

Frigg Field Cessation BASIC ENGINEERING
DP1 Jacket, Main BE Report

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Document Title DP1 Jacket – Main BE Report
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Document Abstract: <p>The document gives a short description of the structure to be removed.</p> <p>Further it gives a detailed description of the work to be performed by the Contractor and the responsibilities the Contractor endorses through the contract.</p> <p>This document is to be read together with the Design Basis for removal.</p>
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TOTAL E&P NORGE AS

General Part	TCP2 Topside	TP1 Topside	DP2 Topside	QP Topside	CDP1 Topside
	TCP2 GBS	TP1 GBS	DP2 Jacket	QP Jacket	DP1 Jacket (wreck)
					Pipelines
					Debris
DP1 Jacket Main report Vol 1	Risk log	DP1 Jacket Drawings Vol 3			



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Revisions

This document, rev 01G, has been revised since the issuance of the 01B revision.

The main change is the new layout (header and footer).

Some of the “revisions” are cosmetic or orthographical alterations with no impact on the technical content.

Revisions worth noting are marked and found on the following pages/sections:

Page	Section	Revision
4	Revisions	Page added
6	3. Definitions	Two last lines deleted
8	4.1.2	Reference to figure 2 has been omitted
9	4.2 Appurtenances	Launch runner frame added to text
13	6. Cessation risk log	Entire section, including header, re-edited
14	6. 2 (old) Reporting	Subchapter deleted
14	7.1 Objects state	Heading and first sentence altered
14	7.3 Interface (topside)	Last sentence rewritten
15	8.2 (old) Verification	This subchapter has been deleted
16	8.5 (old) Removal aids	This subchapter has been deleted
16	8.6 (old) Temporary structures	This subchapter has been deleted
16	8.9 (old)Decommissioning of systems	This subchapter has been deleted
17	8. 6 Sea bed restoration	Last sentence deleted
17	8.7 Final survey of sea bottom	First and last sentences deleted
17	8.8 Disposal	First two sentences deleted and replaced by new sentence
17	8.10 Engineering	First sentence rewritten
19	9. References	Reference 7 updated to include 2004 inspections

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1 Introduction

The Frigg Field is in the termination phase. Production will stop in 2004 and after cleaning the installations will be removed as given in the Frigg Field Cessation plan.

A part of this operation is the removal and the disposal of the Jackets DP1, DP2 and QP. The document presents the activities the potential contractors have to perform in the frame of the removal operation of the DP1 structure.

Further, more specific requirements and guidelines on analyses procedure and conditions for structures are given in the basis documents for the removal activities. Also the present document defines the objectives, the requirement for performance of the work, the limitation for the work and a description of the work to be performed.

2 Objectives

The objectives are to remove the QP jacket from the site, transport it to an inshore site and finally dismantle the structure.

The removal will include the following:

- Preparation for removal
- Release from present secured condition
- Movement to a stable position for transport to shore
- Securing for transport to shore
- Transport from field to inshore
- Movement to stable position onshore
- Breaking and cutting up and disposal

The work shall be performed safely and in accordance with the relevant rules of national authorities.

During the removal period the structure shall be maintained and repaired until removal takes place such that removal can be performed in a controlled and safe manner.

The main objective is to perform the removal and disposal of the jackets with respect to the environment. The degree of reuse and recycling of the removed structure shall be optimized. It is, however, noted that the jacket structures will not be reused as such. Thus the structures may be subjected to permanent deformations during removal provided this will not lead to a functional or safety problem.

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3 Definitions

Removal operation:	includes all activities, required equipment necessary to fulfill the objectives
Contract object:	DP1 jacket, appurtenances with all attachments including risers, J-tubes, caissons, boat landing, piles and pile cluster, anodes, etc and the relevant operative systems including navigation aids, safety equipment, etc
Authority:	NEPD in Norway and Department of Energy in UK
Company:	TOTAL E&P Norge AS and the Partners
Contractor:	The corporation that is responsible for the execution of the contract and all the Subcontractors and vendors involved by the corporation in the execution of the contract.
Third Part Verification:	Independent institution responsible for the verification of Contractor method and calculation

4 Jacket Description

The DP1 platform which was launched in 1974, is located 800 m east southeast from TCP2.

