ZENITH OFFSHORE VENT TIP REPLACEMENT

This paper is intended to provide an overview of the removal and replacement of a cold vent tip, completed on an offshore oil rig located off the coast of Malaysia.

Background

Zenith SAS were approached by a multinational oil and gas provider to propose an innovative solution to remove and replace a defective cold vent tip at the head of a 30m steel stack on one of their production rigs off the Malaysian coast, without the use of a costly barge crane.

The original design intent for tip replacement involved having to rotate the stack through 90^{o} at the base; this would have allowed access to the tip at platform level. However, due to maintenance issues, and previous modifications to the rig, this option was no longer deemed viable by the rigs operator.

Zenith SAS, in conjunction with Zenith Consultants were tasked with proposing an alternative solution which would see the defective tip lowered to platform level and the new replacement tip installed with minimum disruption to the rigs process.

The provision of a purpose designed lifting davit and temporary platform was the preferred option from an early stage as it promised to tackle all the constraints and could be used for future tip works.

Zenith SAS were subsequently appointed to design, fabricate and install the innovative bespoke lifting davit, utilising traditional steeplejacking activities to access the head of the stack and to carry out the essential maintenance works.

Proposed Solution

A practical, lightweight, easy to transport and easy to assemble solution was required. In such remote locations reliability is crucial, so any lifting apparatus needed to be robust enough to deal with the environmental conditions and simple enough to minimise any risk of reliability issues often associated with mechanical plant.

It was decided at an early stage in the project that the use of motorised equipment would add unnecessary complications to the logistics of the operation.

A hand operated manual hoist would provide the ideal solution, with the required lifting capacity to hoist the 750 kg vent tip up 30m to the head of the stack.

The davit support bands incorporated the brackets for the temporary access platform, the structural form of such a temporary platform is akin to the traditional steeplejack '*V Stage Scaffold'.* Due to proximity of the supports for the guy wires and the redundant lifting bracket careful consideration had to be given to the

geometry of the platform, this was achieved by creating a 3 dimensional model of the stack based on historic drawing information.

Figure 1 illustrates the proposed method of temporary platform and davit installation.

