Sargent & Lundy LLC

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November 14, 2011

OWNER'S ENGINEER

IAEA/ANL - Management & Safety Infrastructure for Introducing and Expanding Nuclear Power Program

Argonne National Laboratory- USA

- Sargent & Lundy
- Owner's Engineer
  - Commercial Technical Specification
  - Quality Assurance/Oversight
  - Independent Engineer's Evaluation
  - Integrated Project Schedule
  - Training Plans
  - Deployment Activities
- Why Owner's Engineer?
- Summary

Profile

- 120 years of leading global power industry experience
- Headquartered in Chicago
- Exclusive focus on power industry
- Nuclear Quality Assurance Program
- ISO 9001:2008 Certified Quality System
- 2,600+ staff members
- April 2011: Ranked #2 Globally in Power by Engineering News-Record.

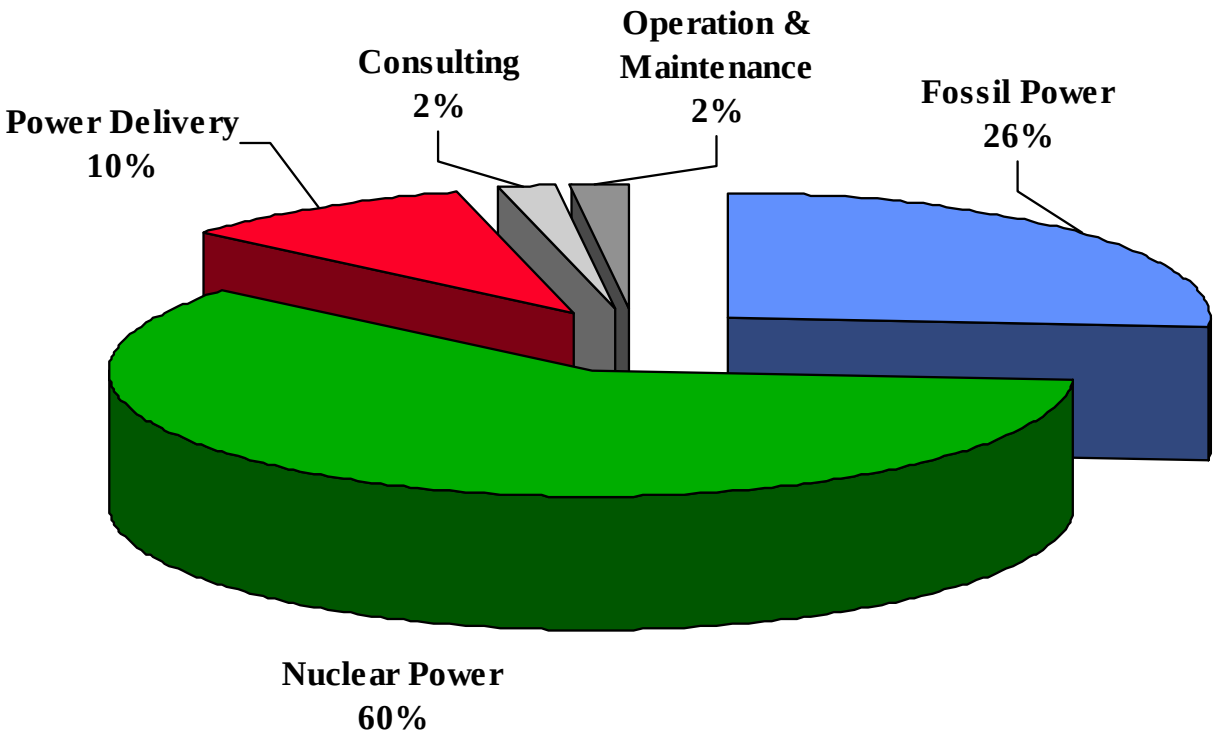
Offices

- Chicago, IL – Headquarters
- Warrenville, IL
- Chattanooga, TN
- Phoenix, AZ
- Wilmington, DE
- Baroda, India
- Faridabad, India
- Kolkata, India

Client Base

- Over 600 clients
  - 150 fossil power clients
  - 120 nuclear power clients
  - 40 power delivery service clients
  - 340 consulting clients

S&L's Current "Mix" of Business



Areas of Expertise Include:

-- Project Concept Development

-- Preliminary Financial Evaluation/Capital Cost Estimating

-- Site Selection, Feasibility studies

-- Transmission Impact Studies

-- Environmental Evaluation

-- Licensing, Permitting, and Document Preparation

-- Detailed Design/EPC Implementation

-- Procurement/Quality Control

-- Construction Management

-- Preparation and System Startup Testing

-- Operations & Maintenance Consulting

S&L Quality Program Focus

- ISO 9001:2008 independent certification
- Nuclear Quality Assurance Program as a Topical Report which has been reviewed and accepted by the USNRC.
- Standard Operating Procedures governing all major work steps
- System of Processes - each process has a process owner with direct responsibilities
- Performance Improvement Program (PIP) - online quality program used by all employees
- Quality Indicators published monthly for all large projects
- Mandatory design reviews at key project milestones
- Quality Council - chaired by CEO

Owner's Engineer

Owner's Engineer is a term often given to an independent third party representative of the commissioning company of a construction or engineering project.

Owner's Engineer Tasks

- Engineering, Procurement, Construction (EPC) Commercial Technical Specification and Bid Assistance
- Site Selection
- Licensing support
- Contract negotiations support
- Develop overall project plan
- Develop an integrated project schedule
- Develop project cost estimate
- Identify and quantify project risks and develop a risk mitigation plan

Owner's Engineer Tasks (cont.)