The main vertical rows are denoted as 1, 2, 3 and 4 where 2 and 3 are the launch frames; the longitudinal rows are named B and the east row A. The launch runners are located on row A. A general lay out drawing of the DP1 platform is shown in Figure 1. It is noted that the figure 1 is only indicative with regards to information given on drawing

The jacket has been damaged during the launch operation. Due to collapse of the buoyancy tank the jacket has probably hit the sea bottom with the result of large damage at the lower part of the jacket.

As a consequence of the mishap the installation of the jacket has never been completed (no pile) and the jacket has never been used.

The water depth at the location is approximately 104 m.

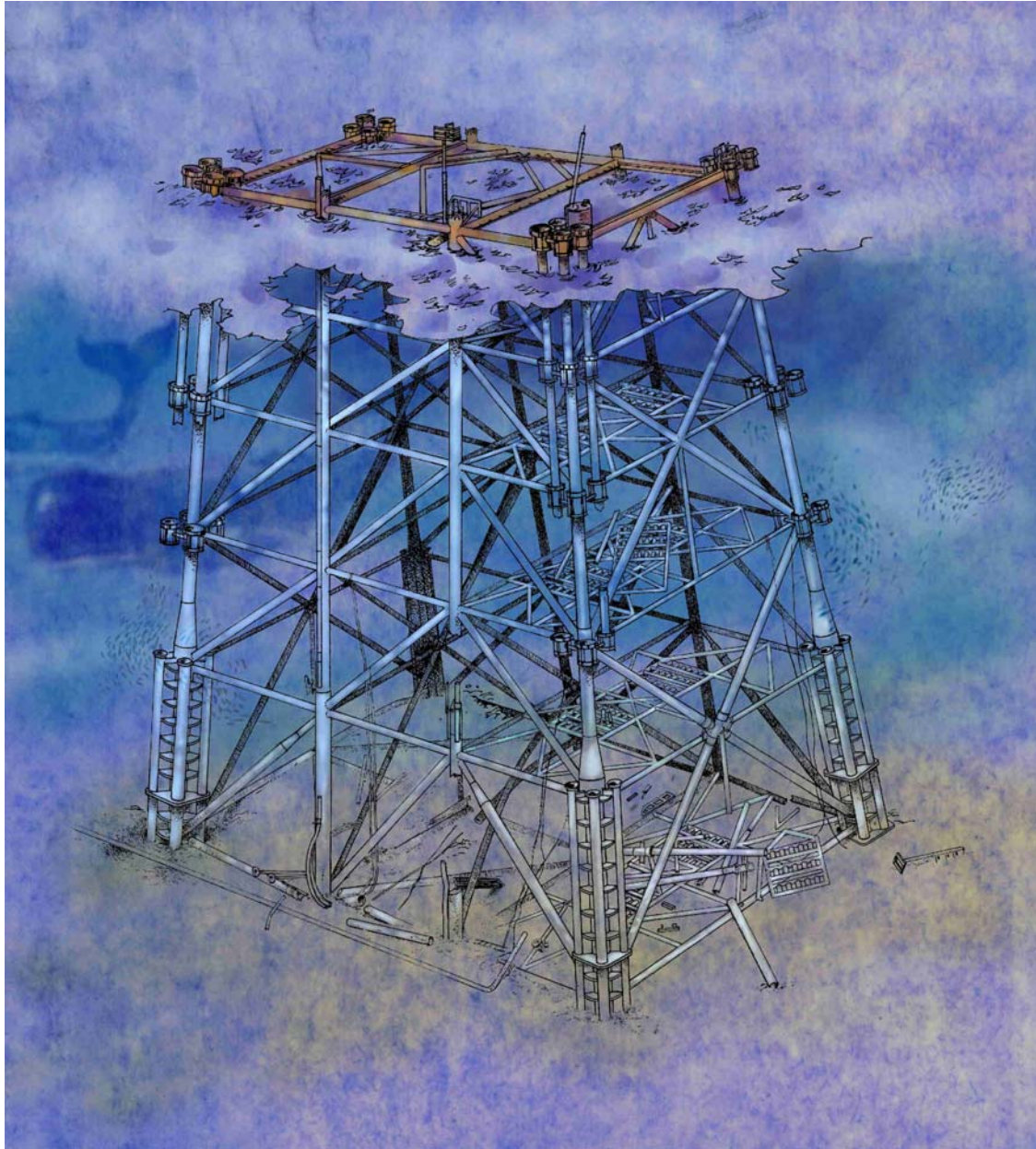
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Figure 4-1 General layout drawing of DP1 jacket

4.1 Main Data

The DP1 structure is an 8 legged jacket, launched installed. It should have been piled to the sea floor by 4 x Ø 54" piles at the each corners and 4 insert piles (Ø 48") in the mid legs of Row 2 and Row 3.

