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Guidelines for the Selection and Operation of Jack-ups in the Marine Renewable Energy Industry

Industry guidance aimed at jack-up operators, developers and contractors

Version 1

Acknowledgements

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The Working Group

Mr Jeremy Carnell	PMSS	Chair
Mr. David Pettigrew	Fugro Seacore	Member
Mr. Peter Hodgetts	Searock	Member
Mr. Ian Johnson	E.ON Climate & Renewables	Member
Mr Kevin Lennon	Vestas Offshore	Member
Mr Chris Mallett	London Offshore Consultants	Document author / editor
Mr John Trickey	London Offshore Consultants	Document author / editor
Mr Mike Frampton	London Offshore Consultants	Document author / editor

Key Consultees

Mr. Thomas Broe	A2sea
Mr. Tony Millward	A2sea
Mr. Bill Cooper	ABP Marine Environmental Research
Mr. Stephan Henrikson	Dong Energy
Mr. Huw Powell	EMU
Mr. John Gleadowe	Fugro Seacore
Mr. Chris Garratt	Garrard Hassan
Mr. Bill Hodges	Global Maritime
Mr. Gary Hogg	Global Maritime
Mr. Alan Dixon	The Health & Safety Executive
Ms. Judith Tetlow	The Health & Safety Executive
Mr. John Howard	Howard Marine
Mr. Ad Van der Pennen	Jack-up Barge BV
Mr. Duncan Wilson	MPI
Mr. Malcolm Blowers	MPI
Mr. Mark Hayward	Noble Denton
Mr. Mike Hoyle	Noble Denton
Mr. Julian Garnsey	RWE NPower Renewables
Ms. Samantha Henshaw	PMSS
Mr. Jim Sandon	RES
Mr. Julian Osbourne	RPS
Mr. Spencer Chiu	RPS
Mr. Tjerk Suurenbroek	Seafox Contractors
Mr. John Vingoe	Seajacks
Mr. Rob Maynard	Searock
Mr. Christian Seeberg Braun	Siemens Wind Power
Mr. Joris Wortelboer	Smit
Mr. Per C. Finsaas	Statoil Hydro
Mr. Henning Norholm Just	Vestas Offshore
Mr. John Fris Londal	Vestas Offshore
Mr. Christopher Andersen	Windcarrier AS

Preface

The UK has potentially the largest offshore wind resource in the world, with relatively shallow waters and a strong wind resource extending far into the North Sea. The UK has been estimated to have over 33% of the total European potential offshore wind resource - enough to power the country nearly three times over. The growth in UK offshore wind farm projects has increased substantially in recent years. Many Round 1 (see Crown Estate) developments are operational or nearing completion with a number of Round 2 projects well into the development phase. Bids for Round 3 projects closed in March 2009.

The precise scale and timelines for future offshore developments are not finalised but what can be expected is a substantial increase in offshore construction and operation and maintenance activities. Jack-up barges, which are the focus of these guidelines, are likely to play a major role.

BWEA is committed to raising Health and Safety standards across the wind, wave and tidal electrical generation sector. The justification for these guidelines is twofold:

- Safety: jack-ups are often large and complex vessels that can operate in extreme environmental conditions. Failure to ensure the correct selection and operation of these vessels could have serious safety implications including loss of life.

- Knowledge: some participants in this growth sector may be less familiar with the key Health and Safety issues, legal standards and industry practices for Jack-up operations.

For these reasons BWEA commissioned LOC in 2008 to deliver these guidelines in order to raise the knowledge and awareness of the issues to the industry and to share proven good practice.

These guidelines will be reviewed periodically by BWEA to reflect improvements and technology changes in Jack-up design and operational practice.

STATUS

These guidelines have been developed in consultation with the industry to reflect established and proven good practice and sound methodology in the selection and operation of jack-up's in the offshore wind, wave and tidal industries.

The guidelines are not a standard in their own right, but do make reference to the relevant parts of a number of existing and established marine standards in the text.

There is no compulsion for the industry to adhere to these guidelines but in the opinion of the authors and BWEA careful cognisance of and adherence to the guidelines together with sufficient competence in this field of activity will minimise risk of unsafe acts or conditions arising during jack-up operations.

It is likely that in the event of a marine jack-up incident that is subject to investigation by UK enforcement agencies this guidance may be referenced as 'industry good practice' to which it would be expected that measures equal to or better than those in the guidance are in place.

DISCLAIMER

The contents of this guide are intended for information and general guidance only, do not constitute advice, are not exhaustive and do not indicate any specific course of action. Detailed professional advice should be obtained before taking or refraining from taking action in relation to any of the contents of this guide or the relevance or applicability of the information herein.

Contents

Appendices

1. Introduction

1.1 Instructions

This document has been prepared by London Offshore Consultants Limited for BWEA following various BWEA/HSE discussions and consultations with others involved with the jack-up industry. The report provides guidelines on the safety and integrity of jack-up rigs deployed in the marine renewable energy industry.

1.2 Nature of the guidelines

This guidance is intended to be relevant to all organisations contributing to the operation of jack-up vessels in nearshore areas but it is particularly relevant to jack-up owners' or operators' technical staff and crews responsible for the operation of jack-up vessels and to project managers in the marine renewable energy industry.

These guidelines have been drawn with care to address what are likely to be the main concerns based on the experience of this working group and others. This should not be taken to mean that this document deals comprehensively with all of the concerns which will need to be addressed or even, where a particular matter is addressed, that this document sets out the definitive recommendations to be followed for all situations.

The guidance is based upon the assumption that the user is familiar with the fundamental aspects of the marine operations of jack-up barges. Those less familiar with these vessels may find it useful in the first instance to acquire a basic understanding of the different types of jack-ups and the risks associated with their various operating modes. This information can be obtained through study of background reference material listed in Appendix A.

This document should be treated as providing guidelines for good industry practice to be followed for the selection and operation of jack-ups. The guidelines contained in this document should be reviewed in each particular case by persons responsible to ensure that the particular circumstance is addressed in a way which is adequate and appropriate.

Nothing contained in these guidelines shall relieve the owners, operators, managers or masters and crews of the jack-ups of their responsibility for exercising sound judgement based on education, training and experience.

These guidelines are not intended to exclude alternative methods, new technology or new equipment, which may provide an equivalent or greater level of operational safety.

This guideline is based on and as far as is reasonably practicable is consistent with the guidance contained in existing reference documents listed in **Appendix A.**

1.3 Area of application

This guideline shall be deemed to apply to all jack-ups operating in the inshore and coastal waters adjacent to England, Scotland, Wales and Northern Ireland in the area bounded by Highest Astronomical Tide (HAT) and the seaward limit of the UK territorial waters, and to all areas that are located within UK Renewable Energy Zones (REZ) beyond the UK territorial waters seaward limit 12 miles offshore.

1.4 Terms and definitions

See glossary containing definitions, terms and abbreviations used in this guideline in **Appendix B**. Defined terms used in this guideline have been italicised in the text.

2. Legislation and guidelines

2.1 Reference is requested to BWEA Guidelines for Health and Safety in the Marine Energy Industry, which provides a basic introduction on the legislative requirements that govern the operations considered in this guideline. Particular reference shall be made to:

- The Health and Safety at Work Act 1974
- The Management of Health and Safety at Work Regulations 1999
- The Construction (Design and Management) Regulations 2007 (CDM)
- Provision and Use of Work Equipment Regulations 1998 (PUWER)
- Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)

2.2 Contractors shall ensure that they fully understand and comply with the CDM regulations when operating jack-ups engaged on projects to which these regulations comply. A guide to these regulations is contained in the Approved Code of Practice (Managing Health and Safety in Construction) (ACOPS).

2.3 The adoption of codes and standards for the design, construction, and operation of jack-ups and attending vessels is governed by marine legislation promulgated by the state in which the vessel is registered (the flag state) and by the state which, by international agreement, has been assigned control over the waters in which the jack-up is operating (the port state).

2.4 Jack-up vessels in transit and positioning within UK waters are governed by the Merchant Shipping Act and the Marine and Coastguard Agency (MCA) is the principal government agency responsible for monitoring the implementation of UK marine legislation. In accordance with this legislation, jack-up operators shall arrange to receive Merchant Shipping Notices (MSN), Marine Guidance Notices (MGN) and Marine Information Notices (MIN) issued by the MCA and they shall heed warnings and comply with advice contained therein.

2.5 In addition, jack-ups shall comply with regulations issued by local port or river authorities and harbour masters whenever they are in transit or engaged in elevated operations in waters controlled by such authorities.

2.6 Jack-ups shall be designed, constructed and operated in compliance with the rules, standards, and codes applicable to their flag, type, tonnage, size and manning. These rules have been adopted under the terms of the International Conventions on Maritime safety and Marine Pollution and subsequent protocols and amendments as produced by the International Maritime Organisation (IMO).

- International Safety Management (ISM) Code 2002
- Safety of Life at Sea (SOLAS 1974)
- International Convention on Loadlines 1966
- Preventing Collisions at Sea Regulations COLREGS
- Standards of Training, Certification and Watchkeeping for Seafarers (STCW) 1978
- Prevention of Pollution from Ships MARPOL 1973/78
- Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972
- Incidents by Hazardous and Noxious Substances, 2000 (HNS Protocol)
- Control of Harmful Anti-fouling Systems on Ships (AFS), 2001

The list above includes the conventions and codes likely to apply to jack-up operations in the area considered; however, this list is not exhaustive. The responsibility for obtaining all relevant IMO documents and any latest amendments rests with the jack-up owner or operator.

2.7 The United Kingdom Health & Safety Executive (HSE) is responsible for enforcing all of the relevant Health and Safety legislation pertaining to work activity in Britain including work activities on jack-ups operating in UK Territorial Waters or within the UK Exclusive Economic Zone (EEZ). Therefore jack-up operators should obtain copies of current HSE Research Reports Information Sheets and Offshore Technology Reports relevant to jack-up operations [Appendix A] and be guided by the advice contained therein.

3. Jack-up management and manning

3.1 Registry and class

3.1.1 Jack-ups should be officially entered on a vessel registry maintained by a *recognised maritime nation*.

3.1.2 Jack-ups certified to operate only within a specific trading area or within a limiting distance from a safe haven shall operate only within the limits prescribed by their *flag state* as stated on the jack-up's registry certificate or certificate of seaworthiness and trading area.

3.1.3 *Permanently manned jack-ups* fitted with *certified accommodation* and jack-ups exceeding 24m in length shall be classed and class maintained in accordance with the rules of a *recognised classification society*.

3.1.4 *Unmanned jack-ups* not fitted with *certified accommodation* and not exceeding 24 metres in length that are not classed shall be certified in accordance with the MCA Small Commercial Vessel and Pilot Boat (SCV) Code as set out in MGN 280, or certified in accordance with equivalent foreign rules promulgated by the *flag state*.

3.1.5 It is recommended that *permanently manned jack-ups* operating in *unrestricted mode* are classed by a member of the International Association of Classification Societies (IACS) with jack-up experience and having established rules and procedures for the classification of jack-up hulls, legs and machinery including elevating and holding systems. Such classification societies can usually be identified through the *class notation,* which should include the term "self elevating" to confirm that the jack-up has been designed, constructed and maintained to operate in both floating and elevated modes.

3.1.6 It is recommended that *permanently manned* jack-ups fitted with *certified accommodation* are certified in compliance with the MODU code. In the absence of a MODU (or MOU) certificate, the vessel should, as a minimum requirement, be provided with a class certificate or statement of facts verifying the provision of adequate safety equipment for the type of vessel and for the number of personnel on board.

3.1.7 It is a fundamental requirement that the jack-up hull, machinery and equipment shall be maintained in satisfactory condition. An adequate inventory of spare parts should be carried on board. Particular attention should be paid to the provision of replaceable parts for critical jacking system and power system components, where failure of such parts could render the systems inoperative.

3.1.8 It is recommended that site developers obtain an independent suitability survey or general condition survey prior to hiring a jack-up; however, the type and condition of the vessel can provisionally be assessed by review of the specifications and the registry and class certificates and survey reports [Appendix C]. Particular attention should be paid to the valid dates and any outstanding items or recommendations related to the class approval of design, drawings, manuals, materials, fabrication, modification, maintenance, damage or repair as listed on the document attachments.

3.1.9 Outstanding class items or recommendations should be reviewed by a *competent person* in order to determine whether any listed defect or deficiency could create unusual risk or otherwise adversely affect the proposed operations. The *competent person* should recommend, where appropriate, that these be rectified before the jack-up is deployed. Particular attention should be paid to the structural strength and watertight integrity of the jack-up, the operability of the jacking system and the provision of safety equipment.

3.2 Draft and leg height marks

3.2.1 Draft marks shall be clearly marked on each side of the jack-up hull at each end in accordance with the rules contained in the International Convention on Loadlines 1966. Jack-ups exempted under these rules shall carry the same marks.

3.2.2 Leg height marks shall be clearly marked on each leg at vertical intervals not exceeding one metre. A fixed point at the deck level or on the jack-house or jack-frame top shall be marked as a reference point against which the leg height marks can be read. The leg height marks and the fixed reference points should normally be clearly visible from the jacking control position.

3.2.3 Where the configuration of the jack-up is such that leg height marks and reference points cannot be observed from the jacking control position and where no mechanical or electronic leg height measurement system is fitted at the control position, then trained crewmembers will usually be required to relay leg height information to the jacking engineer during jacking operations.

3.2.4 Jack-ups shall be fitted with longitudinal and transverse inclinometers capable of providing accurate readings of tilt to within 0.2 degrees of accuracy or better. These instruments shall be calibrated to ensure accuracy.

3.3 Certification and documentation

3.3.1 Original certificates, documents, publications and drawings listed in **Appendix C** should be carried on board the jack-up. Certificates for jack-ups not fitted with permanent superstructures, enclosed control rooms or accommodation may be kept on board the towing vessel or at the owner's office and should be made available for inspection prior to vessel deployment. Holding copies of certificates and documents on board or ashore is a sensible precaution but presentation of copies should not be accepted as proof of validity.

3.3.2 Every jack-up shall be provided with an operating manual. The contents of the operating manual should contain, as a minimum, the information listed in **Appendix D** of this guideline.

3.4 Management

3.4.1 Certification or registration of jack-up owners' or operators' companies to a standard recognised by the International Standards Organisation is not an absolute requirement; however, in the absence of such accreditation, they should be independently audited to verify that they practice an acceptable standard of management.

3.4.2 Standards of vessel management that are certified under the provisions of the IMO International Safety Management (ISM) code will be deemed satisfactory. In the absence of ISM Certification, it shall be demonstrated that the vessel is managed in accordance with a documented procedure that includes the key requirements of the ISM Code.

3.4.3 The safe management of jack-ups requires a wide range of technical skills:

- Structural and offshore engineering
- Vessel design and analysis
- Vessel machinery operation, maintenance and repair
- Navigation, seamanship and offshore operations
- Meteorology
- Soil investigation and analysis

Where technical staff holding the relevant qualification and with the appropriate training and experience are not employed by the owners or operator of the jack-up then a *competent person* must be outsourced as appropriate.

3.4.4 Jack-up owners and operators shall formulate, publish and enforce a drug and alcohol policy.

3.5 Manning

3.5.1 Jack-ups shall be manned in accordance with the Safe Manning Certificate if so certified. Jack-ups less than 24m in length shall be manned in accordance with the MCA Small Commercial Vessel and Pilot Boat (SCV) code as set out in MGN 280 or equivalent foreign rules promulgated by the flag state.

3.5.2 Whether certified or otherwise, jack-up masters and any licensed person authorised by the master to operate the radio equipment shall demonstrate proficiency in the English language. All emergency and external operating communications shall be conducted in the English language. In addition to the master, a sufficient number of the crew shall be proficient in English so that orders and instructions can be translated swiftly and effectively to non-English speaking crewmembers or project personnel. Internal instructions may be conducted in the common language of the crew.

3.5.3 In every case, jack-up owners or operators shall man their vessels with sufficient crew to manage the vessel and the marine operations making proper allowance for rest periods. The following key positions are usually manned on jack-ups more than 24m in length.

1. Vessel or barge master (offshore installation manager)
2. Tow master for transit and positioning (may be covered by (1) above)
3. Jacking engineer (may be covered by (1) above except where (1) is tow master)
4. Engineer, motorman or mechanic
5. Electrician (may be covered by (4) above if competent)
6. Welder (may be covered by (4) above if competent)
7. Crane operator(s) (units fitted with cranes)
8. Boatswain and seamen (number sufficient for the size of the jack-up)
9. Deck foreman and riggers (as required for operations)
10. Catering crew (as appropriate for the number of persons on board)
11. Medic (may be an individual or any trained crewmember assigned to this duty)

3.5.4 The medic (or paramedic) should as a minimum hold a First Aid at Sea Certificate or Medical First Aid certificate and in some cases should hold a Proficiency in Medical Care Certificate (or its predecessor, the Ship Captain's Medical Certificate). For jack-ups <24m in length reference is requested to refer to the Small Vessel Code MGN 280 annex 3 page 118. The limitations of the basic training related to these certificates should be recognised and in some cases a higher qualification will be appropriate. The level of training, proficiency and qualification required in each case should be determined through a risk assessment carried out considering the:

- Number of persons on board
- Proximity to the shore
- Vessel and site equipment's capacity for rapid medivac
- Access by emergency services (including coastguard helicopter and RNLI)
- Access restrictions imposed by the jack-up configuration, weather or tide

3.5.5 Masters and crew serving on self-propelled jack-ups shall be in possession of valid Certificates of Competence issued under the provisions of the STCW 95 as required by the vessel's Safe Manning Certificate, including GMDSS Operator's Certificates and DP endorsements as appropriate.

3.5.6 It is noted that the Jack-up Owners Association has expressed an intention to develop a competence framework for barge masters; however, there is currently no statutory requirement for certification or training of crews serving on non-propelled jack-ups. Notwithstanding the lack of a statutory requirement, it is recommended that barge masters serving on *permanently manned* jack-ups should be in possession of a Certificate of Competence in a marine grade and, in addition, should have received formal training in jack-up operations.

3.5.7 Whether certified or otherwise, the barge master shall, as a minimum, demonstrate a satisfactory level of competence in the areas listed below. Competence may be demonstrated through Certificates of Competence issued under the provisions of STCW 95 or through other certification or accreditation, or in the absence of such documents, through documented work experience and references.

- Applicable laws and regulations
- Vessel management
- Marine operations, equipment and practices
- Marine firefighting
- Operation of survival craft and sea survival
- Pollution prevention
- The GMDSS system and operation of radio equipment
- First aid
- Meteorology for mariners
- Management of barge floating stability and jack-up elevated loads
- Jacking operations and foundation hazards

and shall, as a minimum, be in possession of:

- GMDSS Radio Operators Certificate
- Sea Survival Certificate
- First Aid Certificate (or higher qualification)

3.5.8 There is currently no statutory requirement for certification or training of jacking engineers; however, it is recommended that jacking engineers receive formal training in jack-up marine operations including the fundamentals of jack-up soil foundations. Most importantly, the jacking system shall be operated only by, or under the supervision of, persons who have been trained to operate the type of system fitted to the jack-up on which they serve.

3.5.9 Crane operators shall be in possession of a Crane Operator's Certificate appropriate for the operation of the equipment installed.

3.5.10 Jack-up crew members shall be in possession of:

- Valid certificates of Basic Offshore Survival Training of the type provided in the course of induction for personnel engaged in the offshore oil & gas industry (For example: UK OPITO Basic Safety Induction and Emergency Training) or similar merchant navy training for seafarers
- Valid certificates of Medical Examination appropriate to service offshore or in the merchant navy (for example: UKO or (UK) ENG-1 or foreign equivalent)

4. Planning of jack-up operations

4.1 Suitability of the jack-up

4.1.1 The design of site-specific specialist structures and construction planning for the installation of the structures is a separate activity which may form the basis of jack-up selection. This will usually pre-date the selection of the jack-up; however, it should be recognised that construction planning may be influenced by the type and capacity of jack-ups likely to be available at the time the plans are to be executed.

4.1.2 The suitability of a jack-up for a particular operation can only be determined if the objectives to be achieved and the operations necessary to achieve the objectives are thoroughly understood. Based on this understanding, the jack-up's type and operating limits must be assessed in consideration of the conditions likely to be encountered on the intended transit route and at the selected work site in order to determine whether the jack-up is capable of undertaking the required operations safely and efficiently.

4.1.3 Jack-ups are not designed, constructed or intended for unlimited service at sea. Each stage of the proposed operations must be considered separately because different limiting environmental criteria will apply to each sequential jack-up operating mode. Jack-up operations can typically be divided into the following stages:

- Mobilisation
- Loadout
- Transit (including jacking down and refloating)
- Positioning (including jacking up and preloading)
- Elevated operations (including lifting and load transfer operations)

4.1.4 The suitability of a jack-up for transit will depend upon the characteristics of the sea route and the unit's seaworthiness and sea keeping capability. The suitability of the jack-up for elevated operations at any location is determined by a *site-specific assessment*. This assessment is a study of environmental, bathymetric and seabed soils data relevant to that location, together with a leg footing penetration analysis and a structural assessment of the rig itself to determine whether the unit is capable of:

- Avoiding contact with seabed obstructions or debris
- Achieving a stable foundation in the seabed soils
- Elevating high enough to stand above the predicted extreme wave crests
- Withstanding the static and dynamic loads imposed upon it when elevated
- Safely extracting the legs from the soil on removal from the location

4.1.5 Preliminary site-assessments based solely on information related to the site water depth and the jack-up's leg length may serve to exclude some units from consideration for proposed works at an early stage. Similarly, preliminary assessments based solely on *nomograms* may be useful but these should be treated with some caution because they may use safety factors less than those associated with the *recommended practice* and they may be based on assumed assessment parameters that are different to those at the site.

4.1.6 It is stressed that the suitability of any jack-up for elevation and for the performance of the necessary operations on site can only be properly judged by means of a *site-specific assessment* carried out in accordance with the *recommended practice*.

4.1.7 The fundamental suitability of a jack-up should be established prior to planning or executing jack-up operations. Outline guidance on suitability is included as the final **APPENDIX I.**

4.2 Requirement for planning

4.2.1 Jack-up *transit, positioning and elevated operations* should be planned and prepared in accordance with the provisions described in this guideline. The planning should include the provision of a documented procedure (or method statement) for each stage of the operation and an estimated time for the conduct and completion of each stage together with an adequate contingency for delay.

- Departure from the present location
- Passage between locations
- Arrival and positioning at the new location
- Elevated operations to be undertaken at the new location

4.2.2 In addition to the documented procedure, a full risk assessment of planned operations should be undertaken, and an emergency response plan and Health and Safety plan should be developed, both of which should be available onboard the vessel. The responsibilities and lines of communication should be clearly stated.

4.2.3 The procedure document should address the:

- Objectives to be achieved
- Operations necessary to achieve the objectives
- Operational procedures to be adopted
- Vessels, equipment and services required to conduct the operations
- Geophysical, geotechnical, environmental and operating constraints and limits
- Organisation and responsibilities of the parties and personnel involved
- Communications
- Contingency plans

4.2.4 Generic procedures for refloating, towing or self-propulsion, *dynamic positioning, jacking, preloading,* and *elevated operations* as applicable to the routine operation of the jack-up are usually included in the vessel's operating manual.

4.2.5 Detailed procedures for the safe operation and maintenance of the jacking machinery should be provided in the form of a jacking system manual if not included as part of the operating manual. Similarly, detailed procedures for the operation of vessel equipment such as engines, bilge and ballast systems and mooring systems should be provided in the vessel's equipment manuals. These manuals need to be referred to, but may be excluded from the procedure document.

4.2.6 The operating manual and procedure documents shall be prepared in the English language.

4.2.7 All aspects of the planning shall be subject to review by a *competent person*. The planning and the review shall include the aspects detailed below.

