NOBLE DENTON

Noble Denton
International Ltd
Marine and Engineering
Consultants and Surveyors

Self-Elevating Platforms
Guidelines for
Operations and Towages

Report No. 0009/NDI

UNCONTROLLED

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PREFACE

This document has been drawn with care to address what are likely to be the main concerns based on the experience of the Noble Denton organisation. This should not, however, 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 view of the organisation for all situations. In using this document, it should be treated as giving guidelines for sound and prudent practice on which our advice should be based, but these guidelines should be reviewed in each particular case by the responsible person in each project to ensure that the particular circumstances of that project are addressed in a way which is adequate and appropriate to ensure that the overall advice given is sound and comprehensive.

CONTENTS

1. INTRODUCTION

1.1 This report is intended to provide guidelines for operations and transportation of self elevating platforms (jack-ups). They refer to engineering and marine studies and are complementary to inspection of the unit.

1.2 Where approval by Noble Denton and Associates (NDA) is required, sufficient information should be submitted by the client in order to allow confirmation that the unit meets the criteria.

1.3 These criteria are intended to cover the structural design of the unit, rather than the feasibility of operating on any specific location. However, the sea bed conditions and the structural design of the unit are closely inter-related, so references to sea bed conditions are made in this report. Any approval for operations indicated by compliance with these criteria is subject to the sea bed conditions, and the normal marine and operational recommendations of Noble Denton offices.

1.4 These proposed criteria supersede those contained in Report No. 0002/NDI/JR dated 1st May 1981. The principal changes and revisions are:

1.4.1 Changes in the definition of the pin-point for the legs (sections 2.6.2, 2.6.3).

1.4.2 Redefinition of factor of safety against overturning for mat-supported units (section 2.6.6) and introduction of factor of safety against sliding (section 2.7).

1.4.3 Change to API RP2A as stress code (sections 2.8.5 and 3.6.1).

1.4.4 Introduction of ultimate limit state design for 50 year storm conditions (section 2.8.6).

1.4.5 Introduction of alternative criteria for tropical revolving storm areas (section 2.9).

1.4.6 Introduction of requirement for strength of spudcan and leg to spudcan connection (section 2.11).

1.4.7 Consideration of hull strength (section 2.14).

1.4.8 Relation of preload values to jack capacities (section 2.15.3).

1.4.9 Introduction of punch-through criteria (section 2.16).

1.4.10 Consideration of operations in earthquake areas (section 2.17).

1.4.11 Introduction of definition of a "Field Move", to cover short duration moves of a unit. Redefinition of a "Location Move" to cover moves of longer distance in Field Move configuration (section 3.1).

1.4.12 Reference to criteria for dry transport on self propelled vessels (section 3.2.4).

1.4.13 Introduction of the concept of design storm (section 3.3.2 - 4 and 3.8.5).

1.4.14 Introduction of more detailed computation of leg loads (section 3.4.2).

1.4.15 Change in criteria for range of intact statical stability (Section 3.8.1 - 2).

1.4.16 Introduction of alternative criteria for range of intact statical stability (section 3.8.3).

1.4.17 Changes to requirements for strength of towing connections (sections 3.10.2 - 6).

1.4.18 Changes in criteria for helideck immersion (section 3.11).

1.5 Alternative criteria to those set out in this report may be considered, provided it can be shown that the proposals or arrangements are in accordance with safe marine and engineering practice.

1.6 These guidelines are intended to lead to an approval by Noble Denton & Associates (NDA). Such approval does not imply that approval by designers, regulatory bodies, harbour authorities and/or any other party would be given.

2. OPERATING CONDITION

2.1 Air Gap

2.1.1 Air gap (i.e. clearance to underside of hull) shall be computed above lowest astronomical tide as follows :-

Air gap =	mean high water spring tide	(A)
	+ 50 year surge	(B)
	+ 50 year seiche effect	(C)
	+ 50 year maximum wave crest elevation above still water level	(D)
	+ Reserve	(E)

2.1.2 The reserve (E) shall be computed as follows:-

$E = 0.1 \times (A + B + C + D)$

unless meteorological confidence levels for a specific area indicate that a different reserve is justified.

2.2 Leg Reserve

A leg reserve of 1.5 metres shall be available above the upper guide or jacks, to allow for further jacking if required to maintain air gap. For mat supported units the reserve shall be 1.5 metres or one useable jack stroke, unless the penetration (measured to the bottom plating of the mat) is anticipated to be 1.0 metre or less, in which case zero reserve may be applied, provided the soil strength has been shown to be increasing with depth.

