GOOD PRACTICE.
FOR THE CARRIAGE OF OIL CONTAMINATED CARGOES FOR TRANSPORTATION BY OFFSHORE SUPPLY VESSEL.

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1.0 OBJECTIVE

To provide specific advice for the safe transportation, offshore handling, tank cleaning, onshore handling and onshore disposal or treatment of wet bulk back loads contaminated during drilling and other operations. This guidance is aimed at offshore installations, Offshore Supply Vessels and appropriate onshore staff (e.g. Surveyors, Tank Cleaners, Base Operators, and Waste Processors). **In particular, analytical tests should be carried out and made available to the Ship's Master prior to back loading, confirming that Flash point exceeds 60°C and that there is no trace of Hydrogen Sulphide in the product mass.**

2.0 BACKGROUND

Industry, in conjunction with the Chamber of Shipping and the Marine Safety Forum has produced this Good Practice document to assist operators in better describing the wet bulk back load cargoes they wish to transfer to shore for processing, using the bulk mud tanks on Offshore Supply Vessels (OSVs).

In the course of well operations, water based fluids such as seawater, brine or water based mud may become contaminated, commonly with oil based mud or base oil from oil based mud, (herein after called wet bulk waste) which cannot be legally discharged to the marine environment. These contaminated fluids are returned to shore for treatment or disposal.

Operations giving rise to such fluids include:

- Well bore cleanup operations where oil base mud is displaced from the wellbore to seawater or completion brine.
- Operations where water base mud becomes contaminated with oil base mud during displacements.
- Cementing operations with associated spacers.
- Pit cleaning operations.
- Drilling operations where wellbore fluids are contaminated with oil based mud, crude oil, or condensate.
- Other tank cleaning operations where fluid chemical components cannot be discharged because of the Offshore Chemical Regulations.
- Rig floor drains where the fluid is oil contaminated.
- Any of the above fluids may also be contaminated with hydrogen sulphide (H_2S), typically from sulphate reducing bacteria (SRB) activity

When fluids are severely contaminated and of small volume, then general industry practice is to transport to shore in Tote tanks or similar type carrying units. For fluids that are “lightly” contaminated, general industry practice has been to back load to the mud tanks on the OSVs. It is this latter practice in particular that has raised grave concerns for the following reasons.

a) It is difficult to accurately describe the chemical make up of the fluid and hence provide a Material Safety Data Sheet (MSDS) sheet that adequately describes the material.
b) Gas testing on OSVs returning to shore with this cargo has found on a significant number of occasions, high levels of H_2S in the atmosphere above the cargo. Lower Explosive Limit (LEL) tests also revealed an explosive atmosphere in excess of that which the which the OSV has the capability to safely transport.
c) The mud tanks on the OSVs are not designed or classified to contain and transport wet bulk cargo with a flash point of less than 60°C. The pump rooms and pumping systems for the discharge of the product tanks are not intrinsically safe. This classification is only found onboard specialist type OSVs.

The reason for the very high LEL % values that have been recorded is contamination with crude oil and condensate. The bulk mud tanks on OSVs are not designed for this purpose and under **NO CIRCUMSTANCES** should fluids contaminated with the mentioned products be back loaded to an OSV's mud tanks.

Recognising the relatively complex nature of the cargo, this **Good Practice** document has addressed the issue by recognising that a series of tests should be undertaken on the material intended for back load to provide an indicative view of the constituent make up and reactive qualities of the material. It must be recognised that because of the segregation issues described in section 3.0 below, these tests can only be indicative.

The tests can be performed either on the rig or onshore. The rate at which these fluids are generated during certain operations on the rig may preclude sending samples to shore for testing necessitating rig based testing. In either case, the results of the tests must be made available to the Master of the OSV prior to the back loading hose connection taking place. Once tests have been carried out no more fluid should be added to the intended cargo on the offshore installation. If any further additions are made a further test will be required.

The results of these tests will allow the Master, through confirmation with the attached checklist, to establish if the back load is acceptable for carriage onboard the OSV. Acceptance is based on the reported analytical information and the measured physical properties, the known nature of the chemical make up and the previous cargo carried in the OSV's tanks. A generic risk assessment will be available onboard the OSV and updated when new or improved/different information and circumstances become apparent. Offshore installation staff should be aware that in certain circumstances the Master of the OSV may require advice from the OSV's onshore technical advisors and that a response from onshore may take time to progress. **If there is any doubt regarding results repeat the tests and review.**

The back load hose should not be sent to the OSV and connected up unless there is agreement between the OSV Master and the Installation OIM that the back load is acceptable for transportation.

