UKOOA FPSO COMMITTEE

Tandem Loading Guidelines

Volume 1

FPSO / Tanker Risk Control During Offtake

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1 INTRODUCTION

These UKOOA guidelines were prepared to compile and learn from joint operator and cross industry experience of FPSO tandem offtake operations. This involved reviewing current UK practices, the implications of UK legislation, existing industry guidance and International initiatives. It was undertaken with the active participation of operators, duty holders, the HSE, a tanker operator and marine consultants. The use of shuttle tankers to export crude oil from the field provides an extremely valuable service and assists the exploitation of marginal or remote reserves. All parties agreed that the tandem offtake incident rate, based on published accident statistics (Ref 1), warranted reduction by improved practices, and that close proximity offtake tanker operations pose a potential major accident hazard to the offshore installation. The guidelines are intended to help reduce the incident rate and the inherent risks of a major accident to be as low as reasonably practicable (ALARP) in accordance with UK goal setting legislation.

These guidelines have considered recent draft legislation and believe that offtake tanker operators will shift towards increased use of IMO Equipment Class 2 DP tankers as a result of this legislation. However, UKOOA has also noted from the current work that: -

- Class 2 as well as Class 1 DP tankers have been involved in recent collisions and near misses.
- Non DP tankers also have a role to play in certain UK waters and their current safety record is not inferior to DP tankers, whether they be Class 1 or Class 2.
- The rapid introduction of hardware upgrades has in the past, often led to an initial increase in station keeping incidents before the long-term gain is realised.

These guidelines conclude that operators and duty holders should concentrate on the following principal factors to reduce the risks associated with tandem offtake operations: -

- Undertaking an effective conceptual risk assessment of offtake alternatives as part of the concept selection process for all future UK field developments to ensure concept risks are ALARP.
- Ensuring that the installed hardware and software, as far as reasonably practicable, reduces the ability of a single point failure to cause a significant loss of station, or a significant loss of containment whilst the tanker is in close proximity.
- Ensuring that failure mode effects are tested and understood by the crews, as well as being theoretically analysed. This should apply to modifications as well as the original system.
- Providing appropriate guidance on the equipment failure, operational, metocean and station keeping limits, beyond which the station-keeping mode should be changed or connection abandoned.
- Providing sufficient key personnel of appropriate competence on both the FPSO and the offtake tanker.
- Ensuring the management culture is such that the FPSO's OIM and marine supervisors plus the tanker master and senior DPO's are all confident that any decision to disconnect on the grounds of safety or environmental risk is fully supported by onshore management.

- Encouraging the effective sharing of information on the causes of incidents or potential incidents between operators and tanker managers to speed up learning and reduce the risk of repeat events.

These guidelines deal mainly with the above areas, but only in so far as they affect the risks when the two vessels are operating in close proximity to each other during offtake. Where possible UKOOA have tried to adopt or reinforce appropriate International or Industry guidance rather than develop a new conflicting set of standards.

Generic performance standards are given in these guidelines for offtake critical elements (OCE). OCEs are defined as elements on the FPSO and offtake tanker with a potential impact on safety, pollution or production during preparatory or connected offtake activities. Some of these elements may also be safety critical elements (SCE), but only if they form part of the FPSO fixed installation, and are found to be SCEs by a field specific evaluation process. The performance standards for OCEs largely adopt existing IMO, IMCA and OCIMF guidelines.

The guidance standards set for human competency are based on the application of existing IMO and IMCA standards to typical UK sector offtake operating patterns.

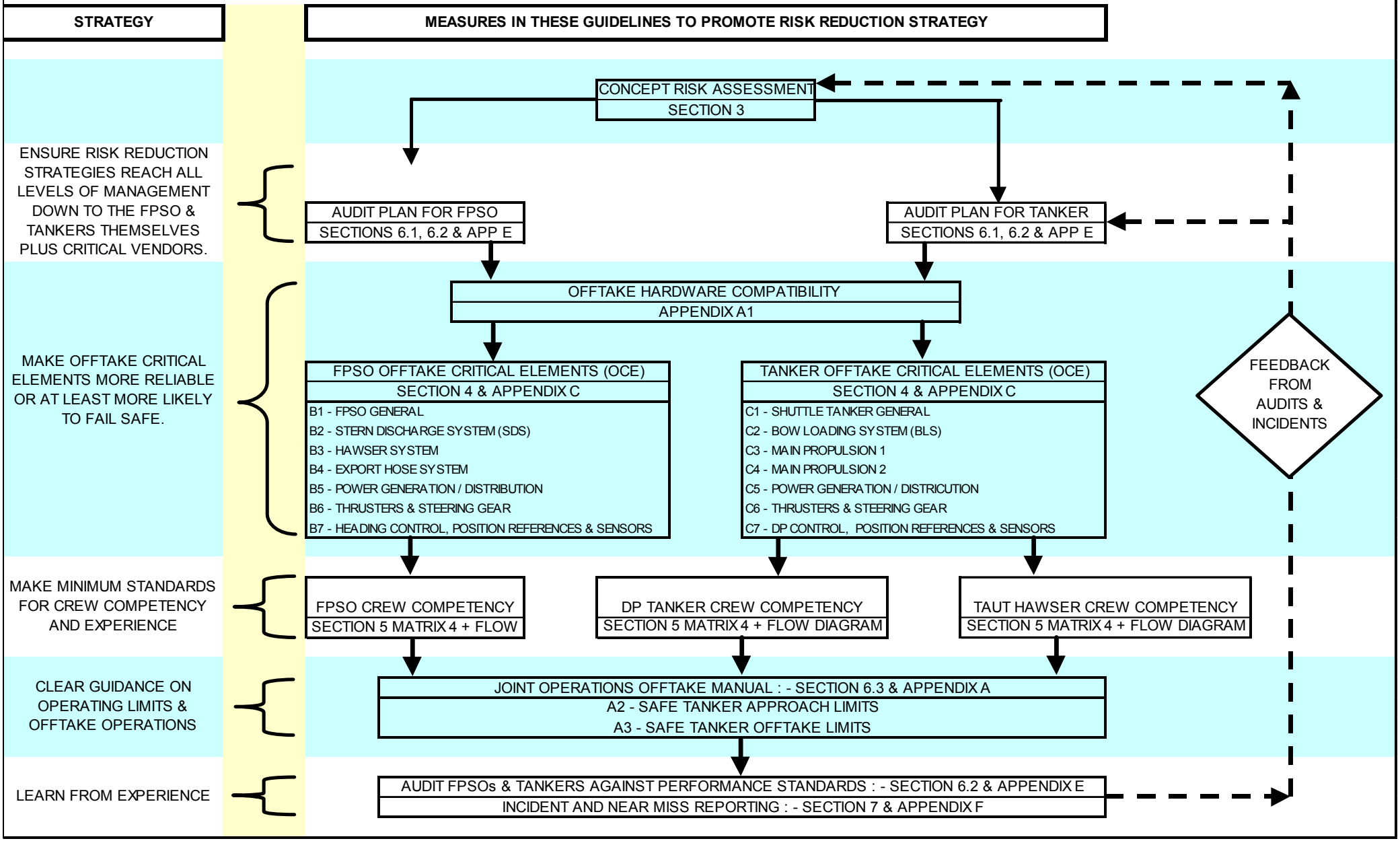
The incident reporting system is based on the adoption of existing IMCA forms.

Under UK goal setting legislation the generic guidance and standards set in this document can be varied or replaced with standards more appropriate to a specific field by any Operator or Duty Holder provided they undertake field specific risk assessments to justify ALARP within their safety case. These Guidelines are intended to focus effort on critical areas and identify typical norms to help manage UK tandem offtake operations in an acceptable manner. They are not intended as a substitute for performing field specific risk assessments, setting field specific standards, or managing on board tanker operations in a safe manner.

The overall UKOOA scheme to manage tandem offtake risks is summarised in Figure 1.1.

Any abbreviations or acronyms used in these guidelines are defined in the nomenclature section.

Figure 1.1 UKOOA TANDEM OFFTAKE RISK REDUCTION STRATEGY



2 UK LEGISLATION & UKOOA RISK REDUCTION STRATEGY

The key piece of Safety Legislation governing the operation of UK sector offshore oil installations is the Health & Safety at Work Act (HSWA) 1974. This act is extended via "The Application Outside Great Britain Order (AOGBO) 1995 Article [4.1b] to cover any activity in **connection** with an offshore installation, or any activity which is immediately **preparatory** thereto, whether carried out from the installation itself, on or from a 3rd party vessel or in any other manner, other than: -

i transporting, towing or navigating the installation.

ii any activity on or from a vessel being used as a standby vessel.

All preparatory or connected activities for tandem offtake are governed by HSWA whether they be on the FPSO / FSU itself, on the tanker or on any attendant towing vessel, unless that towing vessel is primarily the field standby vessel. AOGBO applies HSWA to a connected activity irrespective of whether it is also a normal shipboard activity on a third party vessel.

HSWA Section 2 requires the provision and maintenance of plant and systems of work that are safe. It also requires the provision of information, instruction, training and supervision for those involved.

The HSWA enables further targeted Regulations. Application of these regulations on the FPSO / FSU or any other fixed offshore installation is integrated into each duty holder's Safety Management System and is not repeated in this Guideline. Some of these targeted Regulations, however, also apply to preparatory and connected activities on other vessels and hence affect other parties involved in Tandem Offtake from UK Installations.

Two of the principal targeted regulations, enabled under the HSWA, that bear on the major risks associated with tandem offtake operations in the UK sector are the Safety Case Regulations (SCR) and the Offshore Installations (Management and Administration) Regulations (MAR)

The Safety Case regulations are at the heart of the UK sector's goal setting legislation with responsibility placed on the duty holder to demonstrate that all major hazards have been evaluated, risks reduced to as low as reasonably practicable (ALARP) by means of Safety Case demonstration and written schemes of verification. SCR Regulation [8] requires the installation's design and operating safety cases to contain enough information to demonstrate that: -

a) The duty holder's Safety Management System is adequate to ensure that the installation, work activities and preparatory / connected activities will be in accordance with statutory requirements.

b) Duty holder has made adequate arrangements for systematic ICP audit and ICP audit reporting.

c) All potential major accident hazards have been identified and:

d) Risks have been evaluated and steps taken to reduce risks to ALARP.

MAR Regulation [8] places a duty of co-operation on everyone who can contribute to health and safety on an installation or activities connected with an installation. This includes everyone doing business in connection with the installation: - owners, operators, concession holders, 3rd party employers, managers, employees and people in charge of visiting vessels and aircraft. Masters of

other vessels or aircraft only have the duty to co-operate where it does not conflict with their own statutory duties (MAR [4]).

Taken together SCR [8] requires the duty holder to identify all potential major accident hazards to the installation, evaluate the risks, and demonstrate that the risks have been reduced to ALARP. MAR [8] requires everyone else including vessel managers and crew performing preparatory and connected activities to co-operate with the duty holder in discharging his responsibilities.

The size, weight and close proximity of offtake tankers, makes tandem offtake operations a potential source of major accident hazards requiring ALARP demonstration and risk management. The historical frequency of minor collisions and potential incidents, published by IMCA, HSE and others, suggests that not all operations have reached ALARP standards. Further efforts are required and these will require the co-operation of all involved parties including duty holders and tanker managers. The following hierarchy of risk reducing techniques can be applied throughout the entire field life of any offshore project.

2.1 Concept and Design Phase

	Risk Reduction Technique	**UKOOA Proposal**
1)	Eliminate the hazard by selecting an inherently safe export concept if such a concept exists. If this is not practicable then minimise the hazard by selecting the most appropriate ALARP concept from all possible alternatives during concept selection.	It is recommended that concession holders on all future UK developments should risk assess alternative offtake methods and make an ALARP concept selection as described in section 3.
2)	If it is not practicable to select an inherently safe concept, then continue to reduce the residual risk during the design phase by ongoing risk assessment, adding safeguards and introducing risk control measures until the risks are ALARP.	Duty holders on both new and future installations should ensure that appropriate safeguards and risk reduction strategies are both selected and implemented. UKOOA has chosen to use Performance Standards as a means of identifying guidance criteria for controlling risks on current tandem offtake systems. This is described in sections 4 and 6.

2.2 Operating Phase

	Risk Reduction Technique	**UKOOA Proposal**
3)	Ensure that personnel are adequately trained and have adequate experience levels.	A method for UKOOA members to specify and audit both training and experience levels is proposed in section 5 and App. D.
4)	Ensure that equipment remains fit for purpose and risk reduction safeguards remain adequate.	The Performance Standards in Appendices A, B and C include ongoing assurance as well as initial verification.
5)	Ensure that personnel are adequately briefed on operational limits, procedures and that there is adequate feedback.	The Performance Standards in App. A, B and C include guidance on limits and procedures. Sect. 7 proposes the sharing of incident data.

3 OFFTAKE CONCEPT RISK EVALUATION

The use of shuttle tankers to export crude oil from the field provides an extremely valuable service and assists the exploitation of marginal or remote reserves. However it is important to reduce the inherent risks of tanker export at all stages of a development project. The maximum risk reduction impact can often be achieved for least expense by designing out hazards at the concept design or concept selection stage of a project. Concession holder's and duty holders have often applied only limited resource in a very limited time-scale to this stage of a project. This can, and in some cases has, led to offtake risks being unexpectedly higher than envisaged, resulting in accidents and high financial consequences.

It is recommended that concession holders and duty holders perform an effective risk assessment of all practicable offtake options as part of their concept selection process for all future field developments. Concept selection should be based on the demonstration of ALARP risks for the development as a whole. Particular care should be applied at this stage before selecting untried offtake solutions or applying existing solutions in a new area having different metocean parameters to those experienced before.

Duty holders should consider all of the offtake options that may be practicable for the development and take life of field costs and risks into account in making the ALARP selection. The risks evaluated should include: -

- The hazards to each vessel arising from incidents occurring on the other vessel or due to close proximity operation.
- Environmental / pollution risks as well as safety.
- Risks to life of field production uptime.

Even where the installation is likely to be a FPSO or FSU, consideration should be given to pipeline export, remote loading buoys, submerged loading systems, as well as stern offtake.

The offtake concept risk assessment should consider the following factors: -

3.1 Tandem loading versus pipeline or remote surface / submerged buoy

Exporting oil back through the turret and out to a remote loading system or existing pipeline obviously removes the need to have a tanker in immediate proximity to the manned FPSO. This reduces the risk of low energy tanker collisions and may also reduce the major accident hazard potential of a high-energy tanker collision. However other factors need to be taken into account in the ALARP assessment such as: -

- Ullage availability, tariff structure, age and condition of any existing pipeline; plus the life cycle cost and risks associated with installing an export swivel, riser, pipeline spur, tapping into any existing pipeline and decommissioning at the end of field life.
- Tanker black out collision risks. When a tanker performs a tandem offtake operation it is located close to and down weather from the manned FPSO. Thus the inherent risk of a high consequence collision following tanker loss of propulsion, during off-take, may be lower than if the tanker has

to offload from a remote loading point in the immediate vicinity which will on occasions be upwind of the manned FPSO.

- The life cycle costs and risks associated with installing, inspecting, maintaining and decommissioning an export swivel, riser, seabed line and remote loading system. Note that the environmental risks of a remote system may be higher than from an FPSO even if the personnel consequences may be lower.

- The lost satellite development potential if swivel paths and riser space are used for oil export.

3.2 Passive weather-vaning versus active heading control on the FPSO / FSU

There are a series of passive weather-vaning, FPSOs in the central North Sea which currently have a good offtake safety record and have the merit of being simple with very little opportunity for FPSO equipment failure or operator error to cause a sudden loss of heading during offtake. FPSO heading misalignment problems can normally be controlled by the offtake tanker applying hawser tension in manual control should this become necessary. There is relatively little loss in the useable weather window by using taut hawser in the central North Sea.

Experience suggests, however, that the use of passive weather-vaning FPSOs may be less attractive in other parts of the UK sector where the wind, wave or current climate is significantly more severe. (E.g. the Atlantic frontier, or areas with very high currents). Offtake tankers by nature of their size, shape and thruster configuration have very limited ability to move sideways to follow the stern movements of a passive weather-vaning FPSO without getting seriously out of alignment, in these more stringent metocean conditions. It becomes more attractive to use active heading control on the FPSO to help damp out fishtailing and permit the offtake tanker to adopt an optimum heading to the prevailing conditions. Active heading control also has side benefits in providing the ability to limit roll motions in certain sea conditions. Whenever active heading control is selected it is important that the system is designed with sufficient redundancy and fail safe features to prevent single point failures causing major change in heading. This involves installing thrusters having sufficient power and performance to cope with the expected metocean conditions as well as just providing redundancy. Active heading control does however come with a step increase in complexity, potential failure modes, redundancy requirements and operator training, so would need careful evaluation before implementing, at the concept stage or on existing vessels.

3.3 DP Offtake Tanker operation versus Taut Hawser operation

There is a long history of successful taut hawser tandem offtake operations in the central North Sea and indeed world-wide. Taut hawser has the merits of having few potential failure modes and relatively uncomplicated operator options should something unexpected occur, once the hawser has been attached and the propeller locked slow astern. There is relatively little loss in useable weather window by using taut hawser in the central North Sea. The loss in useable weather window increases in parts of the UK sector having more severe wind, wave or current conditions and the use of taut hawser mode becomes less attractive. DP tankers can connect and remain connected in slightly higher sea-states. In extremely harsh operating areas (e.g. Atlantic Frontier) the tanker must be equipped with thrusters having sufficient power and performance to cope with the expected metocean conditions as well as having adequate equipment redundancy. IMO equipment class 2 becomes more important as falling back on the hawser, as a back up to DP equipment failure becomes less practicable in harsh sea areas.

3.4 FPSO Pumping Rate and Hose Size

The standard offtake tanker bow connector and piping systems are sized to accommodate loading rates of 8000 m^3/hr. Many existing FPSO offtake systems and low budget remote offloading systems are constrained to much lower transfer rates because the installation's pumps, transfer hose or pipeline have been sized to minimise CAPEX. The exposure to hose damage or collision risk is lower, the quicker the tanker can offtake a cargo. For Contract of Affreightment (CoA) users there is also an OPEX saving over the field life if offtakes are quicker. Consideration should be given to the offtake rate at the concept selection stage.

3.5 FPSO Layout, Subdivision and Damage Stability Criteria

Consideration of FPSO layout at the concept selection stage can eliminate or reduce some of the most significant major accident potentials by design.

- Placing the flare tower, gas compression, turbines, exhausts or other process plant at the very stern of the FPSO increases the risk of a minor offtake tanker collision escalating to a major accident scenario. The inherent major accident potential of tandem loading is greatly reduced if the likely stern collision zone is kept clear of process equipment. The probability of being able to easily remove injured personnel from the FPSO after a collision is greater if the helideck can be kept clear of the likely collision zone.

- Designing the FPSO to Marpol damage stability criteria, or otherwise designing it to survive raking damage over a significant length at the stern, dramatically reduces the inherent major accident potential from an offtake tanker contact when compared to the minimum damage stability standards which may be applied.

- Designing the FPSO to have double sides in way of the aft fuel bunker tanks reduces the inherent pollution potential of a tandem loading collision, when compared to normal pre-2000 tanker construction practices.

- Specifying offtake tankers to have double hull reduces the inherent pollution potential of tandem loading collision. If single hull tankers have to be accommodated then requiring them to avoid or at least delay loading oil into forward wing tanks also reduces the pollution potential of a tandem loading collision.

- The concept FPSO design should consider the positioning of telemetry and position reference antennae at the concept / contractual specification stage. The consequences of gyro error can be drastically reduced if position reference antennae can be fitted at the optimum heights and as near as possible to the stern offtake point. This is to ensure adequate communication line of sight to the tanker's operating sectors and sufficient panoramic field of view to pick up satellites.

3.6 FPSO Storage Capacity versus Offtake Parcel Size

Consideration should be given to the storage volume requirements at the concept design stage. The useable on-board storage volume should ideally be sufficient to cover the desired export parcel size plus a buffer margin to allow for weather down time or tanker arrival windows. If this ideal storage can not be achieved at the concept design stage, then other means will have to be found later to manage the increased risk potentials. E.g. from taking the tanker in twice for each parcel or from

personnel having subconscious pressure to hook up and discharge in excessive weather conditions. A holistic systems approach should be adopted to match FPSO storage volume, parcel size, weather down time and contractual limits to ensure that offshore personnel are not put under sub-conscious pressure to repeatedly accept tankers in unsuitable conditions for offtake.

If the development has less inherently safe design features then it is placing a greater stake on tanker and FPSO station keeping control and extra safeguards may be necessary to demonstrate ALARP.

4 PERFORMANCE STANDARDS

4.1 How to Use The Performance Standards

These guidelines use performance standards to supply guidance on how duty holders can verify that their tandem systems fulfil their intended duty. These performance standards are intended to focus effort on critical areas and identify typical norms to help manage UK tandem offtake operations in an acceptable manner. They are not intended as a substitute for performing field specific risk assessments, setting field specific standards, or managing on board operations in a safe manner.

Tandem offtake operations are by definition joint operations involving not only the installation duty holder but also the offtake tanker management company. These guidelines use the term Offtake Critical Elements (OCE) to identify major elements of the joint operation, upon which the close proximity phase of the operation depends, to avoid adverse impacts on safety, pollution or production loss. The OCEs fall naturally into three main groupings

- OCEs which are entirely under the duty holder's control on the FPSO or FSU, but which should be controlled in such a manner that they can-not jeopardise the offtake tanker's safety, cause a joint pollution incident, or jeopardise production.

- OCEs on board the offtake tanker which should be controlled by the tanker management company to satisfy not only maritime legislation and their own standards but also in a manner to assure the duty holder that the operation is satisfactory in terms of safety, pollution risk and potential production impact.

- OCEs which are common to both the FPSO / FSU and the offtake tanker and there is a joint responsibility for compatibility.

These guidelines use OCE performance standards to supply guidelines on how duty holders can verify or be assured that their tandem systems fulfil their intended duty in a safe and acceptable manner. These guidelines do not require tanker managers to prepare performance standards for each OCE element or sub-element on a tanker before it is permitted to visit an UK field. If the performance standards are read correctly it will be seen that the main tools for providing assurance are based on maritime industry standards and offshore industry practice such as: -

- FMEA analysis, FMEA proving trials and ongoing periodic trials to demonstrate adherence to IMO DP Classification or Performance Standard Criteria.

- Normal design analysis, backed up by commissioning tests / periodic proving tests

- Control of modifications and, where appropriate, tests

- Inspection and planned maintenance routines.

- Audits

4.2 Background to Station Keeping Assurance

The International Maritime Organisation (IMO) has issued extensive DP guidelines in the form of

- MSC 57 (27) : DP Guidelines 1990
- MSC / Circ 645 : DP Guidelines 1994

MSC Circ 645 sets good standards for equipping, checking and testing DP vessels. However UK duty holders should be aware that MSC / Circ 645 only applies to DP vessels having keels laid after 01/07/1994. Moreover Circ 645 has not universal Flag State adoption and some Flag States, which have adopted it, do not apply it to all types of DP ships even if their keels have been laid after 01/07/1994. IMCA have developed further DP guidance (M 103 & Draft M 161) for offtake tankers based on MSC 645 but the development and adoption of IMCA standards is also voluntary on a case by case basis. Similarly there is no obligation for an FPSO to be either Flagged or Classed and the application of equipment standards and assurance testing to heading control systems has in some cases been voluntary and self-certifying.

The bottom line is that there have been DP tankers performing tandem offtakes in the North Sea right up to the present day (March 2001) that have had neither a DP Class Notation nor been able to readily demonstrate that they have performed FMEA proving trials. The top quality tanker managers are already, of their own volition, starting to apply standards in line with MSC 645. Duty holders should support such responsible tanker managers by requesting similar standards from all tanker managers operating in the UK sector.

One of the prime objectives of the current guidelines is to try and bring clarity to the issue of equipment standards and verification thereof in the UK sector.

4.3 IMO Equipment Class

MSC Circ 645 [2.1] states that 1) the equipment class of a vessel required for a particular operation should be agreed between the owner of the vessel and the customer based on a risk analysis of the consequence of a loss of position. 2) Alternatively the administration or coastal state may decide the equipment class for the particular operation. For UK FPSOs, UK FSUs or tankers performing DP offtakes in UK fields and where there are no more rigorous administration or coastal state prescriptive definitions of equipment class for UK then:

- These guidelines propose that best practice is to adopt IMO MSC Circ 645 Equipment Class 2 standards, as far as reasonably practicable, for FPSOs intended for tandem offtake with active heading control, and for offtake tankers intended for DP offtake in the UK sector.

