



DPC: 25/30512757 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 03 July 2025

Origin: International

Latest date for receipt of comments: 26 August 2025

Project No. 2025/01146

Responsible committee: B/525/12 Design of offshore structures

Interested committees:

Title: Draft BS EN ISO 19905-4 Oil and gas industries including lower carbon energy - Site-specific assessment of mobile offshore units. Part 4: Jack-up installation and removal at a site.

Please notify admin.start@bsigroup.com if you are aware of any keywords that might assist in clarifying or identifying the standard or of the content of this standard:

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD. THIS DRAFT IS NOT CURRENT BEYOND 26 August 2025

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <https://standardsdevelopment.bsigroup.com/>.

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 19905-4

Oil and gas industries including lower carbon energy — Site-specific assessment of mobile offshore units —

Part 4: Jack-up installation and removal at a site

ICS: 75.180.10

This document is circulated as received from the committee secretariat.

ISO/TC 67/SC 7

Secretariat: **BSI**

Voting begins on:
2025-07-03

Voting terminates on:
2025-09-25

THIS DOCUMENT IS A DRAFT CIRCULATED FOR COMMENTS AND APPROVAL. IT IS THEREFORE SUBJECT TO CHANGE AND MAY NOT BE REFERRED TO AS AN INTERNATIONAL STANDARD UNTIL PUBLISHED AS SUCH.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

Reference number
ISO/DIS 19905-4:2025(en)

Full document details: 25/30512757 DC

© ISO 2025  **Documents**
Document Sharing Hub



COPYRIGHT PROTECTED DOCUMENT

© ISO 2025

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	vi
Introduction.....	vii
1 Scope	1
2 Normative references	2
3 Terms and definitions.....	2
4 Symbols and abbreviated terms.....	13
4.1 Symbols	13
4.2 Abbreviated terms	14
5 Overall considerations.....	15
5.1 General	15
5.2 Interaction with SSA-E	15
5.3 Competency of the assessor	16
5.4 Planning	16
5.5 Personnel certification and travel logistics	16
5.6 Regulations	17
5.7 Classification of unit	17
5.8 Analytical tools	17
6 Potential causes, effects and consequences of damage	17
6.1 General	17
6.2 Causes	18
6.3 Effects.....	18
6.4 Consequences.....	19
7 Operability limits.....	19
8 Data, studies and preparation	20
8.1 Collection of data	20
8.1.1 General	20
8.1.2 Site Data	20
8.1.3 Jack-up data	20
8.2 Elevated suitability	21
8.2.1 Review of the Site-Specific Assessment – Elevated.....	21
8.2.2 Review of the requirements for the elevated operations	21
8.3 Installation and removal guidance and assessment.....	21
8.3.1 General	21
8.3.2 Preparation of operability guidance	21
8.4 Risk assessment	21
8.5 Operational advisory.....	22
8.6 Marine assurance	22
8.7 Management of change	22
9 Rig move procedure development for installation and removal	23
9.1 General	23
9.2 Reference documents.....	23
9.3 Outline contents.....	23
9.4 Jack-up and move-specific factors	24

9.5	Chain of command and communications.....	24
9.5.1	Chain-of-command	24
9.5.2	Communication of operational limitations	24
9.6	Roles and responsibilities.....	25
9.7	Management of change (MOC).....	25
9.8	Confirmation stage	25
9.9	Execution Stage	25
9.10	Acceptability of the installed condition	25
9.11	Installation information retention	26
9.12	Removal information retention	26
9.13	Sign-off of the RMP	26
10	Supplementary engineering analyses	26
11	Supplementary seabed activities	27
Annex A	(informative) Additional information and guidance	28
A.1	Guidance on scope	28
A.2	Guidance on normative references.....	28
A.3	Guidance on terms and definitions.....	28
A.4	Guidance on symbols	28
A.5	Guidance on overall considerations.....	28
A.6	Guidance on potential causes of damage.....	28
A.6.1	General.....	28
A.6.2	Causes.....	29
A.6.3	Effects	37
A.6.4	Consequences	40
A.7	Guidance on Operability limits	41
	Guidance on.....	41
A.8	data, studies and preparation	41
A.8.1	Collection of data.....	41
A.8.2	Elevated suitability.....	54
A.8.3	Installation and removal guidance and assessment	54
A.8.4	Risk assessment.....	58
A.8.5	Operational advisory	58
A.8.6	Marine assurance	58
A.8.7	Management of change.....	59
A.9	Guidance on rig move procedure development for installation and removal.....	59
A.9.1	General.....	59
A.9.2	Reference documents	60
A.9.3	Outline contents	60
A.9.4	Jack-up and move-specific factors	60
A.9.5	Chain of command and communications.....	62
A.9.6	Roles and responsibilities.....	64
A.9.7	Management of change.....	69
A.9.8	Confirmation stage	70
A.9.9	Execution stage	71
A.9.10	Acceptability of the installed condition	71
	Installation i.....	71
A.9.11	nformation retention.....	71
A.9.12	Removal information retention	74
A.9.13	Sign-off of the RMP.....	74
A.10	Guidance on supplementary Engineering analyses.....	75
A.10.1	General.....	75

A.10.2	Operability limits at the stand-off location	75
A.10.3	Positioning at site	76
A.10.4	Preloading and punch-through	78
A.10.5	Weather restricted operations	85
A.10.6	Acceptance Criteria	86
A.11	Guidance on supplementary seabed activities	88
A.11.1	General	88
A.11.2	Stomping	89
A.11.3	Reaming	89
A.11.4	Gravel pads	89
A.11.5	Seabed excavation	89
A.11.6	Perforation drilling`	90
A.11.7	Modification of the seabed to assist with leg extraction	90
A.11.8	Scour protection	90
Annex B	(informative) Data and checklists	91
B.1	Data	91
B.1.1	Data that operator should supply to the jack-up owner	91
B.1.2	Data that the jack-up owner should supply to the operator	91
B.1.3	Data that jack-up owner should supply to the marine warranty survey company (MWS)	92
B.2	Checklists	93
B.2.1	Checklists for jack-up installation	93
B.2.2	Checklists for jack-up removal	94
B.2.3	Information required for developing the anchoring plan	95
B.2.4	Information required for the development of the tow routing plan	96
B.2.5	Jack-up readiness survey	96
B.2.6	Towing vessel survey	97
B.2.7	Information retention for lessons learned	97
Annex C	(informative) Rig mover competence	99
C.1	General	99
C.2	Experience	100
C.3	Qualification	100
C.4	Training	100
C.5	Records	101
Annex D	(informative) Example of the steps involved when entering and departing safety zones and responsible parties	103
D.1	General	103
D.2	Preparation (before jack-up approaches the defined safety zone)	103
D.3	Preparation (entering the defined safety zone and jacking up)	104
D.4	Location Departure (jacking down and leaving the defined safety zone)	104
Annex E	(informative) Example Rig Move Procedure (RMP)	106
E.1	Guidance for this Annex	106
Bibliography		cxliv

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, Subcommittee SC 7, *Offshore structures*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 12, *Oil and gas industries including lower carbon energy*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 19905 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The International Standards on offshore structures prepared by TC 67 (i.e. ISO 19900, the ISO 19901 series, ISO 19902, ISO 19903, ISO 19904-1, the ISO 19905 series, ISO 19906) constitute a common basis covering those aspects that address design requirements and assessments of all offshore structures used by the oil and gas industries worldwide. Through their application, the intention is to achieve reliability levels appropriate for offshore structures, whatever the type of structure and the nature of the materials used. Application specific requirements for different energy industries are given in the relevant standards. For example, for the offshore wind industry, IEC 61400-1 and IEC 61400-3-1 outline the design requirements (e.g. return periods) for offshore wind turbine support structures.

It is important to recognize that structural integrity is an overall concept comprising models for describing actions, structural analyses, design or assessment rules, safety elements, quality of work, quality control procedures and national requirements, all of which are mutually dependent. The modification of one aspect of design or assessment in isolation can disturb the balance of reliability inherent in the overall concept or structural system. The implications involved in modifications, therefore, must be considered in relation to the overall reliability of all offshore structural systems.

The International Standards on offshore structures prepared by TC 67/SC 7 are intended to provide wide latitude in the choice of structural configurations, materials and techniques without hindering innovation. Sound engineering judgment is, therefore, necessary in the use of these documents.

This document states the general principles and basic requirements for the site-specific assessment of the installation and removal of mobile jack-ups; it is intended to be used for the site-specific assessment of installation and removal and not for jack-up design.

Site-specific installation and removal assessment is normally carried out before an existing jack-up unit is installed or removed at a specific site. The installation and removal assessment is not intended to provide a full evaluation of the jack-up; it assumes that aspects not addressed herein have been addressed using other practices and standards or with the assessment for survival conditions in the elevated condition on the specific site. In some instances, the original design of all or part of the structure could be in accordance with other International Standards on offshore structures prepared by TC 67/SC 7, and in some cases, different practices or standards could have been applied.

The purpose of the site-specific installation and removal assessment is to ensure that the jack-up and its foundations have been adequately assessed, taking into account the consequences of failure. It is important that the results of a site-specific installation and removal assessment be appropriately recorded and communicated to those persons required to know or act on the conclusions and recommendations. Alternative approaches to the site-specific installation and removal assessment can be used, provided that they have been shown to give a level of structural reliability equivalent, or superior, to that implicit in this document.

Annex A provides background to and guidance on the use of this document. The clause numbering in Annex A is the same as in the main text in order to facilitate cross-referencing.

Annex B (Informative), data and checklists identifies the documentation to be gathered and exchanged and provides checklists of information and actions for the stages of installation and removal operations.

Annex C (Informative) provides guidance on the competence of the rig mover.

Annex D (Informative) provides guidance on the parties responsible for entering and departing safety zones.

Annex E (Informative) provides an example rig move procedure (RMP).

In a subsequent edition further Annexes will each provide a detailed calculation procedure for assessing the limiting criteria for a procedure used during the installation or removal of a jack-up

In this document, the following verbal forms are used:

- “shall” indicates a requirement;
- “should” indicates a recommendation;
- “can” indicates a possibility or a capability;
- “may” indicates a permission.