- Develop conceptual design site specific activities
- Review EPC contractor's procedures and related documents
- Represent client in EPC contractor's procurement activities
- Perform design reviews for Owner of documents (e.g., drawings, calculations, specifications, constructor/vendor document submittals, etc…)
- Review EPC contractor costs, schedule, progress and application for payment
- Deployment Activities

Owner's Engineer Tasks (cont.)

- Licensing support
- Monitor testing completion
- Provide construction management, startup and commissioning support
- Interface with operating units
- Independent engineer evaluation
- Training activities
- Miscellaneous support

EPC Commercial Technical Specification

EPC Commercial Technical Specification Requirements Overview

- Relationship to EPC Contract
  - Will be a Supplement to EPC contract
  - Includes technical requirements

EPC Commercial Technical Specification Requirements Overview (Cont'd)

- Goal = Issue Commercial Technical Specification that delivers a State of the Art Plant to the owner
  - Emphasis on nuclear industry Lessons Learned to date
    - » 60 year design life
    - » Industry requirements
    - » Specific operating experience
    - » INPO/WANO operating experience
    - » S&L design experience
  - Augment the Proven Technology (DCD)
  - Specify critical design and procurement requirements

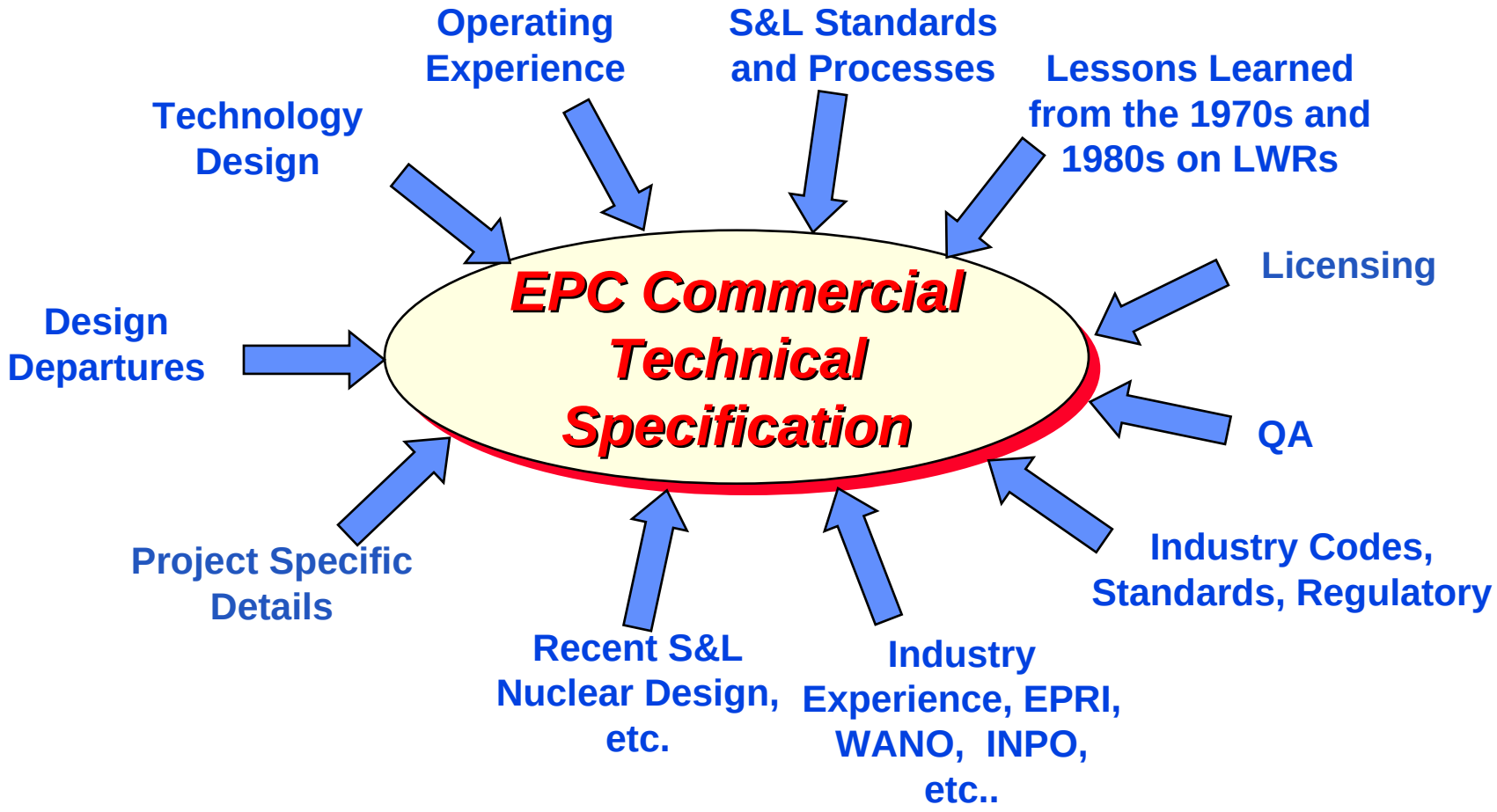
EPC Commercial Technical Specification Requirements Overview (Cont'd)

- Add value relative to requirements affecting:
  - Plant operations
  - Reliability
  - Availability
  - Maintenance
  - ISI/IST
  - ALARA
  - Design philosophy
  - Design margin
  - Transition from construction to operation
  - Outage optimization