- These guidelines recognise that there are existing active heading controlled FPSOs, FSUs and also DP offtake tankers in service, which are exceptionally difficult to upgrade to fully comply with IMO Equipment class 2 requirements. UKOOA consider the bare minimum class 1 requirements are insufficient for either FPSO / FSU active heading control or tankers performing DP offtake. However under the UK goal setting regime it is possible to risk assess such vessels and upgrade many of the less difficult, but more critical systems, to reduce collision risks to ALARP levels. Some such installations and tankers already have equipment levels nearer to class 2 standards than class 1 in many safety critical areas. These Guidelines recommend that such existing units should demonstrate their adequacy by A) risk assessment, B) making

enhancements where practicable towards class 2 levels, and C) appropriate FMEA analysis with proving trials. In the case of the enhanced class 1 tankers, some residual short falls in best practice redundancy may be compensated by reverting to taut hawser operation in certain failure scenarios where this is compatible with FPSO / FSU systems. The performance standards in Appendices B & C indicate guideline acceptance levels for "enhanced class 1" systems.

- UKOOA propose that DP Class 1 tankers may still be used in manual taut hawser mode provided that they have adequate safeguards to prevent CPP drive off ahead following single point failure.

The Performance Standards governing station-keeping hardware are based on the following premises which appear to be supported by the analysis of past incidents in the IMCA Report M150 "Quantified Frequency Analysis of Shuttle Tanker Collision During Offtake Operations".

- Tanker failures which could cause erroneous but active drive off are the most critical, and hence most in need of mitigation through failsafe mechanisms or automatically implemented redundancy.

- FPSO failures which could cause erroneous FPSO heading change, or active DP drive off on the tanker are most critical, and hence most in need of mitigation through failsafe mechanisms or automatically implemented redundancy. Note that in the case of an active heading controlled FPSO, failures that lead to FPSO thruster failure and loss of heading control are included in this category. This is because, if the FPSO uses active heading control, it is unlikely to be sitting in its natural weather-vaning attitude and so is likely to make a sharp heading change on loss of active control. This rapid heading change will in turn affect the stability of the tankers positioning model.

4.4 DP Failure Mode Effect Analysis and DP Trials

These Guidelines propose that the standards of FMEA analysis and subsequent FMEA trials and periodic testing outlined in MSC Circ 645 and further detailed in IMCA M 103 are applied both to FPSO /FSU active heading control systems and also to tanker DP systems to ensure ongoing assurance. E.g.

- In the absence of a Flag State Verification and Acceptance Document; a FMEA, including a complete FMEA proving trial, should be conducted by an independent competent person ICP. The trial should cover all systems and components and ability to maintain station after a single component failure. Since the minimum UKOOA acceptance standard for DP offtake or active heading control has been enhanced to an intermediate standard between IMO class 1 and class 2 there should be an ability to maintain station for as many single failure modes as reasonably practicable. Hence the FMEA proving and other DP trials should be based on the class 2 rather than the class 1 philosophy to ensure that failure modes are identified.

- Conduct annual surveys and trials, which may be performed by the installation duty holder / tanker operator to an ICP accepted programme. The extent and level of survey and trials to be in accordance with IMCA M103 and may be embedded in the vessel maintenance programme to the satisfaction of an ICP. The annual trials may be performed and documented by ships staff.

- ICP re-survey and retest the system against the FMEA every 3rd year to the same standards as above, or after either a major (station keeping / DP system) failure or modification.

- Whenever a fault is discovered and repaired or the system modified in even a minor way, full tests of the effect of the changes should be performed and logged. This may also be performed by the installation duty holder / tanker operator but the changes and type of tests performed / results recorded for the next ICP check. A note of the tests and results should be made in the onboard FMEA trial report.

- Onboard DP / Heading control crew checks to an ICP accepted vessel specific "location" checklist before every offtake or critical DP / heading control operation.

The Performance Standards in appendices A to C use the FMEA including proving trials and the above tests and checks as the primary means of providing initial and ongoing assurance of station keeping hardware integrity.

5 CREWING LEVELS TRAINING & COMPETENCY

5.1 Introduction

Crew competency in station keeping tasks is a key factor in reducing offtake risks to ALARP levels. UKOOA recommend the use of goal setting matrices for evaluating whether tanker and active FPSO heading control crews have sufficient competence to undertake offloading operations in UK waters. The first is a training matrix; the second is an experience matrix. The standards set out in the matrices are in addition to the existing flag state competency requirements for tanker masters, deck and engineering officers and crews as required by IMO's STCW 95.

The training elements for DP shuttle tankers concentrate on issues related to dynamic positioning and offshore loading and are inclusive of training requirements for relevant auxiliary equipment and systems. The experience elements are concerned principally with tanker experience, experience at the specific type of loading facility and DP playtime to hone ship-handling skills. Training and experience gained, including DP playtime hours, should be logged in the officer's individual DP logbook.

5.2 Goal Setting Matrices

It is proposed that the tanker owner/manager should complete the blank training and experience matrices for each tanker crew and that the duty holder should complete for each FPSO crew. For each crew the responsible party should ensure that there is the best match of training and experience within each watch. UKOOA recognises that there is a natural turnover of personnel and that new personnel need to gain experience. UKOOA also recognises that, at the time of writing (2001), availability of training courses can create problems. Hence there may be periods where one individual is below the preferred level of training or experience. This can be acceptable provided the overall training and experience on that particular watch is equivalent to the overall levels in the matrix concerned.

The matrices are configured to cover all known types of offshore loading facility, so that the tanker managers only have to complete one pair of forms, rather than a different set of forms for each duty holder or field. Completed matrices should be updated whenever new crewmembers join the ship and supplied to the field duty holder before a new tanker is introduced and thereafter every 6 months whilst the tanker continues in use. Additional updates may also be requested for audit or spot check purposes. Alternatively tanker managers who have their own system for tracking and controlling experience may transfer equivalent data from their system to the duty holder for comparison to the UKOOA standards.

Crew training and experience will be assessed against three UKOOA levels or standards. The standards are denoted by 'L', 'H' and 'M'.

- 'L' represents the lowest recommended standard, below which a tanker / FPSO should not fall. If the crew in every watch do not meet this minimum standard then the responsible manager should provide additional personnel to bring the overall level of experience on each watch up to the minimum until the long-term crewmembers reach the required standard.

- In the event that a new tanker / FPSO operator enters the market or a new offtake facility is developed then there may be a point where the crew have general offshore experience, but lack in depth practical experience of critical offtake systems. Special consideration may be given to compensating for the lack of actual experience with simulated and practical ship handling and cargo handling training for the application in question. The operation should be tightly controlled by the duty holder whilst the crews build up first hand experience.

- It is the nature of most offloading operations that there is a long-term business relationship between individual tankers and a particular type of facility. High quality tanker owners and managers will continue to build up experience in the crew and to build up training levels to reduce risk, permit safe fleet expansion and development of their operations. Hence UKOOA have adopted two higher levels of training and experience. These will be used to measure the quality of a vessel manager's management system. Ongoing monitoring may be used to give early warning of potentially inadequate competency levels in the event that competency levels start falling from high to medium.

- 'H' represents the target standard. The standards set at this level were derived by applying IMCA's DP recommendations to a typical shuttle tanker and FPSO operating profile. High quality vessel operators will rapidly build up training and experience to these levels on any tanker regularly used at a particular type of loading facility. The top quality DP tanker operators already provide most crews at this experience level. However if a tanker or FPSO fleet expands then it is accepted that the safest way to crew a new unit is likely to be by allocating experienced crews to the new tonnage. This may dilute the experience and training on existing units and hence an intermediate 'M' standard has been set.

- 'M' represents an acceptable middle or transition standard which recognises that the operators still need flexibility to expand their fleet or otherwise manage organisational changes.

Tankers or FPSOs at level 'L' for the type of loading facility are acceptable on first introduction or when a "one off" alternative tanker has to be substituted due to operational or logistical problems with the normal tanker(s). Responsible managers will rapidly (within 12 to 18 months) build up to level 'H' particularly if the same tankers are used for a particular loading facility but may drop back to level 'M', on occasions, before building back up to level 'H'. The build up of experience on an FPSO is heavily dependent on production rate and parcel size. Managers who continue to operate at level 'L' or between level 'L' and 'M' even after 12 months of service are sending clear signals that: -

- They definitely have not taken on board a key lesson from the recent offtake tanker incidents.
- They could be expanding their fleet too rapidly, with inadequate regard to maintaining a quality
- They could be developing management problems that are causing quality crew to leave.

The matrices and minimum acceptable experience levels are described in the following sections. Blank matrices for FPSO and Tanker completion are included in Appendix D.

5.3 FPSO Experience Matrix 1

Matrix 1 contains the UKOOA experience standard for FPSOs. These Guidelines recognise that some operators have competence programmes set to National Vocational Qualifications, or equivalent, for marine roles and these may be used as an alternative method for demonstrating competence. The latter approach to competency is being furthered by joint industry work currently (2002) ongoing with OPITO.

OPITO are undertaking separate work in parallel with this guideline to set minimum training and competency standards for personnel serving on FPSOs. The OPITO work will address training requirements and standards. Individual duty holders should then develop competency assurance schemes to ensure that all personnel performing tandem offtake functions are qualified and remain competent to fulfil their role. The current guideline has been limited to identifying minimum experience levels to cover all offtake tasks in the event that operators do not yet have such competency assurance schemes in place.

This will include the following critical operations being performed in quick succession or in some cases in parallel within the 20 to 30 hour period: -

- The tanker has to be moored and the hose deployed.
- Regular FPSO communication must be maintained with the tanker master to ensure the tanker is still able to maintain position within safe limits and it is safe to continue cargo transfer operations. In the near future there may be a requirement to monitor tanker position or DP function displays on board the FPSO on a continuous basis.
- FPSO position references, sensors and telemetry systems have to be monitored.
- The cargo has to be completely discharged and the FPSO re-ballasted without exceeding the hull's structural shear force or bending moment limits.
- The FPSO must be cycled through her complete discharge envelope without exceeding stability or allowable centre of gravity limits at any step.
- The cargo tanks all have to be inerted to ensure the atmosphere is kept within safe non-explosive limits.
- Some tanks may have to be crude oil washed to limit wax and sediment build up.
- On FPSOs with active heading control the FPSO heading must be maintained within agreed limits and adjusted in tandem with the tanker.
- The tanker must be un-moored and all running rigging and hoses inspected for wear or damage as they are recovered.
- The crude quality must be analysed and commercial documentation prepared and sent onshore.

The management structure on many FPSOs tends to be strongly focused on manning efficiency and production plant requirements. However this focus should not undermine the crew's experience or

competency under stress, to ensure that the FPSO is unloaded and ballasted within her bending and stability limits and that the offtake only continues when the tanker is within the agreed positioning limits. It may be possible to use experienced marine personnel with suitable re-training to work with the production plant during the more relaxed loading cycle, but there should always be sufficient competent personnel available to safely cover the complete discharge cycle.

Matrix 1 is based on the premise that the OIM is production oriented and that detailed offtake functions are performed by a separate Marine Superintendent and cargo / station keeping operators. Hence the OIM is shown with a lower offtake experience standard than the specialist personnel. In this context the OIM needs enough experience to understand offtake issues to the extent necessary to discharge his responsibilities under his particular FPSO's Safety Management System as the overall responsible person onboard. For example the offtake experience proposed for an OIM may be fully omitted provided the OIM has fully delegated offtake control to a separate heading control / marine superintendent, and fully accepts that he will defer to that authority in matters that the latter deems might prejudice safe offtake. In contrast there are less production management demands on the OIM onboard a FSU, and it is more likely that the OIM is also the Marine Superintendent. In this context the OIM would be required to have the higher experience standard required in Matrix 1 for the Marine Superintendent.

On passive FPSOs there is no heading control work to be undertaken so the minimum level of competent supervisory personnel would be one marine superintendent, two cargo operators, and one deck foreman. However it is vital that these people have relevant experience for their functions. To this end the cargo operators must have Nautical Institute (Ltd) certification and endorsements as well as experience as ticketed sea-going chief officers or masters. They should have several years of direct hands on experience of cargo control during loading and discharge on either a tanker or an FPSO. This is as indicated for Marine Superintendent and Cargo Operators 1 and 2 in matrix 1. The Cargo Operator's practical marine based cargo control training and experience is important, especially during stressful periods, to reduce the discharge risks to ALARP without exceeding allowable stability or hull structural limits. The cargo operators will also require special facility specific familiarisation and training.

If the FPSO also has active heading control then it is important that the responsible personnel on the FPSO also have DP experience and an effective competency in how to control FPSO heading to minimise the tanker's close manoeuvring problems. It is also important that the manning levels are such that heading control or station keeping requirements do not interfere with the discharge control functions.

Minimum navigating officer levels on an active heading FPSO performing a tandem offtake should be set at a Heading Control Master (normally the Marine Superintendent) plus 4 Thruster Control / DP operators all experienced as per Matrix 1. At least 2 of these personnel will be in the CCR at any one time and Thruster Control / DP / positioning control changes must be repeated and verified by the 2nd person. The thruster control watch keeper must be rotated from the console every hour to minimise the risk of concentration lapses. All such officers must have Nautical Institute (Ltd) or NMD certification plus the specialist Thruster Control / DP qualifications identified in the UKOOA / OPITO study or by field specific safety assessments. The Thruster Control / DP experience will be apportioned as evenly as possible between the watches. (I.e. a senior and junior DPO on each watch). Matrix 1 addresses active heading control by introducing requirements for DP / ATC experience for relevant personnel. Two extra Cargo Operators 3 and 4 are introduced into the matrix for this type of vessel and they have higher DP / ATC levels of experience but lower tanker loading experience than the levels set for Cargo Operators 1 and 2. The marine superintendent should where possible combine both DP / ATC and ship loading experience. The intent is to get an adequate level of both

station keeping and tanker loading experience on each shift given that personnel with DP experience will not necessarily have loading experience to start with and vice versa. All DP/ATC operators should maintain a DP logbook as per IMCA M117.

The FPSO should have an electrician or instrument technician who has been trained on the position reference, telemetry and station keeping control systems including basic maintenance and fault finding.

UKOOA Matrix 1 : - Experience of personnel o/b FPSO_____

DATE___/___/_____

Please turn form sideways and print name below rank in this row.	OIM	Marine Superintendent	Cargo / DP / ATC Operator 1	Cargo / DP / ATC Operator 2	DP / ATC / Cargo Operator 3	DP / ATC / Cargo Operator 4	DECK FOREMAN	DECK CREW	INST/ ELECT TECH	HEADING CONTROL MASTER (Normally Marine Superintendent):- MONTHS SINCE OFFTAKE AT FACILITY TYPE	UKOOA Level of Experience
General Experience (Active or passive FPSO's)											
Years of experience at present rank	>3	>3	>3	>3	>3	>3	>2	>2	>3	N / A	H
	>2	>2	>2	>2	>1	>1	>1	>1	>2	N / A	M
	>1	>1	>1	>1	>0	>0	>0	>0	>1	N / A	L
Total years experience	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A
Time o/b present FPSO	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A
Total years offshore tandem loading experience	>4	>7	>2	>2	>2	>2	>5	>2	>6	N / A	H
	>1	>3	>1	>1	>1	>1	>3	>1	>4	N / A	M
	>0	>1	>0	>0	>0	>0	>1	>0	>2	N / A	L
Total combined years of tanker or FPSO stability, cargo loading & ballasting experience	N / A	>7	>7	>7	>5	>5	N / A	N / A	N / A	N / A	H
	N / A	>3	>3	>3	>2	>2	N / A	N / A	N / A	N / A	M
	N / A	>1	>2	>2	>1	>1	N / A	N / A	N / A	N / A	L
DP/Thruster control experience (Active FPSO's only)											
Enter the number of 'Hands on' FPSO DP/ATC offloading operations you have completed on any FSU / FPSO if any (See Note 6).	12	50	21	21	21	21	N / A	N / A	N / A	See Flow Diagram	H
	4	20	8	8	12	12	N / A	N / A	N / A		M
	0	6	2	2	6	6	N / A	N / A	N / A		L
If no previous FPSO / FSU active heading control experience, how many years experience have you as a hands on DPO on any vessel with DP or ATC (See Note 6).	0	17	7	7	7	7	N / A	N / A	N / A	See Flow Diagram	H
	0	7	3	3	4	4	N / A	N / A	N / A		M
	0	2	1	1	2	2	N / A	N / A	N / A		L
Number of 'Hands on' FPSO DP/ATC offloading operations you have completed on this FSU / FPSO	12	25	15	15	15	15	N / A	N / A	N / A	See Flow Diagram	H
	4	12	8	8	8	8	N / A	N / A	N / A		M
	0	0	0	0	0	0	N / A	N / A	N / A		L
Confirm that DP operators have sufficient experience as per the IMCA guidelines or for vessels with ATC that marine control room operators have training in the use of ATC and guidance on the modus operandi	Y	Y	Y	Y	Y	Y	N / A	N / A	N / A	N / A	H,M&L
Shuttle tanker handling Experience (Active or passive FPSO's)											
Number of Shuttle tanker connections you have performed on aft deck (General exp)	N / A	50	4	4	4	4	20	10	N / A	N / A	H
	N / A	20	2	2	2	2	10	5	N / A	N / A	M
	N / A	6	0	0	0	0	4	0-4	N / A	N / A	L
Number of Shuttle Tanker connections you have performed on aft deck on this FPSO. (Specific exp)	N / A	12	4	4	4	4	12	Avg 6	N / A	N / A	H
	N / A	6	2	2	2	2	6	Avg 4	N / A	N / A	M
	N / A	2	0	0	0	0	0	0-4	N / A	N / A	L
Confirm that the aft deck crew have received on board induction training on operation of connection equipment. (Y or N) (Specific exp)	Y	Y	Y	Y	Y	Y	Y	Y	N / A	N / A	H, M & L

Notes

1) On Some FPSO's the OIM is not directly involved with the offloading operations and his experience does not apply. Where the OIM is directly involved, then the experience levels should be as stated for the Marine Superintendent / Heading Control Master if he fulfills these roles.

2) The use of DP on FPSO ranges from assisting with heading, surge and sway control on turret moored systems to full DP operation with no mooring. For DP vessels the DPO's should be trained and experienced to industry standard, which is specified in the IMCA document M117 entitled 'Training and Experience of Key DP personnel (refer also to current (2000/2001) UKOOA / OPITO work on FPSO competency).

3) The use of thrusters and associated control systems (ATC) requires training and specific guidance on their use and M117 above should be used as a guide to the levels required. (Refer also to current (2000/2001) UKOOA / OPITO work on FPSO competency).

4) For manual thruster control it is sufficient that personnel are trained in their use and the modus operandi.

5) For deck crew whose experience may be mixed, the average of their experience should be estimated.

6) If no previous experience in active heading control of FSU's / FPSO's then UKOOA members accept previous DPO experience on other DP / ATC vessels in lieu. Hence the two rows denoted by " (See Note 6)." can be assessed as an "equivalent mixture of both types of experience" or "either / or"

7) **KEY: -** N = no experience, N/A = not applicable or no specific requirement, DP= Dynamic positioning, ATC =automatic thruster control, <2y = less than 2 years. H = UKOOA target standard, L = UKOOA minimum, Normal range should be between M and H standard.

5.4 DP Tanker Training and Experience Matrices 2 & 3

All DP operators should maintain a DP logbook as per IMCA M117.

Matrix 2 contains the UKOOA training standard for DP tankers

The required training courses are listed in the left-hand column of the matrix. Key DP personnel are listed along the top row. There are three standards for each key position and for each training element. The standards are denoted by 'H', 'M' and 'L' in the right hand column.

Note however that where equipment maintenance courses are concerned there is just one standard, that at least one person on board the tanker is required to have undergone appropriate training. Typically, this is likely to be the onboard electrician, however the matrix gives tanker operators flexibility to allocate the training to some other position on board. However, in the case of telemetry and DP maintenance the tanker operators are expected to provide the electrician with the appropriate training.

Matrix 3 contains the UKOOA experience standard for DP tankers. The experience matrix has been developed on the same basis as the training matrix. The key DP personnel are listed along the top row with the experience elements listed in the left-hand column. There are the same three standards for each key DP position.

The experience matrix is broken down into two categories, i.e. professional (inc. DP shuttle tanker) experience and facility type specific experience.

The first category, professional experience, is concerned with years in rank, total tanker and also DP shuttle tanker experience, regardless of the offtake facility type.

The second category is concerned with experience associated with specific types of facility. Three types of offloading have been considered. Type 1 is offloading in DP mode at STL, OLS, SPM or SAL facilities. Type 2 is tandem offloading in DP mode at heading controlled FPSOs. Type 3 is tandem offloading in DP mode at passive weathervaning FPSOs and it should be noted that experience of offloading in taut hawser mode without DP is also required at these facilities. Required numbers of offloading operations are given against each type.

Minimum navigating officer levels on a DP tanker performing a tandem offtake should be set at a Master plus four navigating officers / DPOs all qualified and experienced as per Matrices 2 and 3. At least 2 of these will be on the bridge at any one time and DP / positioning control changes must be repeated and verified by the 2nd person. For this reason the 2 on duty DP watch keepers should not be involved in critical cargo loading operations. The DP watch keeper must be rotated from the console every hour to minimise the risk of concentration lapses. All such officers must have Nautical Institute (Ltd) or NMD certification plus the specialist DP qualifications identified in the matrices. The DP experience will be apportioned as evenly as possible between the watches. (I.e. a senior and junior DPO on each).

Minimum engineering manning levels on a DP tanker performing a tandem offtake should be set to permit 24 hour / day manning of the Engine Room during offtake plus an electrician competent to trace and repair position reference, telemetry and control system faults. The chief engineer, the 1st engineer and electrician should all be familiar with the vessel and her equipment with the experience levels set in matrices 2 and 3. All the above officers should be qualified to the appropriate level

under STCW 95 code preferably to Nautical Institute Ltd. or NMD certification with appropriate training on the actual vessel's equipment over and above this.

UKOOA Matrix 2: - Training of personnel o/b DP Shuttle Tanker_____ Voy._____ Date____/____/____

Please turn form sideways and print name below rank in this row.		Master	Chief officer	1st Officer	2nd Officer	3 rd Officer	Chief Engineer	1st Engineer	Electrician	UKOOA Level of Experience
DP Basic[1] (Induction)		Y	Y	Y	Y	Y	N / A	N / A	N / A	H
		Y	Y	Y	Y	Y				M
		Y	Y	Y	Y	Y				L
DP Advanced[1] (Simulator)		Y	Y	Y	Y	Y	N / A	N / A	N / A	H
		Y	Y	Y	Y	N / A				M
		Y	Y	N / A	N / A	N / A				L
Bridge Resource Management		Y	Y	Y	Y	Y	N / A	N / A	N / A	H
		Y	Y	Y	Y	N / A				M
		Y	Y	Y	N / A	N / A				L
Offshore Loading Phase 1 (Basic)[2]		Y	Y	Y	Y	Y	N / A	N / A	N / A	H
		Y	Y	Y	Y	Y				M
		Y	Y	Y	Y	Y				L
Offshore Loading Phase 2 (Advanced)[2]		Y	Y	Y	Y	Y	N / A	N / A	N / A	H
		Y	Y	Y	Y	N / A				M
		Y	Y		N / A	N / A				L
Offshore Loading Phase 3 (Refresher)[2]		Y	Y	Y	N / A	N / A	N / A	N / A	N / A	H
		Y	Y	N / A	N / A	N / A				M
		Y	Y	N / A	N / A	N / A				L
Date of Last DP Training or Refresher Course		<2Y	<2Y	<2Y	<2Y	N / A	N / A	N / A	N / A	N / A
Restricted NMD / Nautical Institute DP certificate		Y	Y	Y	Y	Y	N / A	N / A	N / A	H
		Y	Y	Y	Y	N / A				M
		Y	Y	N / A	N / A	N / A				L
Date of Last Facility Specific DP Training course, Please specify type in blank row if other than FPSO or SAL	FPSO	<2Y	<2Y	<2Y	<2Y	<2Y unless 1off visit	N / A	N / A	N / A	N / A
	SAL	<2Y	<2Y	<2Y	<2Y	<2Y unless 1off visit	N / A	N / A	N / A	
	specify other						N / A	N / A	N / A	
Position Reference Operating courses	Artemis	Y	Y	N / A	N / A	N / A	N / A	N / A	N / A	N / A
	DGPS	Y	Y	N / A	N / A	N / A	N / A	N / A	N / A	
	DARPs	Y	Y	N / A	N / A	N / A	N / A	N / A	N / A	
	HPR	Y	Y	N / A	N / A	N / A	N / A	N / A	N / A	
	HiPAP	Y	Y	N / A	N / A	N / A	N / A	N / A	N / A	
	BLOM	Y	Y	N / A	N / A	N / A	N / A	N / A	N / A	
	specify other						N / A	N / A	N / A	
Position Reference Maintenance courses	DP	N / A	N / A	N / A	N / A	N / A	1 Person onboard tanker trained for each system.			N / A
	Telemetry	N / A	N / A	N / A	N / A	N / A				
	Artemis	N / A	N / A	N / A	N / A	N / A				
	DGPS	N / A	N / A	N / A	N / A	N / A				
	DARPs	N / A	N / A	N / A	N / A	N / A				
	HPR	N / A	N / A	N / A	N / A	N / A				
	HiPAP	N / A	N / A	N / A	N / A	N / A				
	BLOM	N / A	N / A	N / A	N / A	N / A				
	specify other	N / A	N / A	N / A	N / A	N / A				

Notes

1) Various NI Approved training institutions provide DP basic and Advanced courses. They include Aberdeen College, Lowestoft College, Kongsberg Simrad. The basic and advanced DP training courses should include theory and practice of shuttle tanker operations and be carried out on the type of DP control system fitted to the tanker.

