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Farid Berry  
Sargent & Lundy LLC  
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*Construction Materials Management,  
Testing and Quality Assurance*

IAEA Workshop on Construction Technologies for  
Nuclear Power Plants,  
Charlotte, NC- USA

# *Construction Materials Management, Testing and Quality Assurance*

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- **Sargent & Lundy**
- **Power Plant Project Development**
- **Material Management Program**
  - Program
  - Processes
  - Support Facilities and Systems
  - Quality Assurance / Quality Control (QA/QC)
    - Inspection and Test Management
- **Summary**

# Sargent & Lundy...

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- More than 119 years of power industry leadership and experience
  - 100% exclusive dedication to power industry (Nuclear, Renewables, Fossil, Power Delivery and Consulting)
  - Reputation for consistently providing high quality engineering services
  - Extensive state-of-the-art technical resources (people, tools, and processes)
  - More than 2,600 staff resources
  - Consistently ranked by Engineering News-Record as a leading global power industry consultant

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## ➤ Power Plant Project Development (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...)

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## ➤ Power Plant Project Development (Planning through Operation) (continued)

- Develop 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...
  - 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...

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## ➤ Materials Management Program

- Established early prior to the construction phase to ensure:
  - Material management process in place
  - Timely placing of orders for materials
  - Quality Assurance/Control processes are in place
  - Logistics for tracking & transportation of material to site
  - Receiving, inspecting material at warehouse and storage;
  - Issuing material to construction location
  - Installation and turnover of completed systems with complete quality records that meet the license requirements
  - Establish a materials management system used early in the project during the construction phase and carried over to plant operations

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## ➤ Materials Management Program Attributes:

- Program Development & Implementation
- Material Information
- Procurement
- Inspection of Equipment Suppliers
- Material on site
  - Receipt
  - Inspection/Expediting of equipment suppliers
  - Warehousing & Storage
  - Documentation
  - Distribution
- Installation

*Program Development &  
Implementation*

Materials  
Managers

Engineering

*Material Identification  
(Design Parameters)*

*Procurement*

Procurement  
Logistics  
Personnel

Procurement  
Buyers

Procurement  
Order  
Administrators

*Source Inspection of Equipment  
Suppliers*

QA Source  
Inspectors

Warehouse  
Managers

*Receipt/Inspection/Warehousing/  
Documentation/Distribution*

Field Engineering  
Representatives

Warehouse  
Supervisory Staff

Warehouse  
Receiving Staff

Material Control  
Reviewers

Calibration Staff

Document Control  
Coordinators

QA/QC  
Inspectors

*Installation*

Construction/  
Contractors  
Installers



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## ➤ Materials Management Program Processes:

- Assigning of material codes
  - Complete definition and description of goods
  - Consistent information from the design process, the procurement process, the manufacturing process, the receiving and inventory process, and including the final issue for installation
- Recording, coding and incorporating material requirements — Bill of Material (BOM)
  - Project material supply requirements
  - Project installer material responsibilities
  - Project material installation locations for building/area/room/elevation
- Monitoring of project supply vs. demand
  - Project baseline of material supply
  - Project spares parts supply
  - Destination of materials
  - Maintenance and preservation of project inventory (i.e. storage, shelf life, etc...)

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## ➤ Materials Management Program Processes (continued):

- Record receipt of goods upon delivery:
  - Receipt of goods is reviewed against a purchase order in a complete and consistent manner (Material Traceability)
  - QC has approved the receipt of the goods
- Maintenance of warehouse storage locations
  - Optimize storage facility
  - Handling of minimum/maximum inventory items (spare parts)
  - Supply of material shortage reports
  - Return of material from the field
- Calibrated tools - maintained and used in a controlled manner

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## ➤ Materials Management Program Processes (continued):

- Recording of material equivalents/replacements/substitutions
- Requirements for approving material issues
- Transport & tracking of material to site, staging area, work location
- Training and familiarization of the labor force with use and application of material management program will reduce errors, design deficiency, and schedule improvement

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## ➤ Materials Management Program Processes (continued)

