



DYNAMIC POSITIONING CONFERENCE

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Operations and Requirements

A Practical Approach to Managing DP Operations

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BACKGROUND

Following some costly DP related incidents Shell embarked on evaluating all DP vessels to be used by them for critical operations. This was seen as a means of avoiding similar problems in the future. After performing this on some 12 DP vessels a process was established and a requirement specification developed by the authors, to encapsulate this process for use on all future projects involving DP.

INTRODUCTION

The requirement specification covers the types of equipment and minimum performance levels that Shell requires for conducting operations safely using a DP vessel.

Shell's philosophy is to manage DP operations using these requirements to gain a clear understanding of the safest mode of operation for the vessel. A pre hire verification process is initiated to gain this understanding. Upon final selection of the vessel and placement of a contract, the Contractor is to develop Field or Well Specific Operational Guidelines that will be used to execute DP operations safely. The FSOG and WSOG for the safest mode of operation being decided in collaboration with the contractor.

The overriding philosophy behind developing the process was to: -

- 1) Understand the worse case failure and significant single point failures (if any) of the DP system.
- 2) Determine the configuration for the safest mode of operation.
- 3) Undertake defined critical activities with vessel's DP system, configured for safest mode of operation.
- 4) Ensure that all key DP Personnel on the vessel are brought to the same level of understanding with regards to the FSOG/WSOG.
- 5) Have robust contingency plans in place.

This paper presents the contents of the Requirement Specification that has now been incorporated as a Shell 'DEP' (Design and Engineering Practice).

SCOPE

The types of equipment and minimum performance levels required to conduct operations safely using a dynamically positioned (DP) vessel are specified.

DP Vessels operated or chartered by Shell, need to comply with the specification, additionally project specific operational guidelines (FSOG or WSOG) are to be established for the project and implemented during the execution of the work.

The requirements are applicable to the following activities

- Offshore Construction
- Accommodation Support
- Drilling and Well Intervention

- DP Offshore Supply vessels when executing specific construction activities.

REFERENCE SPECIFICATIONS

The following documents are referenced and are to be complied with unless specifically directed otherwise.

Specification	Title
IMCA M 103	Guidelines for the Design and Operation of DP Vessels (Feb 1999) and supplement M161
IMO MSC Circular 645	Guidelines for vessels with Dynamic Positioning system
IMO MSC Circular 738	Guidelines for Dynamic Positioning system (DP) Operator Training

DP CLASS

The DP equipment class required for a particular operation is to be based on a risk analysis of the consequences of a loss of position for the specific activity being considered. In certain areas of operation the administration or coastal state may dictate the minimum class required.

TECHNICAL CAPABILITY

Contractors are to provide necessary documentation for assessment of the technical capability of the DP vessel being proposed. Documentation and evidence is also to be provided to help assess the competence of the contractor's operational management and personnel.

VERIFICATION PROCESS

The contractor needs to provide documentation listed in Tables A and B for the purpose of

- Validation of technical suitability of the vessel for the activity
- Identifying the vessel's configuration for the safest mode of operation
- Understanding the vessel's station keeping capabilities following the worst case failure
- Understanding the general level of compliance with reference documents
 - IMCA, Guidelines for the Design and Operation of DP Vessels (IMCA M 103 Feb 1999) and supplement M161 – two vessel operation
 - IMO DP Guidelines for vessels with Dynamic Positioning system MSC / Circ 645
 - Relevant class requirements
 - Any relevant mandatory standards and guidelines applicable in the particular Coastal State
 - Training and experience of key DP personnel IMO MSC/Circ.738. (Refers to IMCA 117 as acceptable standard).

Project specific requirements may demand a higher standard than the IMCA guidelines.

A formal submittal of the following is required as part of the Contractor's proposal. Documents requested in Table A: Documentation for detailed review is to be subjected to a detailed review. The outcome of this review along with submittals requested in Table B, Documentation for Basis for Audit, will be used to aid in carrying out audits.

