

FPSO Commissioning and Start-up:

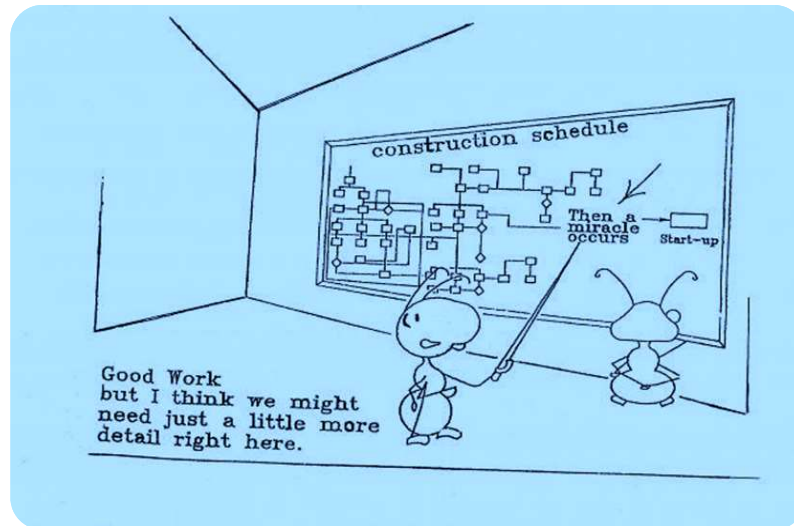
Getting it done on time

Paris, Dec 2016

Agenda – FPSO Commissioning

- The Commissioning challenge
- Establishing a commissioning and hand-over strategy
- Adding value by effective commissioning
- Selecting a Project completions management system
- Key activities moving towards Start-up