4.3 Planning jack-up transit

The jack-up's limits afloat (including leg strength and securing arrangements) should be considered and the aspects to be documented and reviewed shall include the:

- Defined environmental criteria and duration of the transit
- Stability calculation and watertight integrity of the jack-up
- Motion response of the jack-up in the design sea state considered

- Strength of the cranes, deck equipment and seafastening arrangements
- Details of the cargo and stowage plan
- Strength of the cargo together with the grillage and seafastening arrangements
- Towing arrangement plan, towing equipment and tug specifications (towed jack-ups)
- Passage plan (all transits)

4.3.1 It should be verified that the arrangements listed above are adequate for the intended transit and sufficient to withstand the loads and motions for the jack-up's condition afloat.

4.3.2 The tugs together with the towing arrangements and towing equipment should be verified as suitable for the proposed transit and in compliance with the requirements set out in this guideline.

4.3.3 It should be verified that the transit route has been planned in accordance with the principles of good seamanship having due regard for narrows, water depths, *squat* effects, tidal heights and currents, vessel traffic and separation systems and all navigational hazards. The jack-up's air draft with legs fully raised should be considered in connection with maintaining safe clearances below overhead obstructions such as bridges and cables. It should also be verified that the provision of navigation equipment, charts, tidal data, and nautical publications is adequate to complete the transit safely.

4.3.4 The transit route should be documented and should include designated safe havens en route and/or alternative safe jacking locations. The maximum transit time between safe havens or alternative jacking locations should be considered having due regard for the time required for jacking down, transit, positioning and jacking up to the minimum safe air gap at the next location.

4.3.5 Seabed surface and soil conditions at alternative safe jacking locations shall be investigated and documented as suitable for *positioning*. The selection of alternative jacking locations with very soft soils or locations where risk of rapid settlement is deemed to exist should be avoided.

4.3.6 The risk of failure of propulsion machinery or towing gear should be considered. Routes passing rocks, shoals and other hazards to navigation should be planned with allowance, where practicable, for time to repair machinery and reconnect the tow and for possible drift during such operations.

4.3.7 Planning jack-up *transits* shall include arrangements for the provision of marine weather forecasts obtained from a recognised meteorological authority in accordance with the detailed requirements described in section 18.3.

4.3.8 The planning should include contingency plans and emergency procedures as detailed in Section 19.

4.3.9 Planning jack-up transits should include information on the departure location and the proposed arrival location together with the arrangements for positioning the jack-up on location as follows.

4.4 Planning jack-up positioning

4.4.1 The planning and review shall include a *site-specific assessment* in accordance with the *recommended practice* for the jack-up at the proposed arrival location.

4.4.2 The procedure document shall include or make reference to the jack-up soils assessment and the *site-specific assessment*. These documents shall be placed on the jack-up and shall be reviewed by the persons responsible for positioning the jack-up in advance of the move.

4.4.3 The planning should also include site-specific jacking and preloading procedures (if any) that may have been developed in response to previously identified jack-up foundation hazards and/or recommendations (if any) contained in the site-specific assessment or the soils investigation and assessment reports.

4.4.4 In considering the suitability of jack-up rig locations due consideration should be given to site accessibility. The marine aspects of the approach to and positioning at the arrival location such as water depth, tidal range, tidal current velocity, duration of slack water and navigational hazards should be considered. Particular consideration should be given to the proximity of fixed or floating installations and sub-sea pipelines and cables. It needs to be demonstrated in the plan that the site can be reached without incurring unusual marine risk.

4.4.5 The plan shall include details of the method to be employed and the tugs, moorings and survey equipment required to move the jack-up into position afloat at the required geographical co-ordinates and on the required heading.

5. Weather restricted and unrestricted operations

5.1 Operations considered

5.1.1 Jack-up operations in the following modes are considered:

1. Afloat under tow
2. Moored afloat
3. Partly elevated with the hull partly buoyant in leg-stabilised mode
4. Elevated in the operating mode at a working air gap
5. Elevated in the survival mode at air gap ≥ the minimum recommended safe air gap

5.1.2 Most jack-ups are required to operate in *unrestricted mode (5)* above, because the nature of their activity requires that they remain on location for many days or weeks and the distance offshore and the complexity of their equipment and moving arrangements means that they cannot be quickly or easily removed to shelter.

5.1.3 Jack-ups that are not designed or constructed to achieve the survival air gap or to withstand the stresses likely to be imposed by the 50 year design storm in the elevated condition may operate safely in *weather restricted mode* in accordance with the guidelines for *weather restricted operations*.

5.2 Jack-up - unrestricted operations

5.2.1 Good industry practice for *unrestricted operations* elevated requires that the jack-up be capable of elevating to the minimum survival air gap and that the unit's design meets the minimum acceptance criteria for survival elevated as defined in the *recommended practice*.

5.2.2 The *site-specific assessment* (section 10) shall demonstrate that the unit is capable of remaining safely elevated on location in the prescribed 50 year extreme storm condition or the 10 year extremes for the de-manned condition (section 10.2.4) with a limited amount of additional penetration and with all structural stresses remaining within allowable limits.

5.2.3 When operating in *unrestricted mode*, the hull elevation for survival mode is to be set at or in excess of a minimum elevation to provide for 1.5 m clearance above the 50 year return period wave crest or to just clear the 10,000 year return period wave crest, whichever is greatest.

5.2.4 Seasonal variations in the 50 or 10 year extremes may be considered if the jack-up is to remain on location for a limited period only during specified months.

5.2.5 Storm directionality may be considered if there is sufficient reliable evidence that the extreme wind, waves and current at the location are directional. In such cases it may be possible to orientate the jack-up on the most advantageous heading in order to achieve the required values for the checks associated with the acceptance criteria. Particular care shall be taken in making assessments where the environmental conditions are highly directional, that is where they may change significantly over only a few degrees.

5.3 Weather restricted operations

5.3.1 Jack-up operations in the first four modes listed in (5.1) above may be undertaken as a *weather restricted operation*. In this case the jack-up's design limits for each mode and the limiting weather criteria for each mode must be clearly defined in advance. With due regard for the confidence in the predicted weather conditions, planning must be in place to remove the jack-up to shelter afloat or to an alternative safe location where the jack-up can be elevated before the onset of any weather that is forecast to exceed the specified limits.

5.3.2 The conduct of a *weather restricted operation* requires that detailed site-specific marine weather forecasts be obtained from a recognised authority at intervals no greater than 12 hours (section 18.3).

5.3.3 The planned duration of a *weather restricted operation* should not normally exceed 72 hours. However, the duration may be indefinitely extended in prolonged periods of benign weather provided that the limits for the restricted mode are never exceeded, and provided also that a future weather window suitable for moving the jack-up to the safe location is clearly and consistently identified by the duty forecaster with a high level of confidence on each weather forecast.

5.3.4 If a future weather window for safe removal of the jack-up cannot be identified with a high level of confidence within the next 72 hours and risk of continued severe weather to follow is deemed to exist such that the limits for the restricted mode (as defined in paragraph 5.3.1) could be exceeded, then the jack-up should be moved to shelter immediately before the sea state limit for jacking down and moving off location is approached or exceeded.

5.3.5 The conduct of *weather restricted operation* requires that a procedure document shall be in place containing details of the proposed work schedule with particular reference to the anticipated duration of each operation, the time needed to suspend operations and to reach the nearest safe haven or safe elevated location and to complete positioning. A contingency for delay caused by leg extraction problems, waiting for slack water, breakdown or other delay shall be allowed. In no case shall the total time estimated for suspension of operations, removal to shelter and positioning at the safe location exceed 48 hours including contingency for delay.

5.3.6 A safe jack-up location may be a port or a sheltered bay or estuary where the jack-up can remain afloat under tow or moored, or a location where the jack-up can be elevated providing:

- The strength of the seabed soils is known to be sufficient to support the jack-up without further settlement after preloading
- The jack-up can be elevated to or above the minimum survival air gap
- The jack-up is capable of achieving the survival mode with all stresses remaining within allowable limits

5.3.7 As part of an emergency response procedure, where insufficient time remains to reach a safe jack-up location before the anticipated onset of adverse weather and where the risk of remaining afloat is deemed to be greater than the risk of elevating on a location with an unproven jack-up foundation, then consideration should be given to elevating the jack-up on the nearest location with suitable water depth before the onset of adverse weather, whether the strength of the seabed soil is known or otherwise.

5.3.8 The action described in 5.3.7 (above) should only be attempted at the master's discretion following receipt of advice from the *designated person ashore* and the Maritime Rescue Coordination Centre (MRCC). In these circumstances, and where practicable, it is recommended that all non-essential personnel should be removed prior to elevation and consideration should be given to temporarily abandoning the jack-up as soon as it has been preloaded and elevated to the minimum survival air gap.

5.3.9 It should be recognised that the operation of a jack-up in *weather restricted mode* may result in prolonged delays caused by the potential for frequent interruption of the work in order to move the jack-up to shelter to await a suitable weather window (or series of weather windows) of sufficient length to continue the proposed works. The limiting condition for the movement of most jack-ups is with significant wave heights between 0.5m and 1.5m. The incidence of such benign conditions may be infrequent and of short duration in many areas, particularly in the winter season.

5.3.10 It should also be recognised that the operation of a jack-up in *weather restricted mode* involves higher risk than operation in *unrestricted mode* and consequently the planning and execution of a *weather restricted operation* requires a high level of competence. In consideration of the higher risk, developers or contractors may consider it appropriate to engage Marine Warranty Survey Services for review and approval of the procedures.

6. Floating condition: motions and stability

6.1 Application

6.1.1 Jack-up dry transport, self-propelled jack-up ocean transit and non-propelled jack-up ocean tow is not considered in this guideline. This guideline applies only to jack-up *location moves* and *field moves*. Guidance on ocean towing can be found in Noble Denton 0030/ND Dated 15/04/200 Guidelines for Marine Transportations and IMO Guidelines for Safe Ocean Towing, December 1998 (MSC/Circ.884).

6.2 Design environmental criteria

6.2.1 This guideline assumes that all *transits* of self-propelled jack-ups when carrying project cargo and all *transits* of non-propelled jack-ups with or without cargo will be undertaken as a *weather restricted operation* with the jack-up essentially in *field move* configuration.

6.2.2 Specific environmental criteria shall be defined for a *weather restricted operation* and these shall be appropriate to the planned route and the duration of the tow.

6.2.3 The duration of the passage under power or under tow should include any additional time for jacking and preloading on site and any standby time that may reasonably be expected as a result of delays. Planned contingencies for diversion at any point en route to reach a place of shelter should be in place.

6.2.4 The design seastate for a jack-up transit conducted as a weather restricted operation shall be based on the *significant wave height* (Hs). Typically, the maximum wave height will be 1.86Hs. The design wind speed shall be the one-minute average velocity at 10m above sea level. The incident wave shall be considered to be omni-directional.

6.2.5 The operating criteria shall be set lower than the design criteria to allow for potential inaccuracy in wave height forecasts. Typically weather restricted towages should not commence in seastates greater than 50% of the design maximum as the observer will often report the significant wave heights rather than the maximum wave height.

6.3 Motion response criteria

6.3.1 The jack-up, cargo, grillage and seafastenings shall be designed to withstand the motions and forces resulting from the design environmental criteria. Friction shall be ignored. It is recommended that either a motion response analysis is made or that model tests are performed for each case.

6.3.2 The motion response analysis should utilise proven software and techniques. For both motion response analysis and/or model tests, a realistic combination of environmental loads and wave directions and periods, representing bow, stern, quartering and beam sea conditions shall be used. If required, the analysis shall be validated by correlation with model tests for similar units or by performing new model tests. Alternatively, additional analysis may be performed covering more seastates or using different software

6.4 Default motion criteria

6.4.1 Alternatively, and subject to consideration of the length of the voyage, the risks involved and any mitigating factors for reducing the risks, the jack-up, cargo, grillage and seafastenings shall be designed to withstand the motions and forces derived by using

default motion criteria tabulated below.

Type of jack-up	Barge dimensions L & B m	Roll amplitude degrees	Pitch amplitude degrees	Heave acceleration m/s^2
Large jack-up	LOA ≥ 76 and B ≥23	± 20	± 12.5	± 0.2g
Small jack-up	LOA < 76 or B < 23	± 25	± 15	± 0.2g
Ship shape unit	LOA ≥ 76 and B ≥23	± 20	± 12.5	± 0.2g
Field move	All jack-ups	± 10	± 10	± 0.1g

The standard criteria shown above should be applied in accordance with the following:

- The roll and pitch amplitude are single amplitude values assumed to apply for a 10 second full cycle period of motion
- The roll and pitch axes should be assumed to pass through the centre of floatation.
- The phasing considered should be assumed to combine, as separate load cases, the most severe combinations of: roll ± heave; pitch ± heave.

6.5 Inland and sheltered water criteria

6.5.1 For inland and sheltered water transportation, whichever of the following has the greatest effect shall be taken into account:

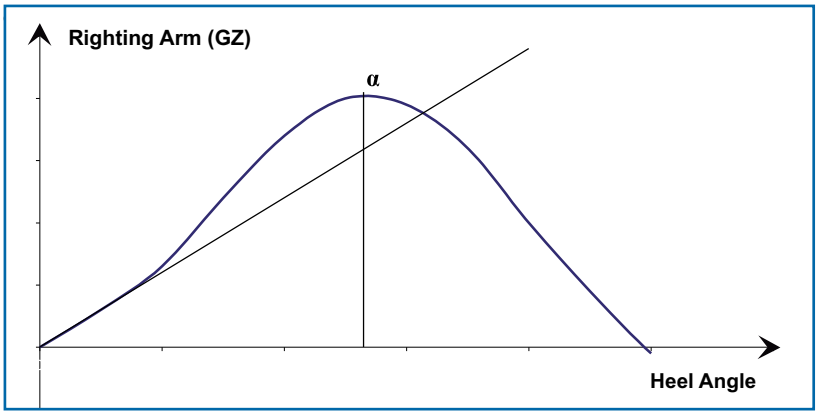
- Static loads caused by an acceleration of 0.1g applied parallel to the deck in the roll or pitch direction
- The most severe inclination in the damage condition, as determined by the damage stability calculations including the additional heel or trim caused by the design wind.

6.6 Intact static stability

6.6.1 Jack-up stability afloat shall be calculated to demonstrate compliance with the rules published by a *recognised classification society* or the rules contained in the MODU Code or the rules contained in MCA - MGN 280 as applicable to their type, tonnage, size and classification, or in accordance with the guidelines provided below.

6.6.2 The intact stability, or intact range of stability, is the range between 0 degree heel or trim and the angle at which the righting arm (GZ) becomes negative (see figure. 6.1).

Figure 6.1 - Illustration of stability terms



6.6.3 The transverse metacentric height (GM) must be positive, at zero angle of heel.

6.6.4 The range of transverse static stability should normally exceed 40 degrees. Correction to values of GM to allow for free surface effects should be included in this computation.

6.6.5 The acceptability of barges with a range of 30 to 40 degrees will be dependent on motion response predictions.

6.6.6 In the event of the range of static stability being greater than 30 degrees and less than 40 degrees, it shall be demonstrated that the maximum predicted roll angle is less than the angle at which the maximum righting lever occurs.

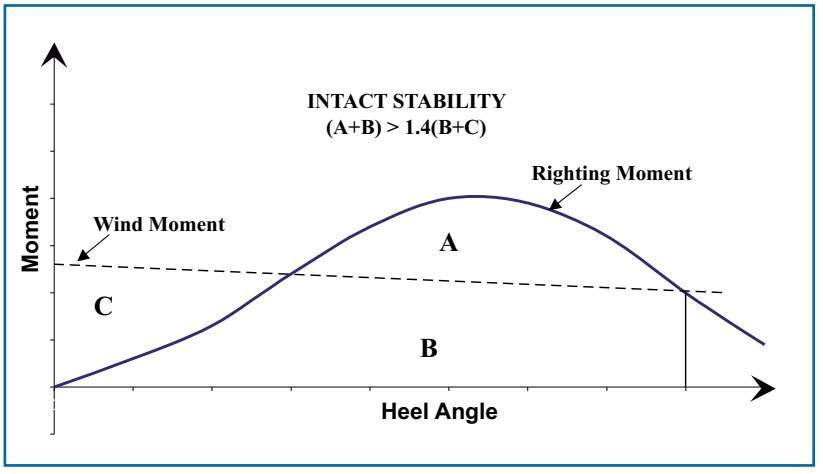
6.6.7 A range of static stability less than 30 degrees will not normally be accepted.

6.7 Intact dynamic stability

6.7.1 The areas under the righting moment curve and the wind heeling moment (or wind moment) curve should be calculated up to an angle of heel which is the least of:

- The angle corresponding to the second intercept of the two curves
- The angle of down flooding

Figure 6.2 - Intact stability requirement



6.7.2 For guidance on how to derive the wind heeling moment curve, reference is made to IMO resolution A.749 (18) Code on Intact Stability for all Types of Ships covered by IMO instruments.

6.7.3 The wind velocity used to compute the wind heeling moment curve should be the one-minute sustained wind for the operation as defined in section 6.2.

6.8 Damage static stability

6.8.1 As a minimum, the jack-up should have sufficient stability and reserve buoyancy to remain afloat at a waterline below any opening where progressive flooding may occur with any one-compartment adjacent to the sea flooded.

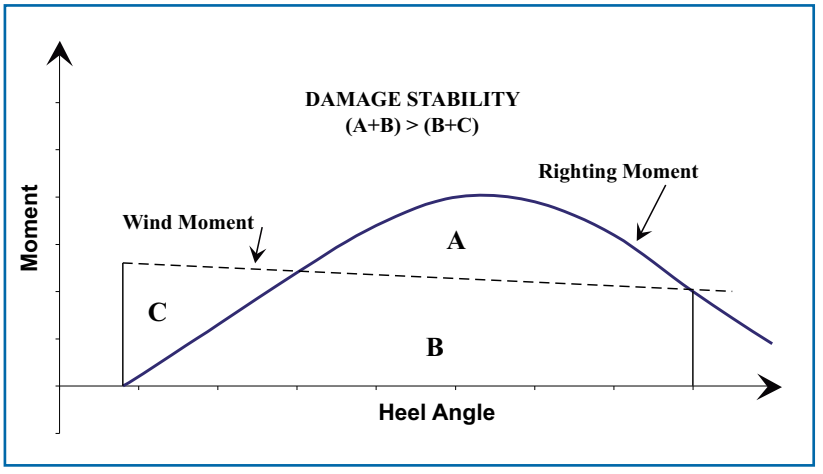
6.8.2 Damage to any compartment above the intact waterline that could lead to loss of stability should be considered when assessing damage stability.

6.8.3 The loss of water from a full compartment should be considered if it gives a more severe result than the flooding of an empty compartment.

6.9 Damage dynamic stability

6.9.1 The area under the righting moment curve should be not less than the area under the wind heeling moment curve.

Figure 6.3 - Damage stability requirements



6.9.2 The areas under the righting moment curve and the wind heeling moment curve should be calculated from equilibrium up to an angle of heel which is the least of:

- The angle corresponding to the second intercept of the two curves
- The angle of down flooding

6.9.3 The wind velocity that is used to compute the overturning moment curve may be 25m/s. However, if the design wind velocity for the operation, as defined in section 6.2 is less than 25m/s, the design velocity should be used instead.

6.9.4 Where it is impracticable to comply with damage stability recommendations, a risk assessment should be carried out, and appropriate mitigating measures taken.

7. Grillage, seafastening and cargo design

7.1 Loads during transportation

7.1.1 The components of load to be considered when analysing the total forces acting on the cargo, the vessel and grillage and seafastenings are those due to:

- The static weight of the cargo
- The dynamic loads which result from the vessel's motion in all six degrees of freedom
- The static component of weight which acts parallel to the barge deck when the vessel rolls or pitches
- Loads caused by heave acceleration including the heave.sin (Θ) terms
- Wind load
- Loads resulting from immersion of any part of the cargo support frames
- Ballast distribution in the barge
- Ice where appropriate

7.1.2 Regarding the loads due to motions above, the combination of motions that give the highest loading in any direction shall be considered. In the absence of information to the contrary (such as a motion analysis taking account of phase relationships to compute acceleration vectors), the highest loadings resulting from the following motions shall be combined as two separate load cases:

- Roll, heave and sway
- Pitch, heave and surge

7.1.3 Loads may normally be calculated using the assumption that all motions approximate to sinusoidal motions.

7.1.4 Structural loadings due to green water impact shall be based on the true relative motion between the structure and wave surface.

7.1.5 Account shall also be taken of any substantial loads in the grillage and seafastenings resulting from the relative deflections of vessel and cargo, whether due to changes in ballast arrangement or due to environmental effects.

7.1.6 When using the default criteria as defined in section 6.4 seas from headings other than the bow, stern and beam the horizontal accelerations may be resolved as applicable to the required heading. The resultant acceleration in the desired direction shall be obtained from taking the square root of the sum of the squares of the resolved accelerations. The heave acceleration will remain unchanged.

7.2 Stresses

7.2.1 The grillage and seafastenings shall be designed in accordance with a recognised standard or code of practice. Wherever possible, the design should be carried out to the requirements of one code only.

7.2.2 The seafastening shall be designed such that the static stresses in all members do not exceed the allowable stresses in accordance with AISC manual or other acceptable code. The 1/3 increase in allowable stresses referred to in earlier editions of the AISC manual may be used for stresses in cargo, grillage and seafastening where the steelwork is of high quality. It should not be used for the design of grillage and seafastening connections to the vessel or assessing the underdeck strength except when the condition of all steelwork associated with the load path has been verified as being of high quality with full material certification.

7.2.3 If the AISC 13TH edition is used the allowables shall be compared against member stresses determined using a load factor on both dead and live loads of no less than:

	WSD option	LRFD option
SLS:	1.0	1.60
ULS:	0.75	1.20

7.2.4 Any load case may be treated as a normal serviceability limit state (SLS)/normal operating case.

7.2.5 Infrequent load cases occurring no more frequently than the maximum design wave, which are dominated by extreme environmental forces may generally be treated as an ultimate limit state (ULS)/survival storm case. This only applies to steel of high quality which has been verified by a thorough and appropriate NDT inspection.

7.3 Grillage

7.3.1 The grillage design and layout should take account of any limitations imposed by the load transfer method.

7.3.2 The basis for the design of the grillage shall be the loads derived from the vessel motions as defined in section 6.3 or 6.4.

7.3.3 The relative stiffness of the barge frames and bulkheads shall be taken into account when deriving the load distribution between the grillage and the barge.

7.3.4 The effects of super-position of loads shall be accommodated in the design when welds/connections are made between the grillage and barge deck following load out.

7.4 Seafastening

7.4.1 The purpose of the seafastenings is to secure the cargo during the *transit* and *positioning* so that neither the cargo nor vessel suffers loss or damage as a result of the loadings derived from the vessel motions caused by the environment conditions.

7.4.2 Seafastenings should not in any circumstances be removed until the jack-up has completed preloading or predriving and elevating to the operating air gap. Primary seafastenings should be designed to be removed without damage to the cargo. During and following removal of primary seafastenings, adequate residual seafastening should remain to safely restrain the cargo until its removal from the vessel.

7.4.3 The entire load path, including the potential sliding surfaces, should be demonstrated to be capable of withstanding the design loads.

7.4.4 Small items of cargo ≤1000kg should be secured in accordance with good practice using appropriate lashings or securing arrangements that are adequate to ensure they are safely secured and will not be a hazard to any person in the event of bad weather or an emergency.

7.4.5 If the seafastenings are welded to the cargo it is recommended that they be fitted after the vessel has been ballasted to the transport condition.

7.4.6 Where the same seafastenings are to be used for multiple transits, inspection of welded seafastenings and/or bolted connections is required prior to commencing each transit. Where practicable, locking nuts/devices should be used in preference to ordinary bolts.