2) At the time of writing Offshore Loading Courses Phases 1, 2 and 3 are only available at the SMS facility in Trondheim.

3) The form contains training for systems that may not be applicable on some tankers or offtake facilities. Please respond with N where no training has been undertaken. Oil Companies should disregard information provided on systems that are not fitted nor required for offtake from their particular installations.

4) **KEY: -**Y=Training Complete, N=No Training, N/A = Not applicable, <2y = less than 2 years. H = UKOOA target standard, L = UKOOA minimum, Normal range for regular tanker should be between M and H standard.

UKOOA Matrix 3: - Experience of personnel o/b DP Shuttle Tanker_____ Voy._____ Date____/____/_____

Please turn form sideways and print name below rank in this row.	Master	Chief officer	1st Officer	2nd Officer	3 rd Officer	Chief Engineer	1st Engineer	Electrician	**Master** :- Months since last offtake at Facility Type	UKOOA Level of Experience
General Professional Experience										
Years of experience at present rank	>3	>3	>2	>2	>1	>3	>2	>3	N / A	H
	>2	>2	>1	>1	N / A	>2	>1	>1	N / A	M
	>1	>1	>1	>1	N / A	>1	>1	>1	N / A	L
Total years experience	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A
Total years tanker experience	>10	>10	>2	>2	>1	>6	>3	>3	N / A	H
	>5	>5	>1	>1	N / A	>4	>2	N / A	N / A	M
	>5	>5	>1	>1	N / A	>4	>2	N / A	N / A	L
Time o/b present vessel	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A
Number of offloadings performed in **DP-mode at any offshore installation: -** STL-, OLS-, SPM-,SAL- or FPSO	21	21	21	13	13	21	8	21	N / A	H
	12	12	12	5	4	8	5	8	N / A	M
	6	6	6	4	N / A	6	4	6	N / A	L
Facility Specific Experience										
Number of offloadings performed in **DP-mode** at, **STL-, OLS-, SPM-** or **SAL-** offshore installations	12	12	12	4	4	N / A	N / A	N / A	See Flow Diagram	H
	4	4	4	4	4	N / A	N / A	N / A		M
	2	2	2	2	N / A	N / A	N / A	N / A		L
Number of **Tandem DP** offloadings performed at **heading controlled FPSO's** (Captain, Schiehallion, Petrojarls, Gryphon, Jotun, Balder, Norne)	12	12	12	4	4	N / A	N / A	N / A	See Flow Diagram	H
	4	4	4	4	4	N / A	N / A	N / A		M
	2	2	2	2	N / A	N / A	N / A	N / A		L
Number of **Tandem DP** offloadings performed at **passive** weather vaning **FPSO's** (Uisge Gorm, Glas Dowr, Alba, Bleo Holm, Triton)	12	12	12	4	4	N / A	N / A	N / A	See Flow Diagram	H
	4	4	4	4	4	N / A	N / A	N / A		M
	2	2	2	2	N / A	N / A	N / A	N / A		L
Number of **Tandem**[4] offloadings performed in **Taut Hawser** mode without DP (Anasuria, Maersk Curlew, & in some circumstances Uisge Gorm, Glas Dowr, Bleo Holm, Triton)	12	12	8	8	N / A	N / A	N / A	N / A	See Flow Diagram	H
	8	8	2	2	N / A	N / A	N / A	N / A		M
	2	2	N / A	N / A	N / A	N / A	N / A	N / A		L
Hours of DP Play Time in last 12 months.	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A	N / A

Notes

1) The form contains experience which may not be applicable for some tankers or offtake facilities. Please respond with none where no experience has been undertaken. Oil Companies should disregard information provided on offtake systems that are not used at their particular installations.

2) Oil companies should appraise the experience noted on the forms based on there being equivalent experience on a bridge watch. I.e. Any individual may be below the ideal experience provided there are arrangements in place to compensate for this. E.g. His counterpart is more experienced than the minimum or additional qualified DPO on watch / compensation by master.

3) **KEY: -** N = no experience, N/A = not applicable, >2 = longer than 2 years, other numbers are minimum number of offtakes or maximum number of months since last offtake as defined in the table's headings. H = UKOOA target standard, L = UKOOA minimum, Normal range for regular tanker should be between M and H standard.

4) The prime mode of operation being assessed on this sheet is as a DP tanker. However there are circumstances at passive weather vaning FPSO's where DP tankers may operate in taut hawser mode and hence experience in this area is appropriate. Higher experience levels are required where taut hawser mode is the prime mode of operation eg at Anasuria & Maersk Curlew. These are reflected on a separate sheet.

5.5 Taut Hawser Tanker Training and Experience Matrix 4

Matrix 4 contains the UKOOA training and experience standard for taut hawser tankers

Minimum navigating officer levels on a taut hawser tanker performing a tandem offtake should be set at a Master plus four competent navigating officers all with experience levels as per Matrix 4. At least 2 of these will be on the bridge during approach, mooring, offtake, unmooring and departure. Current taut hawser operations tend to be long standing operations with the same tankers. Hence the actual close proximity manoeuvring experience is gained by sharing bridge duties with a more experienced master and then performing the tasks under their supervision until competency is established. In the event that a new tanker is brought in with an inexperienced team then it would be appropriate to put an experienced mooring master / officers on board until experience is built up. If a new operator, with no experienced masters, is brought in then it would be appropriate to provide approach and close manoeuvring training with simulator courses and then, where practicable, full size approach practice to buoys located offshore before allowing tandem offtake.

Minimum engineering manning levels on a taut hawser tanker performing a tandem offtake should be set to permit 24 hour / day manning of the Engine Room during offtake plus an electrician competent to trace and repair control system and telemetry faults. The chief engineer, the 1st engineer and electrician should all be familiar with the vessel and her equipment with the experience levels set in Matrix 4.

All the above officers should be qualified to the appropriate level under STCW 95 code preferably to Nautical Institute Ltd. or NMD certification with appropriate training on the actual vessel's equipment over and above this.

UKOOA Matrix 4: - Training of personnel o/b Taut Hawser Shuttle Tanker_____ Voy._____ Date ____ / ___ / _____

Please turn form sideways and print name below rank in this row	MASTER	CH OFFICER	1ST OFFICER	2ND OFFICER	3RD OFFICER	CHIEF ENG	1ST ENG	ELECTRICIAN	**MASTER :-** MONTHS SINCE OFFTAKE AT FACILITY TYPE	UKOOA Level of Experience
General Professional Experience										
Years of experience at present rank	>3	>3	>2	>2	>1	>3	>2	>3	N/A	H
	>2	>2	>1	>1	N/A	>2	>1	>1	N/A	M
	1	1	1	1	N/A	1	1	1	N/A	L
Total years experience	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total years tanker experience	>10	>10	>2	>2	>1	>6	>3	>3	N/A	H
	>5	>5	>1	>1	N/A	>4	>2	N/A	N/A	M
	2	2	1	1	N/A	2	1	N/A	N/A	L
Facility Specific Experience										
Time o/b present vessel	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Number of **tandem** offloadings performed in taut hawser mode at **passive FPSOs** (e.g. Anasuria, Curlew, Triton etc)	20	20	20	10	10	20	10	5	See Flow Diagram	H
	10	10	10	5	5	10	5	3		M
	2	2	2	1	1	2	1	1		L
Number of offloadings performed in taut hawser mode at STL (e.g. Beryl etc.)	20	20	20	10	10	20	10	5	See Flow Diagram	H
	10	10	10	5	5	10	5	3		M
	2	2	2	1	1	2	1	1		L

Notes

1) The form contains experience which may not be applicable for some tankers or offtake facilities. Please respond with none where no experience has been undertaken. Oil Companies should disregard information provided on offtake systems that are not used at their particular installations.

2) Oil companies should appraise the experience noted on the forms based on there being equivalent experience on a bridge watch. I.e. Any individual may be below the ideal experience provided there are arrangements in place to compensate for this. E.g. His counterpart is more experienced than the minimum or additional qualified DPO on watch / compensation by master.

3) KEY: - N = no experience, N/A = not applicable, >2 = longer than 2 years, other numbers are minimum number of offtakes or maximum number of months since last offtake as defined in the table's headings. H = UKOOA target standard, L = UKOOA minimum, Normal range for regular tanker should be between M and H standard.

4) Current taut hawser tanker operations are at existing facilities with tanker operators having a long track record of these operations. Hence the above Matrix is predicated on all officers being qualified to the appropriate level under STCW 95 code and then obtaining onboard training and experience under the guidance of a master experienced in close proximity offshore approaches and tandem offtake before performing manoeuvring tasks. In the event that a new tanker is brought in with an inexperienced team then it would be appropriate to put an experienced mooring master / officers on board until experience is built up. If a new operator, with no experienced masters, is brought in then it would be appropriate to provide approach and close manoeuvring training with simulator courses and then full size approach practice to buoys located offshore before allowing tandem offtake.

5.6 Master's Experience Flowchart (Refer to Flowchart 1)

There are specific experience requirements for the tanker master and the FPSO heading control "master", which are in addition to the above training and experience matrices. The experience requirements in Matrices 1, 3 or 4 do not differentiate between offloading operations carried out in a particular rank, e.g. the required number of offloads may have been carried out at a lower rank. However, the master's experience flow chart does address the issue of the master's actual experience in command of shuttle tanker operations.

In order for a master to be allowed to carry out an unsupervised offload operation at the facility in question, he must be able to comply with the requirements of the flowchart as well as the training and experience matrices.

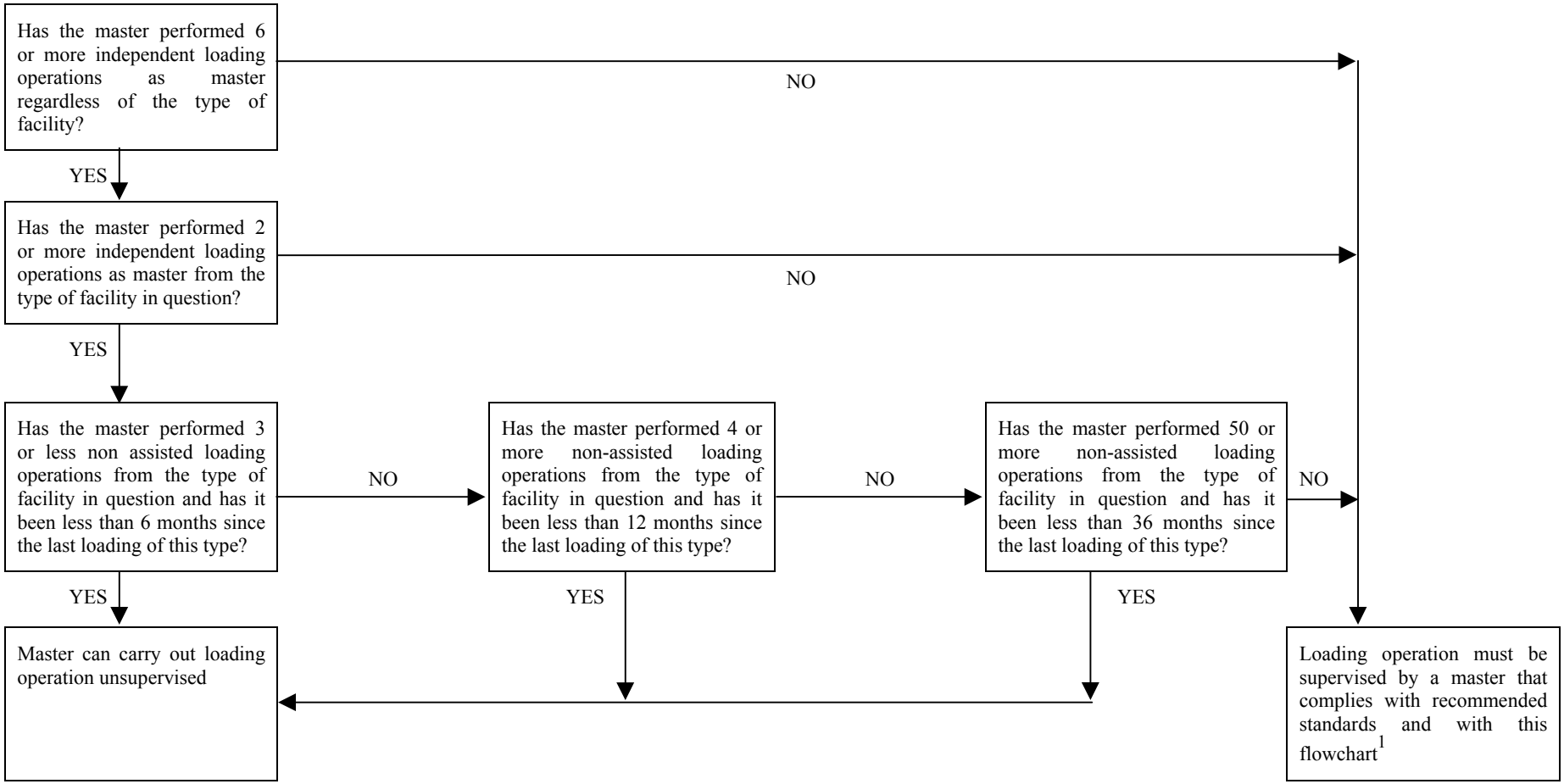
The flowchart is self-explanatory. If the serving master does not comply with the provisions of the flow chart then the vessel manager should transfer an appropriately qualified and experienced master to the FPSO or tanker. The additional master will remain on board the tanker in an advisory capacity for the duration of the offloading operation. The additional master will not take command of the vessel. A column is included on matrix 2 for the master to indicate how long since he last performed an offtake from each type of loading facility.

5.7 DP Practice Time

Some UKOOA members and tanker operators started in 1999/2000 to permit shuttle tankers to use lay time at the field to permit DP operators to practice their DP and their "DP auto" to "DP manual" transition skills, at a safe distance from the loading facility but using field positioning references. DP practice time should be logged along with all other training and experience in the DP operator's individual DP logbook.

A row is also included in matrix 3 to permit Duty holders to monitor that DP playtime is actually being put to good use. UKOOA members should actively encourage tanker masters to use lay time for DP play time whenever it can be accommodated without jeopardising other in field operations.

FLOWCHART 1 MASTER'S RECENT EXPERIENCE FLOWCHART



[1] Note that a master who requires supervision under the terms of this flowchart will be permitted to perform a loading operation unsupervised at the type of facility in question following one supervised loading.

6 MANAGEMENT SYSTEM

The object of the Field Operator and duty holder's management systems should be to ensure that: -

- All new offtake systems have been selected with due consideration to reducing inherent risk to ALARP at the field concept selection stage in accordance with the requirements of section 3.

- All offtake critical elements on both the FPSO and all associated offtake tankers have been adequately designed, installed, assured and verified as per the performance standards in Appendices A, B and C as well as the principles described in section 4.

- All key personnel on both the FPSO and associated offtake tankers have been trained and have adequate experience in accordance with the requirements of section 5.

- Duty holders, offtake tanker managers and key personnel on the FPSO and associated offtake tankers all learn from previous experience by being open about problems experienced and sharing incident data as described in section 7.

- Key personnel on both the FPSO and all associated tankers have clear guidance on the special features, duty holder requirements and operational limits for each field by issuing a Joint Operations Loading Manual as described in section 6.3.

- There are adequate management controls and audit checks all the way down the supply chains for both FPSO and Offtake tanker services to ensure that risk reducing measures are applied effectively on both vessels participating in any tandem offtake (FPSO and Tanker) as described in sections 6.1 and 6.2.

6.1 Management Audits

The contractual structure is often complicated for the supply of offtake critical elements and services on both the FPSO and associated offtake tankers.

A field operator may have devolved responsibility for the FPSO by leasing the unit from a third party company who may or may not be the installation duty holder. The duty holder may have devolved responsibility for the specification, design procurement and installation of critical offtake equipment to an EPIC contractor. Further sub-contracts may be in place for the maintenance of each OCE and provision of competent personnel on the FPSO.

On the tanker supply side, the offtake tanker supply contractor may have a contract with the field operator rather than the duty holder. The tanker supply contractor may be supplying several tankers to the one field from his supply pool but the tankers supplied are likely to come from several different vessel management companies or owners.

The field operator and duty holder have a joint responsibility to ensure that each level in the supply chain, right down to the FPSO, Tankers and OCEs, are being managed in accordance with effective procedures to ensure a safe offtake regime on the field. The field operator (in co-operation with the duty holder if separate) shall maintain and act on a management audit plan covering the audit of all levels down the supply chain. This will include both direct audits of main contractor's organisations, review of each main contractors own audit plan for relevant subcontractors or vessels, and sample

observation / participation in the main contractor's audits of their sub contractors and vessels to ensure that the overall system is consistent and that risk reducing strategies are not diluted as they pass down the supply chain.

6.2 Vessel Acceptance and Auditing

The FPSO and shuttle tankers should be audited against field specific performance standards and UKOOA training and experience requirements. Any findings should be actively closed out and documented closed. The tanker audit programme should cover both initial acceptance and ongoing maintenance in a fit for offtake condition. This is the management tool to ensure that equipment and personnel are initially checked as fit for purpose and continue to be maintained in that condition.

The general safety condition of the FPSO to perform production and / or storage should be covered by the duty holders existing SMS and ICP inspection under UK regulations. However offtake systems and tandem offtake station keeping aids, do not fall readily within the experience of many of the specialist companies or personnel who routinely deal with these issues on production platforms. There is room in the industry for standard guidance on the inspection and auditing of offtake related systems.

The general safety condition of a tanker to perform crude oil transport and discharge at inshore terminals is already well covered by the OCIMF SIRE system. The SIRE system however does not cover bow loading systems or close proximity station keeping arrangements. There is an inspection gap on areas that are critical for safe tandem offtake, and given the historical incident rate duty holders should ensure that this gap is plugged.

There would be benefits for both duty holders (shared cost) and tanker owner/managers (less disruption) if duty holders could appoint ICP auditors that could check the vessel for more than one operator / duty holder at a time. A model for a common acceptance system is proposed in Appendix E.

6.3 Joint Operations Offtake Manual & Emergency Response

The field specific joint operations offtake manual is the main procedure controlling discharge operations on any field. It should contain the following information: -

- Summary field position and field layout and FPSO information including plans of her stern offtake arrangements, and appropriate photographs.
- Contact numbers, call signs and communications channels for both Operational and Emergency use.
- Description of the offloading equipment and in particular the OCEs on board the FPSO.
- Description of standard and occasional joint operations including cargo transfer rates, line flushing etc.
- Data sheets on all tankers approved for regular offtake at that field.
- Tendering and accepting Notice of Readiness (NOR), and any special requirements for cargo quality, Bills of Lading and Cargo calculations

- Speed reduction sequence and limits on approaching Facility / FPSO. Speed should normally be reduced to
    - < 12 knots @ 10 nautical miles from the Facility / FPSO
    - < 5 knots @ 3 nautical miles from the Facility / FPSO
    - < 0.5 knot @ 1000 meters from the Facility / FPSO
- Operational limits and executive actions on exceeding limits (Refer to Performance Standards A2 and A3).
- ESD systems and executive actions at each ESD level. (Both for the FPSO ESD system and the joint "Offtake ESD" system).
- Detailed check lists for the FPSO covering each stage of pre offtake checking, approach, offtake, disconnection and post offtake checking of hardware.
- Detailed check lists for each type of tanker covering field specific actions and requirements not covered by the tankers own detailed checklists.
- Duties and requirements for the towing assist vessel.
- Emergency responsibilities and procedures. Note this section of the joint operations manual should be prepared jointly between the duty holder's management team responsible for running the installation, and the tanker management company to ensure that there are no gaps or overlaps in cover. (Some duty holders prefer to cover this topic by a separate bridging document or emergency response manual for this reason).
- Bearing in mind that many tankers operate on a COA basis visiting many different fields with different procedures each joint operations offtake manual should include:-
    - A short synopsis describing key requirements and where to find more detailed information on each topic within the manual. (I.e. An overview that the Tanker Master can quickly use to get the key facts without having to wade indiscriminately through the full manual).
    - A station-keeping sector limits diagram giving key operational and station keeping limits and key communications channels. (I.e. key information that can be posted on one sheet on the bridge for immediate use). An example of this diagram is included on the following page.