DOCUMENTATION FOR DETAILED REVIEW

Table A: Documentation for Detailed Review

No.	Document	Remarks
1	Vessel's Class Notation and Copy of Certificate	
2	FMEA of DP System	See FMEA requirements later
3	FMEA Proving Trials Results	
4	Annual Trial Results	
5	Power System discrimination and selectivity study, protective device calibration/testing documentation and vessels bus tie philosophy	Power System Study is to be sufficiently detailed and provide a clear understanding of the safe mode configuration for the vessel. Closed bus tie operations may be accepted if this study shows this to be a safe mode. However operations with an open bus may still be required for critical operation.
6	DP Capability Plots	Capability plots must include condition following worst-case failure. Capability plots should include current conditions of 1.0kt, 1.5 kt and 2.0 kt
7	Results of Capability proving tests for intact condition and worst case failure	
8	Results of tests that show generators and thrusters can produce full power upon worst case failure	

9	Philosophy for carrying out critical DP operations in proximity of sub sea or surface hazards	Includes methodology for risk assessments and contingency planning (examples to be provided)
10	Service reports concerning the DP system (last three years)	
11	Details of any DP related modifications since last FMEA	
12	Details of any acoustic noise tests conducted on the vessel	For Determination of suitability of the Acoustic Position Reference System
13	Audit Results (last three years) of Vessel and DP inspection	Include close out reports
14	DP Operations Manual	Vessel Specific DP Operations Manual (not manufacturer's DP manual).
15	DP Incident reports (last three years) including close out reports	Advisory, yellow alert and red alert levels
16	Details of spare capacity and interface for additional position reference sensors	
17	Details of Logging/Data Capture Capability	
18	Examples of FSOG/WSOG that vessel has used in the past	See Appendix for example

DOCUMENTATION REQUIRED AS BASIS FOR AUDIT

Table B: Documentation Required for Basis for Audit

No.	Document	Remarks
1	Vessel's Class Notation and Copy of Certificate	
2	FMEA of DP System	
3	FMEA Proving Trials Results	
4	Annual Trial Results	
5	Power System discrimination and selectivity study, protective device calibration/testing documentation and vessels bus tie philosophy	
6	DP Capability Plots	To include copies of relevant certification and record of DP hours
7	Results of Capability proving tests for intact condition and worst case failure	
8	Results of tests that show generators and thrusters can produce full power upon worst case failure	
9	Philosophy for carrying out critical DP operations in proximity of sub sea or surface hazards	Includes methodology for risk assessments and contingency planning (examples to be provided)

10	Service reports concerning the DP system (last three years)	
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FMEA / PROVING TRIALS AND ANNUAL TRIALS

FMEA/proving trials and Annual Trials submitted have to comply with the following minimum requirements

- FMEA clearly defines safest mode of operation, the worse case failure(s) and significant single point failures in the summary.
- FMEA has been updated after any major modifications and proving trials have been conducted.
- FMEA's have been reviewed and updated once every five years (even if no major modifications have been carried out). Proving trials (if necessary) or comprehensive Annual trials will be conducted following this review. This review will incorporate lessons learned within the industry and from failures and incidents on the vessel.
- FMEA Proving Trials must be adequate.
- Periodic FMEA testing will be scheduled for high-risk FMEA issues (e.g. blackout recovery).
- Annual trials are adequate and have been conducted in the past 15 months and were witnessed by an independent party.
- Action items from FMEA, proving trials, annual trials, audits and incidents have been or are in the process of being closed out. Closing out of actions items is to be well documented and auditable.

FMEA's are required to have vessel specific

- Details of governor failure modes
- Details of AVR failure modes
- Details of main switchboard control power failure modes
- Details of position reference system processing provided by the DP control system
- Details of DP control system consequence analysis feature
- DP control system Input/Output Schedule
- Details of Networks
- Satellite based position references one line diagram
- Hydro-acoustic position references one line diagram
- Other position reference systems (e.g. Taut Wire, Laser based etc) one line diagram(s)
- Details of communications and alert systems provided for the DP operator and their redundancy (systems and power supply)

It is recognized that some FMEA's may not contain all the above information. In such cases the requested information must be supplied as separate documents in sufficient detail with clear identification of the content.

OPEN AND CLOSED BUS TIE OPERATIONS

The vessel may be expected to operate with an open bus tie(s). Closed bus tie operations may be considered for non-critical operations when it can be demonstrated that closed bus tie operation is capable of preventing a black out under the following fault conditions

- Any single generator or Automatic Voltage Regulator (AVR) fault
 - Any single equipment failure or fault
 - Any single diesel or diesel speed control fault
 - Any single switchboard or electrical buss fault
 - Any single shared systems fault (e.g. control power or fuel)
- and**
- Closed bus tie operation is inherently safer

DATA LOGGING, ALARMS AND SCREEN CAPTURE

Vessels are required to have an independent data logging system.

The purpose of having such a system is to aid in understanding the real causes of failures and provide faster diagnosis and recovery following a failure.