Oil and gas industries including lower carbon energy — Site-specific assessment of mobile offshore units — Part 4: Jack-up installation and removal at a site

1 Scope

This document specifies requirements and guidance for the installation on and removal from site of independent leg jack-up units for use in the oil and gas industries including lower carbon energy. It addresses the assessment of:

- a) the installation operation from when the jack-up enters the defined safety zone of the host platform or the intended site to when it is elevated to the operating hull elevation above LAT and is ready for operations;
- b) the removal operation from when the jack-up is ready to jack-down to when it departs the defined safety zone.

NOTE 1: Whilst this document is for independent leg jack-up units, many of the provisions can be applied to mat-supported jack-up units.

NOTE 2: When the jack-up has propulsion assist or is self-propelled the provisions of this standard related to positioning should be replaced or supplemented as appropriate.

The assessment of a jack-up at a specific site is normally comprised of two parts.

- 1) Assessing that the unit can survive in the elevated mode.
- 2) Assessing that the unit can be safely installed at, and removed from, the site.

Item 1 is addressed in ISO 19905-1 and item 2 is addressed in ISO 19905-4.

Much of the information required for an ISO 19905-1 assessment (referred to herein as a site-specific assessment elevated – SSA-E) is also required for an ISO 19905-4 assessment (referred to herein as a site-specific installation and removal assessment – SSA-I). There is, however, additional information used in an SSA-I that is best gathered at the same time that data for the SSA-E is collected. This is further discussed in 5.1.

This document is for the installation of a jack-up on, and the removal of a jack-up from a site. Specifically excluded from the scope of this document is the move of the jack-up between sites and elevated operations, which are covered by other requirements. This document is structured to consider the issues associated with a particular site and is not necessarily organized in the same way that a jack-up owner or surveyor would develop a rig move procedure (which is normally developed in terms of leaving one site and being elevated at the next), see Figure 1-1.

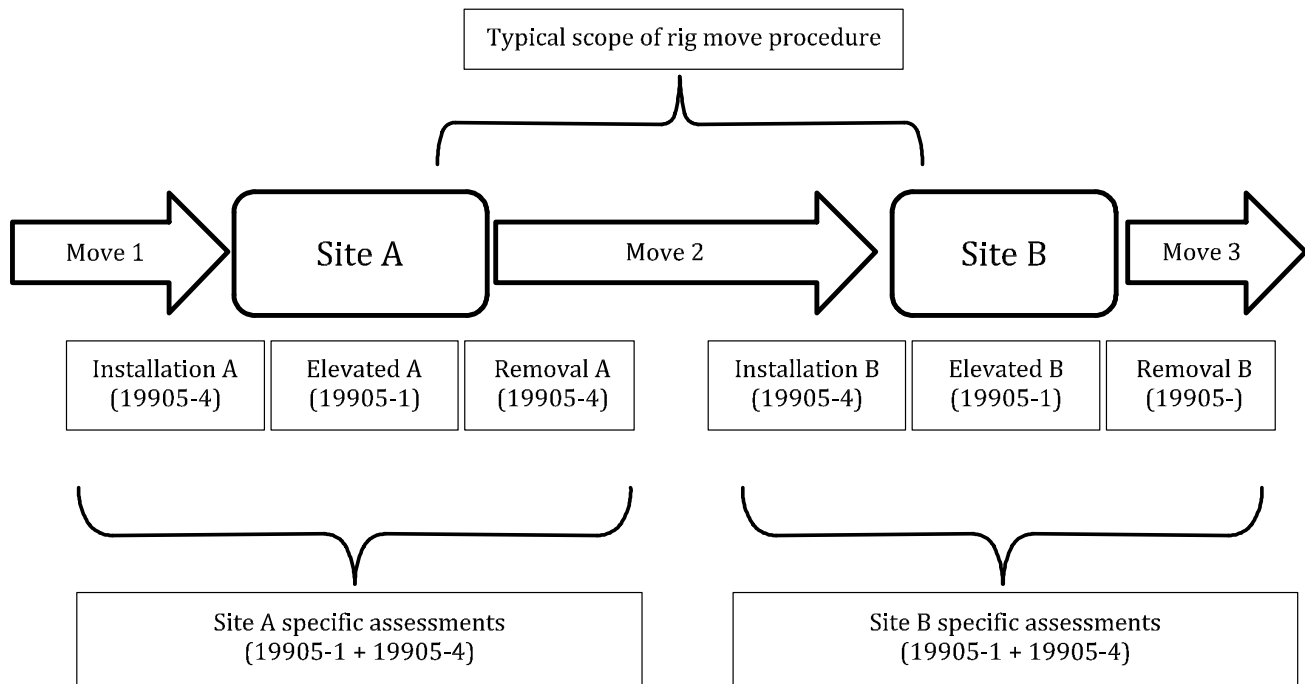


Figure 1-1 — Alignment of specific assessments with multiple sites and rig moves

The provisions of this document form an integrated approach for SSA-I, which is intended to be used in its entirety for the site-specific installation and removal assessment of an independent leg jack-up.

In this document it is assumed that a site-specific assessment for elevated (survival) operations (SSA-E) is available for the specific site.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19900, *Petroleum and natural gas industries — General requirements for offshore structures*

ISO 19905-1, *Oil and gas industries including lower carbon energy — Site-specific assessment of mobile offshore units — Part 1: Jack-ups: elevated at a site*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19900 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

action

external load applied to the *jack-up* (3.23) (direct action) or an imposed deformation or acceleration (indirect action)

EXAMPLE An imposed deformation can be caused by fabrication tolerances, differential settlement, temperature change or moisture variation. An imposed acceleration can be caused by an earthquake.

[SOURCE: ISO 19900:2019, 3.3, modified — "structure" changed to "jack-up".]

3.2

air gap

clearance between the highest water surface that occurs during the current phase of the installation or removal operation and the base of the hull

Note 1 to entry: In ISO 19900:2019 the air gap is defined as: distance between the highest water elevation and the lowest exposed part of the primary deck structure not designed to withstand associated environmental action effects for a defined return period. This differs from the air gap definition historically used by the jack-up industry. In ISO 19905-1 hull elevation above LAT is used for the elevated operational case.

3.3

assessment

site-specific assessment

evaluation of the stability and structural integrity of a *jack-up* (3.23) and, where applicable, its seabed restraint or support against the actions determined in accordance with the requirements

Note 1 to entry: The specific requirements are given in this document.

Note 2 to entry: An assessment can be limited to an evaluation of the components or members of the structure which, when removed or damaged, could cause failure of the whole structure, or a significant part of it.

[SOURCE: ISO 19905-1:2023, 3.6]

3.4

assessment situation

set of physical conditions for which the *jack-up* (3.23) or its components are verified

Note to entry: The assessment situations are checked against the acceptance criteria of this document to demonstrate that the relevant limit states are not exceeded.

[SOURCE: ISO 19900:2019, 3.16, modified — Reference to "design" deleted and "structure" changed to "jack-up".]

3.5

assessor

entity performing the site-specific assessment

[SOURCE: ISO 19905-1:2023, 3.10]

3.6

backfill

submerged weight of all of the soil that can be present on top of the spudcan

Note 1 to entry: Backfilling can occur during or after preloading. $W_{BF,0}$ refers to the submerged weight of the backfilling that occurs up to achieving the preload reaction. $W_{BF,A}$ refers to the submerged weight of the backfilling

that occurs after the maximum preload has been applied and held. Both $W_{BF,o}$ and $W_{BF,A}$ can comprise either *backflow* (3.7) or *infill* (3.22), or both.

[SOURCE: ISO 19905-1:2023, 3.11, modified — Note 1 updated.]

3.7

backflow

soil that flows from beneath the spudcan around the sides and onto the top

Note 1 to entry: Backflow is part of *backfill* (3.6).

[SOURCE: ISO 19905-1:2023, 3.12]

3.8

Certificate of Approval

CoA

certificate issued by the *Marine Warranty Survey Company (MWS)* (3.30) upon review of the: *rig move procedure (RMP)* (3.44); documentation for the intended operations; weather conditions and weather forecast and checking equipment

Note 1 to entry: Separate CoAs can be issued for the removal operation, the rig move, the installation on site and the elevated operation (in relation to the ability to withstand elevated storm conditions).

3.9

chart datum

CD

local datum used to fix water depths on a chart or tidal heights over an area

Note 1 to entry: Chart datum is usually an approximation to the level of the lowest astronomical tide.

Note 2 to entry: Chart datum can differ from one chart to another and care is required if cross referencing sites that are not on the same chart.

[SOURCE: ISO 19901-1:2025, 3.2]

3.10

contingency plan

plan to implement alternate operations in case safety or productivity is jeopardized

3.11

defined safety zone

safety zone around the host platform or operating location under the control of the platform or location OIM (Offshore Installation Manager)

Note 1 to entry: The zone typically extends 500 m from the host platform or operating location, and the zone can be known as the 500 m zone.

3.12

field

the general area where the *jack-up* (3.23) is to operate

[SOURCE: ISO 19905-1:2023, 3.23]

3.13

**fixed load
lightship**

permanent parts of the *jack-up* (3.23), including hull, legs and spudcans, outfit, stationary and moveable-fixed equipment

Note 1 to entry: Moveable-fixed equipment normally includes the drilling package structure and associated permanently attached equipment.

[SOURCE: ISO 19905-1:2023, 3.24]

3.14

footprint

sea floor depression which remains when a *jack-up* (3.23) is removed from a site

[SOURCE: ISO 19905-1:2023, 3.25]

3.15

foundation

soil and spudcan supporting a *jack-up* (3.23) leg

[SOURCE: ISO 19905-1:2023, 3.26]

3.16

foundation stability

ability of the foundation to provide sufficient support to remain stable when subjected to actions and incremental deformation

[SOURCE: ISO 19905-1:2023, 3.28]

3.17

foundation stiffness

rotational and vertical stiffness offered by the soil to the spudcan.

