Technological and Logistical Challenges during Construction & Installation of Deepwater Mega Subsea Development in West Africa

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DNV·GL

Content

- Scale/Size of deepwater mega subsea developments
- FPSO and related considerations (e.g. CLOV)
- Subsea technology considerations
- Installation challenges
  - Logistics
  - Technical
  - Local content
- Conclusions

FPSO → Subsea → Installation

FPSO Typical Footprint & Basic Statistics

Component parts Facts:

No. Vessels – **50** (installation, tugs, barges and support)

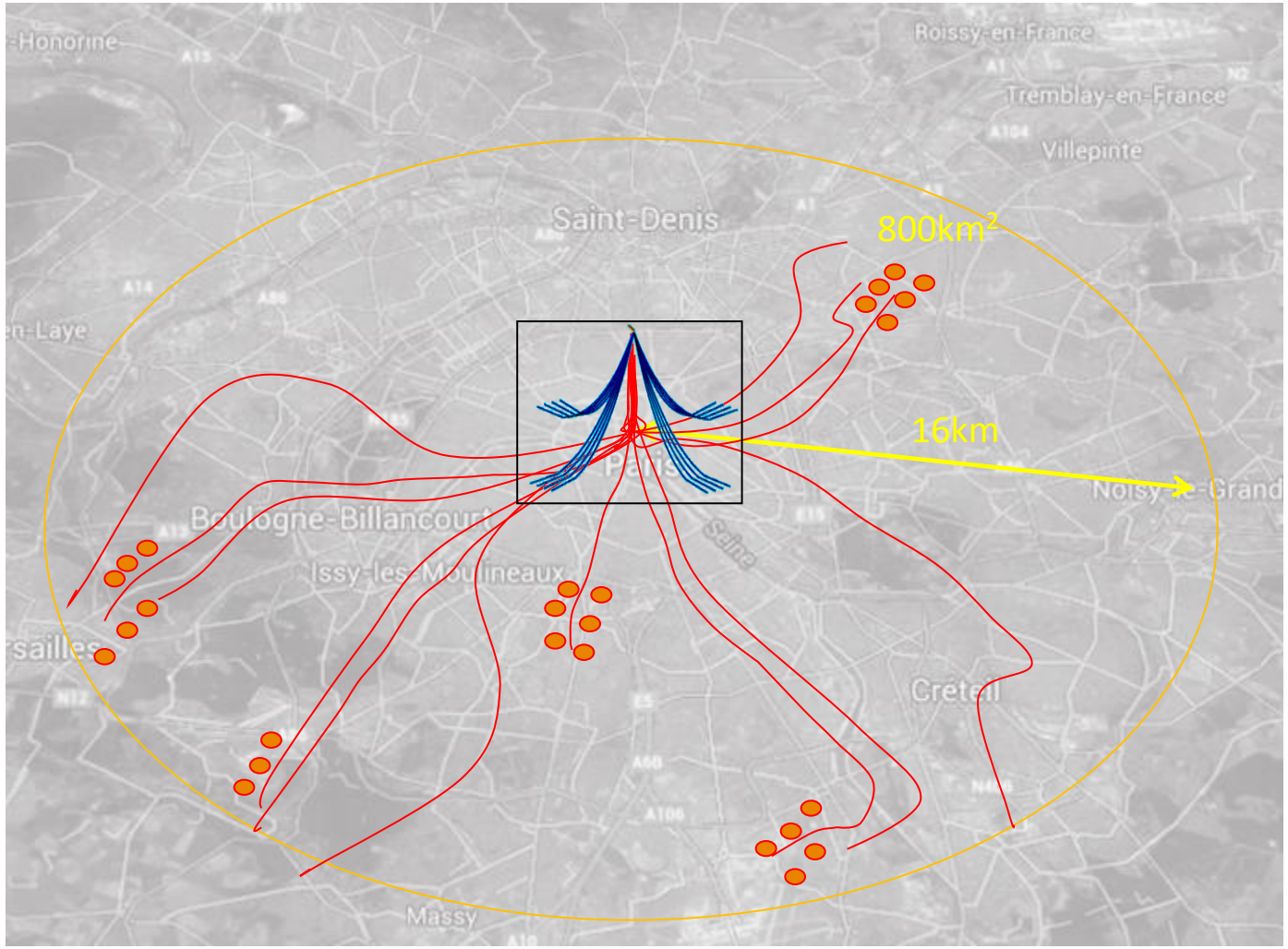
Umbilicals – **80 km**

Water injection flow-line – **60 km**

Production flowline pipeline – **40 km**

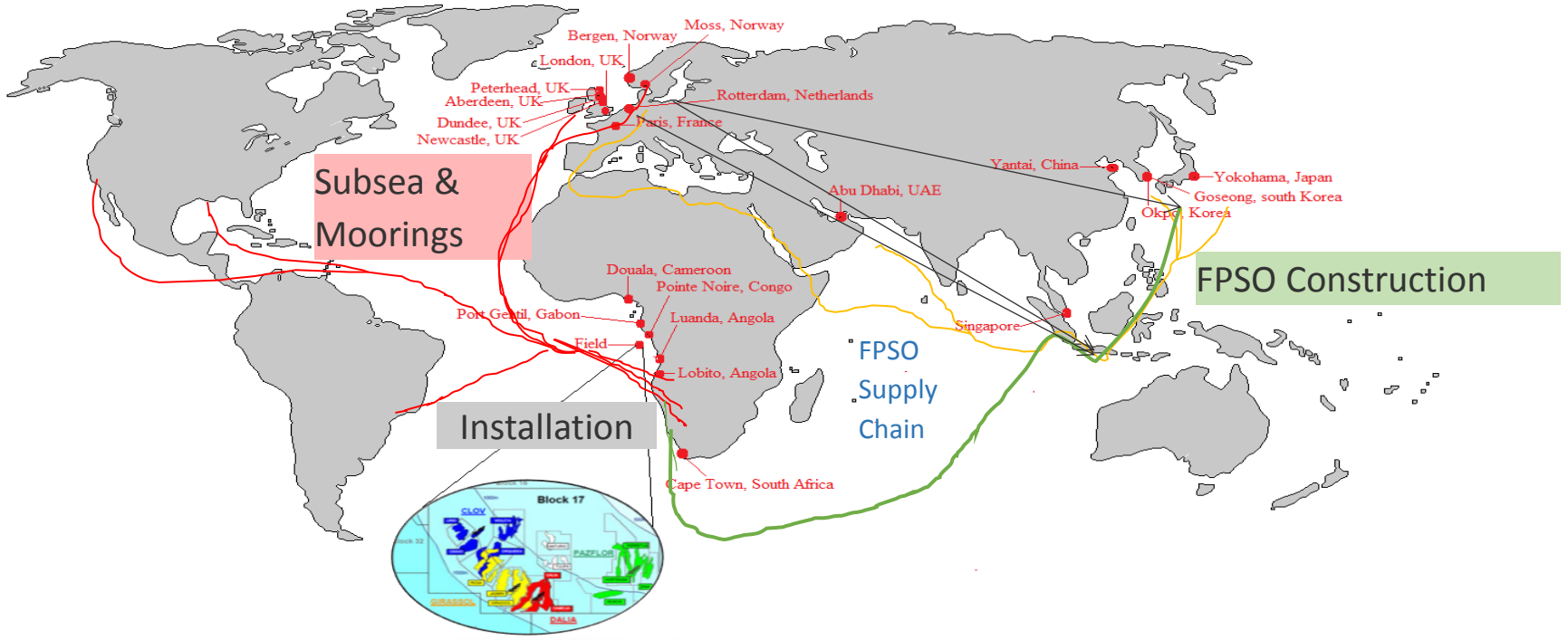
Mooring lines – **10's km**

No. Spools – **37**



Recognition of the project footprint - Global Supply Chain

With the increase in size of projects we have seen a significant increase in the footprint of the global supply chain.



