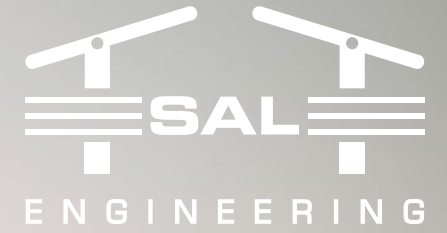


SAL ENGINEERING



WE INNOVATE SOLUTIONS

INTRODUCING SAL ENGINEERING

SAL'S INDEPENDENT SISTER COMPANY

With SAL Engineering you get an independent Engineering house, born from one of the world's leading technical project carriers – SAL Heavy Lift. SAL Engineering provides comprehensive marine engineering services. We do not only develop concepts – we implement our solutions.

OVER 35 YEARS OF EXPERIENCE

We have a track record of thousands of successful projects behind us. For more than 35 years, we have been developing marine heavy lift and installation solutions.

HAMBURG, MANILA, ROTTERDAM

From our headquarters in Hamburg or our offices in Manila and Rotterdam we are able to provide you with our know-how. Our team of experts is ready to tackle your challenges!

WE PLAN PROJECTS –
READY FOR EXECUTION



INTRODUCING SAL ENGINEERING



SUPERIOR ENGINEERING SOFTWARE & SYSTEMS



THOUSANDS OF EXECUTED PROJECTS



HIGHLY SKILLED ENGINEERS & MASTER MARINERS



OUR SERVICES

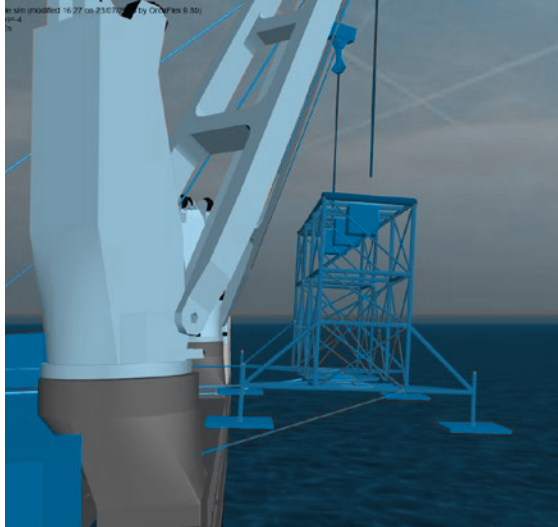
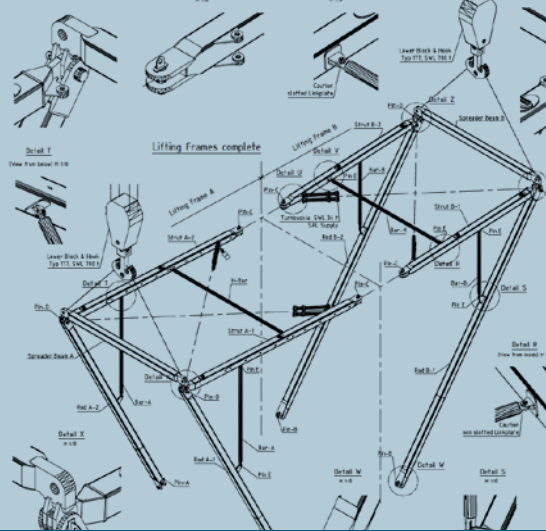
From logistic concepts to dockyard planning, detailed analysis and salvage solutions to technical visualizations and animations – SAL Engineering knows how to master your project. And as an industry partner for technology development, we provide comprehensive engineering services while using the latest software technologies.

We put concepts to the test and deliver unique solutions. Our know-how rests in our work with world leading oil & gas, renewables and engineering consortiums. Whether you are a ship owner, bank, insurance company, shipyard, freight forwarder, EPC, manufacturer of heavy equipment or an engineering office – we will find the right solution for you.



