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The Problem of Inert Gas Venting on FPSO's and a Straightforward Solution

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Abstract

As an FPSO continually loads stabilised crude oil to the cargo tanks, the inert gas (IG) blanket within the tanks is compressed. At a certain pressure, below that which could cause damage to the vessel structure, this mixture of now IG and volatile organic compounds (VOC's), emanated from the loaded crude, has to be vented safely to atmosphere, by some means.

From the very first FPSO that Single Buoy Moorings operated, the *FPSO II* in 1980, errant inert gas (IG) has resulted in a number of emergency shut downs (ESD's) whilst venting the cargo tanks during calm weather. With no wind to disperse the heavier-than-air gas, the result is the mixture falling onto the vessel main deck or the process modules, triggering the FPSO gas detection system and subsequently causing an ESD.

The cost due to loss or delay of production in this manner can quickly become considerable.

More importantly, whilst venting the cargo tanks, personnel are relocated to a safe area to ensure their safety and any hot-work being undertaken is postponed.

Crane and helicopter operations are also suspended.

There is, of course, a cost associated with the loss of personnel productivity during these events.

To prevent reoccurrence of IG venting related incidents, a number of operational measures are used. These usually consist of:

- delaying venting during low wind periods ($<2ms^{-1}$)
- employing the downstream vent mast (if two are fitted, one either side of the vessel)
- monitoring the lower explosive limit (LEL) via the gas detection system. As a high LEL is attained (usually around 40%) venting is stopped until the gas has been dispersed. Typically, the alarm is activated at 20% LEL and the executive action, in this case an ESD, is set at 60% LEL.

With FPSO's becoming larger, production rates correspondingly so – sometimes over 300,000 bbls/day – the financial penalties resulting from an unplanned shutdown are even more significant. Although using operational means can be a successful way of mitigating against both the safety and production risks associated with IG venting, a system that would obviate the need for such procedures has been sought by SBM since their first operating FPSO, over 25 years ago.

This paper describes the evolution of the inert gas arrangements onboard SBM's units, past and present systems that have been employed with varying degrees of success and the recent (July 2005) retrofit of an IG eductor to two SBM FPSO's operating West of Africa. The details of the patented IG eductor, from conception, design, safety studies, construction, installation and operational success are also presented.

Introduction

Many of the problems associated with IG venting can be attributed to the design of the IG facilities being a copy of those employed onboard crude oil and product tankers. This was an affliction of a number of early North Sea FPSO's, necessitating expensive reparation offshore once the unit was operating. Typical difficulties encountered were:

- insufficient isolation to allow safe tank entry
- a poorly located vent mast, dispersing IG and VOC's onto the process area during IG venting
- pressure vacuum (PV) breakers being installed on every tank
- inadequately located and sized PV breakers, that on losing the liquid seal cause a gas release and eventual ESD
- offshore personnel being unfamiliar with a marine system
- the capability of isolating a cargo tank and the subsequent possibility of over or under pressurising the vessel structure

With subsequent FPSO's, more attention was paid to this critical system in the design and the construction phases and how it was to be operated.

IG System Evolution within the SBM Fleet

Kuito FPSO, which began operation in 1999, had a vastly improved IG layout compared to that of *FPSO II* and was the