3.18

hold point

point in time at which operations are evaluated for decision making

3.19

hull level jetting

jetting while applying excess buoyancy, thereby creating over pull with all legs stuck, alternating jetting between legs as needed, or jetting all legs together, while keeping the hull as level as practical within designer limitations, and freeing the legs as close together as reasonably practical

3.20

human error

human action or inaction that can produce an unintended result

3.21

independent leg jack-up

jack-up unit with legs that can be raised and lowered independently

[SOURCE: ISO 19905-1:2023, 3.32]

3.22

infill

soil above the plan area of the spudcan arising from sediment transport or hole sidewall collapse

Note 1 to entry: Infill is part of *backfill* (3.6).

[SOURCE: ISO 19905-1:2023, 3.34]

3.23

jack-up

mobile offshore unit with a buoyant hull and one or more legs that can be moved up and down relative to the hull

Note 1 to entry: A jack-up reaches its operational mode by lowering the leg(s) to the seabed and then raising the hull to the required elevation. The majority of jack-ups have three or more legs, each of which can be moved independently and which are supported in the seabed by spudcans.

[SOURCE: ISO 19905-1:2023, 3.36]

3.24

**jack-up owner
owner**

representative of the company or companies owning or chartering the jack-up

Note 1 to entry: The energy company, the *operator* (3.34), contracts the jack-up and is generally not the owner or charterer.

[SOURCE: ISO 19905-1:2023, 3.37]

3.25

leg run

prolonged vertical leg movement that can be controlled by the jacking system, such that the hull can be maintained within tolerable limits

3.26

limit state

state beyond which the *jack-up* (3.23) no longer satisfies the assessment criteria

[SOURCE: ISO 19905-1:2023, 3.40, modified — "or a structural member" deleted]

3.27

lowest astronomical tide

LAT

level of low tide when all harmonic components causing the tides are in phase

Note 1 to entry: The harmonic components are in phase approximately once every 19 years, but these conditions are approached several times each year.

[SOURCE: ISO 19901-1:2025, 3.18]

3.28

marine assurance

secondary review of marine installation and removal procedures

3.29

**marine operation(s) manual
MOM**

operating manual

latest approved document that defines the operational characteristics and capabilities of the *jack-up* (3.23)

Note 1 to entry: The *assessor* (3.5) is should ensure that any updated weight data are provided.

3.30

**Marine Warranty Survey Company
MWS**

organization approved by insurance underwriters to satisfy the requirements of the warranty clause in a marine insurance policy

Note 1 to entry: The fundamental objective of the MWS is to make reasonable endeavours to ensure that the risks associated with the warranted operation (in this case, the rig move) are reduced to an acceptable level in accordance with best industry practice. The MWS can specify recommendations to be met in order to minimize the risk to the insured jack-up during all phases of the move and to comply with the terms of the warranty.

Note 2 to entry: MWS attendance is not always a requirement of the insurance warranty clause.

3.31

mat-supported jack-up

jack-up unit with the leg(s) rigidly connected by a foundation structure, such that the leg(s) are raised and lowered in unison

[SOURCE: ISO 19905-1:2023, 3.44]

3.32

neutral zone

hull draught zone through which there is vertical load reversal between the legs and the hull

Note 1 to entry: Hull and legs are independent of each other with neither tension nor compression being applied to the jacking system.

Note 2 to entry: The extent of the zone can be larger in the presence of waves.

Note 3 to entry: At this draught, any backlash in the pinion to rack-teeth interface can have detrimental effects (unwinding & rewinding of the planetary gear boxes) even with the brakes set in moderate swell conditions.

Note 4 to entry: The neutral buoyancy effects are most prevalent on floating jacking systems (i.e. causing bouncing of jacking units between shock pads).

3.33

operability limits

pre-defined conditions (e.g., metocean, motions, loads) outside which installation or removal operations are to be suspended

3.34

operator

representative of the company or companies leasing the site

Note 1 to entry: The operator is normally the oil company acting on behalf of co-licensees.

[SOURCE: ISO 19900:2019, 3.35, modified — Note 2 to entry deleted.]

3.35

preloading

installation and embedment of the spudcans by vertical loading of the soil beneath a jack-up leg spudcan with the objective of ensuring sufficient foundation capacity under *assessment situations* (3.4) through to the time when the maximum load is applied and held

Note 1 to entry: Whilst three-legged jack-ups preload by taking water ballast on board, jack-ups with four or more legs typically achieve foundation preload by carrying the hull weight on pairs of legs in turn. This procedure is known as pre-driving and generally does not require the addition of water ballast. For the purposes of this document, no distinction is made between preload and pre-drive.

[SOURCE: ISO 19905-1:2023, 3.55]

3.36

preloading air gap

the distance between the baseline of the hull and the still water level at a point in time during preloading

NOTE 1 to entry: The air gap is defined in ISO 19900:2019 as: distance between the highest water elevation and the lowest exposed part of the primary deck structure not designed to withstand associated environmental action effects for a defined return period. This differs from the definition historically used by the jack-up industry. In ISO 19905-1 and this document hull elevation above LAT is used for the elevated operational case.

3.37

preload reaction

maximum vertical reaction under a spudcan, V_{Lo} , supporting the in-water weight of the jack-up during the entire preloading operation

Note 1 to entry: The in-water weight is the full weight of the hull, variable load and preload ballast, plus the legs and spudcans and any contained water, reduced by the buoyancy in water of any submerged part of the hull and the legs and spudcans (calculated from their external dimensions). Soil buoyancy and the weight of any soil backfill above the spudcan are neglected. It is necessary to take care when accounting for water contained in the spudcan (in some cases this can be included in the quoted leg weight).

Note 2 to entry: This is the maximum reaction on a spudcan, V_{Lo} , that would be obtained during preloading if the jack-up were installed on an infinitely rigid foundation.

Note 3 to entry: V_{Lo} is a key parameter in the geotechnical analysis of independent leg foundations. *Assessors* (3.5) consider values that can be reasonably achieved during preload operations. The assessment is invalidated if the value considered in the site assessment is not achieved during preload operations

Note 4 to entry: The term leg reaction is also used in Marine Operating Manuals and jack-up personnel with no consistent meaning, and is thus a potential source of confusion.

3.38

preload pinion reaction

preload jacking reaction

the maximum load transferred to a leg by the jacking system during preloading

Note 1 to entry: The *pinion reaction* or *jacking reaction* is often referenced by Marine Operating Manuals and jack-up personnel, It less than V_{Lo} by the leg weight and leg water buoyancy.

3.39

punch-through rapid leg penetration

uncontrolled vertical leg movement due to soil failure with the potential for significant consequences

Note 1 to entry: Significant consequences include: damage to the jack-up, damage to other assets, significant loss of time, and injury to personnel.

Note 2 to entry: : There is no consensus on the definitions of punch through and rapid leg penetration and both are used interchangeably within the industry. Such events can occur when a leg penetrates through a stronger soil layer into a weaker soil layer, or penetrates through a soil profile in which there is a negligible increase of bearing capacity with depth, causing the spudcan to experience a relatively large increase in penetration for an incremental increase in footing load. The rate of leg penetration for either definition exceeds that for a *leg run* (3.25).

Note 3 to entry: 4 or 6-legged jack-ups generally do not experience rapid leg penetrations because the load on the leg undergoing punch-through foundation failure redistributes to the other legs.

3.40

rack phase difference RPD

maximum relative difference in the position of adjacent leg chords within a truss leg measured parallel to the longitudinal axis of the chords

Note 1 to entry: This is the out-of-plane distortion of the plan-frame.

Note 2 to entry: RPD is often used as an indication of the amount of bending moment in the leg experienced during installation and removal of the Jack-up.

[SOURCE: ISO 19905-1:2023, 3.59, modified — "maximum" and Note 2 added.]

3.41

RCS recognized classification society

member of the international association of classification societies (IACS), with recognized and relevant competence and experience in jack-ups, and with established rules and procedures for classification and certification of such units used in petroleum-related activities

[SOURCE: ISO 19901-7:2013, 3.23, modified — "floating structures" replaced by "jack-ups", "installations" replaced by "such units".]

3.42

regulator

authority established by a national governmental administration that has legal powers to enforce relevant legislation over the activities of the offshore oil and natural gas and lower carbon energy industries within its jurisdiction, with respect to the overall safety to life and protection of the environment

Note 1 to entry: The term regulator can encompass more than one agency in any particular territorial waters.

Note 2 to entry: The regulator can appoint other agencies, such as marine classification societies, to act on its behalf, and in such cases, the term regulator within this part of ISO 19905 includes such agencies.

Note 3 to entry: In this document, the term regulator does not include any agency responsible for approvals to extract hydrocarbons, unless such agency also has responsibility for safety and environmental protection.

[SOURCE: ISO 19902:2020, definition 3.39, modified — "to oversee" replaced with " that has legal powers to enforce relevant legislation over the", added "and lower carbon energy".]

3.43

return period

average period between occurrences of an event

Note 1 to entry: The offshore industry commonly uses a return period measured in years for environmental events. The return period in years is equal to the reciprocal of the annual probability of exceedance of the event.

Note 2 to entry: For the purpose of this definition, events include both discrete hazardous events as well as exceedances of a threshold value of a relevant variable.

[SOURCE: ISO 19900:2019, 3.42]

3.44

Rig Move Procedure

RMP

procedural document covering the movement of the jack-up rig from the removal site to the installation site

Note 1 to entry: Note that an RMP can include or supersede the guidance information in the *MOM* (3.29).

Note 2 to entry: This document is structured to consider the issues associated with a particular site and is not necessarily organized in the same way that a jack-up owner or surveyor would develop an RMP (which is normally developed in terms of leaving one site and being elevated at the next), see Figure 1-1.

3.45

scatter diagram

joint probability of two or more (metocean) parameters

Note 1 to entry: A scatter diagram is especially used with wave parameters in the metocean context, see ISO 19901-1:2015, A.5.8. The wave scatter diagram is commonly understood to be the probability of the joint occurrence of the significant wave height (H_s) and a representative period ($T_{z,i}$ or $T_{p,i}$).

[SOURCE: ISO 19901-1:2025, 3.30, modified — In Note to entry, "(for example in fatigue assessments)" replaced by ", see ISO 19901-1:2025, A.2.8".]