Commissioning within Major Construction Projects



Commissioning and Start-Up

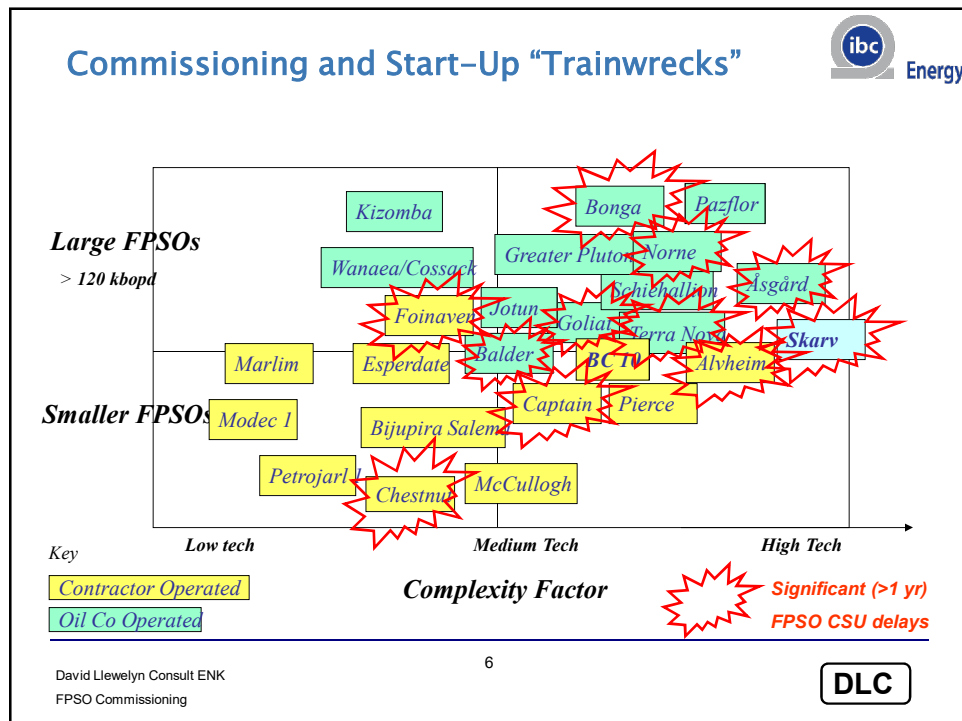
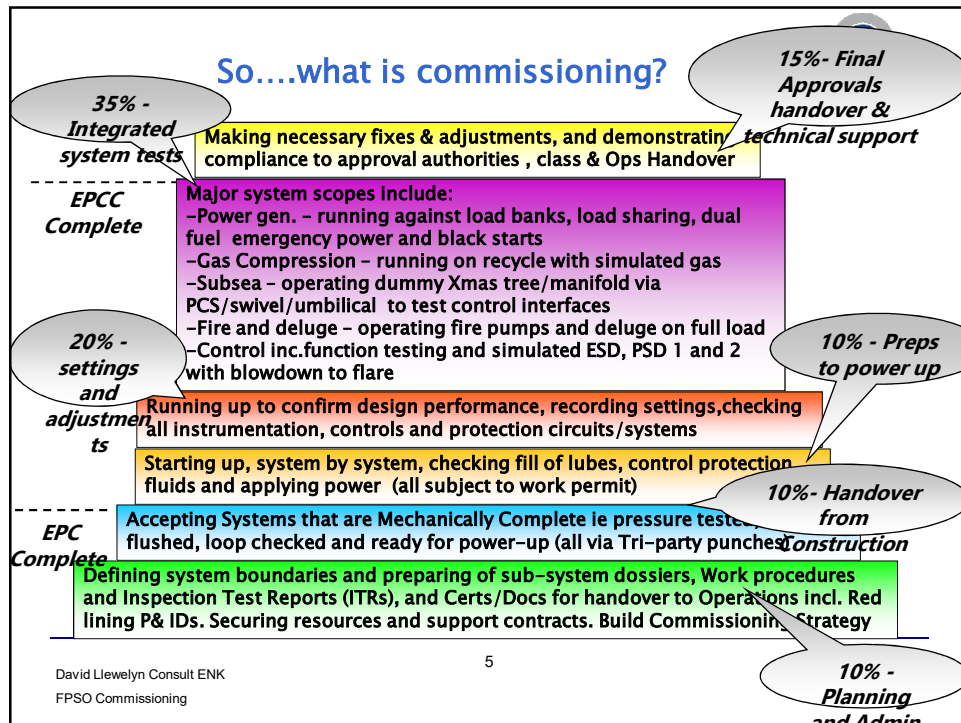
This is the time when you find:

- Design faults
- Construction faults
- Operational constraints
- Gaps in project scope and delivery

The most important requirement for the CSU team is to discover these problems early enough to minimise their impact on cost and schedule.

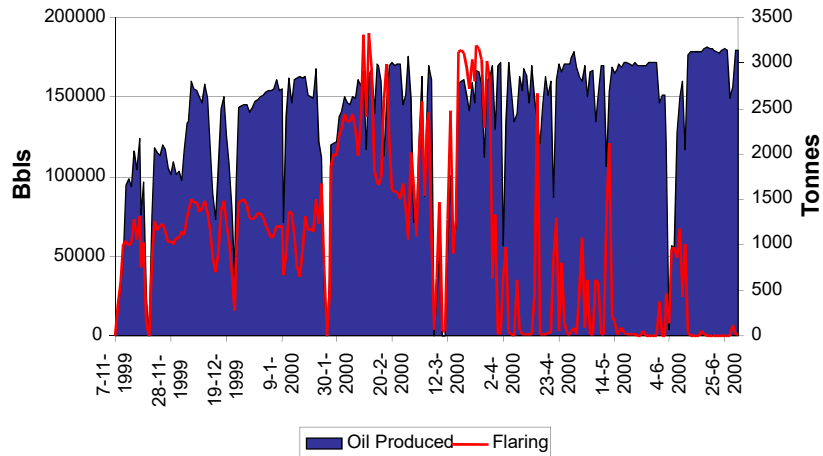
Assuming things will be “all right on the day” is not a wise approach

Commissioning is also an opportunity for the Operators to become familiar with the equipment



