

# Johan Sverdrup Oil Field Development; The Making of a Giant

August 2019

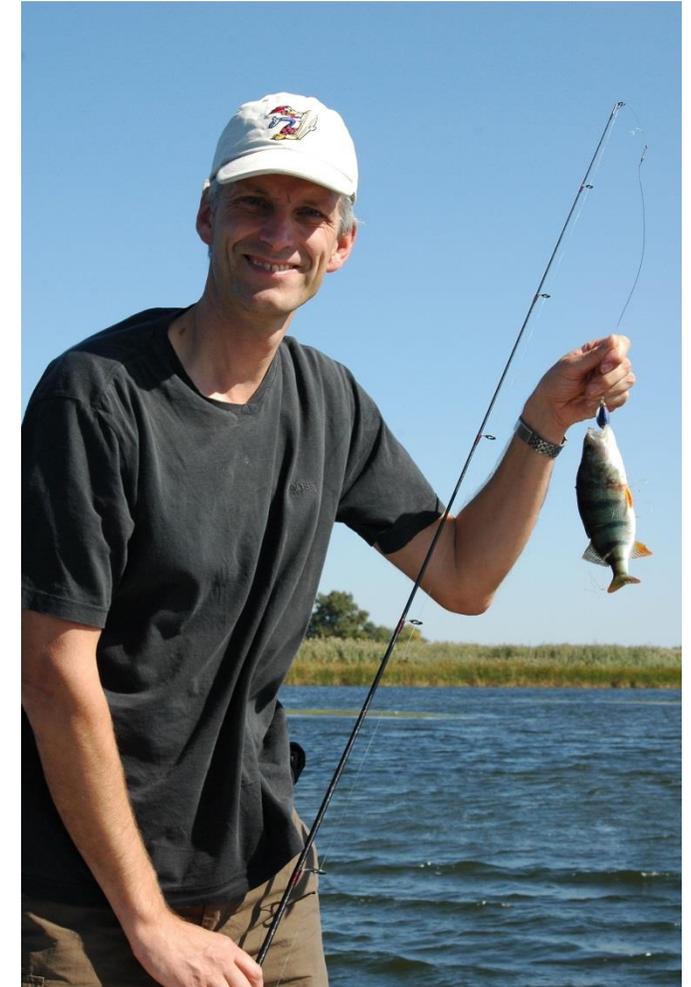
Johan Reenskaug, Project Director

Aker Solutions



# My background

- Graduated from Heriot Watt, Edinburgh, (Mechanical and offshore engineering) 1982
- Worked mostly in Aker Solutions
  - Structural engineering
  - Project management for 30 years
  - Many international projects
  - Currently project manager for engineering on the Njord upgrade project with engineering base in Bergen and Construction at Stord
- Married with Jorunn
- Three grown up children



# Subjects discussed

- Johan Sverdrup project
  - Project highlights
  - Organisation
  - Effect on local communities
  - The customer, external parties and suppliers
- Aker Solutions execution modell

# Johan Sverdrup - the giant value creator



**TOP 5**

One of the largest oil fields ever on the NCS

**70 %**

Ambition - recovery

**50 YRS.**

Production horizon

**170-220 bln.**

Investment estimate for full field development\*\*

**51.000**

Norwegian man years during development

# Johan Sverdrup field centre phase 1

## LQ Platform

- Accommodation
- Life boats
- Emergency power generation
- Utilities
- Kvaerner / KBR EPC

