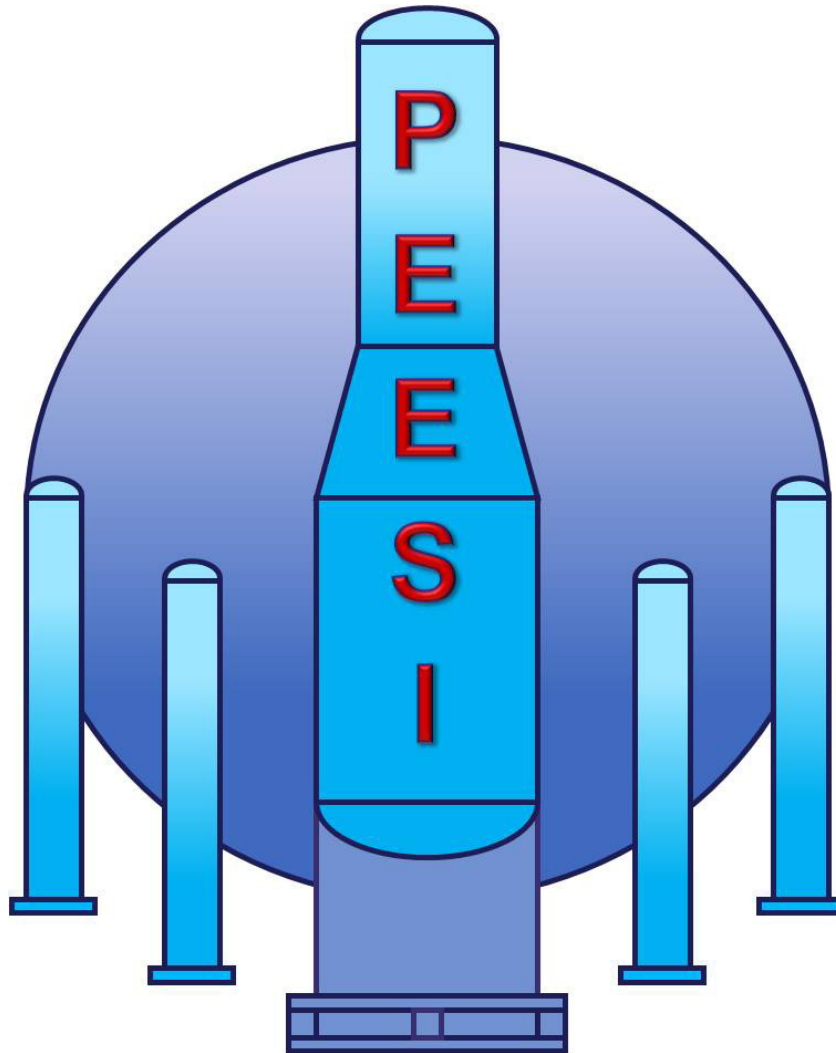


PRESSURE EQUIPMENT ENGINEERING SERVICES, INC.

Engineering Excellence



Engineering / Consulting Services:

- Fitness-for-Service Evaluations
- Finite Element Analysis
- Mechanical Integrity Evaluations
- Fatigue Analysis
- Structural Stability Analysis
- Failure Analysis / Failure Investigations
- Recommendations for Repairs / Modifications
- Technical Due Diligence
- Litigation Support and expert witness testimony

Design, Analysis, Re-rating for:

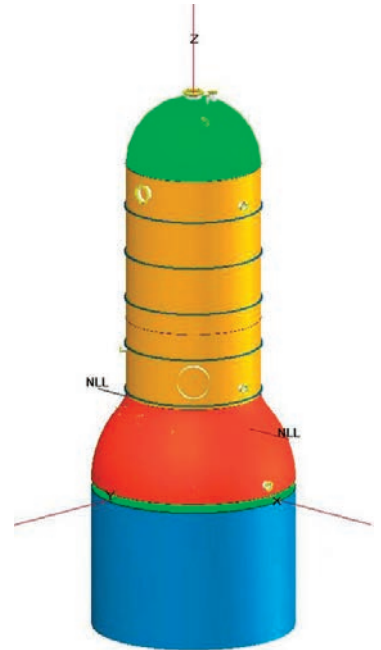
- Tall Columns
- Vertical Pressure Vessels
- Horizontal Pressure Vessels
- Spherical Vessels
- Reactors
- Boilers
- Heat Exchangers
- Storage Tanks
- Piping Systems

