

Johan Sverdrup Oil Field Development; The Making of a Giant

August 2019

Johan Reenskaug, Project Director
Aker Solutions



August 2018

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

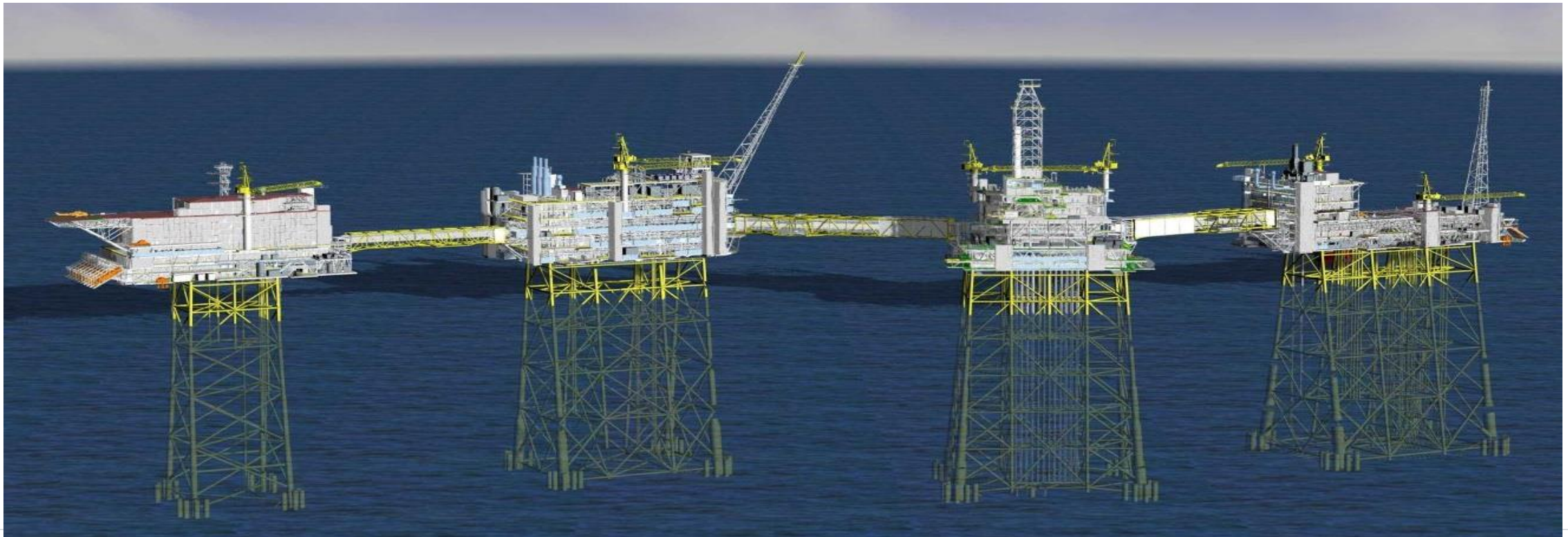
- Main processing facilities
- Main utilities
- AKSO engineering
- Samsung Heavy Industries fabrication (S. Korea)

Drilling platform (DP)

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

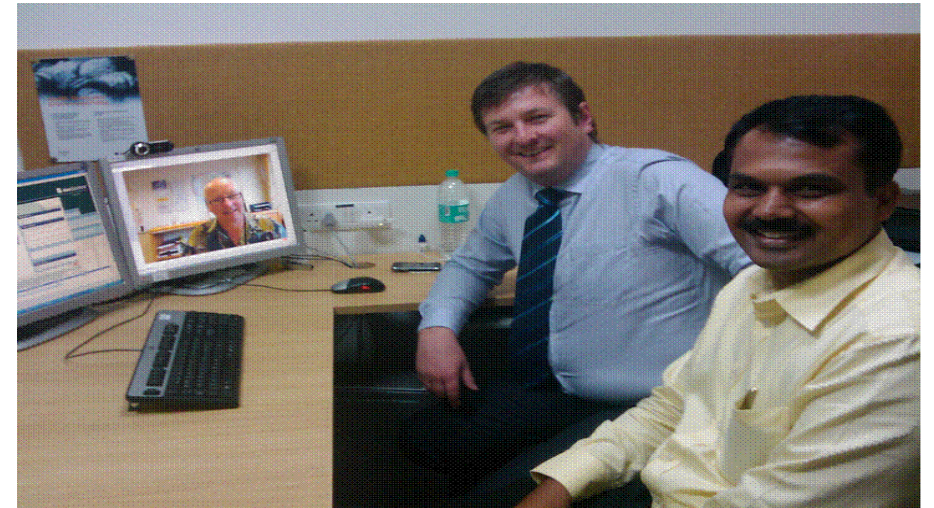
Riser Platform (RP)