7.5 Vessel strength

7.5.1 The calculated still water bending moment (SWBM) and shear force (SF) shall be checked against the allowable SWBM and SF values approved by the classification society. If they exceed the specified permissible loads then the classification society shall be informed and their acceptance obtained.

7.5.2 The legs, jack houses and hull are to be shown to possess adequate strength to resist the loads imposed during the sea passage afloat. Leg chocks, wedges and locking devices shall be considered if fitted.

7.5.3 Local vessel strength calculations shall be required at highly stressed areas of the vessel. These calculations shall take account of any corrosion from the "as-built" scantlings.

7.6 Cargo strength

7.6.1 It shall be demonstrated that the cargo (equipment, tools, modules and wind turbine components etc.) has adequate structural strength to be transported without damage caused by the maximum loadings resulting from the vessel's motions under the environmental conditions described in section 6.3 or from the standard criteria as given in section 6.4.

7.6.2 Local analysis may also be required to quantify load effects in localised highly loaded areas such as grillage supports or seafastening connection points, and to confirm the adequacy of equipment to withstand these loads without damage.

7.6.3 The cargo structure is to be shown to have adequate strength to resist the loads imposed during the voyage combined with the additional loading caused by any overhang of the cargo over the side of the transport vessel.

7.7 Internal seafastenings

7.7.1 Internal seafastenings shall be provided where necessary. These may be in the form of temporary members to provide structural support during transportation, or the securing of equipment and loose items forming part of the cargo. Protection against wave slam or spray should also be provided as appropriate. Calculations may be required for major items of equipment.

7.8 Fatigue

7.8.1 Whether or not fatigue analyses are performed, all seafastenings shall be designed for good fatigue characteristics.

8. Site data required for jack-up site-specific assessments

8.1 General

8.1.1 Site survey is required for the purpose of providing data with which to define the position, boundary and characteristics of the location for the purpose of determining the suitability of the site for the operation of the jack-up.

8.1.2 Geophysical data alone is insufficient to perform a *site-specific assessment* of the soil foundation conditions and this should be complemented by geotechnical information as described in section 8.7, except for jack-ups engaged in soils investigations as provided in section 18.6.

8.1.3 It is recommended that a single uniform survey system (e.g. WGS84) be used for both site investigation and subsequent field development so as to ensure that compatibility and conformity is achieved between the original site investigation and the operations of marine units subsequently involved in the site works.

8.2 Location co-ordinates

8.2.1 The co-ordinates of each jack-up location expressed in terms of degrees, minutes and seconds of latitude and longitude are required. Latitude and longitude co-ordinates should be given to at least two, or preferably three, decimal places of precision and must also include details of the datum and projection used.

8.3 Water depth, tidal range and storm surge

8.3.1 The water depth at each jack-up location, referred to Lowest Astronomical Tide (LAT), is required. Nearshore pre-construction surveys producing results with vertical levels related to Ordnance datum must be converted to LAT before application to jack-up marine operations.

8.3.2 The maximum tidal range and the 50 year storm surge shall be computed for the jack-up location and/or for the area of operations considered. The following data shall be provided as a minimum.

- 50 Year storm surge (m)
- Highest Astronomical Tide (HAT) (m)
- Lowest Astronomical Tide (LAT) (m)

8.4 Wind and wave and current data

8.4.1 Meteorological extremes likely to be reached or exceeded once, on average, every 50 years, are required as listed below. The provision of 1 year and 10 year extremes is also recommended. This information, together with the data in the first two bullet points in 8.3.2 above, is required for the site-specific assessment.

- Wind – one-minute mean (m/s)
- Extreme wave height (m)
- Extreme wave crest elevation (m)
- Associated crest to crest wave period (sec)
- Peak period (sec)
- Significant wave height (m)
- Maximum surface current in downwind direction (m/s)
- Current profile

8.4.2 Particular attention shall be paid to the provision of competent data for inshore sites that may be affected by:

- Shelter afforded by proximity of the coastline or shallows

- Refracted and/or reflected waves
- Breaking waves and surf zones
- High velocity tidal currents (>1.5 m/s) in the vicinity of sand banks and narrows
- Tidal bores
- Wakes from passing vessels, particularly deep displacement ships and fast craft.

8.4.3 Special consideration is required at sites where breaking waves will occur. Calculation of hydrodynamic loads is not straightforward and a degree of judgement is required by the analyst to arrive at correct design values. Guidance on this subject can be found in ISO 19901-1:2005 (E) part one: "Metocean Design and Operating Considerations".

8.4.4 Comprehensive *met-ocean studies* carried out in connection with nearshore and offshore wind farms do not usually take account of the specific data required for jack-up emplacement. This creates a need for interpolation which can lead to inaccuracy and significant differences in the analyses carried out by different contractors for different jack-ups. For this reason it is recommended that such studies be reviewed by a single competent meteorological authority specialising in the provision of meteorological data for jack-up site-assessments and that the data be presented as a jack-up Spot Location Report (SLR) in a simple unequivocal format **(Appendix E).**

8.5 Bathymetric survey

8.5.1 A bathymetric survey is required for an area of approximately 1km square centred on the proposed location. Line spacing of the survey should be typically not greater than 100m x 200m over the survey area. If any irregularities are detected interlining should be performed with spacing not exceeding 25m x 50m. Swathe bathymetry or other techniques providing an equivalent or greater level of accuracy may be used as an alternative method of producing the survey results.

8.5.2 Rapid changes in bathymetry shall be anticipated in shallow areas that are subject to high velocity tidal currents and/or areas that may have been exposed to severe storm waves. The appropriate period of validity of the survey should be considered in all cases having due regard for the site characteristics and the anticipated rate of change indicated by earlier surveys. The survey report should include comment on the anticipated period of validity plus the magnitude and probability of error resulting from seabed changes.

8.5.3 Navigational charts derived for shipping are not usually sufficiently accurate for positioning jack-ups; however, up to date corrected charts for the transit route together with the largest available UK Admiralty navigation charts for the site are required to be carried on the jack-ups and attending tugs for reference. Paper charts may not be required on jack-ups that are ECDIS equipped and certified for ECDIS use only.

8.5.4 Notes and cautions listed on Admiralty charts should be referred to. Navigation should not be attempted through or within areas marked as "not surveyed", or areas carrying the notation "banks and channels subject to frequent change" or similar notation, without reference to recent bathymetric survey information.

8.6 Seabed surface survey

8.6.1 A seabed surface survey is required to identify natural and man-made seabed features, obstructions and debris. The survey should cover the approach to and the immediate area of the intended location (normally a 500m x 500m square for offshore and nearshore sites) and should be carried out using side scan or sector scan sonar, or other high-resolution techniques producing equivalent or better results.

8.6.2 A magnetometer survey is required to reveal the presence of buried pipelines or cables, lost anchors and chains, military ordnance or other metallic debris lying below the seabed surface. The requirement for a magnetometer survey may be waived in certain areas but the lack of this information should be justified in the *site-specific assessment*.

8.6.3 Site and location plans based on the seabed surface surveys should identify wrecks and important archaeological sites and/or marine conservation areas that are subject to protection. Sites where seabed or environmental disturbance should be avoided for any reason shall be identified. Specific information concerning the type of activity to be avoided and or seasonal limits or other qualifying conditions related to these areas should be provided.

8.6.4 The appropriate period of validity of the seabed surface survey should be considered in all cases having due regard for the site characteristics and any surface or subsea activity carried out on site since the last survey. As a general rule, the period of validity should be six months or less in uncontrolled areas and areas where no continuous system for reporting marine activity and lost objects exists.

8.6.5 The discovery of seabed surface obstructions or debris at any time within or without the site area should be reported to the site Marine Traffic Controller (MTC) or, in the absence of an MTC, to the UK Hydrographic Office.

8.7 Geotechnical (soils) investigation

8.7.1 Site-specific geotechnical information is required. The type and amount of data required will depend upon the particular circumstances such as the type of jack-up, soil conditions and previous experience of the site, or nearby sites, for which the assessment is being performed.

8.7.2 For sites where previous preloading and elevated operations have been performed by jack-ups, it may be sufficient to identify the location of existing jack-up footprints. In this case the details of the previous jack-up footing design and the preload applied should be available and it should be verified that the foundation bearing pressure applied previously was in excess of the pressure to be applied by the jack-up under consideration. In the absence of such verification soil investigation involving boreholes or CPT is required.

8.7.3 The location and number of boreholes or CPT's required should account for lateral variability of the soil conditions, regional experience and the geophysical investigation. A borehole may not be required if there is sufficient relevant historical data and/or geophysical tie lines to boreholes in close proximity to the proposed jack-up location.

8.7.4 The geotechnical investigation should comprise a minimum of one borehole to a depth equal to 30m or the anticipated penetration plus 1.5 – 2.0 times the footing diameter, whichever is greater. Investigation to lesser depths may be accepted in cases where only small penetrations are anticipated in hard soils; however, in such cases the advance approval of an geotechnical engineer with appropriate experience with jack-up foundation assessments is recommended and the reduced depth of investigation shall be justified in the foundation assessment.

8.7.5 All layers shall be adequately investigated, including any transition zones between strata, such that the geotechnical properties of all layers are known with confidence and that there are no significant gaps in the site investigation record. Laboratory testing of soil samples may be required.

8.7.6 Geotechnical investigations carried out in connection with construction activities such as pile driving may be of limited use for jack-up site assessments. Care must be exercised to ensure that the soil investigation is adequate in scope and detail for jack-up site-assessment. If in doubt, a geotechnical engineer with appropriate experience with jack-up foundation assessments shall be consulted.

8.7.7 In virgin territory where there is no soil data available, seabed sampling may be carried out from suitable jack-ups prior to installation. In such cases appropriate precautions (section 18.6) must be taken to ensure the safety of the jack-up during the initial period on location and until the soil investigation is complete.

8.7.8 The nature of the seabed surface soil, together with the water depth and the current and wave regimes shall be assessed to determine whether potential for scour may exist. The assessment should consider whether scour has occurred around existing fixed or temporary structures in the vicinity (if any) and records of previous scour that may have affected earlier jack-up installations. In the event that the assessment indicates that the integrity of the jack up foundation could be adversely affected then seabed soil samples may be required and a scour analysis should be performed (section 9.13).

8.7.9 The soil investigation must produce sufficient reliable data on which to base a competent analysis that will provide a recommended soil strength design profile giving lower and upper bound strength estimates. This will be carried forward into the jack-up *site-specific assessment* (section 10).

9. Jack-up foundation (soils) assessment

9.1 Foundation assessment is required in all cases where the jack-up is to be preloaded and elevated above the sea surface to a working air gap or to the minimum safe survival air gap on location. The scope of the assessment and the amount of data required will depend upon the particular circumstances such as the type of jack-up, the soil conditions and variations in the soil across the site, and upon previous experience of the site, or nearby sites, for which the assessment is being performed.

9.2 The jack-up foundation assessment shall be carried out in accordance with the *recommended practice* or in accordance with another recognised and appropriate code of practice that provides an equivalent level of safety. The assessment shall have due regard for potential hazards listed in SNAME T&R Bulletin 5-5A. Foundation risks are tabulated in **Appendix F.**

9.3 For jack-up locations where there is no history of previous jack-up emplacement a complete foundation assessment is required. The assessment shall include or refer to a geotechnical report containing the survey records together with their interpretation by a qualified soils engineer plus a leg penetration assessment for the proposed unit or a unit with similar footing design and load characteristics.

9.4 For jack-up foundation assessment at sites where preloading operations have been performed earlier by the same or another jack-up it may be sufficient to identify the location of existing jack-up footprints. In this case the details of the previous jack-up footing design and the preload applied should be available and it should be verified that the footing type was similar to the jack-up under consideration and the foundation bearing pressure applied during the previous installation was in excess of the pressure to be applied for the jack-up considered. In the absence of such verification a complete foundation assessment is required.

9.5 The combinations of vertical and horizontal load shall be checked against a foundation bearing capacity envelope. The resistance factor may be taken as 1.0 when the load-penetration curve indicates significant additional capacity for acceptable levels of additional settlement. Minor settlement not exceeding the limits contained in the Operating Manual may be acceptable provided that:

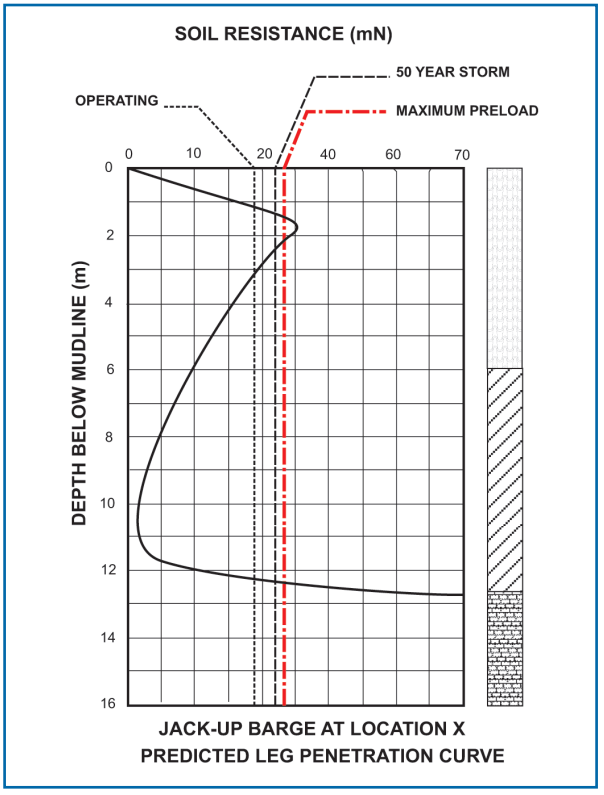
- The jack-up can withstand the storm loading plus the effects of the inclination
- The lateral deflections will not result in contact with adjacent structures
- The jacking system will remain fully operational at the angle of inclination considered

9.6 Consideration shall be given to the operating limits of the jacking system. The capacity of any jacking system to elevate or lower the hull may be significantly reduced or eliminated by leg guide friction (binding) caused by small angles of inclination. Additionally, some hydraulic recycling jacking systems cannot usually be jacked at angles of inclination greater than 1.0 degree because even this small angle can result in inability to extract or engage the fixed and working pins (or catcher beams).

9.7 Extreme caution should be exercised if the soil profile reveals a risk of punch-through when it should be demonstrated that there is an adequate safety factor to ensure against punch-through occurring in both extreme (abnormal) storm events and operating conditions. Particular attention must be paid to the appropriate safety factor in cases where the jack-up's maximum

preload capacity does not produce significantly greater foundation bearing pressure than that to be applied in the operating or survival modes (See figure 9.1).

Figure 9.1



9.8 Calculation of the safety factor against punch-through should normally be in accordance with the *recommended practice*; however, alternative methods that may provide an equivalent or greater level of safety exist and therefore consideration should be given as to which method is appropriate in the circumstances. For this reason reference should be made to other sources of advice contained in UK HSE research report 289 - Guidelines for Jack-up Rigs with Particular Reference to Foundation Stability; Noble Denton 0009/ND Rev 4, dated 16 December 2008 - Self-Elevating Platforms - Guidelines for Elevated Operations; and Det Norske Veritas Classification Note No. 30.4. Ultimately, the assessment of punch-through risk requires a high level of expertise and the exercise of sound judgment based on experience.

9.9 Consideration should be given to the limits of maximum and minimum penetration as determined by the jack-up design or Operating Manual. In cases where the limits stated in the manual are related simply to a sample elevated condition and the leg length installed, it can be ignored provided the leg length is sufficient to meet the survival air gap defined in the *recommended practice*. An analysis should be carried out for any case where the maximum or minimum penetration limit stated in the manual is related to leg or spudcan structural strength or to the jack-up's capacity for leg extraction.

9.10 Particular consideration shall be given to the requirement for extracting the leg footings and the probable effectiveness of the leg jetting system (if fitted). Temporary inability to extract the legs from the soil may involve serious risk if the unit cannot be quickly removed to shelter and/or cannot achieve the elevated survival mode and remain on location.

9.11 For jack-ups fitted with hydraulic recycling jacking systems there is the additional risk that the jacking system may become temporarily immobilised through inability to extract fixed or working pins during the leg extraction operation. If this occurs during a rising tidal cycle then damage or flooding may result.

9.12 Operations involving leg extraction from deep penetration may be considerably prolonged in cases where deep leg penetration has been achieved, particularly if the leg extraction operation is interrupted by periods of adverse weather. The onset of weather conditions exceeding the limits for refloating the unit will require the jack-up to be re-elevated and preloaded and if this becomes necessary any progress that had been achieved with leg extraction prior to such onset will be almost entirely reversed. In addition to the risk described in 9.9 above, this may have a serious commercial impact in terms of costs caused by an extended delay.

9.13 The potential for seabed scour shall be considered. Special consideration shall be given to the movement of seabed soils caused by currents or waves and the potential impact this may have on the integrity of the jack-up foundation over time. At locations where risk of scour is deemed to exist, the foundation assessment shall include an assessment of the potential depth and rate of soil removal and that may affect foundation stability. The assessment shall include a caution to the effect that special jacking procedures may be required to mitigate the risk of foundation instability and should also recommend scour protection measures where appropriate.

10. Elevated operations

10.1 General requirements

10.1.1 Every jack-up shall be provided with an operating manual stating the design limits of the unit for elevated operations.

10.1.2 Every jack-up shall have adequate structural strength and overturning stability to withstand any combination of environmental conditions to which the jack-up may be subjected while elevated at a specified location. Account shall be taken of the properties and characteristics of the seabed and subsoil to ensure there is adequate resistance for applied loads. If rotational foundation fixity can be justified this may be included in appropriate structural analysis.

10.1.3 No jack-up shall be elevated in *weather unrestricted mode* (section 5.2) on a location unless, prior to moving, the owner or operator of the unit has obtained from a competent person:

a. A Meteorological Spot Location report (Appendix E)

b. A Soils investigation and Jack-up Foundation Assessment report

c. A *site-specific assessment* report carried out in compliance with the *recommended practice* confirming that the jack-up is structurally capable of remaining on location and withstanding the extreme environmental conditions with all stresses remaining within allowable limits and that the seabed and subsoil will provide adequate resistance to withstand the loads at the footings.

10.1.4 No jack-up shall be elevated on location in *weather restricted* (section 5.3) unless, prior to moving, the owner or operator of the unit has obtained from a *competent person*:

a. Defined limiting environmental criteria for the operation

b. A Soils Investigation and Jack-up Foundation Assessment report
(except as provided for soil investigations in section 18.6)

c. A site-specific assessment report confirming that the jack-up is structurally capable of remaining on location and withstanding the defined environmental criteria with all stresses remaining within allowable limits and that the seabed and subsoil will provide adequate resistance to withstand the loads at the footings.

10.2 Requirement for site-specific assessment

10.2.1 Before installing a jack-up on any location a *site-specific assessment* shall be performed by a *competent person*.

10.2.2 For multiple locations contained within a defined area, such as an offshore wind farm, the number of *site-specific assessments* for the site shall be sufficient to consider the complete range of physical, environmental and geotechnical conditions across the site. Particular attention shall be paid to any variation in the soil conditions across the site.

10.2.3 The 50 year return period extremes shall be used for the *site-specific assessment* for *permanently manned jack-ups* unless the unit is to operate in *weather restricted mode*.

10.2.4 The 10 year return period may be considered where arrangements (including documented procedures) are in place for the safe removal of all personnel from the jack-up prior to the onset of weather conditions predicted to exceed the limit for safe disembarkation, having due regard for the level of confidence in the forecast weather conditions.

10.2.5 The 10 year return period should only be used for de-manned jack-ups in cases where there is no risk to personnel and where the site developer and the jack-up owner have formally assessed the consequences of catastrophic weather damage to the jack-up and the potential threat to the environment and to shipping, installations, and property in the vicinity. For

cases where the reduced extremes are used it is recommended that the hull should be raised to comply with the 50 year air gap requirements. It is also recommended that site developers consult with interested parties such as the MCA, third party installation owners and underwriters and environmental agencies in connection with the possible consequences.

10.2.6 The *site-specific assessment* shall be carried out in accordance with the guidelines and *recommended practice* contained in the SNAME TR5-5A "Guidelines for Site Specific Assessment of Mobile Jack-Up Units".

10.2.7 The dynamic response of the jack-up shall always be considered and assessed in accordance with SNAME TR5-5A.

10.2.8 The assessment may be carried out at varying degrees of complexity. These are expanded below at increasing levels of complexity. The objective of the assessment is to show that the acceptance criteria are met. If this is achieved by a particular level there is no need to consider a more complex level.

1. Compare site conditions with the jack-up's design or other previous site-specific assessments. Assessment carried out at this level is subject to confirmation that the previous assessment was carried out in accordance with the *Recommended Practice* and the jack-up's design, configuration and footing load is substantially similar to the jack-up considered in the previous assessment.
2. Carry out appropriate calculations according to the simple methods given in SNAME TR5-5A. Possibly compare results with those from existing more detailed/complex calculations.
3. Carry out appropriate detailed calculations according to the more complex methods given in SNAME TR5-5A.

   Reference is requested to the SNAME TR5-5A figure 2.1 overall Ffowchart for the assessment when determining the appropriate level of complexity **[Appendix G].**

10.2.9 The site-specific assessment shall consider the addition of wind loads on temporary accommodation modules, equipment containers, temporary crane installations and project cargo items (if any) that may not have been considered in previous assessments or design reports.

10.2.10 Assessments at all levels require verification by a *competent person* to confirm that the jack-up's original design report or the site-specific assessment has been assessed in accordance with the *recommended practice*. It is recommended that in all cases where a *permanently manned* jack-up is to remain elevated in *unrestricted mode*, the assessment should be verified by an independent third party such as a classification society or marine warranty surveyor.

11. Self-propelled and propulsion assisted jack-ups

11.1 Self-propelled jack-ups

11.1.1 Self-propelled jack-up vessels considered in this guideline shall be defined as power-driven ships capable of undertaking sea passages within their certified trading area under their own power and without tug assistance. Such vessels shall be assigned an appropriate class notation signifying their type and capability.

11.1.2 Self-propelled jack-ups may be considered to be capable of undertaking transits and field moves under their own power; however, due consideration shall be given in each case to the need for tug assistance for port entry and departure, positioning on site, navigating in constricted waters and areas with high velocity currents and positioning in deep water with the legs fully extended below the hull. In some cases national government and local port regulations may require tug assistance regardless of the vessel's own propulsion force.

11.1.3 For vessels certified for unrestricted transit between locations without tug assistance the propulsion force of the vessel shall be sufficient to maintain control under conditions with sustained wind velocity 20 m/s, head current velocity 0.5 m/s and *significant wave height* 5m.

11.1.4 The design, construction, management, manning and operation of self-propelled jack-ups is governed by flag state and port state regulations, international codes and standards and classification society rules for ocean-going ships. Certified compliance with these regulations, standards and codes does not waive the requirement for these vessels to comply with the *recommended practice*.

11.2 Dynamically positioned Jack-ups

11.2.1 In addition to the definition and provisions described in 11.1 (above) dynamically positioned (DP) jack-up vessels considered in this guideline shall be defined as ships equipped with dynamic positioning systems that are capable of positioning and station keeping under their own power and without tug assistance.

11.2.2 DP jack-ups shall be assigned an appropriate class notation signifying their type and capability. They will usually comply with the propulsion power requirements for unrestricted transit as defined above.

11.2.3 DP jack-ups shall comply with IMO MSC Circ.645, *"Guidelines for Vessels with Dynamic Positioning Systems"* which is the principal internationally accepted reference on which the rules and guidelines of other authorities and organisations, including classification societies are based and with recognised standards for DP training, which are set out in IMO MSC Circ.738 *"Guidelines for Dynamic Positioning System (DP) Operator Training"*.