ENGINEERING

- Heavy Lift Transport Engineering
- Hydrodynamics / Motions
- Structural Design
- Workability Assessments / Weather Studies



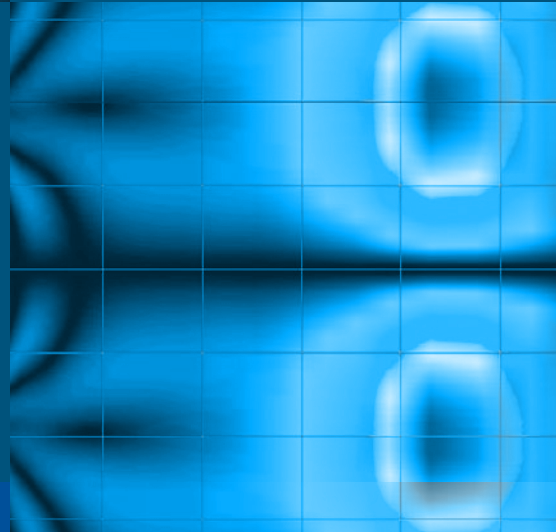
CONSULTANCY

- Design Reviews
- Logistics Concepts
- FEED Studies
- Installation / Decommissioning Concepts



SITE SUPPORT

- Cargo Operations / Condition Surveys
- Route & Site Assessment
- Dockyard Assistance