3.46

scour

removal of seabed material from the foundation due to current and waves

[SOURCE: ISO 19905-1:2023, 3.68]

3.47

sea-state

condition of the sea during a period in which its statistics remain approximately stationary

Note 1 to entry: In a statistical sense the sea-state does not change markedly within the period. The period during which this condition exists depends on the particular weather situation at any given time, however it is often assumed to be three hours in extra-tropical conditions, however it may be as short as 1 hour in tropical cyclonic conditions.

[SOURCE: ISO 19901-1:2025, 3.32]

3.48

shallow gas

gas pockets or entrapped gas below impermeable layers at shallow depth

[SOURCE: ISO 19905-1:2023, 3.72]

3.49

significant wave height

statistical measure of the height of waves in a sea-state

Note 1 to entry: The significant wave height was originally defined as the mean height of the highest one-third of the mean zero upcrossing waves in a sea-state. In most offshore data acquisition systems, the significant wave height is currently taken as $4\sqrt{m_0}$ (where m_0 is the zeroth spectral moment, see ISO 19901-1:2025, 3.40) or 4σ , where σ is the standard deviation of the time series of water surface elevation over the duration of the measurement, typically a period of approximately 30 min.

[SOURCE: ISO 19901-1:2025, 3.36 modified — "see 3.38 spectral moment" replaced by ", see ISO 19901-1:2025, 3.40".]]

3.50

skirted spudcan

spudcan (3.55) with a *skirt* (3.52)

[SOURCE: ISO 19905-1:2023, 3.76]

3.51

site

specific position and orientation at which a *jack-up* (3.24) is to operate within a *field* (3.12)

[SOURCE: ISO 19905-1:2023, 3.74]

3.52

skirt

vertical bulkhead(s), closed in plan view, beneath the main body of a *spudcan* (3.55)

[SOURCE: ISO 19905-1:2023, 3.75]

3.53

sliding

horizontal movement of a spudcan whilst in contact with the seabed

3.54

soft-pinning

lowering the legs of the jack-up into the seabed with just sufficient penetration to allow for translational restraint without significant axial leg loading

3.55

spudcan

footing

structure at the base of a leg supported by the soil

[SOURCE: ISO 19905-1:2023, 3.81, modified — Added footing]

3.56

squall

strong wind event characterized by a sudden onset, a duration of the order of minutes and a rather sudden decrease in speed

Note 1 to entry: A squall is often accompanied by a change in wind direction, a drop in barometric pressure, a drop in air temperature and by heavy precipitation.

Note 2 to entry: The world meteorological organisation (WMO) classification of a squall requires the wind speed to increase by at least 8 m/s and attain a top speed of at least 11m/s, lasting at least one minute in duration.

Note 3 to entry: The duration is insufficient to result in the build-up of associated storm wave-heights i.e. a short period of strong winds but relatively low sea-state

[SOURCE: ISO 19901-1:2025, 3.43 — modified by the addition of "world meteorological organisation" in Note 2 to entry]

3.57

stand-by location

temporary location to be used during the rig move in the event of delays or adverse weather being experienced or forecasted

Note 1 to entry: The *stand-off location* (3.58) can become the *stand-by location*.

Note 2 to entry: If the *stand-by location* is outside the defined safety zone at the final site, it is not within the scope of this standard, however references are made to it for completeness.

3.58

stand-off location

location at which the jack-up starts the installation process that is the remit of 19905-4

Note 1 to entry: In general, the *stand-off location* is approximately 500 m, or less, away from the final site. In many cases the jack-up legs are pinned at this point prior to installation, particularly when moving onto a platform.

Note 2 to entry: Where the jack-up is required to elevate to hull elevation above LAT at a *stand-off location* the location becomes a *stand-by location* (**Error! Reference source not found.**), see A.8.1.3.2.

3.59

trigger point

point in time at which decision is made to proceed with operations based on conditions being within *operability limits* (3.33) and deemed acceptable

3.60

variable load

variable deck load

cargo, materials and fluids carried by the jack-up that are not included in the fixed load

3.61

water depth

vertical distance between the sea floor and still water level at the specific times of interest

Note 1 to entry: The water depth can vary over the duration of installation and removal operations as a result of tide and surge.

3.62**weather-restricted operation**

marine operation that can take place safely within the limits of a favourable weather forecast

Note 1 to entry: It is not necessary that the design weather criteria reflect the statistical extremes for the area and season. A suitable factor should be applied between design weather criteria and operational weather limiting criteria.

[SOURCE: ISO 19901-6:2009, 3.102]

4 Symbols and abbreviated terms**4.1 Symbols**

A_{Fd}	action effect due to factored actions
c_v	soil coefficient of consolidation
D	spudcan or cone diameter
F_d	assessment action
G_E	metocean actions due to the operability limits
G_F	actions due to the fixed load positioned such as to adequately represent their vertical and horizontal distribution
G_v	actions due to maximum or minimum variable load, as appropriate, positioned at the most onerous centre of gravity location applicable to the configurations under consideration
L_1	length of the vector from a specified origin to the factored action effect
L_2	length of the vector from the origin specified for L_1 to the factored interaction surface
Q_H	maximum horizontal foundation capacity
R	factored resistance
$R_{d,OTM}$	factored stabilizing moment
$R_{r,OTM}$	representative stabilizing moment
U	utilization
v	vertical velocity of the spudcan or cone
V_{Lo}	maximum vertical reaction under the spudcan considered required to support the in-water weight of the jack-up during the entire preloading operation ¹⁾

¹⁾ This is not the soil capacity. See definition 3.37.

vD/c_v	normalised velocity with respect to the soil's coefficient of consolidation
$\gamma_{f,E}$	partial action factor applied to the metocean actions
$\gamma_{f,G}$	partial action factor applied to the actions due to fixed load
$\gamma_{f,V}$	partial action factor applied to the actions due to the variable load

4.2 Abbreviated terms

CAD	computer aided design
CD	chart datum
CPT	cone penetrometer test
FE	finite element
HSE	Health, safety and environment
IACS	International Association of Classification Societies
IADC	International Association of Drilling Contractors
LAT	lowest astronomical tide
MOC	management of change
MOM	marine operation manual
MWS	marine warranty survey company
OIM	offshore installation manager
RCS	recognized classification society
RMP	rig move procedure
ROV	remotely operated vehicle
RPD	rack phase difference
SIMOPS	simultaneous operations
SSA-E	site-specific assessment - elevated
SSA-I	site-specific assessment – installation and removal
SSIV	sub-sea isolation valve
SWL	safe working load
UXO	unexploded ordnance
WLL	working load limit

5 Overall considerations

5.1 General

The site-specific assessment of a jack-up comprises two parts:

- The elevated assessment (SSA-E) which shall be undertaken in accordance with ISO 19905-1.
- The installation and removal assessment (SSA-I) which shall be undertaken in accordance with this document.

Site-specific RMP(s) shall be developed for both the installation and removal of a jack-up in accordance with this document.

NOTE This document is structured to consider the issues associated with a particular site and is not necessarily organized in the same way that a jack-up owner or surveyor would develop a rig move procedure (which is normally developed in terms of leaving one site and being elevated at the next), see Figure 1-1.

5.2 Interaction with SSA-E

As stated in Clause 1, the site-specific assessment of a jack-up normally comprises the two parts, an SSA-E (see ISO 19905-1) and an SSA-I addressed in this document. While different personnel can carry out these assessments, much of the same information is used in both, including:

- jack-up data;
- site characteristics;
- geophysical information.

There is other data that is only used in an SSA-E or only used in an SSA-I. For example, the metocean extremes are used in an SSA-E only whereas the normally expected metocean conditions and propensity for squalls are used in an SSA-I only.

Complicating the issue is that much of the data used for the SSA-I is most efficiently obtained at the same time as the data collected for the SSA-E (e.g. soil data). Failure to collect all the data required for both assessments at the same time can be costly and inefficient.

The normal expectation is that the SSA-E will be undertaken before the SSA-I. However there can be cases in which this order is reversed e.g. when the SSA-E is likely to produce a favourable conclusion, but installing the jack-up could be problematic. In some situations the development of the SSA-I will show that the installation is not viable and that deployment of the jack-up to that site should be rejected unless modified conditions can be assured e.g. by means of change of season or use of improved equipment.

There can be cases in which the results of the SSA-E can dictate limitations and requirements for how the jack-up is to be installed on site. Some examples include:

- required heading;
- required preloading level;
- proximity to adjacent structures;

- limits on cantilever extension;
- site remediation e.g. gravel bags, etc.

These limitations and requirements shall be obtained before undertaking an SSA-I (see 8.2).

The following clauses set out procedures and practices to either avoid or mitigate, or both, incidents that could lead to damage, injuries or loss of life, see Figure 5-1.