The jacket was built to support:

- 24 conductors,
- 2 production risers (Ø 26")
- One Ø 8 5/8" kill line

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- One Ø 4 ½" condensate water riser
- One Ø 8 5/8" electrical riser

The steel weight of jacket without pile is estimated to 6 480 tonnes.

4.1.1 Geometry

The dimensions of the jacket itself are given below.

Top dimensions: 48.08 m by 25.10 m

Dimensions at sea bed: 61.63 m by 43.28 mm at elevation -99.212 m

Horizontal levels are located at elevations: 6.572 m, -11.861 m, -29.291 m, -50.606 m, -71.788 m and -97.993 m.

The two launch frames are distant from each other with 18.288 m.

Layout of the horizontal levels

The conductor frames are located at the south end of the horizontal levels. The conductors are in two clusters of 12; 4 rows in south-north direction distant with 2005 mm and 3 rows in west-east direction distant with 2515 mm.

A distance of 8000 mm segregates the two clusters.

The square formed by the four mid legs is stiffened by a diamond brace system. At the corners 2 buoyancy tanks were installed for the launch operation (2 tanks with diameter 2540 mm).

All risers are located along the mid legs.

The North part of the horizontal levels is stiffened with a K bracing system.

Steel layout for the longitudinal frames

Simple diagonal braces stiffen the jacket.

The dimensions of the braces vary from 1.575 m to 1.067 m and the wall thickness from 58 to 15 mm.

The corner leg diameter varies from 3.048 m to 1.575 m while the thicknesses vary from 60 to 15.9 mm.

Note that the leg nodes are heavily stiffened.

The diameter of the launch legs is mainly 1.32 m while the thickness varies from 70 mm at the nodes to 25.4 mm. The launch legs in Row 2 and Row 3 (phase A) are fitted with launch running equipment.

Steel layout for the transversal frames

The transverse frames have an X bracing system.

The diameter of the tubular braces varies from 1.219 m to 0.914 m while the thicknesses vary from 44.5 mm to 25.4 mm for the outside frames.

At the launch frames the tubular braces have a diameter of 914 mm.

4.1.2 Foundation

No piles are installed.

The soil conditions are shortly described in Table 4-1.

A more comprehensive description of the upper layer is presented in NGL report "Top Soil Conditions at Locations DP1, DP2 and QP" (Ref 3).

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Table 4-1 Soil conditions

Depth from mudline	Soil
0 m – 7 m	Fine to medium sand, shell fragments
7 m – 17 m	Silty fine to medium sand, shell fragments silt and clay
17m – 41 m	Very stiff to hard clay
41 m – 47 m	Silty fine sand, silt pockets
47 m – 77 m	Interbedded silty sand, sand silt and clayey silt
77 m – 120,5m	Fine to medium sand

The jacket is supported by the lower frame. At the present time this frame is partly embedded into the soil. The penetration is to be determined.

4.2 Appurtenances

The jacket has been installed with several appurtenances: risers, J-tubes, caissons, instrumentations, anodes, bumpers, boat landing, walkways, ladders and stairs, guides for pile installation and buoyancy tanks and a launch runner frame. Most part of those appurtenances has been removed. The purpose of this section is to give an overall idea of the kind and the quantities of the different items. For more details and exact number the design drawings, as-build and inspection drawings have to be used.

4.2.1 Risers and J-tubes

Along the launch leg B2 the following risers are run:

- Ø 8" kill line
- Ø 26" production

Along launch leg B3 the following risers are run:

- Ø 26" production
- Ø 4" condensate
- Ø 8" electrical

4.2.2 Caissons

No caissons

4.2.3 Anodes

The jacket is protected against corrosion by sacrificial anodes. The major part of the anodes is of stand of type.

