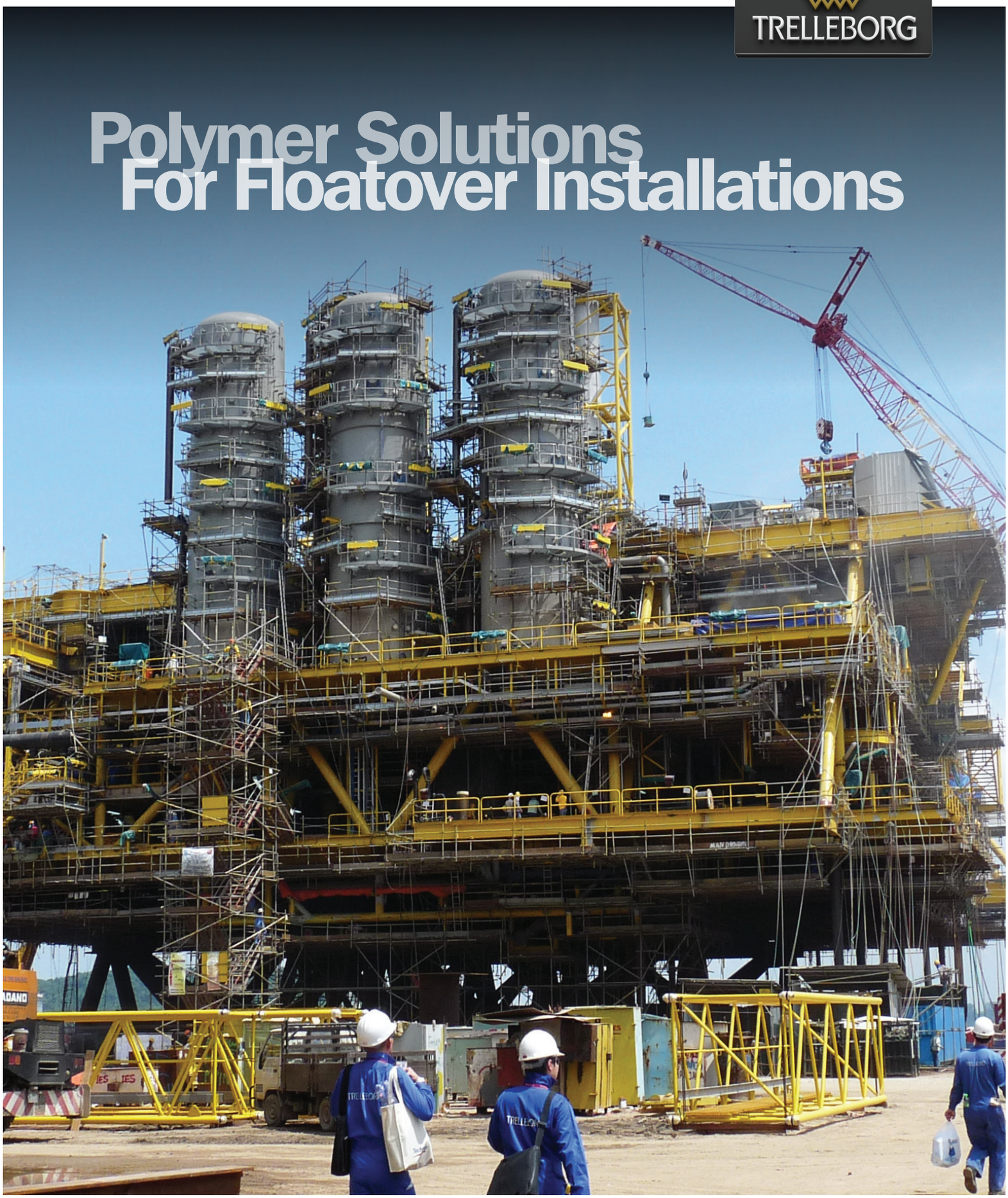
TRELLEBORG ENGINEERED PRODUCTS

Polymer Solutions For Floatover Installations



Trelleborg Engineered Products

With a global footprint and local support, and a track record of over 100 years, Trelleborg Engineered Products applies everyday ingenuity to everything we do.

