Key Principles for Successful Shutdown Maintenance Planning

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Maintenance Planning and Scheduling Handbook
Richard Palmer and Associates
Key Principles for Successful Shutdown Maintenance Planning

• **Introduction to Effective Planning and Scheduling**
  – Benefits of planning and scheduling
  – Additional requirements beyond
  – Principles of planning
  – Principles of scheduling
  – Considering reactive work
Key Principles for Successful Shutdown Maintenance Planning

- **Moving from Weekly Maintenance to Outage Maintenance**
  - Accuracy of task estimates
  - Cycle of improvement, the outage report
  - Controlling scope
  - Short notice outages versus planned turnarounds
Key Principles for Successful Shutdown Maintenance Planning

- Organizing and Executing Shutdowns
  - Outage organizing
  - CMMS benefits and cautions
  - Pre-outage, during-outage, and post-outage tasks
  - Defining outage success
Introduction to Effective Planning and Scheduling
Benefits of planning and scheduling

Consider P&S for non-outage maintenance

• It’s not about parts and tools
• It’s not about using a computer
• It is about getting more work done
• Why do we plan?
  – To increase productivity – right answer
  – To provide job packages – wrong answer
Benefits of planning and scheduling

• Tradesperson “wrench time” commonly thought to be “80% or so”
• Actual industry avg between 25% & 35%
• Improving from 35% up to 55% wrench time is a 57% improvement (55/35)
• 30 mechanics X 1.57 = 47 mechanics (17 free)
• (Improving from 25% up to 50% would double workforce; 30 free mechanics)
Benefits of planning and scheduling

• 1 planner can plan for 20 to 30 tradespersons
• Value of 1 planner = 17 tradespersons
• Industry rule of thumb: $1 invested in proper maintenance = $10 plant profit
• Value of 1 planner = 170 tradespersons?
  – There is money involved

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Additional requirements beyond planning and scheduling

- Workforce focus on quality
- Leadership/communication/teamwork
- Storeroom/tools/shops
- PM/PdM/project work
- Skilled workforce including supervision
- Proper work processes
Essence of planning and scheduling

- **Planning** supports improving individual jobs repeated over time: a cycle of improvement for each job
- **Planning** supports advance scheduling by identifying craft skills and labor hours
- **Scheduling** sets goals to assign a sufficient amount of work
Six principles of PLANNING

1. Planners separate from crews
2. Focus on future work, not chasing parts on current work
3. History files at component level
4. Use planner skill to estimate labor hours
5. Plans recognize skill of tradespersons
6. Recognition of wrench time issue
Six principles of SCHEDULING

1. Need job plans with craft skills and labor hours
2. Credible priority system in use
3. Forecast crew labor availability for week
4. “Schedule” 100% available labor hours
5. (Crew leader handles daily schedule)
6. Measure weekly schedule success
Must consider REACTIVE work

- It’s “okay” to break the schedule
- Reactive work
  - Don’t make crews wait
  - Plan differently: Peek at job and history file; plan scope, skills, and hours
- Emergency work (Unit is down)
  - It’s “okay” to chase parts
Success in routine maintenance

CLOSED WORK ORDERS PER MONTH
Mechanical Maintenance

- Started Weekly Scheduling
- Changed Planning Approach
- Ran Out of Backlog

FY93/94
Moving from Weekly Maintenance to Outage Maintenance
Accuracy of task estimates

• +/- 100% for individual tasks
• +/- 5% to 10% for aggregates of tasks

• **Application:**
  – We can use estimates to control work
  – Don’t get excited about a single task
  – Look for overall progress in areas
Cycle of improvement

• We repeat maintenance over time
• We repeat outages over time

• **Application:**
  – Improve time estimates and quality of individual jobs and outages over time
  – Must have files and good record keeping
  – It’s “okay” if “this” outage is not perfect
Cycle of improvement: Files

- Good library
- Outage notebook and outage checklist
- Evolve shutdown and startup checklists
- Hold critique after outage including managers and tradespersons
- Each project manager within outage must write a report following “project closeout outline”
Cycle of improvement: Files

• Project closeout reports
  – Title and description
  – Work order #
  – Project mgr
  – Start date and substantial completion date
  – Punch list completion date
  – Contractor and subcontractor
  – Purchase order # and issue date
Cycle of improvement: Files

- Project closeout reports (continued)
  - Final project cost
  - Warranty end date
  - 4 copies O&M manuals delivered to maintenance planning dept including
    - Copy of approved submittals (cut sheets)
    - Table of contents
    - Lubrication and PM recommendations
    - Spare parts list
    - Correct size 3 ring binder
Cycle of improvement: Files

- **Project closeout reports (continued)**
  - Inventory
    - Request to planning dept to add new
    - Request to planning dept to delete obsolete
  - Drawings
    - New drawings hard copy and electronic with equip #’s, meaningful titles, and “as-built”
    - Revisions to existing drawings clearly marked for draftsman to understand
Cycle of improvement: Files

- Project closeout reports (continued)
  - CMMS (Computer Maint Mgt Syst)
    - Obtained new equipment #’s
    - Submitted list of obsolete #’s
  - Training
    - Conducted for Maint and Opns as necessary
    - Submitted any operational procedure changes to Opns
- List of any special tools used
Controlling scope

- Why? To limit scope creep
- Need cut off dates for adding scope
- Need process for adding scope
Controlling scope

• **Know why** we are doing this outage
  – To make a successful investment – right
  – Tradition or To get it done – wrong

• Is outage needed?