The total weight of the anodes at installation time was: 332 tonnes.

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None

4.2.5 Walkways, Stairs and Ladders

The walkways installed on the jacket have been removed or has been destroyed by the wave action.

At the present time only a small platform and access ladder for the navigation light remains.

4.2.6 Guides

At each horizontal elevation on the corner legs guides for installation of main piles are located. On the inside of the launch leg, 2 guides for the buoyancy tanks are supported. Only at-site inspection will verify if these guides are intact.

4.2.7 Instrumentation

None

4.2.8 Grout Lines and Inflation Lines

The lines for the air and the grout have been run for the pile cluster inside the leg, however for the launch leg they were located outside the leg.

Packers are located at both ends of the piles sleeves

4.2.9 Valves

In connection with the upending operation the corner legs have been flooded. Valves and diaphragms are also installed on the legs.

4.2.10 Launch Runner

The launch runners are fixed on the two central legs on the east row of the jacket (legs A2 and A3). The present condition of the wooden part of the launch runner is not known.

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4.3 Special Areas

The data given in the above sections are based on the design drawings.

The DP1 jacket has not been installed and secured as planned. After the mishap the jacket has been set down vertically on the seabed. No further action has been taken to stabilize the structure since this date. Due to the wave action the jacket has slightly moved out the vertical and some part of the lower frame has been buried into the sand at the seabed. Further some part of the structure has been damaged. The extent of those should be determinate based on a careful inspection of the structure. Note that the structure is covered with marine growth from seabed to the splash zone, this make the inspection difficult.

Based on the inspection performed in the last year the following may be reported.

1. No conductor frames at the two upper levels. The upper one as probably never been installed, the second one has fallen down to the seabed.
2. The two lower levels are heavily damaged: several members are disconnected from the structure, some other damaged.
3. Lower part of the leg B2 is collapsed and has fallen to the seabed.
4. Lower part of leg B3 as collapsed.
5. One riser has been disconnected from the structure.
6. The jacket is somewhat tilted in longitudinal direction against the side without conductor-guides.

4.4 Materials

The jacket consists mainly of steel.

Some components in the jacket are of other materials:

- Anodes: aluminum (Zn: 3.25±0.3%; Mg: 1.8±0.2%; In: 0.02±0.08%; Sn: 0.007±0.003%) or zinc for reference anodes.
- Launch runners: wood.

The specifications for steel material used in the jacket are listed in the table below

Table 4-2 Steel materials used on DP1

Designation	Steel Grade Acc. DIN 17 100	Additional requirement	Typical Application
High Strength Steel HS 10	St 52-3N	Al-killed, max 0,07 Altot max 1,60 MN max 0,35 Si Max 0,035 P & S CE max < 0,46 CV transvers: Min average 41 J Min single 34 J At -10°C	Jacket braces and piles below El. -3m
High Strength Steel HS 20	St 52-3N	As for HS 10 but CV at -20°C	Jacket braces and piles above el. -3m

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Table 4-1 contd.

Designation	Steel Grade Acc. DIN 17 100	Additional requirement	Typical Application
Special High Strength steel SHS 10	St 52-3N	max 0,03 Altot max 1,60 Mn max 0,55 Si Max 0,020 P Max 0.015 S CE max < 0,46 CV transverse: Min average 41 J Min single 34 J At -10°C	Can section and overlapped heavy wall stubs below -3m
Special High Strength steel SHS 20	St 52-3N	As for SHS 10 but CV at -20°C	Can section and overlapped heavy wall stubs above-3m
ML 0	St 37-3U		Conductor frames below -3m
ML 20	St 37-3N		Conductor frame above -3m

For the non-structural materials the steel quality is:

- For plates: DIN 17100/St 37-3U, ASTM A 285 Gr. C or ASTM A 36.
- For tubular: DIN 1629/BL.3 . St 35, API 5L Gr. B or ASTM A 53 Type E or S, grade B.

5 Limitations

The limiting boundaries of the jacket that shall be removed are:

Top of jacket:

No topside structure has been located at the top of jacket and no interface point exists

Bottom of the jacket:

No piles are installed but the jacket legs and the lower horizontal level has penetrated into the sea bed.