OUR TEAM



NAVAL ARCHITECTS
MARINE ENGINEERS
STRUCTURAL ENGINEERS
WELDING ENGINEERS
MASTER MARINERS



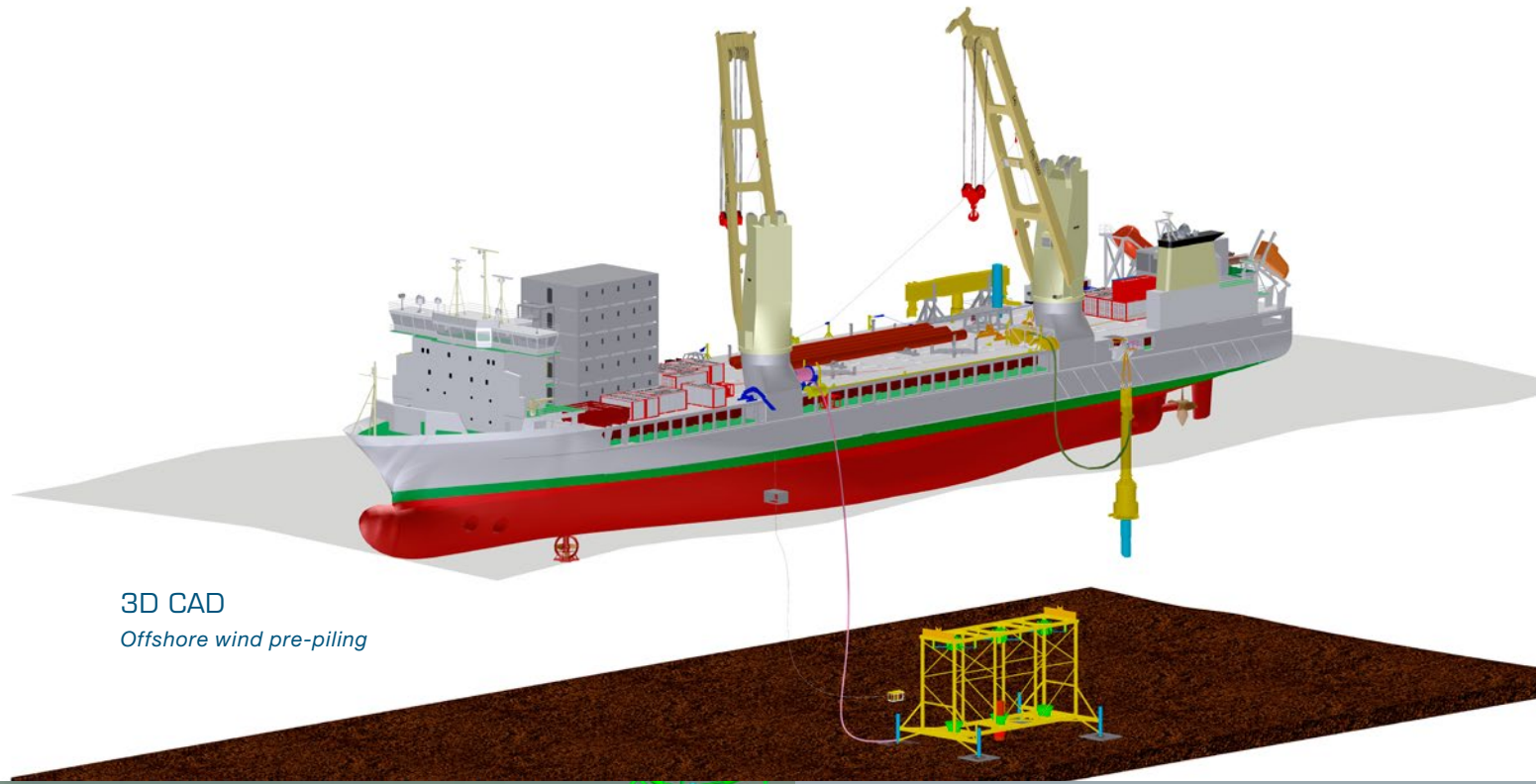


+300
YEARS
OF COMBINED EXPERIENCE

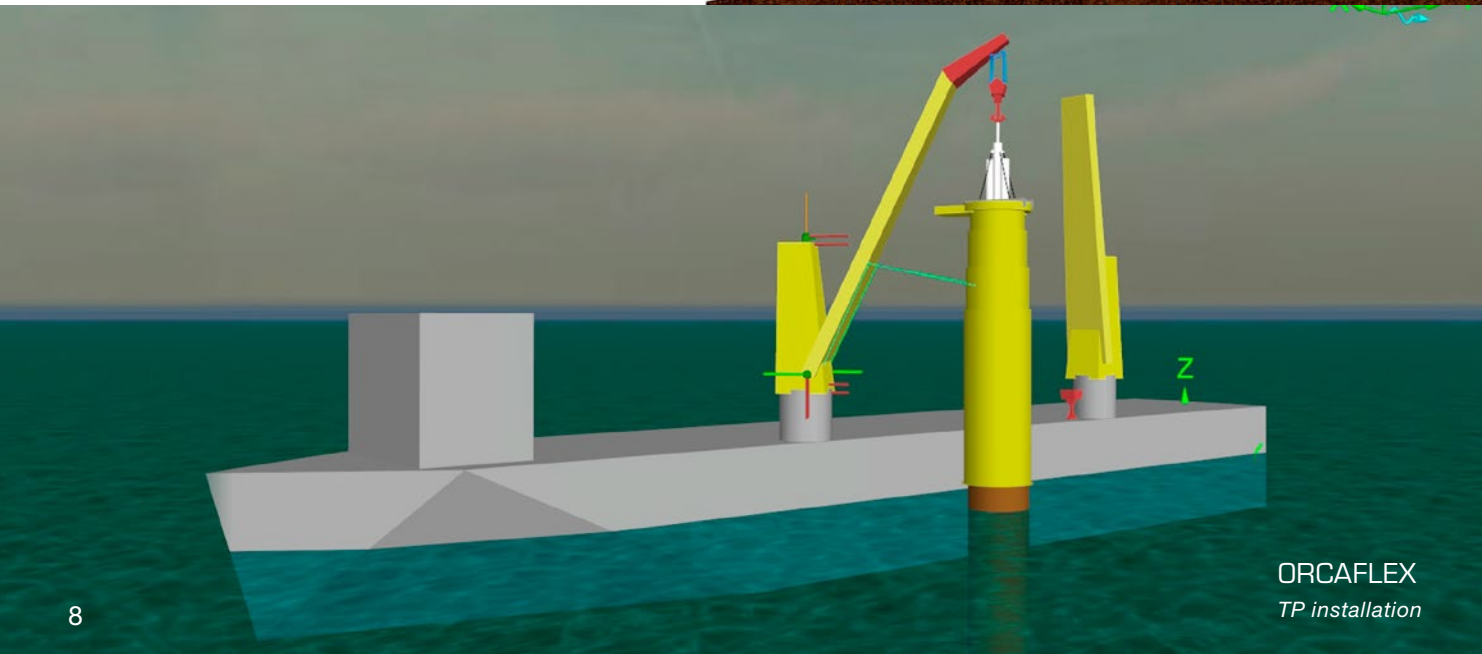


OUR TOOLS

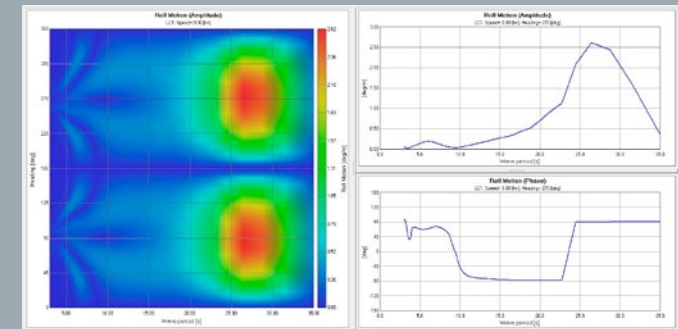
- AutoCAD, Inventor, RFEM, ANSYS® Mechanical
- ANSYS® AQWA, Wasim, OrcaFlex, Optimoor
- OCTOPUS-Office
- E4 Ship Design System
- WASAL – Wave climate analysis algorithm by SAL evaluating latest long-term weather hindcast databases with high spatial and temporal resolution
- Motion monitoring systems