EPC Commercial Technical Specification Requirements Overview (Cont'd)

- EPC Commercial Technical Specification Structure
  - Parallels NUREG-0800 (Standard Review Plans)
  - Additional sections added for:
    - » Cooling Media
    - » Site Infrastructure - Barge Facility, Haul Road, etc…
    - » Initial Site Development
    - » Final Site Development
    - » Misc. Sections

Inputs to EPC Commercial Technical Specification



Technical Requirements (Cont'd)

Discussion of Individual

EPC Commercial Technical Specification

Requirements

Technical Requirements (Cont'd)

1. General Plant Description and Design Philosophy
   - Introduces technical requirements
   - References the technology design basis
   - Presents the general plant description and design philosophy
   - Includes bounding requirements for design, operation, reliability, availability, PRA, code and regulatory compliance, maintainability, standardization, and configuration and information management
2. Site Characteristics
   - Meteorology
   - Hydrology
   - Seismology

Technical Requirements (Cont'd)

3. Design of Systems, Structures, and Components
   - Conformance with NRC General Design Criteria (GDC) 10 CFR 50, appendix A
     - » Specific Requirements for:
       - Wind/Tornado/Hurricane Loads
       - Floods Caused by internal and external events
       - Internally and externally generated missiles
       - Seismic category I and II
   - General civil and structural design requirements

Technical Requirements (Cont'd)

4. Reactor
   - Materials and design methodology per NUREG-0800, Chapter 4
   - Analytical techniques utilized in the reactor and core design, such as nuclear, mechanical and thermal-hydraulic design, to be based on NRC approved methods, criteria and models
5. Reactor Coolant System and Connected Systems
   - Materials, fabrication and testing processes, and design methodology used in the RCS per NUREG-0800, Chapter 5
   - Design of RCPB components, such as pressure vessels, piping, pumps and valves, to be based on NRC approved methods, criteria and models

Technical Requirements (Cont'd)

6. Engineered Safety Features
   - Materials
   - Containment systems
   - Emergency core cooling systems
   - Control room habitability
   - Fission product removal
   - ISI
   - Fission product leakage control

Technical Requirements (Cont'd)

7. Instrumentation and Controls
   - Process instrumentation and controls
   - Control systems
   - Data Display
   - Non-main control room control
   - Plant environmental monitoring
   - Seismic instrumentation

Technical Requirements (Cont'd)

8. Electrical Systems and Equipment
   - Provides for a power distribution arrangement with the goal of high reliability and availability
   - Ensures that the adverse impact of transmission system disturbances, plant upsets, or component failures on the availability of off-site or on-site electrical power is minimized
   - Provides critical system design requirements
   - Provides critical component design and procurement requirements
   - Identifies critical system and component functional requirements

Technical Requirements (Cont'd)

9. Auxiliary Systems
   - Major system groups
     - » Fuel handling and storage
     - » HVAC
     - » Other (fire protection / DG support)
   - Provides critical system design requirements
   - Provides critical component design and procurement requirements
   - Identifies critical system and component functional requirements

Technical Requirements (Cont'd)

10. Steam and Power Conversion
    - Major system groups
        - » Power Cycle Steam, Condensate, and Feedwater
        - » Circulating Water
        - » Service Water
    - Provides critical system design requirements
    - Provides critical component design and procurement requirements
    - Identifies critical system and component functional requirements

Technical Requirements (Cont'd)

11. General Radwaste Protection
    - Regulatory, code, and standards requirements
    - Basic parameters
        - » Capacity
        - » Reliability
        - » Exposure control
    - Equipment requirements
    - Liquid, solid, & gaseous waste management
    - Monitoring & instrumentation requirements

Technical Requirements (Cont'd)

12. Radiation Protection
    - ALARA
    - Radiation sources
    - Design features
    - Dose assessment study
    - Radiation monitoring requirements

Technical Requirements (Cont'd)

13. Conduct of Operations
    - Management, staffing, training
    - Configuration Control and Design Basis
    - Emergency planning
    - Operating area environment
    - Plant procedures
    - Maintenance
    - Physical security

Technical Requirements (Cont'd)

14. Initial Test Program
    - Develop, implement and manage a construction inspection program (CIP) and a construction inspection program information management system (CIPIMS)
    - Initial testing up to and including the power ascension test
    - Inspections, Tests, Analyses, and Acceptance Criteria requirements
    - Reg. Guide 1.68/NUREG-1789

Technical Requirements (Cont'd)

15. Accident Analysis
    - Transient & accident classification
    - Accident analysis requirements
    - Analysis of accident consequences
    - Source term
16. Technical Specification
    - Regulatory requirements

Technical Requirements (Cont'd)

17. Quality Assurance
    - Owner's QA program requirements
    - Owner's right to impose additional requirements to supplement QA program
    - Owner's right to facility access
    - QA/QC program requirements

Technical Requirements (Cont'd)

18. Human Factors Engineering
    - HFE program management
    - Functional requirements analysis and functional allocation
    - Concept of operations
    - Human system interface tests and evaluation
    - Procedure development
    - Training program development
    - Human factors verification and validation

Technical Requirements (Cont'd)