Connections to sea lines (Risers, J-tubes and cables):

No connections to sea lines are established for the jacket.

All relevant HSE aspects must be considered during the removal work.

A safe zone is defined as 500 m from the jacket that shall be removed.

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5.1 Information

The removal of the jacket will be regarded as finalized when:

- All objects / items are removed from the sea bottom
- All parts of the object has been disposed
- The sea bottom has been restored to its original configuration
- Any remaining structures are located at least 1 000 mm below the restored sea bottom. This shall be confirmed by a site survey taking place 3 years after the sea bottom restoring operation.

6 Cessation Risk Log

6.1 Introduction

Management of safety shall be an integral part of the cessation activity.

As part of the Safety Management, an interim Risk Log has been developed. The Risk Log documents the hazards related to removal activities. All hazards that have been identified during Basic Engineering of the Frigg Field Cessation project are listed in the risk log. The Risk Log is a database file including all the platforms on the Frigg Field.

Hazard sessions and a Risk Log Input/Update Form were used as tools to identify the hazards in a systematic manner. The Thesis software was chosen as the tool for supporting the systematic process to identify and evaluate any hazards and barriers. The Risk Log has been recorded into a Thesis database.

Further Risk Log requirements and detailed information are found in the following documents:

- Risk Log, General Introduction.
- Risk Log, Thesis data for the Frigg Field.

The interim Risk Log will be made available to the contractor. The Contractor may adopt and update this interim Risk Log.

The Contractor shall provide a Risk Log appropriate for his planned activities.

The Risk Log shall be maintained within the Thesis Software, and the Contractor will be required to obtain a licence for own use and at own cost.

6.2 Main Hazard Findings

The hazards in the interim Risk Log that have been identified in Basic Engineering for DP2 are found in the Risk Log. A large number of the identified hazards are presented as Construction Industry General Hazards, some as Frigg Cessation special hazards and some (if identified) are presented as the specific platform/jacket special removal hazards.

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(old 6.2 "Reporting" deleted)

7 Assumptions

7.1 Object's State

The DP1 platform is standing alone and do not support any topside. However, a navigation aids system will be still operating on the platform.

7.2 Provided Documentations

The contract objects structural status is described in the documents summarized in Table 7-1 below. More specific references are given in reference section.

Table 7-1 Structural status

Drawings:	Design drawings
Design Documentation:	In place analysis (Ref 2), Installation Report
Inspection reports:	Damaged member record, flooded member (Ref 7)
Inspection program	Company schedule for jacket inspection for the remaining life time
Weight Summary:	Weight estimate of the structure (Ref2) (indicative)
Soil Condition:	General mapping of the top soil condition at the location DP1, DP2 and QP to 20 m below sea bed (Ref 3)
Platforms and Lines General Layout	Give the relative position of the platforms and the location of the pipelines.
Overall Removal Activities Description	explains the total operation done at the Frigg field wherein the Removal is a part (Ref 1)

7.3 Interface

Since DP1 has not been used as a jacket, it has no interfaces towards topside or pipelines.

The only interface will also be related to the operation as such.

The work has to be coordinated with all other ongoing operations in the Frigg area.

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8 Work Description

This section presents the activities that will be part of the removal. This list is not to be considered as complete since it will be strongly dependent on the method of execution of the work.

8.1 General

The main operations in the removal contract are defined in section 2. The release of the contract object from the sea floor is considered as one of the more complicated operations of the removal.

During the operation the released object has to be stable. Also the structure must be able to sustain a given sea state without collapse after it has been disconnected from the sea floor or the rest of the jacket.

A second concern is the presence of residual stresses and restraint in the structure. Those stresses may be the origin of accident under the cutting of members if no precaution is taken. This aspect is very important in the case of DP1 due to the particular history of this structure.

The DP1 structure has not been correctly installed. The forces that have acted on the structure have not been the one expected during the design. The structural condition of the structure is therefore unknown and only careful inspection may give some indications. Some parts of the structure are damaged and are disconnected from the rest of the jacket.

Further the method used has to take into account the load-in operation. The released object could be equipped as a self-floater, on a barge or on a vessel suitable to reach a harbor.

