Planning for Start-Up

CII Education Module
Session 1

• Facility logistics
• Introduction
• Agenda
Facility Logistics

• Safety Topic

• Emergency exit and gathering place

• Restrooms

• Breakout rooms

• Break refreshments and lunch plans
Introduction

• **Introduction**
  • Jonah Collins

• **Background**
  • Why am I here?
    • Startup Manager with 23 years experience in the power generation, and petrochemical industries.
  • Southern Company
    • Southern Company is one of the largest energy providers in the United States producing 45,502 megawatts of electric generating capacity. Based in Atlanta, Ga., Southern Company owns electric utilities in four states (Alabama Power, Georgia Power, Gulf Power and Mississippi Power) and a growing competitive generation company (Southern Power) as well as a licensed operator of three nuclear generating plants (Southern Nuclear).
Agenda Session 1

• Commissioning and Startup Overview
• Critical Success Factor Overview
• Critical Success Factor Detailed Discussion
• War Story
• Break out to groups
• Project Lessons Learned
Terminology

• Commissioning and Start-Up (CSU)
  • CSU Team
• Critical Success Factor (CSF)
Commissioning & Start-Up Overview

Start-up is defined as the transitional phase between plant construction completion and commercial operations, that encompasses all activities that bridge these two phases, including systems turnover, check-out of systems, commissioning of systems, introduction of feed stocks, and performance testing.
Course Reference Material

- Current thinking RT312 reference material
  - RT312 Critical Success Factors (CSF’s)
  - RT312 CSU Planning Model
  - RT312 CSU Phase Chart
CSU Planning Model

- Project Phases
  - Concept Development & Feasibility
  - Front End Engineering (FEED)
  - Detailed Design
  - Construction
  - Checkout and Commissioning
  - Initial Operations
### List of CSU Critical Success Factors (CSF’s)

<table>
<thead>
<tr>
<th></th>
<th><strong>ALIGNMENT AMONG OWNER PM, OPERATIONS, CSU, ENGINEERING, AND CONSTRUCTION</strong></th>
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<tbody>
<tr>
<td>1</td>
<td>The project and CSU will benefit substantially by getting early alignment among CSU, Operations, Project Management, Engineering, and Construction representatives on the key issues of CSU terminology, CSU success drivers, and CSU strategies. Lack of such alignment may pose a threat to CSU success. Sustained alignment between these entities can only be achieved with effective collaboration throughout the life of the project.</td>
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<tr>
<th></th>
<th><strong>INTEGRATED CONSTRUCTION/CSU SCHEDULE</strong></th>
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<td>2</td>
<td>A fully integrated construction/pre-commissioning/commissioning schedule is critical to achieving CSU objectives. This schedule should integrate all checks, tests, and approval-milestones for each component and all systems, and show development of supportive documentation.</td>
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<tr>
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<th><strong>COLLABORATIVE APPROACH TO CONSTRUCTION-CSU TURNOVER</strong></th>
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<td>3</td>
<td>CSU managers should work collaboratively with construction managers in managing construction completion &amp; systems turnover. Proactive communications are needed to minimize construction-CSU conflicts.</td>
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<tr>
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<th><strong>CSU TEAM CAPABILITY</strong></th>
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<td>4</td>
<td>CSU team has a good understanding of the operations performance metrics-oriented requirements.</td>
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<th><strong>SYSTEM MILESTONE ACCEPTANCE CRITERIA AND DELIVERABLES</strong></th>
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<td>5</td>
<td>Establish specific detailed systems/subsystems acceptance criteria and associated deliverables for each major milestone: mechanical completion, turnover, pre-commissioning, commissioning, and handover. All project parties should understand these expectations from the beginning of construction.</td>
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<th><strong>CRITICAL INTERFACES ON BROWNFIELD PROJECTS</strong></th>
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<td>6</td>
<td>For brownfield projects identify early-on all critical interfaces with existing plant facilities and plant operational approaches. Examples include isolation design, system controls, worker access, permitting, and interim operations, among others.</td>
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#### List of CSU Critical Success Factors CSF’s

