

Piping Stress Analysis of FRP Piping System

Key Features

Technology:

CAESAR-II 2017
Navisworks 2017

Duration:

The project was completed in a period of 4 months

Deliverables:

1. CAESAR II Model
2. Piping Stress marked-up Isometrics
3. Piping Stress analysis report
4. Highlights of overstressed conditions in existing piping
5. CAESAR Input List
6. Stress Summary Report
7. Restraint Load Summary Report
8. Displacement Report
9. Flange Leakage Report

The Client

A manufacturer of wide range of corrosion resistant FRP equipment from piping systems to duct, stacks, hoods, covers, cells, and other miscellaneous custom equipment. It offers a full range of services including installation, repair, training, and inspection. The client provides services ranging from component design to stress analysis, as well as inspection of new and existing installations. The client has achieved international recognition as a leader in the design of FRP corrosion resistant products.

The Business Need

Fiber-Reinforced Plastic (FRP) products being proprietary, the choice of component sizes, fittings, and material types are limited depending on the supplier. Stress analysis of FRP piping system is governed by ASME B 31.3, ISO 14692, VS7159 & UKOOA. The values of Stress Intensification Factors (SIF) and Flexibility factors depends on the manufacturing process and the approach adopted for Stress analysis. FRP supports are modified as per the Analysis requirement after the approval of fabricator.

The client required Rishabh Engineering to conduct Piping Stress Analysis of the FRP piping for one of their ongoing project, and create the CAESAR model for the stress analysis.

Rishabh's Solution

We performed the required piping stress analysis by developing a CAESAR model, which includes the routings illustrated on the isometrics

and any critical connected piping. We had completed the piping stress analysis of the FRP Piping in 04 months with a team of 2 Piping Engineers.

➤ **Design Parameters:**

Parameter	Value
Total Piping Systems	20
Total Number of Lines	60
Max. Pipe Diameter	30"
Max. Temperature	200° F
Max. Pressure	125 psi

Challenges & Approach

Technical Challenges:

- Challenge#1: Conservative analysis approach for Piping Stress Analysis.(i.e., high SIF and high Seismic load coefficient)
- Solution: Refinements and reinforcements were applied to have piping within safe operating limits.

- Challenge#2: There was space constraint due to brownfield nature of the project.
- Solution: After multiple discussions with the client, we had re-routed the piping in the essential areas keeping valve operation and maintenance under consideration. In case rerouting of the pipeline is not possible because of space constraint in any particular area, we had suggested using thicker pipe and fittings.

- Challenge#3: Inaccurate location of supports (out of piping scope) leading to a high-stress concentration in new piping.
- Solution: Recommended changes in support types (out of piping scope) for enhanced operation of the plant in future.

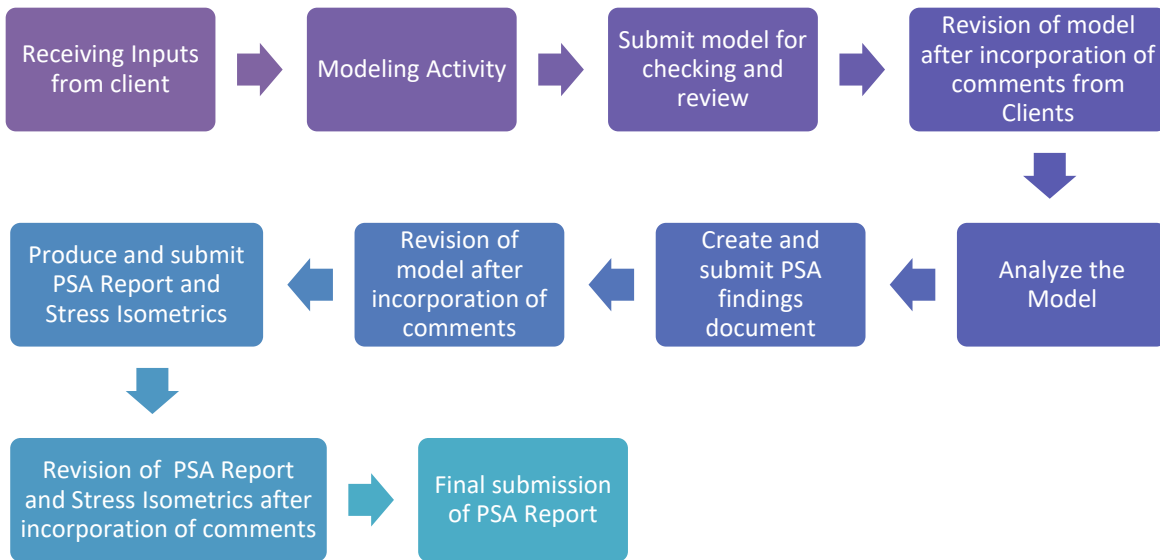
- Challenge#4: Constraint in decision making. The Client is the manufacturer and supplier of FRP, there were deviations from standard PSA methodology leading into To & Fro communication with the client, significantly to counter issues about PSA challenges and solutions.
- Solution: The areas of piping wherein such issues were encountered, we conveyed challenges to the client (regarding report) with multiple solutions in hand and finalized the PSA based on various discussions.