19. Severe Accidents
20. Cooling media and Related Facilities
    - Basin design, Dikes, Drainage, Seepage, Roads, Topsoil, Pumphouse/piping, Blowdown, Circulating water pumphouse / piping, Outfall structures, Spill ways, etc…
21. Site Infrastructure- Barge Facility, Haul Road, etc…
    - Road to barge dock, Barge dock, Gantry cranes, Dikes / Culverts, River bridge crossing, Road access, 100yr Flood, Probable Maximum Precipitation (PMP), Probable Maximum Flood (PMF)

Site Infrastructure

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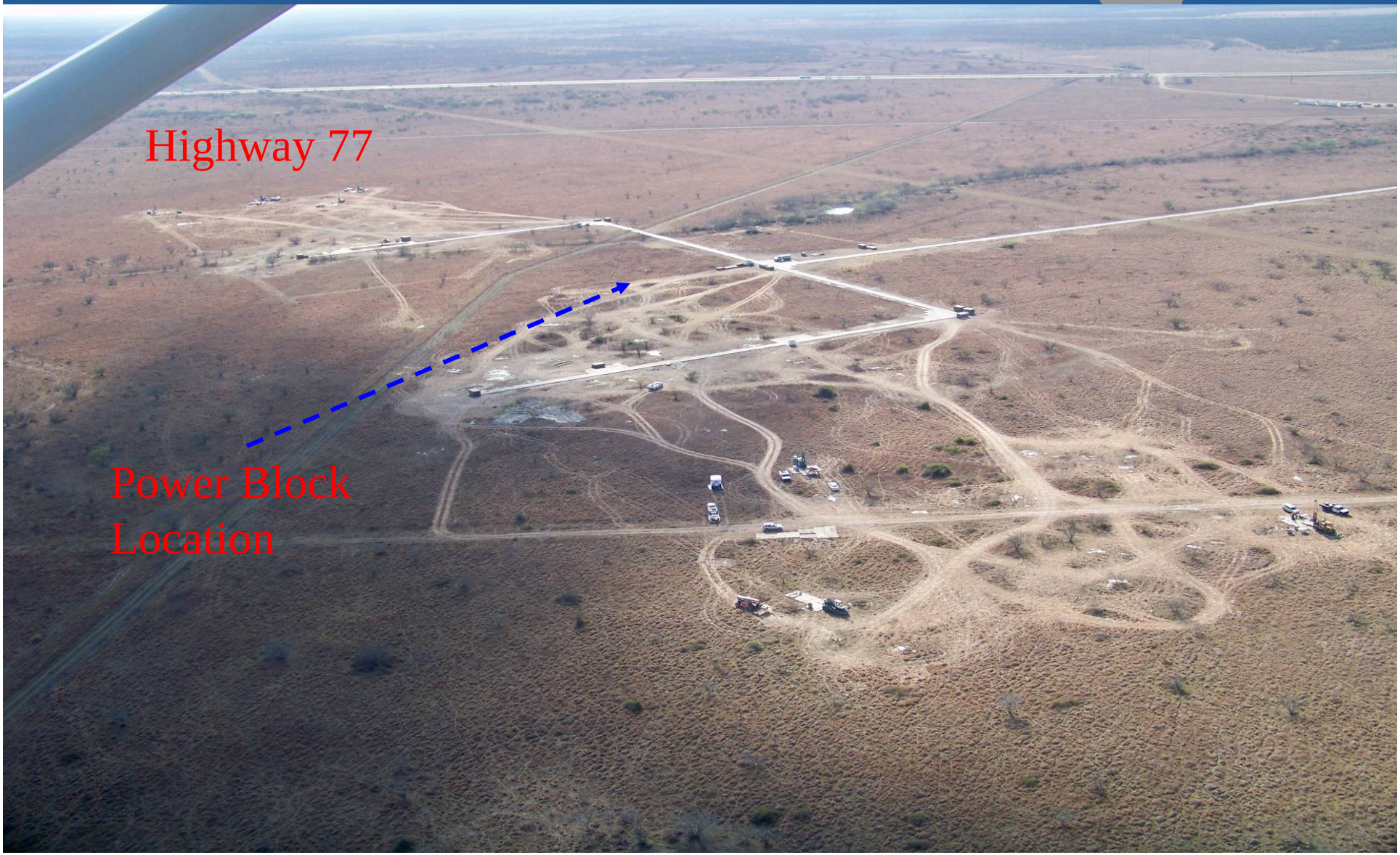

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Technical Requirements (Cont'd)

22. Initial Site Development
    - Earthwork
    - Roads and pavements
    - Drainage and storm water
    - Railroad tracks
    - Construction fencing

Technical Requirements (Cont'd)

23. Final Site Development
    - Earthwork
    - Roads and parking
    - Plant area surfacing
    - Storm water runoff
    - Sanitary wastewater sewer & treatment systems
    - Potable water system
    - Railroad tracks
    - Fencing (Interface with Security) and site restoration
    - Switchyard

Technical Requirements (Cont'd)

24. Unit 1 Transition from Construction to Operation
    - Physical security plan
        - Impact of construction on operating unit
        - Security for units under construction
    - Security Implementation plan
    - Asset protection
    - Access requirements
    - Fitness for duty requirements (Safety cultures, etc…)

Technical Requirements (Cont'd)

25. Items Critical to Quality
    - Material selection
    - Outage optimization
    - Avoidance of "Black Box Design"
    - Knowledge transfer and retention
    - Material Selection - Erosion, corrosion, galvanic action, stress cracking, pitting, thermal weakening, and radiation-induced degradation all play roles in the design, selection and advancement of materials used in construction (i.e. chemistry impact on Alloy 600 vs. thermally treated Alloy 690)

