PLANT SHUTDOWNs

PREPARATION
MANAGEMENT
CONTROL

(TURNAROUND MANAGEMENT)
This document has the aim to describe the operational sequences for the plant maintenance shutdowns planning and execution in the OIL& GAS industry.

The aim of a plant shutdown is to carry out:

- Activities that can’t be run during the ordinary plant operating activities;
- Activities that ensure the restoration of the operability and effectiveness of the maintained system, as provided in the project;
- Compliance activities to regulatory requirements;
- Inspections in accordance with the Machinery Directive/Pressure Equipment;

The system shutdown is characterized by:

- Potential risk for people and environment safety;
- Significant level of complexity due to:
  - Number of activities to be performed;
  - Involvement of many resources both internal and external;
  - Execution time limited;
  - Restricted operation areas;
- High cost of investment, due to resource and assets to be spent in a limited timespan;

In order to ensure the proper shutdown performance it is necessary:

- the strategic objectives of the shutdown be clear and shared, in order to evaluate the best execution policy of the interventions, trying to optimize the cost of the maintenance and minimize the downtime;
- the starting dates of the stops be compatible with the materials procurement and interventions planning;
- the goals of the stop must be correctly evaluated considering the interventions according to the cost / opportunities criteria;
- the organization for the management of the stop be clear;
- Resource management be planned with extreme detail in order to get the best workloads distribution, in order to be able to reduce the shutdown duration;
- The shutdown progress be always monitored, from the operational and economical point of view, in order to promptly intervene in the changes and unpredictable management;
- All the information has to been tracked ex post, in order to assess the effectiveness and efficiency of the stop and have a historical basis for the execution of future shutdowns.

The general design of a shutdown system can be divided into 4 operational phases, as shown below:

**Step 1: Structuring**

Phase that defines the project objectives, in terms of time and cost;

**Step 2: Preparation**

In this phase of the project the following activities are performed;

- Works list definition;
- Planning and procurement of materials/performance;
- GANTT representation inclusive of all planned activities;
- Shutdown splitting o in Macro interventions;

**Step 3: Execution**

This is the execution phase of the project, which covers all activities that are characterized by:

- Using a large number of resources, employed on different disciplines;
- Large amount of man-hours;
- Simultaneous activities in limited operational areas;
- Safety, time and economic constraints;

The monitoring that is carried out during phase 3 is necessary for the examination of the operational performance,
Step 4: Shutting-down, Analysis and Evaluation

The shutting-down phase must provide two basic activities:

a- Restitution of the system under Turnaround, in optimal conditions in order to be put back into operation;
b- Collection of all the technical and economic documentation for the correct analysis and evaluation of the work done during the shutdown and which could be useful for the future interventions.

Phase development: Framing

Formalization of the Team

Due to the complexity of the activities that each systems shutdown provides, it is essential to have an adequate level of control, which is carried out by the establishment of a special Team, whose purpose is to:

- Define the shutdown strategy;
- Monitor the progress of activities and performance expectations;
- Appoint the Shutdown Manager.

The Shutdown Manager evaluates the actions to be made, builds a planning team, involving the technicians of the various plant functions: engineering, inspection and testing, maintenance, programming, operation, technology, purchasing, investments and HSE.

Master Plan Development

The planning team develops and submits for the Shutdown Manager’s approval, a Master Plan which describes the milestones, indicating the execution time within which the planning phases must be carried out.

Shutdown General Plan Development

According to the general indications of the Refinery property, it is developed a first draft of the Shutdown General Plan, where the plants to shutdown and their shutting and starting times can be found.

Kick-off meeting

After the definition of the shutdown general plan, the Shutdown Manager presents the Master Plan and the shutdown expected targets and during the meeting the following issues are addressed:

- Shutdown strategy;
- Shutdown organization;
- Reference Milestone;
- Shutdown budget;

Phase 2 Development: Preparation

Activities definition and description

The aim of the Turnaround is to ensure the integrity, operability and reliability of the plants during the next operating cycle performing all and only those activities which can’t be carried out in normal operating conditions or which is not economical to operate from the point of view of cost.

In general, jobs are offered by the Engineering function (Reliability/Inspections), the maintenance function and the process functions (Exercise/Technology), based on:

- Report of the end of the previous Turnaround’s works;
- Inspections of running cycle;
- Operating reports;
- Plant Improvements proposed by the Technology.

The activities are collected into a single list, where they are grouped by plant and analyzed in terms of criticality due to supplying times.

The first activities list developed is technically analysed by the “functions” involved to verify the reasons and be sure...
that the proposed intervention is necessary; it is also evaluated the inclusion of other activities deemed necessary to minimize the probability of late integration of works due to the malfunctions that might be detected near the stop.