The jacket is now resting almost vertically on the sea floor. The lower part is also embedded in the sand for a height of about 2 m. This explains partly the fact that the structure is now almost stable and has resisted the wave action. This implies that the soil has to be removed. But by doing so the stability of the jacket may be questioned, and shall be very carefully documented. Further it may be expected that the load on the members in the area around the mudline have been loaded in an unusual way, their strength should be also assessed.

The method of removal has to address specifically those aspects.

The weight of the jacket is also determining the choice of removal method. The steel weight can be determined very accurately by a careful weight take off based on the design drawing and the local inspection of the structure. In addition the weight of the appurtenances such as risers, J-tubes, caissons and airlines, vent lines and valves may be calculated in the same way. Water entrapped in the structure may be evaluated based on the inside volume of the legs and the results of a "Flooded member Inspection". The last item to be estimated is the weight of the marine growth. Estimation of it may only be done by inspection of the whole structure.

| (Old 8.2 "Verification of the correctness of the information" deleted)

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8.2 Operative Systems

All systems required for the removal work shall be defined.
The involved systems include but are not limited to:

- Navigation aids
- Power generation for the living quarter on QP
- Any shuttling system from QP to the work site

8.3 Maintenance

The removal period may be considerable. Within this period the jacket may need to be inspected.

The inspection shall ensure that the strength of the structure is compatible with the adopted removal method.

No lifetime studies (fatigue calculations) have been performed for the jacket after installation in 1976.

| (Old 8.5 "Removal Aids" deleted).

| (Old 8.6 "Temporary Structures" deleted)

8.4 Secure Loose Items

Before any operation all items susceptible to fall or cause some injury during the removal operation shall be secured or removed. This implies a critical evaluation of all items attached to the removed object. The effort applied (wind, wave action, inertia load, etc) to all items during the removal operation shall also be determinate and the consequence evaluated.

It is noted that a lot of structural debris is located around and also inside the DP1 structure. This has been verified through ROV inspections performed for the structure (Ref 7).

8.5 Transportation

The transport operation includes the seafastening of the object on the transportation vessel, the transportation itself, the cutting of the seafastening and the load-in of the object on the inshore site.

| (Old 8.9 "Decommissioning of System" deleted)

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8.6 Sea Bed Restoration

In general no steel or remains of the contract object shall be found in the 1 000 mm upper layer of the soil.

8.7 Final Survey of Sea Bottom

A final survey of the area will be performed at the location of the removed object and at the location of the operating vessel(s).

8.8 Disposal

Onshore disposal of the DP1 jacket must be performed in accordance with relevant rules and regulations.

Record of destination of all items shall be kept. This record shall be monthly communicated to Company in a format compatible to the Company own reporting system TEAMS (Ref 4).

8.9 Waste Treatment

Some of the material removed from the contract object will not be recycled. That is for example epoxy material used for tightening, grout, and rubber.

Those materials shall be properly handled according to the Company requirements. All materials and quantities shall be recorded as well as the final disposal site.

All information shall be transmitted to Company. Record of destination of all items shall be kept.

This record shall be monthly communicated to Company in a format compatible to the Company own reporting system TEAMS.

8.10 Engineering

All activities necessary for the execution of the Work will be covered by engineering and include as a minimum:

- Contractor own vessels/lift equipment
- The contract object
- Temporary structures
- Maintenance systems
- Removal aids equipment

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- Seafastening and grillage
- Operation to be performed such as: lift, load-in, set-down for all relevant objects, etc.

The engineering activities shall be done in accordance to the principle given in the “Design Basis for Jacket Removal”.

The engineering shall include all aspects:

- Instrumental / electrical for the system
- Marine
- Structural

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9 References

- 1 Frigg Field Cessation Plan, May 2003. DocsOpen no 677963.
- 2 DP1 Jacket In place analysis, DocsOpen no 682398.
- 3 Top Soil Conditions at Locations DP1, DP2 and QP; DocsOpen no 640888
- 4 TotalEnvironment Accounting and Management System, TEAMS.
- 5 Risk Log, ref. CB-00-RE-07-635923
- 6 Risk Log database, ref. CB-00-RE-07-635924
- 7 Frigg DP1 Inspection Finding Report (subsea including 2004), DocsOpen no 695264