SUT - US

Systems Integration Testing

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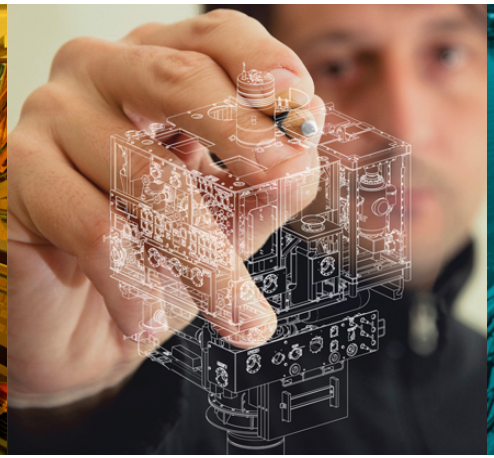
FMC Technologies

We put you first.
And keep you ahead.

Systems Integration

Systems Integration Testing

- Contents
  - Overview of safety, technical, and financial drivers for SIT
  - Overview of SIT Planning Considerations
  - Examples of SIT Operations

- Expectations
  - After reviewing this material, the reader should have a good understanding of:
    - The benefits of SIT
    - Planning and Execution of SIT

Safety Moment: SIT Safety Considerations

- Visitor Management
- Controlled access during Pressure Tests and Lifts
- Perform periodic Safety Audits
- Perform HAZID for all SIT operations
- Perform Job Safety Assessments for activities
- Implement Emergency Management Process
  - Muster Location at New Parking Lot
  - Escape Routes clearly defined
  - Responsibilities