3.0 COMPOSITION OF THE WET BULK WASTE

The final wet bulk waste may contain components and formulated mixtures including:

- Water (both seawater and potable water)
- Oil base mud
- Base oil
- Water base mud
- Well bore cleanup detergents
- Completion brine (including corrosion inhibitors, biocide etc)
- Cement spacers
- Rig wash
- Brines containing various salts.

The major component is normally seawater. The proportions of the other constituents are variable. The wet bulk waste is likely to be heterogeneous in that oil mud will separate to the bottom, base oil to the top, with seawater in between. OSV motion will not normally be sufficient to mix and stabilise the cargo to a homogeneous form.

The components and formulated mixtures may arise from different wellbore operations. The volumes of each component are normally known, although the degree of volumetric accuracy is variable depending on how and where this material is stored on the rig prior to back loading to the OSV.

During discharge to onshore storage tanks and road tankers the make up of the initial discharge may be different in composition to that discharged later due to separation of components during transportation. This may result in higher concentrations of an individual component being transported in road tankers.

Example

Oil based mud /contaminated wet bulk waste containing:

Seawater	75% (volumes)
Mineral oil base mud	10%
Cement spacer with surfactants	10%
Base oil	5%

The above mixture will separate, leaving the base oil on the surface, the seawater below this and the mineral oil mud on the bottom. The cement spacer will mix with the seawater although the surfactants will also mix with base oil and oil mud.

During transfer operations from the OSV to road tankers the initial fluid comprises the heavy oil mud, followed by the lighter seawater and finally the base oil. In the event of a hose rupture or spillage, all component fluids should be treated as oil contaminated and should be contained, preventing discharge to the sea.

4.0 TESTING PRIOR TO BACK LOAD

A wet bulk waste may contain a significant number of chemicals for which Material Safety Data Sheets (MSDS) are available offshore. It is not practicable, however, to develop a description of the wet bulk waste from such an array of documents. Although MSDS will be available for formulated mixtures, there may still be uncertainty in describing the properties of the wet bulk waste. As a precaution the following tests should be carried out, prior to back loading, in order to assist confirmation of the potential hazards:

- pH — Numerical range 0 - 14
- Chlorides — mg/l
- Retort — Oil content volume %; Water content volume %; Solids content volume %
- Flash point (closed cup) °C
- Noxious gases — LEL Explosive gases, H_2S, Oxygen
- Bulk density — Specific gravity

As described in section 2.0, tests may be carried out offshore on the installation by trained personnel or samples sent onshore for analysis by the Waste Processor or other competent laboratory

The analysis should be carried out in a timely fashion on representative samples of each wet bulk waste intended for back loading to an OSV. If back loading is delayed for any reason, such as bad weather, it should be noted on the Appendix II analysis form. If there is any doubt regarding results repeat the tests and review.
Results of the tests should be entered on the Appendix II analysis form and attached to the appropriate Waste Consignment Note e.g. SEPA C note.

5. KEY TEST RESULTS RANKED

Test	Indicator	Range of results	Interpretation.
Flash point	Potential for explosion	> 60°C	Should be > 60° C to back load,. If the flash point is low (<70° C) then an explanation should be provided.
LEL	Potential for explosion	Ideally zero. Meter alarm typically set to 10 - 20% LEL	Consistent with Flash point above - for transport only. If measurable LEL, repeat test and review explanation.
H_2S	Poisonous gas	Ideally zero	Indication of bacterial activity
pH	Measure of acidity or alkalinity	4 - 11	COSHH Personnel Protection Equipment and personnel exposure
Oil % volume	The major component requiring back load	Agrees with components in Appendix II	Confirm retort agrees with Appendix II and Waste consignment note
Solids % content	Potential need for tank cleaning	Agrees with components in Appendix II	Confirm retort agrees with Appendix II components and Waste consignment note. Tank residue could form a source of SRB and H_2S over time.

More detailed Procedures are provided in Appendix I (attached). Test results should be consistent with the information on the Appendix II analysis form.

6. FURTHER TESTING ON THE OFFSHORE OSV

There is no onus on the OSV to carry out further tests. Tank hatches cannot be removed offshore because of safety.

Tests on board OSV at the time of back loading are only possible if sampling ports are available. Consideration should be given to installing suitable sampling ports onboard OSV's to allow the use of the LEL/ H_2S meter. (Usually this can be dropped from the vent system using the extended sniffer hose). If testing has not been carried out the waste processor handling the back load in harbour should be advised and the material condition should be deemed fit for transportation onshore prior to that occurring.