Start-Up Performance

Typical Startup - Extended Flaring/Compressor Problems

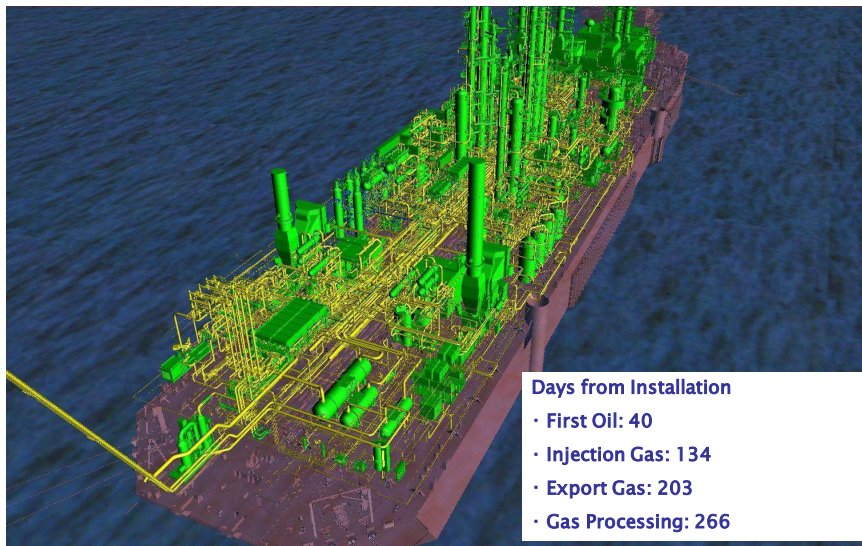


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Start-Up Performance – A complex FPSO – Belanak



Days from Installation

- First Oil: 40
- Injection Gas: 134
- Export Gas: 203
- Gas Processing: 266

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Commissioning and Start-up Challenges – Recent FPSOs



Goliat FPSO

**On location to
First Oil - 16
months**



Skarv FPSO

**On location to
First oil - 10
Months**

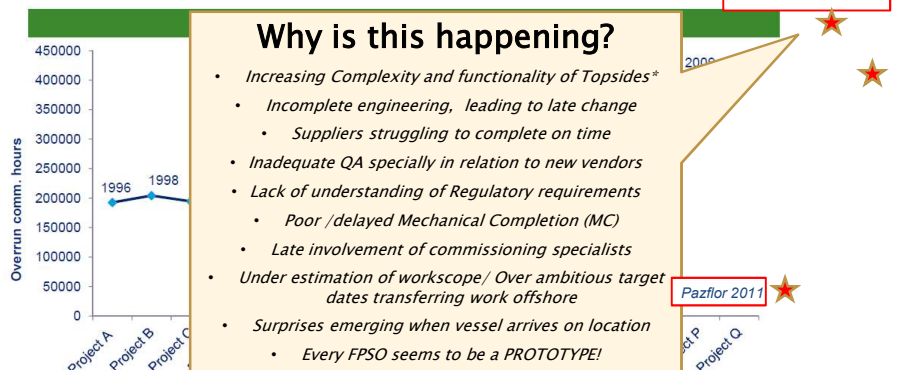
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Industry Experience with FPSO Commissioning

– Source IPA / Deloitte-Trond Bendiksen



Trending – Overrun Commissioning hours (Random FPSO project selection)



* BP Schiehallion (1998) had 34,000 tagged items; BP Skarv (2013) has 155,000 tags, Prelude has 250,000+

World wide experience shows a consistent project overrun factor (estimate vs actual commissioning hours) of around 2.4

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Pazflor benchmarking

- ❑ Pazflor started producing oil on 24 August 2011, less than 44 months after project sanction and nearly 1 month ahead of schedule
- ❑ Production availability, reached 93% in December 2011, with an average of 90.4% in the 4 months after first oil
- ❑ Total made the shipyard DSME responsible for Commissioning, but they were required to partner with Cegelec to deliver the completed FPSO at sailaway



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FPSO/FLNG Commissioning Contracting Philosophies

There are two basic options:

EPC – where the Owner manages Commissioning (*majority*)