2.3 Environmental and Static Loadings

The following loadings shall be computed for both 50 year and 10 year return period conditions:-

a) Loading due to extreme wave and current, plus

b) Loading due to 1 minute sustained wind, plus

c) Static loadings assuming both:

   i) 100% variable load, and

   ii) 50% variable load.

2.3.1 Wave, current and wind loadings shall be considered to act simultaneously and from the same direction, unless some other combination of loading is shown to be applicable.

2.4 Wave Loadings

2.4.1 Wave and current forces shall be computed using the Morison equation. A wave theory appropriate to the wave height, period and water depth shall be used in determination of particle kinematics.

2.4.2 Drag and inertia coefficients valid for the flow regime existing shall be used.

2.4.3 The effect of marine growth on member diameter and drag coefficient shall be considered where appropriate.

2.5 Wind Loading

2.5.1 Wind forces shall be computed using the formulae and coefficients from a recognised code.

2.5.2 Alternatively, wind forces obtained from wind tunnel model tests may be submitted for review.

2.6 Overturning Safety Factor

2.6.1 For overturning safety factor calculations, the unit shall be assumed to be carrying 50% of the allowable variable load, plus the environmental loadings shown in section 2.3. Alternative proposals for variable load may be considered.

2.6.2 For independent leg units, the reaction point for horizontal and vertical loads at each footing shall be considered to be situated at a distance above the spudcan point equivalent to either:-

a) Half the assumed penetration, or

b) Half the height of the spudcan,

whichever is the lesser, unless spudcan design and soil information for a specific location indicate otherwise. Moments shall be taken about the most unfavourable axis through one or more reaction points.

2.6.3 For mat supported units the reaction point shall be assumed to be at the underside of the mat bottom plating.

2.6.4 The orientation and centre of gravity which give the lowest overturning safety factor shall be considered, unless proposals exist for a specific location. The cantilever should be in the proposed survival condition.

2.6.5 For independent leg units, overturning safety factor is to be computed as:

$$\frac{\text{Righting moment}}{\text{Overturning moment}}$$

This value shall be not less than 1.1 in any condition up to and including the 50-year storm condition.

2.6.6 For mat supported units, the positive downward gravity loading on the mat shall be sufficient to withstand the overturning moment for the 50-year loading without the loss of positive bearing on any part of the mat.

2.7 Resistance to Sliding

Mat supported units shall be demonstrated to have a factor of safety against sliding of not less than 1.0 for the 50-year storm condition.

2.8 Stress Levels - Static Analysis

2.8.1 The platform shall be assumed to be carrying 100% of the allowable variable load plus the environmental loadings shown in section 2.3.

2.8.2 For independent leg units, legs shall be assumed to be pinned at the reaction point indicated in section 2.6.2, unless spudcan design and soil information for a specific location indicate otherwise.

2.8.3 The orientation and centre of gravity which give the highest stress levels shall be considered, unless proposals exist for a specific location.

2.8.4 The stiffness and backlash of the elevating system and leg guides shall be considered.

2.8.5 Stress levels computed for 10-year storm loadings shall not exceed those permitted by API RP2A, including the one-third allowance provided for extreme environmental loadings.

2.8.6 Stress levels computed for 50-year storm loadings shall not exceed the yield stress of the material, accounting for buckling where appropriate. Alternatively, ultimate limit state design methods may be considered for the 50-year storm condition, provided that the unit does not suffer permanent damage or deformation severe enough to prevent jacking the unit into the water and towage to a safe location.

2.9 Tropical Revolving Storm Areas

Consideration of the 50-year storm condition may be omitted if all the following conditions apply :

a) The unit is operating in a tropical revolving storm area.

b) A proven storm warning system is in operation which gives an expected 3 days' notice of tropical revolving storms which may pass within 200 nautical miles of the location.

c) Support systems are in existence to evacuate all personnel prior to arrival of the storm, bearing in mind the requirements of other platforms affected.

d) All personnel are evacuated prior to the arrival of the storm, having rendered the well safe.

e) Such evacuation procedures are contained in the operations manual, and are communicated to all personnel aboard.

f) Apart from tropical revolving storms, no other storm with a greater average frequency of occurrence than once in 50 years causes loadings in the unit greater than those allowed by sections 2.6.5 and 2.8.6.

g) Notwithstanding the above, the provisions of section 2.1 regarding air gap shall still apply.

h) Where the unit is the subject of an approval by NDA for insurance purposes, the limitations of the unit are disclosed to underwriters.