## P1 platform

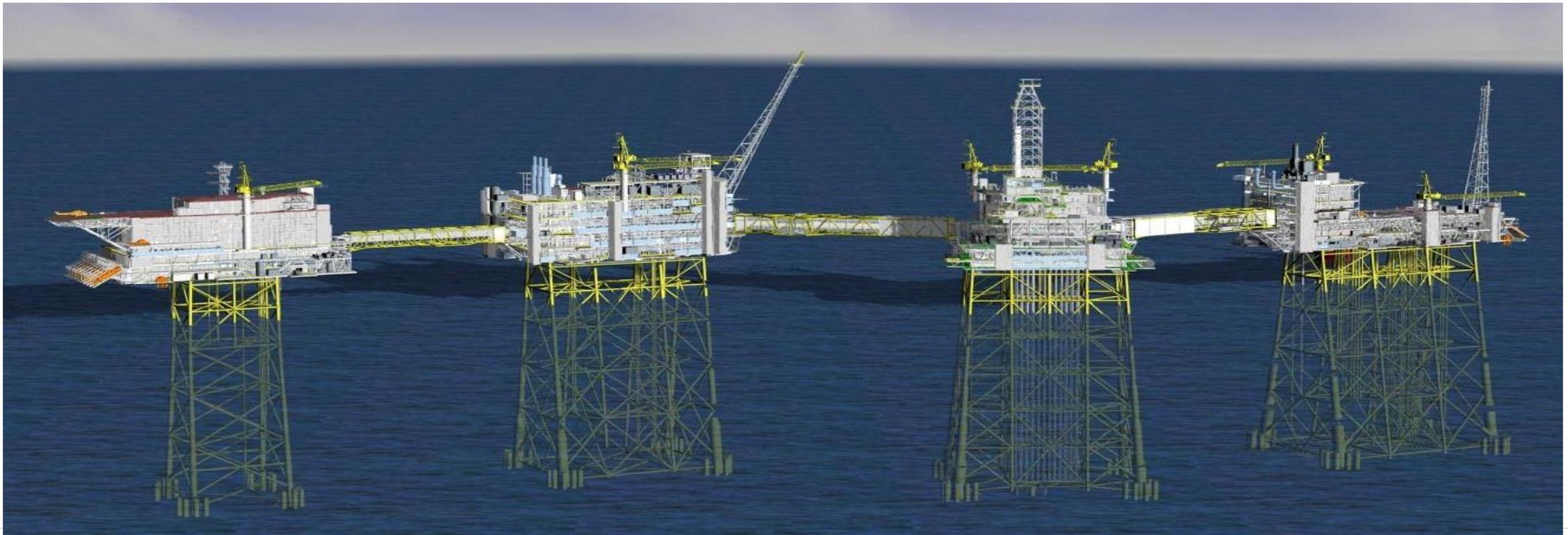
- Main processing facilities
- Main utilities
- AKSO engineering
- Samsung Heavy Industries fabrication (S. Korea)

## Drilling platform (DP)

- Wells
- Production and injection manifolds
- Drilling rig
- Aibel EPC

## Riser Platform (RP)

- Power import from shore + local power
- Oil export pumps and water injection pumps
- Space/weight reserve for future modules
- Execution as for P1



# Workshare

- Use of Mumbai resources is a success for Aker Solutions
- We have achieved continuous work and loyal workforce
- The Mumbai team was integrated with the London and Oslo teams and support them,
  - Assignment of internal «sub-contracts» has not worked so well
- All management functions are in Europe to ease communication with clients, internally in the project and versus suppliers.
- Management included Mumbai resources, but these were seconded to Oslo or London
- For meetings etc, one guy from Mumbai in London or vice versa did wonders



Peer-to-peer video conferencing

Stream Number	1	2	3	4
Intermittent / Continuous	I/C	I	I	I
Operating Temperature	°C	AMB	AMB	AMB
Operating Pressure	bara	6,5	12	11
Gas Flow volume at STD Cond.	Sm <sup>3</sup> /h			
Gas Flow volume at ACT. Cond.	m <sup>3</sup> /h			
Gas Flow Mass at Act. Cond.	kg/h	103		
Gas Flow Mass Max	kg/h	103		
Gas Density at Act. Cond.	kg/m <sup>3</sup>			
Liquid Flow Volume at Act. Cond.	m <sup>3</sup> /h	40	40	22,6
Liquid Mass Flow at Act. Cond.	kg/h	34	34	19,2
Liquid Flow Mass Max	kg/h	34	34	25,84
Liquid Density at Act. Cond.	kg/m <sup>3</sup>	850	850	850
Viscosity	cP	1,6-4,5	1,6-4,5	1,6-4,5