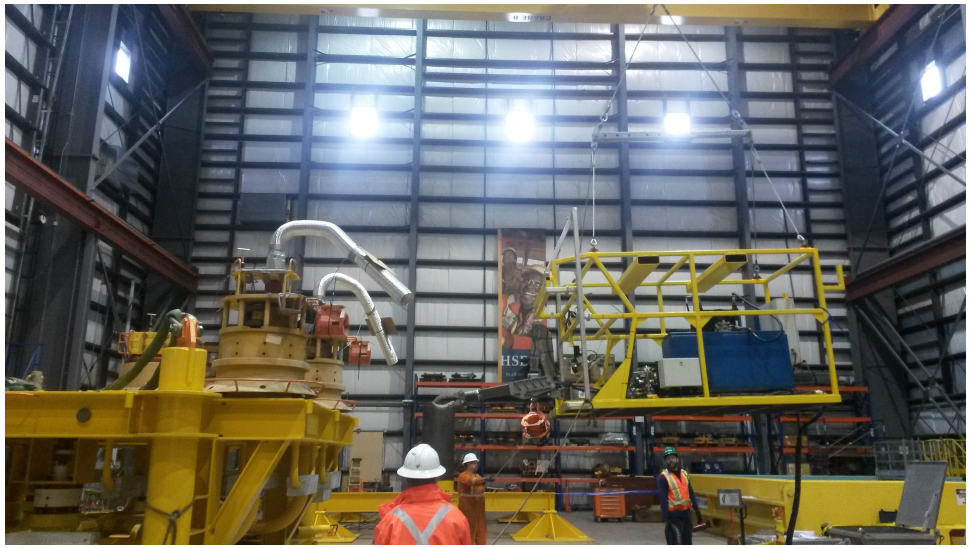
SIT Benefits and Scope

SIT Benefits

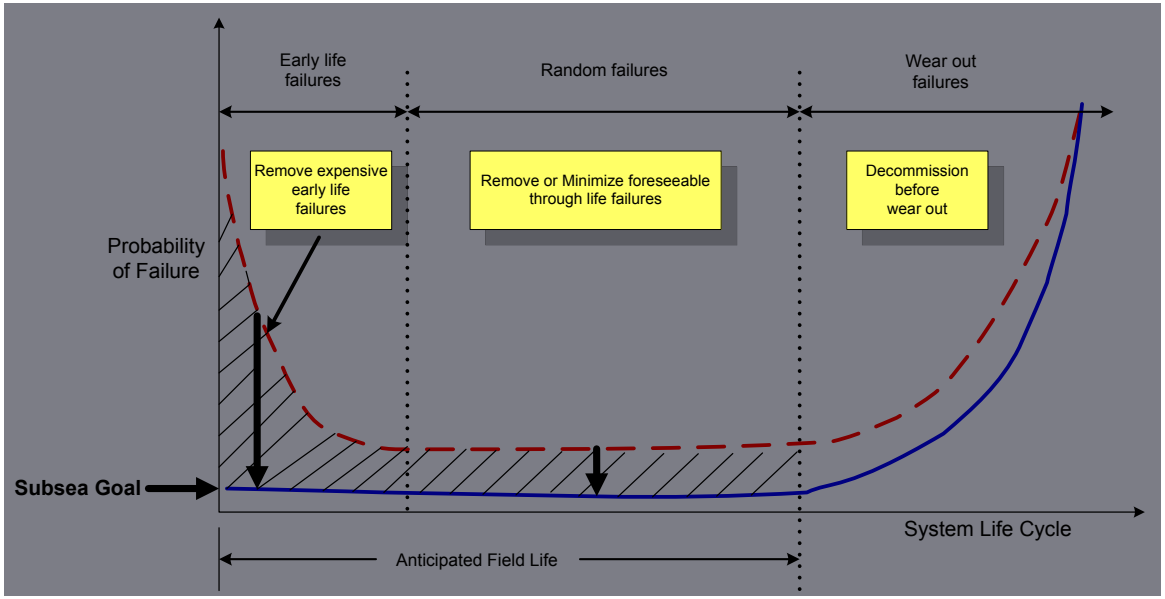
- ✓ **Training and system familiarization**
- ✓ **Personnel accessibility checks**
- ✓ **Identification of operational and safety hazards**
- ✓ **Verification of Operating and Maintenance Manuals**
- ✓ **Verification of Topside Controls Software**

Technical Objectives

- Verify interfaces between Major equipment assemblies of the Subsea System
- Verify tooling interfaces
- Confirm Field Architecture
- Simulate avoidance of sea floor hazards or obstructions
- Verify ROV access and operations
- Verify Installation and Retrieval Operations
- Training opportunity for Customer and 3rd Party personnel in advance of offshore installation



What is the Financial Driver for SIT?



- **Rig time is expensive**
- **Rigs are remote, making shipping expensive and time consuming.**
- **If equipment fails to work subsea it can take 2-3 days to trip back the equipment.**
- **If certain items fail subsea they can be difficult to recover.**

SIT Scope Definition

- **System**
  - **Ext. interfaces to Sub-System Components**
    - **Manifold -> Jumper -> XT**
    - **CWOR -> XT -> TH -> THS -> WH**
    - **HDM -> SFL -> XT, EDU -> EFL -> XT**
  - **Sub-System Testing**
    - **TH to Tubing Head**
    - **TH to EHXT**
  - **Component Testing**
    - **Tree**
    - **Tubing Hanger**
    - **Jumper**
    - **Manifold**