The Pre-stop Inspection Plan is of fundamental importance. This plan is drawn up at the Inspection and Testing Unit, well in time for the beginning of the stop (at least 9 months earlier), and provides the list of ITEM to be inspected (both lines and equipment).

The Pre-Stop Inspections must be conducted and concluded within at least four months before the shutdown starts, in order to have enough time to organize the activities that had possibly been highlighted by the inspection campaign and have the appropriate timing for the material supply.

Within 4 months from the shutdown moreover, the minor ITEMS activities list must be drawn up too, where for minor ITEMS we mean valves, instrumentation, steam control units, etc

**Supplies Planning**

Once the list of activities is defined, supply provisions are planned either with already existing framed contracts or also with specific contracts, according to the needs of the individual interventions.

**Performance Scheduling**

After scheduling activities and supplies, it is drafted a shutdown GANTT, which summarizes all relevant information for each individual intervention and relates to the entire shutdown development.

**Logistics**

Planning the logistics of the activities is another important aspect of an effective shutdown. In fact the Turnaround is characterized by the presence of companies, other personnel and operative resources of much higher quality than in routine maintenance activities. Furthermore, it should be considered also the fact that, during the shutdown activities, there are other systems that are still running.

Therefore the logistics planning should be developed to:
- Minimize people, equipment and materials movement;
- Maximize safety during transports;
- Ensure free routes to emergency vehicles.

During the writing of the logistics plan, also the following activities will take place:
- Identification of appropriate areas for the washing activities of tube bundles and identification of routes for their movement from the plant to the washing zone and vice versa;
- Evaluation of transport routes for any possible special transport;
- Checking the stationing of high tonnage cranes and its internal routes for their movement.

### Phase 3 development: Performance

**Activities monitoring**

Monitoring the activities is crucial to the success of the shutdown activities. The monitoring is performed using the GANTT issued, which will be updated to the information that the field supervisors communicate to the programmers.

The updating is daily for the activities which are considered critical, while one/two times a week for the remaining activities.

The monitoring activities and the GANTT updating are used as a decisional instrument to determine the actions to be taken for the correct progress of the activities.

Everyday there is a shutdown meeting to analyze the problems, in particular:
- Safety;
- Deviations between planned and executed works;
- Evidence of additional works or unexpected operating difficulties.

**Costs monitoring**

Monitoring the costs is crucial to the good result of the shutdown, which extends beyond the description in the budget and must pay particular attention to:
- Costs from unexpected works;
- Costs derived from "on-the-spot/economy" works
Phase 4 Development: Shutdown Stop – Analysis and evaluation

Definition and description of the activities

The post-shutdown activities aim at collecting and sharing the information resulting from the execution of Turnaround, returning them back to proper documentation and making them easily available, in order to capitalize on the knowledge gained and ensure their traceability for future stops.

Collecting and organizing documents

Particularly important for the compilation of a close-out report, which summarizes the documents listed in the paragraphs below and highlighting the performance in terms of time, cost and quality of operations.

The analysis of the Turnaround performance is focused on:

- Safety during the turnaround;
- Cost of Turnaround;
- Duration of Turnaround;
- Any upset to restart;
- Main maintenance and inspection works conducted;
- Resource productivity;
- Critical issues identified in the different phases of the Turnaround;
- Inspected equipment list;
- Inspection evidence on the state of the equipment;
- Unexpected work conducted during the Turnaround;
- Inspection activities to include in the next inspection plan;
- Actions to be planned during the next Turnaround or during routine operation.

Performance analysis

In order to have a clear advancement of the assets and to account to the Company Management of the Turnaround performance, it is necessary to introduce a system of performance indicators (KPI).

In Turnaround it is essential the timing within which an intervention is carried out, therefore, the performance indicators are not calculated statically at the end of the Turnaround, but they are calculated during the whole process frequently and with a set target.

All this in order to always monitor the activities and intervene at the right time for any corrective action if significant differences were highlighted.

Here below key performance indicators for monitoring the planning and execution phases are shown:

Planning activities

- Supply critical materials
  - RDA (%) = No. RDA issued / n. Total RDA;
  - Orders (%) = n. Orders issued / n. Total orders;
  - Check Materials (%) = n. materials arrived / n. ordered materials

- Activities List
  - Delay in freezing (final list issue) shutdown activities = n. late vs expected days;
  - Additional works (%) = n. activitie post freezing / n. frozen activities;
  - Ultimate (%) = (delta Estimates) / Estimate +/- 30%

Running activities

- Work Progress (%) = % Current activities / % Scheduled activities;
- Program Effective Duration (days) = Delta days;
- Additional works (%) = New works / planned works;
- Cost of additional works (%) = additional costs / planned costs jobs
- Turnaround Cost (%) = Cost final balance / fee quote.