<table>
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<tr>
<th></th>
<th>RECOGNITION OF CSU SEQUENCE DRIVERS</th>
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<td>7</td>
<td>The planned sequence of commissioning should be coordinated with construction planners and based on such considerations as construction sequence, plant operations philosophy, ramp-up objectives, plant controls automation objectives, HAZOP awareness, modularization scope, clean-build procedures, sequence of flushing, sequence of leak/hydro testing, preservation steps, system tagging, and sequence of loop checks, among other issues.</td>
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<th>CSU VALUE RECOGNITION</th>
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<td>8</td>
<td>Establish the business case (including CSU staffing plan) for effective CSU leadership. Recognize the value added from successful CSU (e.g., the value of one day of successful operations). Avoid being “dollar foolish” – the Owner and all contractors must buy into (and be aligned on) the economics of effective planning, and the investment required.</td>
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<th>DETAILED CSU EXECUTION PLAN</th>
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<td>9</td>
<td>CSU success requires timely and thorough execution planning, which integrates project planning with CSU planning. Execution Plans should address the appropriate skill mix necessary in both CSU craft and CSU management. Plant operations must be an effective contributor to this planning effort, and common challenges that must be addressed (in the plan) include Operations staff availability, continuity, authority, breadth of experience, and timeliness of input.</td>
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<th>ADEQUATE FUNDING FOR CSU</th>
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<td>10</td>
<td>Project funding for CSU must be sufficiently adequate and budgeted up-front. The common threat from failure to do so is lack of enough operators, with subsequent delays in CSU progress.</td>
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<tr>
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<th>CSU SYSTEMS ENGINEERING DURING FEED</th>
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<td>11</td>
<td>CSU Systems Engineering during FEED is the activity of defining CSU systems within a facility. As the design of facilities has a major impact on how they are fabricated, tested, integrated, and started up, effective FEED design efforts can reduce commissioning and startup challenges. Preliminary P&amp;IDs are key documents for this effort.</td>
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<td>No.</td>
<td>Description</td>
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<td>12</td>
<td><strong>SYSTEMS- FOCUS IN DETAILED DESIGN</strong></td>
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<tr>
<td>13</td>
<td><strong>DEFINITION OF CHECK-SHEETS AND PROCEDURES</strong></td>
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<td>14</td>
<td><strong>CSU LEADERSHIP CONTINUITY</strong></td>
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<td>15</td>
<td><strong>TRANSITION TO SYSTEMS-BASED MANAGEMENT</strong></td>
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<td>16</td>
<td><strong>ACCURATE AS-BUILT INFORMATION</strong></td>
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War Story

• Project and CSU-Related Performance and Outcome

  • Ammonia Release Incident;

  • At 1 a.m. a high ammonia concentration was detected at a storage tank area sensor and an Emergency-Stop Pushbutton was activated, which automatically closed supply valves from ammonia tanks.

  • The anhydrous ammonia was placed back in service while an environmental emergency response team and plant operations monitored for leakage. The leak began to wisp again. The emergency response team tightened the union and leaked stopped.

  • The area of the incident remained barricaded for the remainder of the weekend as a precaution.
War Story

• CSU-Related Problems, Opportunities, & Contributing Factors

  • Installation of a fallible component (union) in a pressurized NH₃ system

  • Inadequate communications
    • Neither the Startup Team, Engineering, nor the Customer were aware of the installed union on the pressurized NH₃ piping.
    • Field personnel were unaware of issues experienced on other projects in the Company System with unions in pressurized NH₃ piping
    • Plant personnel onsite during incident were not aware the Unit forwarding line was pressurized with NH₃.

