SEAFLOOR EARTHQUAKE MONITORING SYSTEM

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ABSTRACT

Data on the response of seafloor sediments to earthquake-induced ground motion are scarce. To learn more about the response of seafloor sediments, the U.S. Minerals Management Service (MMS) installed a seafloor earthquake monitoring system (SEMS) network offshore southern California. The data gained will be used to improve safety standards relating to the structural aspects of offshore facilities. The SEMS is a network of three offshore seismic probes installed in locations of varying water depths. The probes were installed offshore Los Angeles County at Aera Energy LLC's Platform Eureka, Ventura County at Venoco Inc.'s, Platform Grace, and Santa Barbara County at Torch Operating Company's Platform Irene. The MMS and the California Division of Mines and Geology (DMG) have signed a joint agency work agreement for the maintenance and monitoring of the SEMS equipment. Data received from the SEMS will be incorporated into data from the DMG's onshore monitoring network and processed for public distribution to the engineering and scientific community. The DMG will be responsible for archiving all data received. Anyone can access the data from the SEMS by logging on to the DMG home page at:
www.consrv.ca.gov/dmg/csmip.

Keywords: Pacific OCS Region, earthquake, SEMS, DMG.

INTRODUCTION

Data on the response of seafloor sediments to earthquake induced ground motion are scarce. To learn more about the response of seafloor sediments, the U.S. Minerals Management Service (MMS) installed a seafloor earthquake monitoring system (SEMS) network offshore southern California. The data gained will be used to help improve safety standards relating to the structural aspects of offshore facilities. This SEMS is the only currently operating offshore seismic network in the United States.

The SEMS program is the result of recommendations provided by the Marine Board of the National Academy of Sciences to obtain data on seafloor seismic ground motions. In 1979, Sandia National Laboratory, under the sponsorship of the MMS and the U.S. Department of Energy, installed a series of prototype instruments known as SEMS. Since 1979, the MMS has installed four generations of SEMS equipment. The latest generation, SEMS IV, was installed in July 1995.

The SEMS IV is a network of three offshore seismic probes installed in locations of varying water depths. The probes were installed offshore Los Angeles County at Aera Energy LLC's Platform Eureka, Ventura County at Venoco Inc.'s Platform Grace and Santa Barbara County at Torch Operating Company's Platform Irene. The probes are imbedded three to seven feet into the sea floor approximately 400 feet from the platform and hardwired to seismic data recorders installed topside at the platform.

The SEMS IV area of coverage is extensive. A probe can record a magnitude 4.0 earthquake within a 25 mile radius and a magnitude 4.5 earthquake within a 65 mile radius. With 160 miles separating Platforms Irene and Eureka, the coverage for a moderately-sized earthquake in the southern California area is over 25,000 square miles.

The seismic probe was designed to protect the electronics under adverse deep water conditions and to minimize damage during the installation process. Each probe contains a three-axis magnetometer to calculate the probe's orientation after being embedded in the sea floor.

To install the probe, it was first attached to a vibrocorer/coretube assembly which was then slid into an installation cage. A crane was used to lower the equipment to the ocean floor with the help of an underwater Remotely Operated Vehicle (ROV) equipped with a camera. Once the cage was stable on the ocean floor, the vibrocorer was activated. After the probe was sufficiently embedded, the ROV used one of its robotic arms to release the probe from the coretube. The ROV backfilled the hole left behind by the coretube.

The SEMS IV instrumentation system was designed to measure three-axis acceleration. The seismic events are recorded by Quanterra Q680/LT-G computers. The probe and event recorder are powered directly from the platform power system, but backup battery power is also available.

On September 20, 1995 at 4:27 p.m., a magnitude 5.8 earthquake occurred in the Ridgecrest area. Though the earthquake's epicenter was 192 miles from Platform Irene, the earthquake registered loud and clear on its computer. In addition, the SEMS IV recorded the March 18, 1997 Barstow earthquake and several aftershocks to the 1994 Northridge earthquake.

The MMS and the California Division of Mines and Geology (DMG) have developed a joint agency work agreement for maintenance and monitoring of the SEMS IV equipment. Through this work agreement, the DMG will:

- Periodically monitor and test the SEMS IV to ensure that the instruments are operational.
- Perform onsite maintenance and inspection of the equipment once a year or as needed.
- Troubleshoot and repair the system as necessary to assure reliability.

The MMS will reimburse the DMG for any expenses incurred in the maintenance of the seismic equipment as well as provide the necessary software and technical information.

Data received from the SEMS will be incorporated into data from the DMG's onshore monitoring network and processed for public distribution to the engineering and scientific community. The DMG will be responsible for archiving all data received. The data from the SEMS IV can be accessed by logging on to th eDMG home page at: **www.consrv.ca.gov/dmg/csmip**.