- 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 ³ /h			
Gas Flow volume at ACT. Cond.	m ³ /h			
Gas Flow Mass at Act. Cond.	103 kg/h			
Gas Flow Mass Max	103 kg/h			
Gas Density at Act. Cond.	kg/m ³			
Liquid Flow Volume at Act. Cond.	m ³ /h	40	40	22,6
Liquid Mass Flow at Act. Cond.	103 kg/h	34	34	19,2
Liquid Flow Mass Max	103 kg/h	34	34	25,84
Liquid Density at Act. Cond.	kg/m ³	850	850	850
Viscosity	cP	1,6-4,5	1,6-4,5	1,6-4,5

F-62TB001A/B
RAW DIESEL
STORAGE TANK
2x50%
TOTAL CAPACITY: 400 m³

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

F-62XX001
DIESEL
FILTER/COALESCER
PACKAGE

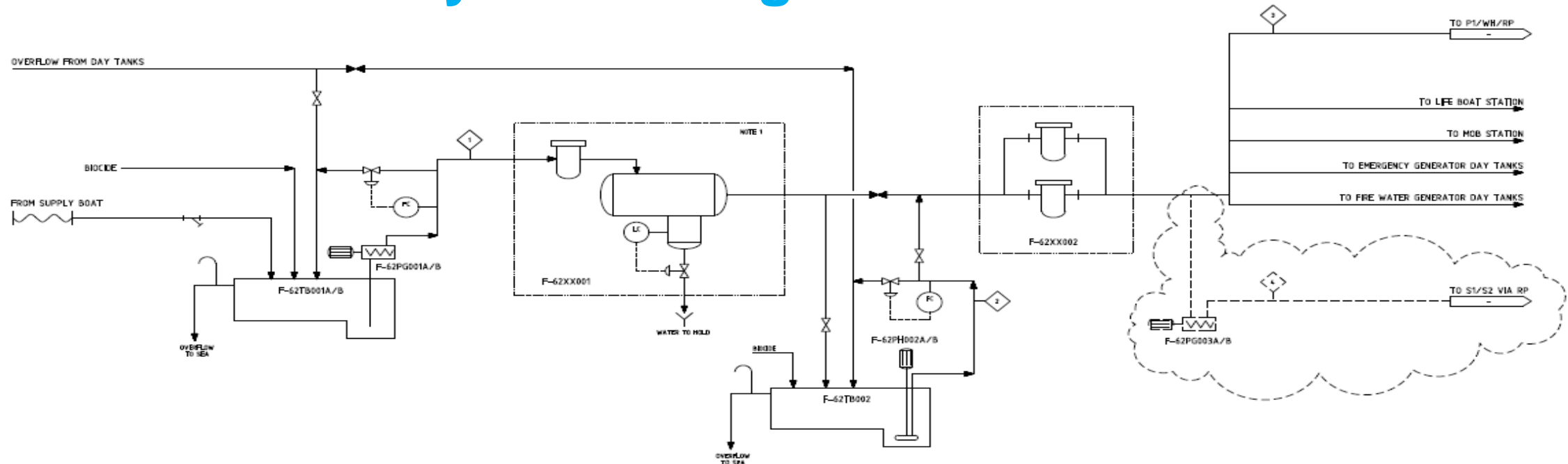
F-62TB002
TREATED DIESEL
STORAGE TANK
TOTAL CAPACITY: 100 m³

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

System Design



- 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.

