STRUCTURAL INTEGRITY MONITORING

Structural integrity monitoring systems mounted on offshore platforms are slowly beginning to prove their worth, in confirming operational performance of the platform, and in providing information to help control the costs, of downstream inspection, maintenance and repair activities.

However, experience with almost all of the structural integrity monitoring systems installed in the North Sea before the mid 1980s, has shown that the data acquired from such systems was not properly integrated into the operational management of the structure.

In some cases, such data was used to confirm the design basis of a structure by comparing operational loads with those predicted from design methods. In most others, acquired data had been archived and forgotten. Resulting in no worthwhile use being made of information from the considerable investment in monitoring systems.

It is too easy for offshore operators to get into a position where a structural integrity monitoring system is designed to collect data for its own sake, with little or no thought being given to the way in which the data will be analysed and used, to achieve some predetermined goal.

The design of an operationally effective structural integrity monitoring system is best done by defining and following the basic elements of a monitoring philosophy. The four main guide lines for such a monitoring philosophy are:

1. The design criteria for a monitoring system should be firmly defined and targeted at meeting specific operational needs. Justification for the cost of a system can then be argued on the basis of operating cost reductions, or safety enhancements delivered by meeting these operational needs.

2. It is essential, that the output of the structural monitoring system is available in a format that can be used within the operating procedures of the production vessel. This requires that the designers of the monitoring system should generate usable, understandable output, and that the vessel operators should have a commitment to incorporating this output into operational decision making.

3. Ideally, the system should have hardware and software that permits automated, unmanned operation with the absolute minimum of intervention - usually once every three months.

4. Recent developments in software algorithms permits significant cost reduction in monitoring systems. This is achieved in two ways: - by using robust software that increases the reliability of low cost hardware, and by using development in analysis software, that permit measured parameters at inaccessible locations, to be deduced from data gathered from accessible locations, at low cost.

The last item above offers a substantial increase in capability, and reduction in cost. The technique is implemented by running a real time mathematical model of the physical structure. Real time data, collected from one part of the structure, and input to the model, then produces good estimates of the behaviour of parameters on any other part of the structure. These analysis techniques can also be used to obtain derived data, such as accumulated fatigue damage, which can be used directly in operational decision making. Some examples of deduced or derived data that can be generated using the technique are:

A. Fatigue damage accumulation on risers, loading system hawsers, mooring lines and platform structural components from strain gauge data.

B. Mooring line integrity from horizontal plane position data for a floating vessel.

C. Vessel hydrostatic stability (centre of gravity position) from measured roll or pitch motion of the vessel.

D. Vortex shedding vibration of tension leg platform tethers and vertical risers from accelerometers mounted at the top of the tethers or risers.

E. Bending moment and curvature at sea bed, for flexible riser and umbilical catenaries, from motions and acceleration data at the surface vessel.

BPP-TECH have supplied many monitoring systems that incorporate these ideas. Among these were:

- An operations advisory system for the McDermott Marine DB50
- The UK's first full flexible riser monitoring system for FPF Emerald Producer
- Hydrostatic stability monitors for several ships and semisubmersibles
- A positioning and mooring chain monitoring system for the Chevron Alba FSU
- Umbilical installation monitoring for the Arco British Well and Orwell fields