KEY PERFORMANCE INDICATORS FOR MEASURING THE SUCCESS OF SHUTDOWN AND TURNAROUND IN OIL AND GAS INDUSTRY.

Prepared by: Ahmed Hussein Ragab
B.Sc. Mechanical Engineering
Abu Dhabi – September 2015
"If You Fail To Prepare, Be Prepared To Fail"
Contents

• **Turnaround Challenges**
  – Why Turnaround in Oil & Gas?
  – Turnaround Size and Complexity.
  – Is Turnaround a Project?

• **How to Measure Turnaround Performance and Why?**
  – Turnaround Leading and lagging KPIs
  – Turnaround Controllable and Non-controllable Indicators
  – Turnaround Audit and Peer Review

• **Turnaround Reporting Tips**
  – Types of Turnaround Reporting
  – Keys to Effective Turnaround Reporting
  – Using Graphs & Software in Reporting

• **Summary.**
Turnarounds pose enormous challenges for plant operators and project engineers who have to aim for a short and safe shutdown — and yet cope at the same time with longer and longer inspection cycles, highly complex technology and ever increasing demands on safety.
Why Turnaround in Oil & Gas?

- **To improve efficiency** and throughput of plant by suitable modification;
- **To make plant safe** to operate till next TAR;
- **To reduce routine maintenance costs**;
- **To increase reliability/availability** of equipment during operation;
- **To achieve the best quality of workmanship**;
- **To upgrade technology by introducing modern equipment and techniques**;
- **To modify operating equipment to cope with legal requirements** and or obligations such as environmental regulation.
Turnaround Constraints

- Turnaround complexity
- Duration of the event
- Resources availability (Manpower, Special Tools, Material, ..)
- Timing during the year, shutdown start date.
- Site temporary facilities and material lay-down areas.
## Turnaround Challenges

The preplanning time line is greatly impacted by the size and scope of the shutdown.

<table>
<thead>
<tr>
<th>Size of Shutdown</th>
<th>Dollars spent in Parts and Labor</th>
<th>Duration of shut down</th>
<th>Leadtime</th>
<th>Use of Project Software</th>
<th>Contractors</th>
<th>How is the team constituted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>Under $250,000</td>
<td>Hours</td>
<td>Weeks</td>
<td>Sometimes</td>
<td>Usually low percentage</td>
<td>Existing staff</td>
</tr>
<tr>
<td>Small Moderate</td>
<td>$250,000 to $1,500,000</td>
<td>Short days</td>
<td>Months</td>
<td>Usually</td>
<td>Usually moderate percentage</td>
<td>Usually existing staff</td>
</tr>
<tr>
<td>Moderate Large</td>
<td>$1,500,000 to $10,000,000</td>
<td>Days</td>
<td>Years months</td>
<td>Always</td>
<td>High percentage</td>
<td>Usually separate shutdown staff</td>
</tr>
<tr>
<td>Large</td>
<td>$10,000,000 up</td>
<td>Weeks</td>
<td>Years</td>
<td>Always and intensively</td>
<td>Very High percentage</td>
<td>separate staff for shutdowns needed</td>
</tr>
</tbody>
</table>

Turnaround Complexity

Source: AP-Networks Turnaround Database!
Turnaround Complexity

High Complexity Turnarounds Are **Unpredictable**

Source: AP-Networks Turnaround Database!
### Turnaround Complexity - *Example*

<table>
<thead>
<tr>
<th>Example Complexity Level</th>
<th>Average Labor-Hours</th>
<th>% Average Capital Scope</th>
<th>Average Peak Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>43,563</td>
<td>8%</td>
<td>238</td>
</tr>
<tr>
<td>Medium</td>
<td>203,710</td>
<td>13%</td>
<td>901</td>
</tr>
<tr>
<td>High</td>
<td>693,960</td>
<td>23%</td>
<td>1,524</td>
</tr>
<tr>
<td>Mega</td>
<td>1,241,648</td>
<td>30%</td>
<td>2,518</td>
</tr>
</tbody>
</table>

Source: AP-Networks Turnaround Database!
Is Turnaround a Project?