  • Inspection, examination, and testing of ammonia piping system was not conducted according to required procedure ASME B31.1.
    • Roles and responsibilities relative to proper testing procedures were not understood
    • Requirements of testing protocol were not understood by startup team; Startup utilized a typical “O&M” type leak test, which was the only integrity test performed prior to pressurizing with NH₃
    • The union was insulated making visual inspection impossible.
War Story

• Take-Away Lessons-Learned or How to Have a More Successful CSU Next Time

• On NH₃ and similar systems, construction should be given (or take) less latitude to make field modifications without engineering review. “As-Built” drawings critically associated with a pressurized NH₃ system should be reviewed prior to performing testing on the system

• Critical information regarding pressurization and testing of the NH₃ system needs to be communicated to appropriate plant personnel

• Enhance the system of communication for system owners, technical services, etc. to share lessons learned and best practices in accordance with company compliance guidelines

• For NH₃ and similar systems, integrity testing should be assigned to construction and performed to applicable codes/standards, and functionality testing should be assigned to Startup. Review turnover packages to ensure testing roles and responsibilities are clearly defined
War Story

Socket Weld Union
Installed on Pipe
War Story

Pipe Trench and Location of Release
Discussion of Project Lessons Learned

Breakout Session (10 minutes)

• Breakout Session

• What CSF would have had the most impact on the project success?
  (Refer back to slides 11-13)

• In what Project Phase would you have implemented the CSF you chose to have the most impact on the project success?
  (Refer back to slide 9)

• Open Discussion of Project Lessons Learned
My Answers on Lessons Learned

• What CSF would have had the most impact on the project success?
  • CSF #5 - SYSTEM MILESTONE ACCEPTANCE CRITERIA AND DELIVERABLES
    Establish specific detailed systems/subsystems acceptance criteria and associated deliverables for each major milestone: mechanical completion, turnover, pre-commissioning, commissioning, and handover. All project parties should understand these expectations from the beginning of construction.

• In what Project Phase would you have implemented the CSF you chose to have the most impact on the project success?
  • Construction Phase
Assumptions Made During the Project

• **CSU Assumptions**
  - System was installed per construction installation drawings
  - Pressure testing was performed by construction
  - Startup coordinator was properly trained to perform leak testing
Agenda Session 2

• Introduction

• **Understanding** the importance of early start-up planning

• Project War Story

• Break out into groups

• Project Lessons Learned
Introduction

• Introduction
  • Edward McDaniel

• Background
  • Why am I here?
    • 25 years of Instrument & Controls, and electrical experience with start-ups around the world
  • CH2M HILL
    • Global leader in Consulting, Design, Design Build, Operations and Program Management. We are 26,000 employees strong spanning six continents.
    • Company is organized into business groups: WBG, Environmental/Nuclear, Transportation, Energy, Facilities/Urban Development, and tunneling.
Learning Objective

• Understanding the importance of early start-up planning
Open Discussion Questions

• Why is start-up often difficult or challenging?
• Why is start-up important?
• Why is start-up planning often neglected?
What Is at Stake with Start-up

• Owner profitability
• Overall project success
Project Success vs. Start-Up Success

PROJECT SUCCESS

START-UP SUCCESS

Unsuccessful

Successful
Project Lessons Learned

What Causal Factors can lead to UNsuccessful Startups?

• Lack of planning
  • (CSF #2 Construction/CSU schedule)

• Lack of management resources
  • (CSF #14 CSU Leadership Continuity)

• Lack of alignment between engineering and startup priorities
  • (CSF #1 CSU/Operations/Engineering/Construction Alignment)

• Lack of clear roles and responsibilities
  • (CSF #3 CSU/Construction Turnover)

• Minimal O&M input
  • (CSF #6 Brownfield critical interfaces)

• Failure to recognize and manage risks
  • (CSF #7 CSU Sequence Drivers)
War Story

As I tell the story keep in mind the causal factors from the previous slide and the CSF’s from (slides 11-13). Think about how they could have impacted the overall success of the project if implemented.
War Story

Project Overview: 96” Pipeline feeding three 48” pipelines that filled a tank. That tank fed six 3000hp pumps. Those pumps filled tanks with potable water that fed all the hotels on the Las Vegas Strip. This is a major distribution line for the City of Las Vegas.
War Story

**Project Scope:**

Replace the existing relay logic control system with an Allen Bradley Programmable Logic Control (PLC) system.

