SAFETY ALERT

FOCAL POINT	NEIL SMITH	APPROVED BY	GLENN CORR	ISSUE DATE	24/06/11

GRYPHON ALPHA LOSS OF HEADING, MOORING SYSTEM FAILURE AND SUBSEQUENT LOSS OF POSITION.

OVERVIEW

The Gryphon Alpha FPSO is located on Blocks 9/18a and 9/18b of the United Kingdom Continental Shelf (UKCS), 175 miles NE of Aberdeen, in a water depth of 112m. The vessel is a purpose built FPSO of a Tentech 850C design, with a length of 260m and 41m beam. It is capable of storing 540,000 barrels of oil.

The vessel has a Tentech turret just forward of midships equipped with a 10 point mooring system with 84mm diameter, K4 grade chains with a design Break Load (BL) of about 730 tonnes. The turret is maintained in a fixed orientation, the vessel rotates around it.

To maintain station keeping and to minimise environmental forces, the heading of the vessel is changed to align the bow into the prevailing seas. This is achieved by using 5 thrusters. The thrusters are positioned 3 aft and 2 fwd.

The control of the thruster system for heading control is maintained by a Position Mooring (PM) system.

INCIDENT

An incident occurred at 07:05 hours on Friday the 4th of February 2011 whilst the Gryphon Alpha FPSO was engaged in production operations. The vessel lost heading & position during stormy conditions (about 60 knots maximum wind speed with a significant wave height of between 10m to 15m).

The initiating event was the low tension failure of windward mooring line 7.

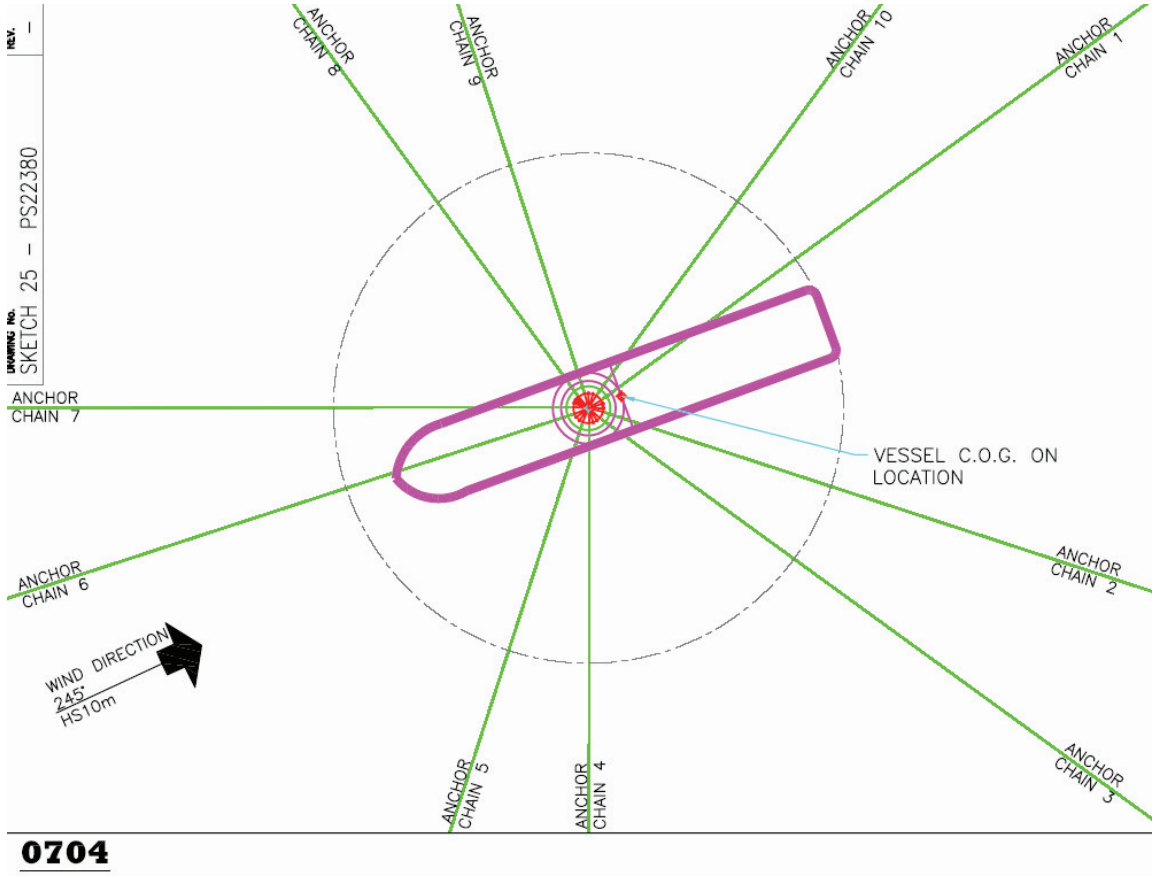
The PM system then drove the vessel beam on to the prevailing weather. This resulted in three further windward mooring lines (in order, 6, 5 and 4) failing progressively as the vessel heading turned beam on to the environment. The mooring lines failed due to the high environmental forces they were subjected to, which exceeded the design criteria.