• One approach is to deal with Turnaround as a Project.
• You should measure Time, Cost, Quality, Scope, Completed, Safety, ...etc.
Turnaround Challenges
Is Turnaround a Project?

<table>
<thead>
<tr>
<th>Project*</th>
<th>Turnaround*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Usually well-defined scope, from:</td>
<td>1. Usually loosely defined scope, from:</td>
</tr>
<tr>
<td>- drawings</td>
<td>- past turnaround experience</td>
</tr>
<tr>
<td>- specifications</td>
<td>- inspection reports</td>
</tr>
<tr>
<td>- contracts</td>
<td>- operations requests</td>
</tr>
<tr>
<td>- permits, memos, etc.</td>
<td>- historical estimates</td>
</tr>
<tr>
<td>2. Scope is static. Few changes occur during execution.</td>
<td>2. Scope is dynamic. Many changes occur as inspections are made</td>
</tr>
<tr>
<td>3. Can be planned and scheduled well in advance of the project.</td>
<td>3. Planning and scheduling cannot be finalized until the scope is freezed and approved, generally near the shutdown date.</td>
</tr>
</tbody>
</table>

- Source: Project Vs. Turnaround white paper [https://www.interplansystems.com/resources.html](https://www.interplansystems.com/resources.html)
Turnaround Challenges
Is Turnaround a Project?

**Project***

4. Projects are organized around cost codes / commodities.
5. Generally do not require safety permits to perform work.
6. Manpower staffing requirements usually do not change during project execution.
7. Project schedules can be updated either weekly or monthly.
8. Projects measure time in days, weeks and months.

**Turnaround***

4. Turnarounds are work order based.
5. Turnaround work requires extensive permitting every shift.
6. Manpower staffing requirements change during execution due to scope fluctuations (from discovery work).
7. Turnaround schedules must be updated every shift, daily.
8. Turnarounds measure time in hours or shifts.

• Source: Project Vs. Turnaround white paper
  [https://www.interplansystems.com/resources.html](https://www.interplansystems.com/resources.html)
<table>
<thead>
<tr>
<th><strong>Project</strong></th>
<th><strong>Turnaround</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Project scope is usually all mandatory.</td>
<td>9. Turnaround scope is flexible. Usually a large percentage of work can be postponed to a later window of opportunity if necessary.</td>
</tr>
<tr>
<td>10. Project schedules are uncompressed. Schedule acceleration can be used to correct slippages in the critical path.</td>
<td>10. Turnaround schedules are compressed. There may be little or no opportunity to correct the critical path by accelerating the schedule.</td>
</tr>
</tbody>
</table>

• Source: Project Vs. Turnaround white paper
  https://www.interplansystems.com/resources.html
How to Measure Turnaround Performance and Why?

- Why Measure?
- TA Performance Criteria's
- Key Performance Indicators
- Leading & lagging KPIs
- Controllable and non-controllable Indicators.
- Shutdown Readiness
How to Measure Turnaround Performance and Why?

Why Measure?
• What can be measured will be understood better.
• What can be measured can be assessed.
• What can be measured can be managed.
• What can be measured can be improved.
How to Measure Turnaround Performance and Why?
Is My Shutdown Completed Successfully?

1. Was the shutdown completed on or under budget?
2. Was the plant put back on line on time or early?
3. Did the plant startup smoothly?
4. Were all jobs completed?
5. Were there any lost time accidents?
# How to Measure Turnaround Performance and Why? Is My Shutdown Completed Successfully?