Replace the existing motorized valve actuators with new hydraulic valve actuators
Chain of Events:

Maintenance arrived as scheduled to lock out and tag out (LOTO) the ROFC train #1. They closed the upstream and downstream valve and placed the LOTO on each valve. They also closed the valve that was getting the new hydraulic actuator.

- The contractor was not onsite when maintenance performed this task
- The valve close or open position was not marked.

The contractor proceeded with the demolition of the existing valve actuator. They took dimensions to make a spool connector piece to mate up the existing valve with the new actuator.

The spool piece was completed and the new actuator was installed. The contractor energized the valve actuator to stroke the valve prior to the arrival of the factory representative.

The valve stoked in the wrong direction, instead of opening the valve closed further reversing the seat inside the valve and binding the valve further closed.

- The valve actuator electronics thought the valve was closed they could not open move the valve back into position and continue to open the valve. They had to wait for the factory representative to arrive and correct the situation. The spool piece was made incorrectly because the valve close direction was assumed and not properly marked.

They had to wait get a new spool piece made for all three valves, they had to wait for the factory rep to arrive, and then when the valve was opened the client wanted the valve leak tested. This entire process caused a two week delay.
War Story

Commissioning Day:

All the repairs have been made the valve actuator is now ready for commissioning.

This is a list of all the people that were onsite for the commissioning and startup of the valve actuator.

- Owner Project Manager
- Owner Inspector
- Design Electrical I&C Engineer
- I&C Contractor
- I&C Start-up Manager (Note: There had been 3 start-up managers on this project)
- Owner Software Engineer
- Owner 3rd party SCADA inspector
- Electrical Contractor
War Story

Initial Operations:

The valve Open/Close time was documented at 90 seconds three separate times.

The Owners Software Engineer started to tune the valve PID.

All the safety interlocks at the station were tested with the new valve actuator. The station Flood signal was checked to ensure that when activated the valve would close.

The contractor was given permission to decommission the second valve. In the process the third existing valve had to be repaired and was taken offline. The only active valve was the one with the new actuator.

The Flood switch activated in the facility causing the valve to close in 90 seconds. The down stream pumping station supplying the 96” line did not have enough time to shut down and this caused the pipeline to rupture with water flowing down the street until the downstream motors were shut down.

The entire station was out of commission at this time.
War Story

Repairs:

Maintenance arrived to make the repairs to the leak in the pipeline. During the discussions maintenance commented on the existing valve had a closing time of 15 minutes from full open, not 90 seconds.

After the repairs were made and the pipeline disinfected, the project was not allowed to proceed until the new electronics for the valve actuators had been re-programmed to for a total stroke time of 15 minutes.

Once the two valves were tested and ready to be put back on line the project had suffered a two month delay.
Discussion of Project Lessons Learned
Breakout Session (10 minutes)

• What Causal Factor would have had the most impact on the project success? (slide 26)

• What CSF would have had the most impact on the project success? (slides 11-13)

• What Project Phase would you have implemented the CSF you chose to have the most impact on the project success? (slide 9)
My Answers on Lessons Learned

• What causal factor could have made the most impact to the project success?
  • (Minimal O&M input CSF #6)

• What CSF would have had the most impact on the project success?
  • (CSF #14 Lack of Startup Management Continuity)

• What project phase should the start-up planning have started?
  • (FEED)
Assumptions Made During the Project

• This project was only a Electrical and Control System upgrade. (No process or mechanical on CSU Team)

• CSU Team did not require a member of Maintenance to be part of the team because Operations, and Engineering were already involved. (Budget driven???)