EPCC – where the Builder manages Commissioning

Recommended

EPC (handover at MC)	EPCC (handover at Sailaway*)
Owner must resource and manage Comms Team	Yard is fully responsible for delivering commissioned FPSO
Must have MC milestones in contract and achieved	Need clear definition of test and acceptance criteria by system
Allows owner hands-on experience with equipment	Owner Operations team involved in verification of work
Shipyard has little incentive to retain FPSO at quay	Yard must demonstrate/partner with competent Comms contractor
Simple Contract to administer	Approach in line with conventional shipbuilding contracts

Doing most commissioning in or near the shipyard is most cost effective, even if means delaying departure !



Commissioning and Start-Up Strategy

The first and most important step is to define the Commissioning & Handover Strategy.

This must be developed started during FEED. It is a key part of the Project Execution Strategy & defines...

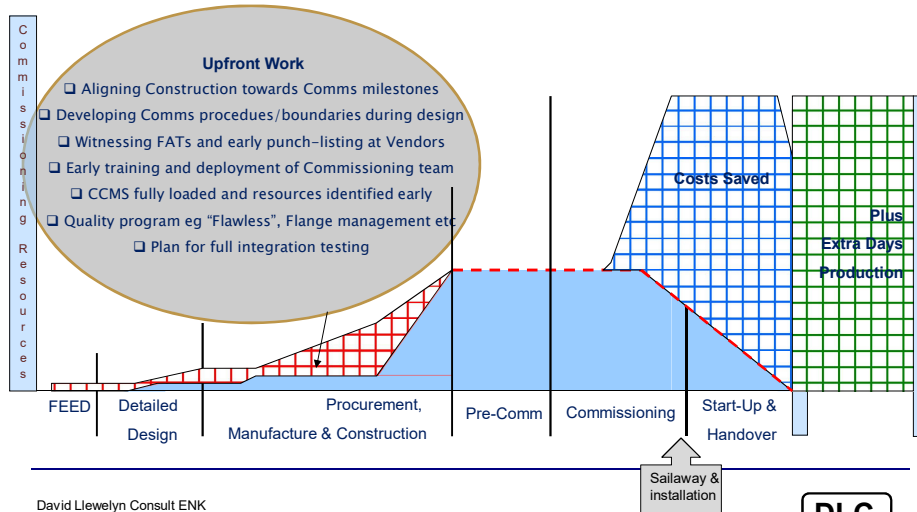
- Roles & responsibilities – owner & activity execution and transitions
- Organisation & resources – Project & operations
- Requirements for Compliance – and completion logic
- Standards & guidelines – work processes, tools & acceptance criteria
- Completions database – eg based on Norsok Z-007
- Location of activities – yard vs site, onshore vs offshore

This means that you must have a Commissioning specialist involved in FEED!

Implementation Controls, Management and Administration Procedures



Upfront Investment in People and Processes = Greater chance of meeting required Start-Up dates.



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Requirements for Compliance



Certain requirements will need to be demonstrated to either the client, regulator or a 3rd party inspector as part of the completions / commissioning checks.

Areas that should be covered:

- Specification Compliance (Client PMT)
- Structure / vessel compliance (Class)
- Production Performance Testing (Investors)
- Safety Function Testing (DNV, HSE, PSA, NII)
- Environmental Performance Testing (SEPA)
- Hazardous Area Equipment Standards (ATEX)

All of the tests, checks and records required need to be retained centrally and securely.

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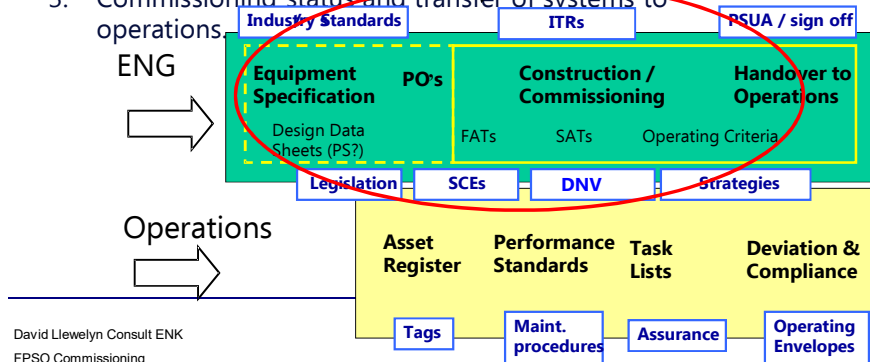
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What does a CMS tool do for Projects?