Engineering Services Offered

Pressure Vessels

PEESI offers the following services for Pressure Vessels (Tall Columns, Vertical Pressure Vessels, Horizontal Pressure Vessels, Spherical Vessels, Reactors, etc.):

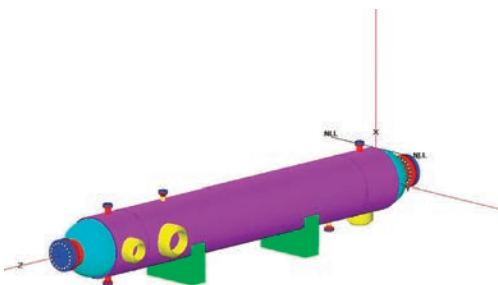
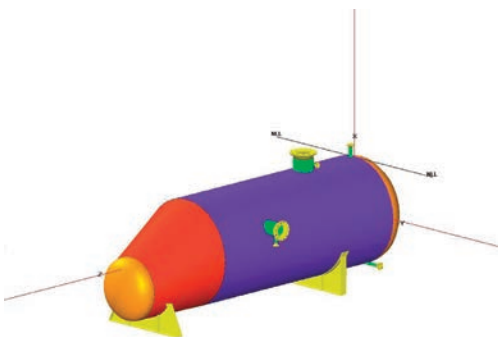
- * Design and Analysis of Pressure Vessels per **ASME Boiler and Pressure Vessel Code, Sec. VIII, Div. 1, Div. 2 and Div. 3.**
- * Design and Analysis of **Power Boilers** per ASME Boiler and Pressure Vessel Code **Sec. I.**
- * Calculations for **repairs and/or alterations of existing Pressure Vessels per API-510 and National Board Inspection Code.**
- * Calculation of **minimum retirement thickness values** for existing Pressure Vessels / Pressure Vessel Components to **maximize the remaining safe and useful life.**
- * **Re-rating** of Pressure Vessels for a new set of design parameters.
- * Calculations to check the suitability of vessels for **in-situ PWHT.**
- * **Fitness-for-service evaluations** for pressure vessels to assure the **structural integrity of equipment** for the intended design parameters and to offer **life extension considerations.**
- * **Fatigue Analysis** to calculate the fatigue life of Pressure Vessels with pressure cycles, temperature cycles and start-up / shut-down cycles.
- * **Failure Analysis** to identify the **root cause of failure** for the failed pressure vessels or pressure vessel components.
- * **Finite Element Analysis** for Pressure Vessels and Pressure Vessel components.
- * **Pressure vessel certification**, calculations and rating / re-rating for pressure vessels that do not contain sufficient design information in their files.
- * **Evaluation of Cracks and Flaws** in vessels by applying Fracture Mechanics techniques.
- * Evaluation of **Minimum Safe Operating Temperature (MSOT)** for existing vessels which do not meet the **MDMT** requirement of the ASME Code.
- * Analysis to assure **Mechanical Integrity of Pressure Vessels** for the following type of flaws: Generalized Corrosion, Localized Corrosion / Thinning, Blisters, Laminations, Bulges, Gouges, Dents, Cracks, etc.