# System Design

**F-62TB001A/B**  
 RAW DIESEL STORAGE TANK  
 2x50%  
 TOTAL CAPACITY: 400 m<sup>3</sup>

**F-62PG001A/B**  
 RAW DIESEL TRANSFER PUMP  
 2X100%  
 DUTY: 15 kW

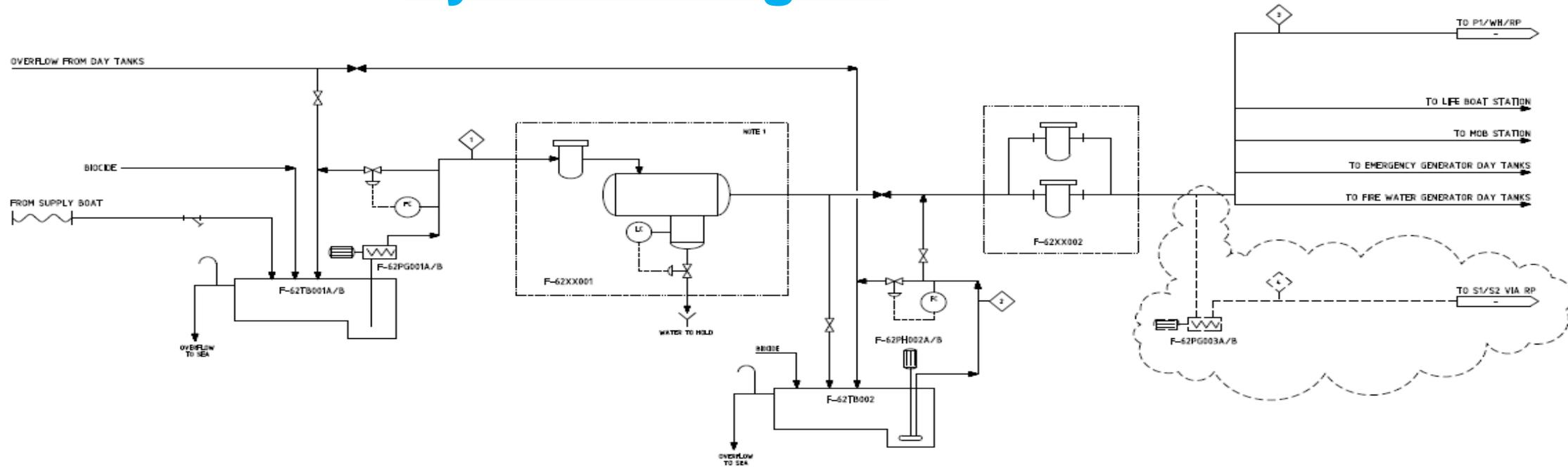
**F-62XX001**  
 DIESEL FILTER/COALESCER PACKAGE

**F-62TB002**  
 TREATED DIESEL STORAGE TANK  
 TOTAL CAPACITY: 100 m<sup>3</sup>

**F-62PH002A/B**  
 TREATED DIESEL TRANSFER PUMP  