2.10 Dynamic Behaviour

2.10.1 The dynamic behaviour of the unit in the elevated condition shall be investigated. It should be demonstrated that the frequency of oscillation of the unit in any of the 3 primary modes is remote from that of the design wave.

2.10.2 If the requirements of section 2.10.1 cannot be satisfied, then a dynamic response calculation shall be performed.

2.10.3 Where any foreseeable wave frequency and the frequency of oscillation of the platform are sufficiently close to cause dynamic amplification of the wave forces such that the amplified values are in excess of the maximum wave forces computed using static theory, the higher values shall be used.

2.11 Spudcan and Leg to Spudcan Connection

2.11.1 Notwithstanding the requirements of section 2.8.2, unless evidence is available to the contrary the spudcan and leg-to-spudcan connection, including the lower sections of leg, shall be designed to loadcases including, but not limited to, the following (hydrostatic loads and overburden shall be included where appropriate):

a) Preloading

i) The maximum available preload shall be applied to the base of the can as a uniformly distributed pressure loading. A range of penetrations shall be considered, from zero (tip loading) to fully penetrated.

ii) The maximum available preload shall be applied to the base of the can as a uniformly distributed pressure over any sector comprising 50% of the base area.

For case 2.11.1(a), stress levels shall be within normal allowables, with no one-third overload.

b) Storm conditions

i) The maximum computed storm loading, including the associated horizontal load, shall be applied to the can as uniformly distributed pressure loadings. A range of penetrations shall be considered, from zero (tip loading) to fully penetrated.

ii) The maximum computed storm loading, including the associated horizontal load, and a moment equal to 50% of the maximum computed lower guide moment from the pinned condition, shall be applied to the spudcan. For this calculation, the soil shall be considered linear elastic and incapable of taking tension.

For case 2.11.1.(b), stress levels shall be within normal allowables, including the one-third overload for the 10-year storm and within yield/critical buckling for the 50-year storm.

c) Minimum penetration

If the tip-loading cases in sections 2.11.1(a)(i) and 2.11.1(b)(i) above cannot be met, then the minimum penetration, and corresponding soil conditions, which lead to an acceptable condition shall be defined, and included in the operating instructions for the unit.

d) Maximum penetration

Consideration shall be given to limitations of penetration.

2.12 Fatigue

The effects of fatigue on structural areas subject to continuous cyclic loading, such as the leg to spudcan or leg to mat connection, shall be considered. Where a unit is intended to operate for a long period in water depths such that the same leg sections are within or near the guides, the effects of fatigue on the legs near the guides and splash zone shall also be considered.

2.13 Elevating System

The loads transferred into the system components are to be shown to be within design limits. If limit state theory is used, then the 10 year loadings shall be within the serviceability limit state and the 50-year loadings shall be within the ultimate limit state. However, the preload requirements as set out in section 2.15 shall always be within the serviceability limit state.

2.14 Hull Strength

2.14.1 Classification

Either the hull shall be built to the requirements of a recognised Classification Society, or:

2.14.2 Alternative Criteria

If the hull is not built to meet the requirements of a recognised Classification Society, then the hull shall be shown to have adequate strength, taking into account static loads, storm loads, leg deflections, preload conditions and dynamic loads where appropriate.

2.15 Preload Capacity

2.15.1 The unit shall have sufficient preload capacity to apply a vertical force at the foot of each leg of not less than the maximum vertical force computed for the 50-year storm loading.

2.15.2 Certain locations with very soft or stratified soils may require greater preload capacity than that indicated in section 2.15.1.

2.15.3 During the preload operation, the maximum permitted loads on the jacks for raising, lowering or holding, as appropriate, shall not be exceeded. The hull shall always be capable of being levelled by adjusting the jacks.