From structural bearing systems to floatover solutions, grout seals for offshore wind farms, corrosion protection and anti-vibration mounts, Trelleborg Engineered Products play a pivotal role in a number of applications, for different types of energy production, including:

OIL & GAS	RENEWABLE ENERGY	POWER PLANTS	OIL SANDS

When it comes to energy production you must be able to adapt to change. Our investment in technology means we can fulfil our dedication to supplying the energy sector with the industry leading structural security it requires. This allows the energy industry to continue to explore ever-more harsh and challenging environments for new ways to fuel the world we live and work in.

Part of the Trelleborg Offshore and Construction business area of Trelleborg Group, Trelleborg Engineered Products is a leading global developer, manufacturer and provider of engineered polymer solutions to the energy, infrastructure and mining industries.

Customers can rely on Trelleborg Engineered Products to deliver innovative polymer solutions that significantly improve the quality, safety and efficiency of its customers' operations worldwide.

Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. The Trelleborg Group has local presence in over 40 countries around the world.

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Deck Support Units

Deck Support Units (DSU) are installed onto the Deck Support Frame of a transport barge. The topside of the platform is loaded onto this deck support frame and the DSUs act to absorb the weight of the topside; these DSUs support the integrated deck and allow relative horizontal movement between the deck and the deck support frame during the mating process.

Our DSUs, which are engineered and specially customized for every separate project, consist of a stack of elastomeric pads installed between two steel casings.

SHWE Platform Case Study

Trelleborg's engineered products operation supplied its floatover mating technology to one the world's largest oil platforms; the SHWE Project in the Bay of Bengal, Myanmar.

Working closely with the engineering, procurement, construction and installation contractor, Hyundai Heavy Industries (HHI), Trelleborg provided a number of its Leg Mating Units (LMU), DSUs, Load Transfer Units (LTU) and floatover fender systems, to meet requirements for the heaviest load that an LMU has ever been commissioned for. With the project's topside weighing in at a substantial 30,000 tonnes, one of the LMUs Trelleborg delivered was designed to bear a compression load of 12,450 metric tonnes.

SM Lee, General Manager of the Offshore Basic Design and Engineering Department at HHI, said: "This project was not without its challenges; we required the highest performance hardware for the job which was not only cost-effective but also met the stringent specification and testing requirements."

"Trelleborg's product expertise and engineering capabilities are first class, and coupled with state-of-the-art machinery, the company was the ideal choice for the project. In addition, Trelleborg was able to perform full-scale testing in-house, to the load specification required, ensuring that all hardware supplied was compliant, high performing and reliable."

JP Chia, Engineering Manager within the engineered products operation of Trelleborg Offshore & Construction, said: "Working on such a significant project with HHI has been a real achievement for Trelleborg, especially given the calibre of our competitors. Though the specification was demanding, we were able to produce tailor-made engineering solutions that were ideal for the environment and application, as well as handle the production from end-to-end."

"With a load capacity of 18,300 metric tonnes and weighing in at 600 tonnes itself, our test press is the largest in the world. This means that we're able to fully test our solutions for bigger and more complex projects. That's something that sets us apart in the industry."

Following a 23 day voyage, which totalled nearly 4,000 nautical miles from HHI's fabrication yard in Ulsan, Republic of Korea, the topside finally reached its destination at a water depth of approximately 110 meters. The barge which transported the topside was equipped with eight of Trelleborg's DSUs. These were fixed to the deck support frame to allow horizontal movement between the deck and deck support frame during and after the mating process, when the barge separates from the topside.

Leg Mating Units

LMUs are steel structures incorporating engineered elastomeric pads that are installed in the topside or the pre-installed substructure.

They are utilised during the mating process of a floatover operation, when the transport barge ferrying the topside of a platform arrives at the installation site. During this process, the barge manoeuvres into position between the jacket legs and aligns the topside with the substructure before it ballasts, slowly connecting the topside onto the substructure.

As the barge ballasts, decompression will occur on DSUs and vertical compression will occur on the LMUs, effectively transferring the weight from the barge to the jacket. The elastomeric pads in our LMUs are designed to take up the static and dynamic forces of the topside structure, as well as the horizontal forces due to open sea motions during the floatover mating operation. After the installation is completed, the topside structure is welded to the substructure.