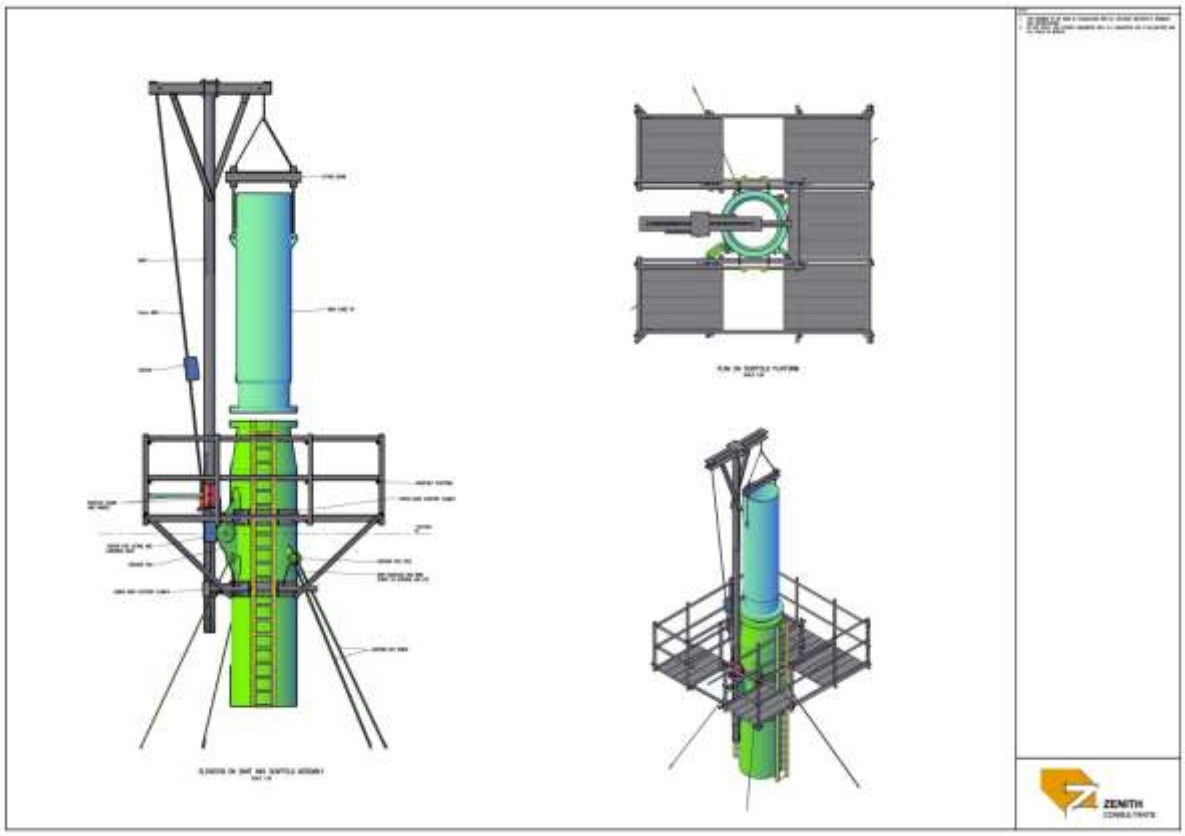

Figure 1

Design Methodology

On undertaking the detailed design of the lifting davit and temporary platform two scenarios had to be considered.

The first being the actual design of the davit and platform itself, incorporating the necessary details which would allow the materials to be hoisted into position.

The second being the structural appraisal of the existing 900mm diameter steel stack and 4 no. guy wires to ensure the additional loading of the platform and the eccentric load of the tip whilst it was being installed did not adversely overload the system.

The design of the lifting davit was developed to minimise the moment forces at the base of the davit, consequently minimising the 'push/pull' reactions on the stack itself. In order to achieve this, the length of the upper boom was kept to a minimum while the introduction of a back stay wire effectively balances out the overturning forces. The majority of the forces are transferred through the davit structure in compression.

The base of the davit structure is held into position at the head of the stack (below the tip), via two steel bands clamped to the shell. The two bands are physically connected using 4no. steel rods, allowing both bands to act in a composite manner. As a means of secondary support, the upper band is to be bolted through an existing fin plate, whilst the lower band is secured to the guy wire fin plates by means of wire strops.

Figure 2

On installation of the two steel support bands, the scaffolded working platform was erected. Using hand operated mechanical lifting equipment the davit would then be lifted, in sections into position and assembled.

Figure 3

Figure 4

Detailed Design Stage

The latest Building Information Modelling (BIM) software was used, enabling a smoother workflow and interoperability between the drafting and the analysis packages.

A loading assessment and detailed structural analysis of the davit and existing stack was undertaken, with a number of loading permutations to establish the stress increases in the stack and within the 4 no. guy wires. The stress increases were interrogated within the model in order to establish if they were beyond the permissible limits.

Figure 5

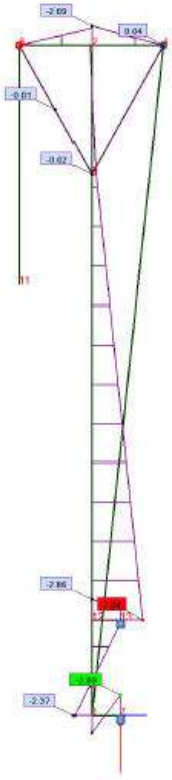

Figure6

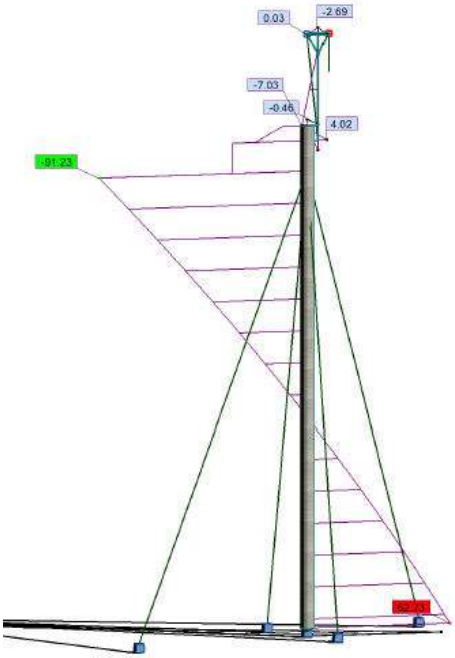

Figure 7

Analysis demonstrated that there was sufficient structural capacity inherent within the system to adequately resist the additional loads imposed onto the structure by the proposed method of tip installation.

The effect on the pre-tension of the guy wires was found to be negligible.

Execution of Works

At the heart of the success of this project was the ability to implement traditional steeplejacking skills in a modern environment. Following the laddering of the stack, the upper and lower support bands were installed.