Heat Exchangers

PEESI offers the following services for various types of Heat Exchangers:

- * Design and Analysis of Heat Exchangers per **TEMA** and **ASME Boiler and Pressure Vessel Code, Sec. VIII, Div. 1.**
- * Calculation of **minimum retirement thickness values** for existing Heat Exchangers / Heat Exchanger components to **maximize the remaining safe and useful life.**
- * Calculations for **repairs and/or alterations of existing heat exchangers.**
- * Calculations for **tubesheet thicknesses** for various types of heat exchangers.
- * Calculations for other heat exchanger components; e.g. **Channel Covers, floating heads, etc.**
- * Calculations for **Fixed tubesheet heat exchangers** for re-rating and fitness-for-service evaluations.
- * **Re-rating** of heat exchangers for a new set of design parameters.
- * **Fitness-for-service evaluations** for heat exchangers to assure the **structural integrity of equipment** for the intended design parameters and to offer **life extension considerations.**
- * **Fatigue Analysis** to calculate the fatigue life of Heat Exchangers with pressure cycles, temperature cycles and start-up / shut-down cycles.
- * **Failure Analysis** to identify the **root cause of failure** for the failed heat exchangers or heat exchanger components.
- * **Finite Element Analysis** for heat exchangers and heat exchanger components.
- * **Heat Exchanger certification**, calculations and rating / re-rating for heat exchangers that do not contain sufficient design information in their files.
- * Analysis to assure **Mechanical Integrity of Heat Exchangers** for the following type of flaws: Generalized Corrosion, Localized Corrosion / Thinning, Blisters, Laminations, Bulges, Gouges, Dents, Cracks, etc.



Storage Tanks

PEESI offers the following services for various types of Storage tanks:

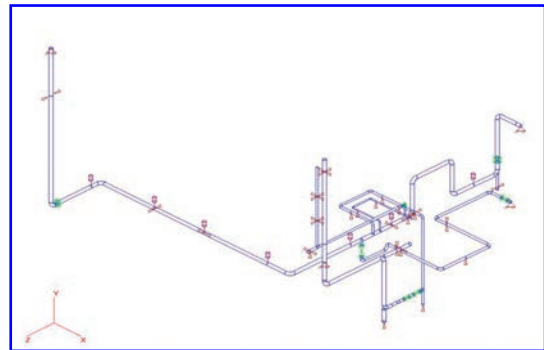


- * Design and Analysis of Storage Tanks per **API-650** and **API-620**.
- * Calculations and **recommendations for repairs, alterations or replacement** of existing storage tanks and storage tank components per **API-653**.
- * **Re-rating of existing storage tanks** for a new set of design parameters.
- * Fitness-for-Service Evaluation of storage tanks with **differential settlement of the tank bottoms**.
- * Calculation of **minimum retirement thickness values** for existing storage tanks / storage tank components to **maximize the remaining safe and useful life**.
- * **Maximum fill height calculation** for tanks where tank walls have corrosion or where higher than design density fluids are to be stored.
- * Fitness-for-Service Evaluations of **tank roofs** along with recommendations for repair.
- * **Fitness-for-service evaluations** for storage tanks to assure the **structural integrity of equipment** for the intended design parameters and to offer **life extension considerations**.
- * **Failure Analysis** to identify the **root cause of failure** for the failed storage tanks or storage tank components.
- * **Finite Element Analysis** for Storage Tanks and Storage Tank components.
- * **Storage Tank certification**, calculations and rating / re-rating for the storage tanks that do not contain sufficient design information in their files.
- * Analysis to assure **Mechanical Integrity of storage tanks** for the following type of flaws: Generalized Corrosion, Localized Corrosion / Thinning, Blisters, Laminations, Bulges, Gouges, Dents, Cracks, etc.