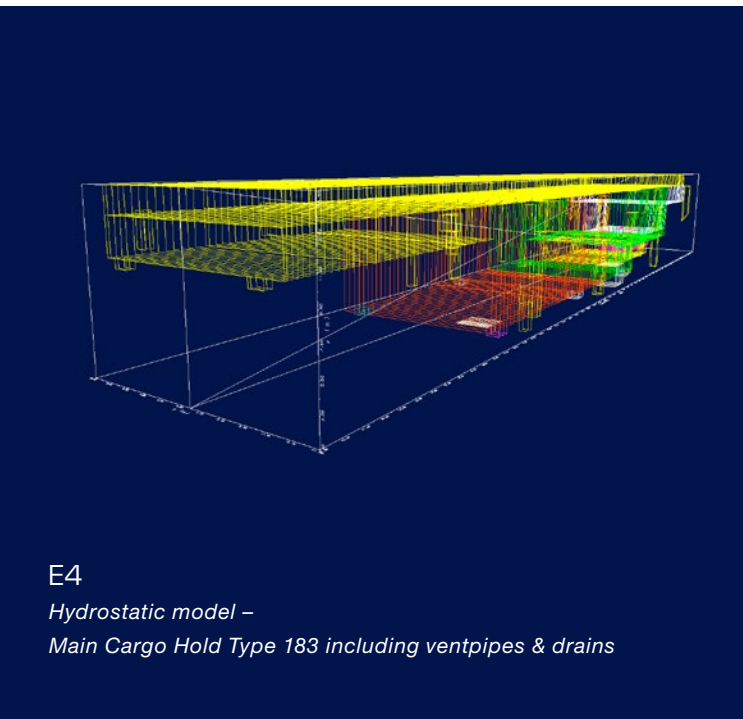
3D CAD
Offshore wind pre-piling



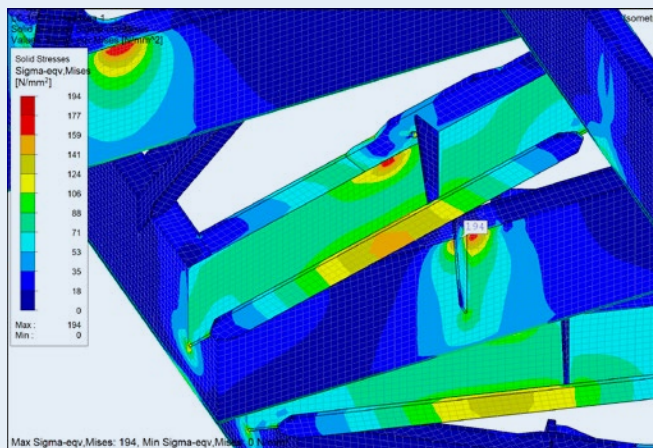
ORCAFLEX
TP installation



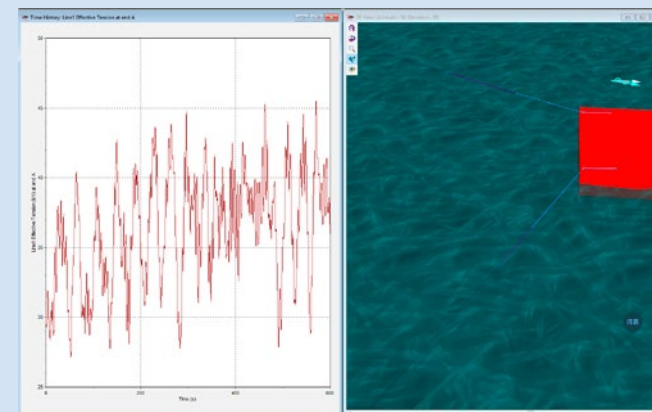
OCTOPUS-OFFICE
RAOs (Response Amplitude Operators)