 2X100%  
 DUTY: 30 kW

**F-62XX002**  
 TREATED DIESEL FILTER PACKAGE

**F-62PG003A/B**  
 TREATED DIESEL EXPORT PUMP  
 2X100%  
 DUTY: 2 kW



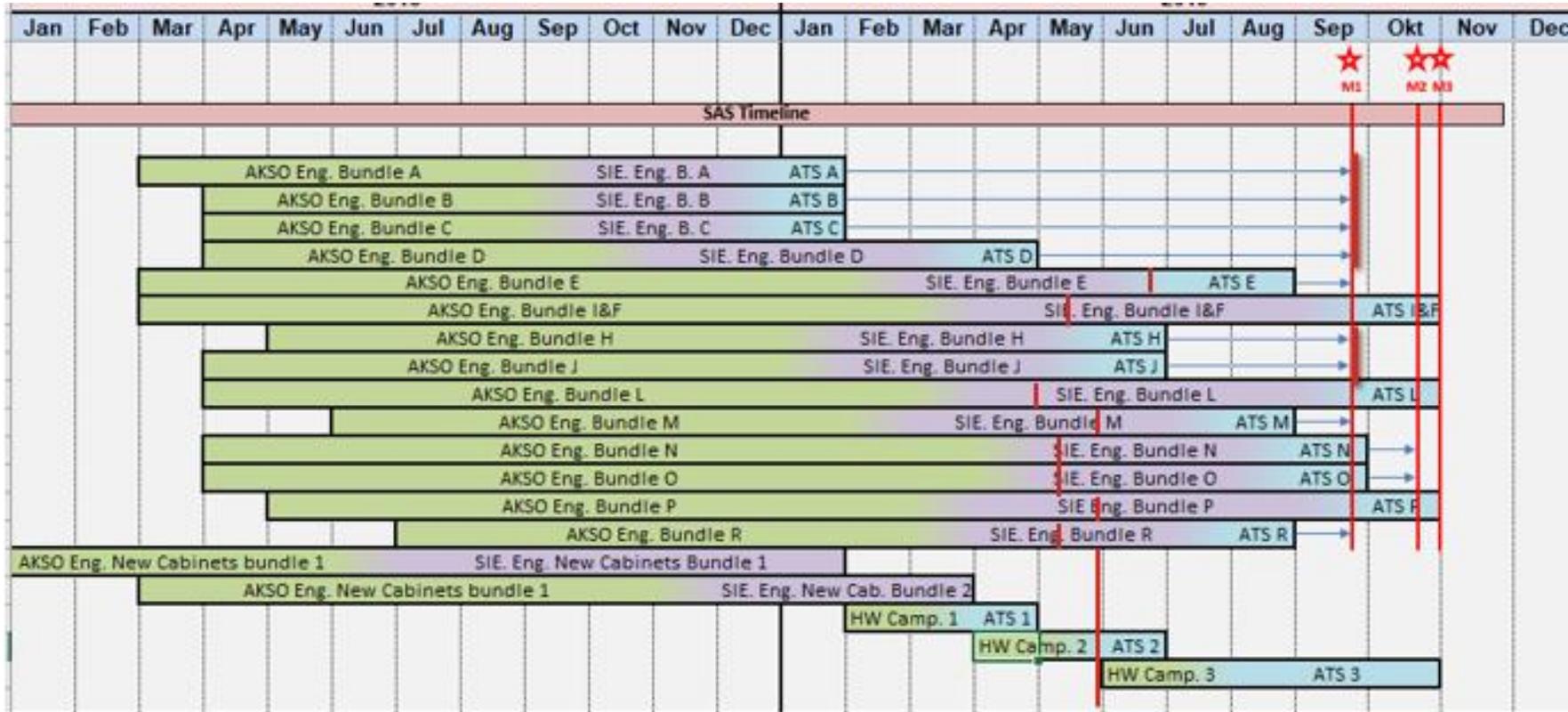
- One Field Engineering group covering all platforms
- Detail design by multiple companies on P&ID level
- Common databases ensuring consistency and multidiscipline approach