Technical Requirements (Cont'd)

26. Construction Oversight, Construction Optimization Including Construction Command Center
27. Procurement Plan, Requirements and Oversight
28. Financial Modeling
29. Risk Analysis and Mitigation
30. Contract Negotiations Plans
31. Training and Training Facilities

Quality Assurance/Vendor Oversight

Quality Assurance/ Vendor Oversight

- Quality Assurance/Quality Control
  - **Implement an independent assessment of the effectiveness** of programs and processes related to design, procurement, construction, maintenance and operation activities, as well as the effectiveness of human performance in implementing program and process requirements
  - **Objective:**
    - » Ensure that the programs and processes deliver high quality project work. This should account for safety culture, including the establishment of a safety-conscious work environment, QA, industrial safety, and problem identification and resolution

Quality Assurance/ Vendor Oversight

- Quality Assurance/Quality Control (continued)
  - **Outcome:**
    - » Copy of all permanent documentation to support plant operation and design basis
    - » An integrated document control system will include all QA records, equipment, material and personnel qualification records, maintenance and testing records, technical manuals, and drawings controlled and maintained to reflect the ‘as-built’ configuration of the plant

Quality Assurance/ Vendor Oversight

- Quality Assurance/Quality Control **Approach**
  - QA/QC is integrated in design, construction and procurement
  - Utilize Commercial Grade Dedication requirements
    - » Technical requirements
    - » Quality requirements
    - » Acceptance Method
  - Verify each level of the procurement chain - audit suppliers often
  - Establish an inspection frequency and scope
  - Emphasize QA and technical requirements through performance-based inspections

Quality Assurance/ Vendor Oversight

- Quality Assurance/Quality Control **Approach** (continued)
  - Assess effective implementation of manufacturing and fabrication processes to provide assurance of product quality
  - Establish and maintain document control and records management systems early
  - **Establish a corrective action program**
  - Emphasize root cause analysis and/or extent of condition as required to ensure that any proposed corrective action addresses the underlying QA performance drivers

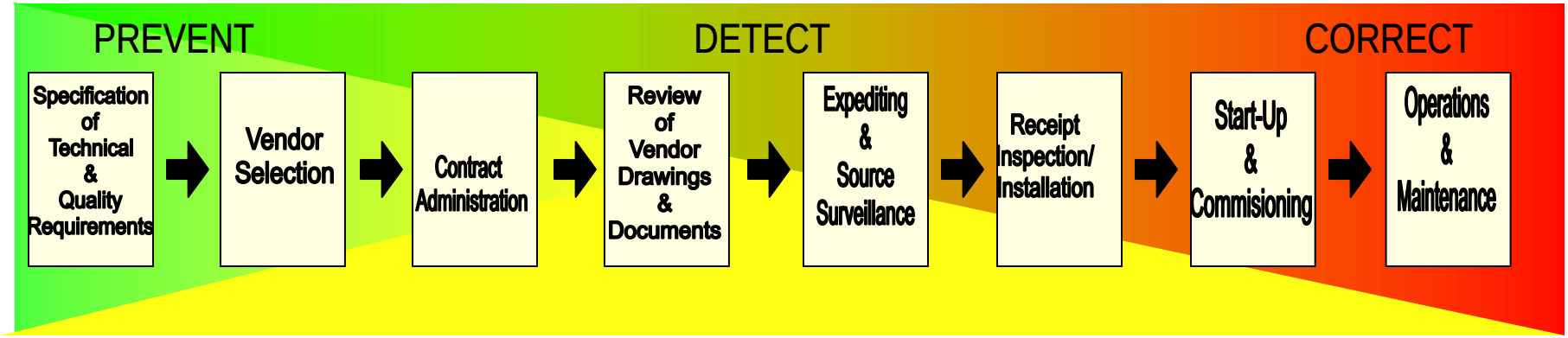
Quality Assurance/ Vendor Oversight

- Quality Assurance/Quality Control **Approach** (continued)
  - Inspection and Test Management
    - » Inspection and test process verifies that the completed project meets specified design basis attributes, including performance features and characteristics
    - » Historical records of calibrations, audits, testing, maintenance, certifications, etc… need to be maintained as part of the permanent plant records
    - » Ensure installed material/components meet intended function and operability requirements
    - » Oversight and inspections of suppliers' facilities

Quality Assurance/ Vendor Oversight

- Quality Assurance/Quality Control **Approach** (continued)
  - Inspection and Test Management
    - » Counterfeit material can compromise safety related components/systems/structures
    - » Establish a process to quickly identify counterfeit material
      - Qualified suppliers
      - Oversight and inspections of supplier facilities
      - Proper material documentation and traceability
      - Material that cannot be traced back to the original source should be considered suspect
      - Corrective action program

Prevention, Detection, Correction



Manufacturing Oversight

- Develop a Manufacturing Quality Oversight Plan for successful overview of equipment and component fabrication

Case Study- Shop Overview

- Field Observation- Perform witness point on transition shell forging
  - Normalizing and tempering witness point implemented and signed off as acceptable (Sequence No. 4)
  - Documentation for steel melt, heat analysis, and forging reviewed and confirmed compliance with SA-508 material spec and shop work control documents (Sequence No's. 1, 2, and 3)
  - Shop Quality Process from a technical and programmatic standpoint found strong

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Case Study-Witness Point Trip Observations

