CHAPTER 2

OBJECTIVE AND SCOPE OF THE INVESTIGATIONS

Corrosion and fatigue are two very important factors deciding the structural performance and longevity of steel offshore platforms. Corrosion is a threat to these structures because of their continuous exposure to the highly corrosive sea water environment. Also, these structures are prone to fatigue failure because of the repetitive sea wave loading. These two phenomena corrosion and fatigue complement each other and the resultant synergistic effect, referred to as 'corrosion fatigue', is much more detrimental.

The immersed zone of steel jacket platforms is protected against corrosion by providing cathodic protection. Normally, aluminium alloy based sacrificial anodes are used for providing the cathodic protection. When a structure/structural component prone to fatigue failure is freely corroding in sea water environment, its fatigue life is found to decrease by a factor ranging between two and three. If the structure/structural component is adequately protected against corrosion by providing cathodic protection, is the in-air fatigue life regained? This question has been addressed by researchers in the recent years and a conclusive answer is still wanting. Some codal provisions take care of this uncertainty by being extra conservative: provide adequate cathodic protection to protect the structure against corrosion; but, from fatigue considerations, treat the structure/component as unprotected and provide the necessary design penalty factor as for a freely corroding case.
In steel jacket platforms, tubular joints are the important locations from fatigue considerations because of the stress concentration encountered at these joint locations. When these joints are exposed to sea water environment, does adequate cathodic protection help these joints to regain the in-air fatigue strength? This is the main question addressed in the present investigations.

Experimental investigations are planned on steel tubular joints typical of welded structural connections of steel jacket platforms used for production and processing of offshore oil and gas reserves. The specimens will be approximately quarter scale models of a typical joint in the jacket platforms in the Bombay High region. T joint configuration is selected and the joints will be strengthened by providing three internal ring stiffeners in the chord member. Internal ring stiffeners contribute towards decreasing the stress concentration factor, increasing the static ultimate load carrying capacity, and improving the fatigue strength. The joints will be tested under axial loading of the brace and under constant amplitude loading. Corrosion fatigue tests will be conducted on cathodically protected joints in synthetic sea water environment. Cathodic protection will be provided by using aluminium alloy based sacrificial anodes. Air fatigue tests will be conducted for comparison of test results.

The objectives and scope of the current investigations are:

(i). to carry out analytical and experimental investigations on Stress Concentration Factor (SCF) in an internally ring-stiffened T joint;

(ii). to carry out experimental investigations on corrosion fatigue behaviour of cathodically protected joints in synthetic sea water environment at different levels of hot spot stress range;

(iii). to validate the test results with standard S-N curves for fatigue life of tubular joints in air and sea water environment; and

(iv). to carry out studies on corrosion fatigue crack growth in tubular joints.
Fatigue tests on large size steel tubular joints are expensive and time-consuming. Corrosion fatigue tests are even more so since the tests have to be conducted at the very low frequency of 0.2 Hz at which the environment acts. Hence, test results available in this area are very limited. Nevertheless, these test results form a significant contribution in drawing fatigue design guidelines and deciding design S-N curves.

Time and expense involved have limited the total number of tests in the present studies. No study has been reported in the country on fatigue life estimation of cathodically protected tubular joints of offshore structures. In view of the fact that a large number of jacket platforms are operating in the offshore environment in the world and a proper understanding of the structural performance of the cathodically protected tubular joints of these platforms is very essential, the present investigations have been taken up.