Corrosion Protection of Deep Water Permanently Moored Floating Production Systems using Cathodic Protection

M.B. Surkein, J.P. LaFontaine, R.E. Tanner
ExxonMobil Development Company
Houston, Texas, USA

ABSTRACT
Floating production systems (FPSs) such as FPSO (floating production storage and offloading) or FSO (Floating Storage and Offloading) hulls physically resemble ocean going transport vessels but operate more like fixed offshore structures. As these production systems are typically designed for long life, 20 to 30 years, corrosion control of the hull is extremely critical to help assure the required performance is obtained. Corrosion control for the hull is normally derived from the use of coatings and cathodic protection. The type of cathodic protection system used for an FPS hull can be either an impressed current type or by galvanic (or sacrificial) anodes. This paper will present a review of offshore vessel and fixed structure CP design, contrasting the effectiveness of impressed current and sacrificial anode designs for the hull.

KEY WORDS: Floating Production System; cathodic protection; anodes; corrosion; impressed current; galvanic anode

INTRODUCTION
The use of floating production systems (FPSs) vessels such as FPSOs and FSOS systems has rapidly increased in recent years. The advantage of FPSOs over other floating production facilities is the ability to store produced fluids, which can be later offloaded to a shuttle tanker. The components of an FPSO include the vessel (which is either a new build or a tanker conversion), the mooring system, the processing facilities, and the storage tanks. A riser system is usually attached to the FPSO to permit produced fluids from subsea fields to be processed on the topsides equipment. FPSO’s differ from mobile ships in that they are positioned in a stationary condition over the production field for years at a time. FSOs are used to store processed produced fluids for future offloading to shuttle tankers but do not include processing facilities. FSOs are often times moored to a fixed platform for connection to a subsea pipeline system. The corrosion control requirements for FPSOs and FSOs are quite similar.

METHOD OF CORROSION PROTECTION

It is generally considered that the preferred form of corrosion control for an FPSO, FSO or mobile ship hull is a combination of coatings and cathodic protection. The offshore industry has long term experience selecting and applying hull coatings, so there is little controversy as to the type of protection to use other than whether to use an anti-fouling coating or not. However, there are differing views regarding the type of cathodic protection system to employ.

IMPRESSED CURRENT CATHODIC PROTECTION

As FPSO/FSO hulls resemble that of trading tankers, the impressed current cathodic protection (ICCP) system design approach commonly used by the tankers also seems to be the first choice for FPSOs. Normally, a goal of the initial design for the impressed current system is to minimize the number of anodes and reference electrode components while fully achieving the criteria for cathodic protection on the hull throughout the entire design life. The criteria for protection is covered by many industry standards and described as polarizing the entire submerged hull steel to a minimum electrical potential of -0.800 volts vs. Ag/AgCl reference electrode or +250 mv zinc reference electrode.

The cathodic protection current required to cathodically protect a mobile ship hull varies due to factors such as ship speed, water velocity, temperature and changing water chemistry. To account for the sometimes rapidly changing current requirements, impressed current cathodic protection (ICCP) systems are most often applied to these vessels. Hull mounted