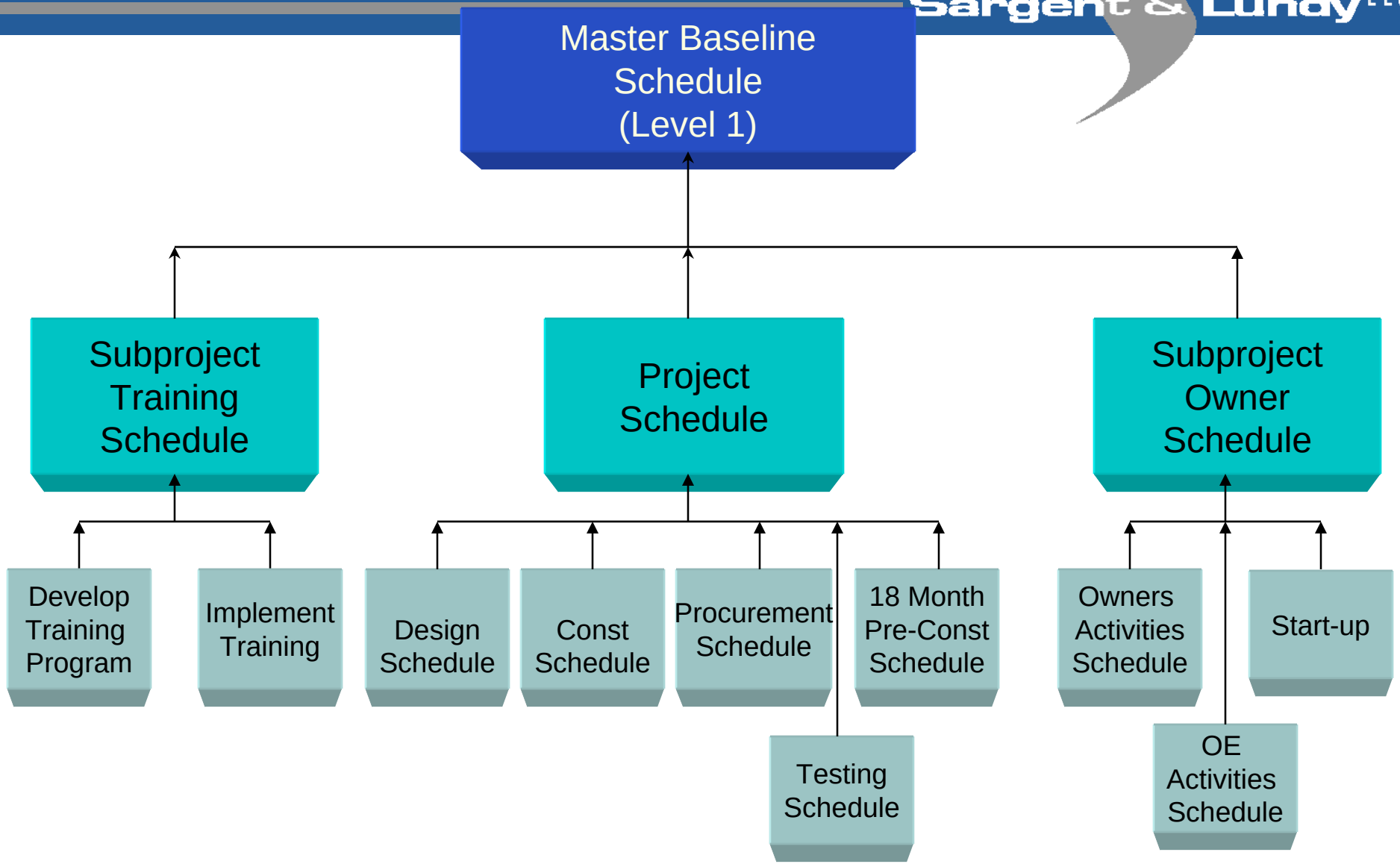
- Equipment calibration documentation acceptable
- Work control documentation maintained current
- Procedure requirements correctly reflected in work control documents
- Heat analysis documents material specification compliance
- Shop quality control reviews completed as required
- Earthquakes occurred during the test.
  - Had no effect on operations but no procedure in place to mitigate

Independent Engineer Evaluation

Independent Engineer Evaluation

- Conduct Independent Engineer's Review
  - Project siting and permitting
  - Engineering and design
  - Contractual requirements
  - Environmental compliance
  - Testing and commissioning
  - Operations and Maintenance
- Assess project development status
- Identify project risk areas

Integrated Project Schedule


Master Baseline Schedule (Level 1)
Subproject Training Schedule
Project Schedule
Subproject Owner Schedule
Develop Training Program
Implement Training
Design Schedule
Const Schedule
Procurement Schedule
18 Month Pre-Const Schedule
Testing Schedule
Owners Activities Schedule
Start-up
OE Activities Schedule

