ZENITH

Flare Tip Change out, Tengiz, Kazakhstan
A Different Approach

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This paper is intended to provide an overview of a flare tip change out, completed at Tengiz Oil Field, Kazakhstan, where circumstances dictated that a different approach to a repetitive and common project was required.

1. Background

The project in Tengiz Oil Field, Kazakhstan was to change out a defective combustion flare tip of a one hundred and twenty metre high stayed wire supported elevated flare structure. The flare tip was to be changed out as part of a regular maintenance program with minimum impact on productivity.

In conjunction with the flare tip change out, inspection works and subsequent repairs were anticipated. The change out process is a repetitive task with the normal course of action being the deployment of a heavy duty lifting mobile crane. The deployment of a crane was an option but failed to address the potential for repeat business in the future. The impact of cost and delivery time of the required crane was deemed to be excessive at an early stage.

A second option available was to use the existing lifting derrick incorporated within the original design. However, the potential of exposure too the aggressive environment at the top of the flare structure added to the fact that no reliable physical inspection records of the derrick existed, resulted in the potential for using the existing detail being deemed a substantial risk.

In consultation with client's team, combustion engineers and a specialist height contractor a new proposal was developed.

2. Constraints

The major constraints at the planning stage included the following: - (This list is not exhaustive).

2.1 Time line

The anticipated project start date was three months from the time of planning. The timescale available forced the parties to address the various constraints and make early decisions to any proposal.

2.2 Isolated Site

The isolated site and potential cost impact virtually ruled out the crane option.

2.3 Inclement Weather

Typical weather conditions for the time of year projected wind speeds exceeding the 9 Metres per second limit of this duty crane.

2.4 Economics

The parties to the contract worked to provide a solution that was both a success on this project and could offer substantial savings in the medium to long term.

2.5 Maintenance

The solution was to include the provision for inspection and maintenance to the structure at the same time of flare tip change out.

3. Other Factors

3.1 Repetitive Task

This particular site has a number similar structure, which requires regular maintenance. The client was keen to engage a system which could be adapted to the adjacent structures either at short notice, if necessary.

4. Appraisal

In order to deliver this project within the constraints a practical solution was sought. Using the experience gained on similar and dissimilar projects the provision of a purpose designed lifting davit was a preferred option at an early stage, which tackled all the constraints and also addressed the potential of repetitive deployment.

In preparing detail design for the lifting davit, two principal schemes were developed of very similar detail.

The first detail (shown in figure 1) is constructed from traditional steel scaffold tube and fitting, incorporating traditional unit beams, to provide additional rigidity when used in the application.

The second scheme (shown in figure 2) is constructed from typical super slim (RMD) units with rapid tie steel bars providing cross bracing for rigidity.

During further appraisal both schemes had favourable advantages. However, the over riding factor that promoted the selection of scheme 2 was the durability of the super slim arrangement when deployed on a regular basis in a harsh environment. With agreement of the clients' team the super slim scheme warranted further development.

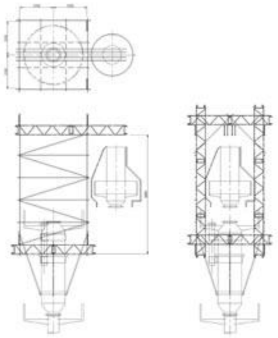

Figure 1. Traditional Scaffold Tube & Fitting

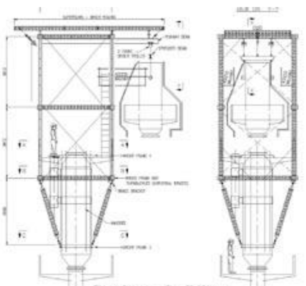

Figure 2. Scheme two - 'Super Skin' System

The design team used a number of standards in the development scheme. Of particular note in this scheme were the following British Standards.

BS 2853 – Specification for the design and testing of steel overhead runway beams
BS 449 – Specification for the use of structural steel in building.

The design team used these and a number of other sources to compile detailed calculations to support the design. This included stress calculations on all individual components to prove that the collective would perform satisfactorily in the field. A STADD loading diagram (Figure 3) was also used to simulate the stresses placed the lifting frame during the lift. All the calculations returned a satisfactory result and the scheme was developed in detail.

STAAD Loading diagram

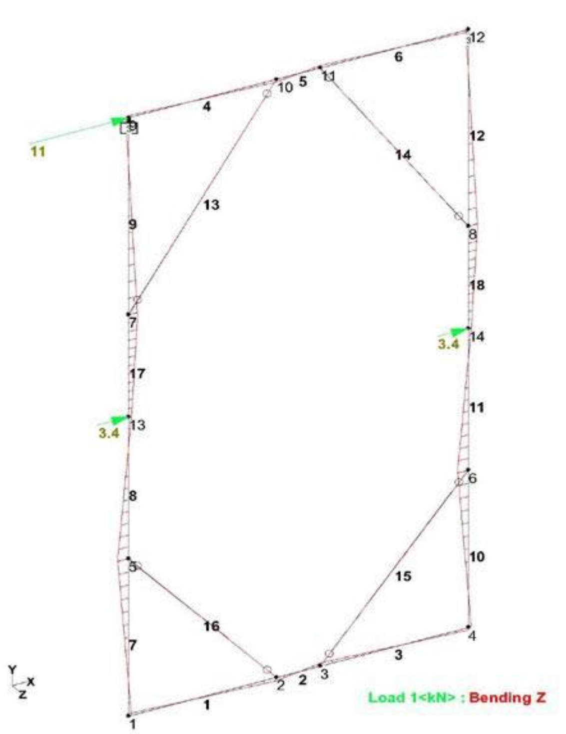

Figure 3. STAAD Loading Diagram

A significant late impact on the scheme was the increase in load of the tip from an estimated 2600 Kg to an actual load of 3250 Kg. In order to counter this, the team re-visited the scheme. The inclusion of a counter balance wire returning to grade provided a solution to the potential over loading problem without a significant impact on the design. The calculations were revised to take account of the additional loading, again proving the validity of the scheme.