Wheatstone Case Study

Trelleborg's Engineered Products operation has recently supplied its largest and highest performing LMUs to one of the world's biggest single integrated floatover installations – the Wheatstone Project, Australia.

Contracted by Daewoo Shipbuilding & Marine Engineering Co. Ltd (DSME), Trelleborg Engineered Products (TEP) provided 16 DSUs and four LMUs, as well as a selection of bearings and fenders. Together, the LMUs will support the substantial 37,000 tonne topside – one of the heaviest loads recorded to date.

Hyun-Wook Cho of DSME, Lead Structural Engineer for the Wheatstone Platform Project, says: "The significant weight of the topside required a robust mating system which could cater to the loads placed on it, so that performance and safety could be guaranteed. If the system wasn't designed to suit the environment, the heavy topside coupled with high sea waves and swell, could have caused significant damage - and downtime and delay as a result."

"However, we were ensured peace of mind, as Trelleborg customised its products specifically to meet the stringent needs of the project. They provided support and input right from the preliminary stages, as well as proven quality and quick turnaround times - both imperative for a high stakes project like Wheatstone."

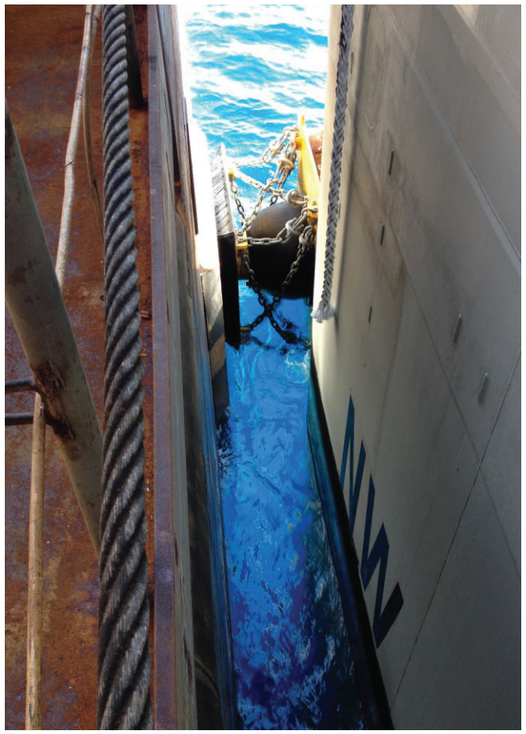
Julian Wee, Managing Director for TEP's Singapore operation, says: "The large loads had to be transferred from the barge to the in-situ base structure in a controlled manner. We knew that a standard leg mating unit wouldn't be enough for this transfer process, but working closely with DSME, we designed our largest units to date, to ensure that the floatover would happen safely and efficiently – which it did."

LMUs consist of steel structures incorporating engineered elastomeric pads and they make a floatover transition possible by damping the forces created as the topside's load is transferred to the jacket. The elastomeric pads are designed to take up the static and dynamic forces of the topside structure, as well as the horizontal forces due to open sea motions during the floatover mating operation. The assembled LMU can be installed either on the topsides or jacket.

Sway & Surge Fenders

Barge fendering systems are used during the floatover operation, and protect against damage arising from potential impact between the barge and the substructure legs during the entrance, mating and exit phases. The fenders also assist in ensuring the design clearances during this operation.

Our fendering systems are custom designed to comply with the client's specified stiffness requirements in both compression and shear. We can offer a cost-effective system for attaching the fenders to the barge structure, if required.



Trelleborg's Floatover Technology Facilitates Successful Installation of Stalled China Seas Project

Trelleborg's engineered products operation fast-tracked the manufacture, testing and delivery of its floatover mating technology, for a major oilfield project in the South China Sea, in just four months. This allowed the stalled project to quickly and safely commence installation, ending an eleven month delay.

The project previously experienced an unsuccessful floatover operation in August 2013, causing structural damage to the barge and the jacket. As such, an overhaul of the floatover system was required and Trelleborg was contracted to provide its customized solutions to the project as quickly as possible.