11.2.4 It should be recognised that the requirements indicated above represent a minimum standard and that some companies and some owners may require more than just a certificate of class and a statement of condition and equipment.

11.3 Propulsion assisted jack-ups

11.3.1 Propulsion assisted jack-ups considered in this guideline shall be defined as all other jack-ups that may be fitted with propulsion equipment but that do not match the definitions listed in section 11.1 and 11.2 (above) and that may require tug assistance for *transit* and *positioning*.

11.3.2 For *transit* of propulsion assisted jack-ups not certified for unrestricted transit the vessel's propulsion capacity shall be sufficient to maintain a minimum speed over the ground of 2 knots in the environmental condition considered.

11.3.3 For *transit* and *positioning* of propulsion assisted jack-ups, the requirement for assisting tugs may be waived and/or a reduction in the number and power of tugs may be acceptable where it is demonstrated that effective control over the movement of the unit can be maintained in the limiting environmental conditions considered and with the legs extended below the hull to the maximum depth likely to be encountered en route and on site.

11.3.4 For *transit,* propulsion assisted jack-ups as defined in this guideline shall be considered the same as non-propelled jack-up barges with respect to the requirements described in section 12.

12. Non-propelled jack-ups

12.1 Manned and unmanned tows

12.1.1 Jack-up barges certified for manned towage under the loadline rules and having certified crew accommodation should be manned by a marine crew for location and field moves.

12.1.2 Jack-up barges not certified for manned towage under the loadline rules may carry a riding crew on *location moves* and will always be manned for *field moves*. Provision shall be made for embarking and disembarking riding crews whenever necessary and sufficient means of escape, firefighting appliances and lifesaving equipment for the riding crew shall be available ready for deployment.

12.2 Ballasting

12.2.1 The ballasting system, if fitted, should be in good condition and suitable for the following:

- Correction of draught or trim
- Damage control purposes in event of hull damage, grounding etc
- Modification to the draft, trim, or heel if required for installation on location

12.2.2 In cases where the jack-up is unmanned, specifications and operating instructions for the ballast system shall be readily available and retained on board the lead tug with details of the ballast status during the tow.

12.2.3 In cases where the jack-up is not fitted with a permanently installed ballasting system and power source, the jack-up or the tug must carry sufficient portable pumps and equipment to carry out the operations considered in section 12.2.1.

12.3 Watertight integrity

12.3.1 All weather deck openings shall have adequate securing arrangements to ensure watertight integrity.

12.3.2 Door openings on weather decks shall be fitted with sills and deck hatches shall be fitted with coamings in accordance with International loadline regulations. Exemptions for semi-permanently bolted closures not fitted with sills or coamings may be accepted subject to approval by the classification society.

12.3.3 Compartment manholes shall be properly secured with bolts and gaskets, which must be maintained in good condition. A set of tools shall be provided on board for releasing and re-fastening the manhole covers.

12.3.4 If manholes to critical compartments are covered by cargo, grillage or seafastenings, care shall be taken to ensure they are properly secured before being covered.

12.4 Barge deck openings

12.4.1 Barges having low freeboards, where there is risk that a portion of the deck may become flooded in the damage stability condition considered in section 6.7, should be provided with "top hats" with suitable means of fixing to the barge deck, which can be used in an emergency to gain access through a manhole that may be awash.

12.4.2 At least one standpipe shall be provided with suitable fittings, such that it can be screwed into sounding cap holes that may be awash.

12.5 Mooring arrangements

12.5.1 This section is applicable to the general provision of moorings for jack-ups alongside quays. Moorings for jack-up operations afloat on site are covered in section 14.

12.5.2 Mooring bitts or bollards shall be fitted on either side of the jack-up, suitably spaced in accordance with Class rules if applicable. As a minimum, mooring bitts or bollards shall be fitted on each side at each end of the barge. At least four suitably dimensioned mooring ropes in good condition shall be carried on board. If the towing tug has spare mooring lines then this may be considered as a part of the barge's mooring lines.

12.6 Navigation lights and shapes

12.6.1 The jack-up shall be equipped with navigation lights (including anchor lights) and day signals in compliance with the international regulations for the prevention of collisions at sea.

12.6.2 The lights shall be provided with sufficient power or fuel from an independent source to last for the duration of the voyage plus a reserve of 50%.

12.6.3 A full set of spare navigation bulbs or gas mantles (as appropriate) and shapes shall be carried on the tug or the barge. In addition, spare parts for the navigation lights such as cables or hoses and connections (as appropriate to the system) shall be carried.

12.6.4 Where obstruction or danger to navigation is caused or is likely to result from installation of the jack-up on site; and where it is required under consents granted under the provisions of the Coast Protection Act 1949 - Consent to Locate Offshore Installations – provision for marking offshore installations; the jack-up shall be equipped with obstruction lights (white 360 degree Morse "U") displayed at each corner of the vessel and with a fog signal.

12.6.5 Small jack-up barges operating within port limits may carry alternative obstruction lights such as flashing orange beacons, subject to the approval of the harbour master.

12.7 Access

12.7.1 Safe ladders that extend from the manhole opening to the compartment bottom shall be provided in each compartment.

12.7.2 Ladders shall be available on each side of the jack-up, extending to the lowest water line, to permit access when afloat. Steel ladders and adjacent protective fenders, if fitted, shall comply with class rules if applicable. Rope ladders shall comply with the rules for the construction and rigging of pilot ladders. The condition of these ladders shall be checked by the master of the jack-up or the tug master prior to commencing each jack-up transit and they shall be checked by the person intending to use them immediately prior to each use.

12.8 Fenders

12.8.1 It is recommended that adequate fenders are provided for berthing operations.

12.9 Towing arrangements

12.9.1 The jack-up shall be towed from the forward end using a bridle of suitable construction. If two tugs are used, the bridle may be split and each tug connected to a single leg of the bridle. Alternatively the second tug may be connected with a wire towing pennant through a closed fairlead to a separate towing connection.

12.9.2 When assessing the strength of tow connections and fairleads on the barge and bridle, the effect of the tug pulling at its maximum bollard pull in any direction shall be considered.

12.9.3 All towing equipment shall be in satisfactory condition. Test certificates for all the items specified in this section shall be valid and available for inspection. Certificates shall provide clear identification of the respective equipment.

12.9.4 Alternative towing configurations appropriate to operations conducted in narrow channels and confined areas may be used in inland waters and within port limits.

12.9.5 A plan or drawing of the towing arrangement showing the configuration of the towing gear and each component and stating the breaking load (BL) of each component shall be prepared and shall be made available on board the towing vessel.

12.10 Tow connections

12.10.1 Towline connections to the barge shall be of the quick release type where possible. For strength purposes they shall be located over the intersections of transverse and longitudinal bulkheads and they shall be provided with adequate back-up structure. They shall also be secured against premature release.

12.10.2 The breaking (ultimate) strength of the tow connections shall conform to the following:

- At least three times the static bollard pull of the tug
- Designed to be greater than the breaking load of the bridle

12.11 Fairleads

12.11.1 Capped fairleads or panama type fairleads shall be fitted forward of and in line with the tow connection points except where the towing connection is installed at the deck edge. Anti-chafe protection shall be provided along the deck edge.

12.11.2 The breaking strength of the fairleads and their connections to the barge deck shall be greater than that of the bridle.

12.12 Towing bridle

12.12.1 The towing bridle shall consist of two legs having an included angle at the apex between 45 degrees to 60 degrees.

12.12.2 If the bridle is a chain bridle it shall be composed of stud link chain, with enlarged open links at each end to facilitate connections. Connection should be made without removal of the stud from the stud link chain.

12.12.3 If a composite bridle is used it shall comprise two lengths of stud link chain, extending beyond the deck edge, connected to wire pennants fitted with hard eye thimbles.

12.12.4 The bridle legs shall terminate in a shackled connection at a towing ring, triangular (Delta) plate, or other approved and certified device.

12.12.5 The breaking strength of each bridle leg and bridle terminator shall generally be at least three times the static bollard pull of the tug. Under no circumstances should the breaking strength of each leg of the towing bridle be less than the BL of the towing wire.

12.13 Intermediate Tow Pennant

12.13.1 For longer tows in the transit condition an intermediate wire tow pennant shall be included between the towing bridle and the tug's main towline. The pennant shall be fitted with hard eye thimbles, and shall be at least 10m in length. The pennant may be shorter or may be omitted if necessary to reduce the overall length of the tow gear for in harbour or field moves.

12.13.2 The breaking strength of the wire pennant shall be not less than that of the main towline of the tug, and shall be of the same lay as the main towline.

12.14 Shackles

12.14.1 The certified safe working load (SWL) of all shackles included in the towing arrangement shall be greater than the static bollard pull of the tug to be used. Some reduction in this requirement may be allowed for a tug with a bollard pull in excess of 100 tonnes, but in any event their breaking load shall be greater than three times the bollard pull.

12.15 Bridle retrieving arrangements

12.15.1 A retrieval system shall be provided to recover the bridle in the event of the towline parting.

12.15.2 The retrieving wire shall be connected at the bridle apex either to the triangular plate or to an end link of the bridle leg. The wire shall be either led back to a retrieving winch, suitably led via an "A" frame or block arrangement or an alternative system appropriate for the area of operation shall be provided.

12.15.3 The retrieving winch shall be adequately secured and the capacity of the winch shall be sufficient to take the load of the bridle, apex connection, pennant and connections with some reserve. The winch drum capacity shall be such that the required length of retrieval wire can be spooled.

12.16 Emergency towing arrangements

12.16.1 Emergency towing arrangements shall be provided for use in the event of loss of towline or bridle recovery system or other unforeseen circumstances. Two systems are suggested below although modified forms of these may be accepted:

1. Two spare towing connections shall be fitted forward located inboard of the main connections. A bridle, which may be of chain or wire and chain with a triangular plate or towing ring at the apex, shall be attached to these connections. The towing ring or delta plate shall be secured to the barge by lashings. A pennant, with hard eye thimbles, shall be shackled to the towing ring or delta plate and clipped or lashed along the barge side, outboard of all obstructions. At the stern of the barge a floating line with a buoy attached shall be shackled to the end of the pennant and streamed astern.
2. A single spare towing connection shall be fitted, located on the barge centre line either forward or aft. If the connection is fitted forward, a pennant shall be connected to it and led aft to a floating line, as in alternative one (above). If the connection is fitted aft the towing pennant shall be flaked on deck with the floating line connected to it.

12.16.2 The pennants and towing connections shall, in either of the above alternatives, be sized similarly to the main towing equipment and shall be lead over the top of the main bridle if fitted forward.

12.17 Anchor

12.17.1 The jack-up shall have at least one operable anchor during transit. The anchor is to be of sufficient capacity and with sufficient length of mooring line available for emergency anchoring.

12.18 Safety rails

12.18.1 The perimeter of the jack-up deck shall be protected by permanently installed safety rails or removable stanchions and safety wires. These shall be designed and constructed in compliance with the applicable rules (Classification society or MCA MGN 280). Openings in the rails or wires allowing for temporary access for mooring lines or other equipment shall be closed with chains or ropes when not in use.

13. Towing vessels

13.1.1 The proposed tug(s) shall be in satisfactory condition. The tug(s) and towing equipment, machinery, manning and fuel requirements shall be suitable for the proposed operation. Certification and documentation required by the flag state shall be in order and the tug shall be classed by a *recognised class society* or certified under the provisions of the MCA Small Commercial Vessel (SCV) and Pilot Boat Code (as currently set out in MGN 280) or foreign equivalent.

13.1.2 The tug(s) shall be provided with a Bollard Pull Test Certificate stating the continuous (sustained) bollard pull based upon a bollard pull test carried out within the last 10 years.

13.1.3 All towing equipment shall be in satisfactory condition. Test certificates for all items shall be valid and shall be available for inspection with clear means of identification of the respective equipment.

13.1.4 The towing vessel shall have a spare towline that shall be similar in all respects to the main towline. Where the spare towline is not spooled on to a second winch drum it shall be stowed in such a manner that it can be spooled on to the main towing drum by the crew at sea.

13.2 Bollard pull requirements

13.2.1 The total environmental load acting on the jack-up and cargo due to the combined effects of the following conditions shall be calculated and the minimum tow-line pull required (TPR) should be calculated to hold the jack-up at zero forward speed in a fully developed gale defined as:

- Significant wave height (Hs): 5m
- Wind speed: 20 m/s (approx. 40 knots)
- Current: 0.5m/s (approx. 1 knot)

13.2.2 For short coastal tows, field and harbour moves, lesser criteria for calculation of TPR may be agreed. Generally these should not be reduced below 15 m/s wind speed, 2.0m *significant wave height* and 0.5m/s current, acting simultaneously.

13.2.3 The tow should be capable of making reasonable speed with average weather conditions throughout the passage. It is recommended that the tow be capable of maintaining a minimum speed of 5 knots in conditions with *significant wave height* 2.0m and wind speed 10m/s.

13.2.4 In all cases due consideration shall be given to the number of tugs and the TPR required to control the jack-up in the anticipated maximum current on site with the legs fully extended below the hull.

13.2.5 The TPR should be related to the continuous static bollard pull (BP) of the tug(s) proposed by:

$$TPR = \Sigma(BP \times Te/100)$$

Where:

Te is the tug efficiency in the sea conditions considered, %

BP is the continuous static bollard pull of each tug

(BP x Te/100) is the contribution to the TPR of each tug

Σ is the sum for all tugs assumed to contribute to the TPR.

13.2.6 The tug efficiency, Te, depends on the size and configuration of the tug, the sea state considered and the towing speed achieved. In the absence of alternative information, information, Te may be estimated according to table 13.1 (below).

Table 13.1 - Estimation of the tug efficiency

Bollard Pull	Calm	H.sig = 2.0 m	H.sig = 3.0 m	H.sig = 5.0 m
BP ≤ 30	80	50 + BP	30 + BP	BP
BP 30 - 90	80	80	52.5 + BP/4	7.5 + 0.75 x BP
BP > 90	80	80	75	75
		H.sig Significant wave height, metres BP Continuous static bollard pull, tonnes Te Tug efficiency, in percentage of the bollard pull		

13.3 Towing winches

13.3.1 Towing vessels shall be fitted with a suitable towing winch. Towing from a towing hook will not be accepted for open sea passages but may be accepted for harbour moves or movements in inshore sheltered waters.

13.3.2 Two towing drums shall normally be provided. Where a second towing drum is not fitted then means of reconnection of the spare towline shall be supplied. The spare towline shall be in good condition and of the required strength. There must be suitable means for connecting the line to the tug and making a rapid reconnection to the emergency towline on the towed barge.

13.3.3 The tow winch shall have a minimum holding power of three times the static bollard pull of the tug at the inner layer on the drum.

13.3.4 All towing winches shall be fitted with an emergency release brake mechanism.

13.4 Towline control

13.4.1 Towing pods where fitted shall be of adequate strength, and well faired to prevent snagging.

13.4.2 Alternative arrangements for towline control may be accepted. If gog ropes are used they should be adjustable from a remote station. If a single gog rope system is fitted then the connection point shall be on the centreline of the vessel. A spare gog rope shall be provided.

13.4.3 Mechanical, hydraulically or manually operated stops (pins) to control the towline shall, if fitted, be well maintained, and capable of being withdrawn or removed when not in use.

13.5 Towing wire

13.5.1 For jack-up location moves the length of the tow wire should never be less than 500m and shall be determined as follows: L = (BP/BL) X 1200m.

13.5.2 For harbour moves and tows in inshore sheltered waters different tow wire lengths may be accepted.

13.5.3 The wire shall be in good condition, free from kinks, snags and with no opening of strands. Hard eye thimbles or towing sockets shall be fitted.

13.5.4 The MBL of the towing wire shall not be less than the following values:

Bollard Pull (BP)	**BL**
Less than 40 tonnes	3 x BP
40 to 90 tonnes	(3.8 – BP/50) x BP
Over 90 tonnes	2 x BP

13.5.5 Synthetic rope towlines shall not be used by the main towing vessel for jack-up location or field moves. Synthetic fibre towlines may be used by assisting tugs for harbour moves or tows in inshore sheltered waters.

13.6 Stretchers

13.6.1 Stretchers (if used) shall only be connected between the tug's wire and the intermediate pennant and not to the bridle apex connection. In general, a stretcher made up as a continuous loop is preferable to a single line. The breaking load shall at least 1.5 times that of the main towline, and hard eye thimbles are to be fitted at each end. These ropes are to be in good condition.

13.7 Tailgates/stern rails

13.7.1 The tailgate or stern rail, if fitted, shall have an upper rail of radius not less than 10 times the diameter of the main towline. Smaller diameter may be accepted for inland tows and harbour moves.

13.7.2 Anti-chafe gear shall be carried on the tug and fitted as necessary. The stern rail shall be well faired to prevent snagging.

13.8 Additional equipment

13.8.1 The following additional equipment shall be carried on board the towing vessel:

- Oxygen/acetylene cutting equipment
- Damage control equipment
- Spare shackles (sized in accordance with the towing gear plus smaller sizes)
- A searchlight to illuminate the tow

and if the jack-up is unmanned:

- Portable radio transmitter/receivers with spare batteries for communication
- Hand lamps or torches with spare bulbs and spare batteries
- A powered workboat fitted with adequate means of launching and recovery (Excepting small tugs < 24m in length)
- A portable pump equipped with sufficient length of suction hose to enable dewatering of the compartments considered in section 6.7 and a self-contained power unit with sufficient fuel for 12 hours running

13.9 Bunkers

An adequate quantity of fuel and consumables shall be on board for the proposed tow. An adequate amount of fuel at full speed consumption shall be kept in reserve.

13.10 Manning

13.10.1 The towing vessel shall be manned by a qualified and experienced crew in compliance with the requirements of the tug's flag state. There should be sufficient crew to deal with contingencies such as the parting of a tow wire and the need to board the tow in the case where the towed jack-up is unmanned.

13.10.2 For towage of unmanned jack-ups there must be sufficient accommodation and certified life-saving capacity to accommodate the barge riding crew (if assigned) on board the towing vessel(s).

14. Moorings for positioning

14.1 General

14.1.1 Positioning is defined as the marine operation necessary to move the jack-up into the required position at a new location and to carry out the jacking and preloading operations necessary to install the unit on location.

14.1.2 All positioning operations are weather restricted and are to be conducted in sea states not exceeding the jack-up's design limits for going on location (engaging the bottom). This means that the operation must be completed within 72 hours to the point where a temporary safe condition has been achieved.

14.1.3 The jack-up shall be considered to have reached a temporary safe condition when the integrity of the seabed foundation has been proven by preloading and the unit is capable of:

a. Withstanding the reduced environmental loads selected for a weather restricted operation.

or

b. Withstanding the environmental loads corresponding to the 10 year seasonal condition for an unrestricted operation.

A permanent safe condition for unrestricted elevated operation has been achieved when the unit can withstand the environmental loads corresponding to the 50 year all-year condition for the location.

14.1.4 Plans for *positioning* operations shall state the environment limits that are not to be exceeded. The limits shall not exceed the allowable criteria for engaging the bottom and/or for jacking and preloading as prescribed in the jack-up's operating manual.

14.2 Positioning systems

14.2.1 When *positioning* close to surface or sub-sea structures, pipelines or cables and whenever fine positioning tolerances are required, jack-ups relying on *dynamic positioning* systems shall be assigned the appropriate class notation for dynamic positioning (DP). The capacity of the DP system shall be documented to demonstrate the vessel's capacity to operate in DP mode in the defined environmental criteria and the system shall be function tested with acceptable results prior to commencing each *positioning* operation.

14.2.2 When *positioning* close to surface or sub-sea structures, pipelines or cables and when fine positioning tolerances are required, jack-ups not equipped with DP systems and all non-propelled jack-ups shall be equipped with a suitable mooring system except as provided in 14.2.3 and 14.2.4 (below).

14.2.3 At locations where positioning tolerances are less critical and where there is low risk of contact with any proximate surface or seabed obstruction, self propelled jack-ups may position using their propulsion system alone provided that the system is capable of controlling the jack-up's speed and heading so as to reliably achieve a constant heading and near-zero horizontal movement relative to the seabed in the environmental conditions considered.

14.2.4 At locations where positioning tolerances are less critical and where there is no risk of contact with any surface or seabed obstruction, non-propelled jack-ups may position using tugs alone provided that the towing vessels are capable of controlling the jack-up's speed and heading so as to reliably achieve a constant heading and near-zero horizontal movement relative to the seabed in the environmental conditions considered.

14.3 Mooring equipment and procedures for positioning afloat

14.3.1 Mooring equipment for jack-ups (if fitted) will normally consist of a four point mooring system using mooring winches, wires and anchors. The mooring system shall be designed and constructed and maintained in accordance with the rules of the vessel's classification society.

14.3.2 When positioning close to surface or subsea structures, pipelines or cables a mooring layout plan shall be prepared. Additionally a mooring analysis shall be performed if it is necessary to determine the clearances between the mooring lines and the nearby structures (see 14.4). Further details regarding the mooring analysis are given in 14.5.

14.3.3 The capacity of the mooring system, including the holding capacity of the anchors in the soil conditions on site shall be demonstrated as sufficient to withstand the loads likely to be imposed during positioning of the jack-up in the environmental conditions considered.

14.3.4 The system shall be subject to regular survey and shall be maintained in good condition. The manufacturer's test data stating the safe working load of the winch, the rated pulling capacity (first wrap) and the rated brake holding capacity together with original certificates for each mooring wire, termination socket (if fitted), shackle, anchor pennant and anchor shall be kept on board the jack-up.

14.3.5 In cases where the mooring winch is to be operated manually from a local control and where the operator can maintain a clear view of the winch drum, the fairlead, and the portion of the wire above the sea surface, the monitoring of line length and tension may be accomplished visually.

14.3.6 In cases where the mooring winch is operated remotely from a central control the equipment shall be fitted with means of displaying length and tension data at the control station. If there is no clear view of the winch drums from the control station then either CCTV coverage shall be fitted or competent crew equipped with radios shall be stationed safely in the vicinity of each winch to monitor the spooling of wires.

14.4 Clearances during positioning

14.4.1 Sufficient clearance should be maintained between the jack-up and adjacent structures or other vessels and between mooring lines and fixed structures or other vessels and sub-sea pipelines and cables during positioning. The direction of movement to the final position and the environmental conditions shall be considered in order to establish sufficient clearance.

14.4.2 The minimum clearance between the jack-up hull and an adjacent structure or another floating vessel during positioning should not be less than 3m at any point during the positioning operation.

14.4.3 The minimum clearance between the jack-up's leg footings and an adjacent structure should not be less than 5m at any point during the positioning operation. The minimum clearance between the jack-up's leg footings and a subsea pipeline or cable should not be less than 10m at any point during the positioning operation.

14.4.4 Smaller clearances may be accepted following a thorough review of the characteristics of the site, the procedures to be adopted, the limiting environmental conditions, back-up systems such as thrusters, lowering the legs to engage the seabed, the use of fenders and the deployment of sonar sector scan equipment when positioning close to subsea pipelines or cables. Due consideration shall be given to the consequences of contact and the ability to remove the jack-up from the location following completion of the operation.

14.4.5 The minimum clearances described below are based on the understanding that anchors are deployed from an anchor handling tug equipped with a DGPS based tug management system that has been specifically calibrated for the selected site. Greater clearances shall be allowed where this equipment is not fitted or is not in service.

14.4.6 Greater clearances than those described in this section are usually required around 'hot' hydrocarbon installations and pressurised pipelines. Anchors shall not be deployed within designated pipeline or cable corridors or exclusion zones. Note that exclusion zones may include areas excluded in marine and environmental permits.

14.4.7 Port authorities, gas and oilfield pipeline operators and other concerned parties may have more stringent clearance requirements related to the protection of critical pipelines and sub-sea or overhead electrical and communications cables. These must be complied with.

