outage Manager (Contract or Company)	Facilities and/or Reliability Engineer
Materials and Work Planner or Procurement	Environmental, Safety, and Health Representative
Area Maintenance Techs, Electricians, Mechanics	Area Operations Representative
Contract Maintenance Company Representative	Contract Maintenance Lead Tech
E & I Supervisor or Maintenance Manager	

5.0 Kick off Meeting

Depending on the amount and detail of the upfront planning outage prep work, the outage kick off meeting may or may not be extensive. The meeting should be facilitated and led by the outage manager with the following goals in mind to accomplish:

- Change / Define Roles and Responsibilities
 - What additional personnel will be required?
What personnel will not be required?
- Scope of Work defined and finalized
 - Start date, end date of outage finalized
 - Valve tag listing is reviewed and prioritized according to criticality and PM requirements
 - Valve tag listing is vetted to add or remove valves from list based upon many factors
 - Budget review along with contractor input of estimated costs
 - Repair / Replacement Parts Strategy agreed upon
 - Use storeroom inventory, internally purchase or contractor supplied?
- Valve Repair Budget Established
 - Valve tags with description of work to be performed given to contractor for estimate/RFQ
- Scope Creep Budget Established to handle costs of additional repairs / replacements found when outage is performed (issues found when repairs take place that are unplanned)
- Technical and Application Review
 - Discuss electrical, process piping, control logic changes, equipment changes, utilities upgrades, etc. that makes sense to perform while area is down

Sometimes plant personnel are hesitant to invite contract personnel to the outage kick off meeting. If outside contract personnel are going to be used, the representative can offer invaluable advice and can lay-out logistical requirements for the people performing the work. In addition, they can begin collecting the information required to prepare their quotations for the manpower and materials needed.

6.0 Pre-Outage Logistics Meeting

Upon completion of the kick-off meeting, a pre-outage logistics meeting is advised. When the outage manager is planning and working out the logistics of the “how, where, when, and who” will be using support equipment needed to perform the valve repair work, interdepartmental communication within the organization can be very important. Similar to the kick-off meeting, the outage manager determines the correct attendee list for the pre-outage logistics meeting. Once again, it is recommended that the contract maintenance company representative attend this meeting.

6.1 Ancillary Support / Logistic Items

A discussion now needs to take place concerning the equipment and services required to perform the valve maintenance work. The following items need to be considered with action taken prior to performing the repair or replacement of valves on-site during the outage to ensure that the work can be accomplished:

- Compressed air availability
- Power availability for tools
- I/O Loop Power and Controller/DCS Signal Active for loop checking
- Order / rent cranes, rigging, man-lifts, safety harnesses, fork lifts
- Machine shop availability and capabilities with notification to the department
- Valve maintenance manuals availability or placed on order
- Special tools availability or ordered for valve disassembly or setting
- Test equipment availability

6.2 Impact to Outage Timeline

Many factors can negatively impact the outage timeline as the planning moves forward and the actual outage event takes place. It is common for additional outage work to take place in adjacent areas to the valve repair locations at the same time so the sharing of cranes, hoists, rigging, or man-lifts may be possible. Make sure to check with all other departments participating in the outage when planning for the use of those items. But there can be a downside to other craft departmental personal performing work in the same area of the facility where the valve work is taking place; access to the valves may be limited. Again, communication among all departments participating in the outage both before and during the outage is paramount. If particular valves cannot be temporarily accessed, personnel can move to a nearby valve and work until the adjacent work is finished.

Another timeline consideration is valves that are located outside on systems such as heat exchangers, flash steam condensate collection tanks, cooling towers, and HVAC units. Local weather must be considered. Severe weather can impact everything from equipment rental availability to an employee's ability to travel to work. There must be contingency plans made to allow the work schedule to change, slide, or cancel and reschedule. A much smaller valve work list with only the critical repair/replacement valves should be created in case time or resources are limited based upon a severe weather event.

6.3 Contract Personnel Access, Training, Safety, Equipment

Similar to permanent facility maintenance employees, contract outage employees must have access to safety equipment, training and certifications, work permits and facility areas. While contract employees can receive training and certifications prior to the outage, they will

still need to complete applications for permits, complete badging forms, gather specific personal protection equipment (PPE), and register their vehicles. Some of the common work and facility entry requirements are shown in Table 2.

Table 2

Contractor Medical, Safety, and Training	Contractor Facility Access
Contractor Medical Conditions / History	Contractor Person and Vehicle Badging
Safety Training (MASC or similar completed)	Contractor Parking
Personal Protection Equipment	Contractor Tools and Machinery
Lock-Out/Tag-Out System Training	Contractor Vehicle Area Entry
Safety Harness Certification	Contractor Facility Escort Identified
MSDS' for Chemicals Available	
Hot Work Permits	
Man-lift Operation Training	

6.4 Generate PO to Contractor for Parts and Personnel

Based upon the quotations received from the contractor, any purchase orders for repair parts, equipment, and contract valve maintenance personal must be finalized and issued to the contractor at this time. Valve technicians have specialized training, knowledge, and skill sets that sometimes require the contractor to actually find

and employ new personnel just to fulfill the needs set forth in the work scope document. This fact coupled with long lead times of ordered valve parts and repair kits can take several months to obtain prior to the outage. The longer the contractor has to plan for the event the better prepared they will be when they arrive on-site.