2.16 Resistance To Punch-Through

For independent leg, three-legged units, the legs shall be shown not to be stressed beyond the ultimate limit state when the unit suffers a punch-through during preloading under the following conditions:-

a) The rig is carrying the maximum allowable variable load for jacking operations;

b) Maximum allowable preload water for the variable load in 2.16(a) above is on board;

c) Leg length below the hull for this calculation shall be the sum of :-

   i) Maximum allowable water depth including tidal rise, or any lesser water depth, plus

   ii) Maximum final penetration allowable at the water depth considered in 2.16.c(i), up to a maximum of 30 metres, plus:

   iii) 2 metres.

d) A sudden increased penetration of any one leg has occurred such that the hull takes an inclination to the horizontal of 8 degrees, or the additional penetration equals 6 metres, whichever is the lesser.

e) No hull buoyancy shall be allowed in the calculation.

2.17 Earthquake Areas

Operations in areas subject to seismic activity may need special consideration, and a study of earthquake loadings shall be carried out where appropriate.

2.18 Ice Areas

2.18.1 Operations in areas affected by fast- or sea-ice are not covered by this report, and would require special consideration.

2.18.2 The effects of ice accretion should be taken into account in the loadings on the structure.

3. TOWAGE CONDITIONS

3.1 Definitions

3.1.1 Field Move

A field move is any move within or in the vicinity of an oil or gas-field or other area of operations, and which can be completed within the time for which a reliable good weather forecast may reasonably be expected, having due regard to area and season. Jacking or other operations at the start and finish of the move shall be taken into account.

3.1.2 Location Move

A location move is a move which, although not falling within the definition of a field move, may be expected to be completed with the unit essentially in field move configuration, without overstressing or otherwise endangering the unit, having due regard to the length of the move, and to the area (including availability of sheltered locations) and season.

3.1.3 Ocean Towage

An ocean towage is any move which does not fall within the definition of a field or location move in 2.1.1 or 2.1.2 above.

NOTE: Throughout this report a "towage" includes a "voyage" of a self-propelled unit.

3.1.4 Benign Area

A benign area is defined as an area which is free from tropical revolving storms and travelling depressions, (but excluding the North Indian Ocean during the Southwest monsoon season, and the South China Sea during the Northeast monsoon season). The specific extent and seasonal limitations of a benign area should be agreed with the NDA office concerned.

3.2 Motion Criteria

3.2.1 Field Moves

a) Independent leg units

When afloat in the move condition, legs and associated structures shall be capable of withstanding a roll or pitch of 10 degrees each side of vertical in a 10 second full cycle period. Axes of roll and pitch shall be assumed to pass through the centre of flotation.

b) Mat type units

For mat type units floating on their hull, legs and associated structures shall be capable of withstanding a roll or pitch of 8 degrees each side of vertical in a 13 second full cycle period. Axes of roll and pitch shall be assumed to pass through the centre of flotation.

3.2.2 Ocean Towages On Own Hull

a) Independent leg units

When afloat in the towage condition, legs and associated structures shall be capable of withstanding a roll or pitch of 20 degrees each side of vertical in a 10 second full cycle period. Axes of roll and pitch shall be assumed to pass through the centre of flotation.

b) Mat type units

For mat type units floating on their hull, legs and associated structures shall be capable of withstanding a roll or pitch of 16 degrees each side of vertical in a 13 second full cycle period. Axes of roll and pitch shall be assumed to pass through the centre of flotation.

3.2.3 Transport on Transport Barge

For units carried as cargo on a non-propelled transport barge with dimensions greater than 76m x 23m, the following criteria shall be applied:

Roll: 20 degrees single amplitude in 10 seconds full cycle period

Pitch: 12.5 degrees single amplitude in 10 seconds full cycle period

Heave: 0.20g

Roll and pitch axes shall be assumed to pass through the centre of flotation.

Phase angles shall be those which give the most severe combination of:

a) Roll and heave

b) Pitch and heave

3.2.4 Transport on Heavy Lift Vessels

For transportation on self-propelled heavy lift vessels, the criteria to be adopted shall be that contained in report 0007/NDI/JCT entitled "Proposed Criteria for the Dry Transportation of Mobile Offshore Drilling Units on Self Propelled Heavy Lift Ships on Ocean Voyages".

3.3 Alternative Motion Criteria

3.3.1 Variations on the criteria given in sections 3.2.1, 3.2.2 or 3.2.3 above may be accepted if supported by model tests or motion response calculations. Oceanographic input shall be as described in sections 3.3.2, 3.3.3 and 3.3.4.

3.3.2 Design Storm

a) The design storm for the towage shall be the 10-year return period monthly extreme storm for the location move area or towage route, reduced as appropriate for exposures of less than 30 days.

b) The most severe areas of the towage route shall be considered for both wind and waves.

c) The design seastate shall be defined by the significant wave height (H_{sig}), as described in Section 3.3.4.

d) The design wind shall be the 1 minute mean velocity.