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Oil out to on-spec product, days or day/year</td>
</tr>
<tr>
<td>Total cost</td>
<td>Turnaround and routine maintenance</td>
</tr>
<tr>
<td>Turnaround costs</td>
<td>Actual and annualized by plant function</td>
</tr>
<tr>
<td>Frequency</td>
<td>Run length, months</td>
</tr>
<tr>
<td>Predictability</td>
<td>Actual versus planned work hours, duration, and cost</td>
</tr>
<tr>
<td>Safety</td>
<td>Accident number and rates</td>
</tr>
<tr>
<td>Start-up incidents</td>
<td>Days lost due to rework</td>
</tr>
<tr>
<td>Unscheduled shutdowns</td>
<td>Days lost during the run</td>
</tr>
<tr>
<td>Mechanical availability</td>
<td>Time available, percentage</td>
</tr>
<tr>
<td>Additional work</td>
<td>Actual versus contingency</td>
</tr>
<tr>
<td>Environmental incidents</td>
<td>Impact of incidents attributable to a shutdown</td>
</tr>
<tr>
<td>Savings</td>
<td>Money saved resulting from changes to above indices</td>
</tr>
</tbody>
</table>
How to Measure Turnaround Performance and Why?

Performance Measures

KPIs

Peel to the core to find the KPIs

PIs

Peel the skin to find the Pls

KPIs

10 /80/10 Rule
How to Measure Turnaround Performance and Why?

Performance Measures

• **Key Result Indicators (KRIs):** What we have accomplished.

• **Performance Indicators (PIs):** What must we do to increase or to meet performance?

• **Key Performance Indicators (KPIs):** What is the critical performance indicators that can drastically increase performance or accomplishment of the objectives.
How to Measure Turnaround Performance and Why?

Performance Measures

• Pareto analysis is the technique which can be applied to minimize effort and to obtain best results.

• It is also called the 80/20 rule because 80% of the effect is provided by 20% of the cause.

Vilfredo Pareto (1848 – 1923)

20% of the total indicators will have impact on 80% of the Project or TAR.

RULE IS USUALLY APPLIED WHEN SELECTING THE NUMBER OF KPIS IS: KRI S 10, PIS 80, KPI S 10
How to Measure Turnaround Performance and Why?

Performance Measures

Anatomy of KPI

- **KEY** = a major contributor to success or failure.
- **PERFORMANCE** = a metric that can be measured, quantified, adjusted and controlled. The metric must be controlled to improve performance.
- **INDICATOR** = reasonable representation of present and future.
How to Measure Turnaround Performance and Why?

Performance Measures
Hierarchical Model.

Key Performance Indicators (KPIs)

Characteristics of Effective KPIs

- Aligned
- Owned
- Predictive
- Actionable
- Few in numbers
- Easy to understand

- Balanced and Linked
- Trigger Changes
- Standardized
- Context Driven
- Reinforced with Incentives
- Relevant

Source: Harold Kerzner, PH.D., Project Management Metrics, KPIs, and Dashboards, IIL and Wiley 2011.
Leading and Lagging Indicators

Leading indicators
• Measure and track performance before a problem arises
• Respond faster than results metrics
• Selected to indicate progress towards long term objectives

Lagging indicators
• Measure performance afterwards
• Lagging KPIs are the results, such as maintenance cost (effected if scheduling is not working).
Leading and Lagging Indicators

Measure the result of management effort with these lagging indicators.

**Lagging KPIs**

**Leading KPIs**

Results of Best Practices:
- Turnaround Cost
- LTIFFR
- Turnaround Duration
- Plant Availability & Reliability

Manage the Turnaround and Shutdown functions with these leading indicators.

**Lead KPIs**

- Work Identification
  - Scope Definition
  - Scope Control

- Scheduling
  - Schedule Integration

**Planning**
- % Planned work
- % Planned accuracy
- % Rework
Turnaround Uncontrollable Leading Indicators

- Turnaround complexity
- Availability of skilled labor
- Amount of piping work
- Amount of I&E work
- Equipment congestion

The level of control that the turnaround organization has over these characteristics is very limited!
Turnaround Controllable Leading Indicators

• Team alignment
• Scope definition and control
• Comprehensive planning (including SIMOPS, Conflict resolution,..)
• Schedule Integration
• level of preparedness
Leading Indicators

Inherent Characteristics (Uncontrollable)
- Size: # of labor hours
- % capital projects
- labor market
- new technology
- area congestion
- material condition, etc.

