

Practical Management for Plant Turnarounds

Chapter 1

Plant Turnaround

Owners of commercial facilities, manufacturing processes, and industrial plants recognize that maintenance of their equipment assets is a reality. Most inspection, repair, replacement, alteration, and minor maintenance work can be done while the plant is in operation or “on line.” However, there will come a time when a plant has to undergo a scheduled process outage for the major maintenance work. This outage is referred to as a “plant shutdown.”

The management of a plant shutdown is known as the “plant turnaround.” The plant turnaround procedure is a continuous process from one major scheduled maintenance outage to the next. It starts well before the plant is taken off-line and continues for a period of time after the scheduled major maintenance work has been completed. The plant shutdown is part of the plant turnaround procedure called the “execution phase.”

Plant shutdowns for scheduled major maintenance work are the most expensive and time-consuming of maintenance projects because of the loss of production and the expense of the turnaround itself. They can be complex; and as the complexity increases, they become more costly and difficult to manage. A plant shutdown always has a negative financial impact. This negative impact is due to both loss of production revenue and a major cash outlay for the plant turnaround and shutdown expenses. The positive side is not as obvious; therefore, it is often overlooked. The positive impacts are an increase in equipment asset reliability, continued production integrity, and a reduction in the risk of unscheduled outages or catastrophic failure.

A major scheduled plant shutdown is of short duration and high intensity. It can consume an equivalent cost of a yearly maintenance budget in four to five weeks. It also requires the greatest percentage of the yearly process outage days. As the plant shutdown is the major component of plant downtime and maintenance costs, proper plant turnaround management will have a significant impact on the bottom line.

Owners or senior management teams trade off the economic balance of a plant's process integrity and equipment asset reliability against the business plan budget and overall process outage days.

Business plan budgets and process outage schedules are estimates predicted long before detailed estimates are derived from the maintenance work packages and plant turnaround support plans. To have realistic estimates, it is imperative that several conditions be recognized and accepted by the owner or senior management team.

Without scheduled maintenance outages, equipment will fail, and an unscheduled outage is up to ten times more expensive than a scheduled outage. The cost is much higher again if the outage is due to a catastrophic failure.

A business plan that has developed a formal plant turnaround management process and procedure, which supports a plant turnaround management philosophy and long-term strategy, will produce a higher level of business plan budget and schedule accuracy. (See Figure 1.1)

The planning, organizing, execution, and closeout phases of the plant turnaround procedure are important in predicting and maintaining the business plan budget and schedule.

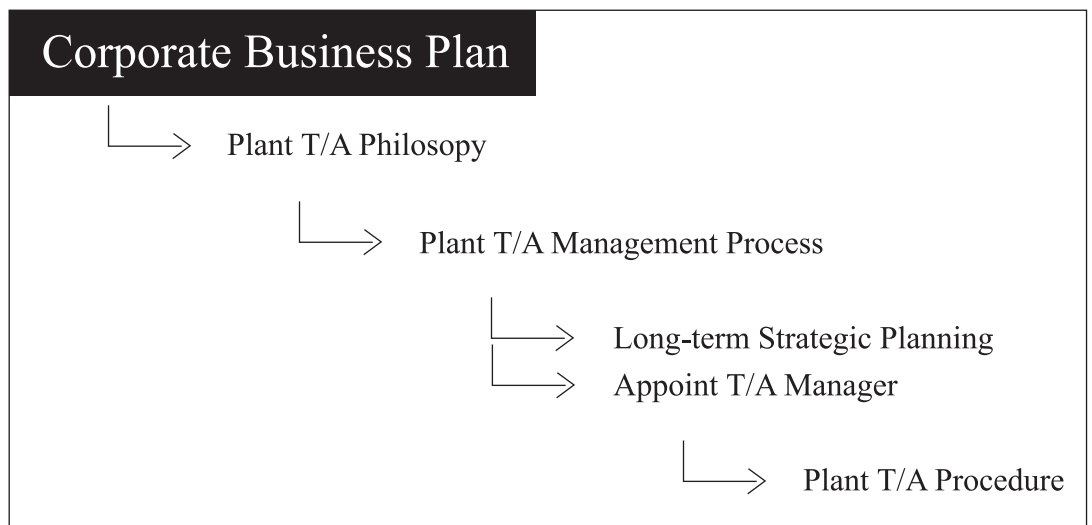


Fig 1.1 - The corporate business plan supports the plant T/A Procedure.

Equipment archives and current knowledge of the plant equipment asset conditions are major keys for developing the plant turnaround business plan strategy. Maintaining these knowledge systems has a positive cost impact on the plant turnaround that exceeds their combined day-to-day costs.

