Metocean services and solutions

Offshore oil and gas

BMT

Where will our knowledge take you?

With over 30 years of experience and a rich heritage of marine research, we apply our understanding of the marine environment to reduce risk, whilst minimising costs in challenging engineering projects.

We offer analysis and prediction of the metocean conditions that can be customised according to our clients requirements. This can range from a simple statistical assessment of the sea state to support an offshore pipe-lay operation to complex studies supporting feasibility, detailed engineering and vessel manoeuvrability assessment during site selection and development of an LNG terminal.

BMT invests in its people and the development of the company to provide solutions to customer requirements in a technology driven environment. As a company founded on the core principle of innovation; pioneering research and development is key to BMT's success. Operating as an Employee Benefit Trust affords us the opportunity for equitable distribution of rewards, ensuring staff engagement and our independence.

Striving for service excellence, all BMT companies implement and maintain management systems compliant with internationally recognised standards covering health and safety, quality and environmental management, in line with the BMT Group Ltd. accreditation to ISO9001, ISO14001 and OHSAS18001.

BMT metocean information provides solutions to:

- Assess the marine environment and metocean risks during initial exploration
- Increase asset availability by eliminating unnecessary weather downtime
- Assess the operability & safety of floating and fixed structures during design
- Support subsea pipeline feasibility and engineering studies, including scour assessments
- Support effective transport & installation of offshore assets
- Study vessel manoeuvrability in terminal design and tanker offloading operations

BMT metocean services are used throughout the life-cycle of marine infrastructure developments in offshore and coastal regions worldwide. To provide these services BMT maintains over 30 years of extensively validated in-house global archives of modelled and observed metocean data. This allows BMT to provide customers with a rapid turnaround of metocean data to gain a better understanding of the marine environment at their site of interest throughout the world.

> "Our metocean operability assessment services provide insight into the risks associated with marine operations."

Contents

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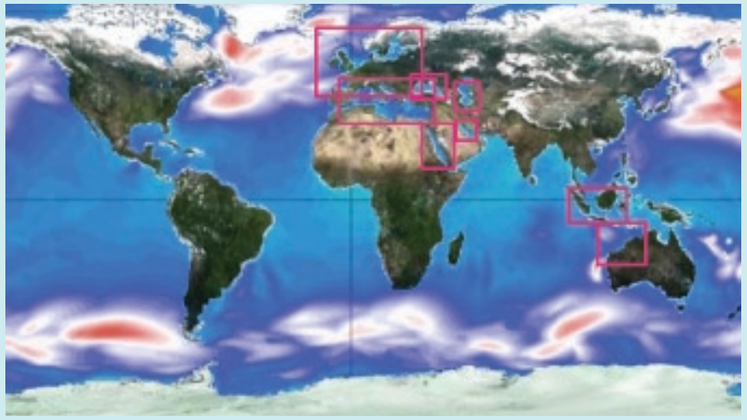
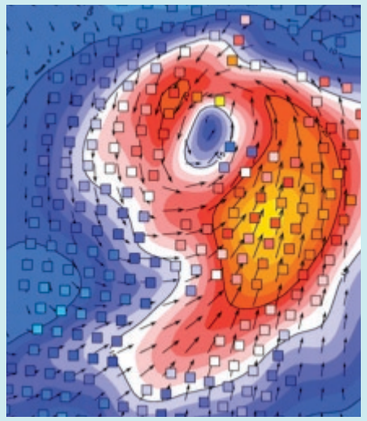
Metocean statistics and data

BMT's extensive metocean databases based on over 30 years of hindcast modelling calibrated with satellite altimeter observations, coupled with in-house knowledge and experience and in-situ measurements of working in the marine environment are used to derive site-specific metocean statistics and identify operational risks.





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1: Example of maximum wave height for a month in 2011 from the global model

2: Wind speed and direction of a storm from the global model with overlaid satellite observation

3: Operability at a Marine Terminal, Carribean.

4: Operability at an offshore site, Brazil.

Percentage Exceedence Level

	Min.	90%	70%	50%	30%	10%	5%	1%	0.5%	0.1%	Max
Jan	0.49	0.89	1.11	1.35	1.59	2.01	2.3	2.78	3.25	3.35	3.35
Feb	0.45	0.82	0.93	1.25	1.69	1.87	2.3	2.45	2.80	2.99	2.99
Mar	0.35	0.52	0.74	0.96	1.23	1.64	2.3	2.13	2.15	2.20	2.20
Apr	0.45	0.91	1.50	1.76	1.89	2.11	2.3	2.31	2.37	2.43	2.43
May	0.21	0.35	0.69	0.89	1.15	1.25	2.3	1.85	2.05	2.15	2.15
Jun	0.19	0.34	0.55	0.82	0.93	1.16	2.3	1.47	1.59	1.89	1.89
Jul	0.35	0.41	0.96	1.21	1.35	1.69	2.3	2.11	2.35	2.54	2.54
Aug	0.17	0.27	0.59	0.67	107	1.29	2.3	2.09	2.40	2.54	2.54
Sep	0.38	0.55	0.78	1.24	1.35	1.63	2.3	1.96	2.25	2.59	2.59
Oct	0.45	0.92	1.18	1.29	1.38	1.89	2.3	2.78	3.01	2.59	2.59
Nov	012	0.38	0.75	0.89	1.37	1.68	2.3	2.05	2.58	2.59	2.59
Dec	0.18	0.34	0.82	1.15	1.68	1.79	2.3	2.69	2.97	3.15	3.15