• Equipment problems including wear
  – Don’t just fix symptoms every outage, solve root causes

• New technology
Controlling scope

• **Have a strategy** for outages overall

• Plan knowing strategy
  – Large outage every 5 years or
  – Component outage every 2-3 years (HP/IP, LP)

• Do as much as possible outside the outage
  – Yet consider ease of clearing equipment for work

• Publish 1 year and 10 year outage plans
  – Update monthly
Controlling scope: Outage plans

One Year Outage Plan for June 2006 (by season)

Changes
None since last month

New outages
None since last month

Fall 2006 outages
- NS 2 TURBINE UPRATE (10/25/06 – 12/19/06)
- NS CT 6 MAJOR OUTAGE/TURBINE WHEEL REPLACEMENT (09/15/06 -12/15/06)

Spring 2007 outages
- NS CT 5 HOT GAS PASS INSPECTION/TURBINE WHEEL REPLACEMENT (ROW 1-3) (02/17/07 - 05/11/07)
- PP 1 INSTALL NOx TIE INS BLR/BFP TURBINE VALVES (02/24/07 – 04/02/07)
- NS 1 INSPECTION/REPAIRS (4 WEEKS SPRING 2007)
- KS CT 7 COMBUSTION INSPECTION (10 DAYS SPRING 2007)
- NS 3 GENERATOR REWIND (11 WEEKS BEGINNING IN MARCH 2007)
Controlling scope: Outage plans

Ten Year Outage Plan for June 2006 (by unit)

Changes
The fall 2008 NS2 outage has been cancelled
The spring 2010 KS CT3 outage has been lengthened from 7 to 8 weeks

New outages
None since last month

Outages
PP1   INSTALL NOx TIE INS BLR/BFP TURBINE VALVES  (02/24/07 – 04/02/07)
      BOILER/FGD   (02/25/08 – 04/03/08)

NS 1   INSPECTION/REPAIRS   (4 WEEKS SPRING 2007)
      INSPECTION/REPAIRS   (4 WEEKS SPRING 2008)
      INSPECTION/REPAIRS   (4 WEEKS SPRING 2009)

NS 3   GENERATOR REWIND   (11 WEEKS BEGINNING IN MARCH 2007)
      MAJOR OUTAGE   (4 WEEKS FALL 2010)
      MAJOR OUTAGE   (4 WEEKS FALL 2015)
Controlling scope

• **Start** 1½ to 2 years before the outage

• Review *previous outage* reports for what you might expect this time

• **PdM** (predictive maint) group must share info

• Conduct *meetings* (inclg tradespersons) and make “discovery” lists

• Republish *lists* with increasing freq as start date approaches

• **Communicate** with everyone, sideways + up and down + inside and outside
Controlling scope

• A lot of **discovery work** added too late will wreck an outage
  – Prevent: Reduce with PdM; Anticipate from history

• Adding discovery work
  – Watch for impact items; items that affect funding, resources, schedule
  – Have review process; who will pay?
  – Don’t sweat little stuff
Controlling scope

• Have **component outages**
  – Easier to defer discovered work
  – Less financial burden, spread out costs
    • $3-5 million every 1-2 years instead of $15-20 million every 5 years
  – Allows focusing resources
  – Less overwhelming
Controlling scope

- **Avoid “routine” rebuilds** which introduce infant mortality

Rebuilding equipment in Figure A at Point X may result in Figure C instead of Figure B
Controlling scope

• Routine PM (*preventive maintenance*)
  – Issued well in advance into backlog
  – Planner review for material and contractor needs
  – State “(During Outage)” in title as well as use outage codes
  – Prioritize as “Must”, “Prefer”, “If time”
Controlling scope

- Learn to say “No”
- Shutdown manager needs authority
- Scope freeze time
- Need organizational discipline (leadership)
Controlling scope

• Use a work breakdown structure
  – Defines scope and deliverables
  – Gives visibility

Diagram:
- Shutdown
  - Condenser work
    - Disassemble
    - Inspect
  - Turbine uprate
    - Modify Blades
    - Repair
  - Actuator rebuilds
    - Reassemble
  - Project 4
    - Backlog work Mech
  - Project 5
    - Backlog work Elec
    - Backlog work I&C
Short notice outages versus planned turnarounds