• We do not need to think about the Hydraulics of the system because it has been running like this for 20 years. We are only changing the control system. (Typical Electrical and I&C mentality focus on what you know)
Agenda Session 3

- Drop Zone Project Startup
- Break Out to Groups
- Tie to CSF’s and CSU Planning Model
- Discuss Group Answers
Drop Zone (DZ) Overview

• Project Objective
  • Provide a safe DZ for skydivers to enjoy their sport.
    • Goals:
      • Provide a Landing Zone (LZ)
      • Provide a parachute packing area
      • Provide an airplane and all support items for the plane

• Tools
  • CSU Planning Model
  • CSU Critical Success Factors CSF’s
  • CSU Phase Chart
Choosing a CSU Team

- **Owner** — Provides funding only, does not have any technical understanding or knowledge of the sport.
- **CSU Manager**
  - Load Master/DZ Operations Lead
- **Operations**
  - Pilot
  - Skydivers
- **Airport Staff**
  - Fueling Station
  - Air Traffic Control

- Choose Two CSF’s that you think will have the most impact on the DZ startup as it relates to the CSU team.
- Choose from the CSU planning model when each CSU team member is introduced and should start participating in the project.
What CSU team member helped with defining the landing patterns?
What team member has primary responsibility for this system?
What team member thought of and installed the wheel guard?
What CSU team members decided to modify the interior of the plane?
System Based Focus

- **Areas**
  - Hangers, Runway, LZ

- **Systems**
  - Parachute, Airplane, Fueling Equipment
  - Parachutes need assembly by a certified rigger
  - Airplane arrives on a truck and needs assembly by a certified mechanic and all modifications inside the plane need to be made to accommodate jumpers.
  - The Plane needs fuel and a runway to make the maiden flight.

- Choose Two CSF’s that you think will have the most impact on the DZ startup as it relates to Systems verse Areas.
- Choose from the CSU planning model when a shift to a System based focus should be initiated and in what other project phases a System focus is critical.
This system has a AAD, Container, Main Parachute, and Reserve Parachute all of which need to be assembled by a certified rigger.
Final assembly is almost complete for this system.
System is complete and ready for Pre-commissioning
Pre-Commissioning/Commissioning

• Construction has turned over the project to the CSU team
  • Detailed Pre-commissioning and Commissioning can start
    • Fuel Station
    • Radio Communications
    • Airplane (Factory Acceptance Testing) Instrument Calibrations
    • Parachute riggers certifications of the rig
    • Plane’s first flight

• Choose Two CSF’s that you think will have the most impact on the DZ startup as it relates to the Commissioning activities.
• Choose from the CSU planning model when the commissioning activities should be introduced.
First Flight
First use of Runway
Initial Operations

- **Ready for Startup**
  - Startup of the DZ can begin
    - Detailed Plane Loading Plan
      - Jumper exit plan is important, need to maintain plane balance
      - What are the upper wind speeds and directions
    - Detailed Dive Flow Plan
      - Gear Safety Checks
      - What maneuvers are we going to perform, Star, Ring
      - What is the break away altitude
      - What is the opening altitude for the first jump, compared to other jumps
    - What is the landing pattern
      - How do we communicate ground wind changes to pilot and jumpers
    - How many jumps before Commercial Operation

- Choose Two CSF’s that you think will have the most impact on the DZ startup as it relates to the Initial Operation of the DZ.
- Choose from the CSU planning model when the CSU team should start thinking about the initial operations
Safety meeting before going to the plane
Instructions on plane loading and plane exits
Plane loaded and ready for take off
Jumpers out at 12,000 Ft AGL
Landing pattern established on final approach
Safe Landing the first jump was a success
Initial operations were successful, ready to move into the Performance Testing phase of the project
Breakout Session (10 minutes)