"Sample Field" FPSO is located at	57° 05' 02.1" **North,**	00° 53' 32.8" **East**
Turret Centre TM co-ordinates, Central Meridian 0°, ED 50	Eastings	554 094.0
	Northings	6 327 224.0

Communications	**Tel**	**Fax**	**e-mail**
	Primary **Ch 12**	Call Sign	
	Backup Ch 8	MMSI No.	
UHF (Simplex)	**453.050 MHz**	Backups 453.025 MHz or 459.900 MHz	

DP TANKER OPERATING LIMITS (Hawser Length = 80 m)

Parameter	Approach & Mooring Limits		Limits During Offtake	
	Take Action If	Action to take	Take Action If	Action to take
Wind Speed	> 40 knots	OIM and Tanker Master to delay mooring, unless both agree safe to moor on joint evaluation of current & forecast weather.	> 50 knots	ERS, unless OIM and Tanker Master both agree safe to continue on joint evaluation of current & forecast weather.
Hsig	> 4.5 m		> 5.5 m	
Hmax	> 8.0 m		> 9.5 m	
Visibility	<500		No visual contact	ERS Disconnect
ESD Telemetry	No Signal	Don't connect	No signal	ESD Stop Pumping
DP Computers	< 2 working	Don't connect in DP mode. OIM and Tanker Master to delay mooring unless both agree weather limits and onboard experience adequate for taut hawser offtake.	< 2 working	Tanker master to take over in manual and go slow astern to taut hawser mode. If weather or experience marginal then ERS. Otherwise Tanker Master to discuss continuing on manual taut hawser with OIM.
FPSO Gyros	< 2 close agreement		< 2 close agreement	
Tanker Gyros	< 2 close agreement		< 2 close agreement	
Position References	< 2 Relative + 1 Absolute		< 2 Relative + 1 Absolute	
FPSO Thruster Power (If fitted)	>60%	Adjust headings or delay mooring until thruster utilisation decreases	>60%	Adjust headings to try and reduce required thrust. ERS if thrust >75% on either vessel
Tanker Thruster Power	>60%		>60%	
Hawser Tension (Tonnes for a 650 Tonne NDBS Nylon Hawser)	N / A	N / A	>100 T once	ESD & OIM / Master evaluate whether to disconnect.
			>100 T twice in 30 minutes	ERS Disconnect
			>120 T once	ERS Disconnect

IF TANKER REVERTS TO TAUT HAWSER MODE THEN THE WEATHER LIMITS FOR TAKING ACTION DECREASE TO: -

LIMIT	APPROACH	OFFTAKE
Wind	>35 knots	> 45 knots
Hsig	> 3.5 m	> 4.5 m
Hmax	> 5.8 m	> 7.5 m
Visibility	>1000 m (unless position references are functioning)	

ERS = **DISCONNECT AND TAKE MANUAL EVASIVE ACTION.**

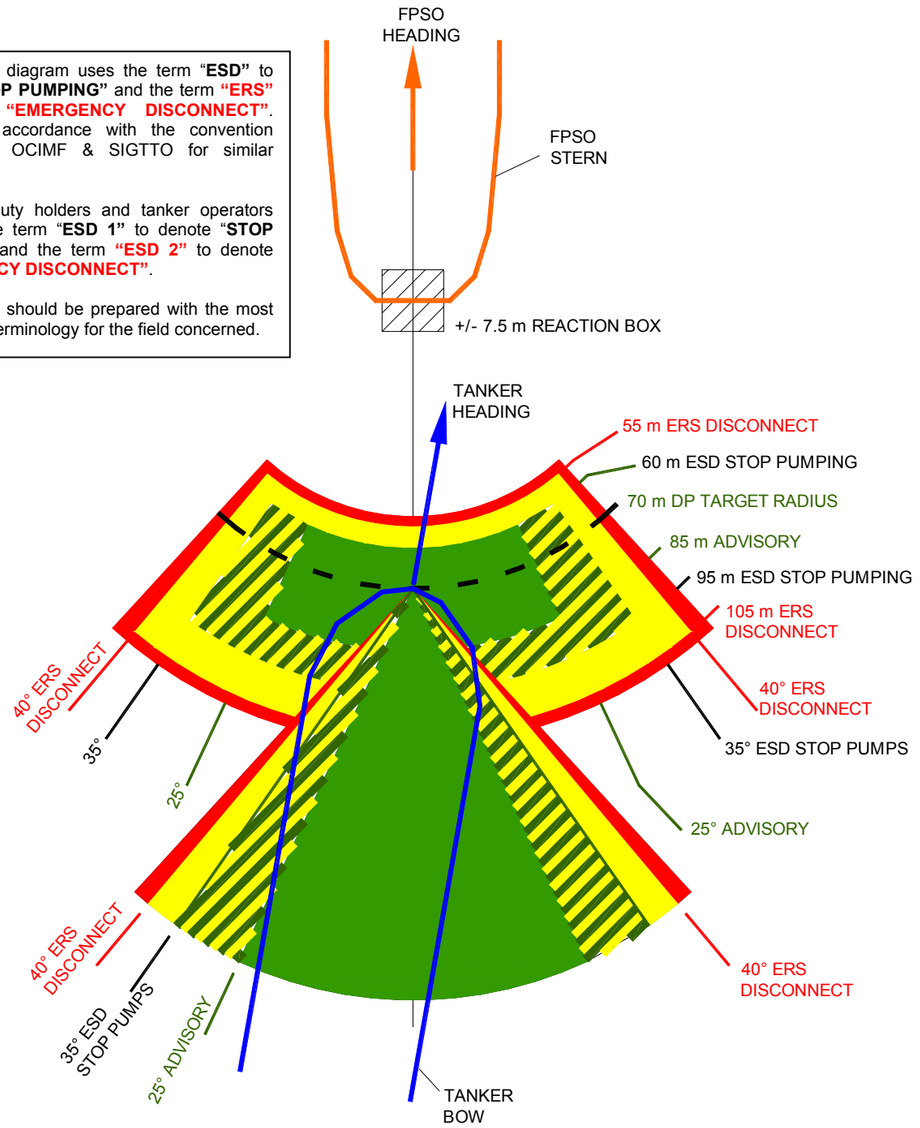
ESD = **STOP PUMPING, PREPARE FOR MANUAL EVASIVE ACTION.**

ADVISORY = TANKER MASTER AND FPSO MARINE SUPERINTENDENT EVALUATE THE POSITION IF IT IS STABLE. HOWEVER IF IN DOUBT DISCONNECT.

This sample diagram uses the term "**ESD**" to denote "**STOP PUMPING**" and the term **"ERS"** to denote **"EMERGENCY DISCONNECT"**. This is in accordance with the convention adopted by OCIMF & SIGTTO for similar scenarios.

Some UK duty holders and tanker operators may use the term "**ESD 1**" to denote "**STOP PUMPING**" and the term **"ESD 2"** to denote **"EMERGENCY DISCONNECT"**.

The diagram should be prepared with the most meaningful terminology for the field concerned.



7 LOSS OF POSITION & LOSS OF REDUNDANCY REPORTING

7.1 Objectives

UKOOA members have made an undertaking to the HSE to significantly reduce shuttle tanker incidents and near misses during the next two years. This risk reduction strategy must be underpinned by a scheme to report and learn from all potential incidents or factors that might increase the risk of a potential incident. Rather than start a new scheme, UKOOA have worked with IMCA who already have an existing scheme in place. Hence UKOOA members are requested to request both FPSO staff and Shuttle Tanker masters to report the following events on the IMCA reporting form included in Appendix F.

This reporting scheme should be introduced as a field requirement on all FPSOs engaged in tandem offtake. MAR Regulation [8] places a duty of co-operation on everyone who can contribute to health and safety on an installation or activities connected with an installation. This includes everyone doing business in connection with the installation: - owners, operators, concession holders, 3rd party employers, managers, employees and people in charge of visiting vessels and aircraft. In this context it is reasonable to ask all visiting tankers to co-operate.

The completed forms should be returned to UKOOA via each duty holder's onshore management representative. UKOOA will scan the form (less field name and tanker name) and placed on the UKOOA website for members and associates to access. Three separate folders will be used on the web-site; one for active heading controlled FPSOs, one for DP tankers and one for taut hawser tankers. The forms should also be forwarded directly to IMCA for thruster assist FPSO and DP tanker incidents so that the industry can gain maximum learning value from the information. IMCA have already put a scheme in place to analyse DP incidents and are best placed to analyse emerging trends and advise on improvements. UKOOA members gain by co-operating with IMCA as the latter organisation gathers data from all types of DP vessels and position references and can cross-fertilise lessons from other sectors back into tandem offtake. IMCA will disseminate its annual report on DP incidents to UKOOA, as an associate member of IMCA, for dissemination to members.

UKOOA members and the HSE should take note that if the scheme is a success then there will paradoxically be an increase in the number of incidents reported. It is strongly suspected that station keeping incidents, which don't actually result in collision, are currently under reported.

7.2 Events to be Reported

It is proposed that reports are completed and returned for the following events: -

7.2.1 ACTIVE HEADING CONTROL FPSOs

A report should be completed for the following events whether they occur during a tandem offtake or any other time.

- For any unexpected loss of position and more particularly heading.

- For any unexpected loss of functionality or availability of equipment which results in a reduced level of redundancy leading to a degraded operational status.
- When the DP or Automatic Thruster Control system performance differs from the operator's expectations.
- For any unexpected high hawser loads beyond the operational limits.

7.2.2 DP TANKERS DURING TANDEM OFFTAKE

A report should be completed for the following events during an approach, tandem offtake or disconnection.

- For any unexpected loss of relative position and/or heading (including sudden large heading changes of passive FPSOs).
- For any unexpected loss of functionality or availability of equipment on either FPSO or tanker which results in a reduced level of redundancy leading to a degraded operational status.
- When the Tanker DP or FPSO Automatic Thruster Control system performance differs from the operator's expectations.
- For any unexpected high hawser loads beyond the operational limits.

7.2.3 TAUT HAWSER TANKERS DURING TANDEM OFFTAKE

A report should be completed for the following events during an approach, tandem offtake or disconnection.

- For any unexpected loss of relative position and/or heading (including sudden large heading changes of passive FPSOs).
- For any unexpected loss of functionality or availability of equipment on either FPSO or tanker which results in a reduced level of redundancy leading to a degraded operational status.
- For any unexpected high hawser loads beyond the operational limits.

8 NOMENCLATURE

ALARP	As Low as Reasonably Practicable
AOGBO	Application Outside Great Britain Order
ATC	Automatic Thruster Control
BLS	Bow Loading System
CAPEX	Capital Expenditure
CCR	Central Control Room
CCTV	Close Circuit Television
CoA	Contract of Affreightment
COW	Crude Oil Washing
CPP	Controllable Pitch Propeller
DARPS	Differential & Absolute Relative Positioning System
DCR	Design & Construction Regulations
DGPS	Differential Global Positioning System
DISPORT	Discharge Port
DP	Dynamic Positioning
DPO	Dynamic Positioning Operator
DSV	Diving Support Vessel
ERS	Emergency Release System. The term ERS (or sometimes ESD 2) is used to denote the instruction for the shuttle tanker to stop pumping and make an immediate emergency disconnection.
ERRV	Emergency Response & Rescue Vessel
ESD	Emergency Shut Down. Besides denoting the progressive emergency shutdown of the FPSO production plant the term ESD (or sometimes ESD 1) is also used to denote “stop pumping” between the FPSO and tanker.
FMEA	Failure Mode and Effects Analysis
FPSO	Floating Production, Storage & Offtake vessel

FSU	Floating Storage Unit
HiPAP	High Precision Acoustic Positioning
HPR	Hydro-acoustic Position Reference
HSE	Health & Safety Executive
HSWA	Health & Safety at Work Act
ICP	Independent Competent Person
IG	Inert Gas
IMCA	International Marine Contractors Association
IMO	International Maritime Organisation
LV	Low Voltage
MAR	Management and Administration Regulations
MARPOL	International Convention for the Prevention of Pollution from Ships (as amended). The principal body of rules, framed by IMO to control pollution of the marine environment.
MBC	Marine Breakaway Coupling
MBL	Minimum Breaking Load
MODU	Mobile Offshore Drilling Unit
MSC	Maritime Safety Committee
MSS	Marine Services Superintendent
NDBS	New Dry Breaking Strength of a hawser. This is often listed as the ropes MBL in equipment catalogues.
NMD	Norwegian Maritime Directorate
NVQ	National Vocational Qualification
OCE	Offtake Critical Element
OCIMF	Oil Companies International Marine Forum
OIM	Offshore Installation Manager
OLS	Offshore Loading System

OPEX	Operating Expenditure
OPITO	Offshore Petroleum Industry Training Organisation – The UK National Training Organisation For Oil & Gas Extraction
PM	Planned Maintenance
PPE	Personal Protective Equipment
PS	Performance Standard
PSD	Process Shutdown
QCDC	Quick Connect Disconnect Coupling
ROV	Remotely Operated Vessel
SAL	Single Arm Loading System
SCE	Safety Critical Element
SCR	Safety Case Regulations
SIRE	OCIMF's Ship Inspection Report Programme
SMS	Safety Management System
SPM	Single Point Mooring System
ST	Shuttle Tanker
STCW 95	1995 amendments to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW),
STL	Submerged Turret Loading System
SVQ	Scottish Vocational Qualification
TAV	Towing Assist Vessel
TM	Transverse Mercator
UHF	Ultra High Frequency
UKOOA	United Kingdom Offshore Operations Association
UPS	Uninterrupted Power Supply
VHF	Very High Frequency
VOC	Volatile Organic Compound

9 REFERENCES

1)	Guidelines For Vessels With Dynamic Positioning Systems.	IMO -1994 MSC Circular 645 IMCA
2)	Training and Experience of Key DP Personnel.	IMO – 1996MSC Circular 738 IMCA
3)	Guidelines For The Purchasing And Testing Of SPM Hawsers.	OCIMF -2000
4)	Guide to purchasing, manufacturing and testing of loading and discharge hoses for offshore moorings	OCIMF - 1991
5)	Guidelines for the handling, storage, inspection and testing of hoses in the field	OCIMF - 1995
6)	Offshore Loading Safety Guidelines With Special Reference To Harsh Weather Zones.	OCIMF - 1999
7)	Guidelines For The Design And Operation Of Dynamically Positioned Vessels	IMCA – M103
8)	DP Training And The Experience Of Key Personnel	IMCA – M117
9)	Standard Report For DP Vessels Annual Trials	IMCA – M139
10)	Specification for DP Capability Plots	IMCA – M 140
11)	Quantified Frequency Analysis of Shuttle Tanker Collision During Offtake Operations	IMCA - M150
12)	Guidelines for the Design and Operation of 1999 Dynamically Positioned Vessels	IMCA – M103
13)	Guidelines for the Design and Operation of Dynamically Positioned Vessels – Two Vessels Operations – A Supplement to IMCA M103	IMCA – M161
14)	Guidelines on Thruster-assisted Mooring by FPSOs and Similar Turret-moored Vessels	IMCA – 159
15)	Risk Minimisation Guidelines for Shuttle Tanker Operations Worldwide at Offshore Locations	INTERTANKO

APPENDIX A

PERFORMANCE STANDARDS COMMON TO BOTH FPSO & TANKER

CONTENTS **Page Number**

APPENDIX A PERFORMANCE STANDARDS COMMON TO BOTH FPSO & TANKER

The following generic performance standards have been derived for Offtake Critical Elements (OCE) which are common to both the FPSO and the Offtake Tanker. OCEs are defined as major elements of the offtake operation which are critical for safety or the avoidance of either pollution or production loss during the close proximity phase of the offtake.

The standards consider two types of FPSO / FSU, those which have active heading control , and those which just passively weather vane around their turret. There are two ways of operating the shuttle tanker during offtake; either in DP with a slack hawser or slow astern in manual control with a taut hawser. The equipment requirements on the FPSO vary not only with whether they use active or passive heading control but also with which type of tanker is attached. Hence each OCE description identifies which combinations of heading control and tanker control method they apply to using the following abbreviations.

FPSO or FSU with active heading control	= active
FPSO or FSU with no heading control	= passive
Tanker operating in manual mode on taut hawser	= tauthaw
Tanker operating on DP	= dptank
All FPSOs and Tankers, irrespective of type	= all

Hence the term “Applies active, dptank” means the performance requirement indicated applies only if the FPSO uses active heading control or the offtake tanker is on DP.

The performance standards in appendix A relate to areas where the Duty Holder and Tanker Manager have to ensure compatibility, between their units and work together to ensure the operation is performed within pre-agreed safe limits.

A range of typical values or guidance information is included in *{italic text}*. This typically applies to a shuttle tanker in the Aframax to Suezmax size range and is intended as preliminary information to Duty Holders unfamiliar with the subject rather than as a substitute for correct design.

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
A1	**Hardware Compatibility** (Applies to all) • To ensure connection integrity with minimum offshore remedial action.	Duty Holder and Tanker Manager to agree all interfaces during the FPSO design and build / conversion phases for any new field. The following areas represent the principal interfaces between the two vessels.	**Initial Assurance :** Interface review and information exchange during design and procurement. Check of layouts on FPSO tanker. *{It is particularly important that all antennae transmitting to the tanker have the correct position, separation and height on the aft end of the FPSO to avoid interference but assure alignment with corresponding tanker antennae. Normally they should have clear line of sight astern +/- 70 degrees to cater for relative yaw between the FPSO and tanker.}* Factory acceptance tests or contractor acceptance test when fitted to FPSO / Tanker to ensure that frequencies, channel ids, address codes etc are as agreed. **Verification :** Trial of position references and telemetry by passing tanker's when FPSO first installed or tanker first proposed followed by trial connection for physical interfaces.
	Verbal Communications	1) Agree telephone, fax and / or e-mail details plus VHF channels for initial long range contact and exchanging notices and reports. Each FPSO should have 2 x Simplex UHF channels *{primary and back up in case of external interference}* dedicated for offtake operations. There should be UHF radios fitted for both agreed channels in the FPSO CCR, Tanker Bridge, ERRV bridge, TAV bridge and minimum 2 x hand-helds on each of the tanker foc'sle and FPSO aft deck. *{the deck hand-helds should have headsets to leave hands free and offset surrounding noise. Common send and receive frequency should be used so that hand-helds can monitor both sides of conversations between tanker bridge and FPSO CCR. The frequencies should be chosen to avoid clashing with other frequencies used on the FPSO or adjacent fields}*	
	Telemetry System	2) Agree telemetry frequencies with a view to minimising interference from surrounding fields.	
	Position references	3) Agree address code and frequency pair for each Artemis beacon. Agree telemetry channel for each DARPS system and notify other fields in UK and Norway which use the same channel. Agree requirements for other systems if fitted e.g. HPR beacons, fanbeam etc	
	Hawser Interface	4) Agree size and length of hawser chafe chain to match tanker stoppers. Agree make-up, diameter, and lengths of hawser messengers to a)match tanker traction winch, b)fit on tanker storage drum, c)provide sufficient length for transfer to tanker at a safe distance & d) avoid excess length that may foul tanker bow thrusters or slow the operation. Agree hawser transfer mechanism *{Normally pneumatic rocket for DP tankers, but possibly longer messengers and end float run out by TAV for taut hawser tankers}*	
	Hose Interface	5) Agree the interface requirements to match the FPSO's dry break coupling flange to the tanker's bow loading system. *{Normally dry break flange thickness and diameter plus the length and diameter of the dry break coupler's body (behind the flange) have to be matched to the tanker's flange, tanker's latch settings and the space required to engage the tanker's latching dogs behind the dry break flange. The pitch between the two eyes on the dry break coupling's lifting ring need to be wide enough for the hose bridle to pass around the bow loading systems latching mechanism without fouling. Bridle and suspension line size, materials, and lengths have to be agreed.}*	
	Operating procedures, limits and disconnect criteria.	6) It is vital to agree a safe system of work and communication details before the first trial connection on the field.	

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
A2	**Safe tanker approach limits (Pg. 1of 2)** (Applies to all. Note differences in guidance limits for different types of vessel are noted in the text) • To ensure tanker only comes within close proximity of the FPSO if it is a) safe to do so and b) can offtake oil. 1) Limiting Weather for approach & Connection 2) Communications, Position References & Telemetry systems (common to both FPSO and Tanker) 3) FPSO equipment	1) The offtake tanker should normally only approach within 3nm provided the maximum, wind speed, Hs, Hmax, visibility, and FPSO motions and yaw rate are within safe limits. *{Typical values for DP tankers are measured 10 min mean wind < 40 knots, Hs < 4.5 m, Hmax < 8.0m, Visibility > 500 m, FPSO heading stable +/- 5 degrees}. {Typical values for taut hawser tankers are measured 10 min mean wind < 35 knots, Hs < 3.5 m, Hmax < 5.8m, Visibility > 1000 m, FPSO heading stable +/- 5 degrees}. {Note if the FPSO heading changes more than 15 degrees during approach then DP tankers may have to pause and realign whereas taut hawser tankers may have to abort and recommence approach on the new heading if they don't have transverse thruster capability. Where taut hawser tankers have a primary and secondary relative position reference system to the FPSO stern and know the FPSO heading then it too can make an approach when visibility is between 500m and 1000m. If either FPSO or tanker roll or pitch excessively on the approach heading then the offtake may have to be postponed to avoid excessive hawser loads on connection}* 2) VHF communications should be established at or before 10 nm. All possible position references and telemetry systems should be tested and confirmed operational prior to the tanker approaching within 10 nm with the remaining short range relative position references tested and confirmed operational as soon as possible thereafter. UHF communications should be established and tested for interference at 3nm. The approach should be aborted if the minimum levels of communications, position references or telemetry are not available at each test *{Both telemetry channels and effective two way verbal communications should be working before tankers proceed within 3 nm. For DP tankers at least two relative position references should be giving adequate quality fixes or else it should revert to a taut hawser operation, or perhaps abort in more severe sea areas}*. 3) FPSO Gyros should be checked against each other before the shuttle tanker approaches within 10nm to ensure that they all agree *{check no gyro is drifting}*. FPSO cargo & ballast pumps, IG plant, load computer, valve controls, stern discharge system and necessary power supplies should all be tested and functioning. (For active heading controlled FPSOs the DP controls, all thrusters and redundant power supplies should have been tested and be functioning adequately to ensure heading control. The thrusters and generators should be holding the FPSO on the required approach heading within agreed thrust / power limits *{<60% Capability}* and with any load shedding system giving thrusters priority. All FPSO on board plant adjustments, maintenance, equipment / fuel changeovers and other activities which may trip generators to an extent where the FPSO could lose heading control should have been completed or put on hold until the offtake tanker has finished and departed). The FPSO should complete all checks prior to the tanker approaching within 3nm. **Continued on following sheet.**	1, 2, 3, 4, 5 & 6) **Initial Assurance :** System design limits, appropriate FMEA / trial results, and previous experiences from the duty holder, tanker operators and incident lessons incorporated into useable check lists and understandable limits within the offtake terminal manual. **Verification :** Review of manual by offtake tankers, tanker managers and an independent competent person from within duty holder's organisation (or external). Checklists tested by use during trial connection. **Ongoing Assurance :** All checks and information exchanges performed during approach, at the correct approach distance, for each offtake. FPSO OIM / Marine Supervisor and tanker Master to discuss the actual conditions and equipment versus the advisory limits and take a joint decision on it being safe to proceed with mooring approach. Both parties must be fully aware that either has the right to abort or postpone the offtake if they are not fully happy that it is safe to approach.

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
A2	**Safe tanker approach limits (Pg. 2 of 2)** 4) Tanker Equipment	**Continued from previous sheet.** 4) Tanker Bow Loading System (BLS), cargo lines & all equipment in machinery space required for close proximity operations should be tested and functioning, sufficient generators should be on line and available; all pitch controls including fail safes, all thrusters and steering motors, redundant power sources should be tested and confirmed functioning *{at 10nm range}*. Tanker gyros & repeaters should be checked against each other *{before the shuttle tanker approaches within 10nm}* to ensure that they agree *{check no gyro is drifting}*. The thrusters and generators should be tested for holding the tanker on the required approach heading within agreed thrust / power limits *{<60% Capability for approach to continue}*. The machinery space should be manned up *{at 10nm}* and all electrical and mechanical maintenance that could inadvertently lead to critical systems tripping should be brought to a close, until after the tanker has completed the offtake and departed. For DP tankers, the tanker's DP systems should be tested before approaching within 500m of the FPSO. *{Must have both computers and two good quality relative position references working and on line, else the tanker should abort or revert to performing a taut hawser offtake.}*	
	5) Tanker Approach Speed	5) The tanker should reduce speed to agreed limits as it approaches the FPSO and confirm having done so to the FPSO at each stage. *{Typical speed limits are transit speed @ > 10 nm, <5knts @ 3nm, <2knts @ 1000m and < 0.5 knots @ 500m.}*	
	6) Helicopter & 3rd party ship Operations	6) Helicopter Operations to either the FPSO or the tanker should be suspended whilst the tanker is approaching or departing. *{They may be permitted during actual offtake provided the tankers' IG vent plumes are prevented from interfering with the helicopter approach and departure tracks.}* All third party ship operations within 500m of the FPSO should be suspended prior to approach and the vessels sent to a safe standby location prior to the tanker approaching within 3 nm. *{e.g. Supply boats, ROV vessel, DSVs etc.}* The presence of any other facility within 3nm should have been risk assessed prior to the tanker giving notice of readiness *{e.g. MODU moored over adjacent wells, Seismic survey vessel etc}*. The FPSO OIM/ MSS and Tanker Master must evaluate its presence versus pre-agreed exclusion sectors, weather direction and desired approach route / drift directions. *{The approach / offtake should be postponed if the 3rd party vessel may be in jeopardy and can not be moved for the offtake to proceed}*.	