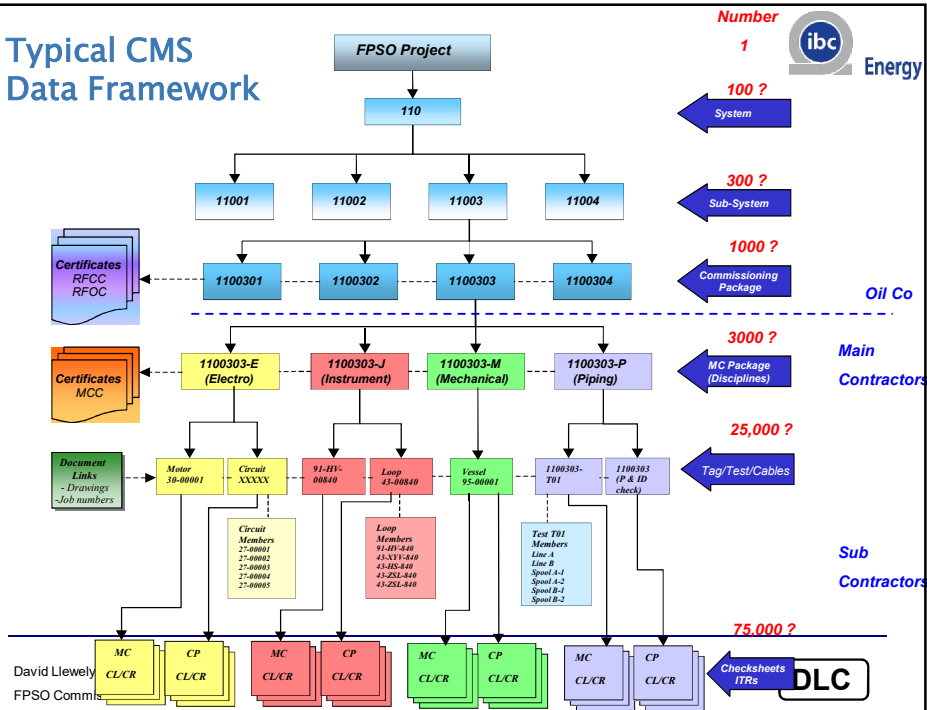


The Completions Management System is a tool used in **all projects** to systematically manage:

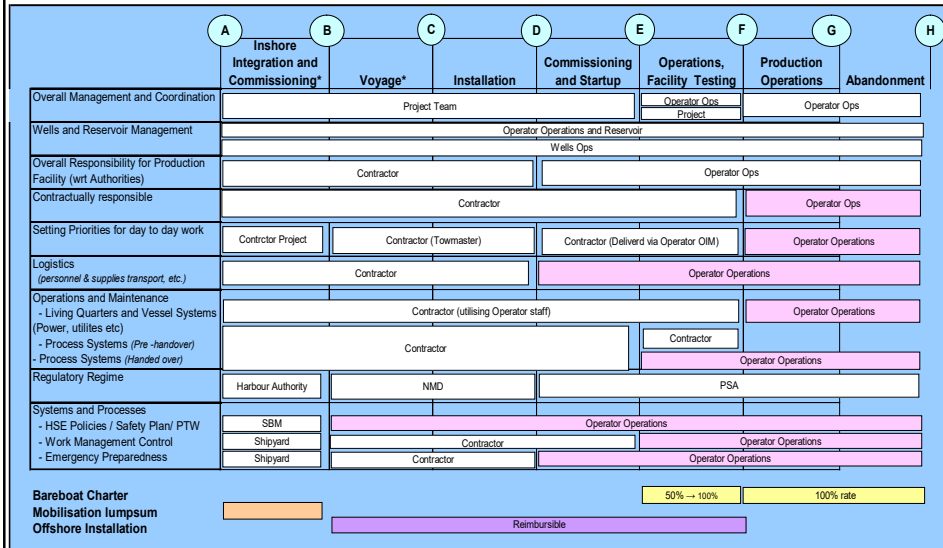
1. The execution of inspection/testing records (ITR's) – multi site
2. Staged completion certificates and punch-list management
3. Commissioning status and transfer of systems to operations