Significant Wave Height for Given Percentage Exceedence

Metocean data is vital in the reduction of weather downtime

BMT metocean statistics and data support:

- Regional metocean climatology assessment
- Weather windows and persistence analysis to assess risk of marine operations
- Rig selection and site specific operability assessment
- Feasibility studies for early assessment of project finance and concept design
- Workability assessment and planning of marine infrastructure installation
- Heavy lift operations and pipe-lay
- Weather forecasting to support tow route and marine transport operations
- Assessment of FPSO performance and offloading operations
- Vessel manoeuvring simulation studies to study terminal operability
- Marine forensic incident investigation

Safe operational working limits for weather and sea state, and the number of working hours required for the completion of each phase of a project may be provided in a short turnaround from existing data sets, thus providing valuable information to operators and installation contractors' during the construction and operation of marine structures.

By customizing metocean services to the requirements of a customer, BMT can provide detailed information about the local climatology, determine the probability of occurrence of suitable weather windows, assess the likely hood of extreme events occurring in the area and provide an assessment of an assets, performance in the marine environment throughout its lifetime.

Where insufficient existing data are available to meet a design or operational need, BMT can support design and execution of a metocean measurement campaign to obtain additional site specific data.

Operability at a Marine Terminal, Caribbean

BMT carried out a study of the feasibility of placing an unsheltered LNG Marine Terminal in the Caribbean. This involved conducting an evaluation of arrival and departure manoeuvres as well as the behaviour of the ship at berth.

In-house developed Simulation Software (REMBRANDT) was used to determine the ideal location, alignment, layout and mooring facilities. Using BMT metocean data, a 25-year simulation of operations was conducted which identified the operational downtime, cargo transfer and cargo storage requirements during this period. The study also confirmed that, given an adequate configuration of the terminal, no breakwater needed to be built to achieve acceptable longevity and operational conditions.

Operability at an offshore site, Brazil

An offshore contractor needed to assess the operability at a site offshore Brazil for a series of heavy lift operations. BMT was able to assist by providing a hindcast of full 2-D wave spectra. The data provided enabled the customer to analyse various different scenarios in-house enabling assessment of the response of the vessel to local wave climate and the risks involved with the operation.

Operability at Makassar Straits, Indonesia

Pearl Oil's development of a new oil and gas field in the Makassar Straits required the design of a 350km pipeline to deliver the products to land facilities safely and with minimum risk and detailed criteria study. BMT completed a metocean measurement campaign to gather the data needed to support the pipeline design.

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1: Gas Field Development (Norwegian Sea).

2: The strategy for the metocean basis for design varies according to location, type of structure and available data sets.

3: BMT metocean advisors are able to assist in enabling the optimal design of vessels, sub-sea infrastructure, offshore structures and coastal facilities all over the world.

Design Criteria

Metocean information is essential for the safe and economical design of a marine facility, from the initial concept feasibility assessment through to the final detailed design. Using in-house historical metocean databases, tailored numerical modelling and data analysis expertise, BMT metocean advisors are able to assist in enabling the optimal design of vessels, sub-sea infrastructure, offshore structures and coastal facilities all over the world.

Our understanding of the metocean processes and conditions that influence the design and operation of the marine infrastructure necessary to facilitate oil and gas developments is based on extensive experience in the industry. BMT maintains an suite of proprietary software for the quality control, statistical analysis, extreme value extrapolation and presentation of in-situ, modelled and satellite observed metocean data to ISO engineering standards.

The requirements of a customer can range from general advice for location selection during the pre-feasibility phase of a development through to the detailed metocean criteria required for Front End Engineering Design (FEED).

The strategy for the metocean basis for design varies according to location, type of structure and available data sets.