- Choosing CSU Team Answers
  - CSF #4 CSU Team Capability
  - CSF #1 Alignment among Owner PM, Operations, CSU Engineering and Construction
  - Owner Phase: Concept Development & Feasibility
  - CSU Manager Phase: FEED
  - Operations Phase: Detailed Design
  - Airport Staff Phase: Construction

- System Based Focus Answers
  - CSF # 12 Systems-Focus in Detailed Design
  - Phase: Detailed Design
  - CSF # 15 Transition to Systems-Based Management
  - Phase: Construction
Breakout Session (10 minutes)

• Pre-Commissioning & Commissioning Answers
  • CSF #13 Definition of Check-Sheets and Procedures
  • Phase: Detailed Design
  • CSF #3 Collaborative Approach to Construction-CSU Turnover
  • Phase: Construction

• Initial Operation
  • CSF #1 Alignment among Owner PM, Operations, CSU Engineering and Construction
  • Phase: Concept Development & Feasibility
  • CSF #10 Adequate Funding for CSU
  • Phase: Detailed Design
Agenda Session 4

• Power Plant Overview
• Power Plant System Startup
• Break Out Group Objectives
• Discuss Group Answers
Power Plant Overview

• 3 Major Areas
  • Generator
  • Turbine
  • Boiler
    • Boiler Overview Presentation
Power Plant System Start-up

• Project Objective
  • Safely Commission Boiler Water Circulation System
    • Boiler Water Circulation Pump
    • BWCP Presentation
Power Plant System Start-up

• **Break Out Group #1 Objectives**
  • Factory Acceptance Test (Pump & Motor)
    • Reference CSF #5, 4 items required for adequate check sheet criteria prior to accepting from factory
    • In which project phase should this be addressed?
Power Plant System Start-up

• Break Out Group #2 Objectives
  • Specific Milestone Acceptance Criteria and Deliverables from CSU Team
    • Reference CSF #13, 4 items required for functional checkouts prior to commissioning system
    • In which project phase should this be addressed?
Power Plant System Start-up

• Break Out Group #3 Objectives

  • Issues with installing new BWCP on Brownfield Projects
    • Reference CSF #6, identify 4 areas of opportunity with existing plant facilities
    • In which project phase should this be addressed?
Power Plant System Start-up

• Break Out Group #4 Objectives
  • Issues with incorrect drawings from design engineering
  • Reference CSF #16, what actions should be taken if drawings are incorrect from Design Engineering i.e. P&IDs, Piping Isometrics, Electrical Single Lines etc.
  • Who is responsible for making corrections to incorrect drawings from Design Engineering?
  • In which project phase should this be addressed?
Group Discussion

• My Answers
  • Group #1 - 4 items required for adequate check sheet criteria prior to accepting from factory?
    • Installation Manual
    • PM Procedure
    • Bill of Material
    • Factory Operational tests

• In what phase? Construction
Group Discussion

• My Answers
  • Group #2 - 4 items required for functional checkouts prior to commissioning system?
    • Motor Test Report
    • Pump/Motor Alignment Report
    • As built Drawings
    • System Specific Commissioning Procedure

• In what phase? Checkout and Commissioning
Group Discussion

• My Answers
  • Group #3 - 4 areas of opportunity with existing plant facilities
    • System Isolation
    • Up-to-date drawings of existing plant systems
    • Personnel training
    • Additional Spare Parts

• In what phase? Front End Engineering (FEED)
Group Discussion

• My Answers
  • Group #4 – What actions should be taken if drawings are incorrect from Design Engineering?
    • Design Engineering should be notified and any “field” modifications should be approved by Design Engineering before being constructed or commissioned. Once approved, “As-built” drawings should be developed by “field” personnel and submitted to Design Engineering so that the corrections can be properly documented.
  • Who is responsible for making the corrections to the incorrect drawings from Design Engineering?
    • Any “field” personnel that finds the discrepancy and gets approval from Design Engineering
  • In what phase? Construction and Checkout and Commissioning
Questions