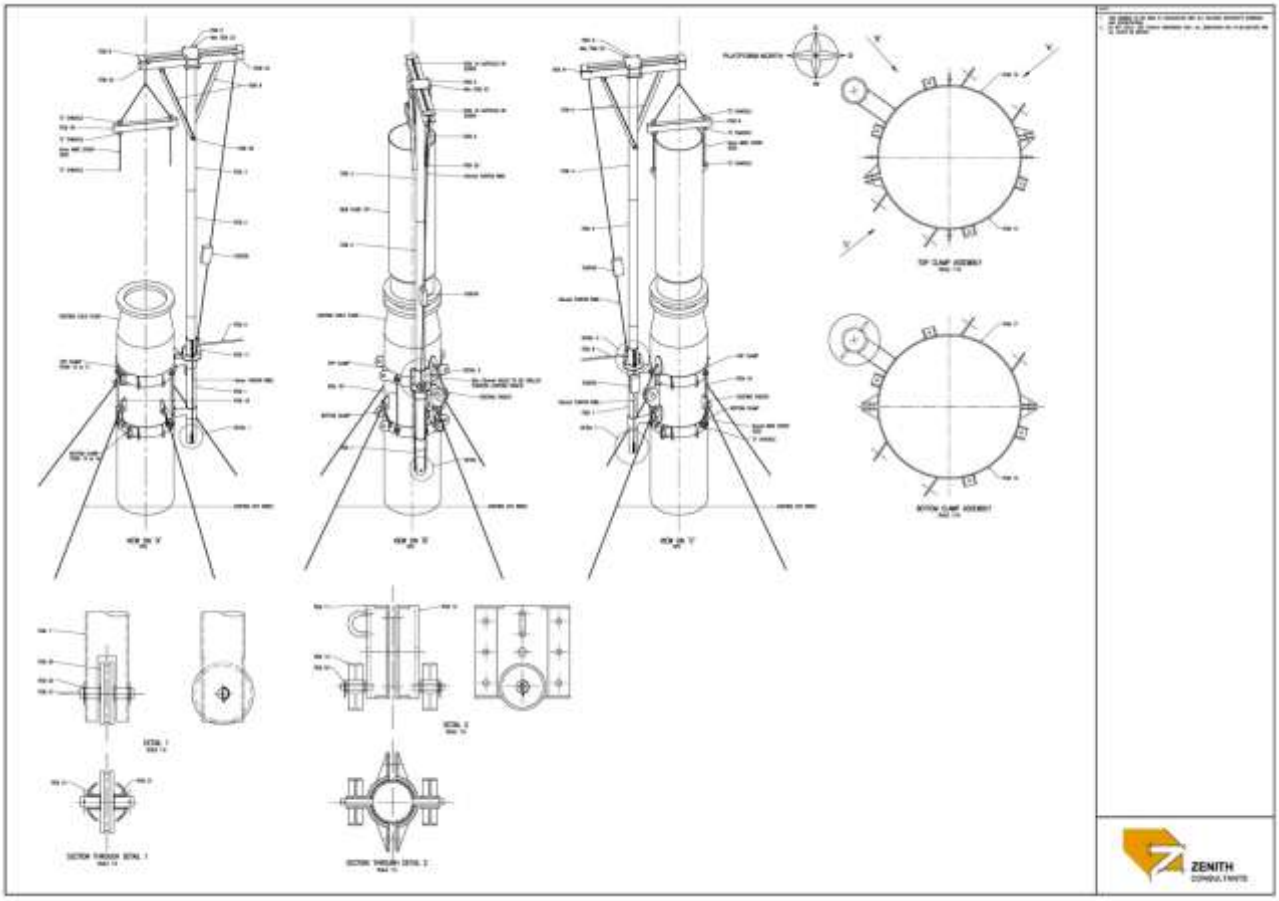

Figure 8

Figure 9

Progressively the temporary platform was constructed and secured to the vent stack, with the lifting davit hoisted into position in sections and constructed at the work face.

Figure 10

Conclusion

The key to achieving the successful delivery of the project was the ability to identify and eliminate potential problems at the design stage, and to be able to transfer the information to the highly skilled operatives undertaking the work on site.

- Understanding the clients' goals and brief.
- Assembling a competent team with a proven track record.
- Good communications throughout the team.
- Technical competence and the ability to develop early stage designs through to completion.
- Safe Work Procedure and Risk assessment.
- Execution of the Project.
- Project review and Appraisal.