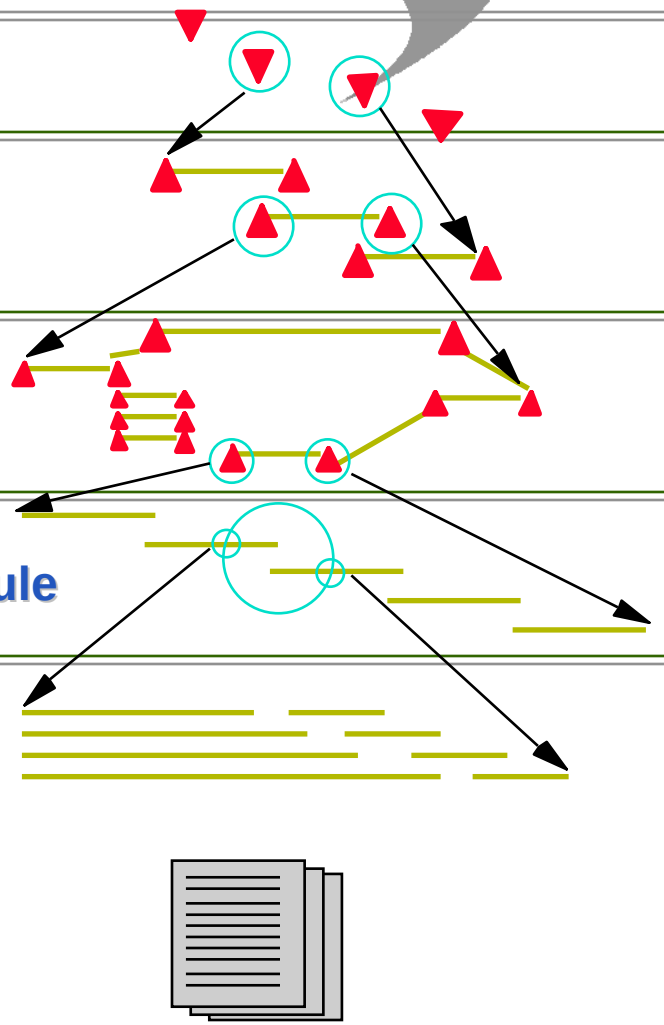
Level 0: Project Milestone Summary

Level I: Project Summary Schedule

Level II: Management Summary

Level III: Publication / Control Level Schedule

Level IV: Supporting Details
Schedule fragments or
Deliverable listings, quantity
data, etc..



Integrated Project Schedule - Output

- Level I Schedule
  - Baseline schedule
  - Executive level milestones & activities
- Level II Schedule
  - Management summary milestones & activities
  - Pre-construction details with some summaries
  - 60 month construction summaries
  - Training activities with some summaries
  - Permitting activities

Integrated Project Schedule-Output (Continued)

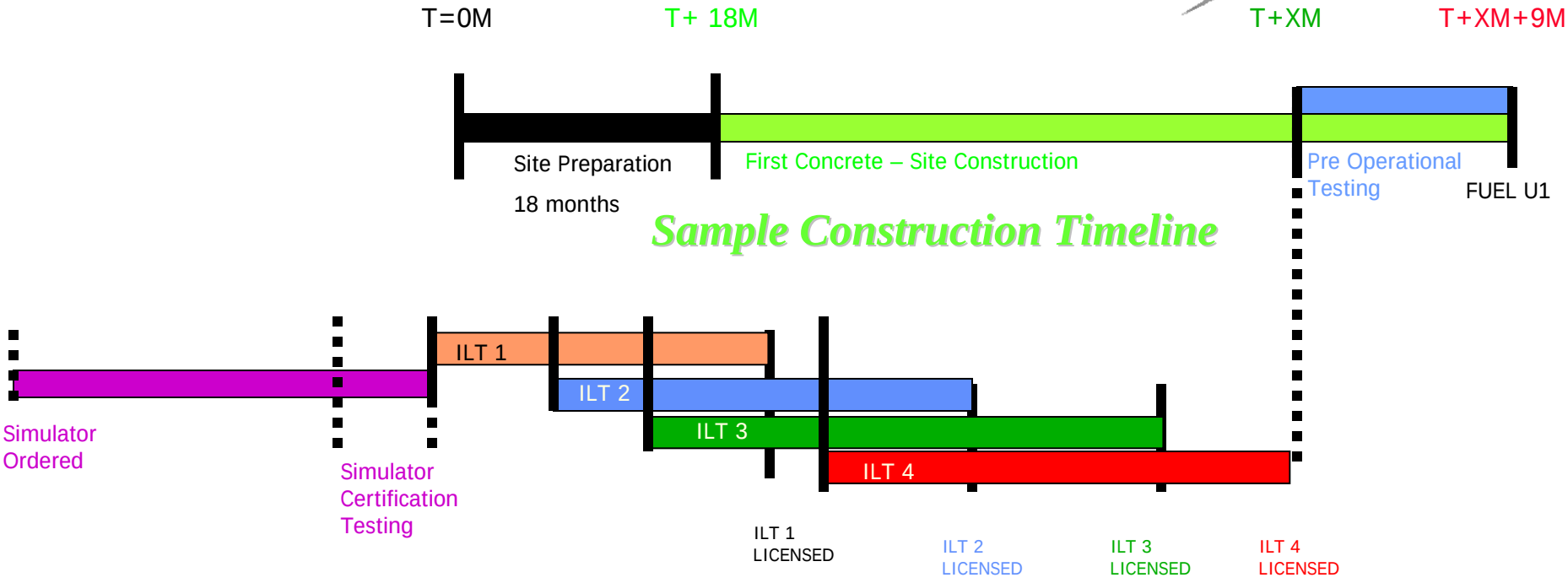
- Level III Schedule
  - Detailed schedule
  - Details to support the monthly reports
  - Major milestones, major elements of the engineering, construction, training, and start-up activities
  - Resource Loaded
  - 30, 60, and 90 day look ahead reports
  - Critical Path Reports, and Target Variance Reports
  - Percent Complete Curves, Production Curves

Integrated Project Schedule-Output (Continued)