3.3.3 Seastate

For the analysis, seastates shall include all relevant spectra up to and including the design storm seastates for the most severe areas of the proposed towage route "Long-crested" seas will be considered unless there is a justifiable basis for using "short-crested" seas. Consideration should be given to the choice of spectra.

3.3.4 Wave Periods

a) For all seastates considered, the peak period (Tp) should be varied as :-

$$\sqrt{13\, H_{sig}} \quad \leq \quad T_p \quad \leq \quad \sqrt{30\, H_{sig}}$$

Where H_{sig} is in metres, T_p in seconds.

b) Alternatively, if a detailed analysis of the joint probability distribution of significant wave height versus peak wave period is carried out, the following method may be applied:-

i) Analyse the unit for the design storm waveheight for the most probable value of peak period (T_p) $\pm$ 1 sec.

ii) Analyse the unit for the combinations of significant waveheight and peak period having the same joint probability of occurrence as the design storm waveheight and the most probable peak period. The effect of swell shall be considered in the above criteria.

3.3.5 Motion Response Computer Programs

Motion response calculations shall be carried out using a computer program which has been validated against a suitable range of model test results in irregular seas. The validation is to be made available to NDA and is to contain appropriate analytical work which must be compared with the model tests under review. The analyses are to be carried out for zero speed and head, quartering and beam seas. The maximum responses are to be based on a 3-hour exposure period. For a triangular jack-up on its own buoyancy, a 3-dimensional program will normally be required.

3.3.6 The Effects of Free Surfaces

Free surface corrections to reduce GM and hence increase natural period will not generally be approved. The effect of any reduction in GM must, however, be considered in intact and damage stability calculations, and when computing wind induced heel or trim.

3.4 Loadings in Legs and Associated Structures

3.4.1 Derivation of Loadings

a) When a unit is transported, the legs, associated structures, and seafastenings are to be capable of withstanding the maximum loadings imposed upon them. These loadings shall be determined from the motions shown in sections 3.2 or 3.3 as applicable.

b) Alternatively, the loadings may be determined from model tests or detailed motion analysis, using the seastates as defined in section 3.3 plus the direct wind load and gravity loads caused by the computed maximum angle of roll or pitch, including wind heel or trim of the unit.

3.4.2 Computation of Leg Bending Moment and Shear Force

a) Bending moment (M) applied to the leg shall be :

$$M = 0.9\,(M_1 + M_2 + M_3 + M_4 + M_5 + M_6)$$

Where M_1 = moment caused by static wind heel/trim angle;

M_2 = moment caused by surge/sway accelerations;

M_3 = moment caused by pitch/roll accelerations;

M_4 = moment caused by gravity component of pitch/roll amplitude;

M_5 = moment caused by direct wind load;

M_6 = moment caused by heave acceleration.

except that if wind induced or wave induced loads individually exceed the reduced total load shown above, the greatest single effect shall be considered.

b) The effects of varying phases between each motion may be considered if the method of calculation has been suitably validated.

c) Where the accelerations are derived from the motion criteria stated in sections 3.2.1, 3.2.2 or 3.2.3 without modification, then the bending moment applied to the leg shall be:

$$M = M_2 + M_3 + M_4 + M_6$$

using the definitions of 3.4.2(a) above.

d) 20% shall be added to the bending moment unless the legs are properly secured against horizontal movement by means of shimming in the upper and lower guides or by use of an approved locking device.

e) The corresponding shear loads shall be similarly derived.

3.4.3 Cribbing and Seafastening Loads

When the unit is transported on a barge, the loads on the cribbing, seafastening and bottom plating shall be derived, using the method adopted for leg loadings.

No reduction in seafastening forces shall be made on account of friction.

3.5 Hull Strength

3.5.1 Classification

Either the hull shall be built to the requirements of a recognised Classification Society, or:

3.5.2 Alternative Criteria

If the hull is not built to meet the requirements of a recognised Classification Society, then the requirements of sections 3.5.3, 3.5.4 and 3.5.5 shall be applied.