Contracted by Ashburn Offshore Oil & Gas Equipment & Engineering Company Ltd., Trelleborg designed, fabricated and delivered eight LMUs – four inner legs and four outer legs – and floatover fenders. With the topside weighing 12,500 tonnes, each LMU was designed with a load capacity of 1,800 tonnes.

Bian Shaoping, Manager of the Market Structure Department at Ashburn, comments - "We've received excellent feedback about Trelleborg's products following the successful installation, due to their reliability, safety and ability to provide peace of mind."

Julian Wee, Managing Director at Trelleborg's engineered products operation in Singapore, comments – "The project suffered setbacks during its initial installation attempt. It was at this point that we were contracted to supply our floatover technology. We supplied our customized sway and surge fenders to absorb any kinetic forces the floatover barge would exert on the jacket. This ensured that the floatover process, especially when installing the topside onto the jacket, was completely safe for both the topside and jacket structures. In conjunction with our fenders, our high performance LMUs were easily able to support the weight of the topside and maintain stability during installation, even in high sea swell conditions."

"We knew that there was a lot of pressure to get this right in light of previous events; this project required fast and quality solutions which would perform perfectly. We were proud to be able to provide our solutions and guaranteed reliability, to get the platform online for our partners as quickly as possible."

Trelleborg managed to decrease its throughput time from manufacture to delivery when the urgency of the project was realized. It was moved to the top of Trelleborg's priority list to ensure a concise and fast turnaround; extra shifts and staff were assigned to ensure the contractor's needs were met. Trelleborg manufactured, tested and delivered the solutions in just four months, making the project's second floatover process a success.

Future of Floatover Technology

Floatover Technology and Wind Energy

With the advent of renewable energy and increasing attention to sustainable sources such as wind and solar, Trelleborg has recognised the need to adapt our technology to suit the needs of our partners.

Offshore wind farms far from the coast need offshore substations to convert DC power to AC power before the power is transferred to land. These substations can weigh as much as 22,000 tons and Trelleborg is working to offer floatover technology to place them on offshore jackets.

Traditional transport and installation methods in the shallow-water offshore oil industry cannot cope with the size and weight of larger topsides. A similar trend in the offshore wind industry is predicted, as floatover processes are more efficient, faster, safer and more cost-effective.

So as the hunt for more energy continues, Trelleborg is helping to harness conventional sources more effectively, as well as making possible the next big leap into alternative energy.

The Bouyant Tower and Floatover Concept

The oil and gas industry is known for its constant rate of innovation. It pushes the limits of subsea exploration as deepwater fields and wells are drilled even deeper and located further offshore. So it is no surprise that a new generation of oil platform has been designed. The first of its kind, the Buoyant Tower which currently sits in the Pacific Ocean, may well revolutionize exploration and production around the world.

New generation design

Designed to reduce the overall timelines from offshore exploration to production, this new concept facilitates the fabrication and installation of a drilling and production platform, while enabling reduced project timings and costs, and provides the flexibility to re-use and re-locate the Buoyant Tower anywhere in the world.

Comprising four cylindrical tubes with one central suction pile, each cell measures 8.4 meters / 28 feet in diameter, and 60 meters / 197 feet in length. The central suction pile, integral to the full structure, attaches the structure to the seabed. On top of the 2,500 ton Buoyant Tower hull, sits a 1,500 ton platform where the production drilling is carried out. Suitable for water depths between 50 and 280 meters / 165 and 920 feet, it can be used in any type of field with any variation of reservoir characteristics – oil, gas or a combination, and the drilling can be modularized to adapt to the needs of the operation.

The tower is designed on existing cell spar technology and due to the simplicity of the cellular components of the hull, it falls in the category of a ‘compliant structure’ – one that accommodates the dynamic forces through flexibility instead of resisting the loads rigidly, thereby limiting the internal dynamic loads - and is less expensive than fixed platform alternatives. Similarly, the system is well suited for regions with seismic activity, better than a traditional fixed platform.

An important aspect of the design is to help dampen the loads while performing the floatover; the crucial challenge being to transfer the load from the topside to the tower mating points in a controlled manner without causing damage to either structure

Using LMUs and DSUs will provide a cost-effective solution and offers a proven technology and successful installation method for offshore constructions, compared to traditional lifting installations.

