

Title	OTH94 430: Blast and shock induced vibrations in offshore jacket installations
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Executive Summary	<p>The subject of shock induced vibration is not frequently considered in current designs of offshore platforms. Seismic ground motion has been treated as the most severe form of dynamic loading, and any analyses that have been carried out attempt to demonstrate platform integrity under this form of loading. Equipment critical to the safety of the platform will be subjected to strong vibration, and hence may be at risk from dynamic loading. This study considers various accidental loads and predicts the vibrations which result. A form of specification is suggested so that suppliers can design equipment capable of withstanding the vibrations caused by accidental loads.</p> <p>A major part of the study was devoted to the effect of blast loading. Predicting blast overpressures is complex, and there are three techniques currently in use to give pressure time histories, Computational Fluid Dynamics (CFD) codes, phenomenological models and scaled tests. Each will give a different pulse shape for the same conditions. Since no one technique can claim to be always superior, two or three pulses of each type have been considered for the analyses.</p> <p>A finite element model of a "typical" fixed leg platform has been created in sufficient detail to represent the global bending modes and local modes in the topside structure. The blast overpressure pulses with a peak pressure of 1 bar have been applied to six possible blast wall configurations and the response of the platform calculated for a period of 10 seconds. Those locations in the topside structure where the largest motions occurred were identified and the time histories of the response presented. The maximum acceleration predicted across the range of blast wall configurations and blast pulses was 2g.</p> <p>Ground motions have been identified that might be expected in the North Sea region for earthquakes of return periods 50, 100 and 10000 years. These prescribed inputs have been applied to the base of the jacket and the response of the platform calculated using the same solution technique as that used for the blast loading cases. The response showed that the maximum acceleration from the 1 in 10000 year earthquake was one third that of a 1 bar overpressure blast load.</p> <p>Ship impact was considered by assuming that the vessel made a glancing impact with a stiff part of the jacket. The accelerations from this event were comparable with those from the blast loads, except on the helicopter deck where response in a local mode of vibration caused levels of 3.6g.</p> <p>Dropped loads with locations chosen to cause maximum vibration were also compared. Even so, the peak accelerations were only 0.26g.</p> <p>Existing guidelines for the assessment of platform vibration have been summarised. The most meaningful information discovered was that given by Det Norske Veritas in their "Rules for Classification of Fixed Offshore Structures". Vibration levels are given as a function of frequency for different locations on the platform. No distinction is made between those vibrations arising from normal operations, pumps and motors for example, and strong vibrations from accidental loads.</p> <p>A survey has been carried out of suppliers of equipment to North Sea operators to discover the extent of vibration specifications currently being set. This survey concluded that no special requirements to withstand strong vibration were requested, and although other industries had made such demands, none had so far come from the offshore industry.</p>

Strong vibration has the potential to cause direct injury to personnel and the study has investigated this effect in light of current knowledge of this subject. It was concluded that there was little risk of direct injury, but indirect injury from falls and projectiles was much greater.

The methods used by other industries, in particular the nuclear industry, to specify equipment for withstanding strong vibration, were investigated. In a nuclear power station, floor response spectra are specified to the supplier who can use the information to determine the level of vibration that individual items of equipment must withstand in specific limitations within the station. This technique can also be used for the offshore industry and examples of location specific spectra have been developed and presented as part of the study.

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