Level of Readiness (Controllable)
- team alignment
- scope control
- capital integration
- contract strategies
- planning practices
- cost estimating, etc.

Driving Performance
- Safety
- Schedule
- Cost
- Operability

Source: APN - Asset Performance Networks, LLC
Turnaround Leading Indicators
Shutdown Readiness Pyramids (by APN)

Readiness relative to industry best practices Can be measured and quantified

Source : APN - Asset Performance Networks, LLC
Long Range Plan:
Long range planning is the process for establishing Turnarounds based on Reliability Issues, Capital Planning, and Economic Decision Models.
Effective Long Range Planning permits sound management of Capital Projects together with Operational and Reliability Issues and permits an organization to better allocate its Human and financial resources.

Source: APN - Asset Performance Networks, LLC
Turnaround Team:

- The Management of a Turnaround from conceptual stage to completion is a team effort.
- Team members must clearly understand their Roles and Responsibilities and work in an effective manner.
- Key practices include the organization, the leadership or steering team, and the team building process.

Source: APN - Asset Performance Networks, LLC
Lessons Learned:

• A systematic study of critiques of previous Turnarounds and large capital projects is an important element in the preparation for a successful Turnaround.

• Key part of this process is to understand previously encountered issues with improvement action items assigned to individuals with deadline dates for completion.

Source: APN - Asset Performance Networks, LLC
Scope of Work:

- The scope of work for the turnaround refers to all the activities that need to be planned and executed during the shutdown, execution, and startup phases.
- The scope includes all types of activities, including maintenance, inspections, and capital projects.
- Key practices include scope development, growth control, and analysis, prioritization, and evaluation.
Detailed Planning:

• During this phase of the Planning Process the work scope is broken down into job packages which provide all the information to perform the work in the field including trade allocation, drawings, procedures tools, equipment and materials.

• Job walk downs with contractors are also performed during this phase of the planning process.
Resource Planning:

• Resource Planning involves the determination of skilled craft requirements and the staffing needs of the Turnaround management organization.

• Logistical issues and shift schedules are also addressed during this phase of the process.
Using Spider Chart for visualizing the shutdown readiness and accordingly take necessary corrective actions.
## Turnaround Leading Indicators

### Quick Report Card

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organization</strong>: How to organize for a shutdown. The best organizations assign a manager who is given responsibility and authority, planners, support personnel, people who have the time, and all the preparation skill sets needed for an adequate period.</td>
<td></td>
</tr>
<tr>
<td><strong>Planning &amp; scheduling</strong>: Thinking through the jobs, anticipating problems, and developing contingency plans for when something goes wrong. How to perform the work. Defined overall scope, work lists, control, prefabrication, design of schedule, keeping schedule right</td>
<td></td>
</tr>
<tr>
<td><strong>Contractors</strong>: How to integrate external organizations. Create accurate contractor packages, identify and evaluate contractors, identify sub-contractors, build in carrots and sticks, mobilization plans to insure the right people are there on day one, demobilization plans to manage costs.</td>
<td></td>
</tr>
<tr>
<td><strong>Accounting, Costs</strong>: How much did the shutdown cost? How to estimate, report, and control costs. How to fund, estimate, refine, develop contingency cost reporting systems in real time, close out. Evaluate financial risks.</td>
<td></td>
</tr>
<tr>
<td><strong>Logistics</strong>: Organization for the parts, materials, and supplies. Elements of logistics include a site plan, site control, safe routes for lifts, and any off-site management of materials or equipment. Functions are parts receiving, storage, and job site delivery.</td>
<td></td>
</tr>
</tbody>
</table>

Earned Value Analysis

Integrated Project Status (Earned Value) Report

WBS Dictionary

Schedule
Planned Values (Budgeted Cost)
Actual Costs
Earned Value Assessment

Earned Value Analysis

1. Organize the Work
   - Diagram showing organization of work

2. Schedule the Work
   - Control Account Schedule
     - Activity
     - Network Schedule
     - Activity

3. Establish the Budget
   - Timeline with milestones:
     - 50
     - 60
     - 30
     - 30
     - 30
     - 360
     - 400