14.4.8 The clearance between a jack-up mooring line and a fixed structure or floating vessel during positioning shall not be less than 5m.

14.4.9 The horizontal clearance between a jack-up mooring line not crossing (parallel to) a sub-sea pipeline or cable should not be less than 50m. The vertical clearance between a jack-up mooring line crossing a sub-sea pipeline or cable should not be less than 5m. Smaller clearances may be accepted provided that it can be demonstrated that there is no risk of contact between the mooring line and the pipeline or cable.

14.4.10 The horizontal clearance between a jack-up's anchor and a fixed structure or sub-sea pipeline or cable shall not be less than 250m if laid across, or 150m if laid parallel to the pipeline or cable. This clearance may be reduced to 50m if the anchor drag sector is away from the pipeline or cable.

14.4.11 Contact between individual lines is not accepted for crossing anchor lines from two or more vessels.

14.4.12 Minimum recommended clearances are tabulated below:

Recommended minimum clearances during positioning

Element	Direction	Fixed structure or floating vessel	Subsea pipeline or cable	
			Horizontal	Vertical
Jack-up hull	Any	3m	-	3m (afloat)
Leg footing	Any	5m	10m	3m (afloat)
Mooring line	Not crossing	5m	50m	-
Mooring line	Crossing	5m	-	5m
Anchor	Drag sector away	50m	50m	-
Anchor	Drag parallel to	150m	150m	-
Anchor	Drag sector toward	250m	250m	-

14.5 Mooring analysis

14.5.1 For positioning a jack-up in non-critical locations a mooring layout plan shall be prepared.

14.5.2 For long term moorings defined as any mooring system that is deployed not solely for positioning purposes but also for the purpose of station-keeping the mooring arrangements should comply with the guidelines contained in section 14.4 (above) and should be analysed for the appropriate environmental conditions applicable to the season and time period for which the unit will be moored.

14.5.3 Mooring systems used for the purpose of station-keeping may, in general, be analysed by quasi static methods unless the unit is moored close to a fixed or floating structure or any natural hazard or obstruction that could result in contact damage in which case dynamic analysis should be performed. The analysis should describe the possible excursions under defined environmental loads and should demonstrate that there is no risk of contact between the jack-up or its mooring lines and the proximate fixed or floating structure or other obstruction with the moorings intact and in the single line failure mode.

14.6 Anchor handling tugs

14.6.1 Anchors should be deployed by anchor handling tugs. These vessels should be equipped with bow or stern rollers and winches, jaws, forks, pins, release devices and safety rails as appropriate for the safe control of the anchors and wires and to ensure proper protection for the tug crews.

14.6.2 Anchor handling tugs engaged in deploying anchors in the vicinity of fixed structures or sub-sea pipelines or cables should be equipped with a DGPS based tug management system that has been calibrated for the selected site.

14.6.3 An anchor handling tug carrying an anchor across a sub-sea pipeline or cable should carry the anchor on deck and not suspended from the stern roller.

14.7 Anchor handling procedures

14.7.1 Anchor handling procedures shall be documented. The procedures shall include scale anchor plans and shall describe the complete anchoring operation, the mooring equipment and details of the method of deploying and recovering anchors. The procedure shall include contingency plans for vessel and equipment malfunction or breakage.

14.7.2 The procedure shall also include a plan showing areas where anchors may not be deployed for any reason and shall describe the precautions to be taken to avoid contact between anchors and mooring wires and fixed structures, subsea pipelines and subsea cables where applicable.

14.7.3 Where required to maintain the vertical clearances (section 14.4) these precautions may include the deployment of line buoys (damage preventer buoys) installed at points along the length of the mooring wire to prevent it from coming into contact with subsea pipelines or cables. Additional precautions may also be necessary concerning the maintenance of tension in moorings during deployment and recovery to ensure that slack bights of wire do not contact fixed structures, subsea pipelines and cables.

14.7.4 Where the risk of contact between mooring wires and subsea cables and/or contact with the seabed in the vicinity of cables buried to a depth of 1m or less cannot be avoided by using line buoys then means of protecting the sub-sea cables such as rock dumping, concrete/steel mattresses or bolted steel cable protectors shall be employed.

14.7.5 Anchor plans should be reviewed and approved by the owners or operators of fixed structures, subsea pipelines and cables in the vicinity.

14.7.6 Prior to commencing anchor handling the master of the jack-up and/or the tow master (if the master is not the tow master) should arrange a meeting with the tug master(s) of the anchor handling tugs and the survey team to discuss the procedures to be adopted and the safety precautions to be observed. Sequential operations involving the same procedures, equipment and personnel may be addressed at a single meeting.

15. Lifting and load transfer

15.1 General

15.1.1 Lifting operations and lifting equipment shall comply with the Lifting Operations and Lifting Equipment Regulations 1998 (S.I.1998/2307) (LOLER). These regulations are supported by the HSE's technical guidance and approved codes of practice contained in:

- Technical guidance on the safe use of lifting equipment offshore
- Safe use of lifting equipment – approved code of practice and guidance

15.1.2 Marine Lifting Operations shall also comply with the instructions and recommendations contained in a recognised guideline document, such as:-

- GUIDELINES FOR MARINE LIFTING OPERATIONS
  Noble Denton 0027/ND Rev 7 – 15, April 2009
- LOC Guidelines for Marine Operations – Marine Lifting:
  LOCG-GEN-Guideline 003 Rev. 0, May 2003
- Det Norske Veritas (DNV) Rules for the Planning and Execution of Marine Operations, January 2000. Chapter 5: Lifting
- MCA MGN 280 (M) Small vessels in commercial use for sport or pleasure, workboats and pilot boats - alternative construction standards MS+FV lifting operations and lifting equipment regulations 2006.

The Documents listed above are mainly concerned with lifting operations by floating crane vessels; therefore the following section of this document provides additional information on marine lifting operations carried out by jack-ups.

15.2 Planning

15.2.1 Operational planning shall be based on the use of well-proven principles, techniques, systems and equipment to ensure acceptable Health and Safety levels are met and to prevent the loss or injury to human life and major economic losses.

15.2.2 All planning for load out and offshore lifting operations is based where possible on the principle that it may be necessary to interrupt or reverse the operation. However, this may be impractical for some operations and in cases where the operation cannot be reversed, points of no return, or thresholds, shall be defined during planning and in the lifting manual. Checklists should be drawn up detailing the required status to be achieved before the operation proceeds to the next stage.

15.2.3 A comprehensive lifting manual shall be prepared. This manual may form part of an installation manual for the module or component to be lifted and shall include, as a minimum, details of the following:

- Description of the operation
- Time schedule
- Lift module dimensions weight and COG
- Details of stabbing guides and beams (if used)
- Details of auxiliary winches and tag lines
- Details of the jack-up and attending vessels (tugs, transport barges etc)
- Jack-up station keeping arrangement (jacked up, leg-stabilised, moored afloat, DP)
- Transport barge station keeping arrangement
- Specific operations (ballasting, ROV, divers, survey measurements etc)
- Vessel positioning procedures
- Configuration and certification of the crane
- Certification of all lifting equipment

- Crane radius curve (manufacturers/class de-rating of crane when afloat if applicable)
- Proposed clearances between lifted module/crane/legs/vessels/existing structures
- Lifting equipment details, rigging weights and rigging drawings
- Limiting environmental criteria for each lift
- Plan and profile drawings
- Organisation, communications and responsibilities
- Recording procedure
- Pre-lift checklist
- Safety and contingency plans

15.3 Documentation and design calculations

15.3.1 Each crane shall be provided with a report of inspection and a valid certificate of test. Permanently mounted vessel's cranes shall be certified by the jack-up's classification society and details of annual inspections and five year tests shall be recorded in the vessel's lifting gear register.

15.3.2 The lifting capacity of the crane shall be defined and the basis for the load/radius curve shall be clearly described in the crane manual or similar document. When mobile cranes are used onboard the jack-up, care shall be taken to determine whether the weights of crane blocks, hooks and wires have been included or excluded in the defined lifting capacity.

15.3.3 Temporary and mobile cranes not forming part of the jack-up's permanent equipment shall be certified and shall be seafastened in accordance with the provisions of section 7.

15.3.4 Reference is requested to the flowcharts contained in the referenced guideline documents on marine lifting (section 15.1.2) which provide a useful summary of the stages in the design and analysis of lifts using a single crane or two cranes.

15.4 Loads and analysis

15.4.1 The module design weight (MDW) shall include adequate contingency factors to allow for the module being heavier than intended. After completion, the module shall be weighed using an approved weighing method. The as-weighed weight shall be increased by 3% to account for weighing inaccuracies. Documentation should be provided to demonstrate that the equipment and procedures adopted for weighing have the required accuracy.

15.4.2 A further component, the rigging weight (RW), shall be added to the MDW. This allowance represents the weight of the lift rigging and shall include the estimated weight of all shackles, slings, lifting beams, spreaders and rigging platforms. In the final design phase the actual weight of rigging (including contingencies) shall be used.

15.4.3 The plan position of the centre of gravity shall generally be restricted for the following reasons:
- To allow for the use of matched pairs of slings
- To prevent overstress of the crane hook
- To control the maximum tilt of the object

The module COG should be kept within a specified design envelope. The length of the lifting slings/grommets shall be chosen to control the tilt of the module. For practical purposes the tilt of the module should not exceed 2 degrees, however some modules require finer vertical tolerance for installation.

15.4.4 RW shall be added to the MDW to give the static hook load (SHL): MDW + RW = SHL. The SHL shall be checked against the approved crane capacity curve at the maximum planned outreach.

15.4.5 Where the lifting situation may give rise to a dynamic increase in the effective load the dynamic hook load (DHL) shall be obtained by multiplying the SHL by a dynamic amplification factor (DAF): DHL = SHL x DAF. The DAF allows for the dynamic loads arising from the relative motions of the crane vessel and/or the cargo barge during the lifting operations. The DHL shall be checked against the approved crane capacity curve at the maximum planned outreach.

15.4.6 For lifts in air the dynamic load is normally considered to be highest at the instant when the module is being lifted off its grillage. This load, and hence the appropriate DAF, should be substantiated by means of an analysis which considers the maximum relative motions between the hook and the cargo barge and takes account of the elasticity of the crane falls, the slings, the crane booms and the luffing gear.

15.4.7 The description of such an analysis must clearly state the assumed limiting wave heights and periods such that, if the calculated value of DAF is critical to the feasibility of the operation, then those conducting the lift will be aware of the limiting seastates.

Table 15.4.8: DAF factors for jack-up

Weight of module	< 100 tonnes	100 – 1,000 tonnes	Horizontal
Floating mode lifting from vessel afloat			
Lift offshore	1.50	1.40	N/A
Lift inshore	1.30	1.20	N/A
Elevated mode lifting from vessel afloat			
Lift offshore	1.15	1.10	1.05
Elevated mode lifting from leg stabilised barge or jack-up			
Lift offshore	1.00	1.00	1.00
Elevated mode lifting from quayside			
Lift inshore	1.00	1.00	1.00

15.4.8 In the absence of a dynamic lift response analysis being carried out the values of DAF given in table 15.4.8 may be used for lifts in air from a jack-up.

15.4.9 It should be noted that some crane capacity curves already take due account of the DAF and care should be taken to ensure that the DAF is not considered twice in the design calculations.

15.5 Minimum clearances

During all phases of a lift the following minimum clearances should be maintained. Recommended clearances are tabulated below. Smaller clearances may be accepted following a thorough review of the characteristics of the lift, the procedures to be adopted, the limiting environmental conditions and the consequences of contact.

Jack-up	Floating mode	Elevated mode
Below the lifted module	3m	1m
Between module and jack-up legs	3m	1m
Between module and crane boom	3m	1m
Between spreader bar and crane boom	3m	1m
Between module and fixed structure	3m	1m

15.6 Jack-up crane vessel stability

15.6.1 For a jack-up lifting in the afloat condition, load and stability calculations shall be provided to demonstrate that the condition at each stage of the lift operation is within the limits contained in the stability book and/or the operating manual.

15.6.2 A failure mode and effects analysis (FMEA) is a requirement of class for DP jack-ups. The requirement for an additional FMEA or otherwise for a DP jack-up during lifting or positioning shall be determined in consideration of the risk to persons, DP class, proximity of other structures or vessels, lifting configuration, operating environment and any other factor particular to the circumstances of the proposed operation.

15.6.3 For a jack-up lifting in the elevated condition it shall first be verified that the preload operation has been carried out in accordance with the instructions contained in the operating manual and/or in accordance with any approved site-specific procedures that may have been developed for the location.

15.6.4 For a jack-up lifting in the elevated condition, load calculations shall be provided to demonstrate that the load condition at each stage of the lift operation is within the limits stated in the operating manual and that the jack-up's maximum allowable elevated weight (operating) and centre of gravity remains within the specified transverse and longitudinal limits throughout the lifting operation. The calculations shall demonstrate that, during lifting and slewing, individual leg loads will not approach or exceed the legs loads achieved during preloading.

15.6.5 Caution shall be exercised at locations where the seabed foundation may have become altered by scour or other effect over time. In such cases the jack-up preload or pre-drive sequence should be repeated prior to commencing a lift operation. The jack-up should be precisely levelled prior to commencing a lift operation.

15.6.6 Jack-ups with four or more legs should ensure that the leg loads are equalised before lifting in order to reduce the risk of further slight settlement during the lift operation. Following this test the leg loads should be adjusted (if required) to the prescribed loads for lifting and locking devices, fixed catches or pins should be engaged (if required) in accordance with the instructions contained in the operating manual.

15.6.7 When carrying out lifts with two cranes, documentation should be submitted to demonstrate that the jack-up crane vessel can safely sustain the changes in hook load which arise from the tilt and yaw factors combined with environmental effects in the lifting calculations, specifically considering allowable cross lead angles for the crane booms.

16. Crew transfer

16.1 Principal requirements

16.1.1 Equipment shall be provided to allow the crew, project personnel and visitors to safely embark and disembark when the jack-up is:

- Moored afloat or elevated at a quayside
- Afloat or partly elevated with the hull at draft inshore or offshore
- Elevated inshore or offshore

It should be recognised that there will be operational circumstances in which safe access cannot be provided and at which time transfer of personnel should not be attempted.

16.1.2 The access equipment shall comply with the following regulations and codes:

- The Merchant Shipping (Means of Access) Regulations SI 1988/1637
- The Merchant Shipping (Safe Movement Onboard Ships) Regulations 1988
- MCA Code of Safe Working Practice for Merchant Seamen
- MCA Small Commercial Vessel and Pilot Boat (SCV) Code as set out in MGN 280

The responsibility for the provision and maintenance of the jack-up's access equipment shall be the responsibility of the jack-up owner or operator.

16.1.3 Routine access to and from the jack-up will normally be from the quayside or offshore platform (or other fixed structure) or barge or from a crewboat. The term crewboat shall be deemed to include tugs, workboats or RIBs used for personnel transfer. Transfer of personnel by helicopters has not been considered in this guideline.

16.1.4 The safe condition of quaysides and quayside equipment, offshore platforms and crewboats used for the transfer of personnel to and from jack-ups shall be the responsibility of the party who owns or operates the quayside, platform or crewboat. Crewboats shall be constructed, maintained, equipped, manned, and operated in accordance with the rules laid down by their registry and class or in accordance with the *SCV code*, as applicable.

16.1.5 The master of the jack-up and master of the crewboat and the person supervising the transfer shall ensure that the selected method of transfer of personnel to and from the jack-up is safe in the prevailing circumstances and that equipment used for the transfer is in satisfactory condition and has been properly rigged and/or prepared for the transfer. In assessing the level of safety the master of the jack-up should be guided by the instructions and recommendations contained in the site-specific documented transfer procedure.

16.1.6 The master of the jack-up and/or the person supervising the transfer shall also ensure that all transferees have received the required training in the selected method of transfer and that the appropriate PPE is worn for each transfer.

16.1.7 Each person using a gangway, ladder, personnel carrier or other device for transfer to/from a jack-up, offshore platform, crewboat or quayside shall individually and separately accept responsibility for their own safety. No person should attempt a transfer at any point unless they have received the appropriate training and instruction and are confident that they can accomplish the movement safely.

16.1.8 The safe operation of the jack-up and/or platform and/or crewboat is the responsibility of the owner/operators, as applicable. The individual responsibilities of the transferee and the vessel masters and crew involved in supervising transfers, or operating equipment used for transfers, shall be clearly established and documented.

16.1.9 Specific procedures for routine personnel transfer shall be clearly established and documented. For each mode of transfer these procedures should, as a minimum, include details of the equipment to be used, equipment and transfer mode operating limits, training and PPE requirements, provision of safety equipment, communications protocols and the instructions to be given and checks to be carried out prior to each transfer.

16.2 Transfer when the jack-up is moored afloat or elevated at a quayside

16.2.1 When the jack-up is positioned at a quayside the transfer of personnel should be accomplished using an approved gangway and associated equipment that complies with the Merchant Shipping Regulations *(means of access)* 1988. The gangway shall be rigged in accordance with the advice contained in the UK Code of Safe Working Practice for Merchant Seamen.

16.2.2 A dock mounted stair tower shall be provided in circumstances where there is a significant difference in height between the jack-up deck and the quayside, such that the angle of inclination of the gangway, if used alone, would exceed its design limits.

16.2.3 Stepping over from the jack-up to/from the quayside shall be avoided, even in cases where the gap is small and the jack-up deck and quayside are level or almost level. Scaffolding, planks and other temporary equipment shall not be used for the transfer of personnel to/from the quayside.

16.3 Transfer when the jack-up is afloat or partly elevated with the hull at draft

16.3.1 When the jack-up is afloat underway or positioned on location with the hull at draft the transfer of personnel to/from a crewboat shall be accomplished using a fixed steel boarding ladder (if fitted) or an approved rope ladder rigged on the lee side or end of the jack-up. A rope ladder (if used) shall be constructed and rigged in accordance with the advice contained in the U.K. Code of Safe Working Practice for Merchant Seamen.

16.3.2 Personnel may transfer directly from the jack-up to/from the crewboat without using a ladder in cases where:

- The crewboat has a boarding platform fitted with a safety rail
- The personnel transferring are not required to climb over the safety rail
- The height of the boarding platform is almost level with the jack-up's deck
- The vertical movement of the boarding platform in the sea state is ≤ 30 cm
- The jack-up's boarding point has an access opening in the deck rail or bulwark
- The boarding point is manned, lighted and equipped with a lifebuoy and line

16.3.3 The jack-up's fast rescue craft, man overboard boats, workboats or RIBs fitted with class approved davit launch and recovery systems may be used for the occasional transfer of trained seamen and divers. Such transfers should be subject to a specific risk assessment.

16.3.4 Transfer using personnel baskets and man-riding cranes should not be attempted while the jack-up is in the floating mode.

16.4 Transfer when the jack-up is elevated on location

16.4.1 When the jack-up is elevated to an air gap on an inshore or offshore location the transfer of personnel to/from the jack-up is usually accomplished using.

- Bridge to adjacent fixed structure (e.g. wind/current turbine or platform).
  (Further reference is required for specific guidance on turbine access)

- Man-riding crane and certified personnel carrier
- Other approved mechanical device certified for manriding

16.4.2 The use of fixed steel ladders or rope ladders for access by personnel to elevated jack-ups requires extreme caution and should only be attempted in slight sea conditions. Plans for the use of rope ladders should be subject to special consideration and specific risk assessment.

16.4.3 The capacity of purpose built bridges and gangways used for access shall be certified, or in the absence of a certificate, a report on the structural capacity from a *competent person* shall be provided.

16.4.4 Man-riding cranes shall comply with LOLER regulations. In addition a certificate or report shall be provided to demonstrate that the man-riding crane is equipped in accordance with the guidance provided in HSG 221.

16.4.5 Transfer of personnel by personnel basket or other carrier shall be undertaken in accordance with the guidance contained in HSE offshore information sheet, January 2007: Guidance on Procedures for the Transfer of Personnel by Carriers. The type of personnel carrier used shall comply with guidance contained in HSG 221.

17. Marine control for jack-up operations

17.1 Marine control during transit and positioning

17.1.1 Jack-ups in transit and during positioning shall comply with the applicable marine traffic regulations promulgated by the port state controlling the waters through which the transit is made and in which the jack-up is positioned. The jack-up owner or operator shall be responsible for compliance with these regulations.

17.1.2 Jack-up transit and positioning operations usually require notices to mariners to be issued in advance, during, and on completion of each movement. Regulations also require that routine reports are made to vessel traffic services wherever applicable. The jack-up owner or operator shall be responsible for ensuring that the required notices, advisories and warnings are issued and for maintaining communication with the maritime authorities concerned.

17.1.3 Jack-ups operating within port limits shall comply with rules promulgated by local port or river authorities, pilot services and harbour masters. The jack-up owner or operator shall be responsible for maintaining communication with the marine authorities that operate or exercise control in the area through which the jack-up is transiting and in which the jack-up is operating.

17.2. Nearshore and offshore project sites

17.2.1 In addition to large scale navigational charts, jack-ups operating at marine project sites shall be provided with large scale drawings of the project site in both hard copy and electronic format where such files are in use on the jack-up's survey system. The drawings shall contain information plotted using a system of co-ordinates that is compatible with the survey system in use on the jack-up and they shall be continuously updated to reflect both natural and man-made changes as they occur. The following information shall be included:

- Bathymetry
- Seabed surface features including debris and obstructions
- Position, dimensions and depth of any previous jack-up 'footprints'
- Position and dimensions of fixed surface and subsea structures
- Positions (as laid) of all subsea pipelines and cables and proposed cable routes
- Positions and heights of overhead cables
- Positions of vessels and anchors of units on long term moorings
- Clear fairways and exclusion zones
- Designated zones within the site together with notation on the reason for zoning

17.2.2 Jack-ups operating as single isolated units and attended only by their towing vessels (if any) require no additional marine control system. Masters of towing vessels (if any) shall be provided with the procedure document or method statement for the proposed transit and positioning operation and they shall be briefed by the master of the jack-up in advance of the proposed movements.

17.2.3 For jack-ups operating offshore it is recommended that a 500m radius exclusion zone centred on the unit's position be maintained during positioning and elevated operations. No other vessel should enter or move within this exclusion zone until clearance has been received from the master of the jack-up. A lookout on the jack-up or the attending tug should be maintained throughout operations on site. Rogue vessels or small craft approaching the zone without notice should be advised by all available means to avoid this zone.

17.2.4 Where simultaneous operations involving multiple vessels are planned to take place within the same area, marine traffic control (MTC) under a single designated authority is required. Coordination shall be arranged between the various contractors and vessels deployed in order to avoid unsafe conflict between vessel movements and moorings. This is particularly important for jack-up positioning operations and to ensure the safety of the jack-up after elevation.

17.2.5 The area in which MTC applies shall be defined. All proposed vessel movements within the defined area shall be reported to the marine traffic controller in advance for planning purposes. No movement shall take place within the area until clearance is received from the marine traffic controller. The MTC shall be advised on completion of each movement.

17.2.6 Jack-ups operating within an area subject to MTC shall be fitted with the navigation and communication equipment necessary to monitor and transmit communications and to transmit radio identification signals and messages compatible with systems used by the MTC.

18. Conduct of jack-up operations

18.1 Sources of guidance on the conduct of jack-up operations

18.1.1 The jack-up's operating manual is the principal source of instruction and guidance on the conduct of jack-up operations. The operation of vessels governed under the ISM code shall be guided by the relevant safety management manuals. The operation of the vessel's jacking system, cranes and all machinery and equipment should be conducted in accordance with the relevant manufacturer's manuals.

18.1.2 Specific guidance contained in procedure documents should be followed. Proposed departures or deviations (if any) from the instructions and recommendations contained in the manuals referred to in 18.1.1 (above) should follow a management of change (MOC) procedure and should be documented at the planning stage.