Where the back load is to a dirty tank (containing material from a previous oil contaminated back load for example) the previous documentation should be reviewed. The potential for biological activity resulting in H_2S in the dead volume and sludge must be determined. Should the overall pH be reduced through mixing of the fluids H_2S breakout could occur.

Back loads should be discharged from the OSV as soon as possible. The need to clean the tanks should be reviewed on each trip to minimise the risk of biological activity and H_2S build up from any solid residue.

7. TESTING IN THE HARBOUR PRIOR TO OFFLOAD

A gas test for LEL and H_2S must always be performed on the OSV tanks containing the back loaded material prior to offloading in port as a matter of standard procedure.

Waste Processors should also check Appendix II analysis form parameters onshore. Prior to discharge, the ullage air space in the tank will be sampled by the Waste Processor, preferably in conjunction with the Surveyor, for LEL and H_2S, to confirm that no change of condition has occurred. Undertaking these tests will confirm that the properties of the wet bulk waste are properly described in shipping documentation. In the event that there is a significant divergence between offshore analysis and onshore analysis, the Waste Processor should raise a non-conformance. If there is any doubt regarding results repeat the tests and review. The Offshore Operator, the Offshore location, the Ship's Master, Base Operator, Surveyor, and Tank Cleaners should be advised accordingly.

Note.
If the wet bulk waste is back loaded into tanks already containing oil based mud residues as can be the case, then the onshore test results will be different to those measured on the rig.

Test results should be also be provided to tank cleaning companies in the event tank cleaning is required.

8. DOCUMENTION AND REPORTING REQUIREMENTS

Material Safety Data Sheets (MSDS) documentation of the components and mixtures must be made available to the OSV Master. IMDG manuals are carried on the OSV for all types of chemical materials shipped.

A Waste consignment note EA or SEPA C is normally generated to accompany the wet bulk waste being back loaded. This should reference the attached Appendix II analysis form.

The completed Appendix II analysis form is reviewed by the Installation OIM to confirm the back load is safe to transfer.

The Waste Consignment note and Appendix II analysis form is to be made available to the Ship's Master prior to back load operations for review and comment.

Once it is agreed to back load, a copy is forwarded to the Waste Processor onshore by the offshore Installation.

A dangerous goods certificate must be provided by the Offshore Installation based on the requirements of the individual component MSDS.

The Waste Processor checks the samples drawn onshore, comparing the analytical results to those obtained from the per back load offshore samples. In the event of a discrepancy the Waste Processor advises the Operator, Offshore location and OSV Master.

Test results should be also be provided to tank cleaning companies in the event tank cleaning is required

APPENDIX I

Flash Point

The minimum acceptable flash Point (Pensky Martin Closed Cup or equivalent) of 60°C is applicable to wet bulk wastes and will determine whether the material is safe for transportation via the OSV's tanks. SOLAS regulations determine that materials with a flash point below 60°C cannot be back loaded to a OSVs mud tanks unless the OSV is certified for carriage where additional systems of inerting the environment onboard the OSV will be in place. Generally, OSVs do not have the intrinsically safe systems required for the carriage of produced / unrefined hydrocarbons.

Sampling should be set up to detect the worst case situation, particularly where there is potential for crude oil or condensate contamination where the oil will rise to the surface of the tank. Drilling rigs will normally have robust ventilation in the area used to store oil contaminated fluids and this may mask the condition experienced onboard an OSV when carrying hydrocarbon contaminated product. OSV storage tanks are not normally vented. Air sampling from above the drilling rig mud pits may understate explosive gases.

Sampling should reflect the conditions in the OSV tanks i.e. no agitation. Base oils typically have flash points in the range 70 - 100°C. If the only oil component in a bulk waste is base oil then the flash point cannot be lower than that of the base oil itself. If the flash point is relatively low (60 - 70°C) an explanation must be provided on the Appendix II before the form is presented to the OSV Master. Prior to sampling, the installation pit should be left without agitation for at least 30 minutes and then surface sampled. If there is any doubt regarding results repeat the tests and review.

This sample can then be split and one part used for Flash point testing and the other for Noxious gases. Flash point is tested as per Closed cup Flash Point equipment manufacturers instructions.