- Challenge#5: Due to the non-availability of Isometrics/GA Drawings for exact support location in existing piping
- Solution: We had approximated the Boundary condition data on the basis of photographs taken from the field, the Naviswork model & discussions with end client

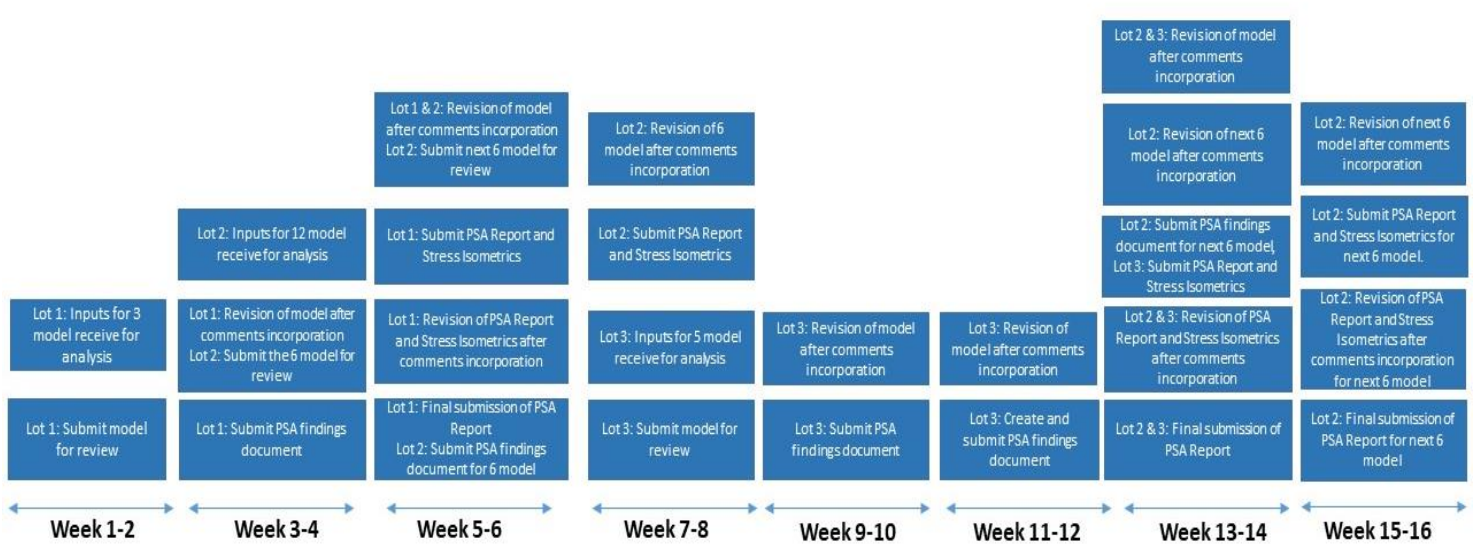
Project Level Challenges:

- Deviation in manufacturing data with design data leading to change in inputs and reanalysis
- The project is divided into Lot 1, 2 & 3, however, due to client’s urgency to execute the Lot 3 on priority we had to deploy additional resource to achieve streamline flow for the project

Project Execution Methodology:

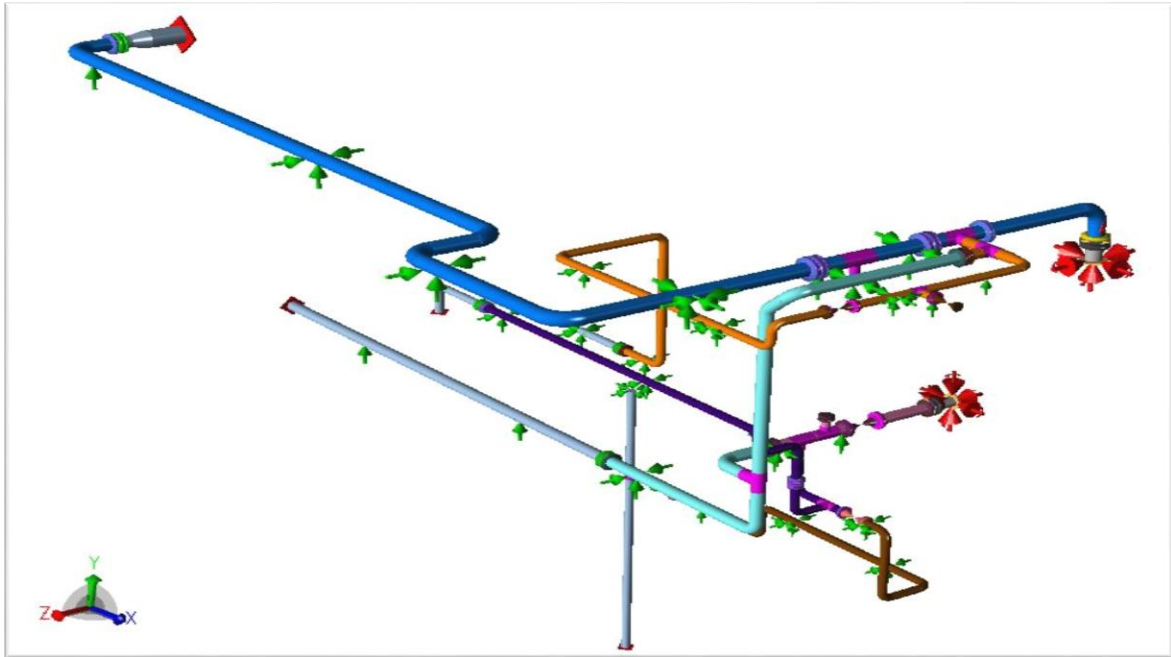


Project Schedule

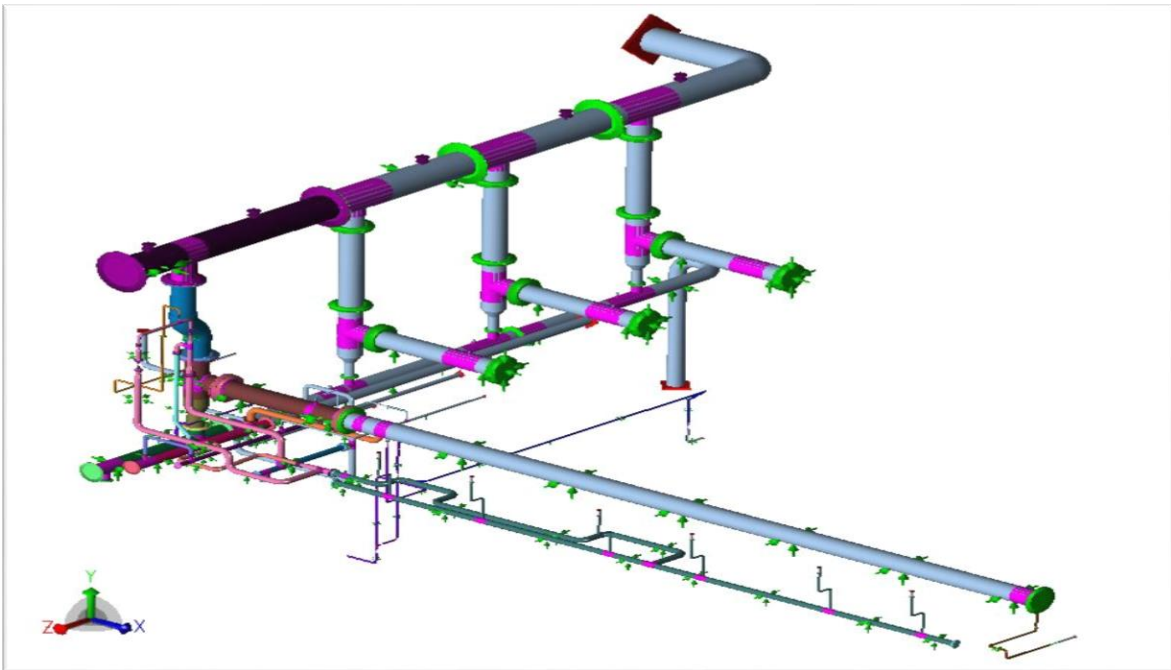


Stress analysis is performed as per ASME B31.3 piping code & Piping stress analysis philosophy of the client. Piping Design and Stress analysis have been done with reference to the Standard & Codes in CAESAR-II software.