18.1.3 The operation should be conducted in such a way that there is no unplanned departure from the guidance provided in the sources listed above except in cases of emergency when the master of the jack-up deems it necessary to take different action or adopt an alternative procedure in order to avoid an unsafe condition or risk thereof. Provision for such emergencies should be identified in the MOC procedure.

18.1.4 In cases where circumstances arise requiring a change to the existing guidance then the operation in progress should be temporarily suspended and the circumstances investigated in accordance with the MOC procedure. Alternative procedures should only be adopted when they have been reviewed, approved and signed off in accordance with the MOC procedure.

18.1.5 The use of jack-up move checklists is recommended.

18.2 Manning for operations

18.2.1 The jack-up shall be manned with a competent marine crew in accordance with the vessel's Safe Manning Certificate (if issued) or in any case with sufficient crew to manage the vessel and the marine operations making proper allowance for rest periods.

18.2.2 Jack-ups without any propulsion units and issued with loadline or loadline exemption certificates for unmanned tow may carry a riding crew sufficient to manage the vessel and the operations subject to the provision of adequate life saving and firefighting equipment.

18.2.3 Where a riding crew is carried the attending tug(s) shall have sufficient certified capacity to accommodate the riding crew and suitable provision to safely transfer all personnel from the jack-up to the tug. The maximum weather conditions for transfer of personnel from the jack-up to the attending tug(s) should be established prior to commencing the tow and provision should be in place for the transfer of personnel from the jack-up to the tug well before deteriorating weather conditions approach the level that would render disembarkation unsafe.

18.2.4 For propulsion assisted or non-propelled jack-ups in the transit condition the manning should be reduced as far as is practicable by the removal of non-essential personnel before departure. In any event the total complement shall not exceed 50% of the total survival craft/liferaft capacity for the transit mode. Manning need not be reduced for field moves.

18.2.5 There is no requirement to reduce manning in the transit mode for self-propelled jack-ups classed for unrestricted transit through the certified trading area; however, the total number of persons on board shall not exceed the vessel's certified lifesaving capacity.

18.2.6 For all jack-ups operating in the elevated mode the manning level including day visitors shall never exceed the jack-up's maximum certified capacity except in cases where emergency assistance is being rendered by the jack-up to another vessel in distress.

18.2.7 Well prior to the onset of extreme storm conditions and before placing the jack-up in the storm survival mode, consideration should be given to the available means of evacuation and the timely removal of all non-essential personnel.

18.3 Weather forecasts

18.3.1 The safety of most jack-up operations is dependent upon the regular receipt of reliable weather forecasts.

18.3.2 Excepting UK Met Office forecasts, no reliance shall be placed upon weather information freely available to the public on the internet or information broadcast by commercial radio and television stations of the type that is general in nature and intended only for those engaged in non-critical leisure activities.

18.3.3 Shipping forecasts, inshore forecasts, gale and strong wind warnings and the latest marine observations issued by the UK Met Office shall be monitored on a regular basis. Routine forecasts and warnings broadcast by the UK Met Office may be sufficient for jack-up operations conducted in harbours or within sheltered bays and estuaries.

18.3.4 For all other jack-up *transit, positioning and elevated operations* conducted anywhere outside sheltered harbours or outside sheltered bays and estuaries, route-specific and site-specific marine weather forecasts (as applicable) are required.

18.3.5 Route and site-specific forecasts are required at intervals not exceeding 12 hours and these should be broken down into four time periods (00, 06, 12 and 18 hundred hours U.T.) for the following three days plus an outlook for the following two days. Each forecast should contain the following meteorological information:

- Wind directions, speed and gusts at 10m
- Wind directions, speed and gusts at 50m
- Maximum wind wave height and period
- Significant wind wave height and period
- Swell wave direction height and period
- Visibility
- Temperature
- Barometric pressure per period
- Type of weather per half-day
- Overall conditions in the form of surface pressure isobar maps
- Forecast reliability ranking for each forecast
- Contact details for the duty forecaster (to be available on a 24/7 basis)

18.4 Transit

18.4.1 Prior to commencing the transit the person responsible for conducting the operation shall be in possession of the relevant *site-specific assessment* report for the proposed new location and shall be familiar with the information, instructions and recommendations contained in the documents described in section 18.1.1 and 18.1.2 (above).

18.4.2 A weather forecast indicating suitable conditions for the proposed transit shall be received and reviewed prior to jacking down. On site conditions of wind, wave and current should be carefully observed and assessed to ensure that the prevailing conditions will not adversely affect control of the movement of the jack-up on departure from the location.

18.4.3 Before jacking down, the load and stability calculations should be completed and all equipment and cargo secured for transit. The jacking system and all main machinery and equipment should be tested and the person responsible for the conduct of the move should be satisfied that the jack-up and the towing vessel(s) (if any) are in all respects ready for the move.

18.4.4 Before jacking down the jack-up's position, heading and clearances between adjacent structures or obstructions should be carefully checked. Particular attention should be paid to the air gap, the water depth, the predicted rise or fall of the tide and the individual leg penetrations. These levels should be checked against individual leg height readings so as to ensure that the person responsible has a complete understanding of the jack-up's elevated status before jacking down.

18.4.5 Caution should be exercised when raising the legs to avoid the risk of injury to personnel on deck caused by loose objects and marine growth breaking loose and falling from the legs.

18.4.6 For manned units, routine checks of the watertight integrity and seafastening arrangements should be carried out during transit afloat. For unmanned units routine inspection of the barge draft and trim can be carried out by the crew of the towing vessel using binoculars.

18.4.7 Jack-ups in *transit* are required to have an anchor ready for release during transit and positioning; however, to avoid accidental release the anchor should be secured with a quick-release mechanism.

18.4.8 A schedule of regular radio contacts should be maintained between the towing vessel and manned jack-ups under tow. Weather forecasts shall be monitored and weather observations logged.

18.5 Positioning

18.5.1 To ensure that the limits prescribed in the operating manual are not exceeded during positioning, a weather forecast shall be obtained indicating that the prescribed limits will not be exceeded over the time required for positioning plus a contingency for delay. On site conditions of wind, wave and current shall be carefully observed to ensure that the prevailing conditions and any anticipated changes will not adversely affect control of the jack-up during the approach and positioning.

18.5.2 Prior to approaching the proposed new location the leg securing system (if fitted) should be disengaged and the jacking system and all machinery and equipment to be used for the positioning operation such as survey gear and mooring winches should be function tested.

18.5.3 Crane booms shall remain secured for the transit condition and all equipment and cargo seafastenings shall be kept in place until the positioning operation is complete. The towing vessel shall remain connected to the main towing bridle until the positioning operation is complete.

18.5.4 The jacking, preloading and elevating operations shall be undertaken in accordance with the instructions and recommendations contained in the operating manual and the jacking system manual (if not included in the operating manual). Limits specified in the manuals shall not be exceeded and all precautions described in the manuals shall be observed.

18.5.5 The jack-up's overall elevating speed, inclusive of time taken to recycle jacks, shall be sufficient to manage the planned positioning and removal operations, having due regard for the tidal range and the rate of tidal rise or fall. Special consideration for operations at locations with large tidal ranges and locations where the duration of slack water may limit the time available for changing from the floating to the elevated mode may be required.

18.5.6 Preloading shall be carried out to ensure that each leg is subjected to the load specified in the operating manual or in the *site-specific assessment*. The preloading operation should be carried out with the hull levelled at the lowest practicable air gap.

18.5.7 In circumstances where risk of rapid leg settlement exists during preloading the level of the hull should be set, as far as practicable, at zero airgap or with the hull partially buoyant before achieving footing loads that are likely to result in rapid settlement. Operations of this type require careful planning; the rise and fall of the tide must be taken into account and the operation can only be conducted in calm weather.

18.5.8 Complex preloading or predriving operations involving leg jetting or other special measures designed to achieve the safe installation of a jack-up at locations where risk of punch-through or other foundation hazards exist should not be attempted without expert geotechnical advice.

18.5.9 Particular attention shall be paid to accurate measurement of actual leg penetrations and associated footing loads during installation so as to monitor progress against the predicted load/penetration curve. Any significant difference between the predicted leg penetrations and the actual progress of the penetration during preloading should be investigated and reported to a *competent person* for review and approval prior to elevating the jack-up to the working air gap.

18.5.10 Following the preloading operation and before elevating the jack-up to a working air gap, the individual leg height readings and leg footing penetrations shall be accurately recorded **(Appendix H)**. Leg height and penetration measurements obtained from mechanical or electronic instruments should be verified by visual inspection of the leg height marks against a reference point at the level of the deck or jack-house.

18.5.11 Following completion of the preloading any significant difference between the penetrations of each leg and/or any significant difference between the penetration anticipated and the penetration achieved should be investigated and reported to the *competent person* responsible for the *site-specific assessment* for review and approval prior to elevating the jack-up to the working air gap.

18.6 Deployment of jack-ups for soil investigations

18.6.1 In virgin territory, where there has been no previously recorded jack-up activity and where there is no adequate advance information on the nature of the seabed soils, the ground investigation may be carried out using equipment deployed from a jack-up operating in *weather restricted mode*.

18.6.2 Compliance with the recommendations contained in this section 18.6 does not relieve the jack-up operator of his responsibility for obtaining, as far as reasonably practicable, any available information on the probable characteristics of the soils likely to be encountered before the jack-up is deployed. Particular reference is requested to the HSE information sheet - jack-up (self elevating) installations: review and location approval using desktop risk assessments in lieu of undertaking site soils borings.

18.6.3 In the absence of reliable advance soil data the jack-up operator must exercise extreme caution during preloading or pre-driving and the jack-up should remain with the hull partly buoyant or elevated to the lowest practical air gap so that it can be refloated quickly should the investigation and analysis reveal that the foundation is unsuitable or if rapid settlement occurs.

18.6.4 A jack-up should not be elevated above the lowest practical working air gap or to the survival air gap on any location until the soil investigation and the geotechnical assessment has progressed to the point where the level of confidence in the integrity of the jack-up foundation has been formally declared satisfactory by a *Competent Person*. It should be recognised that on-site soil investigation alone may prove inadequate and that the results of on-shore laboratory analysis of samples may be needed before this level of confidence is achieved.

18.6.5 The lack of adequate advance soil data means that the risk of encountering unsuitable foundation conditions cannot be reduced to a level that is as low as reasonably practicable until the soils investigation and analysis is complete. Therefore soils investigations undertaken from permanently manned jack-ups should only be attempted with towing vessel(s) in attendance and in periods of benign weather that will allow the jack-up to be refloated and moved to shelter or an alternative safe elevated location at any time.

18.6.6 For unmanned jack-ups, where the crew are routinely accommodated on shore between shifts, the requirement to remove the jack-up before conditions for jacking and refloating are exceeded can be waived if the following conditions are complied with:

- It has been established by a *competent person* through review of the desk top study and/or the progress of the soils investigation that the risk of encountering unsuitable foundation conditions is low.
- A repeated preload operation has exposed no problems and leg penetrations are approximately even.
- The jack-up is capable of withstanding the 10 year storm (foundation bearing capacity assumed to be adequate) and the hull is raised to comply with the 50 year air gap requirement.
- Site-specific weather forecasts stating a high level of confidence are being monitored and all personnel are removed from the jack-up prior to the onset of weather conditions predicted to exceed the limit for safe disembarkation.
- There is no risk to personnel and the consequences of catastrophic weather damage to the jack-up and the potential threat to the environment and to shipping, installations, and property in the vicinity have been formally assessed by the site developer and the jack-up owner.

18.7 Elevated operations

18.7.1 Elevated operations shall not begin until preloading has been completed and the unit has been elevated to the working air gap in accordance with the provisions of section 18.5 of this guideline.

18.7.2 Receipt and review of weather forecasts (section 18.3) shall be continued throughout the period elevated on location.

18.7.3 The progress of elevated operations shall be closely monitored to ensure that weather conditions do not exceed the prescribed limits and to ensure that there is adequate time remaining to implement contingency plans for removal of the jack-up or for placing the unit in the elevated survival mode before the onset of adverse weather, as applicable.

18.7.4 The elevated load condition shall be calculated and any changes in weight attributable to material loaded, discharged or consumed shall be recorded in such a manner that the individual leg loads for all stages of the elevated operation are known.

18.7.5 Hull inclination shall be monitored on a frequent and regular basis. For units elevated by means of hydraulic jacks, the jack pressures shall be monitored on a frequent and regular basis. In the event that any inclination or loss of jack pressure is observed the elevated operations should be suspended until the cause of the inclination or loss of pressure has been investigated and the condition has been rectified.

18.7.6 Consideration shall be given to the potential impact of seabed scour on the integrity of the jack-up foundation over time. Particular consideration shall be given to the potential for movement of seabed soils caused by currents or waves. Where risk of such conditions is deemed to exist, the jack-up foundation analysis shall include an assessment of the level of change that may affect foundation stability. The integrity of the foundation is to be tested by repeating the preload operation following a storm or other event that may have adversely affected the strength of the soil supporting the jack-up.

18.7.7 At locations where potential for seabed scour exists, an increase in leg penetration, inclination and/or loss of hydraulic jack pressure (for units elevated by means of hydraulic jacks) may occur. Scour effect may create a requirement for frequent operation of the jacking system as adjustments to leg heights become necessary to maintain elevated stability. In such cases a suitable 'bedding-in' period must be allowed for and elevated operations should not be attempted until the leg penetration has reached a depth at which the rate of additional penetration caused by scour has reduced to a manageable level.

18.7.8 If any unexpected increase in leg penetration or inclination occurs during elevated operations then all operations should be suspended immediately and expert geotechnical advice should be obtained. Jacking of the unit should only be undertaken after consultation with experts. Subject to the provision of expert advice the hull may be lowered to the lowest practical air gap until the cause of the settlement has been investigated and rectified. After the jack-up has been stabilised the preload operation must be repeated.

18.7.9 Seafastenings for cargo (particularly modules subject to high wind loads) should not be removed until lift rigging is connected and lifting operations are ready to proceed.

18.7.10 Prior to heavy lift operations, the elevated load condition of the unit should be checked by calculation and, for units elevated by means of hydraulic jacks, by equalising the jack pressures. In all cases it shall be verified that the heavy lift operation will not cause allowable leg loads or the centre of gravity offset limits to be exceeded at any point during the proposed lift.

19. Emergencies and contingencies

19.1 Life saving appliances, firefighting appliances and radio installations

19.1.1 Jack-ups shall be fitted with life saving and firefighting appliances and radio installations in accordance with their registry, class and certification. Typically, the following standards will be applied as appropriate.

- IMO MODU code for the construction and equipment of mobile offshore drilling units, consolidated edition, 2001
- IMO Safety of Life at Sea (SOLAS, 1974)
- MCA Small Commercial Vessel and Pilot Boat (SCV) Code (see MGN 280)

19.1.2 Whether required by statutory regulation or otherwise, *permanently manned* jack-ups fitted with *certified crew accommodation* including modular accommodation that is occupied by project personnel or visitors shall, as far as practicable, be fitted with survival craft and means of evacuation and escape complying with the IMO MODU code, chapter 10.

19.1.3 In the case of a jack-up where, due to its size or configuration, lifeboats and launching arrangements cannot be fitted, liferafts complying with the requirements of IMO SOLAS 74 regulation III/39 or III/40 served by launching devices complying with the requirements of regulation III/48.5 or III/48.6 shall be fitted and these shall be of such aggregate capacity as will accommodate the total number of persons on board if:

- All of the liferafts in any one location are lost or rendered unusable
- All of the liferafts on any one side, any one end, or any one corner of the unit are lost or rendered unusable

19.1.4 If two widely separated fixed steel ladders extending from the deck to the waterline when the unit is elevated cannot be installed then alternative means of escape with sufficient capacity to permit all persons on board to descend safely to the waterline shall be provided.

19.2 Emergency procedures, training and drills

Whether required by statutory regulation or otherwise, all jack-ups fitted with permanent crew accommodation and/or modular accommodation that is occupied by project personnel or visitors shall comply with the provisions contained in the IMO MODU code with respect to the following. Chapters and section numbers refer to numbering in the MODU code.

- Emergency Procedures (chapter 14, section 14.8)
- Emergency Instructions (chapter 14, section 14.9)
- Training Manuals (chapter 14, section 14.10)
- Practice Musters and Drills (chapter 14, section 14.11)
- Onboard training and instructions (chapter 14, section 14.12)
- Records (chapter 14, section 14.13)

19.3 Site-specific emergency response plan

19.3.1 Site-specific emergency response plans shall be developed for jack-ups operating on site. Emergency response plans are likely to involve local emergency services such as the coastguard, RNLI, fire, police, ambulance, harbour master and local towage, salvage and pollution response services. Contact should be made with these services to co-ordinate plans prior to mobilising the jack-up. Following mobilisation, joint exercises should be conducted if practicable.

19.3.2 Guidance can be found in the MCA MGN 371 'Offshore Renewable Energy Installations (OREIs) Guidance on UK Navigational Practice, Safety and Emergency Response Issues' and the supporting note 'Offshore Renewable Energy Installations Emergency Response Cooperation Plans (ERCoP) for SAR Helicopter Operations'.

19.3.3 Plans should be based on comprehensive risk assessments and should be developed following consultation with local emergency services to cover all foreseeable emergency situations including, but not limited to:

- Extreme storms
- Evacuation and escape
- Medical aid and evacuation of individuals
- Man overboard
- External response to jack-up vessel emergencies
  (Common perils such as fire, collision, flooding, breaking adrift, settlement etc.)
- External response to pollution (In addition to the jack-up's SOPEP)
- Notifications, contact details and incident reporting

19.4 Route and site-specific contingency plans for transit and positioning

Contingency plans specific to the proposed transit and positioning operations shall be contained in the procedure document and should include:

- Forecast of or unexpected onset of adverse weather ≥ prescribed criteria
- Motions afloat approaching prescribed limits
- Failure of or damage to seafastenings and grillage
- Deviation to designated safe havens en route
- Tug breakdown
- Towing equipment failure
- Jacking system machinery and/or power failure
- Mooring equipment failure
- Survey equipment failure
- Unexpected installation behaviour (leg penetration not as anticipated)
- Pollution response (for units not provided with a SOPEP)
- Communications equipment failure
- Notifications, contact details and incident reporting

19.5 Site-specific contingency plans for elevated operations

Contingency plans specific to the proposed elevated operations shall be contained in the Procedure Documents and should include:

- Forecast or unexpected onset of adverse weather ≥ prescribed criteria
- Jacking system failure
- Main power failure
- Settlement of leg footings and/or leg misalignment and binding
- Removal of the jack-up to a safe haven
- Crane structural or machinery failure with lift suspended
- Notifications, contact details and incident reporting

19.6 Ship emergency response

19.6.1 Under the provisions of the ISM code, self-propelled jack-ups (as ships) are required to have in place a ship emergency response service contactable on a 24/7 basis through the designated person ashore (DPA). This service may be provided by a company's competent person (naval architect or specialist) or by an external company. The service is intended to provide the vessel's master with a swift and effective response in the form of practical advice, support and back-up technical services in the event of unexpected incidents such as grounding, collision, flooding or explosion. Consideration should be given to the provision of a similar response service for all jack-up operations whether required by statutory regulation or otherwise.

APPENDIX A
References

PLEASE CHECK FOR AMENDMENTS, REVISIONS AND LATEST EDITIONS.

BWEA

BWEA Guidelines for Health and Safety in the Marine Energy Industry, October 2008

Background Information on Jack-Ups

Noble Denton Consultants Ltd.
The Marine Operations of Self-Elevating Platforms (Jack-up Rigs)
(Copyright - Noble Denton: Course offered by Aberdeen College of Further Education)

Oilfield Publications Ltd.
Oilfield Seamanship Series, volume two – Jack-up Moving

Bennet & Associates & Offshore Technology Development Inc.
Jack-Up Units. A Technical Primer for the Offshore Industry Professional

UK Government

The Health and Safety at Work Act 1974

The Management of Health and Safety at Work Regulations 1999

The Construction (Design and management) Regulations 2007 (CDM)

Provision and Use of Work Equipment Regulations 1998

Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)
- HSE - Technical guidance on the safe use of lifting equipment offshore
- HSE - Safe use of lifting equipment – Approved Code of Practice and Guidance

HSE Information Sheets

Jack-up (self elevating) installations: rack phase difference
http://www.hse.gov.uk/offshore/infosheets/is4-2007.pdf

Jack-up (self elevating) installations: floating damage stability survivability
http://www.hse.gov.uk/offshore/infosheets/is6-2007.pdf

Jack-up (self elevating) installations: review and location approval using desk-top risk assessments in lieu of undertaking site soils borings
http://www.hse.gov.uk/offshore/infosheets/is3-2008.pdf

HSE Information

The safe approach, set-up and departure of jack-up rigs to fixed installations
http://www.hse.gov.uk/foi/internalops/hid/spc/spctosd21.htm
Guidance on Procedures for the Transfer of Personnel by Carriers.

HSE Research Reports - OTO series

SNAME 5-5B WSD 0: Comparison with SNAME 5-5A LRFD and the SNAME 5-5A North Sea Annex
http://www.hse.gov.uk/research/otopdf/2001/oto01001.pdf

Self-elevating installations (jack-up units)
http://www.hse.gov.uk/research/otohtm/2001/oto01051.htm

Stability of jack-ups in transit
http://www.hse.gov.uk/research/otopdf/1995/oto95022.pdf

HSE RR series

Review of the jack-ups: Safety in transit (JSIT) technical working group
http://www.hse.gov.uk/research/rrhtm/rr049.htm

Guidelines for jack-up rigs with particular reference to foundation stability
http://www.hse.gov.uk/research/rrhtm/rr289.htm

International Maritime Organisation

MODU Code. Code for the construction and equipment of mobile offshore drilling units, consolidated edition, 2001
International Safety Management (ISM) Code 2002
Safety of Life at Sea (SOLAS 1974)
International Convention on Loadlines 1966
Preventing Collisions at Sea Regulations COLREGS
Standards of Training, Certification and Watchkeeping for Seafarers (STCW) 1978
Prevention of Pollution from Ships MARPOL 1973/78
Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972
Incidents by Hazardous and Noxious Substances, 2000 (HNS Protocol)
Control of Harmful Anti-fouling Systems on Ships (AFS), 2001
IMO MSC Circ.645, *"Guidelines for Vessels with Dynamic Positioning Systems"*
IMO MSC Circ.738 *"Guidelines for Dynamic Positioning System (DP) Operator Training".*

Marine and Coastguard Agency

MCA Code of Safe Working Practice for Merchant Seaman
MCA Small Commercial Vessel and Pilot Boat (SCV) Code (as currently set out in MGN 280)
MCA - MGN 371 'Offshore Renewable Energy Installations (OREIs) Guidance on UK Navigational Practice, Safety and Emergency Response Issues'

and the supporting note:

MCA - 'Offshore Renewable Energy Installations Emergency Response Cooperation Plans (ERCoP) for SAR Helicopter Operations'.

Society of Naval Architects and Marine Engineers

Society of Naval Architects and Marine Engineers (SNAME)
Technical and Research Bulletin TR5-5A
Guidelines for Site Specific Assessment of Mobile Jack-up Units
Including the Recommended Practice and Commentary

International Organisation for Standardisation

ISO 19901-1:2005(E) Part 1: MetOcean design and Operating considerations.

Noble Denton

Seabed and Sub-seabed Data for Approvals of Mobile Offshore Units/Mou

0016: 0016/ND Rev 4 - 16 Dec 2008

Self-Elevating Platforms - Guidelines for Elevated Operations
0009: 0009/ND Rev 4 - 16 Dec 2008

Guidelines for Marine Transportations
0030/ND Rev 3 - 15 April 2009

Guidelines for the Approval Of Towing Vessels
0021/ND Rev 7 - 17 Nov 2008

Guidelines for Marine Lifting Operations
0027/ND Rev 7 - 15 April 2009.