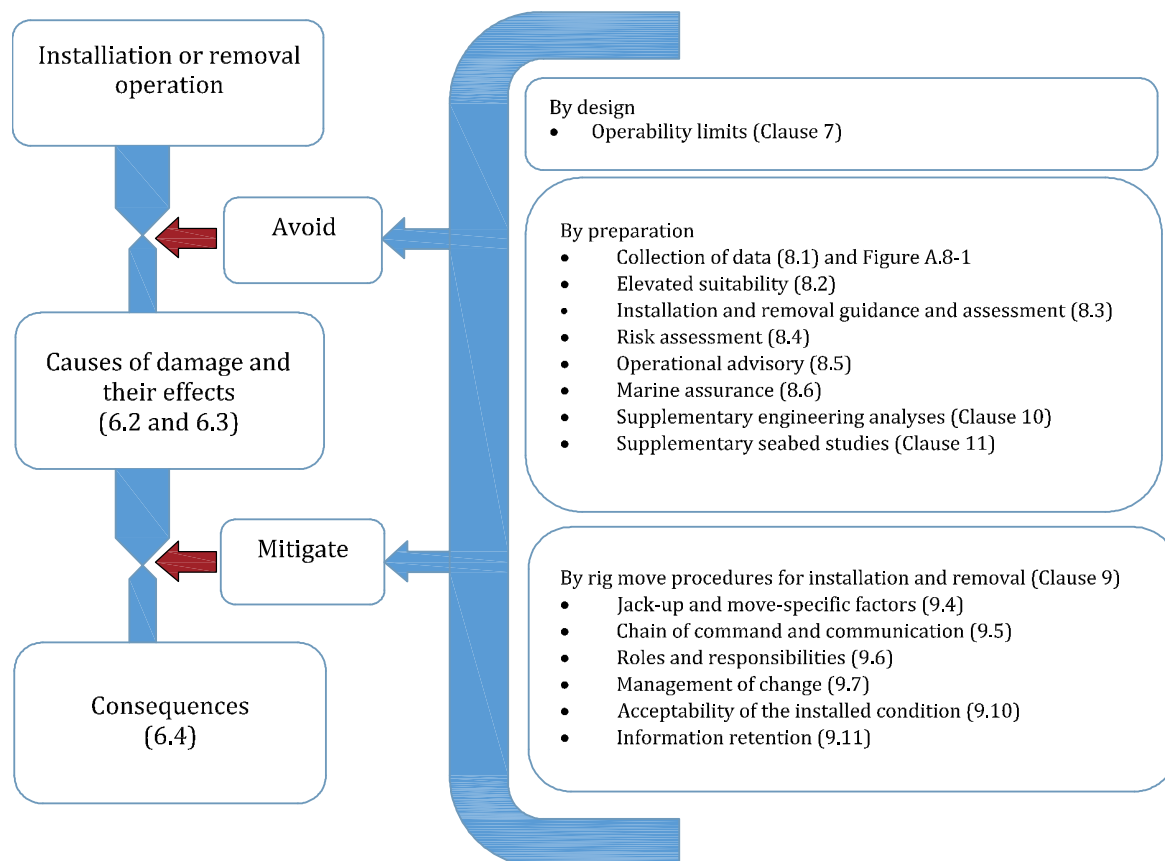


Figure 5-1 — Procedures and practices to avoid or mitigate incidents that could lead to downtime, damage, pollution and injuries or loss of life

5.3 Competency of the assessor

Assessments undertaken in accordance with this document shall be performed only by persons competent through education, training and experience in the relevant disciplines.

5.4 Planning

Adequate planning shall be undertaken before a site-specific assessment is started.

5.5 Personnel certification and travel logistics

It is important that certain logistical matters are arranged in a timely manner for all parties travelling to the jack-up for the rig move. These include:

- visa support for outside rig movers and other parties;

- travel arrangements for participants;
- transit to and from the jack-up arranged by the operator or jack-up owner;
- training, safety, certification and licensing to comply with the operator's requirements;
- oversight requirements (passes, cards, medical, etc.) by flag state, coastal state and operator.

5.6 Regulations

Each country can have its own set of regulations concerning offshore operations. It is the responsibility of the operator and jack-up owner to identify the applicable rules and regulations, depending upon the site and type of operations to be conducted.

5.7 Classification of unit

This document is applicable to independent leg jack-ups that are structurally sound and adequately maintained. To achieve this, the unit shall either:

- hold a valid classification society certification from an RCS throughout the duration of the installation and removal operations at the specific site subject to assessment; or
- have been verified by an independent competent body to be structurally fit for purpose and are subject to periodic inspection, both to the standards of an RCS.

5.8 Analytical tools

Guidance is given in ISO 19900:2019, Clauses 11 and A.11 on the use and validation of analytical tools and models. It should be noted that many software suites do not adequately address jack-up specific issues, such as time domain dynamics, foundations, large displacement effects and appropriate code checks.

6 Potential causes, effects and consequences of damage

6.1 General

Incidents and their consequences that can occur during the installation and removal of a jack-up shall be considered during the planning of rig move operations.

Many of the causes, effects and consequences are presented in A.6. The interrelationship is not necessarily linear and can be iterative, see Figure 6-1.

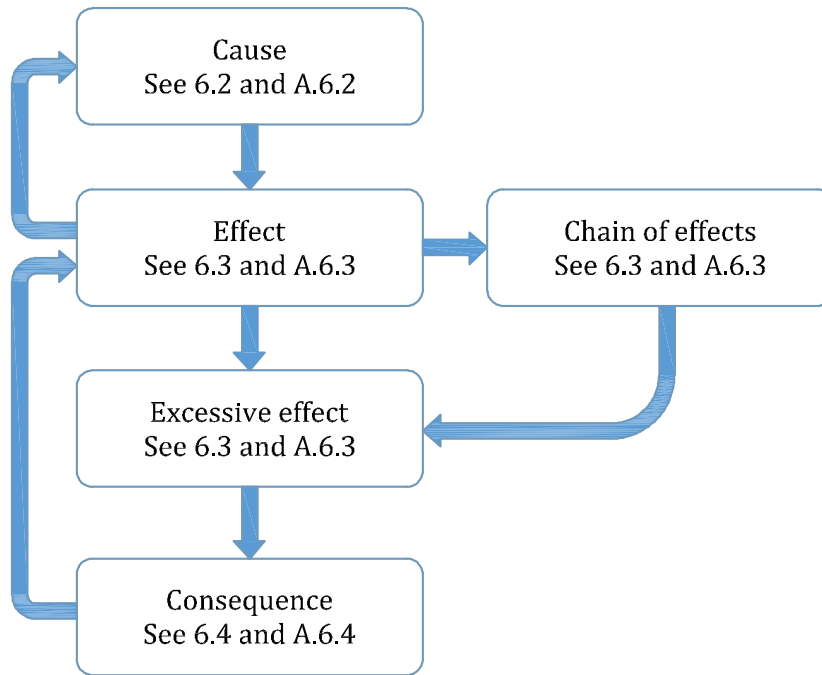


Figure 6-1 — The interrelationship between cause, effect and consequence

6.2 Causes

This clause lists some of the causes of physical damage that can lead to excessive effects during the installation or removal of a jack-up. Such causes include the following.

- Selection and condition of equipment which could be inadequately sized, poorly equipped, poorly maintained or otherwise unsuitable towing vessels can cause damage.
- Seabed and foundation due to e.g. lack of, or inadequate, data; seabed features; existing infrastructure.
- Operational causes due to e.g. human factors; poor control of tugs, towing vessels, winches and mooring systems; excessive leg loading; incorrect preloading.
- Weather induced causes e.g. metocean conditions not, or incorrectly, observed; deterioration of weather during the operation; squalls.
- These causes are discussed in A.6.2.

6.3 Effects

This clause lists potential effects which include:

- overloading of a leg overall due to bending or leg shear; leg binding;
- high local leg loading at the spudcans; leg guides; pinions; leg bracings; leg chords and racks;
- exposure to deteriorating weather can occur as a direct result of one or more of the causes or as a result of a chain of other effects;

— collision with an adjacent platform with damage to both jack-up and adjacent structure.

Delay due to any of the above can necessitate a review of the RMP and implementation of MOC procedures to limit the consequences.

These effects are discussed in A.6.3.

6.4 Consequences

The potential consequences resulting from the causes and effects set out in 6.2 and 6.3 include:

- injury or loss of life;
- financial loss;
- pollution;
- reputational damage.

Some specific consequences that can lead to these high level consequences are given in A.6.4.

7 Operability limits

The operability limits for installation and removal shall be clearly defined. These limits (e.g. loading conditions and motions or metocean limits) will guide the decisions that are made during the actual operation. These limits can be obtained from:

- a) the operating manual, where available or
- b) a site-specific installation or removal analysis undertaken using the guidance in Clause 10.

The latter can be used in unusual situations or to potentially develop less conservative limits than those in the operating manual.

The installation and removal phases of a jack-up are driven by operational aspects such as preparation for the specific site and the skill of the rig mover. The jack-up's design, however, can include features which enhance the operability for specific situations during installation and removal.

These design features should be considered when assessing the operability limits of the jack-up and can include the following:

- spudcan type, shape and size;
- leg scantlings and framing;
- number, capacity and arrangement of jacking and holding systems e.g. capability of jacking with preload;
- guide arrangement;

- monitoring systems that are available, and the corresponding controls that can be used to adjust the operation based on the monitoring output (e.g. motions, load monitoring on the jacking pinions or RPD measurement);
- hull shape, dimensions, displacement and freeboard;
- preload capacity and speed of preloading system;
- jetting system.

8 Data, studies and preparation

8.1 Collection of data

8.1.1 General

Information shall be exchanged between the jack-up owner and operator in order to define the operating objectives, conditions, and limitations. Information should flow in both directions. The safety of operations is heavily influenced by the accuracy of the information exchanged. The information should be exchanged in a timely manner.

An outline of the recommended information, in conjunction with the party responsible for supplying it, is provided in A.8; a non-exhaustive list is given in Annex B. Figure A.8-1 shows some of the information that is required and a suggested supplier. The overall data acquisition and planning process is shown diagrammatically in **Error! Reference source not found.**

There shall be agreement between the operator and the jack-up owner as to the extent of data to be supplied by each party. The data should be reviewed by the recipient for suitability and feedback given to the supplier.

Information on the installation and removal of the jack-up shall be retained for future reference and lessons learned (see 9.1.5).

8.1.2 Site Data

Where operations are taking place within an operator's permit area, the operator shall ensure that all relevant site and stand-off location data is available to the jack-up owner. Such data includes as-built drawings of any infrastructure, the points to be accessed and any constraints (A.8.1 and B.1 for lists of data).

Bathymetry and debris survey data of the site and stand-off locations shall be available. Geophysical survey or geotechnical investigation data, or both, are required as per 6.5 in ISO 19905-1:2023 (data can be from previous surveys with updates to account for previous operations).

8.1.3 Jack-up data

The jack-up owner shall supply all relevant jack-up data to the operator. A non-exhaustive list can be found in B.1.2.

8.2 Elevated suitability

8.2.1 Review of the Site-Specific Assessment – Elevated

The results of the elevated site-specific assessment, SSA-E, shall be reviewed by those involved in the installation and removal process to ensure that limitations associated with the jack-up's elevated site assessment are considered in the preparation of the RMP.