The variability in the supply chain poses particular challenge for consistency in the offshore operations experience and local content during the design, planning and execution of the project

FPSO Topside Integration – Flare Tower

- Language barrier – English to Korean to Japanese for Floating Crane Operator
- Two booms of cranes are manually controlled

MWS Contribution

- Identifying problem at an early stage
- Making the crane operator aware of difficulties and precautions they need to take while operating two booms manually in tandem

FPSO Sailaway

- Initial refusal of yard to complete all seafastening before start of the voyage as they wanted to start sailaway as early as possible
- This was not acceptable to MWS

- *Is it strong enough ?*
- *Is it stable enough ?*
- *Are the marine procedures adequate and safe?*

<u>MWS Contribution</u>

- Seafastening needs to be completed prior to departure
- Working in coordination with CPY we made yard to accept this which is a vital requirement for sailaway and safe voyage

?

FPSO → Subsea → Installation

Berthing Technical Challenges

- Mooring analysis did not satisfy our requirements
- Berth was not designed for large vessels as FPSO
- No mooring winch and other required infrastructure
- FPSO has to moor at shallower draft
- Mooring line failures

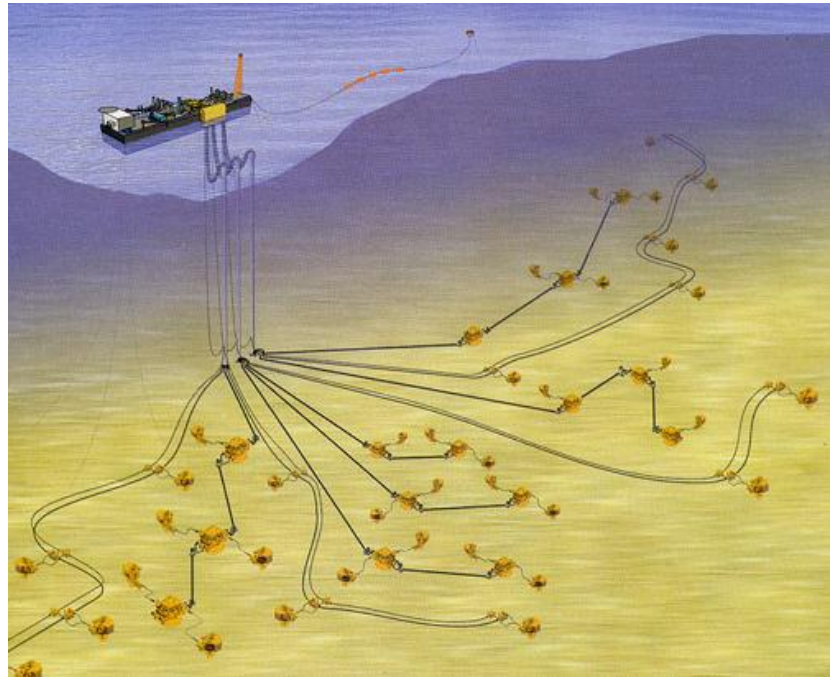
<u>MWS Contribution</u>

- Helping in developing emergency procedure
- Stationing a surveyor to help
- Advise on daily basis by tele-conference
- FPSO remain berthed without any incident till its voyage to field

Installation Technology

- Technical challenges moving to deeper water –
  - Higher loads
  - Higher pressure
  - Extreme temperature
  - Complex installation procedures
  - Challenging installation tolerances
  - Complex subsea field layout

  = Higher CAPEX
- Drive by industry → REDUCE COST
  - Oil Majors cost saving and redundancies
  - Contract larger packages and even whole projects to the mega SE Asia EPC contractors
  - Smaller companies enter deep water pipelay market
  - Pipe technology improvements (weight)



