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Construction Methods: A Summary of What Works Worldwide

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Vienna Austria

IAEA

Atoms for Peace

Objectives

- ✓ Construction Methods Across the Globe
- ✓ Regional Differences to be considered
- ✓ Construction Logistics
- ✓ Construction Innovations
- ✓ Construction Optimization

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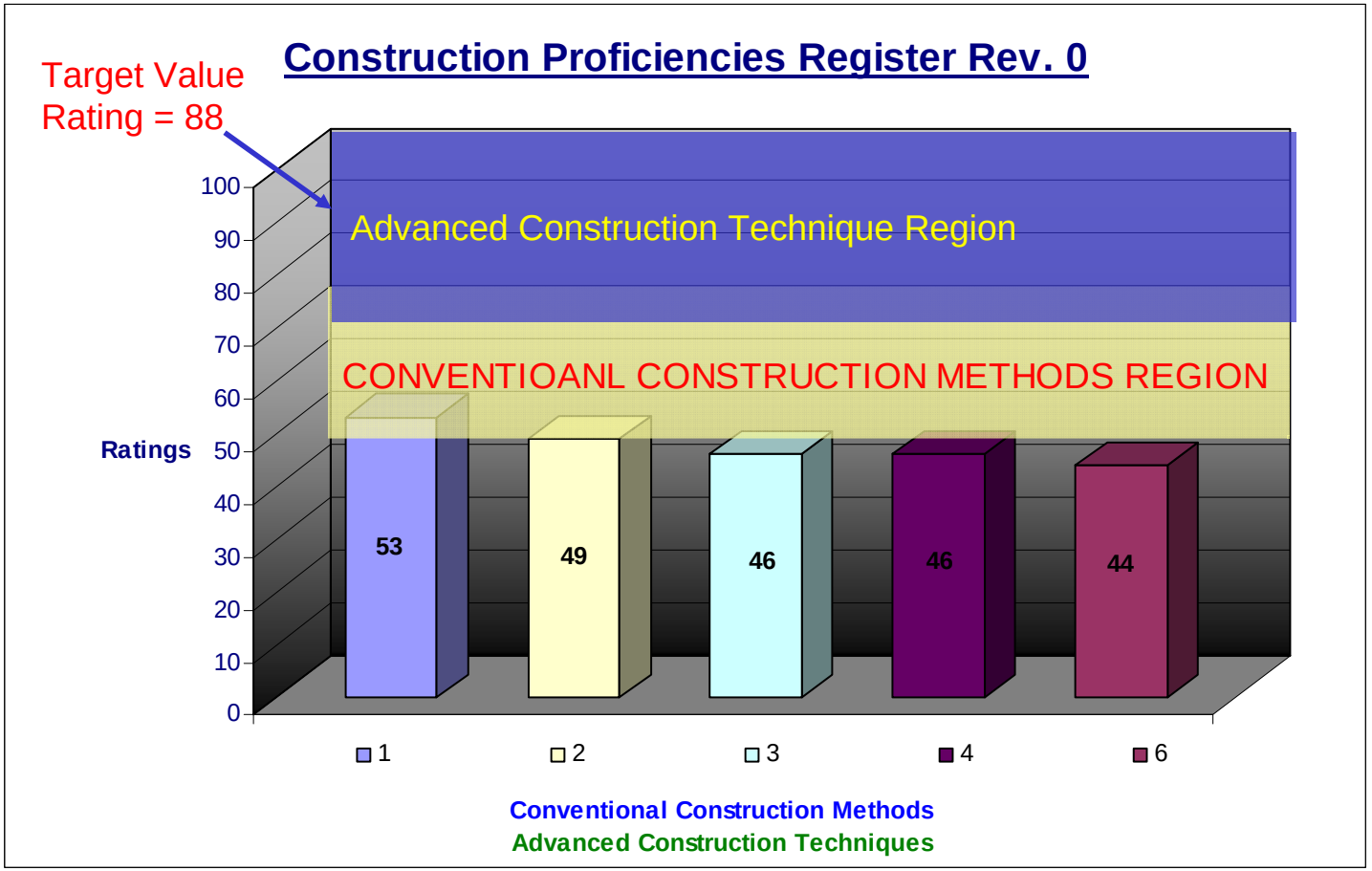
Optimum Construction Methods Across the World

Optimum Construction Methods Across the Globe

- ✓ Stick built
- ✓ Horizontal (slide in)
- ✓ Open top
  - Maximize the use of modules
  - Construct from the bottom up