3.5.3 Overall Strength

The hull shall be shown to possess adequate longitudinal and transverse strength to withstand the following loadings:

a) Static load, afloat in still water with all equipment, variable load and legs in towage position; plus,

either

b) Longitudinal bending due to the wave of that length (Lw) which gives the highest longitudinal hogging or sagging bending moment,

or

c) Transverse bending due to the wave of that length which gives the highest transverse hogging or sagging bending moment,

or

d) Load imposed on the hull and guide support structures by the legs when subjected to the motions indicated in sections 3.2 or 3.3 as appropriate.

NOTE: For the purpose of sections 3.5.3(b) and 3.5.3(c), the wave shall be considered to be a trochoidal wave with height (Hw) equal to either:

$H_w = L_w/20$ or

$H_w = 0.61 \sqrt{L_w}$ (where L_w is wave length in metres)

3.5.4 Plating Strength

External plating is to be shown to have adequate strength to withstand the hydrostatic load due to the immersion of the section of shell plating considered to a depth equal to that which would be caused by inclining the hull in towage condition in still water, to an angle equal to the amplitude of motion indicated in section 3.2.1 or 3.2.2 as appropriate, or the angle caused by one compartment damage, whichever is the greater.

3.5.5 Hull Construction

Hull and superstructure construction, details, materials and workmanship shall be in accordance with sound marine practice.

3.6 Stress Levels

3.6.1 Static Stress Levels

Stress levels computed for towage conditions shall not exceed those specified in API RP2A. The one-third allowance for environmental loadings may be applied as appropriate for the extreme load cases indicated by sections 3.2, 3.3 and 3.4, provided sufficiently detailed structural analysis has been performed. It should not be applied for repetitive loadings (i.e. for loadings with a probability of occurrence greater than that of the design wave).

3.6.2 Fatigue

The effects of fatigue shall be considered. In particular, special attention should be given to any unit which has been transported more than 5000 nautical miles since the last detailed structural survey.

3.7 Drilling Derrick and Other Equipment

The drilling derrick, substructure and associated structures shall be capable of withstanding the loadings indicated in sections 3.2 or 3.3 as applicable. For field moves the crown block is to be in place. For ocean towages the derrick shall be considered in the condition proposed for towage. No setback shall be carried in either case. Other machinery and equipment are to be similarly considered.

3.8 Intact Stability

3.8.1 Range of Stability - Field Moves

Range of intact statical stability about any axis shall be not less than 28 degrees. The righting arm shall be positive throughout this range.

3.8.2 Range of Stability - Ocean Towages

Range of intact statical stability about any axis shall be not less than 36 degrees. The righting arm shall be positive throughout this range.

3.8.3 Alternative Criteria

Alternatively, if maximum amplitudes of motion for any specific towage can be derived from model tests or motion response calculations, the range of intact statical stability shall be not less than $(20 + 0.8\theta)$ degrees, where

θ = maximum amplitude of roll or pitch motion, plus static wind heel or trim angle, in degrees.

3.8.4 Wind Overturning

The area under the righting moment curve to the second intercept of the righting and overturning moment curves or the downflooding angle, whichever is less, shall be not less than 40% in excess of the area under the wind overturning moment curve to the same limiting angle.

3.8.5 Wind Velocity

The velocity taken for wind overturning moment calculations shall be the design storm wind as defined in section 3.3.2. Minimum exposure considered shall be one day, after the expiry of any forecast period. In the absence of other data, 50 metres/second shall be used.

3.8.6 Angle of Downflooding

Any opening giving an angle of downflooding less than 20 degrees or $(\theta+5)$ degrees, whichever is the greater, shall be closed and watertight whilst the unit is afloat, where θ is the angle defined in section 3.8.3.

3.9 Damage Stability

3.9.1 Range of Stability

The unit shall have positive stability with any one compartment flooded. Minimum penetration shall be considered to be 1.5 metres. Two adjacent compartments on the periphery of the unit shall be considered as one compartment if separated by a horizontal watertight flat.

3.9.2 Wind Overturning

The area under the righting moment curve from the angle of loll to the second intercept or downflooding angle, whichever is less, shall be not less than 40% in excess of the area under the wind heeling moment curve computed between the same angles.

3.9.3 Wind Velocity

The wind velocity taken for wind overturning moment calculations in the damaged condition shall be 25 metres/second, or the wind used for the intact calculation if less.

3.10 Towline Connections

3.10.1 Minimum towline pull required (TPR) shall be computed for zero forward speed against a 20 metres/second wind, 5.0 metre significant seastate and 0.5 metres/second current acting simultaneously.