NOTES:  
1. N+1 SPARING OF FILTER AND COALESCER IN PACKAGE

<b>AkerSolutions</b>					<b>JOHAN SVERDRUP CONCEPT STUDIES</b> NAME TITLE <b>UTILITY FLOW DIAGRAM DIESEL OIL</b>	
04	29.11.13	ISSUED AS FINAL (POST CONCEPT PHASE)	TAR	CLJ	TAS	
03	19.09.13	ISSUED AS FINAL	TAR	CLJ	TAS	
02	07.08.13	ISSUED FOR M4 REVIEW	TAR	-	-	
01	30.05.13	ISSUED FOR M2/M3 REVIEW	TAR	-	-	
REV.	DATE	REASON FOR ISSUE	PREPARED	DESIGNED	APPROVED	SCALE
		NTS AT A1		00		
		C156-AA-P-XA-6201-01		04		
11	12	11	12	11	12	11

seed file: statoll\_01.dgn

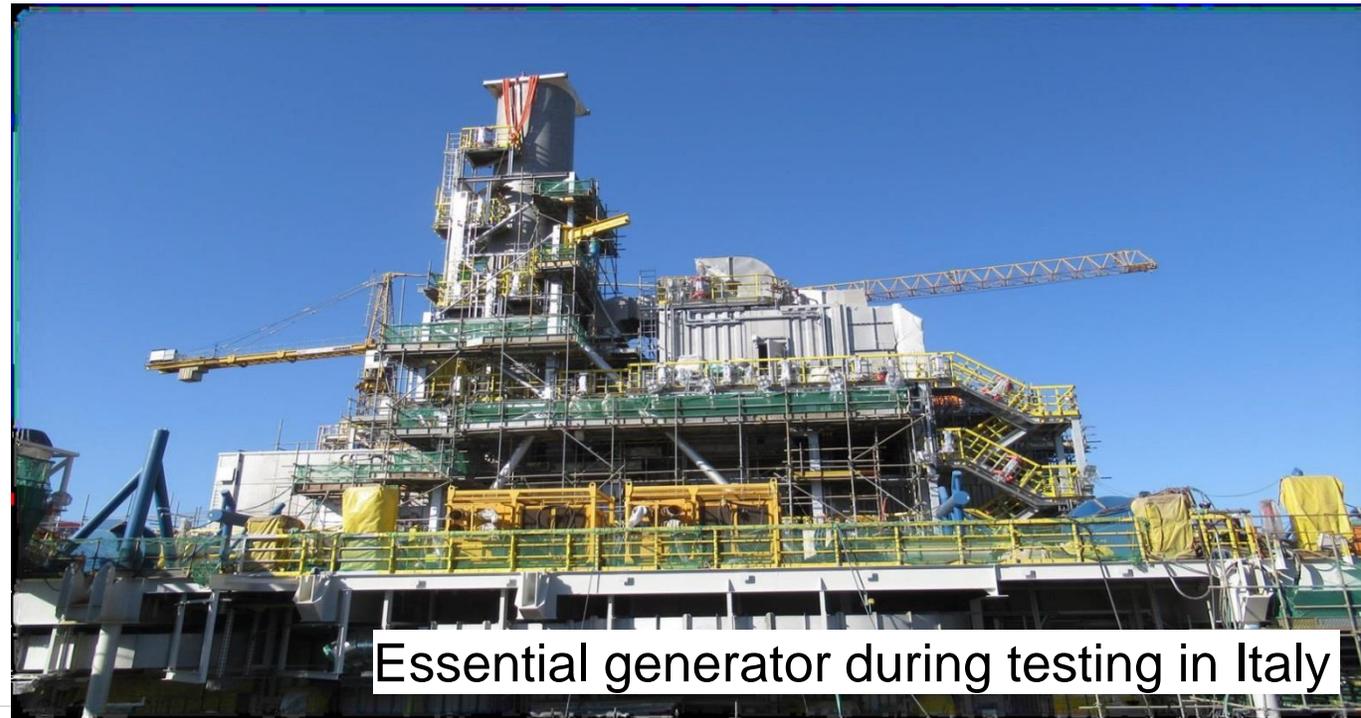
# Safety and Automation System



- Always a major challenge due to dependencies for vendor info, detail design and “everybody else”
- Significant hardware which is needed early
- Crucial for testing and commissioning
- Dependent on close cooperation of all parties