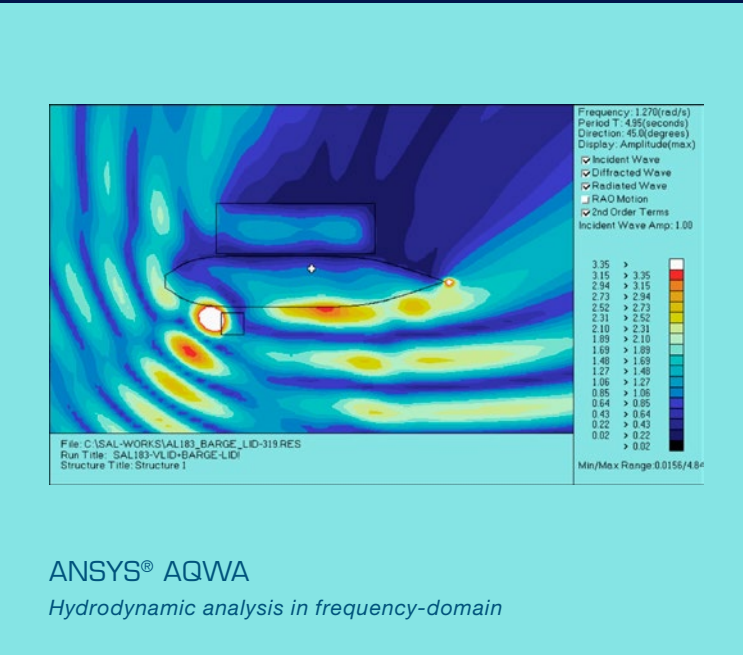
E4
Hydrostatic model –
Main Cargo Hold Type 183 including ventpipes & drains



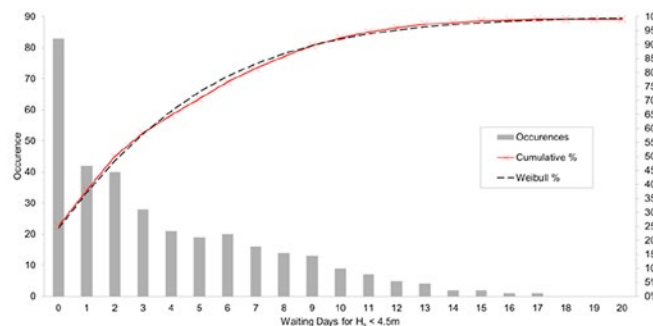
RFEM
Structural strength verification of grillage



ORCAFLEX
Mooring-line tension in time-domain



ANSYS® AQWA
Hydrodynamic analysis in frequency-domain



WASAL
Weather downtime analysis

month:	1																	SUM								
skaways:	7440																									
hs_GEQ/trz_GEQ	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	11	12	13	14	15	16						
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
0.5	0	0	0	0	0	0	0	0	0	1	7	0	1	1	1	0	0	0	0	0	0	13				
1	0	2	3	2	4	1	10	12	13	26	20	5	1	1	0	0	0	0	0	0	0	121				
1.5	3	4	9	20	10	8	16	26	24	40	43	36	15	5	3	5	0	1	1	1	0	271				
2	0	9	13	19	24	18	8	22	35	49	77	113	88	58	33	31	9	6	6	6	8	634				
2.5	0	0	3	31	46	34	27	26	37	54	104	145	138	106	79	48	22	14	14	5	4	940				
3	0	0	1	6	37	42	19	23	39	65	98	130	178	127	104	51	28	18	18	6	2	961				
3.5	0	0	0	2	5	36	37	20	27	46	79	122	148	163	100	111	85	43	26	10	6	1099				
4	0	0	0	1	6	5	22	27	14	31	73	98	107	105	120	82	34	23	20	2	0	770				
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9.5	0	0	0	0	0	0	0	0	0	0	0	0	1	3	4	2	13	14	7	7	0	51				
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10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	1	8	2	3	0	18				
11	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	3	3	3	1	12				
11.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	1	2	0	8				
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2				
12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3				
SUM	3	9	23	71	144	159	135	178	231	345	551	821	958	889	642	762	460	362	240	116	77	16	7	0	1	7440