As a minimum this has to be

- ability to capture and store in electronic media key parameters of a DP system (including key power plant data) for a minimum period of 30 days
- means of analyzing data and depicting it in a usable format (graphs/reports)
- provision of hard copies in color
- capability to read logged data using off the shelf commercially available software and in Windows environment
- data logger processor connected to a UPS
- capability to print DP control system screens to a color printer and printer connected to a UPS
- provision of alarm printers for hard copy of alarms from the DP control system computers (the printing of these alarms should not require any operator intervention).

STATUS ALARM SYSTEM AND COMMUNICATIONS

The status alarm system and DP related communications is required to have

- visual and audible status alarm indication for yellow and red alarms at DP control position, ECR, the work area and the area where the work is controlled
- alarms manually initiated from the DP console.
- alarms logged on the DP alarm printers
- alarms operational in a black out
- alarms recorded on the data logging computers
- accessible redundant means of direct communications between the DP console and ECR, work area and the area where work is controlled from.
- one means of communication for the above to be hands free and still be operational in a black out

DOCUMENTATION

Documentation submitted per Tables A and B is reviewed with a view to gain an understanding of: -

- Effective incident reporting, investigation and closeout.
- Adequacy of DP related drills conducted on the vessel
- Accuracy of vessel's capability plots and proving tests
- Assessment of system reliability and outstanding issues from the service reports
- Confirmation that the capability plots cover the worse case failure(s) identified
- Confirmation that the consequence analysis feature covers the worse case failure(s) identified
- Suitability of position reference system processing
- Suitability of data logging and screen printing features for post incident investigation
- Suitability of communication and alert systems
- Adequate manning of DP operation
- DP operator shift pattern and DP/ECR manning

OPERATIONAL GUIDELINES

A FSOG/WSOG has to be developed for the intended operations. This document is considered as a key document and an important tool to effectively manage DP operations. This encompasses pertinent findings of

- Review of the documents
- Results of Proving/Field Specific Trials
- Risk Analyses
- Specific Nature of Intended Operations

Vessel's operational personnel are to be engaged in risk identification and assessment practices. Operational personnel assigned to a given vessel are to have a key role in the development of the FSOG/WSOG and 'own' the document. This document is to be signed by the OIM and provided to Shell for acceptance.

The FSOG/WSOG can be modified in the field with the explicit concurrence of the on board representative and the vessel's OIM (MASTER).

Nothing in FSOG/WSOG should relieve the operational personnel of the vessel of their responsibility to take the necessary actions in order to bring the vessel to a safe position either at

- the threat of an imminent DP incident
- or onset of an unplanned/unforeseen DP incident

ADDITIONAL EQUIPMENT

Additional equipment and features may be decided upon as required for the particular activity. This will involve a consultation process between Shell and the contractor. The following are examples of additional equipment or features that may be considered

- Force feed forward feature
- Heavy lift mode
- Relative positioning modes
- Position reference sensors

PRE FIELD ARRIVAL REQUIREMENTS

The pre field arrival process is designed to ensure that all DP related equipment is set up correctly, fully operational and fit for purpose. Special attention will be given to the performance of certain systems for the given location and the particular operation to be conducted.

Prior to the vessel arriving at the field the agreed FSOG or WSOG are discussed in detail on board the vessel with all key DP personnel prior to the arrival at the field.

Pre field arrival trials need to include

- Vessel's own standard field arrival tests
- Correct functioning of all manual thruster and propulsion controls
- Repeat of capability test for worse case failure condition
- Additional tests required as a result of the review of the FMEA(s)
- Generator and thruster maximums and step load transfer on worse case failure
- Operation and test while in the safest mode of operation - in particular relating to the power management system and load sharing functionality
- Functioning of additional equipment, special features or special modes of operation
- Key Drills (Vessel Specific e.g. Black out drills)

REPORTING

Reporting is mainly to be dictated by the FSOG/WSOG however

- Records are to be maintained for both field arrival and watch keeping checklists.
- Daily report submitted has to include a section on DP equipment status, planned maintenance and any DP related incidents.

SIMULATOR TRAINING

At Shell discretion and cost, the Contractor may be required to carry out Project Specific Simulator Training. This training will be conducted at a suitable training facility and, as far as practicable, be carried out on equipment similar to that on the vessel. The training has to include theoretical instruction and practical simulation. The intent of the training is to communicate:

- Overview of the Project.
- Criticality of the specific operation(s) to be carried out.
- DP and Contingency Planning required.
- Worst case failure and significant single point failures of the DP system.
- Configuration for the safest mode of operation.
- Development and practical use of Well or Field Specific Operational Guidelines.

The course content developed for the training has to be submitted.

The following personnel need to attend the training

- Master(s)
- Chief Mate(s)
- DPO(s)
- Chief Electricians