= Potential for Increased Risk

FPSO → Subsea → Installation

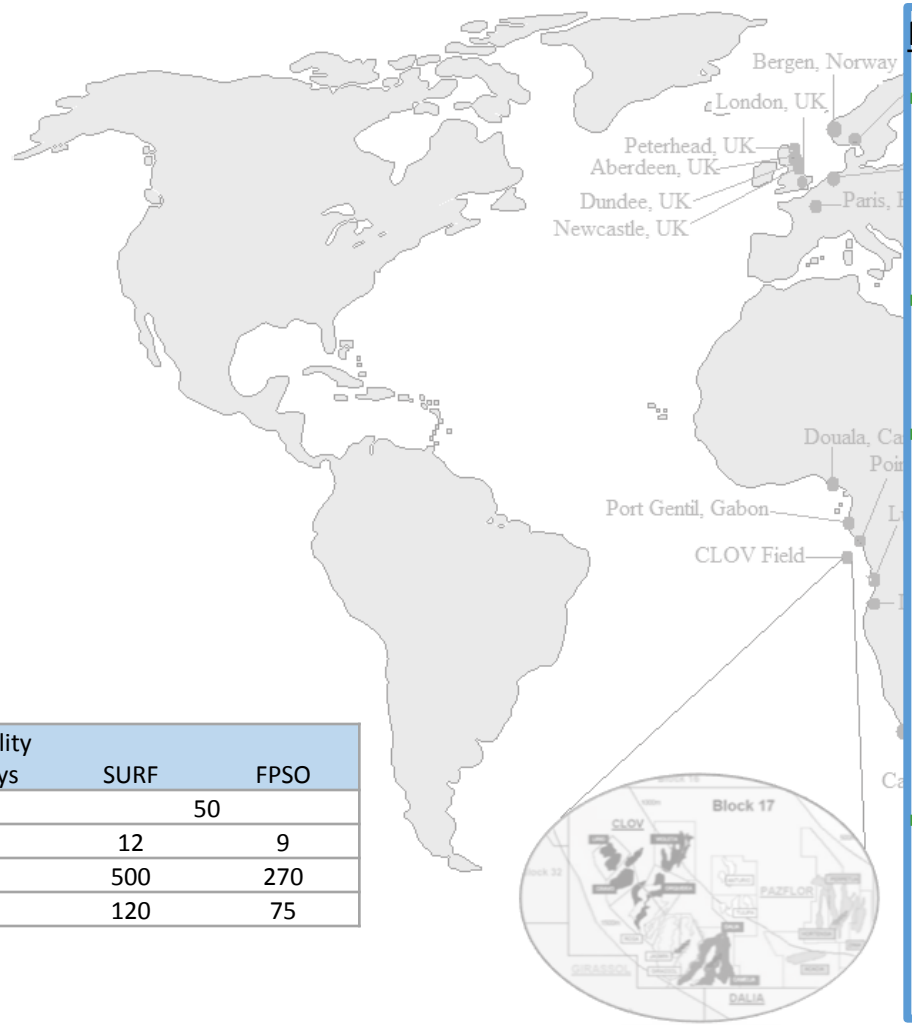
Recent JIPs related to Uniformity

- Installation JIP
  - Bring together installation contractor knowledge and best practice to develop guideline:
    - For installation analysis
    - Limit state criteria
  - In completion phase
- Certification of deepwater installation systems JIP
  - Develop DNV certification for fibre rope deep water installation systems based on technology qualification principles
  - Currently in the third and final phase
  - Advantages of using fibre ropes: strong and light, easier to handle and more environment friendly
- Standardization of subsea equipment and components JIP

FPSO → Subsea → Installation

CLOV. Logistical Challenges

- Stats
- Different travel and visa regulations
- Personal security
- Local cultural sensitivities
- Limited notice period for surveyor mobilisations



	Suitability surveys	SURF	FPSO
Surveyor mobilisations	48	50	
Countries	11	12	9
Days of attendance		500	270
Days of travel		120	75

