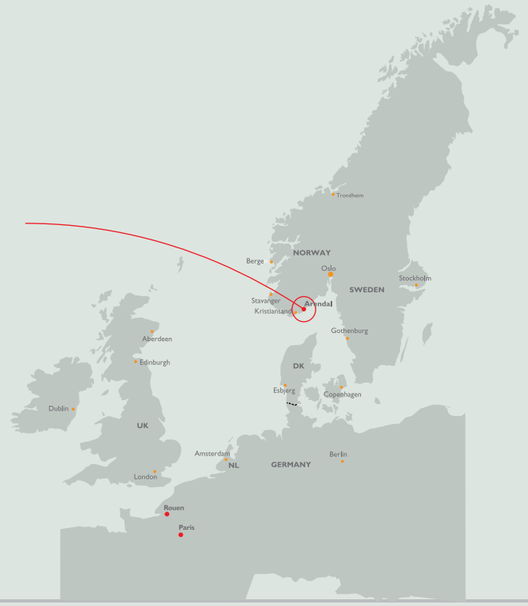

design: www.axis.as rev1002 print: birkeland trykkeri

Advanced Production and Loading AS (APL™) was established early 1993 to develop and commercialise the Submerged Turret Loading (STL™) and Submerged Turret Production (STP™) technology.

APL is responsible for system development, design and fabrication. Based on system components and experience from the proven STL system, APL has developed the Single Anchor SAL™/SAP™ and the BTL floating buoy systems.

Through acquisition of the business activities in Hitec Marine as in 2002, APL has taken over product ownership for the Bow loading System (BLS), Stern Discharge System (SDS), Volatile Organic Compounds (VOC) Recovery and Return and the Sequential Transfer of Tank Atmosphere (STTA) Systems.

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APL

VOC

Volatile Organic Compounds
Recovery System

ADVANCED PRODUCTION AND LOADING AS

APL

Recovery of Volatile Organic Compounds under tanker loading operations

VOC are the crude components with lowest molecular weight. VOC is a health and environmental problem, forming ground level ozone and smog. Under traditional filling of oil tanks, the expelled tank atmosphere containing VOC has been emitted to the environment.

Offshore crude oil loading is a large single source for emissions of Non Methane Volatile Organic Compounds (NMVOC).

APLs VOC Recovery system is targeted for use onboard shuttle tankers facilitating regeneration of fluid oil from the VOC.

APL's NMVOC recovery system, based on absorption technology, is contracted for 6 of total 8 VOC recovery systems to be in operation on the Norwegian Continental Shelf within March 2003.

Shuttle tanker Anna Knutsen with APL's VOC Recovery System

System Description

APL's VOC recovery system is assembled as a standard modular turnkey skid ready for hook-up to the applicable ship's systems, and consists of the following main components:

- Gas Compressor
- Absorption Column
- Instrumentation and Controls

APL's VOC recovery plant is remotely controlled and monitored from the bridge with minimum interface to the ship systems (fire, gas and shut-down). If necessary, additional power can be supplied from a separate power module installed in a safe area onboard the ship. Crude oil and seawater pumps can also be supplied if so required.

APL's VOC recovery system is class approved by DNV.

Process Description

APL's VOC recovery process is based on direct absorption of VOC in crude oil through the absorption column. A side stream of the oil being loaded, typically 5 to 10% of the total loading rate, is routed to the VOC recovery unit.

This side stream is pressurised to 7-10 bars before the oil enters the absorption column. Prior to entering the absorption column, the emitted gas from the tanks is compressed. A bypass line is installed for safety reason in the event that the gas flow exceeds the compressor capacity. In the absorption column the VOC is absorbed in the crude oil under pressure through counter-current absorption. Any remaining NMVOC is vented off through the tanker's riser, while the recovered oil is returned to the crude oil loading line.

Detailed and updated reference list is available on www.apl.no

Regulatory requirements for reduction of VOC emissions:

The Gothenburg protocol to abate acidification, eutrophication and ground-level ozone which aims to cut emissions of SO_2, NOx, VOC and NH_3, by setting country-by-country emission ceiling to be achieved by 2010. 26 countries have committed an average reduction of VOC emission of 42 % by 2010.

To be able to fulfil Norway's obligations, the Norwegian Pollution Control Authority (SFT) has introduced restrictions on the allowable emission of NMVOC gases associated with export of crude oil from the Norwegian Continental Shelf. This new legislation defines a NMVOC recovery rate of at least 78%. Additionally it states that 95 % of all offshore crude oil loadings shall be loaded through a VOC recovery system by the end of 2005.