The subsequent loss of position resulted in significant damage to the subsea infrastructure.

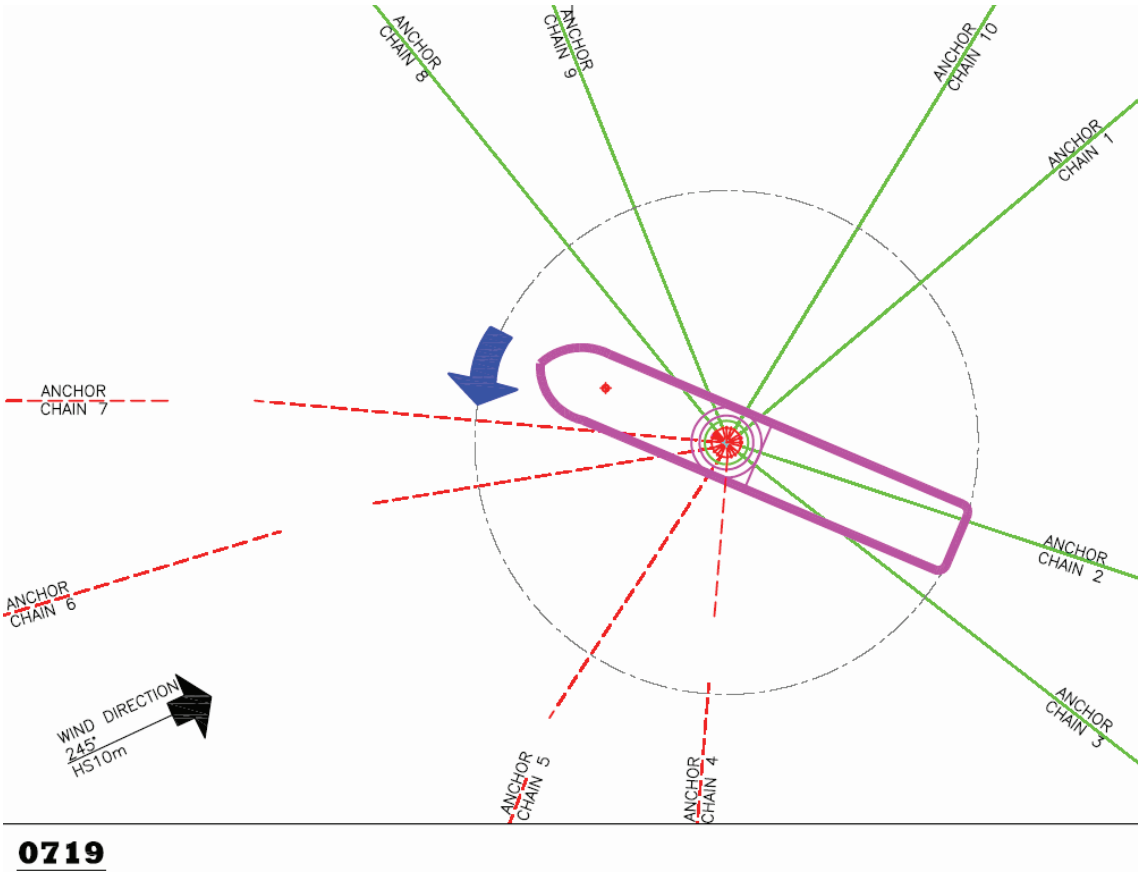
The GPA was manually initiated and production was shutdown and blowndown.