The final design provided a number of advantages over other options including working capabilities of up to a wind speeds of 11 Metres per second, an increase of 2 Metres per second compared with crane option.

5. Regulations

With design and calculations complete the contractor then prepared their methodology to complete the task incompliance with the clients' team. The following regulations are applicable in the United Kingdom and were used as reference points.

- Factories Act – 1961 & Subsequent Revisions
- Construction Regulations (1960's)
- Health & Safety at Work Act 1974
- Management of Health & Safety at Work Regulations 1992 (Rev 1999)
- Provision and Use of Work Equipment Regulations 1992
- Construction (Design and Management) Regulations 1994.
- Lifting Operations and Lifting Equipment Regulations 1998.
- Work at Height Regulations 2005

6. Site Wide Elements

In addition to generic regulations a number of site specific conditions had to be addressed.

6.1 Aggressive local pollutants

The proximity of this flare unit to various adjacent exhaust systems resulted in a potentially toxic environment. This required the contractor to build in a reliable emergency descent/escape procedure in the case of a plant trip. The potential for an unconscious operative was also to be considered.

In order to tackle this potential situation all operatives were issued with hand held emergency escape respirators and a quick deployment escape procedure was developed.

All operatives were specifically trained in all equipment including emergency descent.

In order to satisfy all parties a site simulation was completed prior to starting. This simulation tested the skills of the operatives to work at height and descend from height in emergency circumstances. Acceptable escape times were set at 8 minutes. During the simulation operatives arrived at grade well with in the time limit set.

6.2 Dehydration

In order to address the potential for dehydration a bank of ice, cold drinks, ice and sustenance was installed at high level and re-stocked on a regular basis.

In practice, the elevated position of the activities provided much needed air movement to the operatives. However, the activities at grade level, where air movement was limited and ground conditions were harsh very physically demanding.

7. Execution

In order to achieve the project goal and reduce the potential for unforeseen circumstances, a mock up of the project was carried out at low level in the United Kingdom. A number of potential problems were resolved at this stage. All components were individually labelled prior to packing and shipping to Kazakhstan.

Figure 4 shows the final working drawing. Of particular note is the installation of the counter balance restraint wire returning to grade countering the unexpected increase in load from 2600 Kg to 3250 Kg. In order to satisfy all parties a number of site measurements and

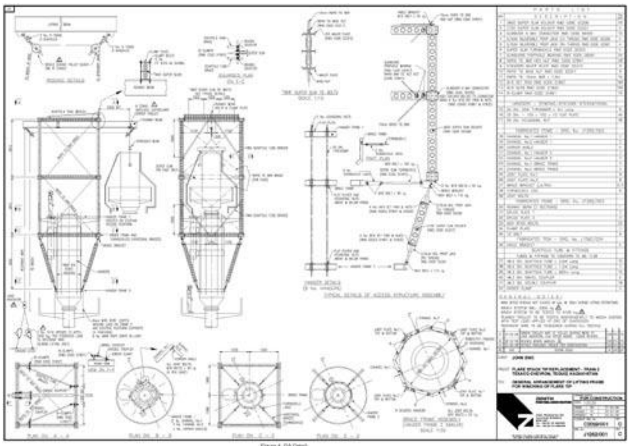

Figure 4: GA Detail

checks were completed on the existing structure to prove the integrity at site.

Figure 5 (photograph) depicts the partially built skeleton of the lifting davit. The components of the scheme were hoisted into position using an air driven winch bolted to a concrete foundation at ground level.

Figure 5. Partially built skeleton.

Following erection of the lifting davit skeleton, the runway beam was installed above the flare unit. The completed arrangement was inspected and tested prior to use. A number of further checks were also completed.

The following procedure was used to lift the flare tip from its connected position and into a position for lowering to grade level.

- Trolley beam located directly above the flare tip.
- Load placed upon the trolley beam and the flare tip lifted vertically.
- With the load placed upon the trolley beam, the suspended flare
  tip was pulled horizontally to the end of the runway beam.
- Once the trolley was positioned at the end of the runway beam the flare tip was lowered vertically transferring the load from the trolley beam to the winch pulley wire.
- With the load transferred to the winch pulley wire the runway beam was retracted, all secondary devises removed.
- The winch wire was then lowered gradually with the tip fully captivated.

Figure 6 (photograph) shows the final stages of the descent with operatives guiding the defective flare tip past obstacles at lower level.

Figure - 6 - Final Stages of descent

The installation of the replacement flare tip was completed in reverse order. Figure 7 (photographs) depict the final installation of the new arrangement.

Figure 7 - Final Stages of New Flare Tip Replacement

On completion of the works the lifting davit was lowered to grade level, labelled and packed in a site container for future deployment.

The client has since congratulated all parties to the contract on the success of the project. The davit requires only minor adjustment prior to future deployment on similar projects.

8. Application

This type of davit has now been successfully deployed on another site in Northern Europe with the end user following the same course as the clients' team in Kazakhstan and purchased all components for future deployment.

A number of other clients have expressed an interest in the scheme for use in similar and unique schemes throughout the world.

9. Conclusion

The key factors in preparing a successful scheme of this nature are:-

Understanding the clients' goals and brief.
Compiling a competent team with a proven track record.
Communication between all parties
Experience at all levels
Planning
Technical understanding and Superior Design
Safe Work Procedure and Risk
Assessment Execution
Project Review

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