### – Computerized Material Management System

- Warehouse receiving staff can view and forecast anticipated arrival date of goods
- Warehouse receiving staff are presented with consistent, clear shipping documentation to complete the receiving process successfully
- Inventory is controlled in a consistent manner and retrievable quickly and efficiently
- Material is traceable from receipt to release for use and upon return to warehouse

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## ➤ Materials Management- Support Facilities and Systems

- Construction buildings
- Material handling and warehousing
- Construction Command Center
  - 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
- Fabrication shops and facilities
- Paint shop and blast booth
- Testing laboratories
- Equipment repair facility

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## ➤ Materials Management- Support Facilities and Systems (continued)

- Distribution and storage of gases used for construction
- Batch plant, mix designs, aggregate storage areas
- Heavy haul and lift designs, lifting points, rigging frames
- Module assembly and system outfitting shops
- VHL crane foundations
- Optical and alignment equipment
- Automatic rebar assembly machine
- Scaffolding/hydraulic man-lifts

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## ➤ Materials Management- Support Facilities and Systems (continued)

- Automatic welding machines
- Earth moving equipment
- Material lay-down facility and Inspection
- Pipe bending machines
- Temporary electric power grid
- Temporary dewatering system
- Construction air system
- Storage areas
- Bulk gas tank facilities

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## ➤ 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



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## ➤ 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

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## ➤ Quality Assurance/Quality Control-Material Program

- 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

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## ➤ Quality Assurance/Quality Control-Material Program (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

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## ➤ Quality Assurance/Quality Control-Material Program (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 plant permanent records
- Ensure installed material/components meet intended function and operability requirements
- Oversight and inspections of suppliers' facilities

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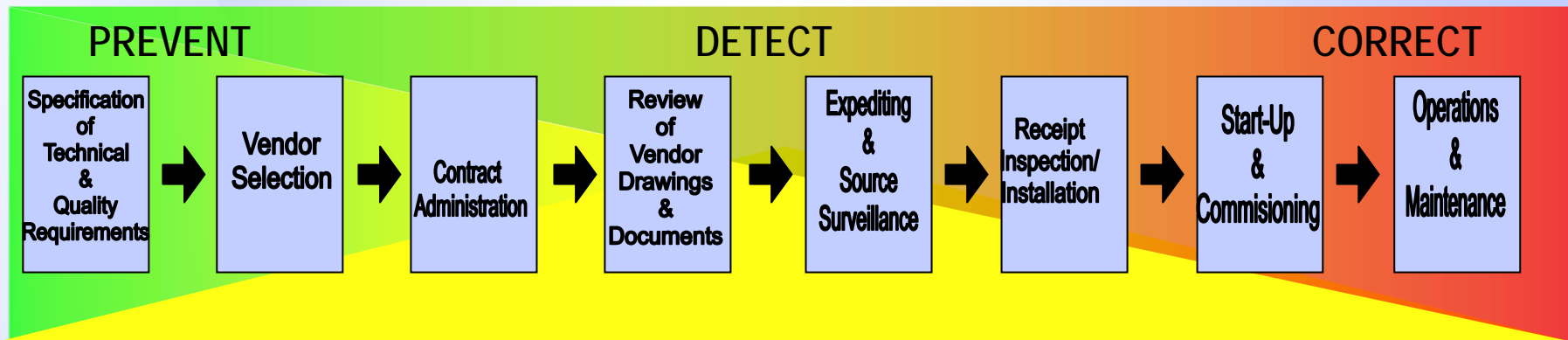
## ➤ Quality Assurance/Quality Control-Material Program (continued)

### – 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

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## ➤ Summary

### – Strategies for **SUCCESS**

- Build necessary skills and oversight processes to protect against issues and delays
- Integrate the procurement process into the overall project schedule and programs
- Leverage demand and relationships to acquire an advanced supply chain program
- 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)

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## ➤ Summary

### – Strategies for **SUCCESS**

- Leverage modular fabrication to reduce complexity and field work
- Shipping logistics recognizing global supply chain
- Material Transport- Use of light-weight materials, ease the movement and placement of components and lighten preassembled skids and modules. Module sizes and content can be increased
- Reducing the weight and increasing performance and safety of construction tools has a direct impact on construction efficiency and cost
- Training of the labor force
- Define and execute robust QA/QC programs



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***Thank You***