3.10.2 For benign weather areas only, the environmental conditions in section 3.10.1 may be reduced to those likely to be exceeded for 0.1% of the relevant month for the most severe sections of the tow.

3.10.3 Continuous static bollard pull of the tug(s) required (BP) shall be related to TPR by:

$$BP = \frac{TPR}{Te}$$

where Te = the tug efficiency in the wind and sea conditions considered. Note that Te normally lies in the region 0.3 to 0.8, depending on the size and configuration of the tug and the seastate considered.

3.10.4 Where a particular tow is expected to pass through restricted areas or an area of continuous adverse currents or weather, a greater BP may be required.

3.10.5 The minimum value of the ultimate load capacity (TC) of the towline connections to the unit, including each bridle leg, shall be related to the continuous static bollard pull (BP) of the tug as follows:

BOLLARD PULL	TC (tonnes)	
	Benign Areas	Other Areas
Less than 40 tonnes	2.5 x BP	3.0 x BP
40 to 80 tonnes	2.5 x BP	(2 x BP) + 40
Over 80 tonnes	(2 x BP) + 40	(2 x BP) + 40

3.10.6 It should be noted that the above criteria represent minimum values for towline connection strength. It may be prudent to design the main towing connections to allow for the use of larger tugs than the minimum required by 3.10.3 above.

3.11 Helideck

For ocean towages, it shall be shown that at an inclination in still water of 20 degrees about any horizontal axis, no part of the helideck plating or framing is immersed.

Alternatively, model tests may be used to demonstrate that the helideck remains at least 1.5 metres clear of wave action, in any sea state up to and including the design storm for the towage.

If neither above criterion can be satisfied, then all or part of the helideck structure shall be removed for towage.

APPENDIX 1

For any generalised approval in principle, the following information should be submitted to NDA:

A.1 Drawings and Technical Information

A.1.1 General arrangement plans and elevations

A.1.2 Designers' general specifications for unit

A.1.3 Leg structural drawings

A.1.4 Spudcan arrangement and structure

A.1.5 Jackhouse or jack frame structure, showing connection into hull

A.1.6 Upper and lower guide structural drawings

A.1.7 Jacking system arrangement and specification, including jack capacities for elevating, lowering, holding and survival

A.1.8 Compartmentation plan

A.1.9 Tank capacity tables

A.1.10 Hydrostatic and stability information

A.1.11 List of weights and centres of gravity, including:

Hull

Fixed Load (machinery and outfitting)

Moveable Load (cantilever, substructure, derrick and draw-works)

Legs

Spudcans and can water (or mat and ballast as appropriate)

Maximum allowable variable load for elevating, lowering, operating, survival and towing

Maximum preload weight

A.1.12 Material specifications

A.1.13 Area and season of operation, or water depth, wave height, current speed and wind speed combinations for which approval is required

A.1.14 For towage approvals, towage route and departure date.

APPENDIX 2

A.2 Operations Manual

A copy of the Operations Manual should be submitted to this office for information. This should contain all information relevant to the safety of the unit, personnel and major items of equipment on board the unit, including but not limited to:

A.2.1 General specification, setting out limitations on operating water depths and corresponding environmental conditions

A.2.2 General arrangement plans and elevations

A.2.3 Compartmentation and piping systems

A.2.4 Weights and centres of gravity of hull and equipment, skid unit, legs and spudcans

A.2.5 Loading instructions, giving limitations on weight and centre of gravity, with worked examples of loading calculations for elevated and afloat conditions

A.2.6 Details of jacking system, stating maximum elevating, lowering and holding loads and all necessary checks before jacking operations, including where applicable the required torque and brake clearance for each motor

A.2.7 Variable load capacities

A.2.8 Tank calibration tables

A.2.9 Details of propulsion units (if any)

A.2.10 Details of critical downflooding openings, means of closure, and instructions for ensuring closed under tow

A.2.11 Limitations for going on and off location

A.2.12 Critical motion curves for towage for relevant leg lengths and positions

A.2.13 Preloading instructions

A.2.14 Maximum and minimum permitted penetration, and reasons for any restrictions

A.2.15 Instructions for filling and emptying spudcans

A.2.16 Jetting system layout and operation

A.2.17 Maintenance schedules for machinery and systems. Inspection schedules for structure

A.2.18 References to more detailed manuals for machinery and systems

A.2.19 Allowable loadings and position of cantilever and substructure for operating and survival conditions.