Lower Explosive Limit (LEL)

The LEL gas detector will confirm potential flash point problems. Note that the LEL meter (which also serves as an H_2S meter) is used in harbour to check vapour condition in the ullage air space above the tank prior to discharge. The test carried out prior to back loading should reflect the conditions in the ships tanks i.e. there will be no agitation and no forced ventilation unless it is specifically required/requested (unlike rig mud pits).

The Noxious gas test is modified to simulate the unvented ships tanks. The sample is placed in a closed container with a sampling port on top and left to equilibrate for 30 minutes. A tube is then connected from the port to the gas analyser and the sample analysed. This method simulates the unvented ships tank. The above Procedure has been agreed with gas analyser manufacturers and Service companies carrying out the test offshore. So far this adaptation has been available through BW Technologies - Gas Alert Max equipment. Other manufacturers are able to offer alternatives.

The flash point and LEL results should be consistent with each other. LEL gas meters are normally set so that the alarm goes off in the range 10 - 20% LEL methane equivalent. Any number above 25% would be considered high. Other gases potentially present can have a different LEL range than methane. If there is any doubt regarding results repeat the tests and review.

Hydrogen Sulphide (H_2S)

Hydrogen sulphide may be detected. H_2S can occur in wellbore fluids but this source would normally be identified by rig equipment, and appropriate measures taken to neutralise and remove the H_2S.

In surface tanks and facilities H_2S most commonly arises from the activity of sulphate reducing bacteria (SRB). SRB will become active provided there is a "food" source and low oxygen conditions. This would be typical of stagnant oil contaminated fluid stored for a long time (several weeks). This environment can arise on both installations and OSVs in tanks and manifolds. Disturbing stagnant fluids or mixing low pH fluid into a high pH fluid containing H_2S could cause the release of H_2S into the void space above the tank.

Hydrogen Sulphide is a heavier than air and an extremely poisonous gas. Maximum exposure limit is 10 ppm over an 8 hour period. The LEL gas meters currently being used also tests for the presence of H_2S. H_2S is a known danger during drilling operations. Offshore sensors and routine offshore analysis methods will detect if H_2S is a potential problem in bulk waste back loads. In the event of a positive test another sample should be collected to confirm the result. If this second result is positive further work may be required to determine the source of the H_2S. A test using a Garrett Gas train will determine the levels of H_2S dissolved in the liquid. As a precaution treatment of the material may be required.

The SRB organisms thrive in a pH range of 5.5 - 8.0. The lower the pH the greater the breakout of H_2S. The back load can be treated on the installation to prevent breakout of H_2S in the OSV tanks. Biocides kill the bacteria but do not remove dissolved H_2S. H_2S scavengers will remove dissolved H_2S but do not stop biological activity. Caustic soda will raise the pH and prevent H_2S gas breakout

In the event H_2S is detected, tests should be carried out offshore to determine the best treatment prior to back loading. After treatment a final H_2S test should be carried out to confirm zero H_2S and noted on the Appendix II analysis form before the hose is connected to the OSV for back load.

Example Procedure for LEL% and H_2S meter only

Collection of Sample

The sample should be taken from below the surface of the unagitated tank to simulate the unagitated OSV tank. Most oil will be in the top layer and will give a worst case oil content.

1. Leave tank or pit unagitated for 30 minutes before taking a 2.5 litre sample.
2. Fill the sample into container provided, up to the marked line and replace screw cap lid
3. If a magnetic stirred is available, mix for 1 hour before proceeding to gas detection. Two large magnetic fleas included in kit.

Gas Detection (% LEL value, combustible gases)
1. Ensure batteries have been fully charged. If not, place in charger and allow charging for 12 hours.
2. Switch instrument on in a clean air environment
3. The detector will beep and run a set of self checks once these are complete the screen will display 3 levels on the screen
   H_2S: 000 ppm
   O_2 : 20.9 %
   LEL: 000 %
4. The pump automatically starts and continues to run until the unit is switched off.
5. Remove the plugs in the sample container lid and place the sampling hose into the head space
6. Any combustible gas will be registered on the LEL monitor.
7. After 5 minutes remove the hose and switch detector off by holding down the on/off button for 5 seconds; (the unit will beep 4 times before switching off)
8. Any gases detected should be reported on the Appendix II.