Construction Methods



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Regional Differences to be considered

Regional Differences

- ✓ Cultural issues
  - Religion
  - Social, ethnic, economic bracketed working class
- ✓ Work force demographics
- ✓ Skilled Labor
- ✓ Training

Regional Differences

- ✓ Contract types
  - Design Build Delivery Model # 1 (Full Wrap Model with OEM – Japanese Model)
    - OEM responsible for the entire contract but constructor responsible for the site
  - Design Build Delivery Model # 2 (Bifurcated with Separate Contracts with OEM and EPC Constructor)
    - Separate contracts to OEM and EPC
  - Design Build Delivery Model # 3 (Construction Management Not at Risk)
    - Construction Management is responsible for managing the site only
  - Design Build Delivery Model # 4 (Full Wrap Model with Construction Manager as EPC Contractor)
    - Construction Manager function as EPC contractor
  - Design Build Delivery Model # 5 (Full Wrap Model with EPC Contractor)
    - EPC responsible for the entire project

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Construction Logistics

Construction Logistics

- ✓ Ocean Access
- ✓ Barge unloading & lay-down facility
- ✓ Heavy Haul Access
- ✓ Rail Access
- ✓ Off-site fabrication facilities
- ✓ Labor force- Availability of qualified force
- ✓ Material availability
- ✓ Management plan and owner oversight
- ✓ 3D models

Construction Logistics

- ✓ Logistical items to be considered
  - Major assumptions to create the schedule including contingencies
  - Security logistics during construction
  - Permitting
  - Engineering complete prior to construction
  - Site investigation and plans in place
  - Procurement plans in place (buy vs. lease)
  - Modularization plans in place
  - Transport (Cranes) plan in place
  - Organized labor

Construction Logistics

- ✓ Logistical items to be considered
  - Schedule (Level I, II and III deployment schedule)
    - Adequate details to determine ties between activities
    - Completeness of the schedule
      - Are all activities included to
        - Support pricing of the plant
        - Support design completion
        - Support pre-construction activities
        - Support site layout and infrastructure
      - Critical path identified
      - Construction packages defined and scheduled
      - Procurement activities linked to the schedule

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Construction Innovations

Construction Innovations

- ✓ Earth moving equipment
- ✓ Pipe bending machines
- ✓ Crane and rigging equipment
- ✓ Optical and alignment equipment
- ✓ Automatic rebar assembly machine
- ✓ Scaffolding/hydraulic man-lifts
- ✓ Automatic welding machines
- ✓ Construction site monitoring and communication

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Construction Optimization

Construction Optimization

- ✓ Lessons learned from past nuclear power plants construction is essential to building the next generation of plants consistent with design requirements, economically and safely. (NUREG-1055, *Improving Quality and the Assurance of Quality in the Design and Construction of Nuclear Power Plants and INPO 08-005):*
  - Organization and Administration
  - Design Control
  - Construction Control
  - Modularization
  - Project Support
  - Training
  - Quality Assurance/Quality Control
  - Test Control

Construction Optimization

- ✓ Organization and Administration
  - Develop organizational charts.
  - Define organizational relationships
  - Develop responsibilities, authorities, and accountabilities.
  - Develop annual goals, objectives, and performance standards.
  - Owners Oversight and control
  - Implement a comprehensive corrective action program

Construction Optimization

- ✓ Design Control
  - Define design authority
  - Design and Engineering complete prior to start of construction
  - Engineering support during construction
  - Configuration control plan
  - Reconciliation of as-BUILT designs with drawings, calculations, configuration documents and the original design
  - Design reviews for constructability, operability, access, interference, and maintenance

Construction Optimization

- ✓ Construction Control
  - CAD models
  - GPS
  - Video
  - Radio connectivity
  - Virtual Briefings
  - Teams and Critical Path shifts
  - State of the art equipment