Testing and Research & Development

At Trelleborg Engineered Products, our continued investment towards improving the performance of our floatover solutions means we utilise efficient and accurate testing and production facilities to provide our customers with the best performing equipment in the industry.

Our in-house Banbury department formulates unique rubber polymers for each floatover project we work on, in order to ensure that our solutions are designed to meet and exceed our customers' expectations.

Our testing facilities are also top notch, including a fully functional laboratory for research and development, as well as the world's largest test press. In addition to FEA modelling, our test press also guarantees our solutions performance under a topside's simulated weight.

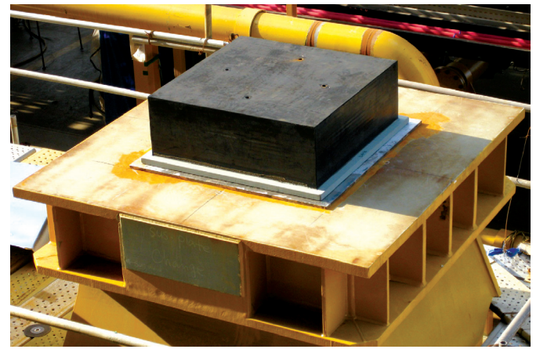
Project Reference List and Floatover Hardware

NO.	OWNER CONTRACTOR T&I	PROJECT NAME LOCATION	JACKET OD TOPSIDE WGT	EQUIPMENT	DESIGN LOAD	UNITS	YEAR
1	CHEVRON HHI	DSO EGP 3A NIGERIA	OD: 48" WGT: 2,755 MT	SHOCKPAD SWAY FENDER SURGE FENDER	1,650 MT	16 4 2	2006
2	MAERSK SIME DARBY ENGRG.	MOQ 16 (BG PLATFORM) QATAR	OD: 84" WGT: 13,500 MT	LEG MATING UNIT	1,700 MT	6	2008
3	MAERSK SIME DARBY ENGRG.	MOQ 16 (BE PLATFORM) QATAR	OD: 84" WGT: 13,500 MT	LEG MATING UNIT	1,900 MT	6	2008
4	PTTEP HHI	BONGKOT 4A THAILAND	OD: 98" WGT: 19,500 MT	SURGE FENDER	269 kN/M	8 2	2009
5	PETRONAS CARIGALI MITCSB	MCR –A TURKMENISTAN	OD: 78" WGT: 5,000 MT	LEG MATING UNIT LOADOUT PAD SWAY FENDER SURGE FENDER	1,000 MT 1,500 MT 108 kN/M 520 kN/M	4 4 16 2	2009
6	WOODSIDE HMC	NORTH RANKIN B AUSTRALIA	OD: 118" WGT: 23,600 MT	SWAY FENDER SURGE FENDER	1,409 MT/M 285 MT/M	72 2	2010
7	ONGC SWIBER	B193 – LQ PLATFORM INDIA	OD: 84" WGT: 7,000 MT	LEG MATING UNIT	1,300 MT	4	2011
8	ONGC SWIBER	B193 – PP PLATFORM INDIA	OD: 84" WGT: 12,000 MT	LEG MATING UNIT	2,400 MT	4	2011
9	DAEWOO INT'L CPY HHI DOCKWISE	SHWE MYANMAR	OD: 118" WGT: 26,800 MT	LEG MATING UNIT DECK SUPPORT UNIT LOAD TRANSFER UNIT SWAY FENDER	8,300 MT 1,000 MT 1,000 MT 820 kN/M	4 8 4 4	2011
10	BPZ GMC WILSON	CX-15 PERU	OD: 60" WGT: 2,500 MT	LEG MATING UNIT DECK SUPPORT UNIT	400 MT 430 MT	4 4	2012
11	PTSC SAIPEM	BIEN DONG VIETNAM	OD: 72" WGT: 11,600 MT	LEG MATING UNIT DECK SUPPORT UNIT	2,700 MT 1,400 MT	4 4	2012
12	CNOOC COOEC	LIWAN 3-1 CHINA	OD: 118" WGT: 32,000 MT	SWAY FENDER SURGE FENDER	800 MT/M 100 MT/M	86 2	2012
13	SOC SAIPEM	ICOEEP PHASE 2 IRAQ	OD: 60" WGT: 8,200 MT	LEG MATING UNIT DECK SUPPORT UNIT SWAY FENDER	900 MT 430 MT 1,000 kN	8 8 8	2012
14	KPOC MMHE	KEBABANGAN MALAYSIA	OD: 79" WGT: 20,000 MT	LEG MATING UNIT DECK SUPPORT UNIT	1,800 MT 2,400 MT	8 4	2012
15	PTTEP SAIPEM	ZAWTIKA M9 MYANMAR	OD: 79" WGT: 15,000 MT	LEG MATING UNIT DECK SUPPORT UNIT SWAY FENDER	3,200 MT 1,200 MT 1,400 kN/M	4 4 4	2012