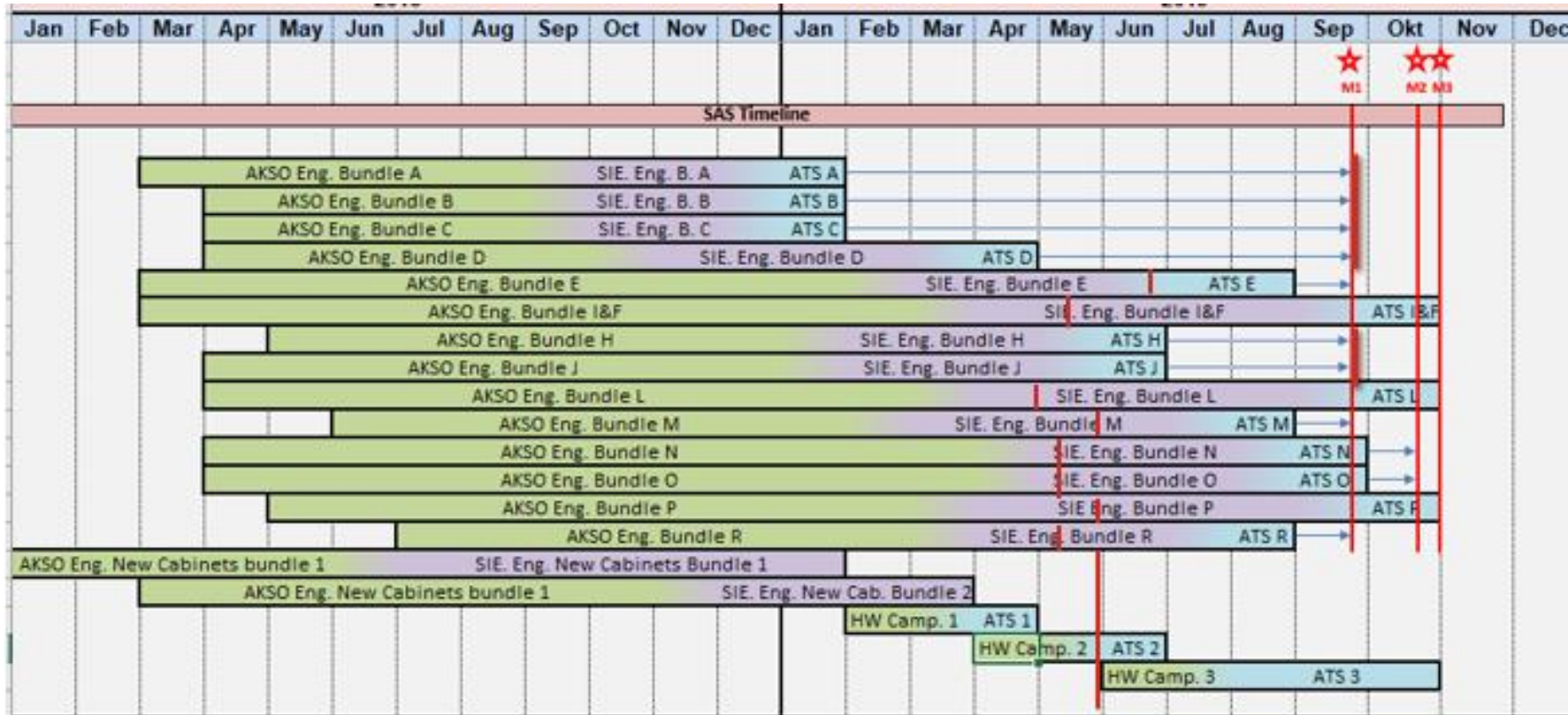
AkerSolutions

REV.	DATE	REASON FOR ISSUE	DESIGNED	CHECKED	APPROVED	SCALE	SIGNATURE	CONTROL NO.	AREA	SYSTEM	PROJ. NO.	DISCLOSURE SPEC.	ISSUANCE NO.	REV. NO.	STATUS
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	-	-										



JOHAN SVERDRUP CONCEPT STUDIES	
SHARED TITLE UTILITY FLOW DIAGRAM DIESEL OIL	
DESIGN NO.	04
C156-AA-P-XA-6201-01	
PROJ. NO.	DISCLOSURE SPEC.
ISSUANCE NO.	REV. NO.
STATUS	