- **Identify work** as requiring an outage
- Plan outage work **expeditiously**
- Pay close attention to **parts** needed
- Take advantage & do as much work as possible **outside planned turnarounds**
- **Be able to find** outage work that can be done within constraints of the SNO

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Organizing and Executing Shutdowns
Organizing for outages

• **Shutdown manager**
  – Comprehend technology of the outage
  – Good record keeping
  – Awareness; manage by wandering around
  – Full time for large outages 6 months to a year before start
  – Agreement with sponsor, authority: what, when, who
Organizing for outages

- Outage organization elements

- Shutdown manager
  - Ops for clearances/permits
  - Project mgrs
    - Maint crews backlog work
  - Maint crews project work
  - Contractors
  - Engrg
    - PdM
  - Safety
    - Environmental
    - Legal
    - QA

- Accounting
- Scheduling
- Purchasing
  - Stores
  - Tools

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Organizing for outages

• Need defined and known processes
  – Budgeting, trend program
  – Stores (inventory), tools
  – Purchasing regarding services, labor, material, receiving, laydown
  – Insulation, scaffolding
  – Safety, certification, reporting, work permits, clearances, lockout-tagout, confined space
  – Configuration mgt, design change notification, project closeouts, as-builts
Organizing for outages

• **Know that you have the resources to do the outage!**
  - Funds, Time (before and during)
  - Crafts, welders, engineers, project mgrs, etc.
  - Tools, cranes, fork lifts, etc.
  - Vendors, contractors

• **Avoid dumb overtime that exceeds fatigue limit**
Organizing for outages

• **Budgeting**
  – Need a budget
  – May need a multi-year budget through different fiscal years
  – Funding timing
  – Anticipate some unknowns
Organizing for outages

• **Cost control**
  – Need tool fairly accurate and timely
  – May have to stop some work or raise budget
  – Understand cost reports when controlling project: committed, encumbered, expensed
  – Trend program
Organizing for outages

• **Contractors**
  – Understand any need to contract
  – Contractors need to be familiar with the way you do business
  – Contract for *known* circumstances
  – Settle on *unknown* circumstances encountered
  – Budget for *anticipated* circumstances
Computerized maintenance

• **Benefits**

• Standardize work processes

• Find work orders and parts
  – Identify any outage work with Unit Condition field code (e.g. 2 = requires unit outage)
  – Identify all work orders for this outage with Outage ID field code (e.g. N03 Spring Outage 2007)

• Assign work order #’s to all projects; add assigned lead name to each

• Information for metrics and reports

• Helps history; see past work orders
Computerized maintenance

- **Cautions**
  - If you don’t know how to do it without a computer, a computer will not help
  - Faulty processes / distraction
  - Improper costing
  - System reliability and speed
  - User friendliness
  - Cost of system
Executing the shutdown
Schedules

• Pre-outage schedule
  – Tracking to see all

• During-outage schedule
  – Detailed or non-detailed (milestones or flags) okay

• After-outage tasks
Executing the shutdown

Pre-Outage

• **Start** planning this turnaround after the last one on this unit
• Budget, prepare to order long *lead time* items
• Investigate lead times, could be 18 months
• Research vendors and availability, consider other companies and spares
Executing the shutdown
Pre-Outage

• Set aside (kit) parts to insure on hand
• Make sure special tools are ready
• Contractors need to mobilize; space, laydown, trailers
• Be ready to clear equipment for work in sensible order
• Communicate with everyone, sideways + up and down + inside and outside
Executing the shutdown
Pre-Outage

Start outage on time!
Need organizational discipline
Executing the shutdown
During-Outage

• Can manage to **milestones** instead of a “weekly” schedule
• Regular, short project **meetings**
• Persons don’t resent going to; have opportunity to share
• Note milestones (or flags) or collect % complete per work breakdown structure as appropriate.

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Executing the shutdown

During-Outage

• Beware the “90% done” syndrome

• Beware Parkinson’s Law (work expands to fill available time)

• Finish outage backlog and do other maintenance work if time left

• Finish outage early if appropriate; but don’t kill self
Executing the shutdown During-Outage

- **Crew supervisors** do daily or shift schedules and coordinate work
- **Outage planners** can chase parts (Unit is down). May need an expediter
- **Communicate** with everyone, sideways + up and down + inside and outside
Executing the shutdown 
During-Outage

- Outage not over until unit is reliably operating
- **Include start up time** as part of the outage schedule
  - Especially with new equipment
Executing the shutdown

After-Outage

- Closeouts
- Critique, lessons learned
- Rate the outage, score numbers
  - e.g. include planned vs unplanned hours and forced outages within 30 days
- Keep in history
Success in outages

- **Outage objective** met; completed scope of work intended; was good investment
- Completed *on* schedule
- Completed *on* budget
- Good safety, environmental, legal performance
- Not overwhelmed by surprises
- Good startup; reliable unit performance
Success in outages

• This outage was better than the last
• Work identified for next outage
• Other information gathered to help next outage and finally
• Outage personnel are still friends
Question time
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