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
A3	**Safe Tanker Offtake Limits (Pg. 1 of 2)** (Applies to all. Note differences in guidance limits for different types of vessel are noted in the text) • To ensure tanker departs from close proximity to the FPSO prior to it becoming dangerous to remain. 1) Limiting Weather for Approach & Connection	1) The offtake tanker should normally only continue offtake provided the maximum, wind speed, Hs, Hmax, visibility, and FPSO motions are within safe limits. *{Typical values for DP tankers are measured 10 min mean wind < 50 knots, Hs < 5.5 m, Hmax < 9.5m, Visibility > 100 m, FPSO / tanker roll and pitch not leading to snatch loads on hawser}. {Typical values for taut hawser tankers are measured 10 min mean wind < 45 knots, Hs < 4.0 m, Hmax < 7.5m, Visibility > 100 m FPSO / tanker roll and pitch not leading to snatch loads on hawser}.*	1, 2, 3, 4, 5, 6 & 7) **Initial Assurance :** System design limits, appropriate FMEA / trial results, and previous experiences from the duty holder, tanker operators and incident lessons incorporated into useable check lists and understandable limits within the offtake terminal manual. **Verification :** Review of manual by offtake tankers, tanker managers and an independent competent person from within duty holder's organisation (or external). Checklists tested by use during trial connection. **Ongoing Assurance :** All checks and information exchanges performed at the agreed frequency during each offtake. FPSO OIM / Marine Supervisor and tanker Master to discuss any change in actual conditions or equipment status / availability on either vessel compared to the advisory limits. They must take a joint decision on it being safe to continue but either may decide it is prudent to stop loading or disconnect. Both parties must be fully aware that either has the right to abort or postpone the offtake if they are not fully happy that it is safe to continue.
	2) Limiting Hawser Tensions	2) The offtake should normally only continue offtake provided the hawser tension remains within acceptable limits. *{**The hawser in a DP offtake** is normally slack with tensions < 3% NDBS, so any significant hawser tension is indicative of a problem. Typical tension alarm values for DP tankers are as follows. Tanker Master and OIM consider disconnect if one pull > 15% of the hawser NDBS and particularly if two pulls exceed 15% of the hawser NDBS in any 30 minute period. Immediate disconnect if any pull exceeds 19%}. {**The hawser in a taut hawser offtake** is obviously used in tension, so it is particularly important that all tension cycles are recorded and added to keep track of fatigue life remaining. Typical tension alarm values for DP tankers are as follows. Tanker Master and OIM consider disconnect if one pull > 19% of the hawser NDBS and particularly if two pulls exceed 19% in any 30 minute period. Immediate disconnect if any pull exceeds 27% of the hawser NDBS}.*	
	3) Position and Relative Heading Limits	3) The offtake should normally only continue if the tanker bow is within agreed separation limits from the FPSO stern and if the Tanker Heading aligns with the FPSO heading within agreed limits. These limits together with appropriate actions should be shown on a drawing within the manual. *{Typical values of separation depend on the hawser and hose length both for DP and taut hawser operations. A typical manual drawing is shown in section 6. The inner yellow (stop export) and red (disconnect) tanker limit are placed relatively close to the tankers normal operating box, to ensure that remedial action is taken before the tanker builds up forward momentum. The outer yellow and red separations are intended to release hose and hawser before the equipment is damaged. The relative heading limit is a measure both of fishtailing and of one vessel being wind rode whilst the other is current rode. Red should normally take place by the time the relative misalignment exceeds 40 to 45 degrees.}*	
	4)Communications, Position References & Telemetry systems (common to both FPSO and Tanker)	4) Cargo transfer should cease automatically if either telemetry link drops out. DP tankers should revert to manual taut hawser operation or disconnect if they have fewer than two position references on line giving adequate quality fixes to the DP system. The offtake should only continue if there are adequate verbal communication links between the tanker bridge and the FPSO CCR. In all cases the change of status will be discussed between FPSO and Tanker as soon as practicable but this will not inhibit the tanker crew taking safe action first. **Continued on following sheet.**	

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
	Safe Tanker Offtake Limits (Pg. 2 of 2)	**Continued from previous sheet.**	5, 6 & 7) **Initial Assurance:** System design limits, appropriate FMEA / trial results, and previous experiences from the duty holder, tanker operators and incident lessons incorporated into useable check lists and understandable limits within the offtake terminal manual. **Verification:** Review of manual by offtake tankers, tanker managers and an independent competent person from within duty holder's organisation (or external). Checklists tested by use during trial connection. **Ongoing Assurance:** All checks and information exchanges performed at the agreed frequency during each offtake. FPSO OIM / Marine Supervisor and tanker Master to discuss any change in actual conditions or equipment status / availability on either vessel compared to the advisory limits. They must take a joint decision on it being safe to continue but either may decide it is prudent to stop loading or disconnect. Both parties must be fully aware that either has the right to abort or postpone the offtake if they are not fully happy that it is safe to continue.
	5) FPSO equipment	5) FPSO should inform Tanker immediately if there is any reduced functionality or in any critical equipment e.g. gyros, FPSO cargo & ballast pumps, IG plant, load computer, valve controls, stern discharge system and necessary power supplies which may either cause the tanker to lose station *(e.g. gyro error)* or inhibit transfer. (For active heading controlled FPSOs this would also include the DP controls, all thrusters and redundant power supplies required to ensure FPSO heading control. The FPSO marine supervisor and Tanker master should agree a new heading if the thrusters and available power supply have difficulty holding the FPSO on the required heading within agreed thrust / power limits *{>60% Capability}*. *{The tanker should be disconnected if the FPSO thrusters / available power utilisation exceed 85%}*. The FPSO should inform the tanker master of any process instabilities which may affect their ability to continue discharge (FPSO plant and generation ESDs) and request him to disconnect immediately if the situation could jeopardise the FPSO's ability to maintain heading.	
	6) Tanker Equipment	6) Tanker Master should inform FPSO immediately if there is any reduced functionality or in any critical equipment e.g. BLS, all equipment in machinery space required for close proximity operations, generators, all pitch controls including fail safes, all thrusters and steering motors, redundant power sources, tanker gyros. The Tanker master and FPSO marine supervisor should agree a new heading if the thrusters and available power supply have difficulty holding the tanker on the required heading within agreed thrust / power limits *{>60% Capability}*. *{The tanker should be disconnected if the tanker thrusters / available power utilisation exceed 85%}*.	
	7) Helicopter & 3rd party ship Operations	7) Helicopter Operations to either the FPSO or the tanker should be discussed by both FPSO and Tanker before arrival *{They may be permitted during actual offtake provided the tankers IG vent plumes are prevented from interfering with the helicopter approach and departure tracks.}* All third party ship operations within 500m of the FPSO should remain suspended and the vessels kept at a safe standby location in case the tanker has a drive off. *{e.g. Supply boats, ROV vessel, DSVs etc.}* The Tanker Master and FPSO Marine Supervisor should discuss and agree whether to continue or disconnect if the FPSO / Tanker rotate so that a third party vessel within 3 nm (e.g. MODU) becomes down environment and potentially in jeopardy from a drifting tanker.	

APPENDIX B

PERFORMANCE STANDARDS FOR FPSO / FSU

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APPENDIX B PERFORMANCE STANDARDS FOR FPSO

The following generic performance standards have been derived for offtake critical elements (OCE) on the FPSO. OCEs are defined as major elements of the offtake operation which are critical for safety or the avoidance of either pollution or production loss during the close proximity phase of the offtake.

The standards consider two types of FPSO, those which have active heading control , and those which just passively weather vane around their turret. There are two ways of operating the shuttle tanker during offtake; either in DP with a slack hawser or slow astern in manual control with a taut hawser. The equipment requirements on the FPSO vary not only with whether they use active or passive heading control but also with which type of tanker is attached. Hence each OCE description identifies which combinations of heading control and tanker control method they apply to using the following abbreviations.

FPSO with active heading control = active

FPSO with no heading control = passive

Tanker operating in manual mode on taut hawser = tauthaw

Tanker operating on DP = dptank

Hence the term "Applies active" means the performance requirement applies only if the FPSO uses active heading control.

A range of typical values or guidance information is included in *{italic text}*. This typically applies to a FPSO in the Aframax to Suezmax size range and is intended as preliminary information to Duty Holders who are unfamiliar with the subject rather than as a substitute for correct design.

The term FPSO is used as a generic abbreviation for any floating vessel moored in a UK field which exports produced oil to an offtake tanker in a direct tandem offtake operation. *{It would include, for example, any FSU with no production plant on board}*

The Performance Standards distinguish between "new" and "existing" FPSOs.

An "Existing FPSO" means any floating vessel already installed on a UK field before 1st July 2002 to export produced oil to an offtake tanker in a direct tandem offtake operation.

A "New FPSO" means any floating vessel which is installed on a UK field after 1st July 2002 to export produced oil to an offtake tanker in a direct tandem offtake operation. *{In this context "New" includes both newly built facilities and existing facilities being relocated to a new field}*.

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
B1	**FPSO General** (Applies active & unless noted otherwise as applying to Passive) • To have accepted safety case for intended duty • To limit pollution risk offshore • To be equipped for stern discharge • To safely maintain heading during offtake (if Active). Else to freely weather vane (if Passive) • *FPSO's may need to be equipped for VOC recovery (where future National regulations or local company policy requires).*	1) FPSO to be run under adequate SMS, to have fully functioning machinery, load computer, cargo system, inert gas & venting systems, ballast system, COW systems, position reference / sensors, radio equipment and safety systems. The FPSO should be suitably manned *{refer to section 5}*, and be able to demonstrate adequate inspection, maintenance and repair. 2) New FPSOs should be double sided including protection around wing bunker tanks at the aft end. Existing FPSOs may have bunker tanks adjacent to the skin. Where possible these should be filled last and emptied first to minimise the risk of pollution, if internal bunker tanks are also available. 3) FPSOs suffer a high rate of fatigue damage when they are permanently moored offshore, particularly on the Atlantic Margin. The duty holder should plan inspection to demonstrate negligible risk of pollution through fatigue or corrosion failure of the hull, based on detailed stress analysis. *{Stress monitoring should be provided on new FPSOs once robust systems have been demonstrated to be reliable and become available. It should be considered as a retrofit on older FPSOs requiring life extension}*	1) **Initial Assurance & Ongoing Assurance:** ICP review and inspection of FPSO build and operation. **Verification:** Auditing of FPSO and independent survey of all arrangements that could affect offtake. 2) **Initial & Ongoing Assurance:** Review of tank layouts and loading plan. For exposed bunker vessels agreement of loading sequence to minimise outflow potential during loading. **Verification:** Auditing of ships. 3) **Initial and Ongoing Assurance:** Vessel built to DCR regulations and reputable Class and surveyed / maintained in accordance with an independently verified scheme under DCR. For vessels over 10 years old or operating on the Atlantic Margin the tanker Owner / operator should be able to demonstrate knowledge of and inspection of critical fatigue locations in excess of Class requirements. E.g. Through analysis of Stress monitoring and or increased inspection. **Verification:** ICP Review of duty holder's inspection.
	Stern Discharge System	4)Covered by separate performance standard	4) Refer to PS B2 for details
	Station keeping capability as follows:	5) **For North Sea & Irish Sea:** *Passive freely weather vaning FPSOs are acceptable.* **For Northern North Sea areas:** Passive *weather vaning FPSOs may work but there is an increasing case for active heading control which should be considered based on field metocean conditions.* **For Atlantic Frontier or other areas with very strong currents and difficult metocean conditions:** *Active heading control should be employed to assist the tanker provided the FPSO can demonstrate adequate redundancy / integrity. New "Active" FPSOs should be built to IMO Class 2 standards.*	5) Refer to PS B6 for details, including the need to document that the systems station keeping capabilities match the expected duty and operating limits at the field.
	FPSO Emergency Shut Down (ESD) System	6) FPSO's typically have a multi-level ESD systems which may include Level 1 Individual Unit / Process train Shutdown, Level 2 Total process shut down, Level 3 Total Facilities Shutdown, Level 4 prepare to abandon FPSO. Certain OCE's are also safety critical, *{e.g. position references, telemetry systems on all FPSOs, and thrusters and ATC / DP / controls on Active FPSOs}*. These should only be shutdown on the higher level of ESD e.g. Level 3 or when there is a direct safety threat from continued operation. (e.g. gas detected in vicinity of aerials / intakes). *{Hose and hawser reel power should also be available at higher ESD levels on FPSOs where trailing equipment poses a risk subsea.}*	6) **Initial and Ongoing Assurance:** Hazop, review of FPSO shutdown logic versus tandem offtake requirements for safe approach both by those skilled in process control and those skilled in offtake tanker collision risks. **Verification:** Testing shutdown logic cause and effects on OCEs.
	Plant layout versus collision zone.	7) New FPSOs should be laid out to minimise the escalation potential from shuttle tanker collision *{e.g. Gas flaring and high risk process plant located away from the stern collision zones}*. Existing FPSOs should evaluate the cost benefit of external structure and fendering to reduce the shuttle tanker collision risk to such process plant.	7) Concept Risk Assessment for New FPSOs or cost / benefit ALARP analysis for existing FPSOs.

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
B2	**Stern Discharge System (page 1 of 2)** (Applies to Active & Passive) • To deploy FPSO hawser	1) Hawser winch to be able to deploy or recover the hawser in a timely manner *{10 minutes}*. Winch to be fitted with automatic spooling gear for the correct rope size. Chafe chain should be attached to drum and winch be capable of withstanding hawser loads including snatch dynamics on new FPSOs. *{i.e. reduce manual handling of bitter end into a separate load bearing stopper}* Hawser winch and hose winch to be controlled by a single man from the same point if hose deployed and recovered with hawser. *{Hawsers left floating in the sea between offtakes in the UK sector have been found to suffer from premature failure due to internal chafing and also to become entangled with hoses. It is recommended that they be recovered on a winch on all new UK FPSOs}.*	1) **Initial Assurance** : Design check winches & foundations versus guaranteed hawser weak link load. *{Load to be applied from all feasible directions due to potential FPSO & shuttle tanker position losses}*. Acceptance test on speed and spooling. **Ongoing assurance** : Planned maintenance of winch and spooling mechanism. Refer to PS B1 for details of interface to FPSO ESD system.
	• To deploy FPSO hose *{Hoses on UK sector have been suspended from the stern, recovered into a chute or recovered onto a reel between offtakes}*.	2) The hose storage and recovery system must be appropriate for the field water-depth and FPSO deck space. A) Chute systems should be covered in Teflon or similar to reduce friction and prevent damage to the hose. There must be adequate recovery and deployment winches to overcome friction in the chute both ways. The mechanism for connecting the inboard hose end to the export pipe should require minimal manual intervention from aft deck crew. B) Powered reels should be capable of deploying and recovering the entire hose length *{within 10 minutes}* and storing the entire length on the drum. The reel should incorporate fluid swivels to allow export crude to be pumped from the export system into the hose without the need to connect the hose to the export pipe work following deployment. The reel should incorporate a spooling mechanism or hose guide on the drum surface. These should be suitably lined or coated to minimise damage to the hose. The hawser winch and hose winch should be controlled by a single man from the same point if hose deployed and recovered with hawser. C) Where the hose is suspended from the stern there should be adequate water depth to prevent the lower end striking the seabed in storm conditions. A retrieval line should be permanently connected to the outboard end dry break coupling for recovery. *{The hose recovery system should be powerful enough to recover a 100% full hose without any need to drain the hose down. All systems should either have redundant power and recovery motors or an alternative means of recovering the hose to a safe configuration should the reel motor fail. All systems including hawser winch should be operated from a safe position, {i.e. a location clear of the hawser} with good vision of the hawser and hose going over the stern and preferably protected from the elements. All systems should have provisions onboard the FPSO to flush oil out of the export hose and back to slops tank}*.	2) **Initial Assurance** : Design check reels or other offtake hose support systems including foundations to withstand a load well in excess of the dry break / marine breakaway coupling pull off load. *{Load to be applied from all feasible directions due to potential FPSO & shuttle tanker position losses}*. Acceptance test on speed and spooling. **Ongoing assurance** : Planned maintenance of all recovery connection and spooling mechanisms. 2) Refer to PS B1 for details of interface to FPSO ESD system. 3) **Initial Assurance :** Test and record PSV leak integrity and closure time from issuing FPSO and tanker ESD signals. **Ongoing assurance** : Annual repeat of leak integrity and closure time tests. **Verification :** ICP reviews records.
	• Telemetry, emergency export stop and disconnect.	3) The export pipework must be fitted with an PSD valve inboard of the hose reel / or other hose coupling. *{On new FPSOs this PSD valve should be located inboard away from potential collision damage zones}*. The PSD valve should shut {tripping export pumps}on export shut down being initiated from either the FPSO or the Shuttle Tanker via a 2 way telemetry system between the two. 4) The telemetry system should also permit the tanker to issue and with-draw a "greenline" permit for the FPSO to start export pumps based on all valves being open and pressures acceptable. The telemetry system must have dual radios powered from separate power circuits and both should be working before commencing export. Permit to export should cease if any telemetry link fails during export. *{The PSD valve shut down time should be quicker than tanker bow loading valve but not rapid enough to damage upstream pipework or pump seals from shutdown pressure surges.}* **Continued on following sheet.**	3) Refer to PS B1 for details of interface to FPSO ESD system. 4) **Initial Assurance:** Commissioning tests, trial tanker connection on field. **Ongoing Assurance:** test telemetry systems functioning before each connection. Trial ESD signal cause and effects every 6 months. 4) Refer to PS B1 for details of interface to FPSO ESD system.

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
B2	**Stern Discharge System (page 2 of 2)** (Applies to Active & Passive) • Servicing and Maintenance • To control the effects of oil ignition • To monitor aft deck operations • To limit risk to aft deck personnel	**Continued from previous sheet.** 5) New FPSOs should be fitted with an aft deck service crane and other local mechanical handling aids so that all mechanical components on the stern discharge system can be serviced in situ and removed for maintenance. FPSOs will have adequate materials transfer equipment and routes to enable components to be safely moved from the stern discharge system area to on board workshops or to the supply boat loading area *{main laydowns}*. 6) On new FPSOs, provision should be made to load & store a spare hawser onto an enclosed storage reel and for the hawser to be transferred directly from the reel to the main hawser winch. 7) On new FPSOs provision should be made to stow up to 4 spare lengths of hose onboard. 8) On new FPSOs provision should be made to remove and replace hose sections, dry break couplings or Marine breakaway couplings on the FPSO aft deck without involving a third party vessel. 9) The stern discharge area should be protected by either a deluge system at the PSD valve the hose coupler and any fluid swivels or by foam monitors which can be trained on these areas from a safe location. 10) The Stern Discharge Area should be monitored by CCTV with a display adjacent to the cargo control console during offtake. Lighting on the aft end of the FPSO shall be configured so as not to blind its own CCTV system or indeed the CCTV used to view the Hawser and Hose catenary from the shuttle tanker. 11) The deck in way of stern discharge equipment should be non-slip coated and fitted with save alls to prevent hydrocarbon overspill to main deck. All machinery should be guarded as far as practicable given the duty. Access platforms and guard-rails should be fitted to ensure messengers can be connected *{e.g. between the hose and hawser end}* without personnel having to hang overboard outside the guarded areas. All machinery and aft deck work should only be performed by FPSO crew having being briefed on the operation, hazards, and machinery and issued with adequate PPE. Control stations and personnel standby locations should be protected from the effects of breaking ropes by location or physical protection. *{All non- inducted personnel should be kept clear during connected operations. Occasional chaperoned access for inspection}*.	5, 6, 7 & 8) **Initial Assurance:** Design review and acceptance tests. **Ongoing Assurance :** Operational feed back 9 & 10) **Initial Assurance:** Design review and acceptance tests. **Ongoing Assurance :** Periodic tests 11) **Initial & Ongoing Assurance:** Design review plus onboard housekeeping and training routines.

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
B3	**<u>Hawser system</u>** (Applies all) • To provide mooring link between FPSO and tanker • To be suitable to connect to tanker BLS system • To be easily deployable and recoverable with easy rigging connections and fast enough winches to minimise the time the tanker is in close proximity. • To be equipped with sensors to alert operators when tension too high {*Typically comprises a chafe chain at each end, where it passes through fairleads or into stoppers, with a nylon "braidline" or "superline" in between}.* This is the main station keeping mechanism for taut hawser tankers. It also forms a backup station keeping mechanism for DP tankers in the event of any single failure occurring. Its slack catenary shape provides a visual back up position check for DP tankers which also can revert to taut hawser mode in the event of a single failure. *{Should contains a weak link, often at the FPSO chafe chain}.*	1)Long enough to maintain adequate tanker to FPSO clearance when connected. *{> 80m though short separation of 40m and occasionally bridle arrangements are used for some taut hawser offtakes, particularly where different FPSO and tanker size makes the arrangement prone to fishtailing on longer hawsers}* 2)NDBS & Load extension properties matched to permit tanker to sit back slow astern on hawser and still absorb relative vessel motions within low tension range. *{Typical range 80m x 650 tonne NDBS Nylon Superline for mixed DP / taut hawser operation to 40m double grommet made from 540 tonne NDBS Nylon Braidline for some taut hawser operations with no DP option. A grommet hawser will have almost twice the NDBS of the rope it is made of:- 2 parts less splicing / bending loss}* 3)To have enough residual strength on retirement to safely survive the maximum 'disconnect' tensions permitted operationally before immediate disconnection. This should allow for fatigue damage and non-inspectable internal yarn degradation, e.g. under high tension or compressive cycling. *{For pure DP operation where the hawser is normally kept slack, this may comprise retiring hawsers when they are either 24 months old or if they receive any single load > 23% NDBS. For operations requiring regular taut hawser connections as well as DP, higher loads are normal and a more sophisticated retirement criteria may comprise retiring hawsers when they are a)16 months old, or b)if they receive a single load > 36% hawser NDBS or c)when they have received cumulative fatigue damage which makes their residual strength or internal condition suspect. The hawser will suffer internal yarn damage if it is left floating in the sea for extended periods, e.g. between loadings. This additional damage must be taken into account in assessing cumulative damage if the hawser is left in the sea rather than being stored on a reel between offtakes}*. 4)Weak link to break at a predictable load *{< 66% of hawser NDBS}* which is greater than the maximum hawser "disconnect" tension but less than the load which can damage the hawser winch mechanism, stoppers or foundations at either end. The weak link is to ensure that the hawser parts rather than cause structural damage.	1,2&3)**Initial Assurance** : Hawser sized by operator / tanker owner's previous successful practice and checked / **verified** by tandem mooring computations and / or model tests for operational metocean conditions. Hawser is specified, manufactured, spliced inspected and tested in accordance with OCIMF Guideline (Ref 3) Specify a retirement criteria based on OCIMF prototype test fatigue load data (wet service) and OCIMF load range vs load cycle relationship. *{Note that a safety factor of 10 on load range should be applied to ensure a factor of at least 2 on fatigue endurance and take account of the inability to inspect internal condition}.* Specify operating tensions where crew should disconnect immediately. *{Typically 1 pull @ 19% NDBS for pure DP operation. Typically 1 pull @ 27% or 2 pulls > 19%NDBS in any ½ hour period for taut hawser operations.)* Fit and calibrate a load cell to monitor tension loads. 1,2&3)**Ongoing Assurance** : Crew inspect hawser for external damage as it is recovered. FPSO & tanker crew disconnect if tensions exceed specified limits. Crew log hawser history and significant tension peaks during each offtake. (Note if the hawser is ever used for taut hawser operations then the crew must calculate cumulative fatigue damage versus retirement criteria for all operations). Regular calibration of load cell in PM system. **Verify** by auditing operations and records. For taut hawser operations **verify** the specified retirement criteria versus reality by destructively testing used hawsers (yarn realisation techniques may be used). 4)**Initial Assurance** : Design check winch & foundations versus weak link load. Weak link concept based on predictable reliable failure *{e.g. Notched well supported section in pure shear}*. **Verify** : Test break of new prototype. **Ongoing assurance** : Inspect weak link during hawser change out & **verify** by test breaking 1st retired weak link.