SIT performed at this level

EFAT performed at this level

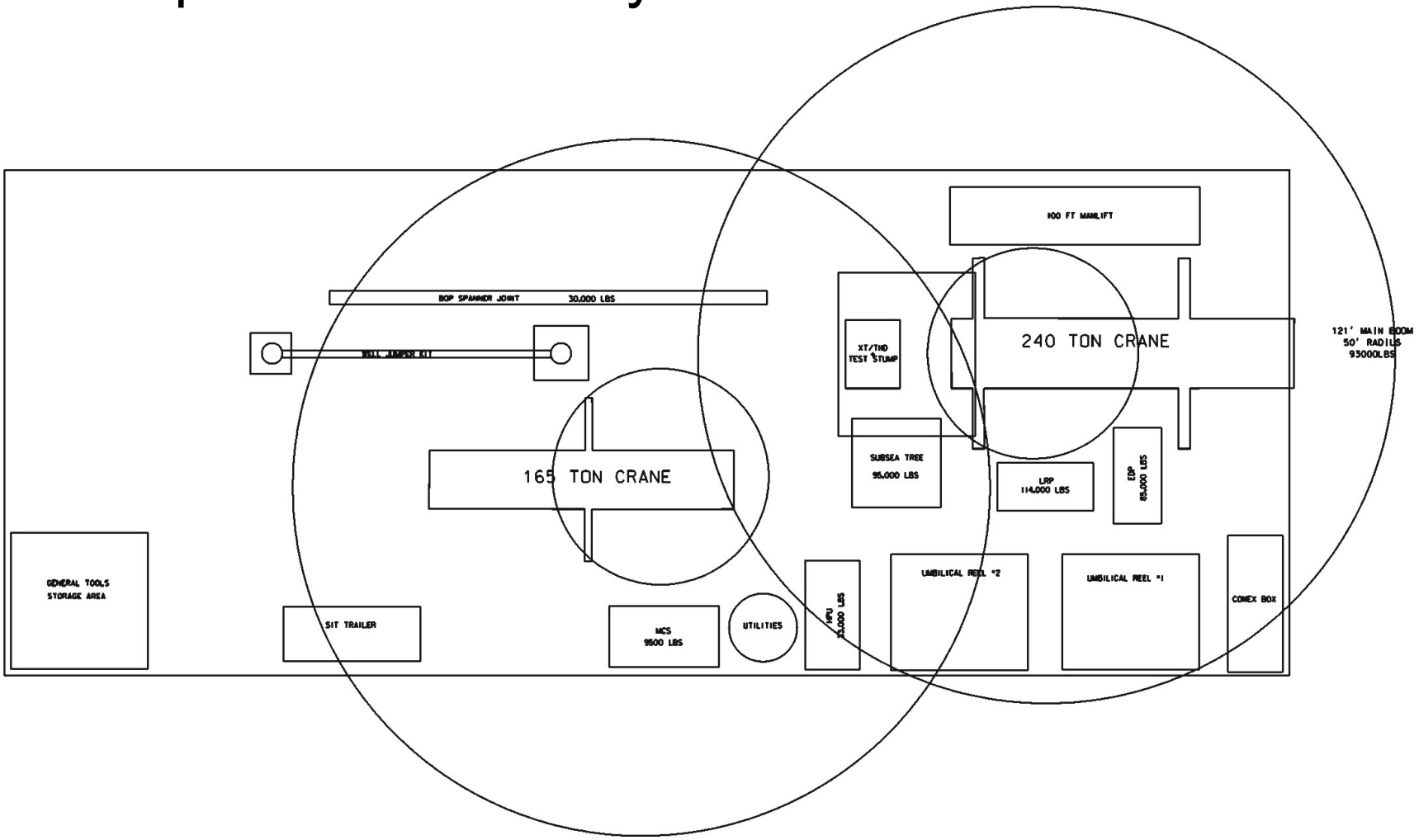
FAT performed at this level

Note: Multiple SITs may be performed based on equipment delivery and installation schedules

SIT Considerations

- Budget : Cost and Time allotted
- Physical and Logistic Limits of SIT Facility: (Site Layout)
- Utilities available onsite: (water, electricity, air, etc.)
- Additional equipment to be contracted: (cranes, HPUs, manlifts, etc.)
- Scheduled delivery of equipment for installation
- Personnel Requirements (SIT Coordinator, Engineers, Technicians Customer Witnesses, 3rd party personnel.)