Many people manage plant turnarounds, but few understand the practice of plant turnaround management. This manual will explain the plant turnaround process and show how the turnaround team, by using this process as a guide, can develop a practical plant turnaround procedure specific to its needs. The core group's areas of responsibility are defined, and the manual discusses how this core group can be more effective with its interrelationships. An explanation is given of how to reduce the stress and chaos that are normally associated with transition points and common pitfalls in this highly intense environment.

Plant Turnaround Philosophy

The development of a plant turnaround philosophy is formal recognition of the plant turnaround's impact on the corporate business plan. Once formally recognized, the philosophy can be integrated with the corporate vision and mission statements as part of the overall corporate philosophy. The recognition of plant turnarounds is the first step in maximizing the benefits and reducing the costs when taking the plant off-line for a major scheduled outage.

Philosophies do not have to be complicated and can be applied to all types and sizes of facilities, such as single boiler units with simple piping systems found in apartment buildings and hospitals; batch or continuous manufacturing and assembly plants; and major industrial process facilities.

The philosophy should be clear and concise with a descriptor of both plant turnaround management and plant shutdown. Different groups interpret the definition of a plant shutdown in their own ways. Operations may consider the plant shutdown to be "feed in to feed out"; marketing will look at the "loss of salable product" days; and maintenance usually quotes in "mechanical days."

The owner or senior management team now turns the philosophy into action by developing the plant turnaround management process.

Plant Turnaround Management Process

The plant turnaround management process document supports the turnaround philosophy, and is considered the fundamental building block for initiating and completing a plant turnaround. As a standard, it provides consistency from plant turnaround to plant turnaround. The process defines a framework that is not restricted to major scheduled plant outages. In an abbreviated form, it can also be used for any short, partial, or rolling scheduled plant outages.

The owner or senior management team develops the management process document. The document sets out the policies, procedures, and guidelines for developing and implementing an effective plant turnaround.

Each plant under the care and control of the owner will need a plant turnaround management process document tailored to its specific needs. These needs include the type of plant, the geographical location, the size of the plant, and the general complexity of the expected plant outage. The document is dynamic and should be reviewed at the end of each plant turnaround to ensure that it is consistent with the needs of the facility.

The framework of the document should address several key issues. To optimize plant run time and avoid major unscheduled outages, a long-term plant turnaround frequency strategy should be developed. The framework will recognize that the plant turnaround procedure has five fundamental phases: strategic planning, detailed planning, organizing, execution, and closeout. The plant turnaround procedure is a continuous process, and the turnaround team (manager) position and responsibilities needs to overlap from turnaround to turnaround. As plant turnarounds overlap, there needs to be a commitment to a continuous budget and a standardized cost control structure. With the time between plant process outages lengthening due to increased process and equipment asset reliability, personnel will need training to refresh or upgrade their roles and responsibilities skill sets.

The turnaround team should represent all areas of responsibility: administration, operations, engineering, maintenance; health, safety, and environment (HSE); quality assurance (QA); procurement, planning, and scheduling; and turnaround supervision (Chapter 8: Areas of Responsibility). As the organizational chart

increases in complexity, it is normal to contract out to third-party consultants and contractors to supplement the company’s internal resources. This organizational chart expansion, which is for the facilitation of the owner’s responsibilities and the management of the plant turnaround, requires a corporate commitment to train all personnel in the owner’s plant turnaround procedures, goals, and objectives.

The turnaround management process lends itself to the standardization of a checklist known as a “master milestone schedule (MMS).” The MMS, uses activities and time periods to guide the turnaround team through the plant turnaround procedure’s five phases. The milestones should include, but are not limited to, the selection of the next turnaround manager; the turnover meeting from the past to the

Milestone - Plant Turnaround Management Process

Milestone	Phase	Origin	Area of Responsibility	Time to Plant Shutdown Date
Selection of T/A manager	1	Process	Owner	
Turnover meeting	1	Process	Outgoing T/A Manager	
Initial cost estimate	1	Process	T/A Team	
Work breakdown structure	1	Process	T/A Manager	
Cost Control Structure	1	Process	Administration	
Organizational Breakdown Structure	1	Process	T/A Team	
Work list cut-off date	2	Process	T/A Team	
Support plans complete	2	Process	Support plan rep	
Work Package complete	2	Process	Planning	
Master Execution Sched complete	3	Process	Scheduling	
Detailed cost estimate	3	Process	T/A Manager	
Procurement of materials	3	Process	Procurement	
Procurement of machinery	3	Process	Procurement	
T/A Readiness Review Audit	3	Process	T/A Team	
Plant feed-out	4	Process	Operations	0 months
Plant feed-in	4	Process	Operations	
Reports & documents complete	5	Process	T/A Team	
Evaluate plant turnaround	5	Process	T/A Team	
Postmortem meeting	5	Process	T/A Manager	
T/A Summary report	5	Process	T/A Manager	

Fig 1.2 - An example of the milestones used for each turnaround and included in the MMS.

present turnaround team; the initial budget cost estimate, the work breakdown structure; the cost control structure; the organizational break-down structure; the work list cut-off date; the completion of the work packages; support plans completed; and the finalized schedule, detailed cost estimate, and plant shutdown dates. After the plant shutdown, the milestones should include an evaluation of the plant shutdown, completion of reports, documents, drawing updates, the post mortem or debriefing meeting, and the turnaround summary report. (See Figure 1.2.). The cycle begins again with the selection of the next turnaround manager.