- Construction schedule
  - Around the clock critical path/near critical path to optimize the schedule
    - » Critical path
    - » Near critical path
  - Parallel activities and resource management
    - » Parallel paths with manpower and equipment
    - » Use the largest of the large equipment to optimize tasks
- Construction control – overall site integration Contingency planning

Training Activities/Plans

Sample Training Timeline



Sample Operator Training Timeline

Training Activities/Plans

- Training Planning Activities

1. Resource Loading of Schedule (Training Development) for
   - » Construction
   - » Technical
   - » Security
   - » Operation
   - » Misc.
2. Training Material Development
   - » Systems, Maintenance, Construction, Radiation Protection, etc…

Training Activities/Plans

- Potential Training Impacts/Risks

1. Simulator
    - » Specification Development
    - » Procurement
    - » Installation
    - » Testing
2. Simulator Certification

Deployment Activities

Deployment Activities

- Division of Responsibility (DOR) Development
- Pre-Deployment Plan:
  - » Pre-Deployment Schedule
  - » Site Assessment Report
  - » Project Execution Plan
    - Organization outline
    - “Smart" construction
      - Can be modelled using the latest technology to provide direction and control of real time field activities; tracking of equipment; and visual and daily debriefing with field personnel while in the field
      - CAD Models
      - Global Positioning System
      - Video Conferencing/Virtual Briefings


“Construction Command Center”

Deployment Activities (continued)

- Pre-Deployment Plan (continued):
  - » Site Infrastructure, layout
  - » Crane plan
  - » Dewatering plan
  - » Excavation plan
  - » Modular plan
  - » Project procedures listing
  - » Procurement plan
  - » Design review and validation plan
  - » Permitting plan
  - » Labor plan
  - » Misc. plans

Why Owner's Engineer?

Why Owner's Engineer?

- Owner's engineer ensures a deliverable in-line with owner's expectations.
- Owner's engineer support the owner in a successful planning, oversight, execution and implementation of the project from inception through commissioning.
- Owner's engineer reduce overall project risk for the owner.
- Owner's engineer can reduce a project's overall project cost (capital, operation and maintenance)
  - Savings through control of project schedule, defined scope and management, and overall project controls.
  - Design optimization that reduce the owner's lifecycle costs.

Why Owner's Engineer?

- Owner's engineer, brought in when project still in conceptual stage, can help with defining the project size, location, technology selection, configuration, scope, interfaces, and schedule.
- Owner's engineer, involved from project inception can help, develop a project execution plan and contracting strategy. Owner benefits from having a dedicated engineering advisor who is familiar with all aspects of the project and will help the owner identify opportunities that may otherwise be overlooked while avoiding or minimizing risks.

Why Owner's Engineer?

- Some of the activities that an owner's engineer can provide include:
  - » Defining and/or reviewing the project scope.
  - » Developing a detailed DOR.
  - » Developing project design criteria.
  - » Assessing and evaluating the budget.
  - » Conducting feasibility and site selection studies and alternatives analysis.
  - » Analyzing available technologies and their suitability to the project and owner's NPP goals.

Why Owner's Engineer?

- Preparing integrated project schedules.
- Preparing technical commercial specifications.
- Support with the licensing process, permitting and environmental processes
- Support with EPC contract documents, including RFP (request for proposal) and evaluations.
- Provide detailed design, overall project management, contract administration, and construction oversight.

Why Owner's Engineer?

- Preparation and/or review of equipment procurement specifications and ensure suppliers are in compliance with all contract requirements.
- Support development of configuration management control that captures the plant design basis.
- Support owner's process management, implementation of earned value, project cost reporting and trending.
- Develop of the training program and capacity building
- Support plant commissioning process (system turnover, start-up tests, punch lists, performance testing, etc…).

Selecting an Owner's Engineer?

- Prior experience:
  - » Design (NI, TI and BOP)
  - » Operation
  - » Licensing
  - » Procurement
  - » Quality
  - » NSSS experience
  - » Oversight
  - » Project Management

Summary

- Strategies for **SUCCESS**
  - » GET INVOLVED
  - » Qualified Owners Engineer
  - » EPC commercial technical specification
  - » Integrated DOR
  - » Integrated project schedule

Summary (continued)

- Planning through operation
  - Planning (Site selection, technology selection, **Material** reservation, etc…)
  - Design (Systems, foundations, structures, component/**Material** specification, etc…)
  - Procurement (Technical specifications, **Material** selection and management, etc…)
  - Construction (Construction execution, oversight, **Material** availability, etc…)
  - Start-up (Training, testing, **Material** replacement/repair, fuel load, etc…)
  - Operation (Maintenance & **Material** management, outages, etc…)

Summary (continued)

- Planning through operation (continued)
  - **Develop and Monitor** an integrated plan that captures:
    - Information and data management of
      - **Design and licensing basis,**
      - **Construction activities,**
        - Prefabrication and pre-assembly of modules
        - Construction site infrastructure and layout
        - Control of inventory and movement of construction personnel, material, tools and equipment
        - Methods and equipment for movement and lifting of large modules and very heavy equipment
        - etc…

Summary (continued)

- Planning through operation (continued)
  - **Develop and Monitor** an integrated plan that captures:
    - Information and data management of
      - **Schedule,**
        - Integrated overall project schedule
      - **Procurement,**
        - Specification and procurement of equipment and material in sufficient time to avoid ‘just-in-time’ material and equipment deliveries (Materials should typically be on site six months prior to the scheduled installation date)
      - **Training**
      - **Start-up**
      - **etc…**

Thank You