Safety and Automation System



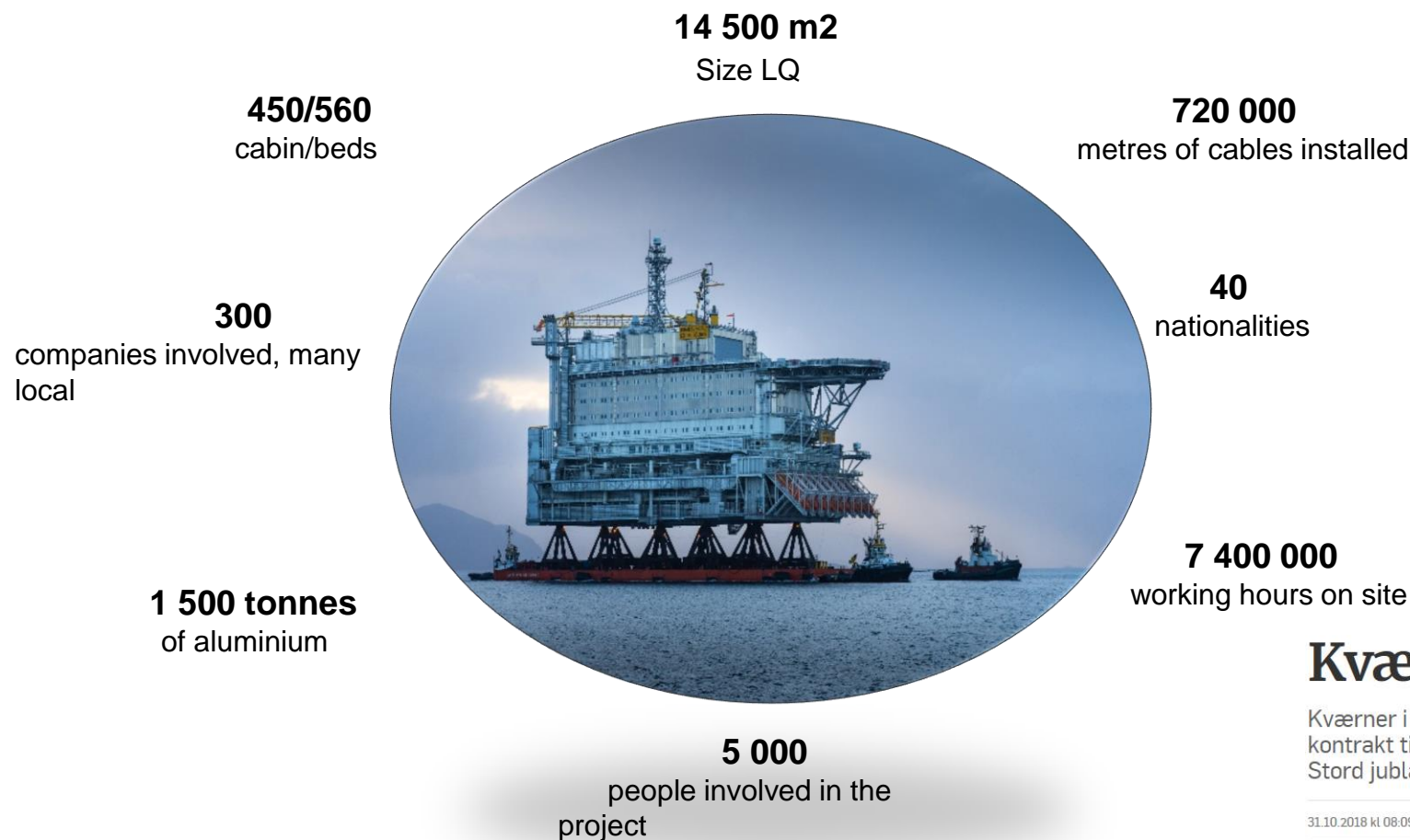
- Always a major challenge due to dependencies for vendor info, detail design and “everybody else”
- Significant hardware which is needed early
- Crucial for testing and commissioning
- Dependent on close cooperation of all parties

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.