Construction Optimization

✓Modularization

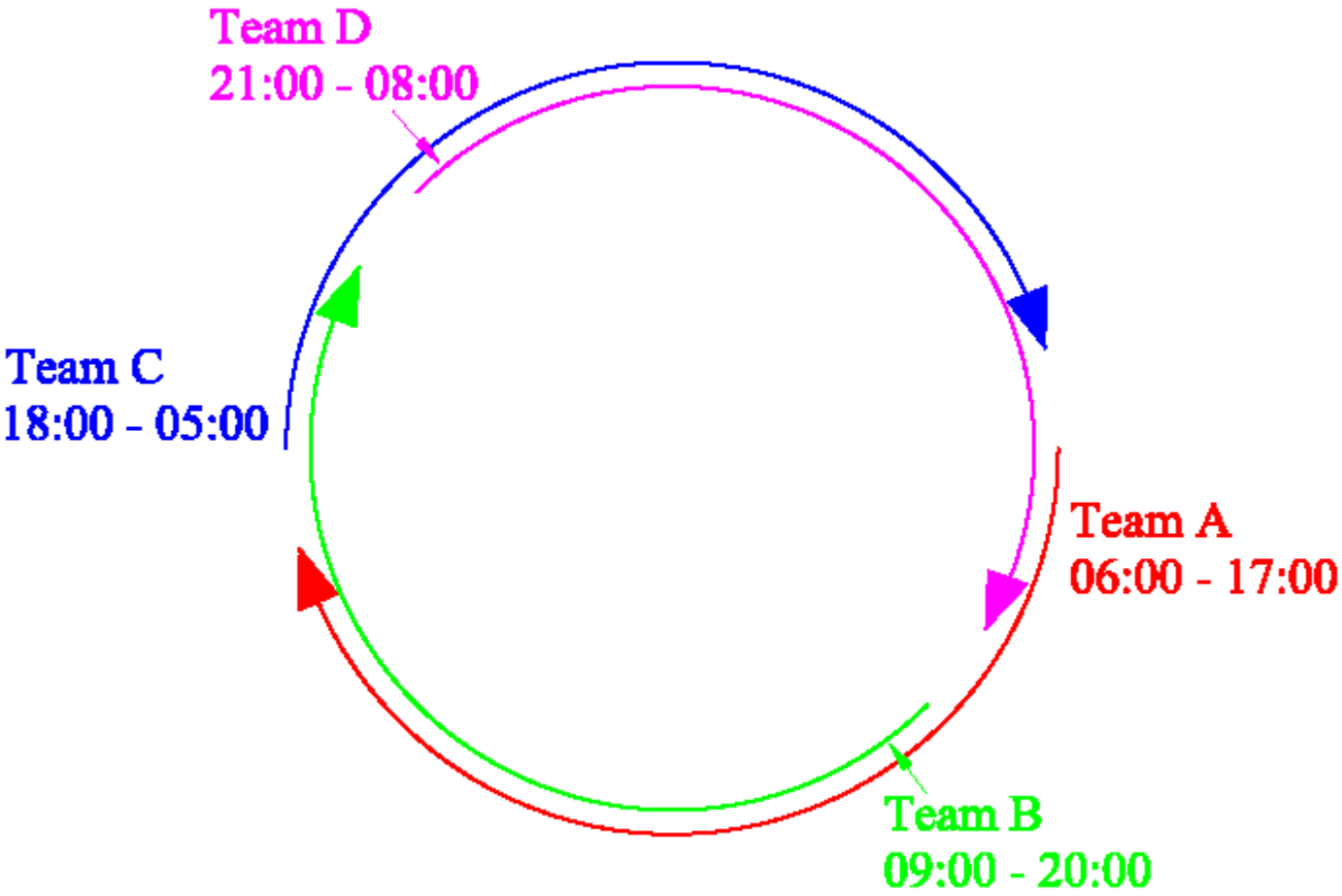
- Numbers, sizes, & weights
- Transportation of modules- ocean access, barges, trucks, rail
- Unloading modules at barge facility (crawlers, etc…)
- Design of on-site modular receipt and storage construction yard
- Contingencies