MWS Contribution

- Coordinate
  - CPY Installation Manager and MWS Project Manager
  - Support drawing on West Africa experiences
- Monitor
  - Weekly update of project schedule and monthly look ahead
- Anticipate
  - Visa and other travel requirements / security issues
  - Advance planning of surveyors meet, greet & accommodation
  - Advance planning of offshore transfer
- **Improve efficiency → reduce cost**

FPSO → Subsea → Installation

CLOV. Technical Challenges SURF

Cargo barge mobilisations at Angola Yard Lobito

- Problems with ballast management on all of first three series barges
- Accuracy of the lift operation plans
- Management of Change procedure
- Riggings certifications
- Project items load out

Suction cans

FLET

CLOV. Technical Challenges SURF

MWS Contribution

- Checking/approving
  - Lift Operation Plan and load out of project items
  - Certification for all rigging items, crane and crane driver
  - Documented barge ballast condition and barge draft records
  - MOC process
- Monitoring
  - Adequate visibility provided during load out at night
  - Port traffic and other related activities in the area

- **Improve safety, reduce risk of damaging product → reduce cost**

Suction cans

FLET

FPSO → Subsea → Installation

CLOV. Technical Challenges SURF

Hybrid riser fabrication and deployment

- One of the most critical stage of CLOV subsea development
- Entire activity (fabrication and deployment) scheduled for 8 days – weather window challenge
- Critically weather sensitive activities (lifting/upending of LRA, URA & buoyancy tank, pulling and docking SHR)
- Operation close to hull and potential collision issues
- Potential for fatigue damage of the SHR during fabrication and deployment

Buoyancy can lifting

URA lifting

Buoyancy can transportation

SHR deployment

LRA lifting

URA transportation

FPSO → Subsea → Installation

CLOV. Technical Challenges SURF

MWS Contribution

- Activity divided into steps – critical review of documents
- Check list prepared for each step with corresponding CoA
- Check of all installation aids and rigging
- Early identification and mitigation of risks – smooth execution essential to avoid delays
- Ensure all relevant guidelines, codes, regulations are satisfied – SHR fatigue damage during deployment is within limit
- In addition to dedicated HAZID and HIRA, a dedicated workshop is arranged between installation contractor, CPY and MWS to run through the entire installation process, closing all MWS comments and concerns
- **Improved deployment schedule of SHR → reduce cost**

URA lifting

Buoyancy can transportation

LRA lifting

URA transportation

FPSO → Subsea → Installation

Local Content and other Challenges in Angola

- Stats
- Lack of experienced personnel in performing operations such as ballasting
- Lack of required infrastructure to berth large vessel such as CLOV FPSO
- Adequate crane facility to handle large subsea spools
- In general less awareness of HSE culture required for safe execution of a job
- Visa and work permit issues

1. *CLOV was to provide 9 million man-hours work for Angolans (20% of global cost of project for local fabrication and assembly)*
2. *Angola labour: 70,548t fabrication and assembly including 8,492t for the FPSO and 60% of the SURF package*

Local Content and other Challenges in Angola

MWS Contribution

- Anticipating problems ahead and putting alternative solutions in place; e.g.
  - consider whether additional calculations & design verification can replace some test / trial requirements
- Spending additional time in explaining to local personnel MWS requirements; e.g.
  - requirements to produce detailed procedures such as lift plans
  - advising and explaining requirement to use certified equipment and riggings
  - help to develop safe work culture in Angola Yard
- Local agent taking necessary steps well in time for visa and work permit requirements
- **Improved safety culture, reduce delays → reduce cost**

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Conclusions

- Mega subsea development main challenges are:
  - High CAPEX
  - Ensuring consistent local content

  a) Facilities , Vessel & Equipment

  b) Experienced Manpower for execution
  - Technological needs → more cost & more specialist equipment i.e. more need for capable local content
- Standardization → reduce risk and reduce cost
- **Cost reduction** through integration of MWS global mobilisation by
  - Supporting safe execution of the project without major incident and claim
  - Providing key component to improve consistency in local content across the whole project installation
  - Supplying expertise on several specialisations and in most challenging environment both technically and logistically

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