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



Kværner feirar med kake i dag

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

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



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



Johan Sverdrup: Kværner 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



Bolted supports in-place

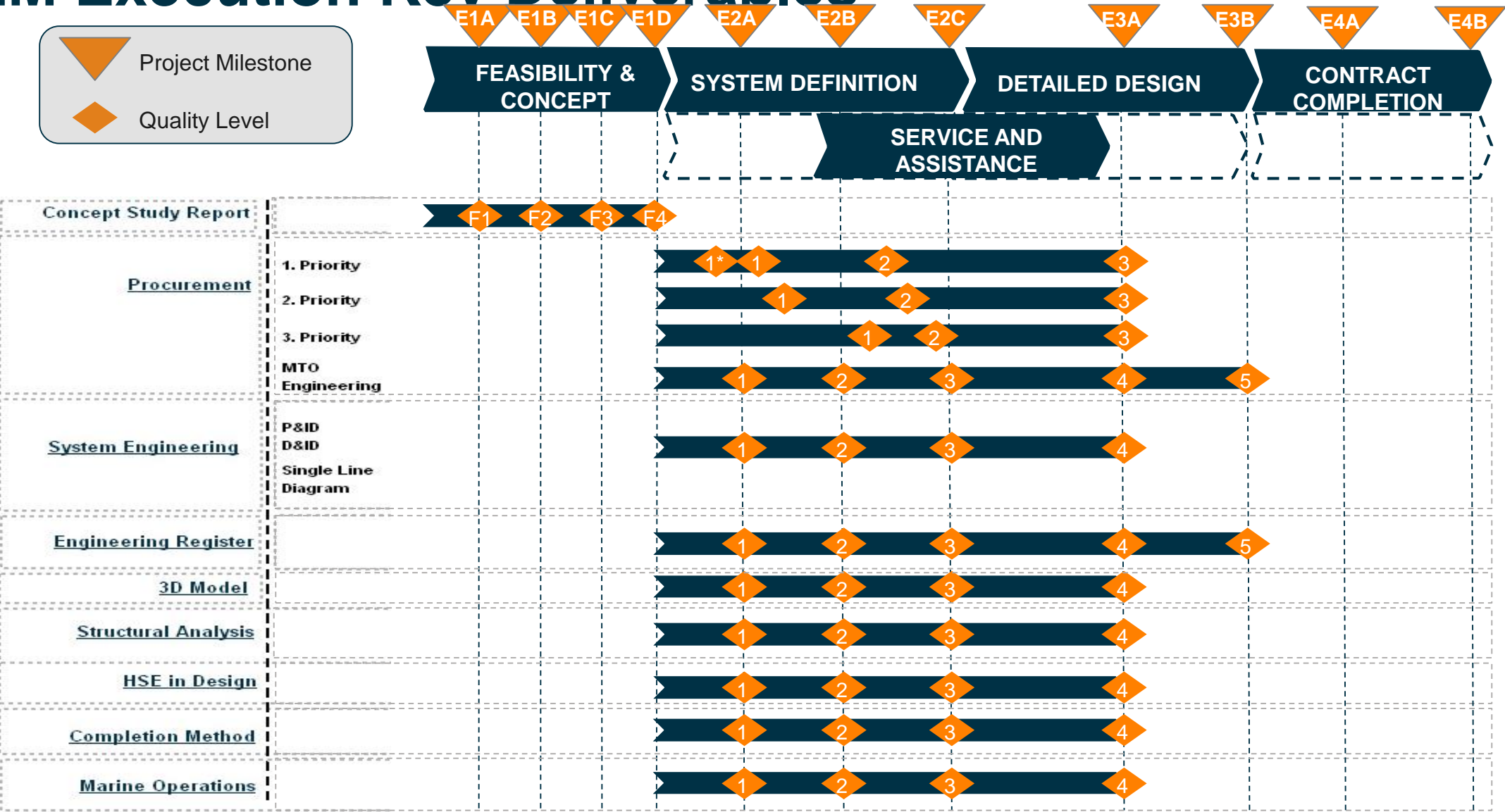
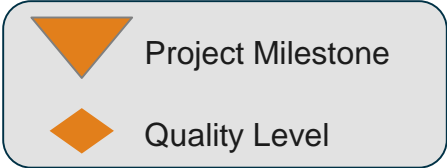
Outfitting structure painted

