ABSTRACT

In the present paper a recently installed Sensor Network for Monitoring the Response (SNMR) of a Floating Structure (FS) is presented. SNMR is deployed on a pontoon-type FS operating as a floating breakwater, located 300m from the coast in the port of Neos Marmaras in Greece. The developed SNMR consists of: (i) sensors for real time measurement of FS’s critical response quantities related with the structural integrity and safety of the FS as well as of environmental parameters and (ii) data acquisition and data transfer and storage system. Characteristic examples of time series of the measure quantities obtained during the operation of the SNMR are presented and preliminary assessed.

KEY WORDS: Structural health monitoring; floating structure; sensor network; field measurement; structural integrity; offshore structures.

INTRODUCTION

Since 1947, more than 10,000 offshore structures of different types, floating or fixed, and of various sizes have been constructed and installed worldwide (Chakrabarti, 2005). Many offshore structures (including their equipment) have reached, or are near to the end of their design lives. Additionally to the usual conditions existing in the case of land-based structures, offshore structures have the inherent difficulty of being placed in the ocean environment, where particular conditions/effects exist affecting their design and service life, e.g. fluid-structure interaction, severe weather conditions, intense nonlinear dynamic effects, impact pressure actions, accidental events and air gap. Up to now several catastrophic events of offshore structures have been recorded having as result in some cases the loss of hundreds of lives and/or difficultly reversible environmental impacts; among them stands out the disaster of the world’s largest floating production system, the Petrobras P-36, that sank in Campos basin in March, 2001 (Barusco, 2002).

Floating Structures (FSs) present a major characteristic category of offshore structures. The “state” of an FS during its life cycle must remain in the domain specified in its design; however, this can be altered by normal aging due to usage, by the action of the environment, and/or by accidental events. The application of an efficient/integrated for monitoring FSs’ performance and structural integrity during FSs’ service life is of paramount importance, since such a system: (a) will allow the diagnosis of the ‘state’ of the constituent materials, of the different parts constituting the FS, and of the full assembly of these parts under different environmental conditions, (b) will contribute to the early detection of possible faults and consequently, (c) will result to the prevention of FSs’ partial and/or total failure.

Chang (1999) defined Structural Health Monitoring (SHM) as an autonomous system for the continuous monitoring, inspection, and damage detection of a structure with minimum labor involvement. In addition, Sohn et al. (2004) is referred to SHM as the process of implementing a damage detection strategy for aerospace, civil, and mechanical engineering infrastructure. SHM encompass approaches for detecting the onset, the propagation or the effects of damage or degradation in structures, as well as approaches for assessing the effects of damage or degradation on structures’ performance. A typical SHM system is composed of a network of sensors that measure the parameters relevant to the state of the structure and its environment. In order to monitor the health of large infrastructures, the outputs from various kinds of sensors should be collected simultaneously and/or sequentially; the sensors may be positioned at different places, bonded on and/or embedded in the monitored structure and they may be wire and/or wireless connected to a local computer, where the data acquisition is performed (Wang and Liao, 2001). The acquired data from a SHM system can be used for estimating the service condition and the remaining service life of the structure as well as for assessing the structure’s integrity and estimating its reliability. Moreover, based on the assessment of the acquired data the life extension of the structure can be achieved. During the past decade, several SHM systems have been proposed, developed and applied for in-situ and/or in-service monitoring of structures (Chang et al., 2003).

The SHM technology for offshore structures has been studied since 1970’s; as described by Begg et al. (1976) based on vibration signals, the structural integrity monitoring and structural parameters’ identification of an offshore structure is performed. So far a number of monitoring methods have been used in the offshore industry, and can