7.0 Outage Event

If planned properly the outage work event should be the most “non-eventful” task barring any major issues found or problems experienced. But that is rarely the case! It is apparent that if all logistical requirements are taken care of and planned for, the movement of personnel, test equipment, tools, cranes/hoists, materials, and replacement valves, etc. will require less resource time than the actual repair to the valve. Other than unplanned repair parts that are found during trouble-shooting, testing and disassembly, most outage materials including repair kits, valve parts, and replacement valves should have been received, delivered, and staged somewhere within the outage facility awaiting the outage event.

As with normal daily maintenance, properly documenting the valve work performed during the outage so that it is historically tracked is as important as analyzing its normal daily performance condition. The CMMS system aids in managing the plant’s PM program and tracks normal repairs. Most systems already require capturing the basic valve information such as manufacturer, serial number, valve type (globe or ball), port size, end connection type, pressure rating, Cv, body material, packing material, actuator information, positioner information, filter regulator and supply pressure. The CMMS must also be updated any time routine maintenance is performed and changes are made to a valve. The outage event work is no different.

7.1 As-found, As-repaired, As-left Description and Photo

During the outage when valves are evaluated, disassembled, repaired or replaced, a brief description (1 or 2 sentences) of what was accomplished and what parts were used should be completed for the daily summary report. Each valve tag’s before-repair and after-repair photo should be taken to document as-found and as-left conditions. Additional photos documenting the condition of the valve trim, body, actuator, and any accessories such as positioner, I/P transducer, filter regulator, relays, switches, solenoids, etc., are also helpful when reporting the repairs and deciding the disposition of the valve.

7.2 Daily Summary Status Report from Contractor

A simple status report of the work performed by tag number should be created and submitted to the outage manager on a daily basis. The report can be as simple as a spreadsheet that shows the intended original work scope, the actual work that was / is performed, the completion status, the number of hours spent repairing, what parts were used, and when it should be completed. The information contained within the daily status report will be used in creating the post outage report and will be combined with as-found photos and as-left photos of the valves repaired.

8.0 Post-Outage Report / Plant Responsibilities

Upon completion of the outage and all relevant valve repair and replacement information has been collected, a post outage report must be written by the outage manager. The post outage report should include a summary of the scope of work performed by both the plant personnel and the contractor personal, a spreadsheet summary that is organized by tag number with the valve serial number, description, as-found condition and photo, as-left condition and photo, and any comments or recommendations.

An accurate accounting of repair parts, inventory, and purchase orders written for cost overruns and scope creep issues that arose should be compiled. This will be necessary in evaluating the success of the planning and budgeting portion of the outage. The plant will use the outage report information to update their CMMS so that valve repair histories can be referenced and PM schedules established per individual valve requirements.

9.0 Valve Maintenance: Outage Evaluation – Was it Successful?

Various stakeholders within the organization will evaluate the success, performance, or failure of the completed valve work differently. Objectively measuring and assessing what worked and what did not is required to improve upon the following year's outage. Success is viewed in terms of the KPI's met, goals accomplished, and milestones reached originally set-forth during the planning stages.

Some of the common criteria for evaluating the outage success include:

Financial – Did the outage total-spend amount come in below budget, at budget, or above budget?

Work Quality – Were all valves repaired and left as-new and are performing as expected?

Timeline – Did the outage begin, progress as expected and end on-time as forecasted?

Material Overruns – Were the correct material, equipment, tools, etc., ordered, used and returned to stock or to the contractor? Or was it excessive?

Scope and Scope Creep - Were the right valves chosen, correct work performed, budgeted for enough time and expense? Were the correct personnel chosen to perform the work and contractor performance satisfactory?

Safety – What were the number of minor mishaps or injuries, major accidents, and lost-time to contractor and/or facility employee?

10.0 Optional Post Outage Closing Meeting

Once the post outage report is completed and distributed to the appropriate outage team members, managers, and stakeholders, an optional closing meeting can be held by the outage manager. The attendees should be plant personnel only. The meeting discusses the details outlined in the report which includes the work scope that was completed or not completed. It also gives team members

a chance to ask questions and encourages discussion of any valve issues still pending that need to be addressed. Lessons learned from analyzing what worked and what did not during the outage allow the plant to capitalize on the positive actions and not repeat the mistakes that were made when the next outage occurs.