Construction Optimization

✓Project Support

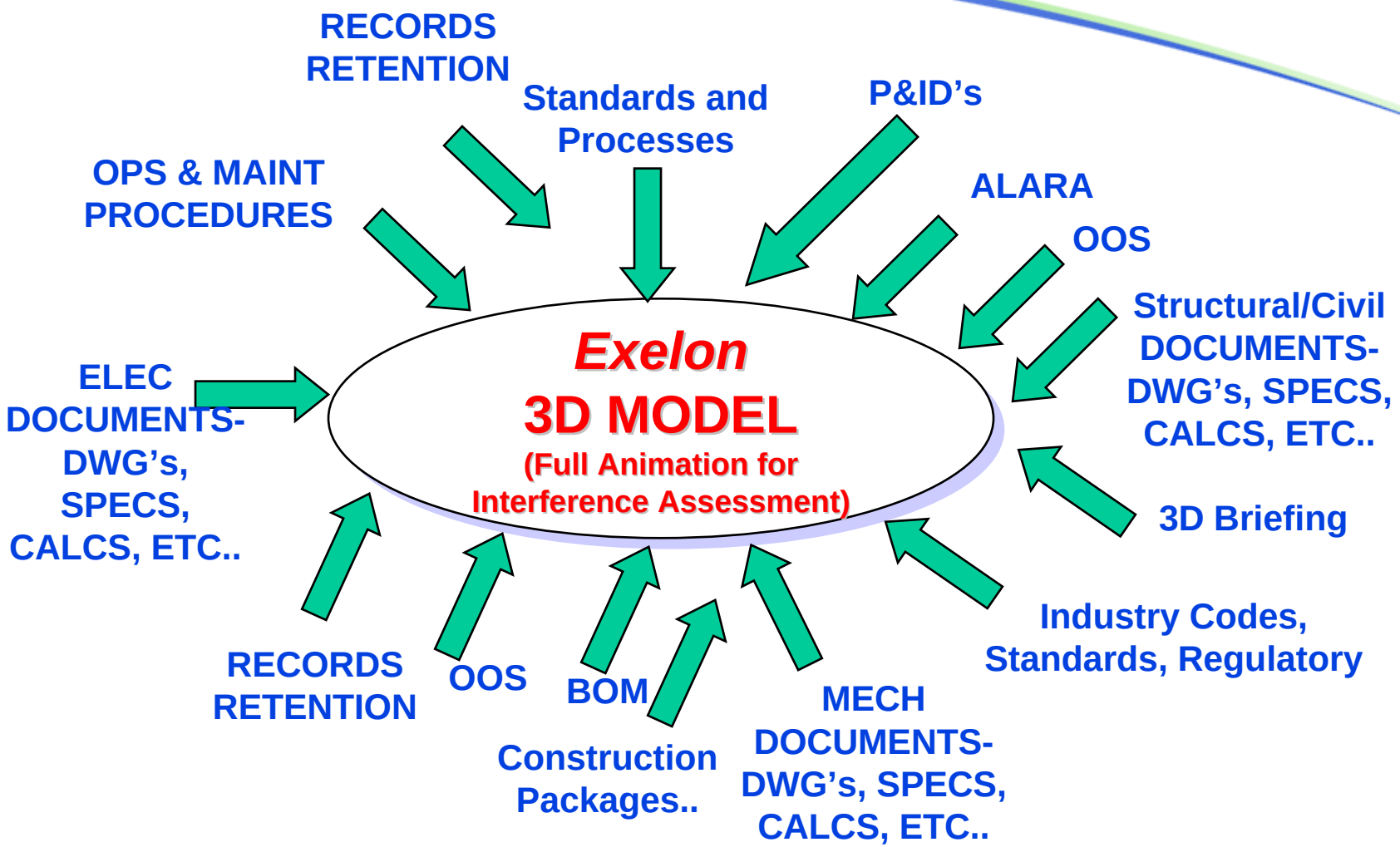
- GPS tracking modules off-site
- GPS tracking on-site
- Equipment tracking
- Site communications
- Tracking personnel on-site
- On-site material
- Schedule
- Contingencies

Construction Optimization



Construction Optimization

- ✓ Training
  - Qualified Crew
  - Continuous and updated training
  - Use clear and sufficient visual aids.
  - Use of 3D model
  - Nuclear Power Plant Fundamentals Knowledge


RECORDS RETENTION
Standards and Processes
P&ID's
OPS & MAINT PROCEDURES
ALARA
OOS
Structural/Civil DOCUMENTS- DWG's, SPECS, CALCS, ETC..
ELEC DOCUMENTS- DWG's, SPECS, CALCS, ETC..
Exelon
3D MODEL
(Full Animation for Interference Assessment)
3D Briefing
Industry Codes, Standards, Regulatory
RECORDS RETENTION
OOS
BOM
Construction Packages..
MECH DOCUMENTS- DWG's, SPECS, CALCS, ETC..

Construction Optimization

- ✓ QA/QC
  - QA/QC programs requirements, scope, and organization.
  - Reporting guidance
  - Understanding of nonconformance significance
  - Audits and trending analysis
  - Inspections are integrated into the procurement and construction stages.
  - Acceptance criteria and tolerances are understood and uniformly applied

Construction Optimization

- ✓ Test Control
  - Define responsibilities and interfaces of startup personnel, QA personnel, and utility personnel
  - Integrate system turnover schedule with startup schedule .

“What is an Enterprise Command Center”