Project Reference List and Floatover Hardware

NO.	OWNER CONTRACTOR T&I	PROJECT NAME LOCATION	JACKET OD TOPSIDE WGT	EQUIPMENT	DESIGN LOAD	UNITS	YEAR
16	CHEVRON HHI	DSO EGP 3B NIGERIA	OD: 65” WGT: 8,500 MT	LEG MATING UNIT SHOCKPADS SWAY FENDER	1,680 MT 1,600 MT 770 kN	4 16 4	2012
17	CHEVRON DSME	WHEATSTONE AUSTRALIA	OD: 150” WGT: 37,000 MT	LEG MATING UNIT DECK SUPPORT UNIT LOADOUT PAD SWAY FENDER	5,000 MT 750 MT 6,000 MT 1,325 kN	4 16 16 8	2013
18	CNOOC COOEC	KENLI KL 3-2 CHINA	OD: 96” WGT: 12,500 MT	LEG MATING UNIT	1,550 MT	8	2013
19	CNOOC COOECI	KENLI BZ 35-2 CHINA	OD: 96” WGT: 12,500 MT	LEG MATING UNIT	1,550 MT	8	2013
20	CNOOC COOEC	HZ 25-8 CHINA	OD: 79” WGT: 14,500 MT	LEG MATING UNIT DECK SUPPORT UNIT SWAY FENDER SURGE FENDER	1,850 MT 1,230 MT 1,000 kN/M 1,000 kN/M	8 4 4 2	2013
21	CNOOC COOECI	QHD 32-6 CHINA	OD: 96” WGT: 14,700 MT	LEG MATING UNIT	1,600 MT	8	2013
22	CNOOC COOEC	JZ9-3 CHINA	OD: 96” WGT: 12,500 MT	LEG MATING UNIT	2,050 MT	8	2014
23	CNOOC COOEC	BZ28/34 CHINA	OD: 96” WGT: 14,600 MT	LEG MATING UNIT	2,150 MT	8	2014
24	CNOOC COOEC	KL 10-1 CHINA	OD: 96” WGT: 14,000 MT	LEG MATING UNIT	1,550 MT	8	2014
25	NEWFIELD/CNOOC COOEC	LF7-2 CHINA	OD: 78” WGT: 12,300 MT	LEG MATING UNIT SWAY FENDER SURGE FENDER	1,800 MT 300 MT/M 120 MT/M	8 78 2	2014
26	CARIGALI HESS HHI	BOOSTER COMPRESS MALAYSIA	OD: 84”	LEG MATING UNIT SWAY FENDER CYLINDRICAL FENDER	2,240 MT 151 kN/M 208 kN/M	6 6 2	2014
27	CNOOC COOEC	JZ25-1S CHINA	OD: 84” WGT: 14,650 MT	LEG MATING UNIT	1,900 MT	8	2015
28	PETRONAS SWIBER OFF	SK 316 MALAYSIA	OD: 79” WGT: 13,000 MT	LEG MATING UNIT DECK SUPPORT UNIT LOADOUT PAD SWAY FENDER	2,177 MT 1,200 MT 3,000 MT 1,538 kN	4 4 4 4	2015

Trelleborg Engineered Products offers reliable polymer solutions for other segments of the Offshore Oil and Gas industry



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