Piping ready for installation

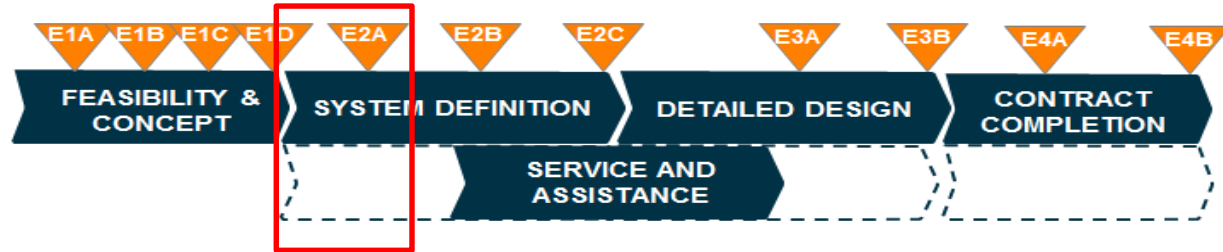
Prefabrication

- Painted
- No over length
- Bolted supports ready for installation

PEM Execution Key Deliverables



Ready for Detail Engineering



Milestone
E3A Quality Level
QL4

Detail design completed



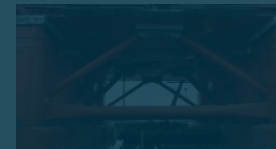
Milestone
E2C Quality Level
QL3

Global design frozen



Milestone
E2B Quality Level
QL2

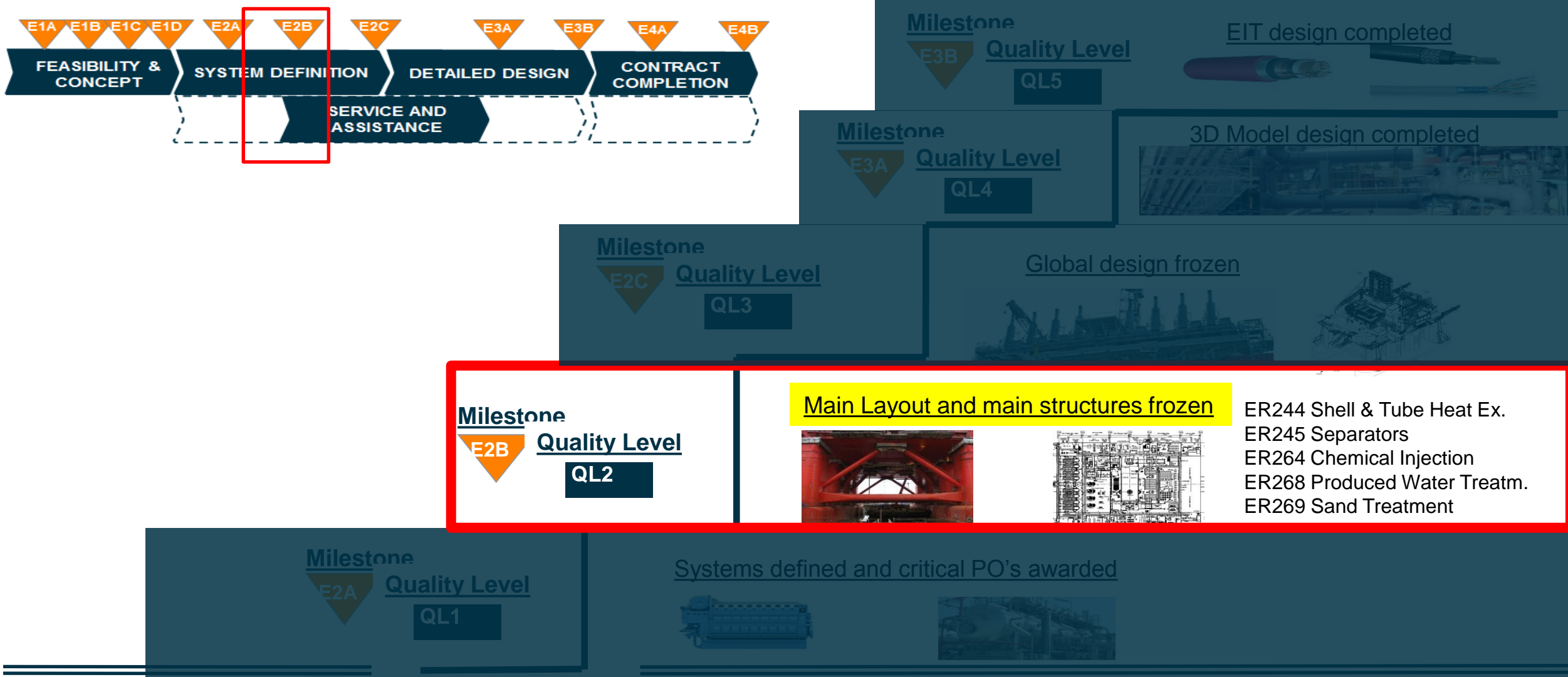
Main Layout and main structures frozen



Milestone
E2A Quality Level
QL1

Concept confirmed and critical PO's awarded





2B

- Main systems designed
- Main layout and main structures confirmed.
- Detail design premises completed
- 1st 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.