8.2.2 Review of the requirements for the elevated operations

Issues that could limit elevated operations at the site shall be reviewed by those involved in the installation and removal process. These issues include platform clearances, spudcan-pile interaction, subsea infrastructure (e.g. pipelines), cantilever reach and hull elevation as these could limit operations at the site, see Clause 9.

8.3 Installation and removal guidance and assessment

8.3.1 General

Operability limits for installation and removal shall be established.

The operation shall be subject to risk assessment (8.4) and marine assurance (8.6).

The operational guidance shall be communicated to those preparing the RMP for inclusion within it. Special attention should be given to the anticipated difficulties at the site.

8.3.2 Preparation of operability guidance

8.3.2.1 Establishing the operability limits

Operability limits applicable to installation and removal operations shall be defined in advance (see 7.1), in preparation for decision-making. These operability limits can be obtained from the operating manual and may be supplemented by site-specific installation or removal assessment (SSA-I) as warranted for the anticipated conditions or difficulties at the site (see Clause 10, when required).

In some cases the operability limits can be refined by either further geotechnical analysis or seabed remediation, or both, see A.11.

8.3.2.2 Monitoring prevailing conditions against operability limits

Methods for obtaining reliable observations or measurements of prevailing conditions (metocean, motions, loads, etc.) should be in place during installation and removal operations to support decision-making.

8.4 Risk assessment

The operator shall conduct an SSA-I risk assessment during rig move preparations with participation by the jack-up owner.

The risk assessment and mitigation measures shall be reviewed and updated just prior to installation or removal operations. See Box 8 and 9 of Figure A.8-2 **Error! Reference source not found.** This can necessitate implementation of the MOC procedures (see 8.7).

Steps shall be taken in the risk assessment to identify, assess and mitigate hazards that can include the following:

- a) collision or contact with surface assets (e.g. host platform, or attending vessels) or sub-surface assets (e.g. pipelines, SSIVs etc.);
- b) foundation issues;
- c) mooring and positioning;
- d) unexploded ordnance (UXO) including recent updates;
- e) structural & mechanical failure;
- f) loss of watertight integrity or capsize;
- g) hydrocarbon release due to contact with host platform or infrastructure;
- h) dropped object on subsea assets;
- i) inaccuracy and inadequacy of data.

Manning levels and the potential benefits and risks of demanning should be considered.

8.5 Operational advisory

An operational advisory shall be developed based on the risk assessment, the operability, and the expected ability to monitor weather conditions on the site.

An operational advisory is an agreed set of operability limits which account for changes in operational and weather conditions and defines the mitigating activities that should be undertaken when each limit is reached.

Uncertainty in monitoring and forecasting of the environmental conditions should be considered, see A.10.5.

8.6 Marine assurance

A marine assurance process shall be established by the jack-up owner to provide a review of SSA-I analyses, guidance, and the procedures (see Clause 9).

NOTE In many cases, the marine assurance can be supplied by the MWS, if engaged.

8.7 Management of change

A management of change process and methodology shall be agreed by the jack-up owner and the operator, see A.9.7.

9 Rig move procedure development for installation and removal

9.1 General

This clause addresses the development of the rig move procedure (RMP) for the operational phases of jack-up installation and removal.

The RMP shall contain or reference the procedures and information required for the installation and removal, including the process for dealing with deviations from the plan or expected behaviours via MOC.

An outline of the planning, installation and removal process is shown diagrammatically in Figure A.8-2 **Error! Reference source not found.** An outline RMP is documented in Annex E.

A RMP shall be created by the jack-up owner for each move. The RMP shall be agreed to by the operator and the Marine Warranty Surveyor, if one is engaged. The RMP revisions shall be documented.

A bridging document shall be developed to link the jack-up owner safety procedures with the operator safety procedures.

The person(s) responsible for each phase of the installation and removal shall be defined (see A.9.6).

NOTE The roles, responsibilities and required skill sets of key personnel are outlined in A.9.6.

The persons identified in the RMP shall meet the competencies required by their employing organisations. Rig mover competence is further described in Annex C.

NOTE This standard does not address the RMP content for the move between the departing and arrival defined safety zones.

9.2 Reference documents

The RMP shall include, but is not limited to, reference the following items:

- the latest revision of the SSA-E (see 8.2);
- the latest version of the risk assessment (see 8.4);
- the basis for the operational guidance included in the RMP (see 8.3);
- the agreed MOC process referenced in the RMP (see 8.7).

9.3 Outline contents

The RMP shall, as a minimum, document the following:

- jack-up and site-specific factors;
- chain of command and communications;
- roles and responsibilities;
- MOC process;

- minimum essential personnel required for the operation;
- risk mitigation measures identified during the SSA-I risk assessment;
- arrangements for at least two independent site-specific weather forecasts;
- confirmation stage;
- execution stage;
- criteria for acceptance of the installed condition;
- requirements for information retention;
- process for signing-off the RMP.

These are discussed in 9.4 to 9.12.

9.4 Jack-up and move-specific factors

A general outline of the jack-up condition, characteristics, limitations and move-specific factors shall be developed, see A.9.4.

9.5 Chain of command and communications

9.5.1 Chain-of-command

The chain of command shall be clearly defined in the RMP, (see the flow chart in A.9.4.1 for an example).

Lines of communication shall be clearly established between the:

- operator and jack-up owner shore-based managements;
- jack-up owner representatives on board the jack-up and jack-up owner shore-based management;
- operator and jack-up owner representatives on board the jack-up;
- host platform OIM (where applicable) and the offshore operator representative ("company person") on board the jack-up.

A line of communication shall be established between the host platform OIM (where applicable) and the jack-up owner representatives on board the jack-up.

The lines of communication shall be included in the RMP.

9.5.2 Communication of operational limitations

The rig mover shall have access to all relevant data, including the operability limits described in the operating manual and other supplemental studies.

NOTE The person with overall responsibility for the jack-up is its OIM.

9.6 Roles and responsibilities

The roles and responsibilities of key personnel shall be documented in the RMP.

9.7 Management of change (MOC)

The MOC process shall be outlined in the RMP. Deviations from the RMP shall follow that defined MOC process.

NOTE Communication is an integral part of the MOC process.

9.8 Confirmation stage

The confirmation stage is the procedure for deciding whether the conditions at the site are within acceptable limits and the operation can proceed. If conditions exceed the standard limits the MOC process may be used to justify alternative acceptable limits.

A confirmation stage procedure shall be developed. It shall be used to ensure that the installation or removal proceed only when conditions have been verified as being acceptable and in accordance with the operational advisory, see 8.5. An example of the decision-making process can be found in **Error! Reference source not found.**, boxes 18 to 23 and 43 to 48. For further detail, see A.9.8.

The confirmation stage procedure shall include condition surveys of the jack-up and towing vessels.

As a minimum, the following shall be verified as part of the confirmation stage;

- prevailing metocean conditions and the forecast are within limits;
- positioning equipment and towing vessels are suitable and operational;
- jack-up and platform are prepared;
- subsea infrastructure is prepared, located and marked.

A checklist of requirements shall be developed, see example in Annex B.

9.9 Execution Stage

The RMP shall require that operations commence only when the requirements of 9.8 are met and continue only whilst conditions remain acceptable, e.g. weather, initial penetration, etc..

9.10 Acceptability of the installed condition

The installation RMP shall include a requirement for a review of the installed conditions to check that they comply with the assumptions used in the SSA-E and the RMP (see A.8.2.1 and A.8.2.2).

The checks shall include, at least: comparison of the leg penetration against the load-penetration curve throughout the installation procedure, final preload applied, the associated preload reaction and preload jacking reaction or preload pinion reaction, hull elevation above LAT, jack-up position and heading within the drilling window, loading condition, and holding system engagement.

A preload methodology change can be required to ensure acceptability of the installation and should be handled through the MOC process.

Deviations from the intended conditions shall be subject to the MOC procedure. This can necessitate an updated SSA-E, based on the as-installed condition to ensure that the jack-up is fit-for-purpose.

NOTE If, during the course of the jack-up's time on site, there are changes in the elevated condition, further review can be required.

9.11 Installation information retention

A rig move log shall be maintained throughout the installation and retained for future reference together with other rig move information (see A.9.11).

Lessons learned shall be retained by the jack-up owner and should be shared with the operator. This information can affect the removal of the jack-up, and future jack-up installation and operations at the site.

9.12 Removal information retention

A rig move log shall be maintained throughout the removal and retained for future reference together with other rig move information (see A.9.12).

Lessons learned shall be retained by the jack-up owner and should be shared with the operator. This information can affect future jack-up installation and operations at the site.

9.13 Sign-off of the RMP

The RMP shall be signed-off by those who prepared it.

Additionally, before operations commence, the RMP shall be accepted and signed-off by appropriate representatives of the operator, jack-up owner and other operational personnel after the on-site, confirmation stage meeting. See A.9.13.

10 Supplementary engineering analyses

The MOM normally provides the metocean and other operability limits for jack-up installation and removal. Supplementary analyses may be used to complement or refine the operability limits.

The following topics can be addressed in the supplementary engineering analyses with due consideration of wave, wind and current actions and site conditions. The supplementary analyses should be verified as applicable for site-specific conditions.

Installation:

- stand-off location;
- positioning at site (including spudcan impact on seabed);
- preloading;
- rapid penetration or punch-through mitigation.

Removal:

- jacking into the water;

- leg extraction;
- moving away from site.

For further guidance see A.10.

11 Supplementary seabed activities

The presence of natural or man-made seabed irregularities can be mitigated by supplementary seabed activities to modify or remediate in-situ seabed conditions to enable safe jack-up installation, operations or removal. Seabed remediation can also be used to overcome issues that are related to soil stratigraphy and properties at the site.

Where supplementary seabed activities are undertaken, they shall be captured in the RMP and related analyses.

For further guidance see A.11.

Annex A **(informative)**

Additional information and guidance

NOTE The clauses/subclauses in this annex provide additional information and guidance on clauses/subclauses in the body of this part of ISO 19905. The same numbering system and heading titles have been used for ease in identifying the subclause in the body of this part of ISO 19905 to which it relates.

A.1 Guidance on scope

No guidance is offered.