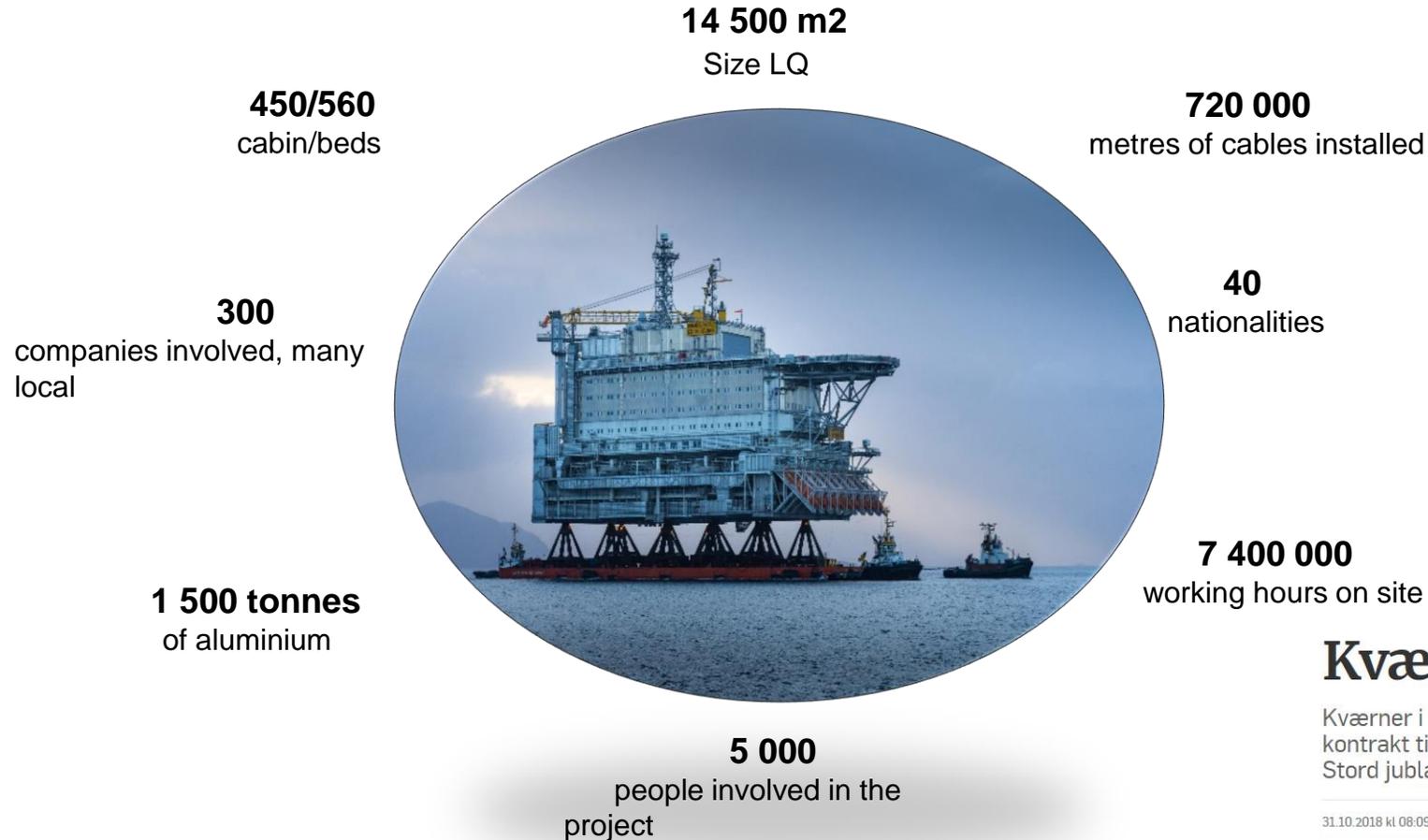
# Procurement

- Major packages are in themselves large projects (Total PO value under our management in the order of 30 billion NOK)
- Engineering work by suppliers are in total similar to our scope (peak around 1000 engineers)
- Sponsor groups set up to discuss
  - Organisation
  - Main issues
  - Contractual aspects (To avoid conflicts at work level)
- Procurement of Engineered packages is very different from procurement of commodities
- Acknowledge that the large packages are project in their own right with organisations, subcontracts etc.



Essential generator during testing in Italy

# Kvaerner Yard at Stord fabricated the LQ topsides Depending on a large network of local suppliers



## Kvæerner feirar med kake i dag

Kvæerner i Verdal fekk stor Johan Sverdrup-kontrakt til 900 millionar – og Kvæerner på Stord jublar.

31.10.2018 kl 08:09 (Oppdatert 31.10.2018 kl 09:13)



I dag vann Kvæerner anbudet på det fjerde stålunderstellet for Sverdrup. Dette betyr 300 arbeidsplassar for Kvæerner sitt verkft i Verdal.



**Johan Sverdrup:** Kvæerner i Verdal drog i land ein storkontrakt i dag. Her ser me bilete frå Johan Sverdrup-prosjektet på Stord i fjor. (Foto: HENRIK MUNDAL ANDREASSEN)

# Local effect - South Korea

- Ship building and offshore construction work is prime industries in some of the local communities
- Much bigger yards than found in Europe, but up to 10 000 people involved in one project gives big local impact
- Completion of Johan Sverdrup was more or less in parallel with completion of other projects and downturn in ship fabrication
- Very visual effect on local business



# Hot lunch to be served to 45 000 workers

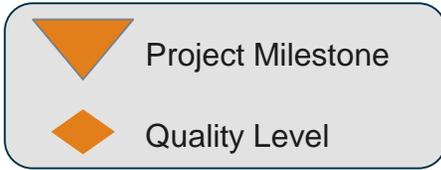


# Engineering

- Mega block with up to 80% pre-outfitting
  - No access issues
  - Minimal paint and sand-blasting
  - Very efficient assembly