Example Work Site Layout



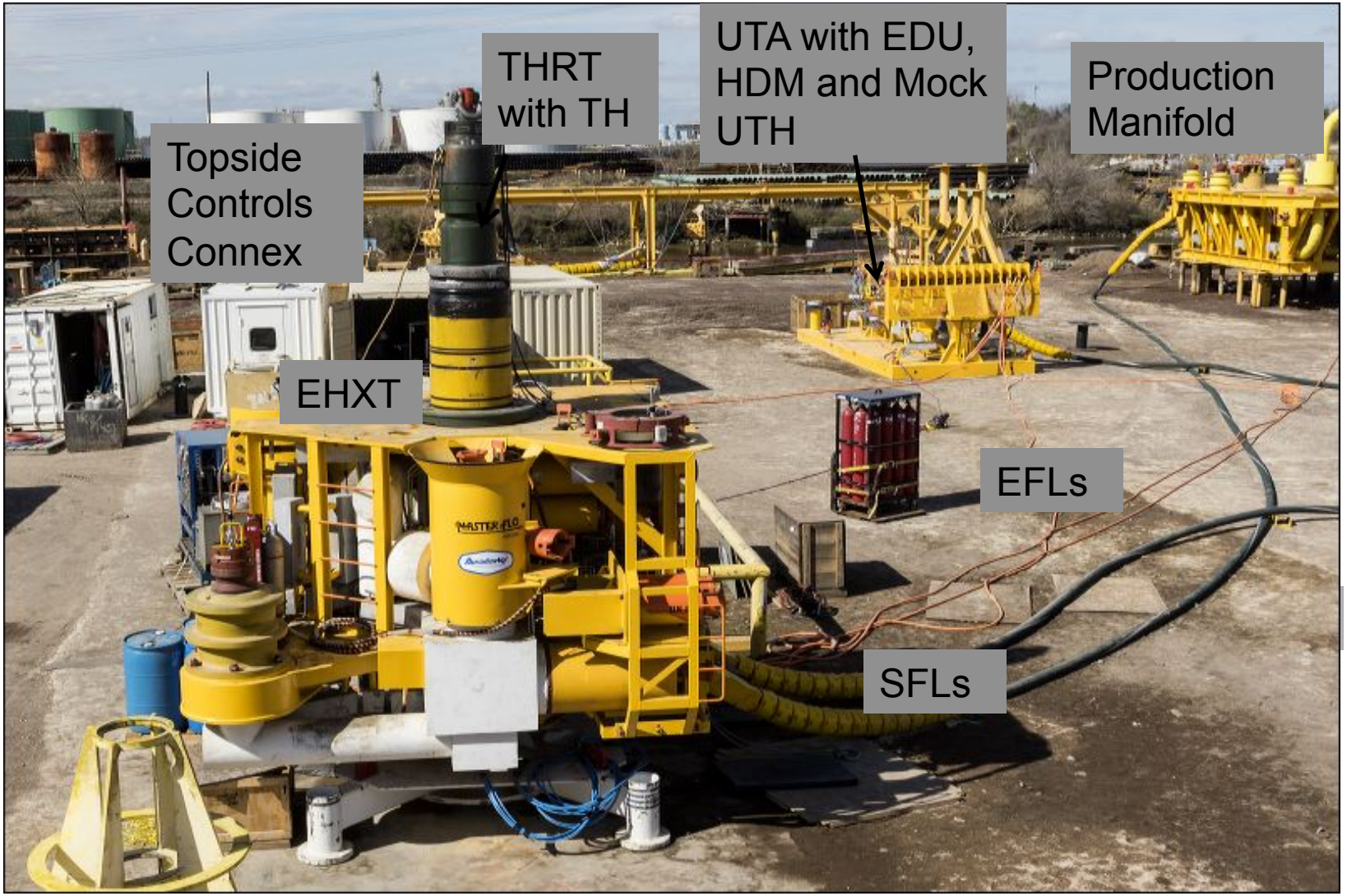
Non-conformance Documents

- Field Non-conformance Reports
  - Document non-conformances that are present upon receipt of the equipment to the field or SIT
  - Document non-conformances that occur while in the field or at SIT

- Punchlist Items
  - All punchlist items should be closed prior to shipment
  - May result in in-house or field repairs, if necessary.

SIT Examples

Subsea System SIT



Horizontal Tree SIT

Tubing Hanger Downhole Line SIT

DH Gauge, SCSSV, Smart Well Eq. Interface

Hydraulic control lines from TH

DH guages, CI mandrel, SCSSV, or SW sleeves

IWOCS Stack-up SIT

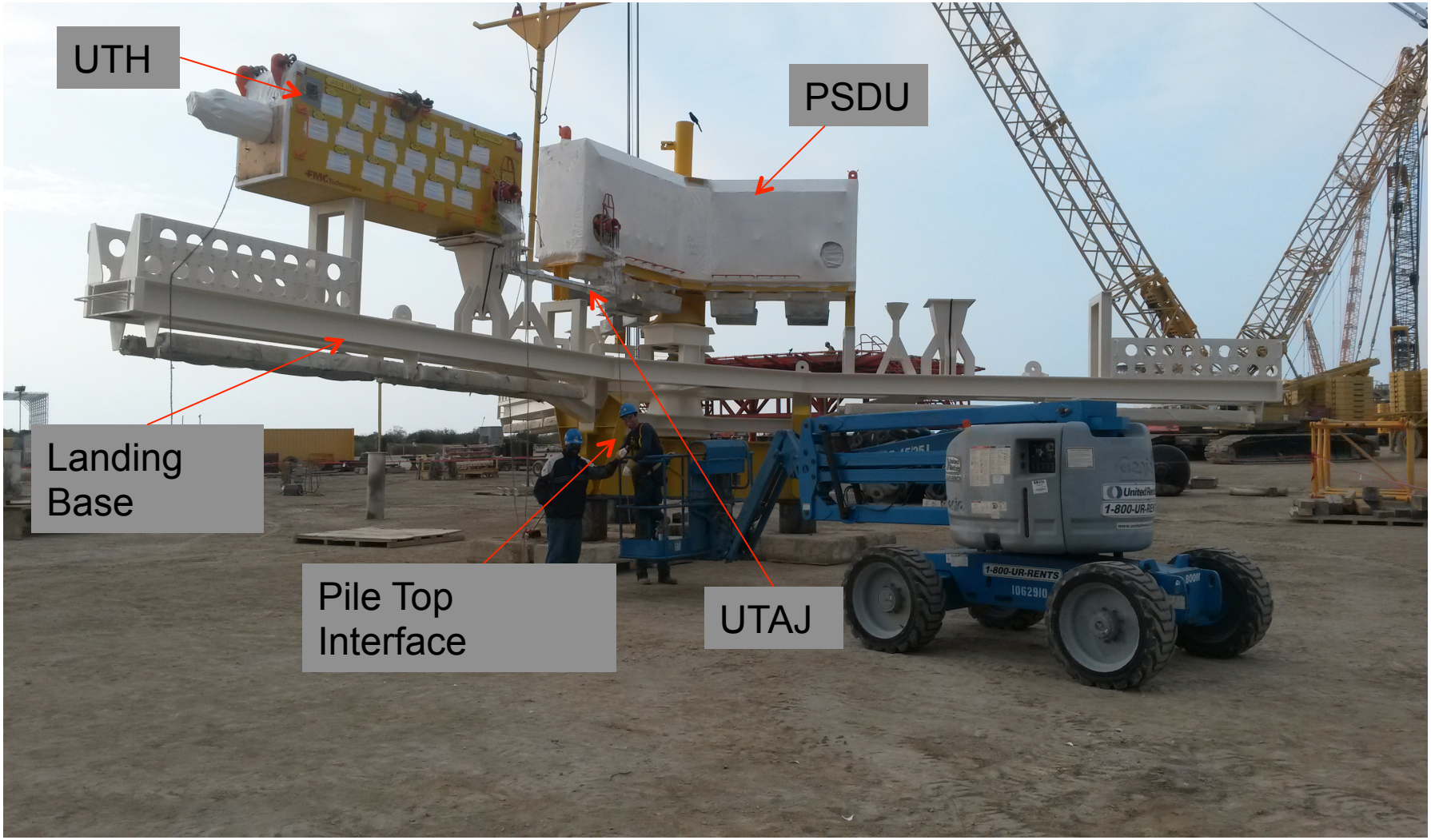
Tree Survey and Access Evaluation

PLEM Tilt Test

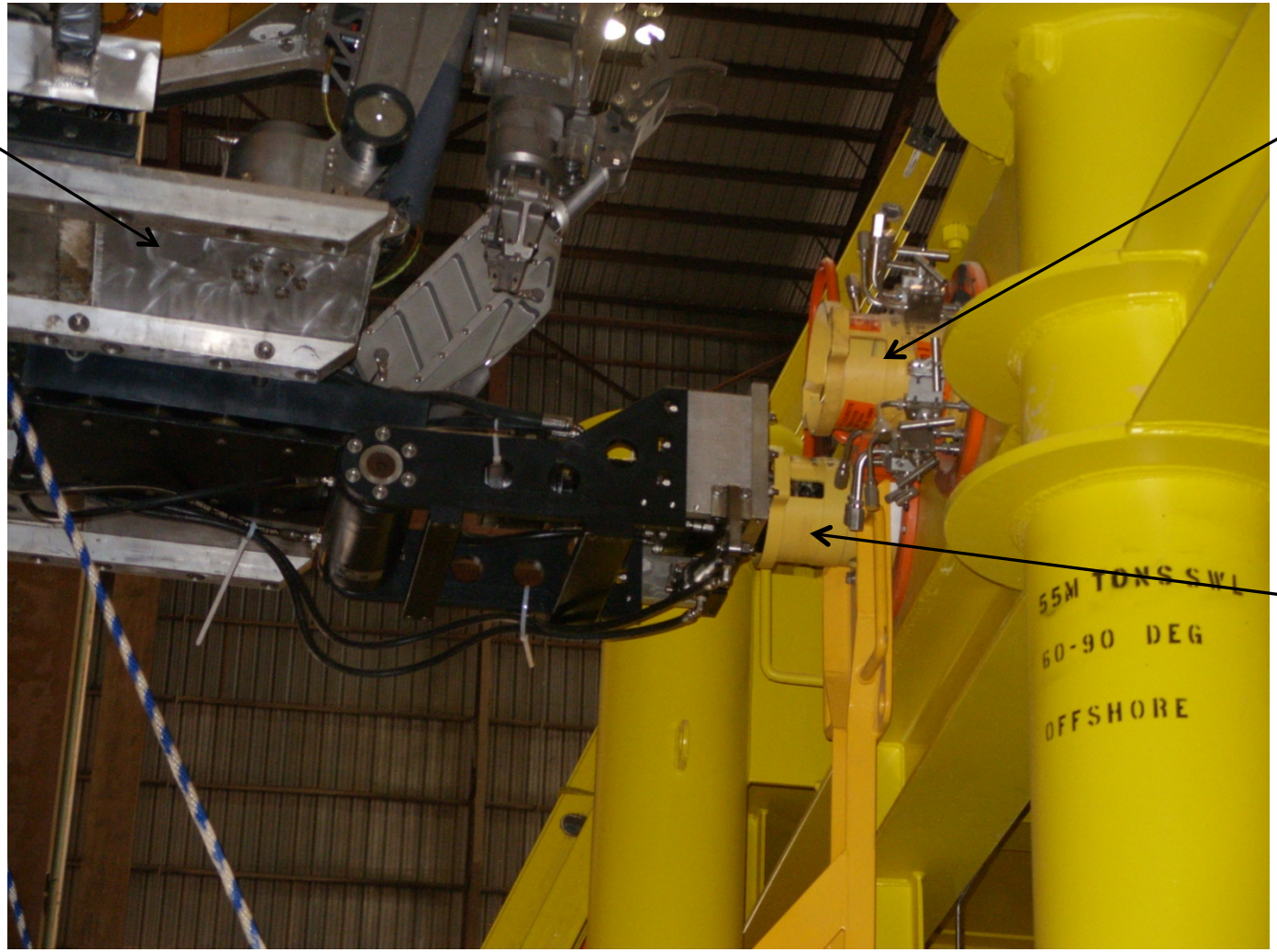
Tree and Manifold Interface

Pigging and Other Field Interventions

Umbilical Termination Assembly SIT



ROV Interfaces to Equipment SIT



Jumper Lift SIT

Connector and Gasket Tooling SIT

Review

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Questions