A.2 Guidance on normative references

No guidance is offered.

A.3 Guidance on terms and definitions

No guidance is offered.

A.4 Guidance on symbols

No guidance is offered.

A.5 Guidance on overall considerations

No guidance is offered.

A.6 Guidance on potential causes of damage

A.6.1 General

This clause details many of the causes, effects and consequences of incidents that can occur during the installation and removal of a jack-up.

Causes in this clause are the direct conditions that could initiate an incident and a chain of effects that in turn, when excessive, result in an undesirable consequence. Some of these consequences can in turn be the cause of another chain of effects, see Figure 6-1.

A.6.2 provides an overview of possible causes, while A.6.3 provides an overview of the possible effects of these causes. A.6.4 provides the possible resulting consequences.

The matters discussed below should be considered when planning the jack-up installation and removal at the site.

A.6.2 Causes

A.6.2.1 General

This section lists some of the causes that can lead to incidents with significant effects during the installation and removal of a jack-up together with an indication of possible consequences. More detail is provided in A.6.3. and A.6.4.

A.6.2.2 Selection and condition of equipment

A.6.2.2.1 Mechanical failures

Failure or stalling of mechanical part(s) of the jacking system or seizing of main engine(s) can lead to structural damage to the leg(s) and jacking system with potential for a forced stop of the jacking operation. This can increase the risk of exposure during transitional phases (e.g. from afloat to elevated or vice-versa) if the hull is at an unfavourable elevation. Such further damage can be directly from wave load or flooding in an increasing sea-state or a rising tide.

Loss of tow vessel power, tow line failure or failure in the mooring system can result in a jack-up with reduced capacity to hold position and at risk of collision with an adjacent structure or subsea assets.

Inadequately secured equipment on deck during rig moves is at risk of becoming loose and can damage the watertight integrity of the jack-up and jeopardise both buoyancy and stability of the jack-up with the potential risk of capsizing. Inadequately secured equipment can cause damage during a punch-through, see A.6.2.3.9.

A.6.2.2.2 Excessive wear and tear in hull to leg interface

Wear and tear of leg guides or rack teeth in excess of the specified limits can lead to:

- increased gaps in the guides;
- misalignment of pinions and rack;
- worn pinions or leg teeth;
- increased leaning of the legs leading to uneven jacking system loads or higher leg loading;
- significant leaning of the legs such that they can contact and damage adjacent hull structure (e.g. jacking frame or adjacent tanks with potential for loss of watertight integrity).

A.6.2.2.3 Inadequate towing vessels or position mooring system

In conjunction with any mooring system deployed, there should be a sufficient number of towing vessels with the power and manoeuvrability to safely position the jack-up on location and maintain that position. Towing vessels, towing gear, tow connection points or mooring systems with insufficient capacity or capability can result in loss of positional control of the jack-up with increased potential for collision with an adjacent structure or subsea assets.

A.6.2.3 Seabed and foundation

A.6.2.3.1 Lack of data and detailed site investigation

A full understanding of the seabed and sub-seabed conditions is a crucial aspect for the safe installation, operation and removal of the jack-up.

The lack of data, incomplete data or poor site investigation can reduce the ability to properly prepare for mitigating hazards that can occur during installation and removal, thereby seriously increasing the risk of damage.

The potential deficiencies include the following:

- The depth of the available borehole data is shallower than the depth of influence of the jack-up foundations.
- The available borehole data is not representative of the soil conditions at each spudcan position. Significant differences in soil profiles can occur between spudcan positions and between the spudcans and the borehole(s) due to lateral soil variability.
- Absence of, or insufficient, laboratory tests can lead to uncertainties in determining the pertinent soil parameters and understanding of the nature and behaviour of soils.
- Absence of, or poorly detailed, seabed and geophysical surveys can result in the failure to identify seabed features and obstructions that can be present at the site (e.g. previous footprints, seabed slope or sloping subsurface soil layer(s), buried channels, pipelines, cables, boulders, shallow gas, fluid expulsion features).
- If a geophysical (seismic) survey is missing or is not interpreted in correlation with the geotechnical data, existing channel infills comprising of soft soils, at or near spudcan positions cannot be identified.

A.6.2.3.2 Differences between the actual seabed soil and the seabed soil data used in the site-specific assessment

Determining the characteristic and design soil parameters is a crucial aspect in geotechnical design and involves many challenges. Due to its variable nature, the selection of representative physical and mechanical properties of soil is often associated with uncertainties and engineering subjectivity.

Lower and upper bound predictions of the initial and final penetrations based on the available soil data should be provided in the site-specific assessment (SSA-E). If the actual soil characteristics differ from those used in the SSA-E predictions, the actual load-penetration response can also be different and sometimes unexpected. The consequences can include insufficient leg length (when the penetrations are deeper), unexpected unequal leg penetrations and punch-through.

When the load-penetration response falls outside the predictions given in the SSA-E, all parties should be aware of the potential risks and a suitable decision made as to how to proceed in accordance with the MOC procedure. For MOC see 9.7 and for acceptability of the installed condition see 9.10.

A.6.2.3.3 Buried channels and channel features

Positioning spudcans on, or adjacent to, buried channels and channel features can cause eccentric loading, horizontal sliding of the spudcan or instability. This induces bending in the leg which is limited due to the structural capacities of the spudcan or leg. The magnitude of such bending is largely dependent on the spudcan geometry (conical, tipped, flat or wide). Eccentric spudcan loads and sliding induce bending moments in the leg and can lead to damage due to:

- increased friction between leg and guides during jacking;
- increased bending exceeding the structural capacity of the leg, spudcan or the leg to spudcan connection.

Interaction between jack-up spudcans and pre-existing footprints can also cause contact with adjacent infrastructure or rapid penetration from sliding into the channel.

A.6.2.3.4 Pre-existing spudcan footprints (including other seabed indentation or protrusion)

Footprints from previous jack-up visits to the site can vary from shallow undulations to deeper craters and hidden craters filled up with disturbed soils. Interaction between jack-up spudcans and pre-existing footprints can cause eccentric loading, horizontal sliding of the spudcan or instability, also see A.6.2.3.3. This induces bending in the leg which is limited due to the structural capacities of the spudcan or leg. The magnitude of such bending is largely dependent on the spudcan geometry (conical, tipped, flat or wide). Eccentric spudcan loads and sliding induce bending moments in the leg and can lead to damage due to:

- eccentric loading on the spudcan;
- horizontal sliding of the spudcan;
- increased friction between leg and guides during jacking;
- increased bending exceeding the structural capacity of one or more of the leg, the spudcan and the leg to spudcan connection.

Interaction between jack-up spudcans and pre-existing footprints can also cause contact with adjacent infrastructure or rapid penetration from sliding into a previous footprint.

A.6.2.3.5 Hazardous seafloor objects

Seabed surface hazards such as boulders, debris, wrecks, unexploded ordnance (UXO) and other objects can be present at the spudcan positions. The most common effect of interaction with these objects is damage to spudcans as the footing penetrates into the seabed. Guidance on UXO can be found in CIRIA, 2015^[11].

If contact with UXO results in an explosion, the effects can be catastrophic.

A.6.2.3.6 Irregular or sloping seabed

Irregularity or sloping of the sea floor or sub-surface soil layers can cause eccentric loading, horizontal sliding of the spudcan or instability, also see A.6.2.3.3. This induces bending in the leg which is limited due to the structural capacities of the spudcan or leg. The magnitude of such bending is largely dependent on the spudcan geometry (conical, tipped, flat or wide). Eccentric spudcan loads and sliding induce bending moments in the leg and can lead to damage due to:

- increased friction between leg and guides during jacking;
- increased bending exceeding the structural capacity of the leg, spudcan or the leg to spudcan connection;
- rapid penetration from sliding into the channel.

Interaction between jack-up spudcans and an irregular or sloping seabed can also cause contact with adjacent infrastructure.

A.6.2.3.7 Presence of pipelines and cables

Pipelines or cables on the seabed can be damaged by a contact with the spudcans of the jack-up during the approach to, installation on or departure from the site. Damage to pipelines can be catastrophic.

A.6.2.3.8 Proximity of other structures

Jack-ups are very often installed in the proximity of existing fixed platforms and subsea infrastructure. With the jack-up close to such an adjacent structure the means of keeping position are important to avoid collision with the adjacent structure.

It is essential that sufficient geometric information on the other structures is available to determine the safe clearance between jack-up and other structures at all elevations (for example at or below the seabed between spudcans and structure foundations).

In the event of a rapid penetration or punch-through close to a fixed platform there is a risk of a clash or a contact with that platform. The movement of the jack-up as a result of the rapid penetration or punch-through should be assessed to determine the potential for contact to occur.

NOTE Depending on the presence of active pipelines or production systems on adjacent structures, operators or local authorities can require a temporary shut-down of the production.

The proximity of other structures should also be considered for the removal of the jack-up. See also A.6.2.3.11.

A.6.2.3.9 Leaning instability, rapid leg penetration or punch-through

The risk of leaning instability, Hambly (1985)^[19], rapid leg penetration or punch-through should be identified in the SSA-E. Leaning instability of an independent leg jack-up can arise when the rate of increase of actions on the foundation with jack-up inclination exceeds the rate of increase of foundation capacity with depth.

Rapid leg penetration or punch-through are defined in 3.39. These can occur if the rate of bearing capacity increase is inadequate to resist the rate of loading increase, imposed by the shift of the structure's centre of gravity. The vertical bearing capacity of the settling leg can also be degraded as lateral and moment loads are applied to the spudcans as the structure tilts.

During a punch-through, the jack-up rotates about the footings of the legs that do not punch-through. In final equilibrium, the hull can be at an appreciable angle to the horizontal and evacuation can be compromised. One or more legs can suffer serious damage, and one or more jacking systems can become jammed or damaged. Loose items on deck can move.