Management Reserve

Performance Measurement Baseline

Baseline Development
Turnaround Earned Value Analysis

• Is project spending meeting budget and schedule objectives?
  – Planned Value: Budgeted Cost of Work Scheduled
  – Actual Cost : Actual Cost of Work Performed
  – Earned Value: Budgeted Cost of Work Performed

\[
\text{CPI} = \frac{\text{Earned Value}}{\text{Actual Cost}}
\]

\[
\text{SPI} = \frac{\text{Earned Value}}{\text{Planned Value}}
\]

If CPI > 1.1 and less than .9 (require assessment)

If SPI > 1.1 and less than .9 (require assessment)
Earned Value Analysis
# Turnaround Earned Value Analysis

## Earned Value Management Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV (BCWS)</td>
<td>Planned Value</td>
<td>What is the estimated value of the work planned to be done?</td>
</tr>
<tr>
<td>EV (BCWP)</td>
<td>Earned Value</td>
<td>What is the estimated value of the work actually accomplished?</td>
</tr>
<tr>
<td>AC (ACWP)</td>
<td>Actual Cost</td>
<td>What is the actual cost incurred?</td>
</tr>
<tr>
<td>BAC</td>
<td>Budget at Completion</td>
<td>How much did you BUDGET for the TOTAL JOB?</td>
</tr>
<tr>
<td>EAC</td>
<td>Estimate at Completion</td>
<td>What do we currently expect the TOTAL project to cost?</td>
</tr>
<tr>
<td>ETC</td>
<td>Estimate to Complete</td>
<td>From this point on, how much MORE do we expect it to cost to finish the job?</td>
</tr>
<tr>
<td>VAC</td>
<td>Variance at Completion</td>
<td>How much over or under budget do we expect to be?</td>
</tr>
</tbody>
</table>
# Turnaround Earned Value Analysis

## Earned Value Management Formula and Interpretation

<table>
<thead>
<tr>
<th>Name</th>
<th>Formula</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Variance (CV)</td>
<td>EV – AC</td>
<td>NEGATIVE is over budget, POSITIVE is under budget</td>
</tr>
<tr>
<td>Schedule Variance (SV)</td>
<td>EV – PV</td>
<td>NEGATIVE is behind schedule, POSITIVE is ahead of schedule</td>
</tr>
<tr>
<td>Cost Performance Index (CPI)</td>
<td>EV / AC</td>
<td>I am [only] getting _____ cents out of every $1.</td>
</tr>
<tr>
<td>Schedule Performance Index (SPI)</td>
<td>EV / PV</td>
<td>I am [only] progressing at ___% of the rate originally planned.</td>
</tr>
</tbody>
</table>
## Turnaround Earned Value Analysis

### Earned Value Management Formula and Interpretation

<table>
<thead>
<tr>
<th>Name</th>
<th>Formula</th>
<th>Interpretation</th>
</tr>
</thead>
</table>
| Estimate At Completion (EAC) Note: There are many ways to calculate EAC. | BAC / CPI                                    | As of now how much do we expect the total project to cost $_____.  
- Used if no variances from the BAC have occurred  
- Actual plus a new estimate for remaining work. Used when original estimate was fundamentally flawed.  
- Actual to date plus remaining budget. Used when current variances are atypical.  
- Actual to date plus remaining budget modified by performance. When current variances are typical. |
| Estimate To Complete (ETC)          | EAC – AC                                      | How much more will the project cost?                                                                                                                                                                           |
| Variance At Completion (VAC)        | BAC – EAC                                     | How much over budget will we be at the end of the project                                                                                                                                                     |
KPIs Used to Measure Shutdown Performance (Examples)