Gas Field Development (Norwegian Sea)

The scope of this work was to evaluate both extreme design and typical (ambient) operational criteria for a site in the northern North Sea (Norwegian sector). The gas field was situated in approximately 115m water depth. This study involved a detailed comparison of multiple hindcasts generated from a selection of in-house and commercially available modelling tools, in-situ measured (Wave buoys) and satellite data (Altimeter and Scatterometer). The final product was a comprehensive metocean study involving basic extreme criteria, environmental contours, wave spreading and fatigue analyses, plus a full suite of operational criteria presented in tabular and graphical engineering formats, e.g. wind roses, scatter plots. The pre–project and Basic Engineering (“FEED”) is now completed and the customer is entering the detailed engineering phase. Extension of this work provided additional criteria to cover the entire development of the field. BMT metocean advisors are able to support operators and engineers with a metocean strategy for any development, offering straightforward customer focused cost-effective desk studies to support the early stages of a development, through to complex modelling and derivation of the metocean extreme criteria tailored to customer requirements.

Metocean Design Criteria Services Support:

- Feasibility and Site Selection Assessment
- Preliminary Design Criteria
- Front End Engineering Design Criteria Studies
- Terminal Access Channel and Manoeuvring studies
- Breakwater and Terminal Layout Design
- Mooring Layout Design Studies
- Scour Protection Design
- Pipeline Lay Out, Landfall and Burial Design
- Pipeline Free Span Analysis

LNG terminal in Yemen.
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Forecasting Services

BMT utilises advanced forecast modelling at global, regional and local scales all combined with satellite observations and in-situ real-time measurements to identify suitable weather windows for marine operations. We are able to offer dedicated, fine resolution atmospheric and deep water or shallow water wave models, capable of capturing local metocean conditions and wave transformation effects resulting from the local bathymetry or coastal topography.

Forecast services are provided in the offshore and near-shore environments:

- Meteorological forecasts
- Global 24/7 meteorological support
- Wave, current and water level forecasts
- Spectral wave forecasts
- Satellite imagery; including ice density studies
- Tow route forecasts and hindcast studies
- Tropical storm warning and tracking services
- On demand, as required forecast services
- Extended outlooks
- Dedicated fine resolution forecast modelling
- Forensic investigations based on hindcast data sets

With the provision of dedicated site-specific forecast services BMT helps to optimise marine operations in all the world’s oil and gas basins.

Based on a history of involvement with environmental and emergency response consultancy, BMT forecasters are able to integrate forecasts with emergency response systems.

Forecast updates are provided up to four times a day through various distribution channels including email, phone briefing, fax and or a customer dedicated website. The forecast service is nested in an established operational infrastructure which includes back-up facilities, data archives and software support, thus ensuring optimal forecast reliability.

A team of experienced maritime meteorologists provide additional forecast interpretation and specialist services such as operational monitoring, warnings and critical operation support. Fully certified on-site meteorologists can support local interpretation for critical operations.

Java Sea

BMT is providing weather forecasts to an major oil company in the Java Sea. Forecasts are being used to ensure the safe transfer of crews to and from offshore platforms and to optimise operability and minimise risks due to unexpected and unfavourable weather conditions during drilling operations.

Coastal Forecast Services

BMT provides forecast services to support the daily operations at an LNG terminal in Yemen. The service has been customised to optimise the operability of the port facilities by minimizing the number of days where operations are halted due to unexpected conditions. Information provided for this site includes:

- Offshore & near shore wave forecasts
- Tidal elevation and current
- Residual currents
- Warnings for Tropical storms, Tsunami’s and other extreme events
- All forecast information is provided using a dedicated web portal and via email.

BMT forecasters support oil and gas operators and contractors with their day to day operations;

- Meteorological forecasts and information on currents during early seismic exploration
- Weather forecasts during rig moves
- Site specific and forecasting support during weather critical operations, e.g. heavy lifts
- Weather window identification and forecasts for installation and construction
- Operational support for flaring, maintenance and helicopter crew transfer operations

Vessel Consultancy

BMT provides consultancy services to evaluate the operability and safety of ships and other vessels. The combination of BMT in-house naval architecture and offshore engineering knowledge, our in depth hydraulic expertise and metocean capabilities enables an integrated approach to support the design, operability and assessment of vessel performance in the offshore and terminal environment.

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1: Tanker offloading.

2: Tow simulation Gulf of Mexico.

3: REMBRANDT bridge simulator.

> “Our experience with challenging marine operations in critical conditions and our ability to simulate these, makes us a valuable partner in the Oil and Gas sector.”

BMT has available a range of multi-body mooring software (both static and fully dynamic) appropriate for any stage of the design and can evaluate any offloading configuration (tandem or side-by-side, FPSO or Floating Liquefied Natural Gas (FLNG), conventional or circular). This can include the determination of required horizontal access and the deter¬ministic and probabilistic depth determination of a port and or vessel.

Built on many years of experience in all aspects of vessel manoeuvrability, the BMT vessel simulator REMBRANDT has been developed to support a range of navigation and vessel manoeuvrability studies for offshore and terminal operations. REMBRANDT provides the advantage of a real-time, flexible software tool, allowing the design of anchor, mooring lines and terminal configurations to be evaluated in simulated metocean conditions.