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / ***{Typical Values / Guidance @ April 01}***	Initial Assurance / Ongoing Assurance / Verification
B4	**<u>Export Hose System</u>** (Applies all) • To provide flexible oil flow path between FPSO and Tanker. • To be electrically discontinuous • To maintain high standards of integrity under all design conditions, including emergency disconnect, to minimise the risk of pollution. • To be easily deployed and recovered back to the FPSO. • To be suitable for connection to ST BLS system . *{Typically comprises bolted sections of reinforced bonded construction offshore loading hose.}* *{Should be fitted with a dry break coupling at the outboard hose end. This typically comprises a fail closed disk valve in the 20" tanker end fitting. The disk valve can only be opened after the tanker connection is made up and the corresponding mushroom valve from the tanker half of the coupling pushed down into the hose end to open the flow path}* *{May be fitted with an intermediate Marine Breakaway Coupling. This typically comprises a link designed to fail at a known load. Spring loaded petals close the upstream hose end automatically on failure}*	1)Long enough to provide enough slack for the hawser system to stretch to breaking point, but short enough to minimise the risk of the hose catenary chafing against the tankers bulbous bow. *{Typical lengths in use, range between 1.5 and 2.0 times hawser length}*. 2)Hose to have the largest reasonably practicable diameter for FPSO aft deck / hose storage limitations to permit transfer of cargo as quickly as possible. *{The standard tanker bow coupling is 20" but some existing FPSO's are fitted with smaller 16" hoses limiting flow}*. 3)Hose sections to be designed and fitted with bend restrictors at the flanged connections as required to match the local bending and torsion loads to which they may be subjected during construction service and offshore replacement. *{Typical reinforcements may be to protect the flanges and hose whilst on a storage reel or chute and to withstand extra local bending or torsion at the outboard dry break coupling, the inboard FPSO coupling, or any intermediate breakaway coupling. The hose design must take account of the degrees of freedom in the attachment systems on both the FPSO and Tanker versus operational movement, and also of tension/bending on the FPSO storage and retrieval system.}* 4)Hose system to resist maximum working pressure under all possible operating conditions throughout life. *{This includes loads when full of oil or seawater and dynamic pressure surges possible under emergency disconnect or pull off scenarios}*. 5)Dry break hose end valve should fail closed under all flow conditions if the hose is released from or pulled off the tanker bow fitting to minimise pollution. *{The hose end disk valve should typically close over a duration of 25 to 35 seconds. Manufacturers of 20"dry-break couplers include Pusnes, Hitec, Speedseal & MIB}* 6) Hose to have an electrically discontinuous section close to each end. 7)Used if the bow fitting on any of the offtake tankers is not designed to automatically release the dry break coupling under loads before the hose ruptures or the FPSO hose / reel connection is damaged. *{If fitted the position should be near the outboard hose end, the design failure load must be > max working tension/bending + max surge pressure load}*.	1&2)**Initial Assurance / Verification** Hose length and hawser length demonstrated by catenary calculations and plots taking into account hawser stretch characteristics and FPSO / tanker geometry. 3)**Initial Assurance** Hose manufacturer design calculations checked as reflecting the correct FPSO storage and retrieval system plus end / ancillary fittings. 4&5) **Initial Assurance** System pressure surge calculations performed and checked in accordance with process design codes & ISGOTT taking due account of actual valve closing sequence and times during all emergency disconnect / shut down scenarios. Valve types *{disk valves may decrease flow linearly with displacement whereas butterfly valves constrict the flow very little in the first 85% of closure and then very rapidly in the last 15%},* closing sequence and closing times **verified** / tested to be in accordance with or in excess to the design assumptions. 3, 4&6) **Initial Assurance** Hose system specified, manufactured and tested in accordance with OCIMF guidelines (ref 4) & ISGOTT. 3,4, &6)**Ongoing Assurance** Hose system handled, stored, maintained and periodically tested in accordance with OCIMF guidelines (ref 5). *{Typically this will include: inspection of the hose for kinking, chafing or oil seepage after each retrieval: annual flushing of entire export system including the pipework back to the pumps and pressure testing the entire export system to 1.5 x max allowable operating pressure for 3 hrs: plus inspection and testing onshore every 3rd year}*. All FPSO, hose and Tanker valves involved in normal or emergency shutdown / disconnect tested annually to **verify** closure sequence and timings remain as per design. 5)**Ongoing Assurance** Inspect MBC for bolt stretch or carcass movement on every recovery. Dismantle , check closure times and remake every third year. 7)**Initial Assurance** Design calculations demonstrate break load in correct range. **Verified** Prototype component testing. **Ongoing Assurance** Inspection for bolt stretch / displacement on retrieval after every offtake. Dismantle , check times / components & remake annually.

Ref.	**Function** / *{Description}* / **Applicability**	**Requirements / Survivability / *{Typical Values / Guidance @ April 01}***	**Initial Assurance / Ongoing Assurance / Verification**
B5	**Power Generation / Distribution:** **(Page 1 of 2)** Applies Active FPSO • To reliably power thrusters, control systems, references and all normal hull, production and stern discharge functions. • To fail to safe condition as a far as can reasonably be achieved. • To alert operators on system malfunction.	1) Existing active heading control FPSOs should have their power generation and distribution systems enhanced as far as reasonably practicable to achieve the ability to maintain heading following a failure of any single active component including a main generator. *{It is important that where thruster and control system power comes from generators & boards also powering main production loads that the overall load shedding logic assigns a top priority to maintaining active heading control during tandem offtake operations. Thruster failure under active heading control could result in a sudden FPSO change in heading and a resulting over correction from the tanker's DP system as it tries to follow}* 2) FPSOs being newly brought into field service where they require active heading control should in future have all power generation and distribution *{which is used to actively control heading}* to IMO DP Class 2 standards in all areas where power loss could affect its ability to maintain station in close proximity FPSO operations. *{Load shedding logic and priorities versus other production supplies should be considering in considering the adequacy of redundancy to resist single failures to IMO DP 2 standards}*	1, 2, 3, 4, 5, 6 & 7) **Initial Assurance:** FMEA including proving trials of FPSO power, thrusters and controls in accordance with IMO and IMCA standards (Ref section 4.4). System capabilities should be calculated and documented both with everything working and with each significant single failure. *{This to illustrate the power balance between duplicate systems is understood, and that crew understand operating limits to cater for the effects of a single failure}*. **Ongoing Assurance:** Annual trials to confirm functioning of equipment and alarms plus retrial following repair or modification (ref. Section 4.4). *{All trials should be carried out by proper simulation of failures (e.g. by removing terminals, disconnecting 24V distribution circuits, tripping machinery etc) and investigating unexpected results and recording results}*. **Verification:** On board independent audit of FMEA, trials reports and annual tests. *{All such reports should be on-board, up to date, and understood by CCR DP / ATC operators and maintenance supervisors / technicians with respect to actions which need to be taken a) to maintain high levels of integrity and b) to diagnose and overcome failures}* 1, 2, 3, 4, 5, 6 & 7) **Refer to PS B1 for details of interface to FPSO ESD system.**
	Power generation and main switch board	3) Single HV switchboards are acceptable for existing FPSOs where it is no longer reasonably practicable to provide redundant supplies to the thrusters. *{However all reasonably practicable enhancement and operational control steps must be taken to ensure integrity so that they don't fail or trip during close proximity operations. This may include limiting large production motor starts / changeovers during offtake and any maintenance activities which could induce load shedding / generator tripping or any other instability in the system. Retaining thrusters should be a top priority during offtake in any load shedding scheme on an active FPSO}* 4) Where thrusters are powered from a single switchboard, the cells should be separated so that a local fire or fault in one thruster cell will not immediately affect the other thrusters cell. A bus tie breaker need not be installed, however there should be suitable means of dividing the bus (by switch or links) in the event of a short circuit and subsequent blackout, to allow propulsive power to be restored quickly. 5) The DP heading control system must monitor the generator outputs versus thruster and additional load consumers and excessive power levels should alarm to alert the operators. Where thrusters are powered by the main bus an alarm should activate at *{60%}* power level, and automatic pitch reduction on the thrusters should initiate at *{85%}* of available bus power levels. Standby generators should be arranged to come on line before the *{85%}* limit is reached. *{NB Alarm levels and actions should be based on consideration of size of generators relative to thruster loads if power coming from main production generators}*. 6) For vessels with power management systems, such systems are to be UPS powered. The UPS must have alarms for low voltage and charger failure. Loss of the power management system should result in the boards "failing as set". Generator control systems and charging units must be alarmed for low voltage and charger failure. **Continued on following sheet.**	

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / ***{Typical Values / Guidance @ April 01}***	Initial Assurance / Ongoing Assurance / Verification
B5	**Power Generation / Distribution:** **(Page 2 of 2)** LV Power / Control system power	**Continued from previous sheet.** 7) Special attention shall be given to the 220V & 24V distribution for DP, references, sensors, controls, & thrusters, such that failure of a single fuse will not disable any non redundant system. On vessels with a single 220 V main board, consumers where single fuse failure could lead to loss of a critical control function, resulting in potential loss of vessel position, should have backup supplies from either the 220 V emergency board or a 24 V system. The 24V distribution should preferably be split into 2 sections via a fast fuse whilst the consumers should be on slower fuses. Systems where single fuse failure could lead to loss of a critical control function, resulting in potential loss of vessel position, should have duplicate power from an independent source. All battery-backed systems should be fitted with status monitoring such that charger failure or low voltage alerts the DP operators.	See sheet 1 of 2

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
B6	**Thrusters & Steering Gear** Applies to Active FPSO • To provide adequate FPSO heading control to assist tanker connection, offtake & disconnection • To fail to safe condition as a far as can reasonably be achieved. • To alert operators on system malfunction	1) Existing active heading control FPSOs should have minimum two operational thrusters at a significant lever arm from the turret. *{The minimum is 2 transverse stern thrusters if the turret is near the bow whereas more transverse bow thrusters may be required if the turret is nearer amidships. Number and size of thrusters to match required moment to maintain heading control after worst single failure}.* 2) FPSOs being newly brought into field service where they require active heading control should have thrust arrangements to IMO DP class 2 requirements and thrusters should be sized with due regard to residual capability following worst single failure matching the required metocean operating limits for offtake at the most severe operating location.	1, 2, 3, 4, 5 & 6) **Initial Assurance:** FMEA including proving trials of vessel power, thrusters and controls in accordance with IMO and IMCA standards (Ref section 4.4). System capabilities should be calculated and documented both with everything working and with each significant single failure. *{This to illustrate the power balance between duplicate systems is understood, and that crew understand operating limits to cater for the effects of a single failure}.* **Ongoing Assurance:** Annual trials to confirm functioning of equipment and alarms plus retrial following repair or modification (ref. Section 4.4). *{All trials should be carried out by proper simulation of failures (e.g. by removing terminals, disconnecting 24V distribution circuits, tripping machinery etc) and investigating unexpected results and recording results}.* **Verification:** On board independent audits of FMEA, trials reports and annual tests. *{All such reports should be on-board, up to date, and understood by CCR DP / ATC operators and maintenance supervisors / technicians with respect to actions which need to be taken a) to maintain high levels of integrity and b) to diagnose and overcome failures}*
	Thrusters & Steering gear	3) Thrusters should be arranged so that they do not fail to full pitch in either direction and that azimuthing gear (if fitted) fails to set. *{Thrusters should sound an audible alarm, if there is a large discrepancy between desired and actual pitch or between desired and actual azimuth. DP / ATA operators should stop the relevant thruster immediately on alarm}.* Thrusters should as far as reasonably practicable be powered from separate sources to reduce the risk that more than one thrusters / rudder fails in the same event.	1, 2, 3, 4, 5 & 6) **Refer to PS B1 for details of interface to FPSO ESD system.**
	Controls and Alarms	4) Thrusters should take control signals from both DP computers and from separate manual control consoles close to the DP console in the CCR and also from a backup location within the engine room. Even on DP class 1 heading control system, 5) FPSO thruster controls should be powered from separate sources with the use of UPS so that no single power failure could result in the loss of sufficient thrusters to cause a loss of FPSO position or heading. 6) Independent thrust & azimuth indicators should be installed close to the DP console, fed from a separate circuit than the DP thruster pitch angle / azimuth signals. Any thruster power failures or thruster failures should sound alarm to alert operators.	

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
B7	**DP Heading Control System, Position References & Sensors (Pg. 1 of 2)** Applies to active and where noted also to passive FPSO's accepting DP tankers. • To provide accurate heading control • To provide accurate FPSO stern position and heading information to DP tanker. • To fail to safe condition as a far as can reasonably be achieved. • To have enhancements that provide adequate redundancy to prevent minor or common single point failures compromising station-keeping integrity. • To alert operators on system malfunction. **Position References & Sensors** Applies to active and also to passive FPSO's accepting DP tankers. **Note:** if a **Passive** FPSO is only accepting **taut hawser tankers** which do not use DP even for approach or departure then it needs to provide no position references other than an approximate heading (+/-5deg). This is only to enable the tanker to make its initial run to pick up the messengers. In this case the FPSO may only have a single gyro and the stated heading should be corroborated by ERRV, or tanker visual during approach.	1) The FPSO DP heading control system should always be a duplex system with 'bumpless' changeover from one to the other. The DP system should be UPS supplied and alarmed. 2) Existing Active FPSOs having IMO DP Class 1 heading control systems must be enhanced so that there are 2 computers configured so that common facilities, interfaces, data check or data transfer routines are incapable of crashing both. Controls must be designed and operated so that no single inadvertent act can cause loss of heading. Unenhanced DP Class 1 FPSOs may alternatively revert to passive weather-vaning mode without thruster assist during tandem offtake operations if their turret type permits. *{Duty holders should be aware that, for FPSO heading control in close proximity operations the Simplex levels of equipment and redundancy specified in IMO guidelines for Class 1 DP are not adequate to provide ALARP if the FPSO could dramatically alter heading on . This is achievable by providing industry standard duplex DP heading control systems, whereby the second system monitors the performance of the on-line system and assumes control in the event of a malfunction of the on line system without affecting the vessel position. This enhancement alone significantly increases the DP system reliability by an order of magnitude}* 3) Loading terminal software must specify limits for offtake ESD and ERS actions. Warning must sound at ESD limits. 4) Hawser tension monitoring systems must have an output to the heading control DP system which alarms when the tension is excessive. The DP heading control system should be equipped with an events printer which should be switched on during close proximity operations. 5) New Active heading control FPSOs must have on line capability plots and warnings if capability being exceeded. 6) Existing FPSOs must provide at least two working independent position reference signals so that a DP tanker can position itself relative to the vessel stern. If one of these fails, pumping should stop, the tanker revert to taut hawser operation or if in doubt that she can stay on taut hawser the tanker should disconnect. Pumping can restart if metocean conditions are suitable and both OIM and tanker master agree that it is safe to perform a taut hawser export. 7) New FPSOs should provide three completely independent relative position references. All new position fixing antennae should be located as close to the offtake point (normally stern) as possible, without causing signal loss, to minimise the gyro error in position data. 8) New FPSOs should take Bloms (or similar) data by telemetry from tankers for use by the Marine Supervisor / CCR in assessing reference quality and tanker station keeping versus ESD and ERS (disconnect) limits. Alternatively the FPSO should independently monitor tanker position via an Artemis or Fan beam system (with direct output on the FPSO rather than the ST) that activates alarms if the ST moves out of predetermined station-keeping limits. Existing FPSOs should make one of these enhancements by July 2003. 9) Existing FPSOs using DP offtake tankers may use two gyros provided these are powered from separate UPS, actively monitored to alarm if the two gyros differ by more than 3 degree. The tanker is to be informed immediately on alarm that the FPSO heading in the **DP** system is unreliable as a gyro may be drifting. New FPSOs should fit high accuracy gyros (0.7 deg / cos Lat or better) 10) The position reference systems and sensors should be UPS supplied and alarmed to provide DP class 2 level redundancy under IMO MSC 645 and alert the DP / ATA operator of any position reference or sensor dropping out.	1, 2, 3, 4, 5, 6, 7, 8, 9 & 10) **Initial Assurance:** FMEA including proving trials of vessel power, thrusters and controls in accordance with IMO and IMCA standards (Ref section 4.4). **Ongoing Assurance:** Annual trials to confirm functioning of equipment and alarms plus retrial following repair or modification (ref. Section 4.4). *{All trials should be carried out by proper simulation of failures (e.g. by removing terminals, disconnecting 24V distribution circuits, tripping machinery etc) and investigating unexpected results and recording results}*. **Verification:** On board independent audit of FMEA, trials reports and annual tests. *{All such reports should be on-board, up to date, and understood by bridge officers and engineers with respect to actions which need to be taken a) to maintain high levels of integrity and b) to diagnose and overcome.* 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10) Refer to PS B1 for details of interface to FPSO ESD system. 7) One potential exception is having 1 DGPS antenna far enough forward to derive heading checks.

APPENDIX C

PERFORMANCE STANDARDS FOR SHUTTLE TANKERS (OFFLOADING FPSO/FSUs)

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APPENDIX C PERFORMANCE STANDARDS FOR SHUTTLE TANKERS (OFFLOADING FPSO / FSUs)

The following generic performance standards have been derived for offtake critical elements (OCE) on shuttle tankers performing tandem offtakes from a FPSO or FSU. OCEs are defined as major elements of the offtake operation which are critical for safety or the avoidance of either pollution or production loss during the close proximity phase of the offtake.

The standards consider two types of FPSO / FSU, those which have active heading control , and those which just passively weather vane around their turret. There are two ways of operating the shuttle tanker during offtake; either in DP with a slack hawser or slow astern in manual control with a taut hawser. The equipment requirements on the FPSO vary not only with whether they use active or passive heading control but also with which type of tanker is attached. Hence each OCE description identifies which combinations of heading control and tanker control method they apply to using the following abbreviations.

FPSO or FSU with active heading control = active

FPSO or FSU with no heading control = passive

Tanker operating in manual mode on taut hawser = tauthaw

Tanker operating on DP = dptank

Hence the term "Applies dptank" means the performance requirement applies only if the offtake tanker is on DP.

The Performance Standards distinguish between "new" and "existing" tankers.

An "Existing Tanker" means any shuttle tanker that either has had its keel laid before 1st July 2002 or has commenced upgrade to accommodate bow loading or close proximity station keeping capability before 1st July 2002, and which is seeking tandem offtake work on the UK sector.

A "New Tanker" means any shuttle tanker that either has had its keel laid after 1st July 2002 or has commenced upgrade to accommodate bow loading or close proximity station keeping capability after 1st July 2002, and which is seeking tandem offtake work on the UK sector. *{In this context "New" includes both newly built tankers and existing tankers being newly converted to permit offshore offtake}*.

A range of typical values or guidance information is included in *{italic text}*. This typically applies to a shuttle tanker in the Aframax to Suezmax size range and is intended as preliminary information to Duty Holders unfamiliar with the subject rather than as a substitute for correct design.

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
C1	**Shuttle Tanker General** (Applies Tauthaw & dptank) • To be certified as trading tanker for intended use • To limit pollution risk both offshore and on port entry • To be equipped for bow loading and manifold discharge • To be equipped to safely maintain station at the proposed offshore location • *Tankers may need to be equipped for VOC recovery (where National regulations or local company policy requires).*	1) The vessel should be fully certified, have no significant limitations of class and be capable of unrestricted trading. DP tankers should have DP class notation and the relevant performance rating. Vessel draft, parallel mid body length and mooring arrangements must be suitable for intended discharge ports (DISPORT). Vessel to be run under adequate SMS, to have fully functioning machinery, cargo system, COW system, inert gas / tank venting system, ballast system, navigation and radio equipment and safety systems. The vessel should be suitably manned, and be able to demonstrate adequate inspection, maintenance and repair.	1) **Initial Assurance & Ongoing Assurance:** Vetting by oil majors under OCIMF SIRE scheme and against DISPORT specific requirements. **Verification:** Auditing of ships vetting records and frequency else independent survey if frequency by oil majors not adequate.
		2) New vessels should be double hulled according to MARPOL requirements. Existing vessels may be single hulled providing safeguards are taken to reduce the potential for oil outflow, however note that such vessels are being phased out and have higher potential for pollution in the event of grounding or collision. *{If existing vessels with single hulls have to be used, they should adopt a loading sequence to keep the wing tanks in the forward 1/3rd of the vessel empty or in a condition to minimise oil outflow in the event of FPSO collision for as long as compatible with a safe loading sequence.}*	2) **Initial & Ongoing Assurance:** Review of tank layouts and class description. For single hull vessels, agreement of modification to loading sequence to minimise outflow potential during loading. **Verification:** Auditing of ships.
		3) Shuttle tankers can suffer a higher rate of fatigue damage particularly when they are performing continuous "Contract of Affreightment" COA duty or operating on the Atlantic Margin. The owner operator should be able to demonstrate negligible risk of pollution through fatigue or corrosion failure of the hull. *{Stress monitoring should be provided on new tankers if the ships are intended for Atlantic margin or COA duties. It should be considered as a retrofit on older tankers performing these duties}*	3) **Initial and Ongoing Assurance:** Vessel built to a reputable Class, surveyed and maintained in accordance with Class requirements. For COA vessels over 10 years old or operating on the Atlantic Margin the tanker Owner / operator should be able to demonstrate knowledge of and inspection of critical fatigue locations in excess of Class requirements. E.g. Through analysis of Stress monitoring and or increased inspection. **Verification:** Review of owner operator's inspection.
	Overfill avoidance systems	4) Cargo tanks should be equipped with a suitable remote level monitoring system with independent alarms *{High & High High Level}*. *{New DP tankers should be equipped so that cargo loading and distribution can be performed from near the DP console on the bridge. This would be to maximise the availability of a 2nd qualified DP operator on the bridge during loading without compromising DP operations}*.	4) **Initial & Ongoing Assurance:** Review of equipment layouts and description. **Verification:** Auditing of ships.
	The Bow Loading System	5)Covered by separate performance standard.	5) Refer to PS C2 for details
	Station keeping capability as follows:	6) **For North Sea & Irish Sea:** *Non DP or 'un-enhanced' DP Class 1 Tankers working on taut hawser are acceptable.* **For Northern North Sea areas:** *'enhanced' DP Class 1 tankers.* **For environmentally sensitive areas (or Atlantic Frontier):** *Class 2 DP tankers should be utilised where possible, though enhanced DP 1 may be acceptable for occasional relief or on permanent basis if demonstrated to have the same risk as DP2.*	6) Refer to PS C6 for details including the need to document that the system's station keeping capabilities match the expected duty and operating limits at the worst anticipated operating location.
	Emergency towing capability	7) Tanker will be fitted with standard IMO / OCIMF pattern emergency towing gear for sea-going duty. *{If it is intended to use towing assist vessels to make rapid connections in field, to reduce risk of close proximity collisions then duty holders should consider fitting suitable light weight synthetic ropes to speed up connection and lessen handling injuries. If these are pulled up and placed over tanker bollards, then the bollards and underdeck strengthening must be designed to resist the maximum breaking load of the rigging to OCIMF requirements}*	7) **Initial & Ongoing Assurance:** Review of equipment layouts, design check calculations and procedure.

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
C2	**Bow Loading System BLS** (Applies to Tauthaw & dptank) • To recover & latch FPSO hawser • To recover & latch FPSO hose • To permit emergency disconnection • To limit the effects of an oil leak from connection by dual channel telemetry and establishment of green line permit to pump • To control the effects of oil ignition • To limit risk to foredeck personnel	1) BLS system should be of standard offshore design with bow roller / fairlead, traction winch for the main hawser, remotely operated chain stopper for hawser chafe chain and powered storage reel for messengers. *{Traction winch should ideally be two speed and pull circa 50 tonnes on slow speed; bow stopper should be capable of being released under hawser tension up to 50% Hawser NDBS and designed to withstand loads in excess of hawser breaking load.}* 2) The hose recovery system should be of standard offshore design and comprise either fine adjustment of chafe chain or a separate hose handling line led through bow rollers and fairleads to a separate hose handling winch. *{Winch should having a 25 tonne pull should be adequate for FPSO duty though many new tankers have 50 tonne winches for submerged OLS or SAL duty.}* 3) The hose latching mechanism should accommodate a standard 20"dry break coupling flange with remotely and locally controlled latching mechanism and downstream ball valve. *(New ships should have a latching mechanism that will release the hose if its tension exceeds circa 35 tonne. A few existing ships may not automatically release hose under tension and these can only be mitigated using a separate dry break coupling}* 4) The hose & hawser should be capable of remote release from the bridge as well as local operation. {*There should be a remote CCTV camera with views of the upper foc'sle, hawser winch hose, winch and coupler.*} 5) There should be hydraulic accumulators in the system to allow the system to operate normally in the event of hydraulic failure. *{The accumulators should also allow emergency shut down and disconnection with no hydraulic pressure available. Coupler claws should have dedicated accumulator}*. The controls should be powered from a UPS supply. 6) The BLS controls should be of the 'green line' principle based on 2 way telemetry with FPSO and with automatic closure of FPSO PSD valve (pump trip) and closure of BLS valves in the event of high crude oil pressure, low hydraulic pressure, coupler not open, end valve not open or inboard valve non open. Three coupler in position sensors to be fitted, 2/3 activating initiate ESD (stop pumping / close valves). *{Note either FPSO or Tanker Bridge should be able to initiate ESD but normally only tanker bridge should initiate disconnect}* 7) The BLS area should be protected by a deluge system at the chain stopper, bow fairlead, traction winch, and cargo hose coupler area with an additional remotely operated foam monitor for the bow loading area. The deluge systems should be arranged to automatically operate on ERS or by manual initiation. *{New ships should consider the merits of a protected escape tunnel from enclosed areas manned near the foc'sle during offtake}* 8) The deck in way of BLS should be non-slip coated and fitted with save alls to prevent hydrocarbon overspill to main deck. All machinery should be guarded as far as practicable given the duty. All machinery and foredeck operations should only be performed by ships crew having being briefed on the operation, hazards, and machinery and issued with adequate PPE. Control stations and personnel standby locations should be protected from the effects of breaking ropes by location or physical protection. *{All non-inducted ships personnel should be kept clear during connected operations. Occasional chaperoned access for inspection}*.	1 to 8) **Initial and Ongoing Assurance:** The bow loading, telemetry and control systems are not covered by a standard OCIMF vetting nor fully covered by class requirement. Hence tanker owner / operators should be able to demonstrate that they have an adequate in house standard / procedure covering functional requirements, operation inspection and testing. This should include testing of ESD functions, telemetry, pressure related trips, and hose connection integrity prior to pumping. **Verification:** Auditing the existence of such a standard /procedure and completion records of testing against it. Verification of working practices.