<table>
<thead>
<tr>
<th>Turnaround KPI</th>
<th>Mobil</th>
<th>Ampol</th>
<th>BP Qld</th>
<th>BP WA</th>
<th>Kemcor</th>
<th>Huntsman</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environment Health and Safety</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Serious Injuries (LTI + MTI)</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>• First Aid Injuries</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>• Near Misses</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>• Safety Audits</td>
<td>M</td>
<td>T</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>• Environmental Incidents</td>
<td>T</td>
<td>T</td>
<td>M</td>
<td>M</td>
<td>T</td>
<td>M</td>
</tr>
<tr>
<td><strong>Schedule/Progress</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Plan</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>• Actual</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>• Earned (productivity)</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Plan</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>• Actual</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>• Earned</td>
<td>M</td>
<td>T</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Additional Work</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Plan vs Actual</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>• % Complete</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>• Earned/Variation</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td><strong>Lost Time/Delays</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Weather</td>
<td>M</td>
<td>-</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>-</td>
</tr>
<tr>
<td>• Permits</td>
<td>M</td>
<td>-</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>-</td>
</tr>
<tr>
<td>• Industrial Relations</td>
<td>T</td>
<td>-</td>
<td>M</td>
<td>T</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td><strong>Reliability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Discrepancies vs NCR’s (non conformance report)</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>• Impact on start up</td>
<td>T</td>
<td>T</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>• Number of NCR’s</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
</tbody>
</table>

T – KPI measured and reported against target

M – KPI measured to monitor performance

Source: Industrial Maintenance Roundtable
February 1998
By: Shutdown, Turnaround Common Interest Work Group
### KPIs Used to Measure Shutdown Performance Targets (Examples)

<table>
<thead>
<tr>
<th>KPI</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safety</strong></td>
<td></td>
</tr>
<tr>
<td>LTI (Lost Time Incident)</td>
<td>0</td>
</tr>
<tr>
<td>Near miss reported during shutdown</td>
<td>0</td>
</tr>
<tr>
<td>Recordable environmental Incident</td>
<td>0</td>
</tr>
<tr>
<td>Awareness Training (for the affected personnel) (PTW, Confined Space, radiation protection, etc)</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Shutdown Schedule</strong></td>
<td></td>
</tr>
<tr>
<td>Compliance with schedule (Actual shutdown duration Vs planned)</td>
<td>100% +/- 15%</td>
</tr>
<tr>
<td><strong>Shutdown Costs</strong></td>
<td></td>
</tr>
<tr>
<td>Against Budget</td>
<td>100% +/- 10%</td>
</tr>
<tr>
<td><strong>Maintenance Activities</strong></td>
<td></td>
</tr>
<tr>
<td>Rework</td>
<td>0</td>
</tr>
<tr>
<td><strong>Plant Start-up</strong></td>
<td></td>
</tr>
<tr>
<td>Leaking flanges on start-up</td>
<td>0</td>
</tr>
<tr>
<td>Loop checks on affected control systems</td>
<td>100%</td>
</tr>
<tr>
<td>No. Controllers in manual as a consequence of shutdown activities</td>
<td>0</td>
</tr>
<tr>
<td>No. Trips following re-commissioning of plant as a result of shutdown affected equipment.</td>
<td>0</td>
</tr>
<tr>
<td><strong>Production Loss</strong></td>
<td></td>
</tr>
<tr>
<td>Production Loss forecasted against actual</td>
<td>100% +/- 10%</td>
</tr>
</tbody>
</table>
## KPIs Used to Measure Shutdown