A further update (to correct a typo) is imminent.

London Offshore Consultants

LOC Guidelines for Marine Operations – Barge Transportation
LOCG-GEN-Guideline 002 Rev. 01 Dated 01/01/2007

LOC Guidelines for Marine Operations – Marine Lifting
LOCG-GEN-Guideline 003 Rev. 0 Dated 05/2003

Det Norske Veritas

Det Norske Veritas (DNV) Rules for the Planning and Execution of Marine Operations:

- Load Transfer Operations *(issued 1996)*
- Towing *(issued 1996)*
- Special Sea Transports *(issued 1996)*
- Offshore Installation *(issued 1996)*
- Lifting *(issued 1996)*
- Sub Sea Operations *(issued 1996)*
- Transit and Positioning of Mobile Offshore Units *(issued 2000)*

Det Norske Veritas (DNV) Classification Notes

Section 8: Foundation of Jack-up Platforms

Lloyds Register

Code for Lifting Appliances in a Marine Environment 2008

UK Offshore Operators Association

Guidelines for Safe Movement of Self-Elevating Offshore Installations (Jack-ups)
UK Offshore Operators Association. April 1995 issue No.1

North Sea Lifting (NSL)

Suitability of Cranes for Man Riding

APPENDIX B
Glossary, terms and definitions

Air gap	Vertical distance between the bottom of the rig hull and the water surface.
Air gap related to LAT	Vertical distance between the bottom of the hull and the level of LAT.
Centroid of the legs	Point on a three-legged jack-up that is horizontally equidistant from each leg centre.
Certified accommodation	Permanent or temporary certified crew accommodation comprising sleeping cabins with sanitary facilities, galley, mess room and recreation spaces intended for occupation by the crew and project workers. This specifically excludes temporary or permanent containerised or modular units installed on the jack-up to provide limited shelter, feeding and sanitary facilities for personnel that are not routinely accommodated on board.
Chart datum	The datum to which the soundings (water depths) are reduced on the location bathymetric chart and to which must be added the tidal height to obtain the actual depth of water at any point in time.
Class notation	Series of symbols, letters and numbers assigned by the classification society to indicate the details of the class assigned to the vessel (For example: "ABS Self Elevating ✠A1", Lloyds ✠100A1 etc.).
Competent person	A person having suitable and sufficient experience in the fields that they work in, to understand the hazards and risks involved with the work, the operating environment, and the type of people they need to work with; and having sufficient training to be able to communicate the results of their assessment to all the people necessary (in writing if necessary) in a clear and comprehensible manner. The Management of Health and Safety at Work Regulations 1999, requires every employer to appoint one or more competent persons to assist with putting measures in place to ensure legal compliance. The competent person can be either an individual or a company providing these services. The person is regarded as competent if they have sufficient training and experience or knowledge and other qualities to properly assist the employer to meet his safety obligations. A competent person is likely to be a corporate body rather than an individual because of the necessary requirement to have access to a wide variety of technical expertise and specialist services. One indication of competence is accreditation and certification.
Contingency plan:	Pre-considered response to a deviation from an intended course of action.
Dynamic amplification factor	The factor by which the 'gross weight' is multiplied, to account for accelerations and impacts during the lifting operation.

Elevated operation	Jack-up marine operation conducted after the unit has been jacked, preloaded and elevated to a working air gap.
Extreme wave crest elevation	The maximum elevation of the storm wave crest above LAT for the return period specified.
Field move	A jack-up move undertaken in the vicinity of a work site which can be completed within the period covered by a single reliable weather forecast (commonly 12 – 24 hours).
Flag state	Nation operating a registry of vessels in which the jack-up has a valid listing.
Freeboard	The vertical height of the assigned deck line above the vessel's waterline.
Gog line (or rope)	System used for the control of the towline to reduce the risk of girding. Commonly a line led from a winch drum or fixed connection through a deck fitting aft of the towing winch and connected to the towing wire so as to control the point at which any transverse load imposed by the towline angle acts upon the towing vessel.
Grillage:	The temporary structural members that support the module and distribute the vertical static and dynamic loads over the barge or vessel framing.
Gross Weight	The calculated or weighed weight of the structure to be lifted including a reserve factor.
Harbour Move	Jack-up move conducted within port limits.
Hook Load	The hook load is the 'lift weight' plus the 'rigging weight including dynamic factor'.
Jack Frame	Jack-up vessel structure at each leg containing the jacking system (also called the "jack house").
Jacking	Operation of the jacking system
Jacking down	Lowering the rig hull when in the elevated mode
Jacking up	Elevating the rig hull when in the elevated mode
Jacking legs down	Jacking the rig hull up
Jacking hull down	Jacking the legs up.
Raising legs	Jacking legs up when in the floating mode
Lowering legs	Jacking legs down when in the floating mode
Jack-up	Ship or barge fitted with legs and jacking machinery providing the capability to self-elevate the vessel above the sea surface.
Leg bind or leg binding	Excessive friction between the leg chords and leg guide usually caused by the rig being out of level and/or by the legs being bent or inclined.
Leg braces	Horizontal or diagonal tubular members of the leg structure connecting the leg chords.

Leg chords	Vertical tubular members of the leg structure of braced type legs.
Leg footing penetration curve	Graphic representation based on geotechnical analysis showing the predicted leg footing load versus the depth of leg penetration.
Leg footing reaction	Equal to the portion of the jack-up's elevated weight including environmental loads imposed on any one leg plus the leg and footing weight minus the leg buoyancy.
Leg load	Portion of the jack-up's elevated weight including environmental loads supported by a particular leg.
Location move	Jack-up move not falling into the definition of an ocean tow or a field move and generally undertaken with the unit in field move configuration as a weather restricted operation within the period of a reliable weather forecast.
Location approval	Certificate and report providing location details and certifying warranty approval for installation of a rig on a specific location.
Location move	A move between two locations which cannot be completed within the period covered by a single forecast but which can safely be undertaken with the unit in field move configuration, having due regard for the availability of standby locations or shelter points en route.
Marine warranty surveyor	Marine surveyor assigned to review procedures and to attend marine operations commonly to satisfy an insurance warranty clause that states that the operation shall be approved by and conducted in accordance with the recommendations issued by a named warranty surveyor.
Medivac	Evacuation of a sick or injured person.
Met-ocean study	Meteorological study of a specific area carried out to determine the probable range of environmental conditions for specific return periods.
Minimum breaking load	The minimum allowable value of 'breaking load' for a particular lifting operation.
Mobile offshore unit	For the purposes of this document, the term includes non-drilling mobile jack-up vessels such as accommodation, construction, and lifting barges.
MODU code	Code for the construction and equipment of mobile offshore drilling units, consolidated edition 2001.
Module	A unit of cargo such as a jacket, integrated deck, topside components, pre-assembled units, items of equipment or parts thereof.
Net weight	The calculated or weighed weight of a structure, with no contingency or weighing allowance.

Nomograms	Graphic representation indicating the jack-up's capacity to withstand defined environmental conditions in a range of water depths and with a range of leg penetrations.
Permanently manned jack-up	Jack-up permanently manned by the crew (and project workers if applicable) where some or all personnel, both on-shift and off-shift, are accommodated on board and are not routinely transported to and from the shore at each shift change.
Positioning (jack-up)	Jack-up marine operation commencing from the time of arrival at a new location and continuing until the unit has completed jacking, preloading and elevating to the working air gap on a new elevated location or until the unit is safely moored afloat at a new location.
Preloading	Preloading is the process by which the jack-up rig's legs are loaded so as to drive them into the seabed soil. The preloading process simulates the expected maximum loads that may be imposed on the seabed and thus the strength of the seabed soil foundation is proof tested in excess of the capacity required to support the rig when it is working or when it is idle in the storm survival mode. The object of preloading is to achieve sufficient capacity to withstand the combination of vertical and horizontal reactions, the applied preload (generally) has to be greater than the storm vertical reaction. When using SNAME, as required in this document, the vertical and horizontal reactions include the effects of the partial load factor and the permitted capacity is reduced by the application of the SNAME resistance factor.
Punch-through	Punch-through is a generic term often loosely applied to an event whenever significant vertical footing settlement is observed over a relatively short period of time. During these events differential footing penetrations usually occur which may dramatically affect the stability of the jack-up. Punch-through can result in structural failure and even total loss.
Rack chocks	Leg fixation device engaged to form a strong connection between the rig hull and legs for units fitted with rack and pinion jacking systems
Rack phase difference	Difference in vertical height between individual chords on one leg on units with braced type leg structures
Recognised classification society (RCS)	A Vessel classification society with established rules and procedures for the classification, survey and certification of vessels used in offshore construction activities
Recognised maritime nation	A nation with maritime laws that maintains a registry of ships and that has adopted the IMO conventions listed in section 2.6.
Recommended practice	SNAME TR5-5A: the Recommended Practice for Site-Specific Assessment of Mobile Jack-up Units Rev, 2 January 2002.
Reflected waves	Wind or swell generated waves that have been reflected through direct impact with obstructions such as cliffs or breakwaters

Refracted waves	Wind or swell generated waves that have been influenced in direction by the geophysical characteristics of the coastline or seabed
Riding crew	Marine crew assigned to an unmanned barge during a tow
Rig mover	Person appointed to be in charge of the planning and execution of the jack-up move
Seafastenings:	Shall in general mean the temporary structures or tie-downs that secure the Module for transportation and berthing forces.
Settlement	The settlement of jack-up leg footings into the seabed soil
Slow settlement:	Leg settlement where the rate at which one or more legs is penetrating is less than the rate at which the hull can be maintained in a level condition by lowering the hull on the other legs.
Rapid settlement:	Rapid uncontrolled leg settlement where the rate at which one or more leg is penetrating exceeds the rate at which the hull can be maintained in a level condition by lowering the hull on the other legs.
Slight settlement:	Leg settlement where the resulting inclination is less than one degree.
Significant settlement:	Leg settlement where the resulting inclination is more than one degree.
Significant wave height	H□ = the average of the highest one-third of all waves.
Site-specific assessment	Assessment of the site soil foundation and the structural capacity of a jack-up to withstand the loads associated with the geophysical and extreme environmental conditions for a specific location.
Spudcan	Very robust tank-like structure attached to the bottom of a jack-up rig's leg and forming the leg footing.
Squat	Temporary increase in vessel's hull draft caused by change of trim when proceeding in shallow water above a certain speed.
Survival mode	Elevated condition achieved by the jack-up when it is capable of remaining on location in extreme storm conditions with all stresses remaining within allowable limits in accordance with the RP.
Tidal window	Period during a tidal cycle where the tidal height provides adequate depth of water and/or current velocity not exceeding a prescribed value for a particular operation.
Tow master	Person usually holding a Marine Certificate of Competency assigned to control the towage, navigation and positioning of the Rig afloat

Transit (jack-up)	Jack-up marine operation commencing from the moment when lowering of the hull commences on departure from an elevated location or when the last mooring line is recovered on departure from a location afloat and continuing until arrival in the vicinity of a new location.
Tug management system	DGPS navigation survey system and telemetry that allows the positions of tugs, anchors and mooring lines to be displayed in real time on remote monitors.
Unaccounted weight	Portion of the vessel's total weight that has not been accounted for in the load calculations. The amount is calculated by subtracting the calculated displacement from the actual displacement obtained by reading the hull draft marks with the rig afloat.
Unmanned jack-up	A non-propelled jack-up barge that carries no permanent crew accommodated on board and is not fitted with *certified accommodation* and where the crew and project workers are routinely transported to and from the shore at the end of each shift.
Unrestricted mode	A jack-up engaged on an unrestricted operation.
Unrestricted operation	A marine operation which cannot be completed within the limits of a favourable weather forecast (generally less than 72 hours). The design weather conditions must reflect the statistical extremes for the area and season.
Variable load	Portion of the vessel's elevated weight that is variable, that is, not forming part of the fixed structure and machinery. This includes fuel, lubricants, fresh water, ballast, drilling materials and equipment, crew and stores.
Visitors	Personnel on board the unit who do not form a part of the vessel's crew.
Weather restricted operation	A marine operation which can be completed within the limits of a favourable weather forecast (generally less than 72 hours), taking contingencies into account. The design weather conditions need not reflect the statistical extremes for the area and season. A suitable factor should be applied between the design weather conditions and the operational weather limits.
Weather window	Forecast period of generally benign weather with wind and waves not exceeding prescribed the limits for a particular operation.

ABREVIATIONS

AISC	American Institute of Structural Steel
ALARP	As low as reasonably practicable (with reference to risk reduction)
BL	Breaking load
BP	Bollard pull
CCTV	Closed Circuit Television
CDM (Regulations)	Construction Design and Management regulations
CPT	Cone penetrometer test
DAF	Dynamic Amplification Factor applied to lifted weights to account for the dynamic motion of vessels in marine lifting operations
DGPS	Differential Global Positioning System
DP	Dynamic positioning
ECDIS	Electronic Chart Display and Information System
EEZ	Exclusive economic zone
GMDSS	Global Maritime Distress and Safety System
HAT	Highest astronomical tide
Hs	Significant wave height
IACS	International Association of Class Societies
IAPP	International Air Pollution Prevention
IMO	International Maritime Organisation
IOPP	International Oil Pollution Prevention
ISM	International Safety Management (ISM Code)
ISPS	International Ship and Port Security
L.A.T.	Lowest astronomical tide
LRFD	Load resistance factor design
MCA	Marine and Coastguard Agency (UK)
MDW	Module design weight
MIN	Marine information notices
MSN	Merchant shipping notices
MGN	Marine guidance notices
MOC	Management of change
MODU	Mobile offshore drilling unit
MOU	Mobile offshore unit
MSL	Mean sea level
MTC	Site-specific (non-governmental) marine traffic control
OIM	Offshore installation manager. The person in charge of the jack-up

PPE	Personal protective equipment
PUWER	Provision and use of Work Equipment Regulations 1998
RCS	Recognised classification society
RNLI	Royal National Lifeboat Institution
RW	Rigging weight for lifting operations
SCV	Small Commercial Vessel Code (Awaiting publication)
SF	Shear force
SHL	Static hook load
SOPEP	Shipboard oil pollution emergency plan
STCW 95	Standards of Training and Certification of Watchkeepers 1995
SWBM	Still water bending moment
TPR	Towline pull required
WGS 84	World Geophysical Survey 1984
WLL	Working load limit (Same as SWL: safe working load)

APPENDIX C

Certificates, Manuals, Publications, Logs and Records

CERTIFICATES REQUIRED

Ref.	Certificate	Self-prop. jack-up ships	Permanently manned and/or classed jack-ups	Unmanned jack-ups with no classification
	Registry	✓	✓	✓
	Flag state inspection report or MCA inspection	✓	✓	✓
	ISM Certificate and document of compliance	✓	✗	✗
	Minimum Safe Manning Certificate	✓	✗	✗
	Builders Certificate	✓	✓	✓
	International Tonnage Certificate	✓	✓	✗
	International Loadline Certificate (or exemption)	✓	✓	✓
	Annual Loadline Survey Report/Endorsement	✓	✓	✗
	Certificate of Class (+Annual endorsement)	✓	✓	✗
	Safety Construction Certificate	✓	✗	✗
	MOU Certificate or Safety Equipment Certificate or: Safety Equipment – Class Statement of Facts	✓	✓	✗
	IOPP Certificate	✓	✓	✗
	IAPP Certificate	✓	✗	✗
	ISPS Certificate	✓	✗	✗
	Safety Radio Certificate	✓	✓	✗
	Radio License (GMDSS)	✓	✓	✓
	Radio Certificate of Shore Based Maintenance	✓	✓	✗
	Fast Rescue Craft Certificate	✓	✓	✗
	Lifeboats (Rigid Survival Craft) Certificates	✓	✗	✗
	Lifeboats davits and launching gear Certificates	✓	✗	✗
	Inflatable Liferaft Service Certificates	✓	✓	✓
	Liferaft Launching Davit Certificates (if fitted)	✓	✓	✓
	Fixed Firefighting Appliances Certificate	✓	✓	✗
	Portable Firefighting Appliances Certificate	✓	✓	✓
	Crane Test Certificate Lifting Appliances Register - Annual inspection & Quadrennial Test	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓
	Sewage Plant Certificate	✓	✓	✗
	Garbage Management Certificate	✓	✓	✗
	Medical Drugs Certified Inventory	✓	✓	✗
	Deratisation or Deratisation exemption Cert.	✓	✓	✗

A = Self-propelled jack-up ships
B = Permanently manned and/or classed jack-up barges
C = Unmanned and non-classed jack-up barges

Safety and security	A	B	C	IMO and other Publications	A	B	C
Emergency station bills posted	✓	✓	✗	IMO SOLAS (1986 consolidated)	✓	✓	✗
Safety equipment Plans posted	✓	✓	✗	IMO load line regulations (1986/81)	✓	✓	✗
Safety equipment signs posted	✓	✓	✓	IMO MERSAR manual IMO ship routeing	✓	✗	✗
Evacuation and escape route signs posted	✓	✓	✗	IMO standard marine navigation vocabulary	✓	✗	✗
Emergency muster points marked	✓	✓	✗	IMO Collision Regulations (1990)	✓	✗	✗
Survival craft launching instructions posted	✓	✓	✓	IMO bridge procedures guide	✓	✗	✗
Lifejacket donning instructions posted	✓	✓	✓	IMO Annex I: to MARPOL 73/78 (Oil)	✓	✓	✗
Health, safety & environmental policy	✓	✓	✓	IMO Annex II: to MARPOL 73/78 (Noxious Subst.)	✓	✓	✗
Drug and alcohol policy	✓	✓	✓	IMO Annex III: Pollution by Harmful Substances	✓	✓	✗
Record of emergency drills	✓	✓	✗	IMO Annex IV: Pollution by Sewage from Ships	✓	✓	✗
Safety manual	✓	✓	✓	IMO Annex V to MARPOL 73/78 (Garbage)	✓	✓	✗
PPE signs posted	✓	✓	✓	IMO IMDG code (consolidated supplement)	✓	✓	✗
Accident/incident reports	✓	✓	✓	IMO ISPS code	✓	✗	✗
Near miss reports	✓	✓	✓	MCA Code of Safe Working Practice	✓	✓	✓
Hazard identification/observation reports	✓	✓	✓	**Bridge / Navigation Publications**			
Risk assessments conducted/recorded	✓	✓	✓	Navigation charts	✓	✓	✗
Safety meetings conducted/recorded	✓	✓	✓	Chart correction log	✓	✓	✗
Tool box talks conducted/recorded	✓	✓	✓	Pilot books & supplements	✓	✗	✗
Permits to work posted	✓	✓	✗	Guide to port entry	✓	✗	✗
Visitors safety briefing record	✓	✓	✗	List of lights	✓	✗	✗
Tag card system	✓	✓	✓	Admiralty list of radio signals (volumes 1 - 6)	✓	✓	✗
Ship security plan	✓	✗	✓	International Code of Signals (1987)	✓	✓	✗
Gangway crew/visitors log	✓	✗	✓	Notices to mariners	✓	✓	✗
Medical log	✓	✓	✓	Flag state marine notices and guidance notes	✓	✓	✗
Plans, manuals and reports				Tide tables	✓	✓	✗
Operating company QA system	✓	✓	✓	Tidal current tables/charts	✓	✓	✗
Company instructions/procedures	✓	✓	✓	Nautical almanac	✓	✗	✗
Ship safety management system manuals	✓	✓	✓	Navigation tables	✓	✗	✗
Non-conformance & corrective action	✓	✓	✓	RPM/Speed data	✓	✗	✗
Vessel operating manual	✓	✓	✓	Manoeuvring data	✓	✗	✗
General arrangement plan / capacity plan	✓	✓	✓	Deck log book	✓	✓	✗
Crew training manuals / records	✓	✓	✓	Rough log	✓	✓	✗
Approved stability book	✓	✓	✓	Radio log	✓	✓	✗
Stability plan for current voyage/operation	✓	✓	✓	Night order book	✓	✗	✗
SOPEP manual	✓	✓	✗	Passage plans	✓	✗	✗
Garbage management plan	✓	✓	✗	Master/pilot exchange form	✓	✗	✗
Engine room & machinery				Vessel check lists [arrival, departure]	✓	✗	✗
Engine log	✓	✓	✗	Operations check lists (jacking)	✓	✓	✓
Bunker check lists	✓	✓	✗	Operations check lists (DP – if DP vessel)	✓	✗	✗
Oil Record Book / waste oil disposal	✓	✓	✗	Equipment operation and maintenance manuals	✓	✓	✓
Machinery operation & maint. manuals	✓	✓	✗	Complete set of drawings	✓	✓	✓

APPENDIX D

Jack-up operating manual (recommended contents)

Operating manuals containing guidance for the safe operation of the unit should be provided on board and be readily available to all concerned.

The manual should, in addition to providing the necessary general information about the unit, contain guidance on and the procedures for the operations that are vital to the safety of personnel and the unit.

The manual should be concise and be compiled in such a manner that it is easily understood. The manual should be provided with a contents list, an index and wherever possible be cross-referenced to additional detailed information in the form of drawings, manufacturer's manuals and other readily available information for the safe and efficient operation of the unit. Detailed information contained in manufacturer's manuals (such as the Jacking System Manual) need not be repeated in the operating manual.

The operating manual should include the following information.

1. Description, particulars and principal dimensions.

2. Organisation and responsibilities.

3. General arrangement plan and capacity plan showing the location and centres of gravity of all tanks and stowage spaces.

4. Plan showing the location of watertight and weather tight boundaries, the location and type of all watertight and weather tight closures, and the location of down flooding points.

5. Limiting design data for the floating mode and the elevated mode.

6. Operational limits and procedures and guidance for the transition between the floating mode and the elevated operating mode and between the operating mode and the elevated survival mode.

7. Information and guidance on the preparation of the unit to avoid structural damage afloat and during the setting or retraction of the legs on or from the seabed.

8. Information and guidance on jacking and preloading.

9. Information and guidance on the preparation of the unit to withstand the extreme environmental limits associated with the limiting design data for the elevated mode described in (5) above.

10. Lightship data together with a list of inclusions and exclusions of semi-permanent equipment and guidance for the recording of light weight changes together with weight data and centre of gravity offset limits including:

    Lightweight
    Weight of movable items (cranes, pile gates/grippers etc)
    Weight of legs and leg footings
    Maximum allowable variable load afloat, jacking, preloading, operating and survival
    Maximum allowable displacement afloat

Maximum allowable elevated weight and maximum leg load for jacking
Maximum allowable elevated weight and centre of gravity limits for preloading
Maximum allowable elevated weight and centre of gravity limits for elevated operations
Maximum allowable elevated weight and centre of gravity limits for survival

11. Tank sounding tables showing capacities, vertical, longitudinal and transverse centres of gravity in graduated intervals and free surface data for each tank.

12. Stability information including hull hydrostatic properties and GZ curves.

13. Allowable vertical centre of gravity curve.

14. Sample stability and trim calculations and guidance for maintaining stability afloat.

15. Sample elevated load calculations and guidance for maintaining leg loads within design limits including leg load limits and/or centre of gravity limits for lifting operations.

16. Acceptable structural deck loads.

17. A plan and description of the towing arrangements for non-propelled vessels together with guidance on safe towing operations.

18. A description, schematic diagram and guidance for the operation of the bilge and ballast system (if fitted), together with a description of its limitations such as draining of spaces not directly connected to the systems.