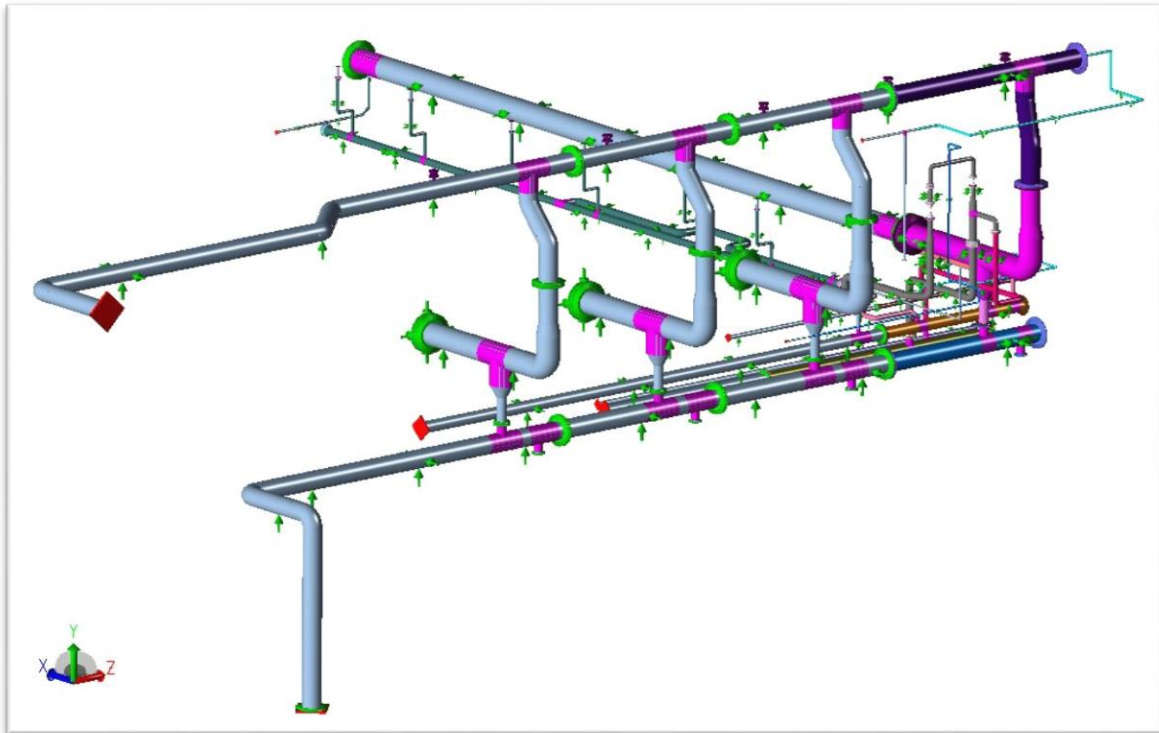




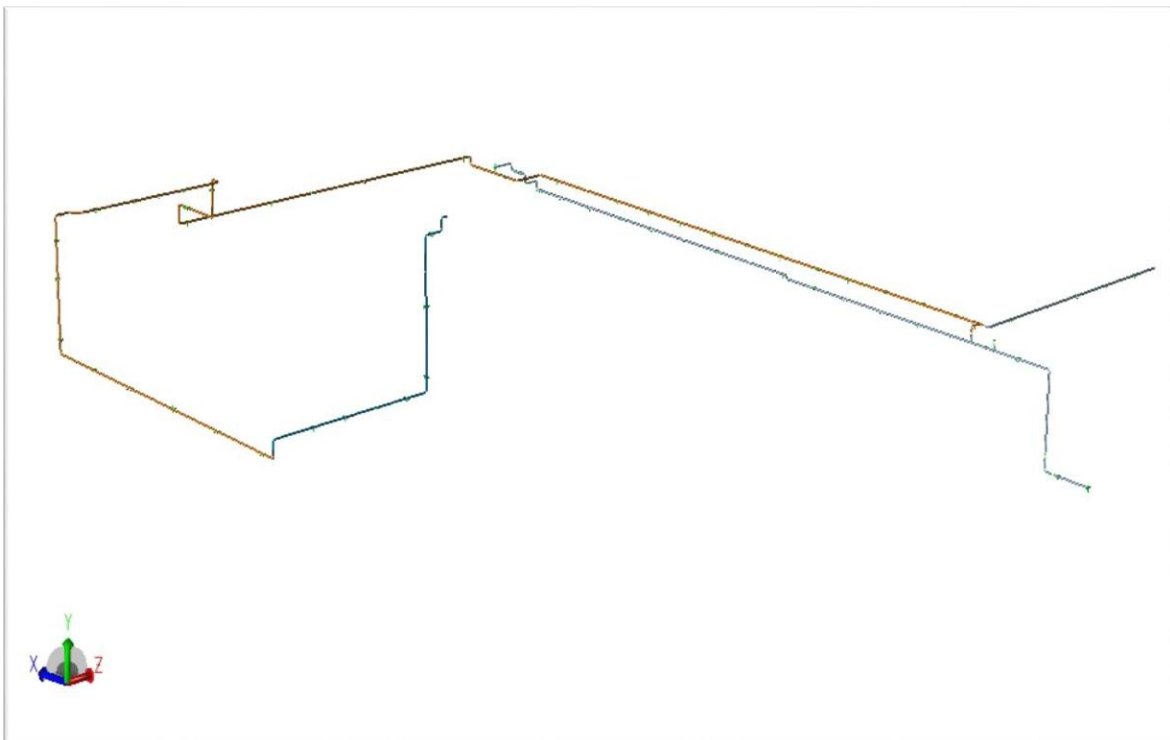
Brine Filter Piping



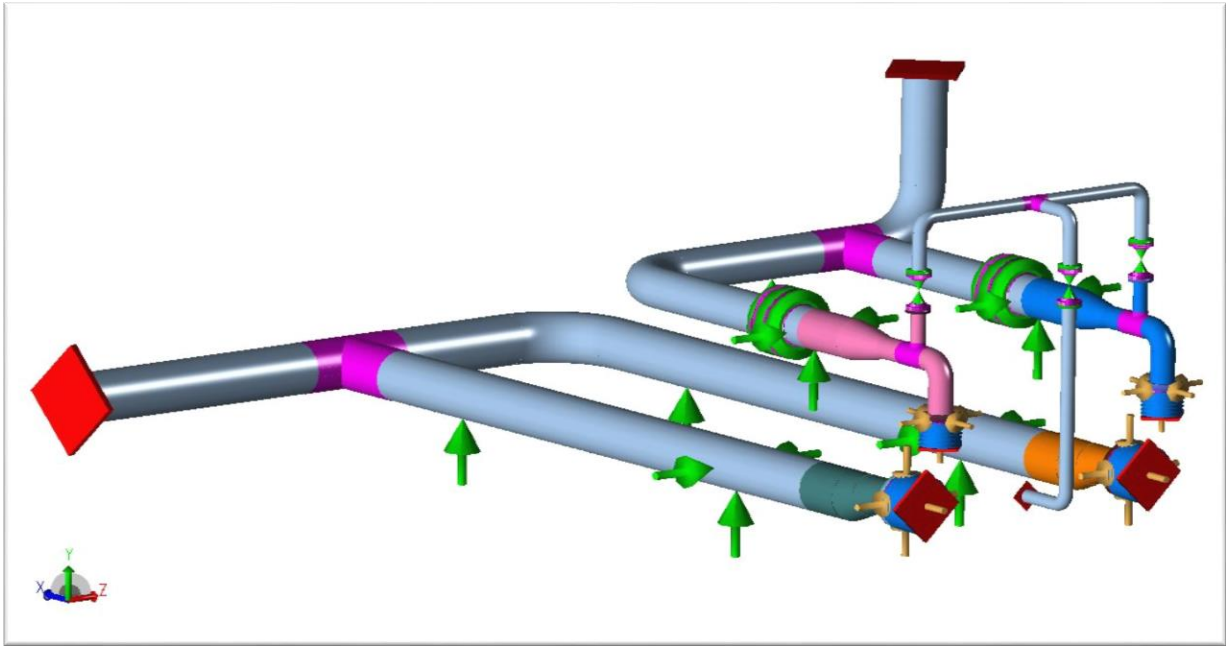
Electrolyzer System Piping-1



Electrolyzer System Piping-2



Hypo/Bleach/Emergency Vent Scrubber Piping



Catholyte Pump Piping

Technology Used

- CAESAR-II 2017
- Navisworks 2017

Key Deliverables

- CAESAR II Model
- Piping stress marked-up Isometrics
- Piping stress analysis report including:
 - a. Summary of model
 - b. Description of modifications due to challenges incurred
 - c. Highlights of overstressed conditions in existing piping
 - d. CAESAR Input List
 - e. Stress Summary Report
 - f. Restraint Load Summary Report
 - g. Displacement Report
 - h. Flange Leakage Report

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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.