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
C3	**Main Propulsion 1:** Applies tauthaw with no DP used during approach, offtake or disconnection. • To provide adequate manoeuvrability for connection disconnection. • To provide finely controlled low power astern thrust for prolonged offtake periods. • To fail to safe conditions. • To alert operator on malfunctions. Propeller(s) Main Engine / CPP Auxiliaries Main Engine / CPP Controls	1)A single main engine is acceptable on existing tankers provided measures have been taken to reduce the risk and consequences of engine failure to ALARP. 2)New tankers entering service should have redundant fore and aft propulsion either by second main engine and CPP, or by dual 'azipods' / 'mermaids' or by secondary azimuthing thrusters or in benign fields by permanently attached stern tugs. 3) Main engine(s) should be suitable for prolonged lower power operations. *{ I.e. by using auxiliary scavenge air supply fan, trace heating on fuel lines, cooling water re-circulation and governor booster pumps as required. Isolating individual cylinders from fuel injection is acceptable.}* 4) Main engine fuel rack should be either alarmed to ECR & bridge crash stop positions or automatically limited and alarmed when in offtake mode *{to prevent excessive power if governor fails to high fuel position}*. If 'Azipods', 'Mermaids' or similar large azimuthing thrusters are used on future units for main propulsion with electrical variable speed drives, the drive units should be arranged such that failure of a single thyristor, or minor component does not result in loss of the thruster. 5) A single CPP main propeller is acceptable on existing tankers provided it fails safe and in particular cannot drift or fail ahead in taut hawser mode. *{Fail safe should be for the propeller to fail astern, or for it to trip the main engine if pitch drifts further ahead than slow astern. Automatic change over to emergency pitch control is also desirable providing the operator is alerted to the malfunction and that the backup control (e.g. push button or lever control on the bridge console) is active}*. 6) New tankers entering service should have redundant fore and aft propulsion. *{Note pitch on both units should still fail-safe and the power on both units in taut hawser mode should be reasonably well balanced after considering remaining failure modes. E.g. A propeller failing full ahead will exert more thrust than an identical unit put full astern to counter it. A 3000 bhp azimuthing thruster may yield circa 30 tonnes thrust whereas a tanker's single main propeller could yield circa 150 tonnes at full ahead}* 7) Key pumps (lube oil, camshaft oil, governor booster, gearbox oil, fuel, and especially CPP hydraulic pumps, should be duplicated and arranged for automatic change over (without engine trip) powered from separate cells of the switchboard. *{The changeover system should be such that failure of a fuse in the changeover relays should not trip all the pumps. An alarm should activate to alert watch-keepers on changeover}*. 8) Main engine / CPP should take control signals from separate manual control consoles on bridge and within engine room. The control units should have a backup (non-follow up) control unit. 9) Main engine and especially CPP controls should have dual supplies, one of which is UPS or battery back up so that equipment continues to function after a single failure. An alarm should sound to alert operators of failure on either power supply or changeover. The back-up non-follow up controls should be powered from a separate third source.	1, 2, 3, 4, 5, 6, 7, 8 & 9) **Initial Assurance:** FMEA including proving trials of vessel main engine, CPP and controls in accordance with IMO and IMCA standards (Ref section 4.4). System capabilities should be calculated and documented both with everything working and with each significant single failure. *{This is to ensure the power balance between duplicate systems is understood, and those crews understand operating limits to cater for the effects of a single failure}*. **Ongoing Assurance:** Annual trials to confirm functioning of equipment and alarms plus retrial following repair or modification (ref Section 4.4). *{All trials should be carried out by proper simulation of failures (e.g. by removing terminals, disconnecting 24V distribution circuits, tripping machinery etc) and investigating unexpected results and recording results}*. **Verification:** On board independent audit of FMEA, trials reports and annual tests. *{All such reports should be on-board, up to date, and understood by bridge officers and engineers with respect to actions which need to be taken a) to maintain high levels of integrity and b) to diagnose and overcome failures}*

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
C4	**Main Propulsion 2:** Applies dptank • To provide adequate manoeuvrability for DP connection, offtake & disconnection. • To provide finely controlled low power thrust for prolonged periods. • To fail to safe conditions. • To alarm on malfunctions. Propeller(s) Main Engine / CPP Auxiliaries Main Engine / CPP Controls	1)A single main engine is acceptable on existing tankers provided measures have been taken to reduce the risk and consequences of engine failure to ALARP. 2) New tankers entering service should have redundant fore and aft propulsion either by second main engine and CPP, or by dual 'azipods' / 'mermaids' or by secondary azimuthing thrusters. *{Existing DP Class 2 tankers already have this redundancy}*. 3) Main engine(s) should be suitable for prolonged lower power operations. *{ I.e. by using auxiliary scavenge air supply fan, trace heating on fuel lines, cooling water re-circulation and governor booster pumps as required.}* 4) Main engine fuel rack should be either alarmed to ECR & bridge crash stop positions or automatically limited and alarmed when in DP mode*{ to prevent excessive power if governor fails to high fuel position. A typical single main engine will not need to deliver its max output circa 150 tonne max ahead thrust when in DP. Note even where class 2 redundancy is provided main engines should still be power limited, fuel rack alarmed and fail stop to avoid the potential to fail full power}*. Where 'Azipods', 'Mermaids' or similar large azimuthing thrusters are used for main propulsion with electrical variable speed drives, the drive units should be arranged such that failure of a single thyristor, or minor component does not result in loss of the thruster. 5) A single CPP main propeller is acceptable on existing DP tankers provided it fails safe and in particular can-not drift or fail full ahead in DP mode. *{Fail safe can be for the propeller to go to either zero pitch or to set pitch, or for it to trip or declutch the main engine if pitch control fails. Automatic change over to emergency pitch control is also desirable providing the operator is alerted to the malfunction and that the backup control (e.g. push button or lever control on the bridge console)is active}*. 6) New DP tankers entering service should have redundant fore and aft propulsion. *{Note pitch on both units should still fail safe and the power on both units in DP mode should be reasonably well balanced after considering remaining failure modes. E.g. A propeller failing full ahead will exert more thrust than an identical unit put full astern to counter it. A 3000 bhp azimuthing thruster may yield circa 30 tonnes thrust whereas a tanker's single main propeller could yield circa 150 tonnes at full ahead}* 7) Even for DP class 1 vessels key pumps (lube oil, camshaft oil, governor booster, gearbox oil, fuel, and especially CPP hydraulic pumps, should be duplicated and arranged for automatic change over (without engine trip) powered from separate cells of the switchboard. *{The changeover system should be such that failure of a fuse in the changeover relays should not trip all the pumps. An alarm should activate to alert watch-keepers on changeover}*. 8) Main engine / CPP should take control signals from both DP computers and from separate manual control consoles on bridge and within engine room. The control units should have a backup (non-follow up) control unit. 9)Even on DP class 1 vessels main engine and especially CPP controls should have dual supplies, one of which is UPS or battery back up so that equipment continues to function after a single failure. An alarm should sound to alert operators of failure on either power supply or changeover. The back-up non-follow up controls should be powered from a separate third source. 10) Distributed control systems, where used should have 2 networks, duplex control computers and separate UPS supply.	1, 2, 3, 4, 5, 6, 7, 8, 9 & 10) **Initial Assurance:** FMEA including proving trials of vessel main engine, CPP and controls in accordance with IMO and IMCA standards (Ref. section 4.4). **Ongoing Assurance:** Annual trials to confirm functioning of equipment and alarms plus retrial following repair or modification (ref Section 4.4). *{All trials should be carried out by proper simulation of failures (e.g. by removing terminals, disconnecting 24V distribution circuits, tripping machinery etc) and investigating unexpected results and recording results}*. **Verification:** On board independent audit of FMEA, trials reports and annual tests. *{All such reports should be on-board, up to date, and understood by bridge officers and engineers with respect to actions which need to be taken a) to maintain high levels of integrity and b) to diagnose and overcome failures}*

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
C5	**Power Generation / Distribution:** **(Sheet 1 of 2)** Applies dptank & where noted to tauthaw • To reliably power thrusters, engine / steering auxiliaries, control systems, references and all normal ships and BLS functions. • To fail to safe condition as a far as can reasonably be achieved. • To alert operators on system malfunction. Power generation and main switch board	1) *{Duty holders should be aware that IMO DP Class 1 permits loss of position following failure of any single active component. This is clearly inadequate to provide ALARP risks for a tanker operating on DP in close proximity to an FPSO.}* Existing Class 1 DP tankers should have their power generation and distribution systems enhanced as far as reasonably practicable to achieve the ability to maintain station following a failure of any single active component. The enhancements listed below should also apply to tankers for taut hawser operation in as far as they influence its ability to avoid collision with the FPSO following main propulsion failure. *{E.g. If a taut hawser or DP class 1 (single screw) tanker is equipped with transverse thrusters these may help avoid collision following main propulsion failure astern of an FPSO in calm weather provided they can still be powered and controlled following the main propulsion failure.}* Tankers being newly brought into shuttle tanker service should in future have power generation and distribution to IMO DP Class 2 standards in all areas where power loss could affect its ability to maintain station in close proximity FPSO operations. 2) For existing vessels single switchboards are acceptable but three generators must be on line during close proximity operations. 3) Where thrusters are powered from the main switchboard, the cells should be separated so that a local fire or fault in one thruster cell will not immediately affect the other thrusters cell. A bus tie breaker need not be installed, however there should be suitable means of dividing the bus (by switch or links) in the event of a short circuit and subsequent blackout, to allow propulsive power to be restored quickly. *{It is recognised that duplicating single switchboards and distribution systems is unlikely to be reasonably practicable on DP Class 1 or non DP vessels already in service, however practicable enhancements to improve integrity should be made.}* 4) The DP heading control system must monitor the generator outputs versus thruster and additional load consumers and excessive power levels should alarm to alert the operators. Where thrusters are powered by the main bus an alarm should activate at 60% power level, and automatic pitch reduction on the thrusters should initiate at 85% of available bus power levels. Standby generators should be arranged to come on line before the 85% limit is reached. *{The system should shed superfluous loads whilst retaining thrusters and position keeping equipment as a top priority during offtake in the load shedding scheme}*. 5) Shaft alternators should not be used to power thrusters on ships with a single main engine. Thrusters should in this case be supplied from main board with at least three auxiliary generators on-line. Shaft alternators can be used to power thrusters on twin engine ships provided both shaft generators are functioning and each shaft generator only supplies one thruster. If the main board is also supplied from the two shaft generators then the board should be split. Alternatively if the main board is being supplied by auxiliary generators then at least three shall be on line during close proximity operations. 6) For vessels with power management systems, such systems are to be UPS powered. The UPS must have alarms for low voltage and charger failure. Loss of the power management system should result in the boards "failing as set". Generator control systems and charging units must be alarmed for low voltage and charger failure. **Continued on following sheet.**	1, 2, 3, 4, 5, 6 & 7) **Initial Assurance:** FMEA including proving trials of vessel power, thrusters and controls in accordance with IMO and IMCA standards (Ref section 4.4). System capabilities should be calculated and documented both with everything working and with each significant single failure. *{This is to ensure the power balance between duplicate systems is understood, and that crew understand operating limits to cater for the effects of a single failure}*. **Ongoing Assurance:** Annual trials to confirm functioning of equipment and alarms plus retrial following repair or modification (ref Section 4.4). *{All trials should be carried out by proper simulation of failures (e.g. by removing terminals, disconnecting 24V distribution circuits, tripping machinery etc) and investigating unexpected results and recording results}*. **Verification:** On board independent audit of FMEA, trials reports and annual tests. *{All such reports should be on-board, up to date, and understood by DPO / bridge officers and engineers with respect to actions which need to be taken a) to maintain high levels of integrity and b) to diagnose and overcome failures}*

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
C5	**Power Generation / Distribution:** **(Sheet 2 of 2)** LV Power / Control system power	**Continued from previous sheet.** 7) Special attention shall be given to the 220V & 24V distribution for DP, references, sensors, controls thrusters, such that failure of a single fuse will not disable any non redundant system. . On vessels with a single 220 V main board, consumers where single fuse failure could lead to loss of a critical control function, resulting in potential loss of vessel position, should have backup supplies from either the 220 V emergency board or a 24 V system. The 24V distribution should preferable by split into 2 sections via a fast fuse whilst the consumers should be on slower fuses. Systems where single fuse failure could lead to loss of a critical control function, resulting in potential loss of vessel position, should have duplicate power from an independent source. All battery-backed systems should be fitted with status monitoring such that charger failure or low voltage alerts the DP operators.	See Previous Sheet for Assurance and Verification.

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
C6	**Thrusters & Steering Gear** Applies dptank & where noted to tauthaw • To provide adequate manoeuvrability for DP connection, offtake & disconnection • To fail to safe condition as a far as can reasonably be achieved. • To alert operators on system malfunction	1) Existing DP vessels should have minimum two bow thrusters with a combined transverse thrust of circa 20 tonnes. 2) Single screw DP tankers should have at least one stern thrusters, of at least 10 tonnes transverse thrust, which works in combination with a high lift rudder to give a total transverse thrust capability of 20 tonnes. 3) The thrust capability for new DP tankers (or for tankers performing on new fields with extreme metocean conditions) should be based on matching the predicted capability to the expected duty and operating limits at the worst anticipated operating location. *{Note: Rudders are ineffective in DP when the main propeller is going astern and are generally programmed to go to the amidships position when stern thrust is be demanded from the main propeller. Therefore lateral stern thrust is provided solely by stern thrusters on this occasion. When a new tanker is intended to go to areas where a stern environment is expect to occur often (due to say large differences in wind and current, such as the Atlantic Frontier), then two stern thrusters with a combined output of at least 20 tonnes should be installed. The operating limits for existing tankers having less than optimum stern thrust capability should be considered}*. 4) Where DP class 2 vessels have two main propellers then twin high lift rudders should be located to take advantage of the propeller wash unless stern transverse thrust is to be supplied solely by stern thrusters for close proximity station keeping. 5) Tankers being newly brought into service as DP shuttle tankers should have thrust arrangements to IMO DP class 2 requirements and thrusters should be sized with due regard to residual capability following worst single failure matching the required metocean operating limits for offtake at the most severe operating location. 6) Tankers intended for taut hawser operation should have a high lift rudder but need not have bow or stern thrusters provided alternative arrangements are made to limit the potential for FPSO collision in the event of main propulsion failure. *{e.g. longer hawser messengers, towing assist vessel connected to stern of tanker. Note a bow and stern thruster can help even a taut hawser vessel considerably in making a safe approach and taking avoiding action should the main engine black out during offtake.}* Thrusters & Steering gear 7) Thrusters should be arranged so that they do not fail to full pitch in either direction and that azimuthing gear (if fitted fails to set). *{Thrusters should sound an audible alarm if there is a large discrepancy between desired and actual pitch or between desired and actual azimuth. DPOs / Bridge Officers should stop the relevant thruster immediately on hearing the alarm. This also applies to tauthaw if using thrusters in close proximity}*. 8) Thrusters and individual steering gear motors should as far as reasonably practicable be powered from separate sources with the use of UPS so that no single power failure could result in the loss of sufficient thrusters or rudders to cause a loss of tanker position or heading. Controls and Alarms 9) Thrusters & Rudders should take control signals from both DP computers and from separate manual control consoles near the DP console on bridge and within engine room. Even on DP class 1 vessels thrusters controls should be powered from two sources, one of which is UPS or battery back up so that a single failure will not result in loss of more than one thrusters. *{This applies also to tauthaw tankers if thrusters used in close proximity manoeuvring prior to main propulsion being put slow astern}*. 10) Independent rudder angle, thrust & azimuth indicators should be installed close to the DP console, fed from a separate circuit than the DP rudder / thruster pitch angle / azimuth signals. Any	1, 2, 3, 4, 5, 6, 7, 8, 9 & 10) **Initial Assurance:** FMEA including proving trials of vessel power, thrusters and controls in accordance with IMO and IMCA standards (Ref section 4.4). System capabilities should be calculated and documented both with everything working and with each significant single failure. *{This is to ensure that the power balance between duplicate systems is understood, and that crew understand the operating limits to cater for the effects of a single failure}*. **Ongoing Assurance:** Annual trials to confirm functioning of equipment and alarms plus retrial following repair or modification (ref Section 4.4). *{All trials should be carried out by proper simulation of failures (e.g. by removing terminals, disconnecting 24V distribution circuits, tripping machinery etc) and investigating unexpected results and recording results}*. **Verification:** On board independent audit of FMEA, trials reports and annual tests. *{All such reports should be on-board, up to date, and understood by DPO / bridge officers and engineers with respect to actions which need to be taken a) to maintain high levels of integrity and b) to diagnose and overcome failures}*

		~~thrusters power failures or thruster failures should sound alarm to alert operators.~~	
Ref.	**Function / *{Description}* / Applicability**	**Requirements / Survivability / *{Typical Values / Guidance @ April 01}***	**Initial Assurance / Ongoing Assurance / Verification**
C7	**DP Control System, Position References & Sensors (Pg 1 of 2)** Applies dptank • To provide accurate station keeping for DP connection, offtake & disconnection. • To fail to safe condition as a far as can reasonably be achieved. • To have enhancements that provide adequate redundancy to prevent minor or common single point failures compromising station-keeping integrity. • To alert operators on system malfunction. **Position References & Sensors**	1)The DP controls system should always be a duplex system with 'bumpless' changeover from one to the other. The DP system should be UPS supplied and alarmed. Existing IMO DP Class 1 tankers must be enhanced so that there are 2 computers configured so that common facilities, interfaces, data check or data transfer routines are incapable of crashing both. Controls must be designed and operated so that no single inadvertent act can cause loss of position. 2) Existing tankers having un-enhanced class 1 DP should use manual control in the approach and departure runs for a manual taut hawser offtake at an FPSO. They should never use full DP for approach or in close proximity operations. *{Duty holders should be aware that, for DP operations in close proximity to an FPSO the levels of equipment and redundancy specified in IMO guidelines for Class 1 DP vessels are not adequate to provide ALARP. For example a basic Class 1 vessel can be fitted with a simplex DP system which is inappropriate for extended close proximity work at an FPSO, particularly as the FPSO is dynamic (i.e. changes heading, surges and sways and oscillates about turret central position in response to environmental loads). In DP operations, the control and monitoring of position has been passed over from the bridge personnel to a computer system, which can fail and if this failure is unnoticed by bridge personnel, then the vessel could easily drift off position unless there is some means of taking over control or alerting personnel. It is, therefore, necessary for the system to be arranged such that it is continuously monitored. This is achievable by providing industry standard duplex DP systems, whereby the second system monitors the performance of the on-line system and assumes control in the event of a malfunction of the on line system without affecting the vessel position. This enhancement alone significantly increases the DP system reliability by an order of magnitude}* 3) Loading terminal software must specify limits for ESD and ERS actions. Warning alarms should sound at ESD limits. DP software should have a "reaction box" facility to be used for tandem offtake. *{The FPSO DP reference point has to move outside the box before the tanker follows}.* 4) Hawser and hose tension monitoring systems must have an output to the DP system which alarms when the tension is excessive. The DP system should be equipped with an events printer which should be switched on during close proximity operations. 5) New DP vessels must have on line capability plots and warnings if capability being exceeded. New vessels must have target box software installed which allow the FPSO stern to move within a predetermined box before the tanker DP system reacts. 6) All DP tanker's must be receiving at least two independent relative position fixes to the FPSO stern, of adequate quality, for it to commence its final approach for a DP offtake. 7) All DP tankers should be receiving at least two independent relative position fixes relative to the FPSO stern and a third absolute position fix during offtake. Both relative position fixes must be of acceptable quality for the tanker to continue offtaking on DP. If not the tanker should revert to taut hawser operation, provided metocean conditions permit, or disconnect. *{The DP system may not recognise the failure of a single reference system (e.g. by freezing) and the vessel will follow the errant position with potentially disastrous results. Even with two references on line it is not easily possible for a computer systems to identify which reference systems is errant and the DP may reject the healthy reference. This can be overcome by independent reference monitoring or by installing a third reference system and operating with the third reference on line at all times during close proximity work. This is a relatively simple upgrade that enhances the reliability of the station keeping system}.* **(Continued on following sheet)**	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 & 14) **Initial Assurance:** FMEA including proving trials of vessel power, thrusters and controls in accordance with IMO and IMCA standards (Ref section 4.4). **Ongoing Assurance:** Annual trials to confirm functioning of equipment and alarms plus retrial following repair or modification (ref Section 4.4). *{All trials should be carried out by proper simulation of failures (e.g. by removing terminals, disconnecting 24V distribution circuits, tripping machinery etc) and investigating unexpected results and recording results}.* **Verification:** On board independent audit of FMEA, trials reports and annual tests. *{All such reports should be on-board, up to date, and understood by DPO / bridge officers and engineers with respect to actions which need to be taken a) to maintain high levels of integrity and b) to diagnose and overcome*

Ref.	Function / *{Description}* / Applicability	Requirements / Survivability / *{Typical Values / Guidance @ April 01}*	Initial Assurance / Ongoing Assurance / Verification
C7	**Position References & Sensors (Continued; Pg 2 of 2)** Applies dptank • To provide accurate station keeping for DP connection, offtake & disconnection. • To fail to safe condition as a far as can reasonably be achieved. • To have enhancements that provide adequate redundancy to prevent minor or common single point failures compromising station-keeping integrity. • To alert operators on system malfunction. **Visual References**	**(Continued from previous sheet):** 8) There must either be three totally independent relative position references *{preferably}* or two independent relative position references and one absolute position reference. All positioning antennae, including Artemis, should normally be situated on the foremast to minimise the effect of gyro errors in the relative position. One DGPS antenna forward and one aft is however an acceptable configuration, if being used to derive heading as an independent check on the gyros. 9) DP tanker should have independent DP monitoring & recording (Blom box or similar system), or alternatively independent position monitoring via an Artemis or Fan beam based system which displays relative position and headings of the ST and FPSO and activates alarms if the vessel moves out of a predetermined sector. *{At present Artemis and DARPS have the most widespread acceptance as position references capable of showing the relative position of the tanker to the FPSO stern. The 3rd. absolute reference is DGPS with FPSO stern position inferred from FPSO turret location and heading. Contenders for the 3rd relative reference include 2nd DARPS, Fanbeam and HPR.}*. 10) Where the third reference system is a second DARPS, great care should be taken to ensure that A) there are no common failure with other DARPS, (except satellites) i.e. separate communication channels and systems, separate power supplies etc. B) The DP reference selection is such that it does not depend solely on the two DARPS systems in any eventuality e.g. should alert DP operator to difference rather than automatically out-vote the third system. *{At present DARPs on the 450 MHz band currently has a limited number of telemetry slots for many users and some incidents of interference have arisen. Ultimately a 2nd DARPS relies on the same satellites as 1st DARPS so if adopted care must be taken that if DARPS 1 and DARPS 2 agree with each other but disagree with Artemis that it is never due to a common satellite induced error. In this situation the system should alert the DP operator that Artemis might be spurious but the 2 DARPS systems should not outvote and automatically override Artemis. Fanbeam laser is an independent position reference system but requires line of sight and may not be available in fog or during low visibility approach. HPR requires a complicated pattern of seabed transponders for tandem operations and can suffer from thruster noise and reflected interference during tandem shuttle operations at some locations. It is only worth considering if already employed for positioning the FPSO}. {There is scope for joint work between duty holders, tanker operators and equipment manufacturers to improve the integrity of existing position references and to install a third independent, high integrity, position reference suitable for tandem offtake.}* 11) The position reference systems, gyros and sensors should be separately supplied and alarmed to IMO DP Class 2 standards of redundancy. 12) Existing vessels may use two gyros provided these are actively monitored to check that neither gyro is drifting. *{Compare readings to each other and to FPSO gyro with due allowance for relative headings}*. New tankers should fit high accuracy gyros (0.7 deg / cos Lat or better) 13) New vessels must have three gyros fitted with majority voting, automatic changeover and alarm if any gyro reads differently to the others beyond acceptance tolerance. 14) There should be CCTV screens adjacent to the DP operating station. Apart from permitting the bridge crew to monitor and check all areas of the BLS by selection, there should be a CCTV monitor permanently showing the hawser and hose catenary during offtake. *{This is to give the DP operator a visual reference on separation from the FPSO stern over and above what the DP system is indicating.)*	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 & 14) **Initial Assurance:** FMEA including proving trials of vessel power, thrusters and controls in accordance with IMO and IMCA standards (Ref section 4.4). **Ongoing Assurance:** Annual trials to confirm functioning of equipment and alarms plus retrial following repair or modification (ref Section 4.4). *{All trials should be carried out by proper simulation of failures (e.g. by removing terminals, disconnecting 24V distribution circuits, tripping machinery etc) and investigating unexpected results and recording results}*. **Verification:** On board independent audit of FMEA, trials reports and annual tests. *{All such reports should be on-board, up to date, and understood by bridge officers and engineers with respect to actions which need to be taken a) to maintain high levels of integrity and b) to diagnose and overcome*

APPENDIX D

BLANK TRAINING & EXPERIENCE MATRICES

MATRIX 1 :- Experience of personnel on board FPSOs

MATRIX 2 :- Training of personnel on board DP shuttle tankers

MATRIX 3 :- Experience of personnel on board DP shuttle tankers

MATRIX 4 :- Experience of personnel on board Taut Hawser shuttle tankers

UKOOA Matrix 1 : - Experience of personnel o/b FPSO_____ DATE___/___/_____

DP / ATC / Cargo Operator 1 is on watch with operator ____ , and operator ____ with operator ____.

