EPC revamping project: execution strategy for a European downstream plant

By Armando Bianco, P.E., PMP®
Engineering Manager
Eniprogetti

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Engineering execution strategy for revamping project: battery limits, key deliverables, on-site activities

Interdependency Schedule: EPC Project baseline integrated in Operation and Turn-around plan

How to meet challenging schedule targets for downstream plant -> Fast-track

Conclusions
The role of FEED (Front End Engineering Design) in the EPC execution strategy by Armando Bianco, Eniprogetti
Key factors for revamping of existing plants

Safety

Environment improvements

Business objectives
Revamping Philosophy

- Reservation Procedures
- Tie-in Package
- Tie-in Location Plan
- Data Collection
- Site survey
- Reverse Engineering
- TIE-IN DESIGN

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Reverse engineering, also called back engineering, is the process of where a man-made object is deconstructed to reveal its designs, architecture, or to extract knowledge from the object. By wikipedia

Step 1

Existing Design Constrain

Existing Layout Constrain

Existing Mechanical Constrains

And many others...

Step 2

Reverse engineering shall be the supported by the engineering approach to overcome the current design and meet the “new” project requirements.

how?

Integrated Process Simulations

Reconfiguration or re-evaluation of existing items

Design margin of existing equipment
Multi-disciplinary site surveys: as-built vs as-is status

- **Original Design Basis**
- **As-built**
- **Original 3D Model**
- **Original Hazop**
- **PCS data collection**

Different kinds of surveys can be envisaged with the aim to verify the current status of as-built drawings vs as-is conditions.

- Aboveground (Integrity check for equipments, dimensional check with laser scanning techniques, etc.)
- Underground Survey (metal detector systems, or hand excavation, etc.)
- Original vendor for revamping of system DCS, substations, packages, etc.
Reservation Procedures

Objective: to allow the physical reservation of available spares or location (spares in DCS inside control rooms, breakers available in substations, available pipe runs on piperacks etc.)
Objective: a comprehensive summary of all the engineering documentation prior to construction start (shut-down)

- General Information
- Flow-check
- Tie-in type
- Tie-in detail
- P&ID
- Tie-ins Location Plan
- Isometric
- Isometric for demolition
- Exception Joints
- Constructability
- Method Statement
- Tools
- Pre-shutdown activities (by operation)
- Start-up activities (by operation)
- Quality assurance documentation
Revamping Philosophy – Key points

- Design to be developed considering the existing constrains from a technical point of view (layout limitation, spares, available tie-ins etc) and involving stakeholders with particular reference to Operations
- On-site engineering with extensive surveys to be executed at the start of the project to avoid future reworks and delays
- Dedicated procedures to be developed according to the rules of the complex to reserve tie-ins allocation
Long Lead Items definitions for a greenfield project

Those components of a system or piece of equipment for which the times to design and fabricate are the longest and for which an early commitment of funds may be desirable or necessary in order to meet the earliest possible date of system completion.

LONG-LEAD ITEMS PURCHASE ORDERS

Give attention to the longest delivery items (long-lead items) on the schedule to see which ones fall on the critical path. If there are several large field-erected

LONG-LEAD ITEM

Long-lead items are components that need to be ordered well in advance of the production of the arms into which they are incorporated. These are typically components involving advanced technologies that cannot be provided by the prime contractor and systems integrator, but that must be ordered from specialist firms. These also are referred to as long-lead
The critical path is the sequence of activities that represents the longest path through a project, which determines the shortest possible project duration [PMBOK 6.6.2.2 Critical Path Method]

Applying Critical Path method for all the systems of a project, even material with a rather short delivery can result to be critical, owing to that we can split LLI in two categories:

- **Typical LLI such as:**
  - High pressure equipment
  - High temperature equipment
  - Special Material equipment

- **Not Typical LLI such as:**
  - Tie-ins: integration with existing Facilities
Tie-ins: integration with existing Facilities

**REFERENCE GREEN-FIELD PROJECT SCHEDULE**

<table>
<thead>
<tr>
<th>Pre-feas. 1-3 MM (typ. Ref.)</th>
<th>Feasibility 3-6 MM (typ. Ref.)</th>
<th>FEED 3-9 MM (typical ref.)</th>
<th>Detail Design &amp; Procurement 9-18 MM 12 - 32 MM (typical ref.)</th>
<th>Construction 3-12 MM (typical ref.)</th>
<th>Commissioning 3-12 MM (typical ref.)</th>
</tr>
</thead>
</table>

**PRODUCTION PLAN of EXISTING FACILITIES**

<table>
<thead>
<tr>
<th>UNIT 10</th>
<th>Shut-down</th>
<th>Plant to be disinvested</th>
<th>Production</th>
<th>Dismantling</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT 20</td>
<td>Shut-down</td>
<td></td>
<td></td>
<td>Dismantling</td>
</tr>
<tr>
<td>UNIT 30</td>
<td>Shut-down</td>
<td></td>
<td>Dismantling</td>
<td></td>
</tr>
</tbody>
</table>

**OVERALL SCHEDULE INTEGRATED WITH PRODUCTION PLAN**

Tie-ins shall be planned in an early stage of the project, with a dedicated engineering, construction and commissioning team. The project schedule incorporates the production plan in terms of turn-around or critical milestones.
## Shut-down Planning