11.0 Conclusion

The outage planning and execution process requires communication between all participating departments before, during, and after the outage. Soliciting and involving the maintenance contractor prior to the outage kick off meeting ensures that proper material and manpower estimates are accurate and quotations are delivered in a timely manner. An accurate outage work scope document can be developed by utilizing information from the maintenance contractor, CMMS valve lists, and walk down information. Using the work scope information to organize operations and maintenance logistics prior to the outage minimizes negative impacts to the outage timeline. Documenting all work performed in daily status reports along with taking as-found and as-left valve photos adds detail to the post outage report. This information is required when the outage is evaluated by all stakeholders.

Regardless of how facilities refer to their maintenance shut-downs, outages, or turn-arounds, they have similar goals; repair or replace critical systems and associated equipment in the shortest amount of time possible while spending the least amount of budgeted or non-budgeted dollars. Reaching these goals can be accomplished by utilizing a methodical, multi-step planning and outage management process as shown in Figure 1. The process can be changed to suite individual plant outage length and scope requirements but the core steps should be followed.

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Valve Maintenance: Outage Planning and Execution Overview

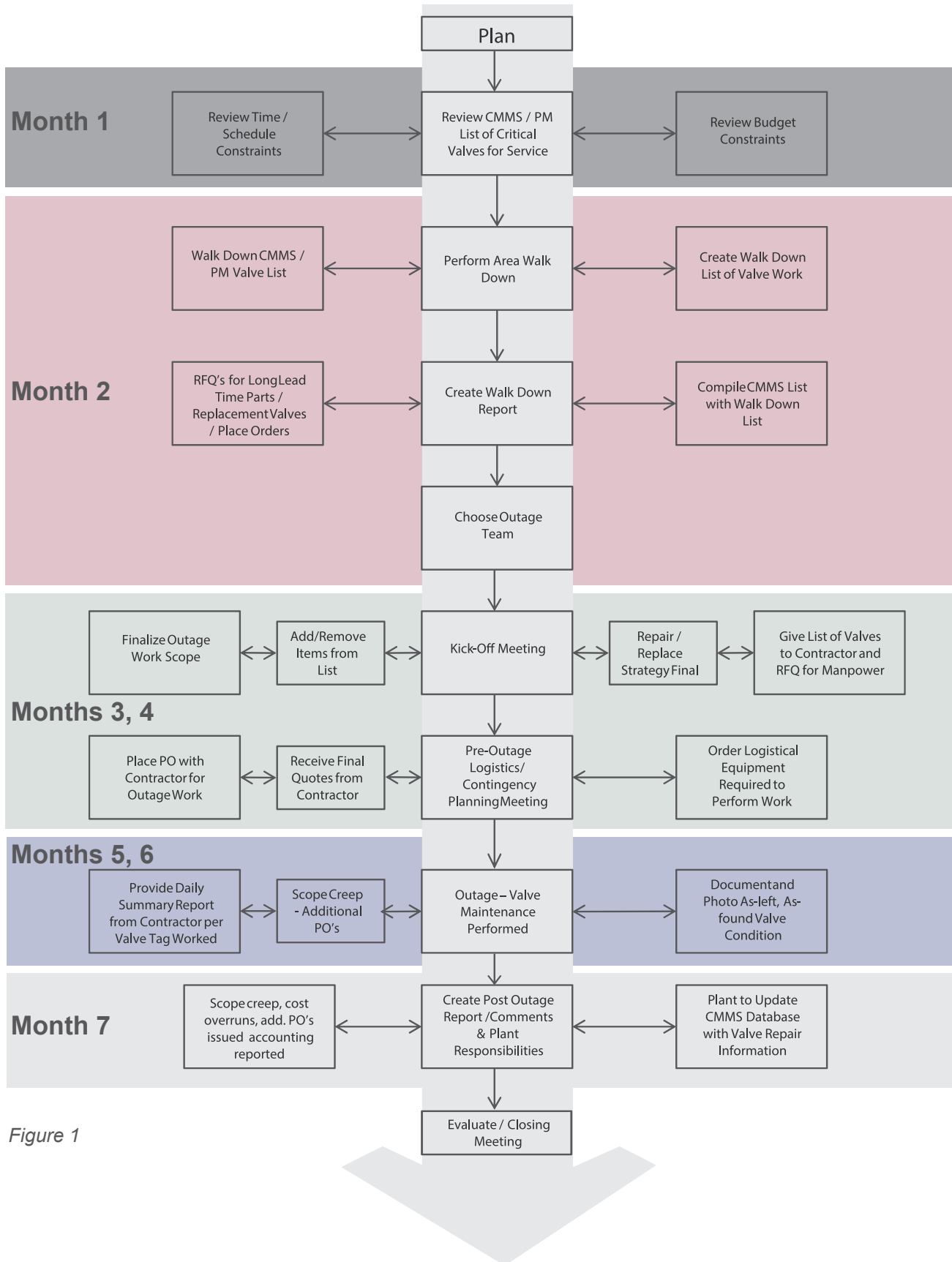


Figure 1



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