### HSE KPIs (Example)

<table>
<thead>
<tr>
<th>KPI</th>
<th>Target planned</th>
<th>Cumulative till yesterday 03-Dec</th>
<th>Today: 04-Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man Hours Without LTI</td>
<td>N/A</td>
<td>1025900</td>
<td>15356</td>
</tr>
<tr>
<td>First Aid Cases</td>
<td>01</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Medical Treatment Cases</td>
<td>01</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>RWDC- Restricted Work Day Cases</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Lost Time Injuries</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fire Incident</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PTW Check</td>
<td>950</td>
<td>2575</td>
<td>17</td>
</tr>
<tr>
<td>PTW Check- Non Compliance</td>
<td>N/A</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>Near Miss Reported</td>
<td>450</td>
<td>737</td>
<td>3</td>
</tr>
<tr>
<td>Management Safety Tour</td>
<td>30</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td>Tool Box talk</td>
<td>2600</td>
<td>2682</td>
<td>69</td>
</tr>
<tr>
<td>Advance Safety Audit</td>
<td>450</td>
<td>417</td>
<td>17</td>
</tr>
<tr>
<td>Spotlight on HSE</td>
<td>60</td>
<td>76</td>
<td>0</td>
</tr>
<tr>
<td>Emergency Exercises</td>
<td>06</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>
Example of TA KPI Interpretation

LTIFR - Lost Time Injury Frequency Rate

\[
LTIFR = \left( \frac{\text{Number of Lost Time Injuries}}{\text{Total Man Hours}} \right) \times 1,000,000
\]

- Personnel are getting injured.
- Safety practices / mechanisms are ineffective.
- Incident reporting is increasing.

<table>
<thead>
<tr>
<th>LTIFR &lt; 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Personnel are NOT getting injured.</td>
</tr>
<tr>
<td>- Safety practices / mechanisms are effective.</td>
</tr>
<tr>
<td>- Incident reporting is reducing.</td>
</tr>
</tbody>
</table>
Example of TA KPI Interpretation

% Rework

\[
% \text{Rework} = \left( \frac{\text{Rework Man Hours}}{\text{Maintenance Work Hours}} \right) \times 100\%
\]

- Maintenance practices / mechanisms are ineffective.
- Poor design.
- Poor operating practices.
- Ineffective work practices.

% Rework < 10%

- Maintenance practices / mechanisms are effective.
- Effective work practices.
- Good design.
Example of TA KPI Interpretation

% Planning Effectiveness

\[
\text{% Planning Effectiveness} = \left( \frac{\text{Number of Scheduled Jobs Completed with Comments}}{\text{Total Number of Scheduled Jobs Completed}} \right) \times 100\%
\]

- Minimum requirements for a planned job not understood.
- Schedule compliance low.
- High level of job delays.
- Maintenance practices / mechanisms are ineffective.
- Maintenance / Production Department communication / cooperation ineffective (Access to equipment).

<table>
<thead>
<tr>
<th>% Planning Effectiveness &lt; 20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Planned requirements well understood.</td>
</tr>
<tr>
<td>- Schedule compliance high.</td>
</tr>
<tr>
<td>- Maintenance practices / mechanisms are effective.</td>
</tr>
<tr>
<td>- Maintenance / Production Department communication / cooperation effective (Access to equipment).</td>
</tr>
<tr>
<td>- Job ticket comments not being completed.</td>
</tr>
</tbody>
</table>
Shutdown Readiness Audit / Peer Review

The event
- Safety
- Organization
- Planning
- Contractors
- Costs
- Logistics
- Execution

Feed upward to business managers
Feed back to ‘team’

Review & analyse
- What went well?
- What didn’t?
- Root causes?
- Action to improve!

Formulate improvement action plan
- What will we do?
- Who will do it?
- By what date?
- How will it be done?
- What is the benefit?
- What will it cost?

Feed forward into planning for next event

Shutdown Readiness Audit / Peer Review

Peer reviews, steering committees and an external audit may reveal deficiencies in the following areas:

• TA preparation planning
• Scope management – define and freeze a reliable scope
• KPIs and reporting
• Process for risk management
• Elements of the contractors’ management process
Turnaround Reporting Tips

Types of Turnaround Reporting

Status Reporting:
Where we are today

Progress Reporting:
What we have accomplished

Forecasting:
What is likely to happen?