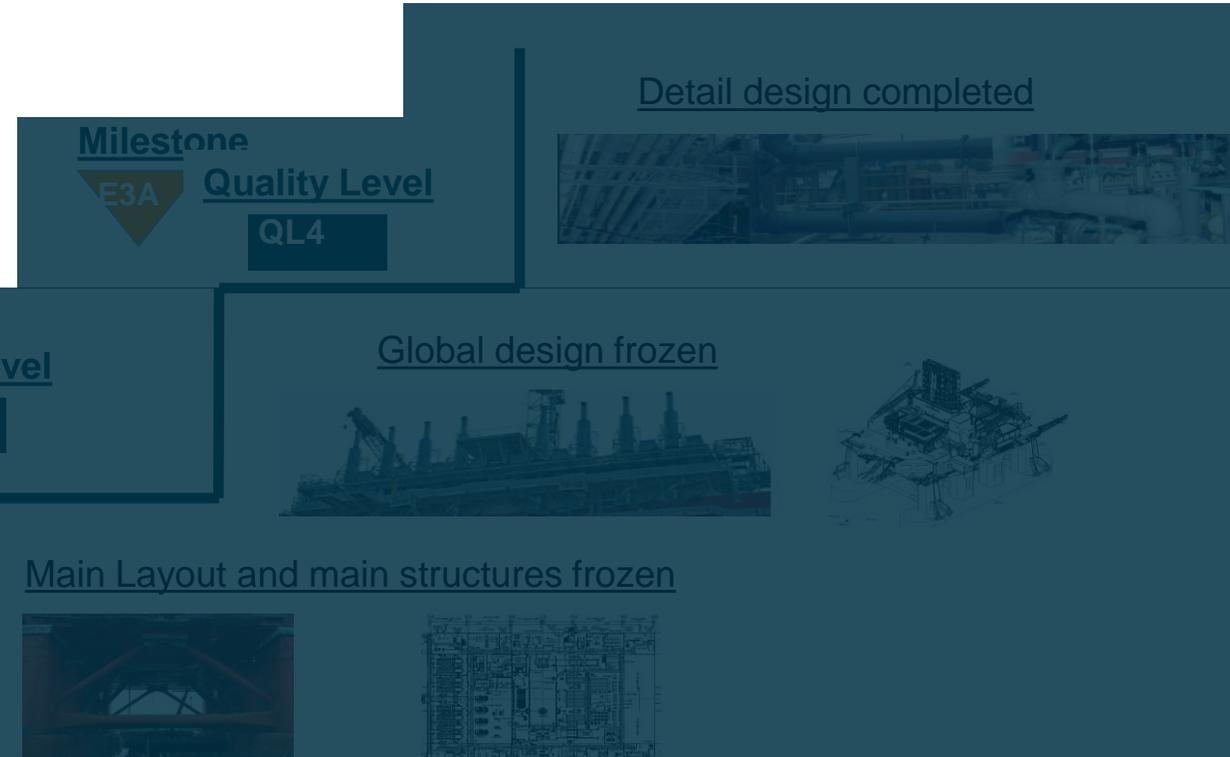


# PEM Execution Key Deliverables



Deliverable	E1A	E1B	E1C	E1D	E2A	E2B	E2C	E3A	E3B	E4A	E4B
<b>Concept Study Report</b>	F1, F2, F3, F4										
<b>Procurement</b>	1. Priority			1*	1		2			3	
	2. Priority				1		2			3	
	3. Priority					1	2			3	
	MTO Engineering				1	2	3		4	5	
<b>System Engineering</b>	P&ID				1		2			3	
	D&ID				1		2			3	
	Single Line Diagram				1		2			3	
<b>Engineering Register</b>					1	2	3		4	5	
<b>3D Model</b>					1	2	3		4		
<b>Structural Analysis</b>					1	2	3		4		
<b>HSE in Design</b>					1	2	3		4		
<b>Completion Method</b>					1	2	3		4		
<b>Marine Operations</b>					1	2	3		4		