Complex operations such as the motion responses of an interacting FPSO and offloading tanker in severe metocean conditions can be analysed by BMT consultants to determine criteria for suspending offloading operations and tanker disconnection.

Weather sensitive procedures for the installation of offshore structures can be simulated at the design and planning stages using BMT software to ensure a safe and cost effective execution.

Tow Simulation Gulf of Mexico

BMT was awarded a contract to provide a Tow Simulation Service for the float out of an offshore structure in the Gulf of Mexico and to test the feasibility of a wet-tow operation. BMT engineered, installed and commissioned a purpose built simulation facility which was located in Houston, Texas for the purpose of training tug captains and other marine personal involved with the inshore phase of the tow.

Included in the simulation was the ability to control seven independent tug boats coupled via lines to the hull to perform the 15 mile tow. REMBRANDT’s real time manoeuvring training software was the basis for the simulator. The simulator gave a realistic hands-on facility for tug captains to develop safe operating strategies for the tow and develop weather and tide operating limits.

Marine Terminal Qatar

BMT carried out a navigation simulation study using REMBRANDT to evaluate the feasibility of a new proposed marine terminal in Qatar. During the simulations the Pilot controlled three purpose designed vessels directly through a control console replicating actual ship controls and issued appropriate tug orders which were carried out by a member of BMT staff. The Pilot had the following information available in real-time:

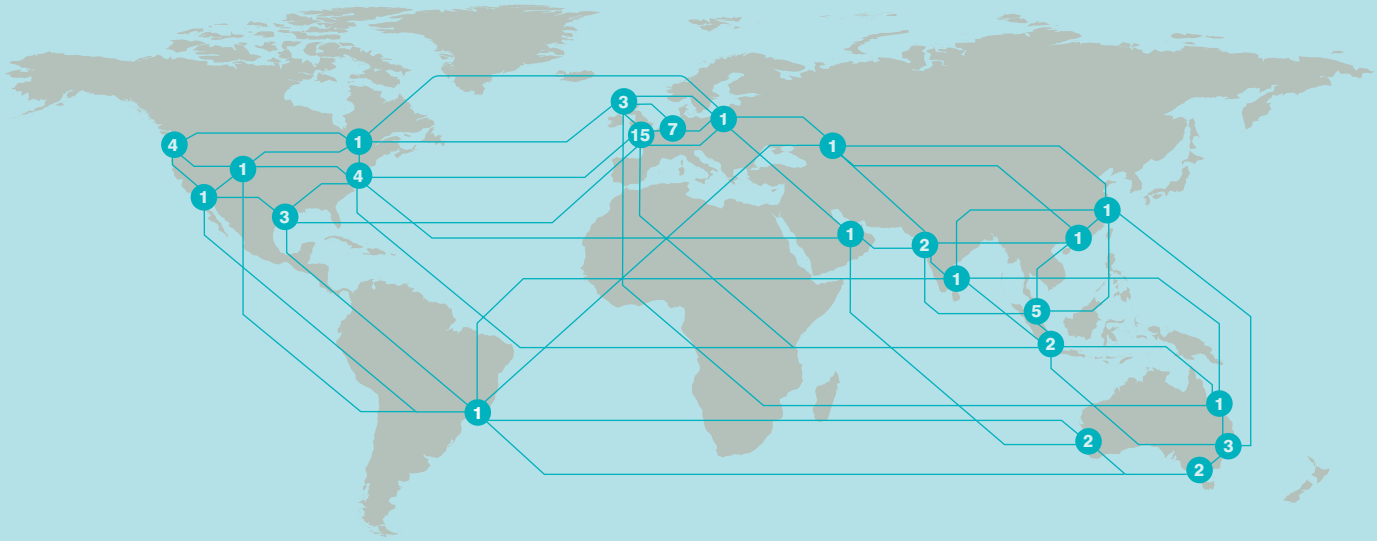
- The electronic chart view
- 3D view from the ship’s bridge
- Run information
- Position and percentage of power

Vessel operations services provided:

- Assessment of conditions for safe arrival and departure of vessels
- Establishment of mooring and berthing loads
- Workability for loading and unloading operations
- Evaluation of the motion responses of FPSO, Tanker and LNG carriers during offloading
- Forensic investigation of marine incidents
- Detailed vessel manoeuvring simulation to validate and exercise critical operations

BMT is an international design, engineering and risk management consultancy, working principally in the energy and environment, transport and defence sectors.

With locations in all of the major markets we serve, ours is an active network that sees us sharing skills and knowledge, combining disciplines and building international teams to create integrated answers to the questions of our national and international customers.



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