

Piping Stress Analysis of Natural Gas Receiving & Conversing Facility, Vasilikos Power Plant (Cyprus)

Key Features

Technology:

Intergraph CAESAR 2018

Auto CAD 2016

NavisWorks 2018

Duration:

The project was completed in a period of 8 weeks

Deliverables:

1. Piping Stress Analysis Report with Stress ISO Mark Ups and C2. File
2. Piping Support Construction Drawing
3. Piping Support Material Take off (MTO)
4. Pipe Support List

The Client

A large EPC conglomerate based in Greece that has executed Construction projects in a myriad of industries, ranging from Commercial Infrastructure to Heavy Industrial and Energy Sectors.

The Business Need

Electricity Authority of Cyprus (EAC), owner of Vasilikos Power Plant, had awarded the construction of the Natural Gas Receiving & Conversing Facility to our client. This facility will thus supply natural gas (feedstock) to Vasilikos Power Plant (which has an installed plant capacity of 868 MW) and be used for metering and regulating the feedstock. Rishabh Engineering was responsible for the following:

- Ensure that all loads (sustained, occasional, and thermal) acting on the piping system are within code limits.
- Avoid piping stresses in excess of those permitted by the referenced Codes and Standards.
- Avoid leakage at flange joints.
- Avoid premature failure of equipment due to excessive piping forces and moments applied to connected equipment.
- Avoid excessive stresses in the supporting or restraining elements.
- Avoid unintentional disengagement of piping from its supports.
- Avoid excessive interference with thermal expansion or contraction of the piping system or connected equipment which is otherwise adequately flexible.
- Avoid damage to piping components and equipment due to shock loading, e.g. slug flow.
- Avoid excessive piping sag in piping systems which need drainage slope.

Rishabh's Solution

Rishabh Engineering was appointed to execute Piping & Structural Detailed Engineering for the Gas Receiving Station (GRS). Major activities included:

1. Piping Stress Analysis

- Equipment Nozzle Allowable check
- Fluid Hammer load Calculation
- Flange leakage check

Different Load Conditions that were considered for analysis included Fluid hammering, Seismic, Wind, Thermal, Pressure, Hydro Test & Sustained (Weight of pipe, insulation & Fluids).

2. Development of Construction Drawings for Piping Supports with MTO: The main areas involved in the project were:

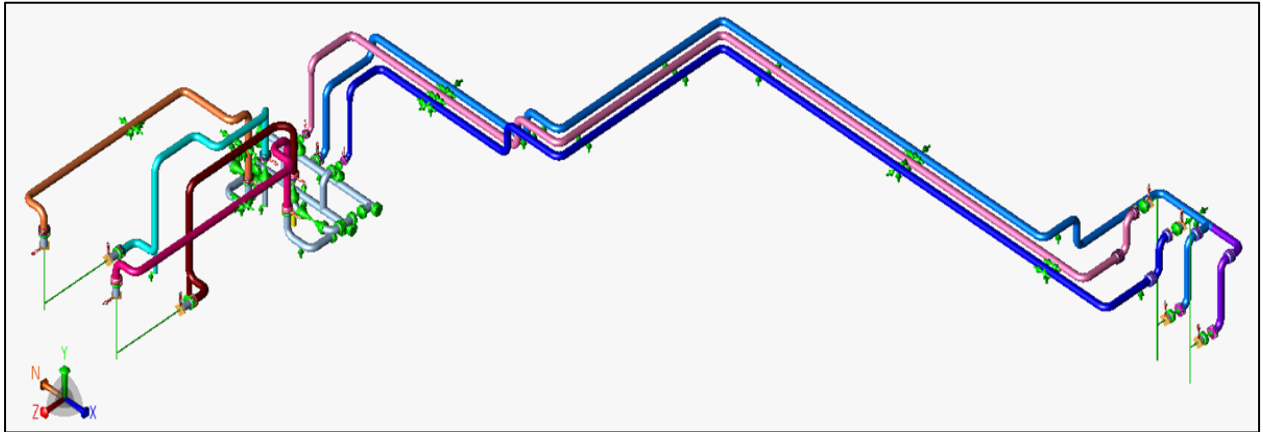
- Incoming pipeline channel to the GRS.
- Interconnection piping between GRS Skids and Auxiliary Boilers
- Interconnection piping between GRS Area and the Vasilikos Power Plant.
- Utility lines (service air and firefighting lines)

Piping flexibility analysis was carried out for the following systems:

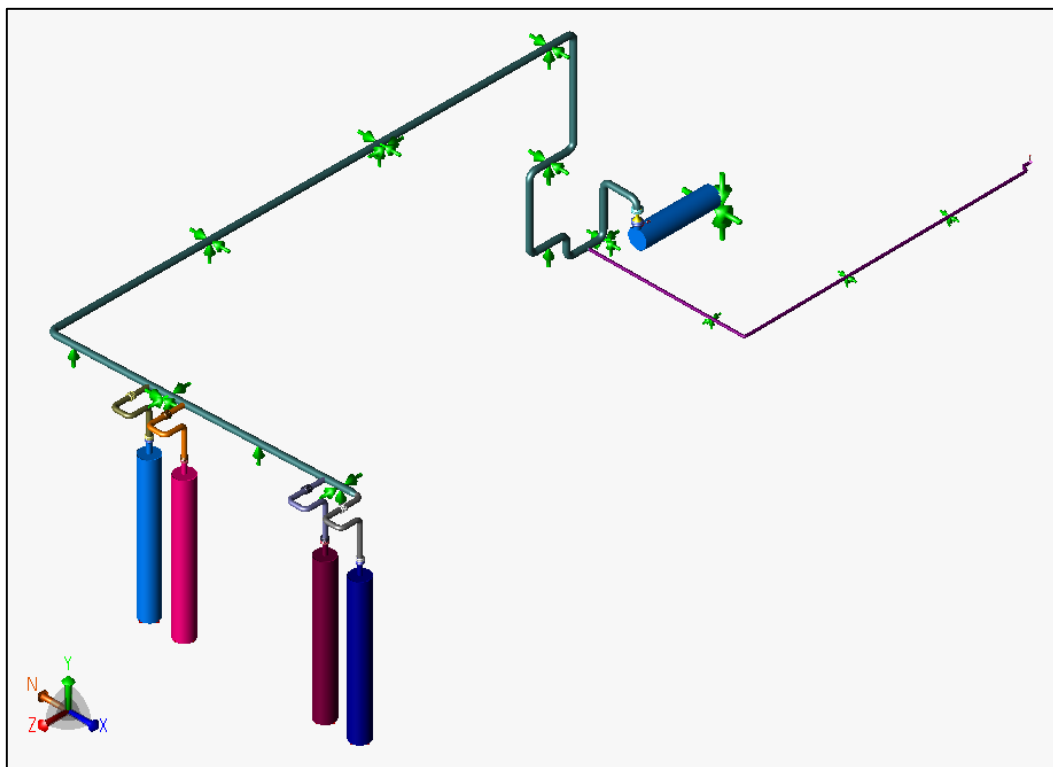
- High-Pressure Steam System
- Low-Pressure Steam System
- Auxiliary Steam System
- Feed Water System (pumps suction)
- Feed Water System (pumps discharge)
- Turbine extraction line to condensate preheater
- Temporary blowoff piping

Design Parameters

Parameter	Value
Standards Used	ASME B31.3
Total Piping Systems	11
Total Number of Lines	44
Pipe Size Range	2" to 14"
Design Conditions	80 bar & -10/+120 °C
Operating Conditions	57 bar, 20 °C
Equipment List	<ul style="list-style-type: none">• Condensate Tank• Auxiliary Boilers• Natural Gas Boilers• Fire Fighting• Compressor (for Air)• Metering Skids for Fuel & Natural Gas



Piping Stress Analysis – Auxiliary Boiler Hot Water Unit



Piping Stress Analysis – Fire Fighting System

We had completed the piping stress analysis of Natural Gas Receiving & Converting Facility in 8 weeks with a team of 02 members (including one team leader).

Challenges & Approach

Challenge #1:

- The client had instructed Rishabh Engineering to avoid using the ground for pipe supports.

Our Solution:

- Rishabh Engineering takes pipe support from the existing structure pertaining in the facility. Our Engineers submitted the construction drawings (approved by client) in our final deliverables for the same pipe supports

Challenge #2:

- Some of the systems that were connected to turbines would be exposed to extreme pressure changes due to fluid hammering caused by turbine tripping during operation. Thus, the resultant spike in pressure could potentially rupture the connected piping, especially at connections and bends.

Our Solution:

- Rishabh Engineering performed detailed fluid hammering analysis to counter this problem by analyzing the maximum fluid pressure that could be exerted at the vulnerable points along the piping route