Piping Systems

PEESI offers the following services for the piping systems:

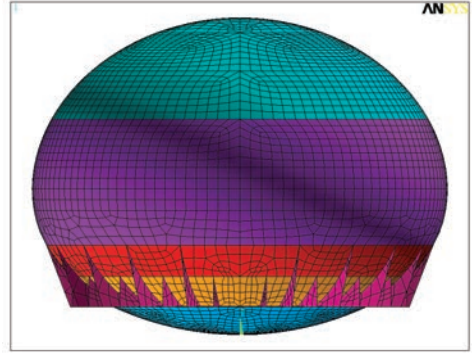
- * **Piping Stress Analysis** and **piping flexibility calculations** for new piping systems for code compliance issues.
- * Piping Stress Analysis and piping flexibility calculations for existing piping systems for **code compliance** and **fitness-for-service evaluations**.
- * Design, analysis and re-rating of piping systems per **ASME / ANSI B31.3, B31.1** and **API-570**.
- * Evaluation of piping systems to address **piping vibration** problems.
- * **Fitness-for-service evaluations** of piping systems to calculate **MSOT** and address **brittle fracture considerations**.
- * Evaluation of piping systems for **correcting / re-specifying pipe supports** to address overstressed piping or piping with inadequate pipe supports or restraints.
- * **Fitness-for-service evaluations** for piping systems to assure the **structural integrity of piping** for the intended design parameters and to offer **life extension considerations**.
- * **Fatigue Analysis** to calculate the fatigue life of Piping Systems with pressure cycles, temperature cycles and start-up / shut-down cycles.
- * **Failure Analysis** to identify the **root cause of failure** for the failed piping or piping components.
- * **Finite Element Analysis** for Piping and Piping components.
- * Analysis to assure **Mechanical Integrity of piping systems** for the following type of flaws: Generalized Corrosion, Localized Corrosion / Thinning, Blisters, Laminations, Bulges, Gouges, Dents, Cracks, etc.



Finite Element Analysis

PEESI offers the following categories of finite element analysis to **design, analyze, evaluate or investigate the root cause of failure** for a variety of stationary and rotating equipment and their components:

- * **3-dimensional structural analysis** using Finite Element Modeling for thin shell structures (where D/t ratios are relatively large) e.g. Pressure vessels, Tanks and Nozzles.
- * **3-dimensional thermal analysis** (steady state thermal analysis, transient thermal analysis and thermal stress analysis) using Finite element modeling for thin shell structures (where D/t ratios are relatively large).
- * **3-dimensional structural analysis** using Finite Element Modeling for **solid structures (where D/t ratios are relatively small)** e.g. tubesheets, flanges, solid shafts, turbine / compressor components, etc.
- * **3-dimensional thermal analysis (steady state thermal analysis, transient thermal analysis and thermal stress analysis)** using Finite Element modeling for solid structures (where D/t ratios are relatively small).
- * **2-dimensional axi-symmetric structural analysis** using Finite Element Modeling for thin shell structures and solid structures.
- * **2-dimensional axi-symmetric thermal analysis** using Finite Element Modeling for thin shell structures and solid structures.
- * **Non-linear structural analysis** for **geometric nonlinearities** and **material nonlinearities**. This includes **contact analysis incorporating gaps in the structures**.
- * **Modal analysis, Buckling analysis** using FEA techniques and software.
- * Finite Element Analysis for all of the above situations is performed using the **state-of-the-art software ANSYS**.



Structural Engineering

PEESI offers design, analysis and evaluation for various structural / mechanical components. The following are some highlights of structural analysis services offered by PEESI:

- * Structural engineering calculations per **AISC**.
- * Calculations of **minimum retirement thickness values** based on structural engineering considerations (also known as Structural Minimum thickness) to avoid jeopardizing the structural stability of pressure equipment.
- * **Structural analysis** and **design of special structures and non-pressure parts** attached to pressure equipment.
- * **Finite Element Analysis** of various structural components.
- * **Structural Stability Analysis** (e.g. nonlinear buckling analysis) to make sure that structure / mechanical component will not buckle for the given design loading.
- * **Design of special lifting devices** (lifting lugs, tailing lugs, skirt braces etc.) to be used during the construction phase.
- * Specialized **structural engineering calculations** to provide **construction support** for various stages of construction.

Commercial Software Used

- * Compress
- * ANSYS
- * Caesar II
- * FE - Pipe
- * PV-Elite
- * NozzlePRO
- * MathCAD
- * Signal FFS

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