Typical CMS Data Framework



Detailed Start-up planning – responsibilities

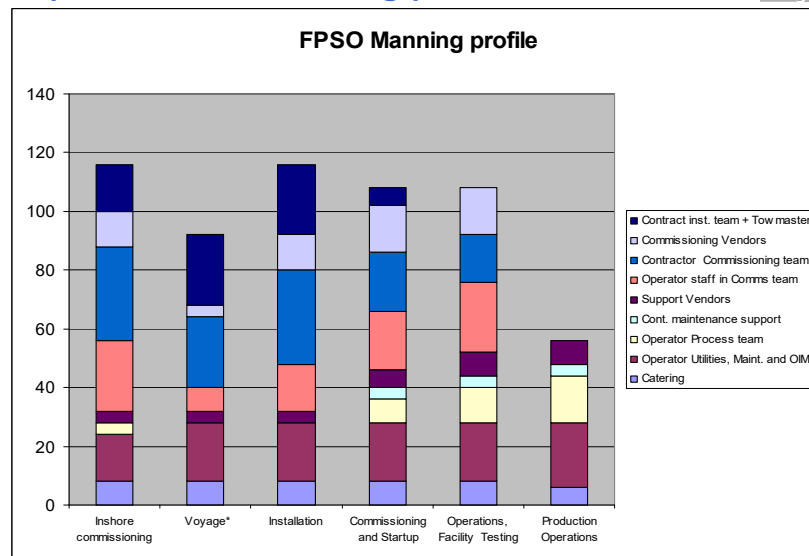


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Example FPSO CSU manning plan (linked to transitions)



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Options for additional Crew during CSU/shutdowns



North Sea

West Africa



10 Golden rules for Commissioning and Start-up

1. Integrate Construction and Commissioning schedules with MC- Take Overs as Project Milestones
2. Ensure Operations and Commissioning teams are involved with design input, operability and early commissioning planning, followed by joint execution (subject to contract strategy)..
3. Conduct Vendor package inspections and FAT acceptance at supplier sites with Commissioning/operations team
4. Involve Operations team, Regulators and Class inspectors on site as early as possible
5. Implement comprehensive and accessible Document management and Completions systems
6. Ensure on-time completion of Engineering, effective management of change and engineering query processes with key specialists on site.
7. Maximise MC and full system testing before sailaway from the yard and control and minimise all carry-over work between phases
8. Do not plan work for the tow or transit, but do plan a number of options for final Completion in country
9. Develop a detailed execution plan for transition from the shipyard to site including responsibilities, manning plans, regulatory transitions.
10. Hold formal risk assessments and implement planning based on P50 and P90 worst case project outcomes, allow for Simops events and worst case weather

Commissioning – Plan for Success!



Commissioning Organisation

- Position commissioning as a value adding activity not a “cost”
- Assess capability of yard to manage site commissioning

Commissioning Strategy

- Determine delivery milestones and acceptance criteria, be clear about who does what
- Ensure early commissioning planning and site inspections/testing

Define Commissioning Plan

- Have Commissioning pulled by Operations not squeezed by Project
- Define commissioning logic plan, resources and workscope

Implement Commissioning

- Build completions data and tagging structure and load CMS
- Monitor MC progress and complete ITRs records at all worksites

Sailaway and Start-up

- Develop detailed Sailaway and Start-up plan with contingency plans
- Maximise “onshore” commissioning and minimise unplanned carry over

