ARAP

KONGSBERG

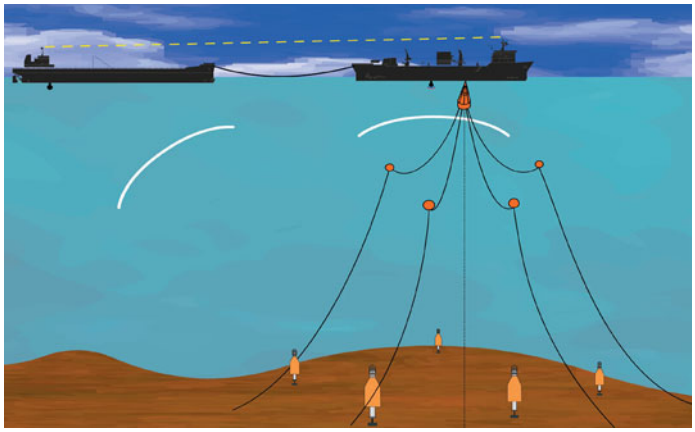
Absolute and Relative Acoustic Positioning - for tandem loading

Introduction

When a Shuttle Tanker is off-loading a *Floating Production and Storage Offshore* vessel (FPSO) or a *Floating Storage Unit* (FSU), both vessels normally have a requirement for a Hydroacoustic Position Reference system installed onboard.

FSU / FPSO achievements

- The vessel is **monitoring its own position relative to the zero point** of the anchoring system, by positioning seabed-mounted transponders with known coordinates to the anchoring system.
- **Anchor line breakage monitoring** - the onboard hydroacoustic system monitors the transponders with depth sensors mounted on the anchor lines.



Shuttle Tanker achievements

The shuttle tanker should be positioned relative to the stern (!) of the FSU, as the FSU's stern will "flutter" due to wind, wave and sea current forces. The shuttle tanker is normally equipped with a Dynamic Positioning (DP) system and reference systems. The DP uses the relevant reference system that gives positioning information about the FSU's stern. Kongsberg Maritime and Teekay Norway has therefore developed an underwater positioning function called **Absolute and Relative Acoustic Positioning (ARAP)**.

855-164980 / Rev.A / August 2004

Absolute and Relative Acoustic Positioning (ARAP)

The ARAP is a function designed for the High Precision Acoustic Positioning (HiPAP) and Hydroacoustic Positioning Reference (HPR) systems used in offshore loading, where one FSU / FPSO is stationary and one shuttle tanker shall stay on DP while loading.

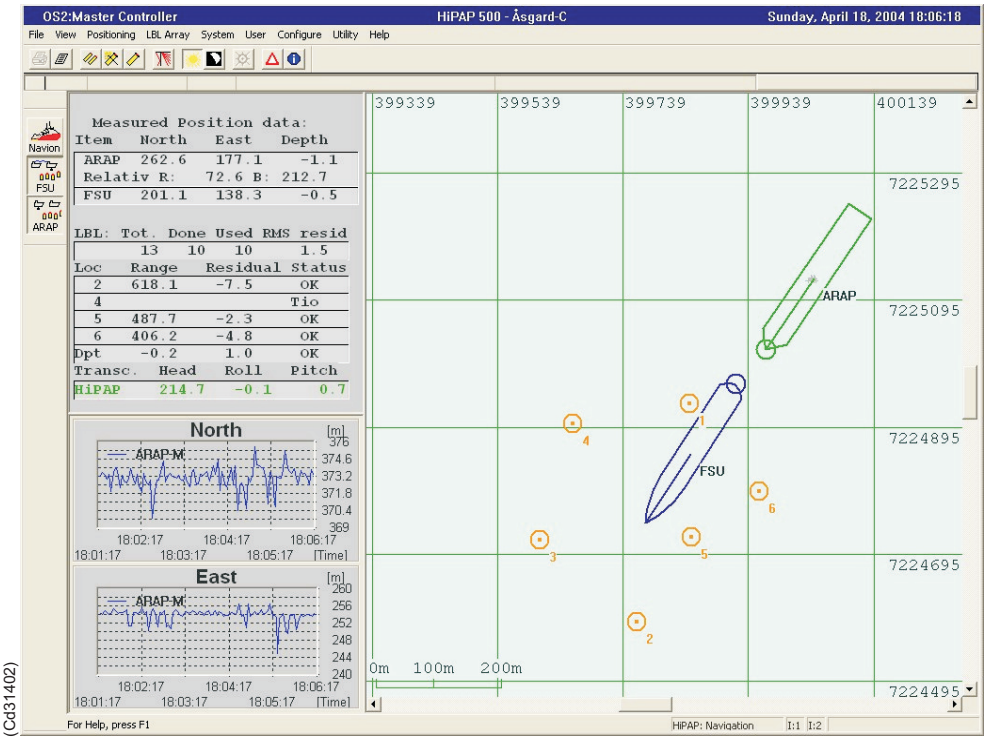
The FSU / FPSO is equipped with a HiPAP or HPR combined Long Base Line (LBL) and Super Short Base Line (SSBL) system, and it uses a transponder-array of typically 5 transponders on the seabed. The FPSO will position itself relative the seabed reference point with an accuracy of (0.5 – 1.5) m.

The shuttle tanker is equipped with a HiPAP 500 system. The HiPAP uses all the transponders in the array as beacon, (it measures the angles on the reply from the transponders). The depths of the transponders are known and by this the north, east and depth co-ordinates of the vessel can be calculated. The accuracy of the "beacon-position" is dependent of correct depth input. Therefore the HiPAP will read the vessels draft directly on a serial line, and compensate for the change in draft during loading. The position and the heading information of the FPSO are transmitted via a radio link to the shuttle tanker. The position is the Central Gravity (CG) position relative to the transponder array's origin. The HiPAP 500 system onboard the shuttle tanker receives this information.

The following information is available:

- FPSO's position and heading.
- Co-ordinates of the LBL transponders relative the specified origin.
- Offsets between loading point and CG of the FPSO.
- Offsets between loading point and CG of the Shuttle tanker.

By use of the above data onboard the shuttle tanker, the relative position and distance between the two vessels are calculated. Onboard the shuttle tanker the HiPAP 500 system displays a graphical bird's eye view of the FSU / FPSO and the shuttle tanker. The accuracy of the relative distance is determined by the position accuracy of the FSU / FPSO and the shuttle tanker in the along-ships direction. The accuracy is dependant on the geometry and the ranges from the shuttle tanker's transducer to the beacons.



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APOS presentation onboard the shuttle tanker

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