Many reports to management have elements of all three.
Turnaround Reporting Tips

Keys to Effective Turnaround Reporting

- Keep It Simple.
- Audience specific.
- Be concise and terse (short).
- Use graphics effectively but honestly and do not overdo them.
- Keep copies of reports in shutdown history binder.
Turnaround Reporting Tips
S- Curve
Turnaround Reporting Tips
Use Software to create Your Own Dashboards

Sample Dashboard Reporting TRIF, Schedule SPI, Budget CPI and Cost Breakdown
Turnaround Reporting Tips
Skyline - Static Equipment
# Turnaround Reporting Tips

**Skyline – Valves (NRVs / PSVs/CVs/LTS)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Area 01</th>
<th>Area 02</th>
<th>Area 03</th>
<th>Area 04</th>
<th>Area 05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned</td>
<td>9 10 9 12</td>
<td>13 11 11</td>
<td>16 5 18 18</td>
<td>4 18 18</td>
<td>18 21 18</td>
</tr>
<tr>
<td>Removed</td>
<td>9 10 9 12</td>
<td>13 11 11</td>
<td>16 5 18 18</td>
<td>4 18 18</td>
<td>18 21 18</td>
</tr>
<tr>
<td>@ Workshop</td>
<td>4 10 9 12</td>
<td>13 11 11</td>
<td>16 5 18 18</td>
<td>4 18 18</td>
<td>18 21 18</td>
</tr>
<tr>
<td>@ Die</td>
<td>2 12 8 4 6</td>
<td>4 16 4 26</td>
<td>27 4 26</td>
<td>27 4 26</td>
<td>27 4 26</td>
</tr>
<tr>
<td>@ Re-Installed</td>
<td>6 8 9 7 2 2</td>
<td>2 1 21 10 12 17</td>
<td>2 1 21 10 12 17</td>
<td>2 1 21 10 12 17</td>
<td>2 1 21 10 12 17</td>
</tr>
</tbody>
</table>

**Summary**

- NRVs: 69
- PSVs: 46
- CVs: 257
- Box Up %: 41%

---

**Diagram**

- 6-C-LT-0012, 6-C-LT-0017, 6-C-LT-0022
- 1-C-LT-0014, 1-C-LT-0019, 1-C-LT-0024
- 4-C-LT-0008, 4-C-LT-0013, 4-C-LT-0018
- 7-C-LT-0002, 7-C-LT-0007, 7-C-LT-0012
- 8-C-LT-0002, 8-C-LT-0007, 8-C-LT-0012

---

**Updated As Of:** 1800 Hrs Thursday, November 14, 2013

---

*Note: The table and diagram provide a visual representation of the turnaround reporting for Skyline – Valves (NRVs / PSVs/CVs/LTS). The data includes the areas and counts for each category, with additional notes on individual valve classifications.*
There are several companies that provide metric management and dashboard software solutions to their clients.
Turnaround Reporting Tips

Turnaround Final Report

The content of TA final report should address the following important topics:

1. Turnaround policy;
2. The work scope;
3. The preparation phase;
4. Planning;
5. The organization;
6. Control of work;
7. Contractor performance;
8. Safety;
9. Quality;
10. Site logistics;
11. Communications;
12. Lessons Learned; and recommendations for improvement.
How to Prepare an Efficient Turnaround?

1. Well defined turnaround premise;
2. Fully implemented standard turnaround work process;
3. Disciplined capable organization; and
4. Deployment of the industry’s best practices.
Summary

• The preplanning time line is greatly impacted by the size and complexity of the Turnaround.
• Efficient preparation of Turnaround with the quality and attention to detail is the key for TA success.
• Leading indicators - such as scope definition and planning practices - have a quantifiable effect on turnaround outcomes.
• Conduct audit or Peer review to identify any deviation from “best in class” practice and provide suggestions for improvement.
• Develop efficient reporting system, simple, specific and concise.
References

• Trinath Sahoo, Process Plants Shutdown & Turnaround Management, CRC Press 2014.
• Harold Kerzner, PH.D., Project Management Metrics, KPIs, and Dashboards, IIL and Wiley 2011.
• Project Vs. Turnaround white paper https://www.interplansystems.com/resources.html
References (Cont.)

• Suketu Nagrecha, MBA, PMP, CAN - An introduction to Earned Value Analysis, March 16, 2002.
Thank you