WASAL
Wave scatter table

A BALLAST PROCEDURE FOR 15 TANKS

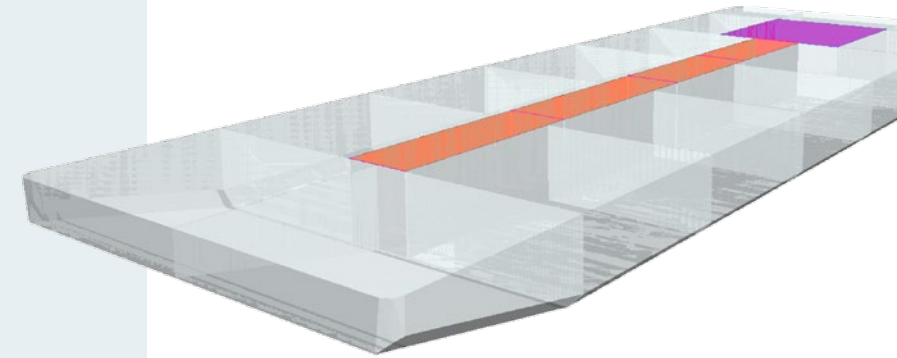


BUOY BARGING

Client	Wellmann Group
Scope of work	Planning and supervision of shifting buoys into/out of water
Engineering scope	<ul style="list-style-type: none">• Supervision on site• Procedure planning• Barge stability calculations• Ballasting procedure• Reporting
Methods / Software	<ul style="list-style-type: none">• AutoCAD• E4

*“With SAL Engineering’s involvement
I was confident to perform the operations.”*

Chris Lyovwaye, Managing Director WELLMANN Group



The 15 ballasting compartments of the barge

OUR SOLUTIONS

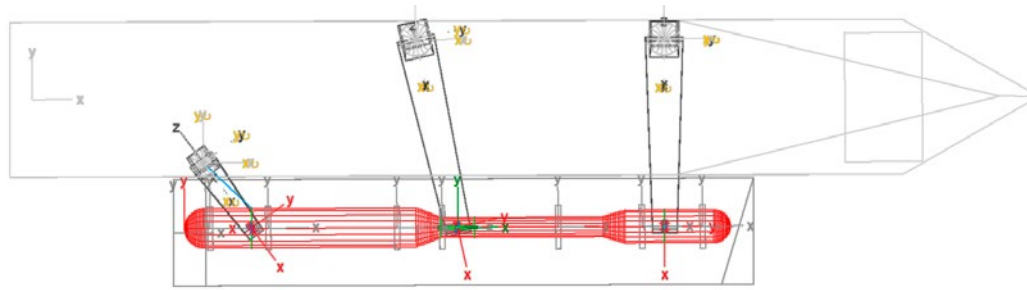
- Complex loading of an SPM Buoy to be refurbished
- Floating on/ floating off scope
- Calculation and design of the ballasting procedure for an 82-metre self-ballastable barge
- Barge had to be in part submerged some 5.5 metres below surface to allow the buoy to be floated onto it, thereafter be skidded from barge to shore and vice versa
- Short lead time: design, develop and on-site execution in only ten days
- Complex computing to specify the sequence of the intake of ballast water into the barge's 15 ballast tanks
- Hydrostatic stability calculations
- Operation supervision and on-site-support by SAL engineering expert



