FPSO LIFE EXTENSION
TOTAL APPROACH

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INTRODUCTION

• Life extension
  – Support and its systems
  – Production
  – Export systems

• This presentation will focus in FPSO HULL
INTRODUCTION

Life extension relies on:

- Integrity Management System involved from Design to Decommissioning
- Design based in proved standards and good quality construction
- Condition assessment: analysis and regular inspection
- IMMR plan in place
FLOATING UNITS AROUND THE WORLD

World fleet: 150 FPSOs (not considering the unconventional as SEVAN)

IN OPERATION

- YEAR 2010s: 6
- YEAR 2000s: 12
- YEAR 1990s: 33
- YEAR 1980s: 99

60% Approx. are converted hulls
FLOATING UNITS: TOTAL’S FLEET

FLOATING UNITS:

NKS II (FGSO, 1996)       Dalia (FPSO, 2006)
Girassol (FPSO, 2001)     Akpo (FPSO, 2009)
Alima (FPU, 2008)         replaced by Kingsway
Pazflor (FPSO, 2011)      
Usan (FPSO, 2012)         
CLOV (FPSO, 2014)

MOST OF THEM SITUATED IN THE GULF OF GUINEA, MILD ENVIRONMENTAL CONDITIONS

SOME NEW UNITS COMING SOON:

EGINA (FPSO, 2017)
MOHO NORD (FPU+TLP, 2016)
LIFE EXTENSION
The EXTENSION OF LIFE keys are:

1. To know the acceptable level of performance for the FPSO
2. To know about the condition of the FPSO
3. To know about how the FPSO is aging.
Drivers for Life Extension are mostly commercial and taken in a case by case basis.

Some particularities:

Specifications highly dependent on past life of the unit
International Reference Standards not specific for FPSO extension of life
Project to be executed with ongoing operations
Relevance of the time varying factors:
Previous repairs “survival”
Coating degradation / integrity
Fatigue
Others:
Metocean reassessment
New technologies
New standards / Rules
MAIN OBJECTIVE: KEEP INTEGRITY OF THE UNIT

Extension of life is also an IN SERVICE philosophy
- Keeping integrity and fitness today for avoiding big scopes in the future
LIFE EXTENSION

MAIN OBJECTIVE: KEEP INTEGRITY OF THE UNIT

Extension of life is also an IN SERVICE philosophy

- Annual Review Meeting of FU Condition
  - GSF, 3rd Party Assist. Cy, Subsidiary
- Inspection Plan
  - Subsidiary
- Models Update & re-Analysis
  - 3rd-p. Comp. (control by GSF)
- Inspection Reporting and Updating of the database
  - Subsidiary
- Inspection Plan Update
  - Subsidiary
- Inspection Plan Execution
  - Subsidiary

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LIFE EXTENSION

MAIN OBJECTIVE: KEEP INTEGRITY OF THE UNIT

Extension of life is also an IN SERVICE philosophy

FATIGUE MONITORING

- Loading (n)
- Resistance (N)
- Damage (D)

Number of cycles vs Stress range (s) [MPa]

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ENGINEERING

1. PAST
   1. Good data (Design, Installation, Operation)

2. PRESENT
   1. Assessment « As it is »: understanding the degradation processes and the response of the unit
   2. Rules and standards in force
   3. New tools

3. FUTURE
   1. Requirements for future operation
   2. IMMR plan
ENGINEERING

1. HISTORY: docs review
   1. Inspection reports: class and owner
   2. Maintenance records
   3. Repairs records
   4. Design dossier: site conditions, corrosion allowances, Class rules
   5. Operational conditions
   6. Definition of Inspection plan for structure and critical equipment

2. INSPECTION
   1. Hot spot driven inspection
   2. Critical equipment
   3. Close visual inspections of hull (cleaning): coating status/corrosion
   4. Equipment inspections/surveys
   5. UTM measurements
   6. Underwater inspections
   7. Mooring—if intended to be kept
ENGINEERING

Be aware of initial **INCERTAINTIES** which may be carried over future life

AND ALSO

of new project uncertainties:

- Unavailable drawings, reports, feedback
- Loads: metocean, operation loads
- New failures types to be considered: pitting? Vibrations?
- Quality of original construction: coating application?
- Computerized models simplifications
3. Preliminary Analysis/ studies
   1. Gap between old Codes and Rules/Codes in force: IMPACT
   2. Site conditions – gap with previous metocean-IMPACT
   3. New Production conditions if any- topsides/equipment
   4. 2D evaluation of actual scantlings
   5. Corrosion forecast-evaluation
   6. Rough Estimation of steel renewal
   7. Equipment to be kept/refurbished/replace: spares availability
   8. Preservation
   9. 2D fatigue screening
   10. 3D fatigue- deterministic?
   11. Mooring

4. Analysis/studies
   1. Full 3D FEM strength and fatigue analysis
   2. Steel renewal: thickness diminution and pitting
   3. Steel repairs/ steel modifications
   4. Equipment compatibilities
   5. Class requirements
   6. Mooring
ENGINEERING

TOTAL General Specifications / Company Standards

• From design to decommissioning

• Enhanced Ship Technology for Offshore Industry needs:
  - additional corrosion margins
  - adapted fatigue safety factors
  - fabrication and construction enhanced focusing in critical areas
  - Yielding, Buckling and Fatigue addressed through latest finite elements calculations methodologies
  - Permanent means of access
  - IMMR plan and conditions included in design.
  - Mooring design as critical system

• Continuous improvement & room for new Knowledge and technology, FEED BACK from Industry and new methods.
WORKS EXECUTION
&
LESSONS LEARNT
LIFE EXTENSION

**DRY DOCK**
- Engineering results: scope
  - Important Steel bottom to be renewed
  - Important equipment to be installed/un-installed
  - Shipyard // offshore units opportunities

**ON SITE**
- Engineering results: scope
  - No Steel bottom to be renewed
  - No topsides modification
  - Pure extension of life (no relocation)

Schedule and economics
CONCLUSIONS
FIRST CONCLUSIONS:

• The number of Life Extension projects is expected to increase with the aging of the existing units

• Aging and life extension is to be faced from day one:
  • By designing for a long and ‘healthy’ life
  • By having in place a committed ASSET INTEGRITY MANAGEMENT

TO BE ENCOURAGED

- PRIORITY TO INSPECTIONS FOR ESTIMATION OF SCOPE OF WORK
- ANALYSIS COVERING BOTH PREVIOUS OPERATIONAL LIVES AND FUTURE CONDITIONS
- PRIORITY TO GOOD CLEANING FOR CLOSE VISUAL INSPECTIONS
- REPAIRS/RENEWAL: FORECAST OF FUTURE DEGRADATIONS
- DO NOT UNDERESTIMATE THE DIFFICULTIES OF EXECUTION IN CONFINED SPACES
- USE QUALIFIED AND RELIABLE VENDORS
ANY QUESTION??

THANK YOU!!
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