Please turn form sideways and print name below rank in this row.	OIM	Marine Superintendent	Cargo / DP / ATC Operator 1	Cargo / DP / ATC Operator 2	DP / ATC / Cargo Operator 3	DP / ATC / Cargo Operator 4	DECK FOREMAN	DECK CREW	INST/ ELECT TECH	HEADING CONTROL MASTER (Normally Marine Superintendent):- MONTHS SINCE OFFTAKE AT FACILITY TYPE
General Experience (Active or passive FPSO's)										
Years of experience at present rank										N / A
Total years experience										N / A
Time o/b present FPSO										N / A
Total years offshore tandem loading experience										N / A
Total combined years of tanker or FPSO stability, cargo loading & ballasting experience										N / A
DP/Thruster control experience for active heading control FPSO's only. Enter N / A if on a passive weather vaning FPSO /FSU										
Enter the number of 'Hands on' FPSO DP/ATC offloading operations you have completed on any FSU / FPSO if any (See Note 6).									N / A	
If no previous FPSO / FSU active heading control experience, how many years experience have you as a hands on DPO on any vessel with DP or ATC (See Note 6).									N / A	
Number of 'Hands on' FPSO DP/ATC offloading operations you have completed on this FSU / FPSO (See Note 6).									N / A	
Confirm that DP operators have sufficient experience as per the IMCA guidelines or for vessels with ATC that marine control room operators have training in the use of ATC and guidance on the modus operandi									N / A	N / A
Shuttle tanker handling Experience (Active or passive FPSO's)										
Number of Shuttle tanker connections you have performed on aft deck (General exp)									N / A	N / A
Number of Shuttle Tanker connections you have performed on aft deck on this FPSO. (Specific exp)									N / A	N / A
Confirm that the aft deck crew have received on board induction training on operation of connection equipment. (Y or N) (Specific exp)									N / A	N / A

Notes

1) On Some FPSO's the OIM is not directly involved with the offloading operations and his experience does not apply. Where the OIM is directly involved, then the experience levels should be as stated for the Marine Superintendent / Heading Control Master if he fulfills these roles.

2) The use of DP on FPSO ranges from assisting with heading, surge and sway control on turret moored systems to full DP operation with no mooring. For DP vessels the DPO's should be trained and experienced to industry standard, which is specified in the IMCA document M117 entitled 'Training and Experience of Key DP personnel (refer also to current (2000/2001) UKOOA / OPITO work on FPSO competency)

3) The use of thrusters and associated control systems (ATC) requires training and specific guidance on their use and M117 above should be used as a guide to the levels required. (Refer also to current (2000/2001) UKOOA / OPITO work on FPSO competency)

4) For manual thruster control it is sufficient that personnel are trained in their use and the modus operandi

5) For deck crew whose experience may be mixed, the average of their experience should be estimated.

6) If no previous experience in active heading control of FSU's / FPSO's then UKOOA members accept previous DPO experience on other DP / ATC vessels in lieu. Hence the two rows denoted by " (See Note 6)." can be assessed as an "equivalent mixture of both types of experience" or "either / or".

7) **KEY: -** N = no experience, N/A = not applicable or no specific requirement, DP= Dynamic positioning, ATC =automatic thruster control. Otherwise fill in numbers to denote no. of offtakes, month since last offtake or years experience as denoted in the table headings.

~~UKOOA Matrix 2: - Training of personnel o/b DP Shuttle Tanker~~

Voy._____ Date____/____/____

Chief Officer is on watch with ____ officer, and ____ officer with ____ officer.

Please turn form sideways and print name below rank in this row.		**Master**	**Chief officer**	**1st Officer**	**2nd Officer**	**3 rd Officer**	**Chief Engineer**	**1st Engineer**	**Electrician**
DP Basic[1] (Induction)							N / A	N / A	N / A
DP Advanced[1] (Simulator)							N / A	N / A	N / A
Bridge Resource Management							N / A	N / A	N / A
Offshore Loading Phase 1 (Basic)[2]							N / A	N / A	N / A
Offshore Loading Phase 2 (Advanced)[2]							N / A	N / A	N / A
Offshore Loading Phase 3 (Refresher)[2]							N / A	N / A	N / A
Date of Last DP Training or Refresher Course							N / A	N / A	N / A
Restricted NMD / Nautical Institute DP certificate							N / A	N / A	N / A
Date of Last Facility Specific DP Training course, Please specify type in blank row if other than FPSO or SAL	FPSO						N / A	N / A	N / A
	SAL						N / A	N / A	N / A
	specify other						N / A	N / A	N / A
Position Reference Operating courses	Artemis						N / A	N / A	N / A
	DGPS						N / A	N / A	N / A
	DARPs						N / A	N / A	N / A
	HPR						N / A	N / A	N / A
	HiPAP						N / A	N / A	N / A
	BLOM						N / A	N / A	N / A
	specify other						N / A	N / A	N / A
Position Reference Maintenance courses	DP	N / A	N / A	N / A	N / A	N / A			
	Telemetry	N / A	N / A	N / A	N / A	N / A			
	Artemis	N / A	N / A	N / A	N / A	N / A			
	DGPS	N / A	N / A	N / A	N / A	N / A			
	DARPs	N / A	N / A	N / A	N / A	N / A			
	HPR	N / A	N / A	N / A	N / A	N / A			
	HiPAP	N / A	N / A	N / A	N / A	N / A			
	BLOM	N / A	N / A	N / A	N / A	N / A			
	specify other	N / A	N / A	N / A	N / A	N / A			

Notes

1) Various NI Approved training institutions provide DP basic and Advanced courses. They include Aberdeen College, Lowestoft College, Kongsberg Simrad. The basic and advanced DP training courses should include theory and practice of shuttle tanker operations and be carried out on the type of DP control system fitted to the tanker.

2) At the time of writing Offshore Loading Courses Phases 1, 2 and 3 are only available at the SMS facility in Trondheim.

3) The form contains training for systems that may not be applicable on some tankers or offtake facilities. Please respond with N where no training has been undertaken. Oil Companies should disregard information provided on systems that are not fitted nor required for offtake from their particular installations.

4) **KEY: -**Y=Training Complete, N=No Training, N/A = Not applicable, <2y = less than 2 years.

UKOOA Matrix 3: - Experience of personnel o/b DP Shuttle Tanker

Tanker_____ Voy._____ Date____/____/____

Chief Officer is on watch with ____ officer, and ____ officer with ____ officer.

Please turn form sideways and print name below rank in this row.	Master	Chief officer	1st Officer	2nd Officer	3 rd Officer	Chief Engineer	1st Engineer	Electrician	**Master** :- Months since last offtake at Facility Type
General Professional Experience									
Years of experience at present rank									N / A
Total years experience									N / A
Total years tanker experience									N / A
Time o/b present vessel									N / A
Number of offloadings performed in **DP-mode at any offshore installation: -** STL-, OLS-, SPM-,SAL- or FPSO									N / A
Facility Specific Experience									
Number of offloadings performed in **DP-mode** at, **each type of single point** offshore installations	**STL**						N / A	N / A	N / A	
	OLS						N / A	N / A	N / A	
	SPM						N / A	N / A	N / A	
	SAL						N / A	N / A	N / A	
Number of **Tandem DP** offloadings performed at **heading controlled FPSO's** (Captain, Schiehallion, Petrojarls, Gryphon, Jotun, Balder, Norne)						N / A	N / A	N / A	
Number of **Tandem DP** offloadings performed at **passive** weather vaning **FPSO's** (Uisge Gorm, Glas Dowr, Alba, Bleo Holm, Triton)						N / A	N / A	N / A	
Number of **Tandem[4]** offloadings performed in **Taut Hawser** mode without DP (e.g at Anasuria, Maersk Curlew, & in some circumstances Uisge Gorm, Glas Dowr, Bleo Holm, Triton)						N / A	N / A	N / A	
Hours of DP Play Time in last 12 months.						N / A	N / A	N / A	

Notes

1) The form contains experience which may not be applicable for some tankers or offtake facilities. Please respond with none where no experience has been undertaken. Oil Companies should disregard information provided on offtake systems that are not used at their particular installations.

2) Oil companies should appraise the experience noted on the forms based on there being equivalent experience on a bridge watch. I.e. Any individual may be below the ideal experience provided there are arrangements in place to compensate for this. E.g. His counterpart is more experienced than the minimum or additional qualified DPO on watch / compensation by master.

3) **KEY: -** N = no experience, N/A = not applicable, otherwise fill in numbers to denote no. of offtakes, month since last offtake or years experience as denoted in the table headings.

4) The prime mode of operation being assessed on this sheet is as a DP tanker. However there are circumstances at passive weather vaning FPSO's where DP tankers may operate in taut hawser mode and hence experience in this area is appropriate. Higher experience levels are required where taut hawser mode is the prime mode of operation eg at Anasuria & Maersk Curlew. These are reflected on a separate sheet - Matrix 4.

UKOOA Matrix 4: - Training of personnel o/b DP shuttle Tanker_____

Voy._____ Date ____ / ___ / _____

Chief Officer is on watch with ____ officer, and ____ officer with ____ officer.

Please turn form sideways and print name below rank in this row	MASTER	CH OFFICER	1ST OFFICER	2ND OFFICER	3RD OFFICER	CHIEF ENG	1ST ENG	ELECTRICIAN	**MASTER :-** MONTHS SINCE OFFTAKE AT FACILITY TYPE
General Professional Experience									
Years of experience at present rank									N/A
Total years experience									N/A
Total years tanker experience									N/A
Facility Specific Experience									
Time o/b present vessel									N/A
Number of **tandem** offloadings performed in taut hawser mode at **passive FPSOs** (e.g. Anasuria, Curlew, Triton etc)									
Number of offloadings performed in taut hawser mode at remote loading point (e.g. Beryl etc.)									

Notes

1) The form contains experience which may not be applicable for some tankers or offtake facilities. Please respond with none where no experience has been undertaken. Oil Companies should disregard information provided on offtake systems that are not used at their particular installations.

2) Oil companies should appraise the experience noted on the forms based on there being equivalent experience on a bridge watch. I.e. Any individual may be below the ideal experience provided there are arrangements in place to compensate for this. E.g. His counterpart is more experienced than the minimum or additional qualified DPO on watch / compensation by master.

3) KEY: - N = no experience, N/A = not applicable, otherwise fill in numbers to denote no. of offtakes, month since last offtake or years experience as denoted in the table headings.

4) Current taut hawser tanker operations are at existing facilities with tanker operators having a long track record of these operations. Hence the above Matrix is predicated on all officers being qualified to the appropriate level under STCW 95 code and then obtaining onboard training and experience under the guidance of a master experienced in close proximity offshore approaches and tandem offtake before performing manoeuvring tasks. In the event that a new tanker is brought in with an inexperienced team then it would be appropriate to put an experienced mooring master / officers on board until experience is built up. If a new operator, with no experienced masters, is brought in then it would be appropriate to provide approach and close manoeuvring training with simulator courses and then full size approach practice to buoys located offshore before allowing tandem offtake.

APPENDIX E

UKOOA MODEL FPSO & TANKER ACCEPTANCE SYSTEM

1. Introduction

The following acceptance process is aimed at enabling duty holders ensure that they can demonstrate taking adequate management actions to ensure that offtake risks are ALARP.

2. Acceptance of New Vessels Intended to be Regularly Used in the Field (Primary / Secondary Pool Tankers)

New FPSOs or tankers should be assessed and accepted by the following process

- Duty Holder's approved ICP to review design, verification and operational documents as listed in table E1 for FPSOs and table E2 for shuttle tankers. Where a third party supplies the tanker or FPSO a vessel information folder should be prepared by the third party and submitted to the duty holder.

- An approved ICP reviews the FMEA study, the FMEA trials report, follow up and close out of any FMEA recommendations.

- Duty holder should send the field Joint Operations Offtake Manual to the new FPSO or tanker to give the crew time to familiarise themselves with the field particulars and procedures. This also gives the new vessel an opportunity to review and comment on any field procedures or equipment that could lead to complications with their vessels.

- Duty holder or approved ICP should assess the new FPSO or tanker by an on-board audit to check that equipment, crew training and experience comply with the required performance standards / assessment matrices (either from this document or field specific requirements). If any serious shortfalls are found they have to be rectified against an agreed schedule, e.g. by hardware rectification or by adding a supplementary mooring master or other supplementary crew whilst experience is built up. The ICP also checks annual DP trials, close out and the recent audit / inspection record on board, together with crews understanding of their DP system and failure modes. The aforementioned assessment of crew competence should be carried out in the field, offloading from a particular FPSO to a particular tanker by the duty holder or approved ICP so that it is not purely paper based.

- The ATC / DP control software and all telemetry and position reference frequencies have to be adapted to reflect the field requirements.

- There should be a field test confirming that all communications, telemetry links and relative position references actual communicate, that all ATC / DP software functions correctly and that the FPSO and tanker(s) are compatible for offtake. Usually the field test is carried out at the start and during an offloading trial or at the start of the first offloading. The Duty holder or approved ICP should attend these tests.

3. Ongoing Acceptance of Regularly used Vessels (Primary or Secondary Pool Tankers)

Once installed, the same FPSO / FSU will probably be used for the bulk of field life. The bulk of the tankers visiting the field will probably be regularly used primary or secondary tankers that have been accepted as a new vessel as per item 1 above. These regularly used FPSOs and Tankers shall be audited and reassessed occasionally by an ICP appointed by the duty holder. As a guidance an interval of two to three years between ICP inspections to assess the tanker and crew as follows: -

- Tanker & hardware assessed against the field specific performance standards for the areas indicated in these guidelines.
- Latest generic OCIMF Sire inspection reports and close out of actions reviewed on board.
- Crew logged experience and training compared to the levels defined in the matrices included in these guidelines for the type of offloading facility concerned. There should be evidence of increasing experience and training levels.
- Latest FMEA and Annual trials documented onboard with evidence that the crew understand the findings and evidence of action close out.

It is further proposed that the tanker operators should update the vessel dossiers described in table E2 for duty holders every second year to reflect updated information e.g. inspections, FMEA / annual trials and new equipment. The duty holder should also update the FPSO dossier described in table E1 on the same frequency.

The before mentioned assessment of the crew's increased competence in offloading from the particular FPSO to the particular tanker should be carried out in the field by witnessing an offloading by the Duty Holder or approved ICP.

4. One off Acceptance of Previously Unapproved Alternative Tankers at Short Notice

Even when quite a large pool of primary or secondary tankers have been approved for a particular field, there may be odd occasions when operational circumstances dictate that none of them are available when the duty holder requires. In such circumstances the tanker owner and duty holder may wish to substitute another tanker which should normal be of equivalent equipment level and standard to those normally used on that field. In such circumstances it may be possible to accept a tanker for a one off operation on a quicker acceptance procedure than that described in item 1 above.

A shortened acceptance procedure would be as follows.

- Tanker operator / manager informs duty holder of the intended substitution as soon as possible by fax / e-mail & telephone to initiate the acceptance as quickly as possible.
- Tanker operator issues the following to duty holder by fax / e-mail in advance of acceptance.
    - justification for using an alternative tanker
    - capacities

- propulsion spec.
- thruster spec.
- DP system
- position reference systems
- bow valve closing times
- confirmation shuttle tanker was subject to FMEA & FMEA revisions, findings and recommendations
- FMEA findings and follow up (i.e. modifications)
- crew training and experience matrices, particularly numbers of offloadings performed from the particular type of FPSOs (active or passive)
- remedial measures to increase experience on the day in order to meet the minimum training & experience requirements for the type of facility concerned (e.g. passive FPSO or SAL).

- Tanker operator places field specific offtake joint operations manual and other operational documentation on board the tanker.
- If tanker is to operate on DP then the DP software must be adapted for the specific field (e.g. install field specific files).
- If the tanker and crew is acceptable based on the above then proceed to field but duty holder should be given the opportunity of putting a representative onboard.
- Field test position references, telemetry and DP if fitted before final close approach and connection.
- Complete field test procedures.

TABLE E1 : OFFTAKE INFORMATION FOR FPSO

Item To Be Included In Information Dossier	Passive FPSO	Active FPSO
A4 Photograph of stern arrangement	✓	✓
Stern Discharge arrangement drawings	✓	✓
Stern discharge valve type and ESD shut in time	✓	✓
Pressure surge analysis of ESD & hose disconnection scenario's on pumps hose and pipe work.	✓	✓
FMEA & Trials of position references, telemetry & gyros including power supplies	If used for close proximity offtake	✓
FMEA + FMEA revisions, all including trials reports as well as study	Only equipment critical to station keeping as per the generic performance standards	Heading Control system, Position references, thrusters, & main machinery etc. as per the generic performance standard
Confirmation of close out statements on FMEA / trials findings	ditto	ditto
Annual trials & close outs	ditto	ditto
FPSO incident record affecting tandem ops	✓	✓
FPSOs offtake related audit / inspection record (last 3 years)	✓	✓
UKOOA Crew Experience Matrix (Each shift) or alternative NVQ / SVQ means of demonstrating competence	✓	✓

TABLE E2 : OFFTAKE INFORMATION FOR SHUTTLE TANKER

Item To Be Included In Information Dossier	Taut Hawser Tanker	DP Tanker
A4 Photograph	✓	✓
General arrangement plan	✓	✓
Tank capacity plan	✓	✓
Fire control and safety plan	✓	✓
Bow loading arrangement drawing	✓	✓
Bow valve type & shut in time (ESD)	✓	✓
FMEA + FMEA revisions, all including trials reports as well as study	Only equipment critical to station keeping as per the generic performance standards	DP, Position references, thrusters, & main machinery etc. as per the generic performance standard
Confirmation of close out statements on FMEA / trials findings	ditto	ditto
Annual trials & close outs	ditto	ditto
DP Capability Plots (all systems running + worst failures)	✓	✓
Vessels offloading incident record	✓	✓
Vessels audit / inspection record (last 3 years)	✓	✓
UKOOA Crew Competence Matrix (Each shift)	✓	✓
UKOOA Crew Experience matrix (Each Shift)	✓	✓

APPENDIX F

BLANK IMCA STATION KEEPING INCIDENT FORM

Comprising 6 pages

IMCA
Station Keeping Incident Form
for
Thruster-Assisted Vessels/FPSOs/FSUs/ DP Tankers/EWTs/Semis/Flotels, etc.

Revision: December 2001

Reportable Station Keeping Incident

This report should be completed and sent to IMCA on the following occasions:

- For any unexpected loss of position and/or heading
- For an unexpected loss of functionality or availability of equipment which results in a reduced level of redundancy leading to a degraded operational status
- When the DP system performance differs from the operators expectations

DOCUMENT DETAILS AND ISSUE RECORD			
Vessel:		Date:	
Place:		Reported By:	
Client:		Position:	
This section is confidential			
Class Notation: (e.g. DYNPOS AUTR)			

Please return completed form to:

Jane Bugler, Technical Director

IMCA, Carlyle House, 235 Vauxhall Bridge Road, London SW1V 1EJ, United Kingdom

E-mail: imca@imca-int.com Tel: +44 (0) 20 7931 8171 Fax: +44 (0) 20 7931 8935

This form is to be populated by the Thruster Assisted Vessel or the Non-DP Vessel. The separate DP Vessels form should be returned by the DP Vessel involved.

1.) Description of work being carried out:

2.) Environment			
Wind Speed:	Wind Direction:	Wave Height:	Visibility:
Current Speed:	Current Direction:	DP Current or Real Current:	Water Depth:

3.) Thruster Assisted Vessel Equipment On-Line			
Control System:		Switchboard Status:	
		Open:	Closed:
Thrusters On-Line: (selected to DP)	Thrusters on Stand-By: (available for immediate start)	Generators On-Line: (selected to DP)	Generators on Stand-By: (available for immediate start)

Position References: (populate fields with numbers)

Status:	HPR	Artemis	Fan-Beam	Taut Wire	DGPS	DARPS	Other
Available							
Stand-By							
On-Line							
Preferred							

Sensors: (populate fields with numbers)

Status	GYRO	VRS	WIND	Other
Available				
Stand-By				
On-Line				
Preferred				

4.) Thruster Assisted Mooring Systems		
Is the vessel Catenary Moored with Thruster Assist? (Y / N)		
	Spread	Turret
What type of primary mooring system is in place?		
If a Turret Moored vessel, what type is the Turret?		
Was the tanker operating on DP or Manual Taut Hawser (if applicable)?		
Is the tanker Non DP classed, IMO Class I DP or IMO Class II DP?		

What is the percentage utilisation of the Thruster Assistance for the following operational modes? (100% for always enabled, 0% for never enabled)	Monitoring	
	Heading Control	
	Damping	
	Position Control	
	Other	

What percentage of the operating time is the Thruster Assist system	a) Manned?	
	b) Unmanned?	

If offtake operations were in progress what was the status?	Approaching	
	Connected	
	Departing	

Shuttle Tanker Equipment On-Line

Control System:		Switchboard Status:	
		Open:	Closed:
Thrusters On-Line: (selected to DP)	Thrusters on Stand-By: (available for immediate start)	Generators On-Line: (selected to DP)	Generators on Stand-By: (available for immediate start)

Position References: (populate fields with numbers)

Status	Artemis	DGPS	DARPS	Other
Available				
Stand-By				
On-Line				
Preferred				

Sensors: (populate fields with numbers)

Status	GYRO	VRS	WIND	Other
Available				
Stand-By				
On-Line				
Preferred				

5.) Sketch (Vessel outline, heading, location of pos. ref., relative positions, hawser length, tracks of FPSO stern and Tanker, etc.)

(Screen grab from DP System if available)

6.) Sequence of Events: (attach DP, PMS/VMS alarm printouts, if available)

1.

2.

3.

4.

5.

6.

7.

8.

9.

7.) Narrative Description of Events: (if available attach internal incident reports)

8.) Incident Numerical Description:	
Distance travelled to peak of Excursion (m):	
Time to recover from Blackout i.e. DP back on-line (secs):	
Time to recover to Green Watch Circle (seconds):	

9.) Corrective Action Taken	Tick as Appropriate
Modify Procedures	
Modify Standing Instructions	
Report to Shore Management	
Repair	
Modify Maintenance Procedures	
Report to Supplier	
Additional Alarm Installed	
Operator / Technician Training	
Warning Label fitted	
Other (specify)	
Is there more work to do before close out is complete?	
Has the incident been closed out with a satisfactory conclusion?	

10.) Human Factors
Were too many tasks being performed, or were there too many people involved/discussions taking place at the time of the incident?
Were the factors leading to the incident adequately covered by the circumstances within the training and familiarisation sessions with the DP Operators?
Would another DP Operator react with a different set of actions?
Have changes been made to the training and familiarisation procedures?
Should changes be made to the Annual DP Trials in light of the incident?

Do you believe that the DP Operator, if faced with a similar situation now, would react in a different way?

11.) Comments

Please add any comments or suggestions that have not been fully covered in the report.

Have you attached any alarm printouts (DP/VMS/PMS), internal reports and correspondence that may assist in the analysis of the incident?

Both DP Vessel and Thruster Assist Vessel/Tanker should return separate forms.