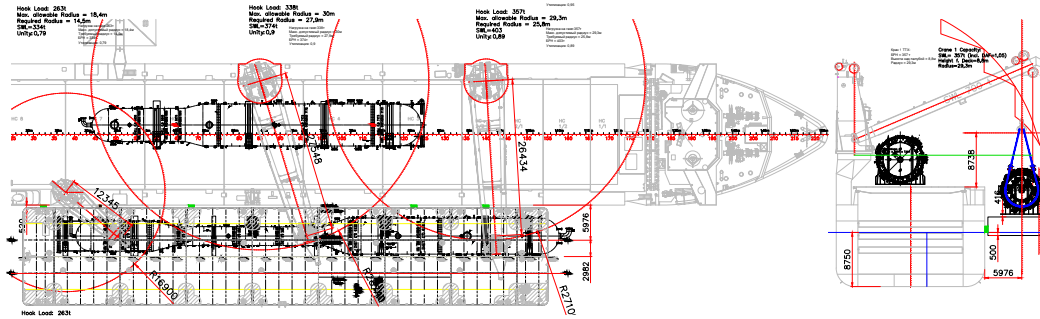
A 3 CRANE LIFT



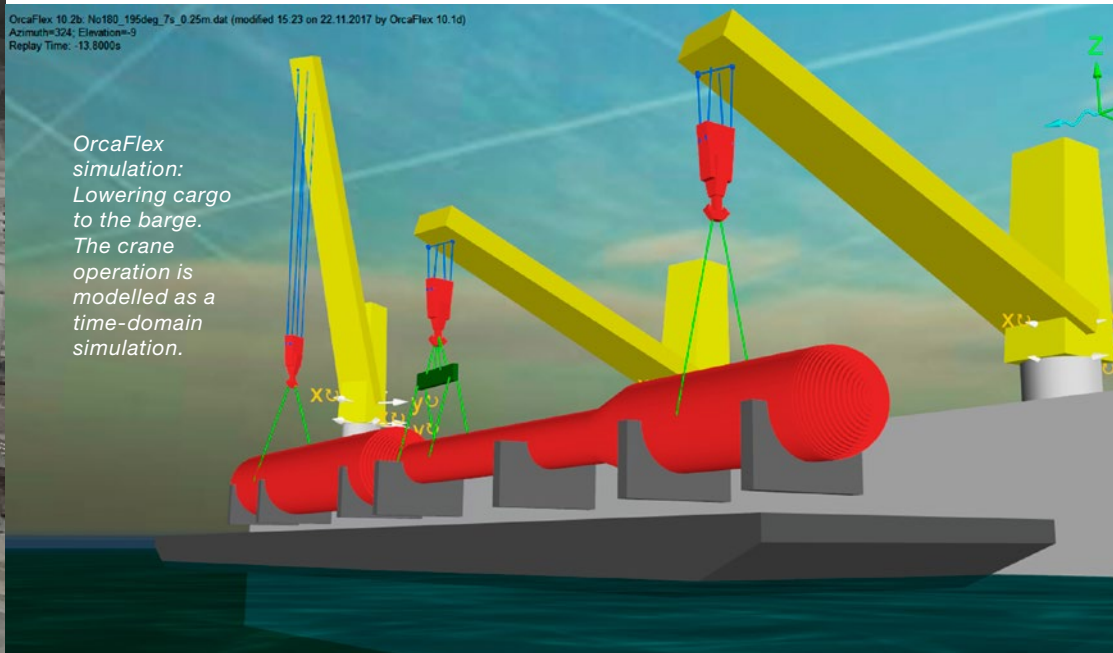
REFINERY EQUIPMENT	
Client	Combi Lift
Scope of work	<ul style="list-style-type: none">• 3-crane-lift solution• loading from shore and transshipment onto barge
Engineering scope	<ul style="list-style-type: none">• Design of lifting arrangement• Crane load calculation• Loading procedure development• Dynamic lifting analysis• Barge mooring analysis• Supply and analysis of local wave climate
Methods / Software	<ul style="list-style-type: none">• AutoCAD• OrcaFlex• WASAL



Vessel and barge motions are calculated using impulse-response method (reacting to the lifted object)



Calculation of crane positions for all steps of the lift to barge



3-CRANE-LIFT SOLUTION



Cargo, safely discharged onto barge

OUR SOLUTIONS

- Calculation of dynamic hook loads taking into account the stiffness of the cranes and rigging as well as the movement of the ship and the pontoon in the seaway and their relative movement with a time-domain simulation in OrcaFlex
- Determination of the maximum sea conditions and wind speeds under which the acting forces and accelerations are within the given limits (DNVGL-ST-N001)
- Estimation of time windows with suitable environmental conditions at the location of the transshipment using the in-house developed software WASAL. WASAL uses fine-resolution weather data from NOAA (National Oceanic and Atmospheric Administration, U.S. Department of Commerce) based on hindcast calculations with the WAVEWATCH III model
- Motion monitoring with a triaxial accelerometer to verify that calculated forces are not exceeded during the operation

A CUSTOMIZED LIFTING TOOL

HORNS REV 3

Client	DEME GeoSea/SAL
Scope of work	Upright transportation of 49 Transition Pieces (TPs)
Engineering scope	<ul style="list-style-type: none">• Project Management• Grillage design and structural calculations• Seafastening design• TP-Lifting tool design• Supervision grillage production• Supervision Transition Piece Lifting Tool (TPLT) production• Procurement Grillage• Route assessment (motion analyses, weather routing)
Methods / Software	<ul style="list-style-type: none">• AutoCAD• Inventor• RFEM• OCTOPUS-Office