Milestones allow the rate of progress to be measured against expectations. If the milestone expectations are not being met, additional resources can be allocated. These milestone periods can be reviewed for adequacy and presented at the post mortem meeting during the closeout phase. This will give feedback to the owner or senior management team as to the time and resources required for future planning and organizing of other major scheduled plant outages.

Most owners do not allow enough time or resources in the strategic and detailed planning phases to plan properly for the execution phase. This is reflected by the variances between the budget and schedule estimates in the business plan, and the actual cost and schedule duration of the execution phase.

A major scheduled outage is an opportunity to make significant design changes in piping, equipment, buildings, and structures; and to update critical job procedures. If a Management of Change (MOC) process is not in place, the owner should take the steps to develop one. This process will control and justify any significant changes and therefore the turnaround costs. In order to capture these changes, there must be a process to justify and record them. The initiation of the MOC process begins before implementation, to allow for interdepartmental review and input, including senior management review and authorization. For future reference, a copy of the MOC should be included in the hard files of the asset that has been changed. Replacement-in-kind or routine job procedure updates, normally, do not require an MOC.

The completion of one plant turnaround is the start of the next. The owner should identify the next turnaround manager before the closeout phase of the previous turnaround. This gives the incoming turnaround manager an opportunity to carry on the work of the previous team, and to participate in the

review of the inefficiencies and excellences during the post mortem meeting. The justification is that the next plant turnaround work list begins the day the operations group has the plant back on line.

For smaller plants, the position of turnaround manager may carry over from turnaround to turnaround. Nevertheless, the company organization should identify the next plant turnaround manager and the responsibilities of the position. It should also make it clear that this person is now the focal point for collecting the next major scheduled outage maintenance work list items.

To maintain the consistency of cost control and reporting, the plant turnaround management process document should provide an accounting or cost-control structure framework compatible with the corporate accounting system. Within this framework should be an interpretation of a capital cost versus a maintenance cost, and a work package direct cost and an indirect or support cost. This will provide comparison consistency from turnaround to turnaround and business plan to business plan.

With the fundamental building block of the plant turnaround management process document in place, the next step is to prepare a long-term strategy for impending plant shutdowns.

Plant Shutdown Long-term Strategy

The owner or senior management team's first task is to determine when to schedule the next major plant shutdown. To answer this question requires input from Marketing & Sales, Accounting, Maintenance, Engineering, Operations, and QA. This information is analyzed and incorporated into the business plan, and provides the long-range strategic planning base. Long-range strategic planning should attempt to forecast maintenance requirements a minimum of 10 to 15 years in the future, with the plant half-life being achievable. It is important to remember that the plant turnaround procedure is a continuous process for the next plant shutdown.

Plant shutdowns have a major impact on the business; therefore, the best strategy is to try to avoid them. This is a risk-based decision-making assessment and must be made from current and reliable information on the condition of the operating system and equipment assets. In reality, it is not possible to avoid a

major scheduled outage, but it may be possible to lengthen the run time between outages, thereby reducing their frequency.

Reducing the frequency of major scheduled outages will be popular with the Operations group, but it is bound to bring resistance from Engineering, Maintenance, and QA groups who may be in the habit of having annual or regularly spaced plant shutdowns. The information supplied by the plant Engineering, Maintenance, and QA groups is fundamentally important to the determination of when to schedule the next major plant shutdown.

Determining the frequency requires a review of the Non-destructive Examination (NDE) comparison report findings and the regular preventative maintenance inspection programs; and a risk assessment of the process system and consideration of influences outside of the plant. Major plant outage frequency is then based on confirmed knowledge rather than past practices.

It is possible, using today's NDE techniques, to inspect the condition of pressure envelope and electrical and mechanical assets, including piping systems for erosion, corrosion, and thermal degradation, while the plant is in operation. With the owner or senior management team supporting a continuous NDE program and historical archive system, comparison of the NDE reports will provide rates of erosion, corrosion, and thermal degradation. Using Code and Engineering Design allowances and analysis of these rates will indicate when repair or replacement in kind of the equipment assets is required.