Calibration:
   O_2 sensor is automatically calibrated each time the unit is switched on.
   LEL sensor is factory calibrated to Methane and can be calibrated using a calibration gas supplied by BW Technologies.
   H_2S sensor is factory calibrated but subsequent calibrations can be done using a calibration gas supplied by BW Technologies.
It is recommended that the LEL and H_2S sensors be calibrated every three months or when the unit is on shore using the appropriate mixed calibration gas from BW Technologies.

pH

Seawater pH is typically 8.3. Oil mud is alkaline and could raise the pH slightly. Cement contaminant is highly alkaline. In general alkaline pH (above 7) protects from corrosion. Highly alkaline materials can be caustic and require care in handling. Cement and sodium silicate can lead to high pH. Low pH

(less than 4) is highly acidic and an explanation should be provided on the Appendix II analysis form. Acids such as citric acid or acidizing chemicals such as hydrochloric acid can lead to low pH.
Note that low pH means any H_2S will already have broken out as a gas.

Salinity - Chlorides

Seawater is typically 20500 mg/l chlorides. Oil mud contains some calcium chloride increasing this level slightly. Sodium chloride brine can contain up to 189000 mg/l. Results should agree with the composition.

Retort analysis (solids, water, oil volume %)

This should match the estimated composition (volume %) on the Appendix II analysis form. Note; that it may be difficult to get representative samples if the liquid tends to separate. Some divergence is expected e g. if oil is noted as 5%, the range could be 3 - 10%. If separation is likely a range is preferred e.g. 5 - 10%. The solids component can form a residue in the OSV tank and a potential location for SRB activity and H_2S.

Specific Gravity - S.G.

Common water based fluids cover the range 1.03 (seawater), sodium chloride (1.2), and calcium chloride (1.33). Rarely used brines such as caesium formate can reach 2.2. Oil mud is typically 1.1 - 1.5 but can exceed 2.0. Mixtures will have intermediate values, most tending to 1.03 as seawater is the major component. Note that if mixtures separate the top half can be a different density than the bottom half.

Appearance

General description confirming if cloudy, clear and colour. Should be consistent with Waste Consignment Note description.

Odour

Slight versus strong odour, consistent with description.

Conclusions

Should demonstrate the various parameters measured are in agreement with one another.

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CHECK LIST REVIEW WET BULKS BACKLOADS

	Operation	Offshore Installation	Offshore Supply Vessel	Waste Processor	Tank Cleaner
1	Ensure MSDS of components and formulated mixtures are available	**X**	**X**	**X**	**X**
2	If test to dispatch period is greater than 48 hours explanation is on Appendix II analysis form	**X**	**X**		
3	Check if Dangerous Goods note required	**X**	**X**		
4	No back loading without completed Appendix II form	**X**	**X**		
5	Data provided in all boxes (no boxes marked N/A)	**X**	**X**	**X**	**X**
6	No additions to the backload cargo after the analysis is carried out	**X**			
7	No Crude oil contamination in back load.	**X**			
8	Flash point significantly higher than 60°C	**X**	**X**	**X**	**X**
9	Base oil flash point noted	**X**	**X**	**X**	**X**
10	Flash point of any other low flash chemical entered on Appendix II analysis form.	**X**			
11	Lower explosive limits consistent with flash point	**X**	**X**	**X**	**X**
12	Hydrogen sulphide (H2S) concentration zero	**X**	**X**	**X**	**X**
13	pH within range 4 - 11, if outwith explanation provided on Appendix II analysis form	**X**	**X**	**X**	**X**
14	Salinity mg/l chlorides - consistent with description	**X**	**X**	**X**	**X**
15	Retort oil/water/solids % volume - consistent with Waste Consignment Note description % or bbl of components	**X**	**X**	**X**	**X**
16	Specific gravity - in expected range of description	**X**	**X**	**X**	**X**
17	Note if any heterogeneity and separation expected.	**X**	**X**	**X**	**X**
18	Waste Consignment Note and Appendix II analysis form consistent	**X**	**X**	**X**	**X**
19	Appendix II analysis form signed	**X**	**X**	**X**	**X**
20	Information reviewed on Installation and results within limits for OSV transportation	**X**			
21	Waste Consignment Note and Appendix II analysis form to ship's Master before back loading confirming that the material is safe for carriage onboard the OSV	**X**	**X**		
22	Master to check dirty tanks previous back load information prior to loading		**X**		
23	Master to confirm to installation that cargo can be back loaded before operation commences		**X**		
24	Onshore test before discharge or tank entry with Waste Consignment Note and Appendix II checked		**X**	**X**	**X**
25	Waste Processor onshore tests and where a significant difference in result is obtained a non conformance raised			**X**	**X**
26	Non Conformance to the Operator, Offshore Installation, Ship’s Master, Base Operator Surveyor, and Tank Cleaner.	**X**	**X**	**X**	**X**