Rig Preservation and Reactivation Challenges

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LR Energy-Drilling

Lloyd's Register Energy

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Agenda

- Preservation - Why
- Preservation – What
- Preservation – How
- Preservation Lifecycle
- Challenges during and after reactivation

Preservation - Why

- Cost reduction
  - Reduction in crew
  - Fuel consumption
  - Insurance costs
- Asset protection
  - Limit asset devaluation
  - Cost effective, preserve only what needs to be preserved
  - Assurance the asset can be reactivated

- Preservation is carried out to protect capital intensive equipment during extended idle periods
- Assure whole-life asset utilization

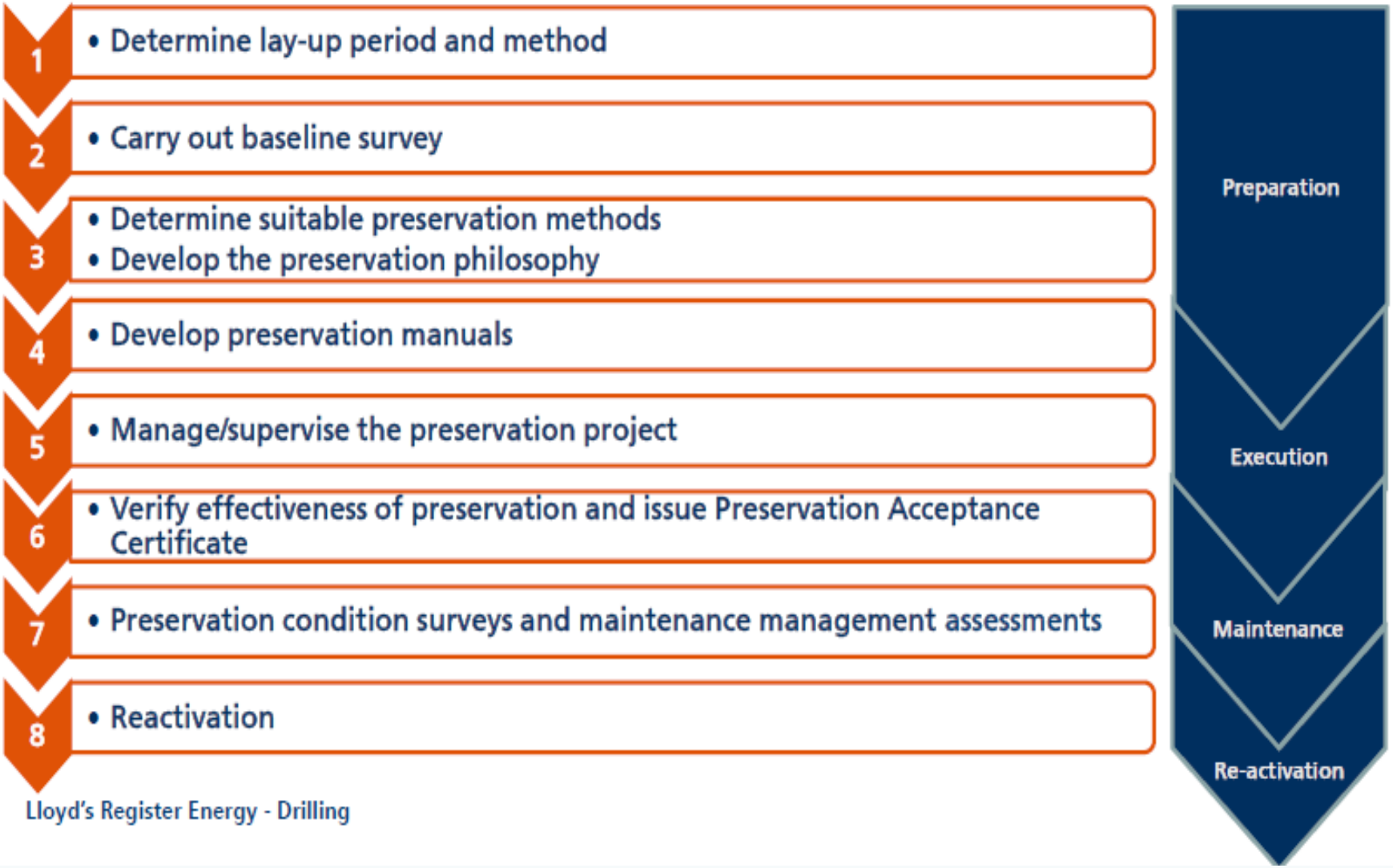
Preservation - What

- Understanding of failure modes, mechanisms, and causes associated with inactivity, and developing plans to prevent/reduce/minimize/optimize their effects.
- Preservation must be able to protect the equipment from damage and deterioration due to a wide range of climate conditions - moisture, electrolytic action, corrosion, oxidation, ultra violet light, biological agents
- Preservation must be able to protect the equipment from damage and deterioration due to extended static loading conditions
- Preservation must be able to protect the personnel from health and safety risk such as fungus, mold spores and bacteria in accommodation areas and HVAC systems and legionaires disease from water pipes.

Preservation - How

- Manage the preservation to avoid costly surprises when reactivating
- Develop a preservation programme and implement.
- Comply with statutory requirements – Class, regulators, insurance
- Utilization of Risk-based approaches
- Include Preservation Maintenance
- Reliability-centered maintenance (RCM) is a process to ensure that systems continue to do what their users require in their present operating context.
  - How do we ensure continued asset functionality when the operating context changes severely?
- Health, Safety and Environmental
  - Reduce HSE risk to crews and the environment during and following the preservation.

Preservation Lifecycle



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1. Determining Lay-up Period and Method

Lay-up period criteria:

- Market forecasts
- Economic factors

- Rig type
- Rig equipment
- Purpose of the lay-up
- Return to drilling ops
- Refurbishment/modification
- Scrapping

1. Determining Lay-up Period and Method (cont'd)

Lay-up factors

- Area: Environmental condition, Logistical issues, Availability of services
- Authorities: Local or port authorities requirements, Class and Flag state requirements, maintenance/ watch crew requirements, legal and regulatory requirements.
- Safety & security: Safety requirements, LSA, fire safety, environmental safety, watertight integrity
- Health: Mold Spores, disease prevention
- Asset criticality ranking
- Other Considerations
  - Replacement, refurbishment, recertification lead times
  - Obsolescence of equipment, electronic control systems in particular
  - Cash flow available throughout the term of lay up and during reactivation

1. Determining Lay-up Period and Method (cont'd)

Lay-up factors

- Cost estimates –
  - Replacement asset value (RAV),
  - Preservation activity costs,
    - Preservation materials, fuel, lubricants,
    - Packaging of equipment
    - Manpower
    - Tools, gensets, etc. required
  - Reactivation costs
    - Getting back to as-new condition
    - Recertification, Class approval
    - Crew training

1. Determining Lay-up Period and Method (cont'd)

Hot Lay-up

- Pros: immediate availability, unit will be marketed
- Cons: marginal reduction in costs

Asset will be kept in an operational condition

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Warm Lay-up

- Pros: short reactivation time, unit will be marketable
- Cons: limited reduction in costs

Asset will be kept in an near operational condition with reduced crew and some preservation.

Cold Lay-up

- Pros: maximum reduction in costs
- Cons: substantial reactivation time, unit will not be actively marketed

Extensive preservation

2. Carry Out Baseline Survey

- Determine level of pre-inspection & maintenance required before preservation.
- Establish and record the condition before the preservation
  - Measurements, e.g. vibration, SPM, megger testing
  - Photographic evidence
- Highlight points of attention before preparation
- Highlight points for reactivation
- Prioritize effort based on asset criticality and observed condition (risk-based approach)

3. Determine Suitable Preservation Methods/Techniques Develop the Preservation Philosophy

- Balance the WHOLE LIFE COST OF OWNERSHIP of the asset vs. the value that the asset provides. Many focus just on the short term preservation costs. Consideration of Strategic Asset Management Planning (SAMP) under ISO 55001.
- Asset Specific
- Effective preservation of capital equipment
- Efficient cost control
- Maximize the reliability and habitability of the unit following the return to service
- Ensure that the laid-up unit is safe
- Present the unit as “Ready to Go”
- Manning levels and required competencies
- Health and Safety Issues
- Environmental issues
- Logistical issues
- Availability of services
- Facilitate risk assessment (FMEA) and maintenance task assessment (MTA) workshops
- Safety Case & Performance Standards amendment

3. Determine Suitable Preservation Methods/Techniques Develop the Preservation Philosophy (cont'd)

Example activities

- Replace oil & grease
- VCI in gearboxes & lubricants as applicable.
- Support/Turnover of larger bearings & shafts
- Dielectric on electric power components
- Desiccant and shrink wrap where applicable
- Denso tape on exposed metals
- Nitrogen purge on piping, or selected systems, maintain a few PSI
- Protection methods for compressed air systems (lubricators, methanol, etc)
- Toxic mold prevention in ventilation, places inhabited by personnel
- Paint/coating reapplication
- Pull thrusters?
- Operation of engines or use of shore power/gen-sets?
- Need for fired detection and fire fighting systems to be active? (driven by insurance company or port requirements)
- **Periodic inspection** of preservation condition
- **Periodic turnover** of critical gearboxes, shafts, bearings.
- **Reapplication of preservation products** – many are recommended to be reapplied every 6 months. Tapes, desiccants, etc.

4. Develop Preservation Manuals

- Work with subcontractor (e.g. fluid providers)
- Equipment list
- OEM recommended procedures
- Preservation material supplier recommendations
- Prepare generic procedures
- Prepare specific procedures for equipment and systems
  - Periodic inspection
  - Periodic turnover
  - Reapplication of preservation products
- Prepare specific procedures to reduce HSE Risk
- Risk Based Maintenance and Inspection considerations
- Reactivation procedures
- Maintenance of Firefighting systems & other systems that need to remain in an ready status.

5. Project Execution

Objectives and Scope:

- Safe shutdown without damaging equipment
- Assure mechanical integrity
- HSE risk management
- Quality Assurance and Quality Control
- Verifiable and easily accessible information
- Project Organization
- Project Execution
  - Oversight
  - Systematic Process approach
  - Transparent and coherent working methods
  - Experienced project managers and team, clear project roles & responsibilities
  - delivery on time/within budget to the required preservation quality standards, ensures minimal costs for reactivation and minimum downtime after reactivation.

6. Verify Preservation and Issue Preservation Acceptance Certificate

- Objective is to ensure that the procedures are followed and the preservation tasks are carried out in an effective manner. If there are comments and recommendations issued regarding the preservation, then these must be cleared.
- Issue a Preservation Acceptance Certificate for the system and its subcomponents.
- The certificate ensures that the tasks completed are in compliance with the preservation procedure for that particular procedure

7. Preservation Condition Surveys and Maintenance Management Assessments

- Regular verification surveys to ensure that any projected periodic maintenance routines have been carried out and preservation level has not deteriorated.
- Verification of records and the preservation monitoring system, e.g. hygroscopic values.
- Verification of Sample analysis, fluids, electrical conductivity, vibration.
- Review of the maintenance records
- Assessments of the maintenance management system
- Survey and Assessment reports

8. Reactivation

De-preservation and re-commissioning project

- Execution of de- preservation
- Execution of repairs, modifications upgrades
- Availability of spares for commissioning and operation.
- Project status reporting
- Punch list management
- Preservation Completion reports
- Re-commissioning tests
- System integration and endurance tests
- Acceptance Tests
- Acceptance certificates
- Handover dossiers
- Assure Pre-startup requirements are met

8. Reactivation

Equipment certification.

- Certificate of Conformance requirements
- OEM's can support warranty extension / deferment requirements

Class involvement:

- Acceptance Tests on power generation, fire fighting systems, bilge/ballast, thrusters, marine equipment.
- Seatrials
- Renewal or reactivation of class certificates

8. Reactivation

- Onshore
  - No code of practice
  - Local regulations
- Offshore Fixed Platforms
  - Local regulations
  - Offshore regulation
  - Guidance documents and approved codes of practice
- MODU's
  - IMO regulations
  - Statutory
  - Class

Drilling contractor Standards

Operator Standards

Industry Standards

ASME

ASTM

NACE

API

EN,

ISO

IEC

Challenges during and after reactivation

- Corrosion due to bacterial contamination of fuel and settling of water.
- Water ingress in the cylinders of diesel engines
- Failures due to equipment deterioration in general.
- Lack on monitoring of humidity and temperature -> Corrosion
- Failures due to corrosion inside piping systems and valves (hydraulic, pneumatic systems).
- Machinery components sit statically in same position or are turned with insufficient lubrication film.- False Brinelling. Failures are not immediate but need time to develop.
- Starting up problems with malfunctioning regulators and control equipment.

Challenges during and after reactivation

- Failures because components have not been cleaned or opened up after months without operation.
- Electronic equipment start-up failures after months without power.
- Failure of electronic control systems.
- Out of date software

- Failures due to hidden defects may develop over time
- Obsolescence of spare parts,
- OEM’s out of business.

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