Process conditions such as internal fouling and catalyst life may require the plant to be shut down. A risk assessment of acceptable minimum flow rates and product specification will determine when the plant is required to come off-line to correct these conditions. These process conditions are known as process maintenance bottlenecks, as opposed to bottlenecks due to original equipment design.

The owner must address outside influences when considering the timing of the next major scheduled outage. Warranty, insurance, government regulatory requirements, time of year, availability of work execution and support resources, feedstock, and market conditions may influence the timing of the plant shutdown.

When supplying equipment assets, Original Equipment Manufacturers (OEM) are asked to guarantee warranty periods, and in turn the OEM may request a level of day-to-day maintenance and frequency of major scheduled outages to maintain the warranty. After the warranty period has expired, regular external NDE inspection and historical maintenance archives will help determine the best time for the scheduled major maintenance overhaul. This may differ from the warranty requirements, as dictated by the OEM at the time of original supply. The insurance policy may clause the frequency of maintenance and inspection.

Government regulations, administered by the local authorized inspector (AI), may stipulate an internal inspection frequency as a condition of maintaining the operating permit. These regulations are based on historical documentation, usually because of catastrophic failure. Through prudent inspection and analysis, owners may be able to have the inspection frequencies extended.

Other outside influences to be taken into consideration include the time of year, as outages scheduled in very cold and very hot weather are less efficient with increased safety risks. The availability of manpower, machinery, material, and contractor support may be at a premium due to construction or other major scheduled plant outages within the geographical area that the resources are drawn from. Owners should be aware of these circumstances and undertake a coordinated effort to schedule outages with as little interference as possible from plant to plant and industry to industry.

Included in the outside influences is feedstock to the plant. A shortage of feedstock requiring the plant to run at less than economic rates or to shut down altogether provides an opportunity for a major, short, or partial plant shutdown. A short plant shutdown may be to satisfy a regulatory requirement that if completed will extend the process run time before the next major plant shutdown is required. A partial plant shutdown may be used to eliminate a process fouling condition in one area of the plant.

Owners and senior management teams need to understand that only work requiring the plant to be shut down should be included in the turnaround work list, unless the work is deemed statistically or economically beneficial in extending the process run time. *Open up or tear down an equipment asset only if the probability of finding a defect is greater than the probability of causing one.* Major scheduled

plant outages are highly intense, chaotic, and stressful. The plant shutdown is more effective and cost-efficient with a minimized work list.

Short duration or partial scheduled plant outages are an alternative to major scheduled outages. Short duration outages are less than 96 running hours of production at less than the minimum turndown rates. The short duration or partial scheduled outage is usually requested by Operations because of process efficiency below acceptable levels. Loss of process efficiency is gradual, and a plant that has implemented a plant turnaround procedure will create opportunities to complete work that was originally scheduled for the major mechanical outage. Reducing the frequency of major scheduled outages by using short duration or partial outages will help provide the justification for economic analysis of the asset that is causing the loss of production efficiency. The analysis may suggest the installation of an alternative asset with a greater run time or twinning of the asset. With twinned assets, they are taken off-line one at a time and serviced, with minimal disruption to the overall production process.

A formal long-range strategic plan will provide milestone targets for project and maintenance engineering to install future tie-ins; make major repairs and alterations; or replace or install major pieces of new equipment.

Timing of the next plant outage is critical to Marketing, Sales, and Accounting. When the plant is shut down, there may be a negative cash flow on the revenue side. To minimize the negative cash flow, the marketing department will be able to provide a general market projection so that the timing of the shutdown corresponds to a low market demand for the product. Low demand usually correlates with a softening in the product sales price. This is a good time to be off-line. Many industries have inventory holding capacities, and maintaining maximum production rates while the sales curve is sliding can be used to increase the product inventory. The reduced market demand and stockpiled inventory allow the plant to be off-line but still continuing to service customer needs from the owner's inventory. For industries that do not or cannot hold inventory, such as producers of electricity, a supplemental alternative to supply customer needs may be required. These spot market alternate supplies should be at lower cost rates as per the market demands.

As part of the long-term strategic planning, the owner's philosophy should include a personnel progression training system for the managing of plant turnarounds. Companies normally use internal personnel resources to prepare, coordinate, and manage their plants through a plant turnaround procedure. With major schedule outages being months apart, the skills learned from the previous outage may be forgotten or "rusty." Also, from turnaround to turnaround, personnel usually progress up the ladder of turnaround management, seldom having the same role and responsibility as in the previous turnaround. If a long-term strategic training and progression program is developed, the personnel will benefit, with resulting economic and social benefits to the company and plant.

With a plant turnaround philosophy in place, a plant turnaround management process framework guide to follow, and the incoming plant turnaround manager identified, the next plant turnaround procedure can begin.

Notes:

