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Retrofitting of ICCP system of Loango Plaftorms DP1,DP2,DP3,PP with LIDA TSA™ Technology.

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Abstract

This paper describes the cathodic protection retrofit undertaken on four steel gravity platforms installed in 1976 offshore West Africa in 86 m deep waters. They were originally protected with galvanic anodes with a design life of 20 years. Insufficient protection conditions were measured on all the structures after only 10 years. A retrofitting intervention was planned in 1987 using an Impressed Current System using the LIDA TSA™ concept.
The main feature of the retrofit system are:
•N. 10 LIDA TSA™ strings on each platform;
•each string supports N. 10 anodes, type LIDA® SW.T.2.5/100;
•total anode current capacity for each platform: 5,000 A for a total installed capacity of 20,000 Amps

The systems were successfully commissioned in 1987: protection conditions were achieved and continuously maintained from start up with a current output of 50 – 60 % of the total installed anode current.
In 2003 the Oil Company decided to extend the life of the four platforms for other 20 years and planned a number of interventions to guarantee the structure integrity for the new residual life. It was decided to fully renew the CP system using the same technology successfully in service.
After 18 years of operation, the entire CP system was replaced in 2005 using LIDA TSA™; the refurbished system was successfully commissioned in 2005 with a 20 years expected design life.

1. Introduction

Four steel gravity platforms, located offshore West Africa in 86 m deep waters (Company: ENI Congo). were installed in 1976, originally protected with aluminum galvanic anodes with a design life of 20 years. Because of underestimation of the local current demand, insufficient protection conditions were measured on all the structures after about 10 years. A retrofitting intervention was planned and designed in 1987 using LIDA TSA ™ strings.

The submerged surfaces to be protected were approximately 27,600 m2 for the 3 "DP" platforms and approximately 20,000 m2 for the PP platform.
The design of the system was based on a maximum current density of 140 mA/m2, with an installed current capacity 30 % higher than the maximum protection current. These figures correspond to a total installed capacity of 5000 A per platform.

The systems were successfully commissioned in 1987: protection conditions were achieved and continuously maintained from start up with a current output of about 50 – 60 % of the total installed anode current. "Cabe, Mussinelli, Tettamanti et al. (1989)"

In 2003 the Company decided to extend the life of all the four platforms for other 20 years and in the mean time planned a number of interventions to guarantee the structure integrity for the new residual life. Within this plan, it was decided to fully renew the cathodic protection system using the same system already in service.

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After 18 years of operation, the entire cathodic protection system was replaced in 2005 using LIDA tensioned strings; the system was commissioned in 2005 with a 20 years design life. The project included supply of engineering and materials: anode strings and supporting ropes; transformer rectifier units; reference electrodes; above water current distribution system; data logger units.

2. LIDA TSA™ Technology.

The LIDA TSA™ technology (fig 1) allows a complete separation of the mechanical supporting system from the electrical system. This ensures that the mechanical forces and resultant stresses acting on the system are carried by the supporting rope.

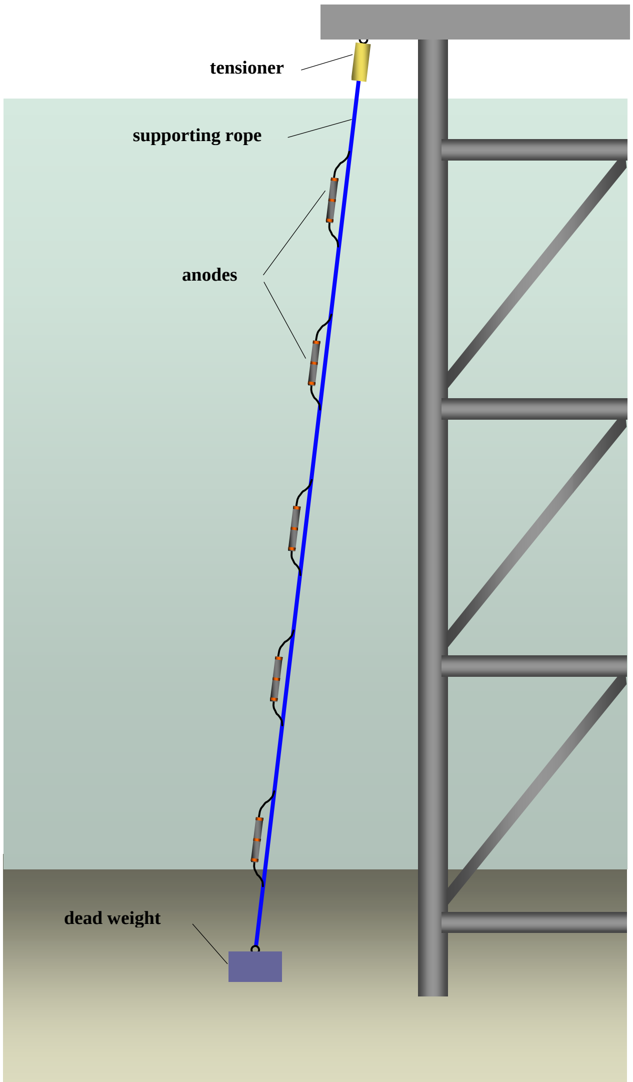

Figure 1. LIDA TSA™ Technology.

The supporting rope is designed to withstand an applied tension force which takes into account the water current flow, wave loading and the physical space between the structure steel members and the anode system during its maximum deflection.

The string is tensioned between a dead weight located on sea floor and a fixed anchor point on the lower deck of the platform.

Locations and spacing of the anodes on the supporting rope take into account the anticipated current demand at different elevations; the tension string system is particularly flexible in this respect.

The advantages of impressed current tensioned string concept are:

- it can be easily adapted to different type of structures, modifying number of strings, string configuration, number of anodes per string, etc.;
- high current output per string;
- high current distribution flexibility: string can be easily designed to face different current demands at different zones of the structure. The feeding system can be easily sectioned allowing the possibility of different current output in different parts of the structure;
- easily of installation, minimizing underwater works, also in case of a deep water platform;
- several retrofitting performed successfully, with systems in operation since several years.

3. LIDA TSA™ Configuration

Design of the LIDA TSA™ installed in 2005 has been based on the previous 1987 project. Some minor modifications have been introduced considering the operating data collected during the commissioning phase and in next years (from 1987 to 1992) as well as data gathered during preliminary site survey.

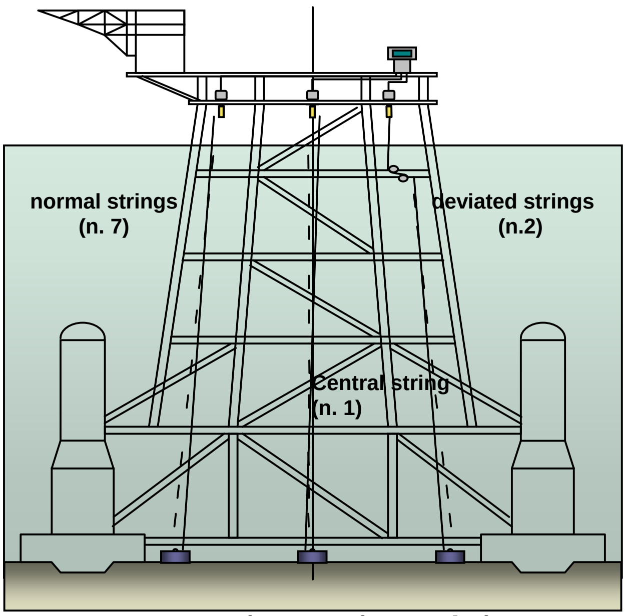

Figure 2. String configuration for one platform.

Some basic configuration of the cathodic protection systems were used for all the platforms.
In summary, the string configuration for one platform “Figure 2 indicates the string configuration for one platform” is the following.

- Number of strings: N° 10;
- String location: same of existing system: N° 1 string in the middle of the jacket and N°9 around;
- N° of anodes: N° 10 anodes per string; N° 100 anodes per platform;
- N° of positive cables: N° 5 cables per string, each one with n° 2 LIDA® Anodes.

The LIDA/ASC strings are electrically fed by N° 5 transformer rectifiers with a total current capacity of 4950 per platform.

4. LIDA TSA™ Installation

The Installation of the CP systems was performed by a deep diving company with a supply vessel equipped with moon pool and bell. The installation of the LIDA TSA™ took about 10 working days for each platforms.

The installation procedure included:

- positioning a principal pulley system between the dead weight and the deck of the platform, applying a 0.5t load to the steel pulley rope which was used as a guide for the string to be installed;
- removing the string from the case starting from the socket to be connected on the dead weight, and temporarily fixed to the guide pulley;
- the string was taken by the pulley to the dead weight on bottom with divers driving it to avoid detrimental contact of any string components with the structure;

- the lower socket of the string was diver-connected to the dead weight, while on the platform, the string is connected to the tensioner, adjusting the length of the assembly with a length of steel chain;
- the ties between anode assembly and guide rope were cut and the protective packing removed from the anodes;
- on the surface, a load applied by means of a hydraulic system and turnbuckle installed between the steel chain and turnbuckle installed between the steel chain and the tensioner, to the design load of 5 tons;
- a camera-equipped R.O.V. monitor was used to record proper installation of the string;
- each assembly was energized by connecting the individual electrical cables to the main power source at a junction box located at the lowest platform deck.

4.1. Recovery of old LIDA TSA ™ system.

During the installation of the new systems the old system components were recovered and will be submitted to characterization tests and and analysis in order to gain useful information to improve the LIDA TSA ™ design.
For example the following system components have been retrieved

- N. 6 anodes, type LIDA® SW.T.2.5/100 of LIDA TSA™ N° 9 of platform DP1 that worked at the following depth levels:
  10m under the ocean level; 38m under the ocean level; 55m under the ocean level; 64m under the ocean level; 76m under the ocean level; 79m under the ocean level;
- Connector Lug of LIDA TSA™ N° 1 of platform DP1;
- Coated galvanized steel rope and electrical cable of LIDA TSA™ N° 1 of platform DP1.

The connector lug and the coated galvanized steel rope as well as the titanium spacers looked in very good conditions after 18 years in the ocean.
The following tests will be performed on the recovered materials:

- Anodes: Helium leak test on LIDA® patented connection; Electrical continuity test; Residual electrochemical activity; residual coating analysis;
- Electrical cable: degradation and swelling analysis on the cable insulation layers;
- Steel rope: zinc coating residual thickness test, mechanical tests

5. Conclusions.

The new system was first energized in October 2005 on platforms PP and DP2 and in December 2005 on platforms DP1 and DP3.

The systems of each platform have performed according to design parameters with respect to polarization levels achieved on the different parts of the structure and particularly at the bottom of the jacket, where the structure is more generically complex. During the system’s first six month of operation no failures, mechanical stresses, or increase of circuit resistance were experienced.

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7. References

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