



Fern proves to be a strong partner for PDL Solutions

PDL Solutions Limited

PDL Solutions (Europe) Limited is a leading provider of advanced 3D Computer Aided Design, Finite Element Analysis and Computational Fluid Dynamics engineering design and analysis services. PDL works alongside client companies operating in all of the main market sectors on a global basis.

The Brief

Fern were asked to perform Static and Dynamic Stress analysis of steam piping associated with Power Generation on board a FPSO (Floating Production Storage and Offloading) platform to be moored in West Africa. The piping systems would be subject to various operating and environmental loads in addition to emergency conditions resulting from a steam turbine fault. The piping systems need to comply with the allowable stress requirements of the ASME B31.1 Power Piping design codes and in addition, the restrictions imposed by steam turbine and boiler manufacturers on forces and moments applied at equipment connections.

3D Modelling

The system was modelled in CAESAR II Version 5.10 and supported with a combination of rigid type restraints, variable spring hangers, lateral restraints and guides.

Statics Analysis

The Static loadings applied catered for the effects of gravity, vessel motions ('g' loads), temperature changes, internal and external pressures and wind. 79 load cases were generated in order to ensure that all necessary combinations of wind and 'g' load directions were accommodated when combined with weight, pressure and temperature conditions. Normal (everyday) wind velocity loading was applied as a Sustained condition and 1000 year storm wind velocity loading was applied as an Occasional condition.

Fluid Flow Analysis

In order to provide fluid force loads resulting from the sudden arresting of high velocity steam (due to sudden valve closure), a transient fluid flow analysis was carried out using valve and steam velocity data.

This established:

- The pressure drop through the system (to derive downstream pressures) – steady state conditions
- The unbalanced forces on each system pipe leg. These are produced from a pressure wave resulting from the simultaneous closure of turbine stop valves for a given turbine – transient conditions

Unbalanced forces with respect to time were then plotted for a given location along each pipe leg; each plot being the graphical representation of a 'loading' file to be used for a Time History based Mechanical Dynamic Analysis of the system.

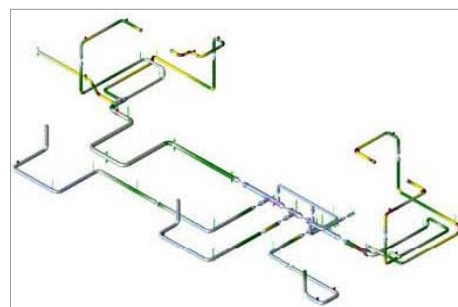
Dynamics Analysis

The unbalanced forces with respect to time produced from the fluid flow analysis were used as input to the piping dynamics analysis and the system was subjected to the shock loading induced by the steam pressure wave for a time period of 2.5 seconds.

Deliverables

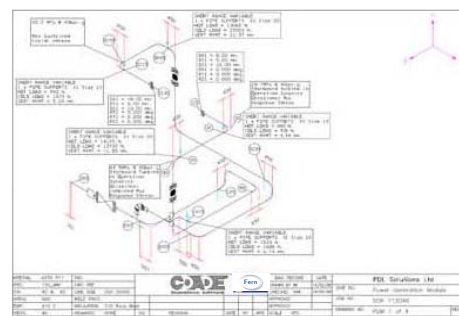
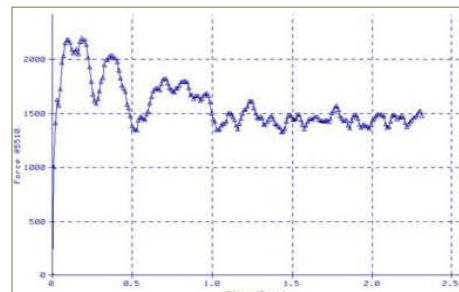
A comprehensive report was produced constituting an introduction and background, executive summary, references, boundary conditions, assumptions, load cases, design methodology, results summary, conclusions and recommendations.

The support locations, loads and high stress locations were depicted on a number of stress isometrics.



"Fern proved to be an excellent partner with first class technical capabilities. They maintained regular communication during the contract, produced a comprehensive report, and most importantly, provided value for money."

*Paul Charlton,
Managing Director at PDL*



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