19. Fuel oil storage and transfer procedures.

20. Description and capacity of main and emergency power systems.

21. Personnel transfer procedures.

22. Limiting conditions for crane operations.

23. Guidance on damage control for incidents of flooding and unexpected settlement.

APPENDIX E

Typical spot location reports

Typical Weather Consultancy
United Kingdom
Telephone No:
Facsimile No:
Email:

TYPICAL WEATHER CONSULTANCY

LOCATION REPORT

Report Reference:	TWC/SS/0000/R.01	Date:	19 June 2009
Descriptive Area:	Offshore Wind Farm	Latitude:	50° 04 '33.35"North
Return Period:	10 & 50 years	Longitude:	005 °19' 21.04"West
Season:	All Year	Water Depth:	10.3 metres @ L.A.T.

The extremes likely to be reached or exceeded once, on average, every 1, 10 & 50 years during the specified season are as follows:

WINDS	**1 Year**	**10 Year**	**50 Year**
1 minute mean at 10 m (m/sec)	30 m/s	36 m/s	42 m/s
3 second gust (m/sec)	36 m/s	40 m/s	53 m/s
WAVES			
Extreme Height (m)	8.2 m	9.3 m	10.5 m
Associated crest to crest period (secs)	6.0 s	6.8 s	7.5 s
Peak Period	6.4 s	6.9 s	7.8 s
Significant Height (m)	4.6 m	5.0 m	5.7 m
WATER LEVELS			
Wave crest elevation (m)	6.1 m	6.5 m	7.4 m
Tidal Rise (H.A.T.)	5.8 m	5.8 m	5.8 m
Storm Surge (m)	2.2 m	2.2 m	2.4 m
CURRENT			
Maximum surface current	1.4 m/s	1.4 m/s	1.4 m/s

The information contained in this report is believed to be correct and is issued in good faith, but a Typical Weather Consultancy cannot accept responsibility for any consequential loss or damage arising from any use that may be made of it.

Stormy Stan

For: Typical Weather Consultancy

APPENDIX F

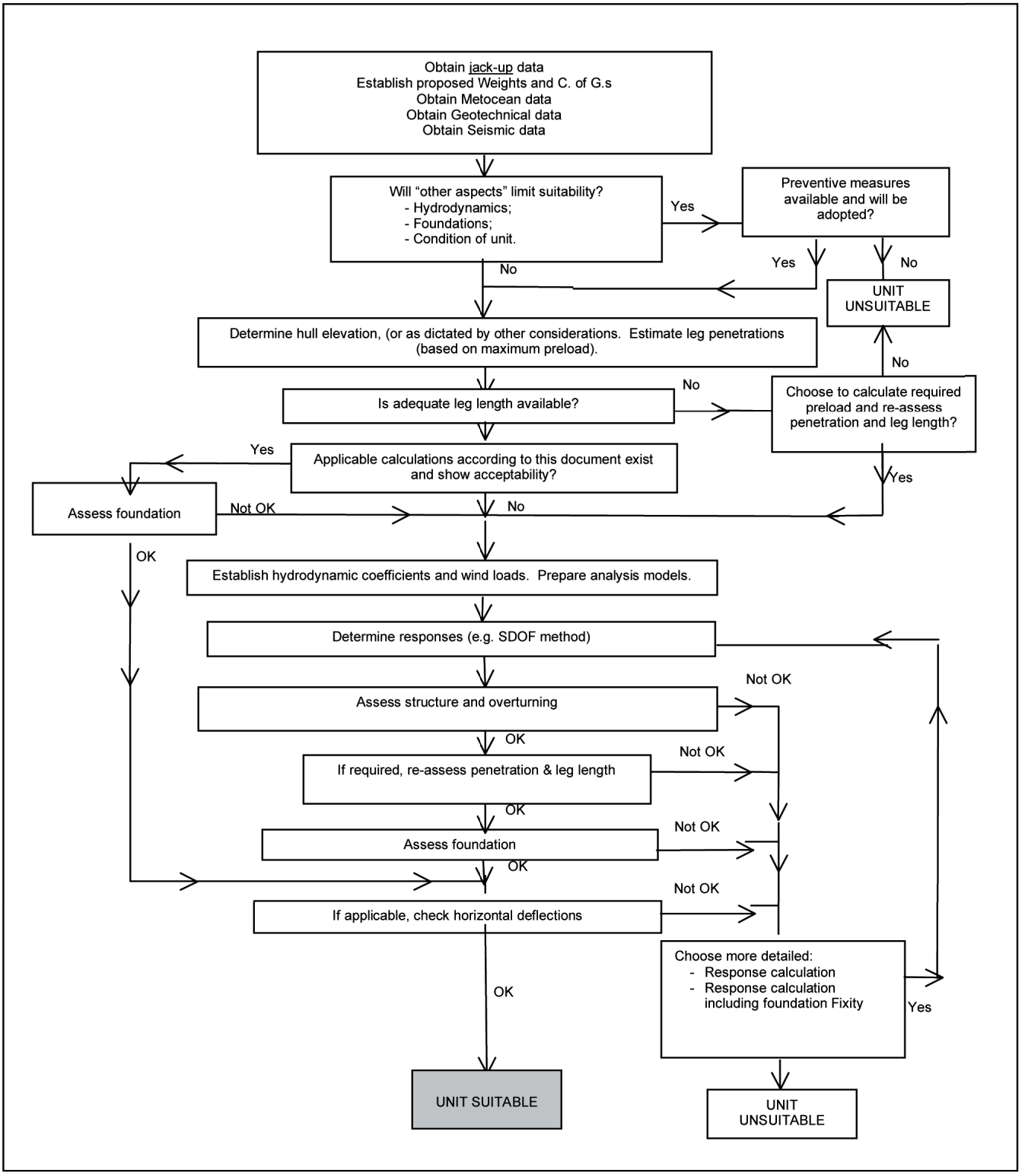
Foundation Risks: Methods for Evaluation and Prevention

RISK	METHODS FOR EVALUATION & PREVENTION
Installation problems	Bathymetric survey Sea floor survey
Punch-through	Geophysical survey Soil sampling and other geotechnical testing and analysis
Settlement/bearing failure	Geophysical survey Soil sampling and other geotechnical testing and analysis Ensure adequate jack up preload capability
Sliding failure	Geophysical survey Soil sampling and other geotechnical testing and analysis Increase vertical spudcan reaction Modify the spudcans
Scour	Bathymetric and sea floor survey (identify sand waves) Surface soil samples and seabed currents Inspect spudcan foundation regularly Install scour protection (gravel bag/artificial seaweed) when anticipated
Geohazards (mudslides, mud volcanoes etc)	Sea floor survey Geophysical survey Soil sampling and other geotechnical testing and analysis
Gas pockets/shallow gas	Geophysical survey
Faults	Geophysical survey
Metal or other object, sunken wreck, anchors, pipelines etc.	Magnetometer and sea floor survey
Local holes (depressions) in seabed, reefs, pinnacle rocks, non-metallic structures or wooden wreck	Sea floor survey Diver/ROV inspection
Leg extraction difficulties	Soil sampling and other geotechnical testing and analysis Consider change in spudcans Jetting/airlifting
Eccentric spudcan reactions	Geophysical survey Geophysical survey (buried channels or footprints) Soil sampling and other geotechnical testing and analysis Seabed modification
Seabed slope	Geophysical survey Seabed modification
Footprints of previous jack ups	Evaluate site records Prescribed installation procedures Consider filling/modification of holes as necessary

APPENDIX G

Flowchart for Jack-up Site Assessment

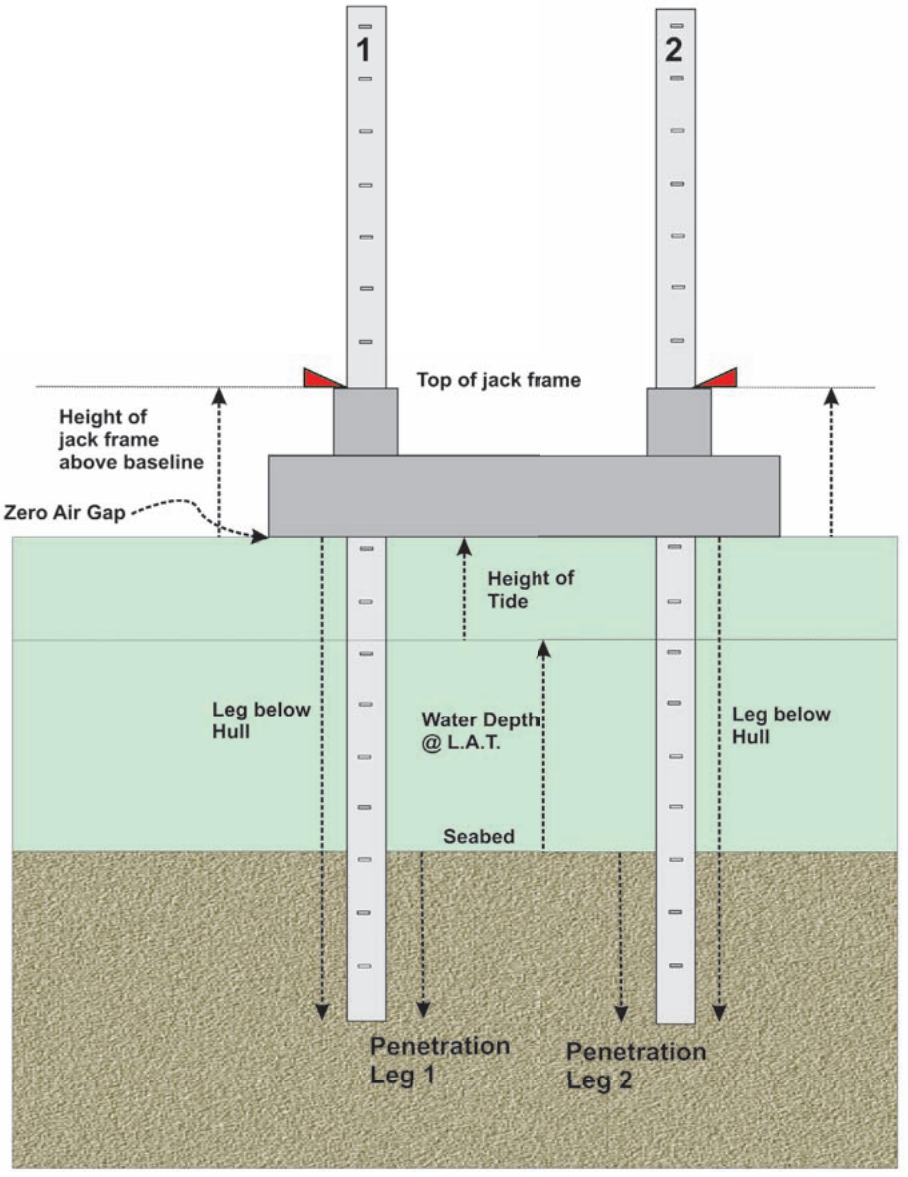
Overall flowchart for the assessment



Source: Adapted from recommended practice for the site-specific assessment of mobile jack-up units, rev 2

APPENDIX H

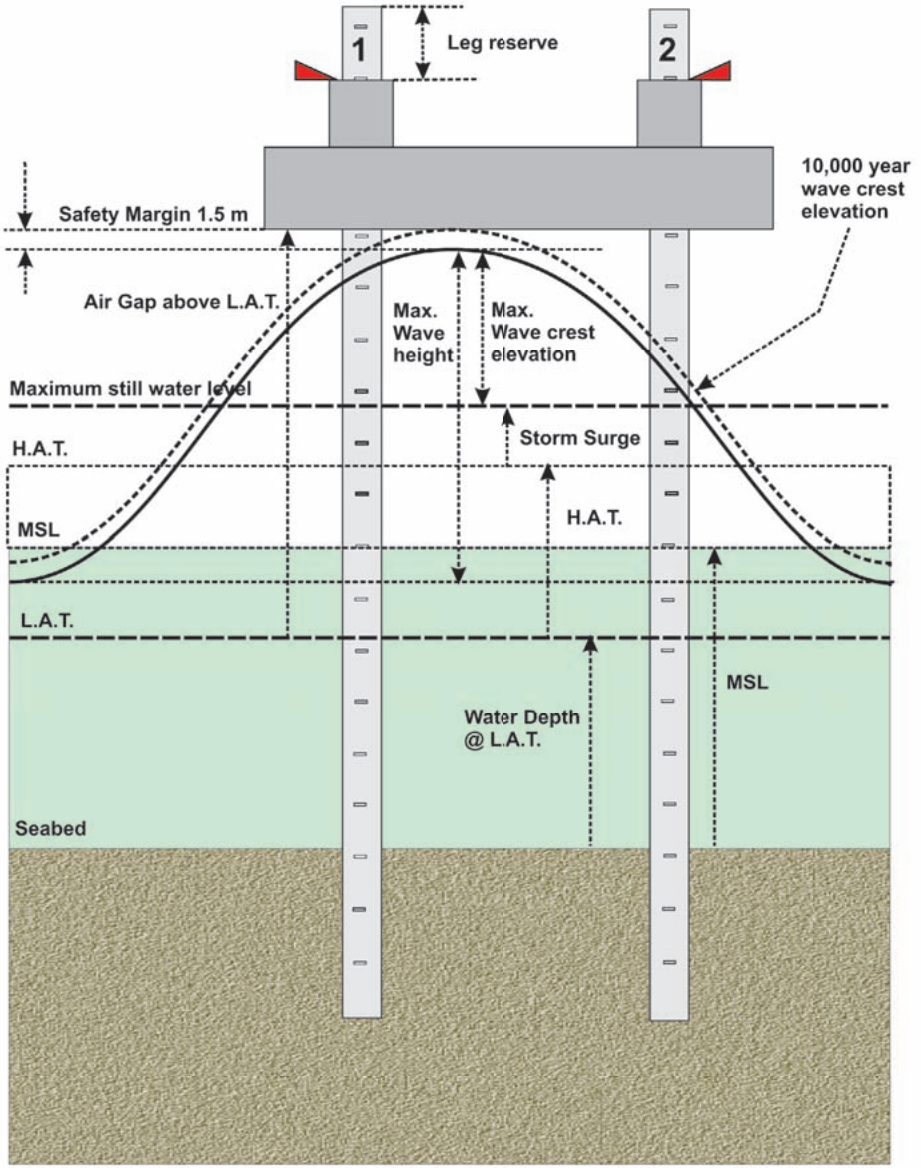
Leg Penetration Check and Air Gap Calculation



Level the hull at zero air gap immediately after preloading to check the individual leg penetrations and to define the level of the hull above LAT

Leg number	1	2	3	4	5	6
Leg height mark at top of jack frame						
- Jack frame height above hull baseline						
= Leg below hull						
- Height of tide						
- Water depth at LAT						
= Leg penetration						

APPENDIX H
continued



MINIMUM (SURVIVAL) HULL ELEVATION

A or B whichever is greatest

A) LAT + HAT + surge + wave crest elevation + 1.5m
B) To clear the 10,000 year return period wave crest

APPENDIX I

Checklist for jack-Up suitability Assessment

Note:

This checklist is presently comprised of approximately 60 questions which are intended to provide an outline assessment of a jack-up's suitability for a proposed operation. Negative or uncertain responses to checklist items suggest issues that may require clarification and/or a more detailed independent assessment by consultants with experience of jack-up operations.

Ref	JACK-UP SUITIBILITY ASSESSMENT	check
1	**Management and manning**	
1.1	Is the owner or operator (the contractor) an established marine contractor with experience of the management and operation of type of jack-up vessels commonly deployed for the type of work required?	
1.2	Does the contractor a) employ civil or structural engineers capable of carrying out jack-up related analyses associated with structural capacity, site-specific assessments, vessel motion response and seafastening design, and heavy lifts, or b) routinely engage third party engineering services to undertake the required analyses?	
1.3	Does the contractor a) employ a geotechnical engineer capable of performing soils assessments for jack-up *site-specific assessments*, or b) routinely engage recognised soils experts to undertake the required assessments?	
1.4	Does the contractor employ a *competent person* having the requisite qualifications, skills and experience to conduct a jack-up *site-specific assessment* and/or to verify that the *site-assessment* has been conducted in accordance with the recommended practice? If not, are recognised marine consultants with experience of jack-up operations routinely engaged to conduct or to verify the assessments?	
1.5	Does the contractor a) employ master mariners and/or marine engineers for planning and preparation, production of procedure documents, and execution of jack-up operations, or b) routinely engage third party services to undertake these tasks?	
1.6	Is the contractor capable of planning jack-up operations in accordance with the provisions described in section 4 of this guideline?	
1.7	Does the contractor understand the regulatory requirements and guidelines for the operation of jack-ups in UK waters as described in section 2 of this guideline?	
1.8	Is the jack-up manned in accordance with section 3 of this guideline?	

2	Offshore jack-ups with accommodation - unrestricted operations	check
2.1	Is the jack-up entered on a vessel registry of a recognised *maritime nation* (the flag state)?	
2.2	Have outstanding flag state recommendations (if any) been cleared?	
2.3	Is the jack-up vessel classed in accordance with the rules of a *recognised classification society* and a member of the International Association of Class Societies (IACS)?	
2.4	Does the class notation a) Include the term "self-elevating" or b) otherwise definitively cover the design, construction and survey of the unit's capacity for safe elevation? *(Some classifications relate solely to the design as a floating vessel).*	
2.5	Does the class status report (and/or the class certificates) confirm that the jack-up is currently class maintained?	
2.6	Have all outstanding class recommendations, defects or deficiencies that may have an impact on the proposed operations been rectified or complied with?	
2.7	Are the certificates and documentation in accordance with this guideline Appendix C?	
2.8	Is the jack-up provided with a class approved operating manual?	

3	Small unmanned inshore jack-ups – weather restricted operation	check
3.1	Is the jack-up entered on a small vessel registry of a *recognised maritime Nation* (the flag State)?	
3.2	Have any outstanding flag state recommendations been cleared?	
3.3	Has the unit's design limits for floating and elevated operations been clearly stated by the vessel manufacturer in a design report or the operating manual?	
3.4	Has the design report or operating manual been verified by an independent authority?	
3.5	If the jack-up is not classed or not covered under MCA MGN-280, is there an independent survey report confirming that the unit is in satisfactory condition with no outstanding defects or deficiencies?	
3.6	Are the certificates and documentation in accordance with this guideline Appendix C?	
3.7	Is the jack-up provided with an operating manual and does the operating manual include the information suggested in Appendix D?	

4	Suitability of the jack-up for transit to site:	check
4.1	If the proposed work site is in coastal waters or an offshore area, is the jack-up designed and certified for transit afloat on its own hull beyond port limits?	
4.2	Does the vessel's certified trading area include the whole of the proposed transit route and the operating site?	
4.3	Has the limiting sea state for transit afloat been defined?	
4.4	Will the limiting sea state for operations afloat unreasonably restrict the jack-up's capability to undertake the transit efficiently in the predicted seasonal conditions?	
4.5	If project cargo and equipment is to be transported on the deck of the jack-up, can the total displacement (including variable load plus deck load) and the trim and the allowable VCG be maintained within the allowable limits for the floating condition?	
4.6	Does the jack-up meet the intact and damage stability requirements for the loaded condition as described in this guideline section 6?	
4.7	In the loaded condition, is the total elevated weight and the centre of gravity within the allowable limits for the a) Jacking mode? b) Elevated operating mode (including lifting operations) and c) elevated survival mode?	
4.8	If project cargo and equipment is to be transported on the deck of the jack-up, will the grillage and seafastening arrangements meet the requirements described in section 7 of this guideline?	
4.9	If project cargo and equipment is to be transported on the deck of the jack-up, can the cranes be stowed and seafastened with the booms lowered in the cradles.	
4.10	If the jack-up is self-propelled and/or fitted with a dynamic positioning system, does the unit comply with the provisions of this guideline section 11?	
4.11	If the jack-up is non-propelled or propulsion assisted, is the unit capable of complying with the arrangements as specified in the guideline sections 11 & 12?	
4.12	If the jack-up is non-propelled or propulsion assisted, will it be towed by suitable towing vessels that meet the requirements of this guideline section 13?	

5	Suitability of the jack-up for positioning and elevating	check
5.1	Has the site geophysical data been obtained as described in section 8 of this guideline and the survey reports delivered to the contractor?	
5.2	Has the site meteorological data been obtained and delivered to the contractor in the form of a spot location report (Appendix E)?	
5.3	Has a site soil investigation been carried out and the results delivered to the contractor?	
5.4	Has the contractor reviewed the site survey and soil investigation reports and confirmed that the data received is adequate and sufficient to complete a site-specific assessment for the jack-up in accordance with the *recommended practice?*	
5.5	Is the jack-up fitted with a station keeping system (DP or 4-Point Mooring System) in accordance with this guideline Section 14?	
5.6	Can the contractor devise an approach and/or a mooring plan that will allow jack-up be moved into the required position while maintaining the minimum clearances prescribed in this guideline section 14?	
5.7	Are the water depths and tidal levels in the approach to, and on site, sufficient to allow the jack-up to be moved always afloat on to the location?	
5.8	In areas where high velocity tidal currents flow, is the duration of slack water periods of adequate length to allow safe positioning and subsequent removal of the jack-up?	
5.9	Based upon the information received, is the contractor satisfied that there are no significant or unusual marine hazards in the approach to, or on site, that could have an impact on jack-up positioning?	
5.10	Based upon the information received, is the contractor satisfied that there are no significant or unusual seabed surface features or soil foundation hazards for jacking and preloading and for subsequent elevated operations?	
5.11	If seabed surface and/or foundation hazard(s) have been identified, is the contractor confident that procedures can be developed to safe jacking, preloading and elevated operations?	
5.12	Have the foundation hazard(s) and the proposed procedures been assessed and found suitable by independent geotechnical engineers and jack-up move experts?	
5.13	Based upon the information received, has the contractor determined through site-specific assessment that the jack-up is capable of operating on site in a) weather restricted Mode or b) *unrestricted Mode?*	
5.14	If the jack-up is capable of operating only in *weather restricted mode*, will this unreasonably restrict the jack-up's capability to operate efficiently in the elevated mode on site in the expected seasonal conditions?	
5.15	Is the jack-up capable of complying with the arrangements for mooring and positioning on site as described in section 14 of this guideline?	

6	Suitability of the jack-up for elevated operations	check
6.1	Has the contractor fully understood the objectives to be achieved?	
6.2	Are the contractor's personnel capable of planning and executing the operations necessary to achieve the objectives without engineering assistance from third party services?	
6.3	Is the jack-up a suitable platform for the execution of the operations with respect to size, configuration, deck height, deck strength, accommodation and facilities?	
6.4	Based upon the site-specific assessment, is the jack-up's leg length sufficient to allow elevation to the extreme storm survival air gap (see Appendix H)	
6.5	If the leg length is not sufficient to achieve the survival air gap, is it sufficient to allow elevation to a working air gap?	
6.6	Based upon the site-specific assessment, is the jack-up capable of remaining elevated on location in the seasonal 50 year extreme storm condition with all stresses remaining within allowable limits in accordance with the RP?	
6.7	If the jack-up cannot achieve the minimum survival air gap and/or cannot safely withstand the extreme storm condition, can the proposed elevated operations be completed safely by the jack-up as a weather restricted operation in accordance with this guideline section 5?	
6.8	If the jack-up is operating in Weather Restricted mode, will the operating restrictions that apply and the potential need to often remove the unit to shelter have an unreasonable adverse impact on the proposed works in the seasonal weather considered.	
6.9	If a weather restricted operation is proposed, can the elevated operations be suspended and the jack-up removed to a safe standby location or to shelter within 48 hours?	
6.10	Is the contractor in possession of, and familiar with, at least one of the guideline documents for marine lifting operations listed in this guideline section 15.1.2?	
6.11	Are the crane and the lifting gear capable of performing the proposed lifting operations (if any) in accordance with the specified guidelines and with this guideline section 15?	

BWEA

Delivering the UK's wind, wave and tidal energy

BWEA
Greencoat House
Francis Street
London SW1P 1DH
United Kingdom

Tel: +44 (0)20 7901 3000
Fax: +44 (0)20 7901 3001

www.bwea.com