When installing on layered soils with a strong layer over a weaker layer punch-through can occur via the following mechanism. During penetration in the strong layer the bearing capacity gradually increases,

but when the spudcan approaches the weaker layer the bearing capacity can reduce to a level significantly below the current load at that spudcan. The leg then loses support and penetrates (rapidly), resulting in a (sudden) inclination and translation of the hull. These displacements cause significant extra global overturning moment and leg shear. These result in bending and shear in all legs and increasing vertical leg reaction of the penetrating leg. These loads increase during the rapid leg penetration or punch-through until equilibrium is reached by either sufficient pickup of hull buoyancy or the penetration reaching the required bearing capacity again. If such equilibrium is not achieved before the leg loads exceed capacity, structural failure and interaction with adjacent structures can occur.

Punch-through can also result in inadequately secured equipment breaking free and causing damage and potential loss of watertight integrity, see A.6.2.2.1.

Preloading is a necessary step during installation to reduce the likelihood of a rapid leg penetration or punch-through in the elevated condition, which can have much higher consequences. Rapid leg penetration or punch-through in either the installation or elevated phases is possibly the most hazardous of all the geohazards for jack-up foundations, ref. MSL^[38].

A.6.2.3.10 Scour

The risk of scour should be identified in the SSA-E.

Scour that occurs after the seabed survey and prior to installation on site can affect the seabed profile or significantly change the thickness of the top soil layer which can affect the expected penetration and associated risks.

For shallow penetrations, local scour realised during elevated operations can induce significant eccentric loading on the spudcan or sliding of the spudcan with potential to introduce leg bending. This can lead to damage when the jack-up is lowered during removal, see e.g. A.6.2.3.6.

A.6.2.3.11 Leg extraction difficulties during removal

One or more legs can experience leg extraction difficulties due to either suction at the base of the spudcan or the weight and the resistance of the backfill on top of the spudcan, or both.

Incorrect procedures when pulling the leg free could cause severe damage, see A.6.2.4.11.

When leg extraction is unsuccessful and taking longer than the planned weather window, the jack-up can be exposed to inclement weather conditions exceeding the limits given in the [jack-up's MOM](#), the [SSA-I](#), or the [rig move procedure](#). In that case the removal operation should be stopped and the jack-up raised to a safe level to await the next suitable weather window after preloading again (when applicable). Guidance for partial or full preload for stand-off locations is provided in A.10.2 and A.10.4 can be applied to such a situation.

A.6.2.4 Operational

A.6.2.4.1 Human factors

Human error during operations can arise due to:

- competence: inadequate understanding or experience or inability to react to unusual situations;
- sharing of information: incomplete or erroneous information;

— fatigue: reduced or compromised mental awareness in judgement making.

A.6.2.4.2 Jacking errors

Operator or control system error or failure can lead to jacking system damage (broken pinion or leg tooth), out of level hull or structural damage to the leg(s).

A.6.2.4.3 Incorrect jack-up loading condition

Inadequate weight control, unrecorded changes to lightweight, human error in collecting amount or position of variable load items or human error in verification can lead to an incorrect understanding of overall weight and centre of gravity resulting in:

- stability problems and unexpected motions in adverse weather conditions;
- overloading of the jacking system resulting in malfunction of, or damage to, the jacking system;
- incorrect spudcan preloading reactions.

A.6.2.4.4 Control of towing vessels, winches and lines

Incorrect operation of attending towing or positioning vessels, anchor winches or positioning lines can lead to impact on and damage to surface and sub-surface infrastructure. Incorrect operation can be due to e.g. human error or excessive operational speed.

A.6.2.4.5 Dragging of legs

Unexpected shallower water depth or complex bathymetry (outcrops, sand waves etc.) can result in unplanned seabed contact and leg dragging. This can result in excessive leg loading and damage to seabed infrastructure.

Extremely soft seabeds and seabed depressions can result in less jack-up slowing than anticipated during operational planning.

A.6.2.4.6 Excessive leg loads at touchdown

Touchdown during installation is from the first contact of one leg with the seabed until continuous contact of all legs.

The magnitude of leg loads during this touchdown phase depends on:

- the horizontal speed of the jack-up over the seabed;
- the jack-up response to sea-state (i.e. motions of the spudcans relative to the seabed);
- the water depth;
- the type of seabed (soft or hard);
- the spudcan geometry (conical, tipped or flat bottom);
- jacking speed and timing of touchdown.

When one or more of these parameters results in leg loads exceeding design limits, damage can occur to spudcans, legs and jacking system.

A.6.2.4.7 Excessive leg load with hull in water

During installation or removal the hull remains subjected to wave action while in the water. In this condition, with one or more legs in contact with the seabed i.e. soft-pinned or penetrated, there is potential for the leg(s) to be subjected to excessive loading from hull-in-water induced motions and loads.

The magnitude of leg loads during the in-water phases of either installation or removal operations of the jack-up depends on:

- wind and current velocities;
- jack-up response to sea-state due to its hull-in-water induced motions;
- loads imposed by attending vessels and anchor or mooring lines, or both;
- water depth;
- amount of seabed leg penetration and fixity;
- time needed to elevate the hull above water level or to lift the legs free from the seabed;
- effect of leg pulling during removal as discussed in A.6.2.3.11.

When one or more of these parameters results in leg loads exceeding design limits, damage can occur in legs or jacking system.

A.6.2.4.8 Inclement weather during installation and removal

When a jack-up is exposed to inclement weather before completion of preloading during installation there is a risk of unexpected settlement or punch-through with possible severe damage to, or loss of, the jack-up.

If during removal one or more legs have been partially recovered, inclement weather can lead to a risk of additional penetration. It can then be necessary to re-preload to the previously achieved penetration depths.

A.6.2.4.9 Preloading to SSA-E levels

The jack-up should be preloaded to the level recommended by the site-specific assessment (SSA-E). Where the preload level applied differs from that used in the SSA-E, the SSA-E should be updated for the actual level of preload and the penetration achieved.

Causes of errors in preloading can include inaccuracy in leg-load measurement (due to the systems or friction in the guides) and inaccuracy in the calculated buoyancy due to errors in draught measurement.

Insufficient preload can result in penetrations shallower than desired and an unsafe foundation for elevated operations.

Excessive preload can result in penetrations deeper than desired and an unsafe foundation. There can also be increased risks associated with leg-pulling. Preloading to a level higher than the jacking system or spudcan structural limits can result in damage.

NOTE In certain areas of the world there can be advantage in taking on the maximum preload possible as long as it is within the capability of the jack-up and planned for in the SSA-E.

A.6.2.4.10 Improper preparation for the fully installed condition

Compliance with 9.10 is necessary for safe operations in the fully installed condition. In case of non-compliance possible severe damage to, or loss of, the jack-up can occur.

A.6.2.4.11 Incorrect leg pulling during removal

There are multiple causes of possible damage during pulling the legs free from the seabed.

- Leg pulling loads exceeding limits (jacking or draught) can damage jacking system and legs.
- Pulling on one or two legs only such that the hull inclines outside limitations, can cause severe damage to the legs, or collision.
- Overdraught above limitations (including upcoming tide), or excessive sea-state, can cause green water on deck which can compromise watertight integrity and jacking ability.
- Leg pulling outside of suitable weather limits can cause excessive motions resulting in leg or jacking system damage or potential collision.

There is significant potential for damage when pulling the final leg e.g. due to hull yawing, hull inclination and metocean actions being reacted by a single leg.

Damage caused by any of the above has potential to cause delay to operations increasing exposure beyond the planned weather window.

Leg retrieval from deep penetrations has potential to carry significant volume of soil, typically clay, affecting afloat stability, etc.

A.6.2.5 Weather

A.6.2.5.1 Inadequate metocean limits and monitoring

Many of the limitations applicable during installation or removal are defined in terms of maximum metocean conditions. Poor or incomplete definition of the operability limits or the failure to monitor either sufficiently or correctly, can expose the jack-up to the risk of exceeding the limitations with delays and damage resulting therefrom.

A.6.2.5.2 Deterioration of weather during the operation (unexpected and forecast)

Operations should not commence until a reliable forecast of the metocean conditions has been obtained that shows conditions are below the defined limits within the required weather window. Complex sites can require an extended weather window for installation or removal. Such sites include those with difficult positioning, risk of punch-through, challenging leg pulling and large tidal ranges. An unexpected delay or deterioration of the weather during critical phases of the operation can cause exceedance of these limitations and possible damage. This is even more the case if inclement weather occurs together with, or in the aftermath of, an incident.

A.6.2.5.3 Squalls

A sudden squall event poses potential to disrupt or delay weather sensitive operations during installation and removal, including, but not limited to, positioning, management of towing and support vessel operations, mooring lines. Such delays have potential knock-on effect that operations can extend outside of the original planned weather window, thereby increasing exposure.

A.6.3 Effects**A.6.3.1 General**

Consistent with the causes presented in A.6.2, this section discusses the effects of an incident during installation or removal and possible paths to excessive effects or to chains of effects.

A.6.3.2 Overall loading of the leg**A.6.3.2.1 Leg bending and leg shear**

Excessive overall leg bending can occur as a result of several incident type causes, including:

- spudcan impact with the seabed;
- eccentric support on one or more spudcans;
- sideways sliding of the spudcan caused by previous footprints or seabed unevenness;
- leaning of the jack-up due to excessive wear on guide surfaces;
- jacking errors or malfunctions;
- inclination during a punch-through or leg pulling;
- incorrect attempts to free a leg stuck in the seabed;
- exposure to unexpected wave, wind and current conditions exceeding limitations, e.g. when the jack-up is immobilised or the operation takes longer than expected;
- as a result of improper dragging of legs due to incorrect operation of towing vessels or position mooring.

Leg bending is transferred to the hull as a combination of shear between the guides and differential forces on the chords, depending on the type and operation of the jacking system. Excessive leg bending can lead to damage or failure initiated through one or more of the local damages discussed in section A.6.3.3.

A.6.3.2.2 Leg binding

Binding of the leg in the guides can occur in cases of high guide reactions due to excessive leg bending and shear. Jacking up or down can become problematic due to high levels of friction on the leg guides as result of e.g. the incidents outlined in A.6.3.2.1.

Severe leg binding can lead to the jack-up being stuck in position and exposed to wind, wave and current conditions exceeding the jack-up capabilities in that position. When the hull is in or close to the water and exposed to direct wave loading on the hull, severe local or overall damage can occur.