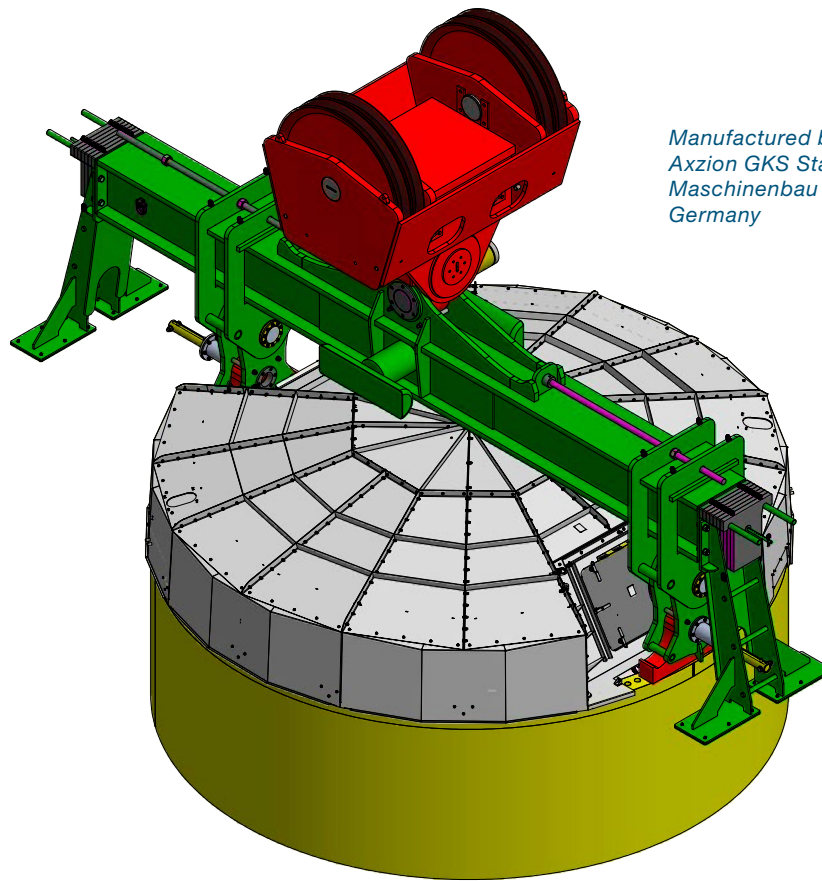


To achieve a very low rigging height for the exceptionally high TPs, the normal crane hook is dismantled while the specially designed TP lifting tool is fixed.

TRANSPORTATION OF TRANSITION PIECES

OUR SOLUTIONS

- Motion response analysis with OCTOPUS-Office to calculate wave induced forces and accelerations acting on the cargo during the transport as basis for the structural design
- Design of a tailor-made seafastening grillage and clamping system and strength verification using RFEM to assure that the stress level in the TP flange, the grillage and the vessels structure is within the limits (DN-VGL-ST-N001) during transportation
- Concept design of a tailor-made TP lifting tool which replaces the crane hook to assure sufficient lifting height despite of the exceptional height of the TPs and the pre-installed roof top
- Extensive project management to get the structures designed, calculated, approved, manufactured, load tested, certified, coated and delivered and to get the vessel mobilised for the project in time
- Project engineering support for manufacturing and installation by naval architects and welding engineers



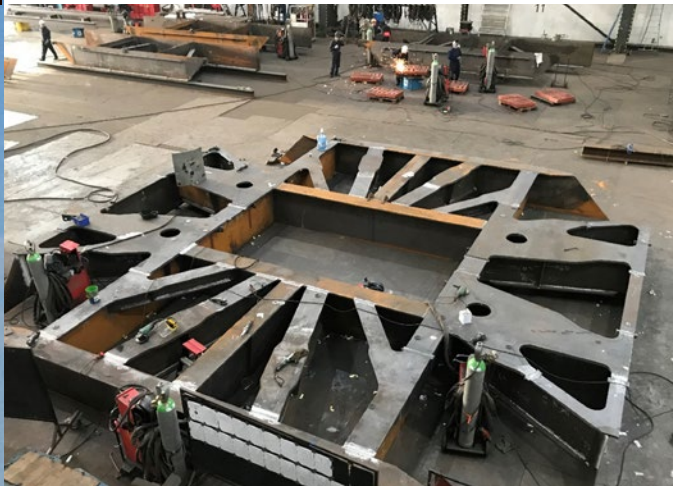
Manufactured by
Axzion GKS Stahl- und
Maschinenbau GmbH,
Germany



Supervision of TP grillage production

Installation of grillage

Grillages finally installed in hold





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Follow us on



A member of the Harren & Partner Group

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Graphic Design: Claudia Badouin

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