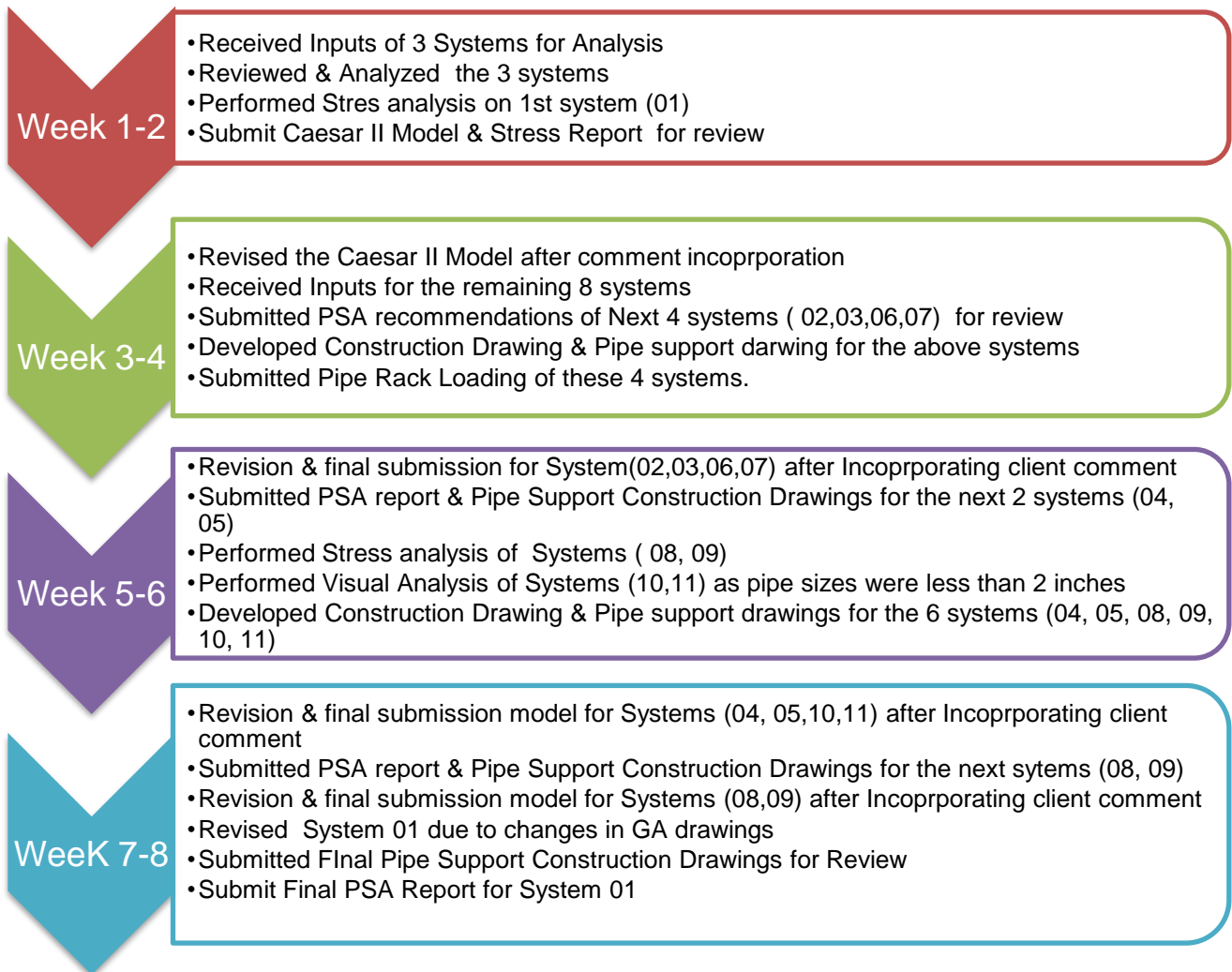
Other Challenges & Solution Delivered:

- Time Constraint: Rishabh Engineering's team was required to perform stress analysis of 11 systems and develop their construction drawings based on the stress recommendations simultaneously (100+ drawings/system). Rishabh Engineering was successfully able to deliver the project within the stipulated deadline.
- Along with piping stress analysis, as a part of Structural Engineering construction drawings for some of the particular support which was not mentioned in the support standards shared by the client, was also considered in our scope. So right from performing the calculations based upon the loads estimated till generation of the fabrication drawings were also included in Rishabh's scope.
- Due to unavailability of the 3D Model or isometrics, our team modeled the piping route in Caesar II using General Arrangement Drawings, Pipe Layouts and P&ID's as a reference to identify the piping dimensions and orientation.

Approach:

1. Rishabh Engineering developed the Stress Design Basis independently on the basis of experience from past projects & inputs provided by the client.
2. Rishabh designed many unconventional supports in line with the client requirement
3. As per client requirement, Rishabh Engineering used some unconventional standards for Seismic & wind Loads of pipe stress analysis, namely:
 - i. EN 1991 (Seismic Loads)
 - ii. ASME E7 (Wind Loads)

Project Execution Methodology



Stress analysis was performed as per ASME B 31.3 piping code & Piping stress analysis philosophy of the Customer. Moreover, Piping Design and Stress analysis have been done concerning the Codes & Standards of CAESAR-II software.

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About Rishabh Engineering

Rishabh Engineering provides multidisciplinary engineering support services to EPC companies in industries like Oil and Gas, Petrochemical, Power and Water treatment. Our parent company, Rishabh Software is a CMMI level-3, ISO9001 and ISO27001 company that provides services in Software Development, Business Process Outsourcing (BPO) and Engineering Services Outsourcing (ESO) to clients globally. Rishabh has offices in USA, UK and India with their main delivery center in Vadodara, India.