# Ready for Detail Engineering

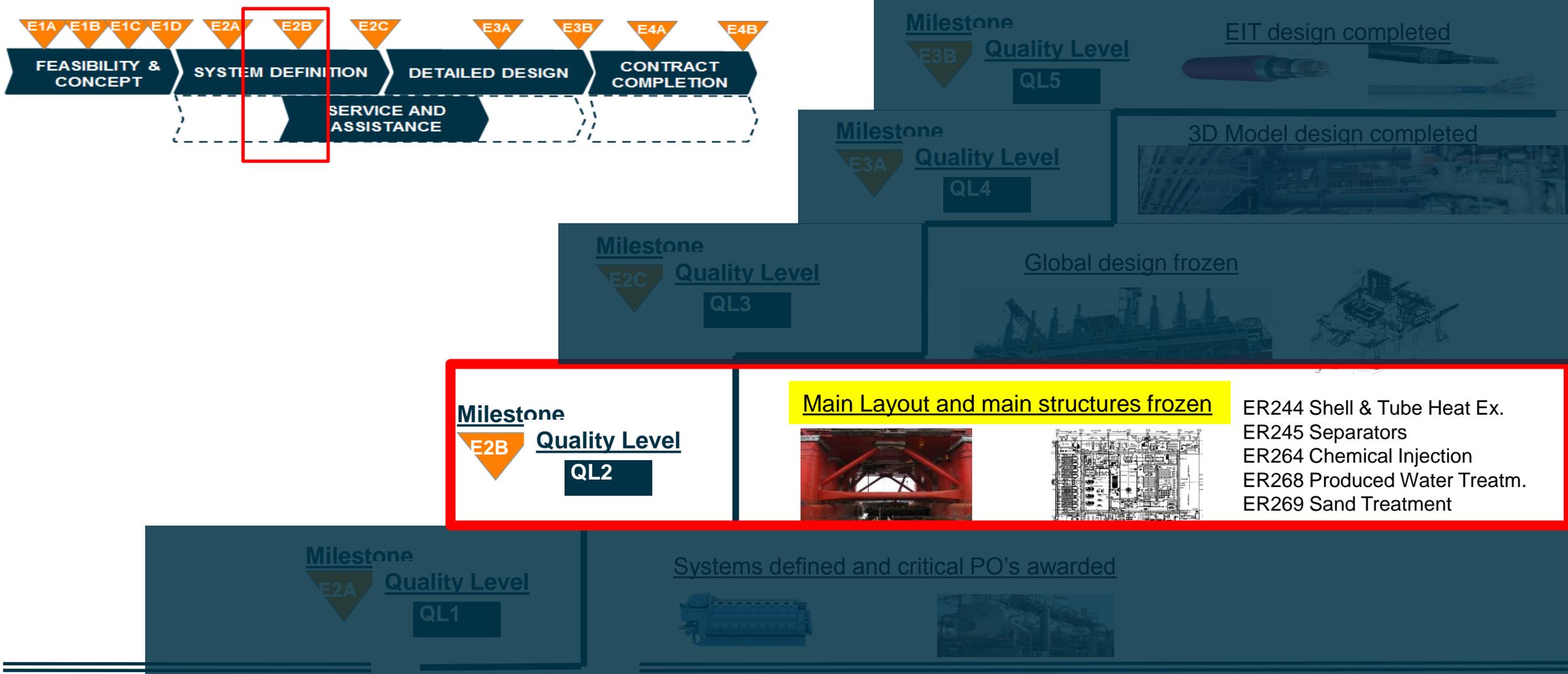


**Milestone E2A Quality Level QL1**

Concept confirmed and critical PO's awarded



Public



## 2B

- Main systems designed
- Main layout and main structures confirmed.
- Detail design premises completed
- 1<sup>st</sup> priority packages purchase orders have been issued, and critical vendor information implemented in design.

# Detail Engineering



- E2C
  - P&ID systems design completed
  - “Frozen supplier interface information” implemented, excluding EIT system design
  - Global model complete and ready for issue of structural and piping drawings.

# External reviews

- At major milestones project status is checked by external resources (I.e outside the project)
  - Is the project evaluation correct ?
  - Is the requirements defined sufficiently
  - Do we have major technical risks
  - Do we have major issues regarding decisions?
  - Do we have contractual risk?
  - Do the project need help?
- The project management usually know the issues, but it may be difficult to spot the main issues if they have developed gradually
- External previewers can be much more open, especially versus the client and partners

# Copyright and Disclaimer

## Copyright

Copyright of all published material including photographs, drawings and images in this document remains vested in Aker Solutions and third party contributors as appropriate. Accordingly, neither the whole nor any part of this document shall be reproduced in any form nor used in any manner without express prior permission and applicable acknowledgements. No trademark, copyright or other notice shall be altered or removed from any reproduction.

## Disclaimer

This Presentation includes and is based, inter alia, on forward-looking information and statements that are subject to risks and uncertainties that could cause actual results to differ. These statements and this Presentation are based on current expectations, estimates and projections about global economic conditions, the economic conditions of the regions and industries that are major markets for Aker Solutions ASA and Aker Solutions ASA's (including subsidiaries and affiliates) lines of business. These expectations, estimates and projections are generally identifiable by statements containing words such as "expects", "believes", "estimates" or similar expressions. Important factors that could cause actual results to differ materially from those expectations include, among others, economic and market conditions in the geographic areas and industries that are or will be major markets for Aker Solutions' businesses, oil prices, market acceptance of new products and services, changes in governmental regulations, interest rates, fluctuations in currency exchange rates and such other factors as may be discussed from time to time in the Presentation. Although Aker Solutions ASA believes that its expectations and the Presentation are based upon reasonable assumptions, it can give no assurance that those expectations will be achieved or that the actual results will be as set out in the Presentation. Aker Solutions ASA is making no representation or warranty, expressed or implied, as to the accuracy, reliability or completeness of the Presentation, and neither Aker Solutions ASA nor any of its directors, officers or employees will have any liability to you or any other persons resulting from your use.

Aker Solutions consists of many legally independent entities, constituting their own separate identities. Aker Solutions is used as the common brand or trade mark for most of these entities. In this presentation we may sometimes use "Aker Solutions", "we" or "us" when we refer to Aker Solutions companies in general or where no useful purpose is served by identifying any particular Aker Solutions company.