Subsequently 74 non-essential personnel were evacuated.

Representation of Vessel During Incident



Vessel just prior to incident at 07:04



Vessel with four failed mooring lines and approx 95m from field centre at 07:19

KEY FINDINGS

- Initiating event was failure of mooring line 7. This line failed as a result of a failure of the flash butt weld of a chain link at a tension significantly below its design load.
- Failure of mooring lines 6, 5 and 4 as the vessel heading turned beam on to the environment.
- The PM system drove the vessel beam on to the prevailing weather due to a chain of coincident events producing inaccurate inputs to the PM system models. This caused erroneous calculation of the forces and moments acting on the vessel. These events included:-
    - Underestimate of wind and wave forces as a result of inaccurate anemometer readings.
    - Loss of DGPS position reference, leading to the mooring model using wrong position to calculate mooring forces.
    - Manual heading change.
    - Failed detection of mooring line break.
    - Mooring line failure resulting in change in position.
    - Automatic PM system mooring model refresh failed.
    - Turret auto rotation.
- Due to hard drive memory settings, only limited data was recoverable from the PM alarm historian, hindering the investigation into the root causes.

LESSONS LEARNT

The incident highlights the need for duty holders to be aware of the potential for loss of heading & position on vessels fitted with Position Mooring (PM) systems.

1. PM System

The Class driven maintenance and functionality checks for a moored PM vessel are less stringent and comprehensive than those implemented by full dynamically positioned vessels such as DSVs. It may be prudent to consider employing a similar philosophy for moored vessels.

During this incident a number of inputs to the PM model were inaccurate, contributing to error forces building up within the model and resultant incorrect forces being applied by the PM system.

Duty holders may wish to review their processes and procedures to ensure that: the data recording system is sufficient; the model is reset or refreshed at a suitable frequency; the maintenance and functionality checks are suitable and sufficient; operators are drilled in the actions necessary in all foreseeable emergency scenarios; and inputs to the PM system are accurate, reliable and have sufficient redundancy.

2. Mooring System.

The basis of design of a PM vessel mooring system assumes that the vessel will not lose heading control, so will remain within approximately 10 degrees of head into the environment.

Analyses of the mooring system showed that the forces placed on the anchor lines would have approached or exceeded the break load of the chain at angles seen during the incident.

Duty holders may wish to review their mooring system's failure mode analysis in order to ensure that the forces applied to the vessel, at reasonably foreseeable angles and environmental conditions are understood and appropriate procedures and processes are in place to manage the risks from loss of heading and those forces.

3. Anchor Chains

During this incident anchor chain number 7 failed at the flash butt weld of one of its links. This failure mode is unlikely to be picked up by visual inspection.

Duty holders may wish to review their inspection and discard criteria for anchor chain, to ensure they remain appropriate in the light of this failure type.

4. Power Management

During the incident, the power management set up was not optimal for the prevailing weather conditions.

Duty holders may wish to review their power management procedure and processes to ensure that they are appropriate for all reasonably foreseeable operating and weather conditions.