<table>
<thead>
<tr>
<th>DUTY</th>
<th>ACTIVITY</th>
<th>PRE-SHUTDOWN</th>
<th>SHUTDOWN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-30</td>
<td>-20</td>
</tr>
<tr>
<td>CTR</td>
<td>Spools Hydro Testing</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>CPY</td>
<td>blind removal on new line</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>CTR</td>
<td>remove insulation</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>CPY</td>
<td>Client shut-down preparation</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>CTR</td>
<td>blind removal on existing line</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>CTR</td>
<td>erection and positioning of flanged spool</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>CTR</td>
<td>Gaskets and bolts installation/ bolt torquing</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>CPY</td>
<td>Client estimated start-up</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>CTR</td>
<td>install insulation</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

**Legend**
- **CPY**: COMPANY
- **CTR**: CONTRACTOR

The duration of a shut-down as an order of magnitude lower compared to the project schedule and it is measured in days (and in hours for micro-planning)

1. IP-CPP-L-00115 & IP-CPF-L-00216
2. In simultaneously one crew will work on the blind located on line No. B-36-36"P-0336-3CS1P and the other crew will work on the blind fixed on line No. B36-48"P-0337-3CS1P.
   - Blind on line No. B-36-36"P-0336-3CS1P:
     - Two proper dimensioned web slug will be fixed on the beam A & B that will support a chain block.
     - Using a bolt torquing machine, the crew will de-bolt the blind and secure it to the chain block.
     - Using the chain block, the blind will be laid down on the ground (as indicated in the snap-shot).
     - The blind on the line NW B-36-20"P-0403-3CS1P01, going to be de-bolted using the bolt torquing machine and it will be laid down by crane located in the area showed in the previous snap-shot.
Long Lead Items strategy – Key points

- The critical path developed for all the project systems allows us to recognize that tie-ins are critical delivery items even though they do not have the longest delivery;

- For a revamping project, the integration of the production plan in the project baseline allows to execute tie-ins during turn-around, minimizing the number of shut-downs and avoiding unnecessary loss of production;
Project objectives and Fast-Track Projects

- **Opt.1) Compress the activity lengths -> Crashing**

- **Opt.2) Parallelization of phases -> Fast-Tracking**

The fast-track is a global concept which can be applied to the overall scope of a project (from exploration to commissioning, overlapping reservoir models to engineering, engineering to procurement and so on). Here is applied for the engineering phases.

Note: time phases are for reference only
Possible outcomes when implementing a Fast-Track in a project

- Relying upon preliminary information
- Overdesign material
- Design based on assumptions
- Increased interface management
- More difficult engagement of personnel
- Not linear approach in decision making
- Increased possibility of inconsistencies
- Higher Cost
- Higher Risk
- More Engineering Man-hours
- More Reworks
- More difficult engagement of personnel

Which is the greatest objective?
How to mitigate risks in fast-track revamping projects

**Feasibility Study**

- Final alignment at engineering milestones mitigates risk to postpone critical decision to further phases

**ENGINEERING**

- Preliminary information evaluated from Basic (used for detail design) are always re-checked and re-updated when more information is available

**MATERIAL**

- Material check/re-rated is re-consolidated both in Basic and Detail Design to avoid reworks during construction and commissioning

**TEAM**

- If the approach is aligned since the beginning with a common goal, all the team is aimed to support unavoidable project changes and reworks activities

**Final alignment**

- Re-cycling Design inputs/outputs

- Early procurement can start with preliminary data, updating more consolidated information during the vendor alignment before PO

**Involvement** of Operation in the project team since the beginning of the project.

Clear definition of the project structure with clear rules for interface management
Interface management in fast-track

- **Interface Management**

Legend:
- Direct (contractual) interface
- Indirect interface

- **FAST-TRACK**
  - OWNER
  - BASIC FEED CONTRACTOR
  - OPERATIONS TIE-IN ENG. CONTRACTOR
  - DETAIL ENG. CONTRACTOR
  - VENDOR
  - MAIN CONSTR. CONTRACTOR(S)
  - SUB. CONTRACTOR
  - TIE-IN SUB. CONTRACTOR

- **BASIC - FEED**
- **PRE-FEAS.**
- **FEASIBILITY**
- **DETAILED ENG.**
- **CONSTRUCTION**
- **FEAS. ENG.**
- **TIE-IN ENG.**
- **CONTRACTOR**
- **VENDOR**
- **SUB. CONTRACTOR**
- **TIE-IN SUB. CONTRACTOR**
- **CONTRACTOR**
- **VENDOR**
- **LICENSOR**

- **brownfield**
- **greenfield**

- **Interface Management**
Main Design Milestones

In practical words the recycling consist of the maximization of the availability of information to all the stakeholders such as weekly revision of P&ID and 3D model constantly updated available to all contractors.
Fast Track – Key points

- The Fast Track with parallelization of phases which traditionally are developed sequentially is a possible strategy to meet Project Objectives in project when the schedule is challenging;

- To mitigate the risk associated to fast track (more interfaces, reworks, designing by conservative assumptions rather than consolidated data etc.) project team needs to be integrated with an interface management plan and dedicated engineering methods such as re-cycling and final alignment need to be set-up in the engineering execution plan

- Involvement of Operation in Project Team is key point
Conclusion

- Tailor fit Design by Project Objectives considering existing constrains
- Integration of Project and Operations -> Resources and Schedule
- Interface management, re-cycling and final alignment for fast-track project