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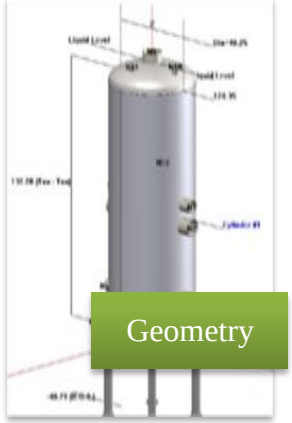
INPUT DATA



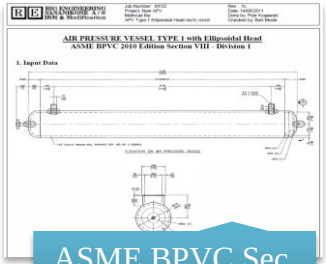
Geometry

Working, Survival & Test Conditions

Nominal or Gauge Thickness

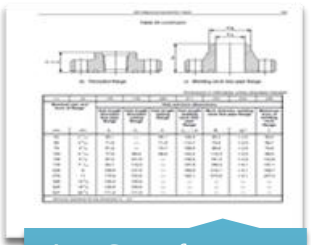
LEVEL 1 - COMPONENT CODE CHECK

ASME B31.3 Ch. II and IX



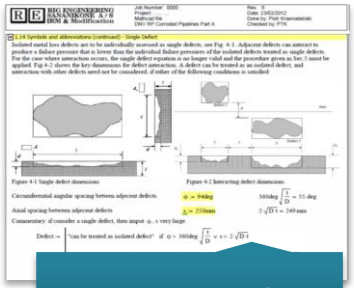
ASME BPVC Sec. VIII Div. 1 & Div. 2

DNV Rules for Piping

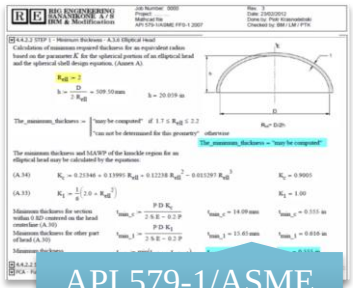


API Specifications for Drilling Systems

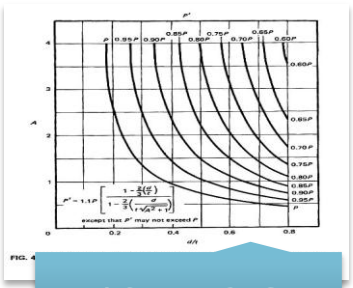
LEVEL 2 - CORRODED COMPONENT EMPIRICAL EVALUATION



DNV-RP-F101



API 579-1/ASME FFS-1



ASME B31G

LEVEL 3 - SYSTEM EVALUATION (FEA ASSESSMENT METHOD)

Bentley AutoPIPE

Algor PipePak

Autodesk Robot Structural Analysis

Autodesk Mechanical Simulation

Key word: Rig Engineering, Pressure Piping & Vessels, ASME B31.3, ASME BPVC Sec. VIII Div. 1 & Div. 2, ASME B31G, DNV-RP-D101, DNV-RP-F101, API 579-1/ASME FFS-1, API 6A, API TR 6AF, Piping & Flange Analysis, Flange Leakage, Corroded Pipelines & Vessels Evaluation, Fitness For Service, Bentley AutoPIPE, Algor PipePak, Codware Compress, Autodesk Robot Structural Analysis, Autodesk Mechanical Simulation

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RIG ENGINEERING ASSESSMENT

LEVEL 1 - COMPONENT CODE CHECK

A. ASME B31.3 Process Piping
- Chapter II Design *(for ordinary service piping)*
- Chapter IX High Pressure Piping
- Straight pipe and pipe bends design check
- Software: *Mathcad calculators prepared by RE*
- Pipe standard ASME B16.5/B16.47 flange and non-standard flange stress analysis and leakage check for internal pressure and external loading, if prescribed
- Software: *Codeware Compress* *www.codeware.com*

B. ASME Boiler & Pressure Vessel Code, Section VIII Division 1 and Division 2 Part 4 Design by Rules (DBR)
- Air Pressure Vessel (APV) and Mud Gas Separator (MGS) vessel types and Bulk Tanks
- Vessel body / opening / nozzle flange stress analysis and leakage check using Div. 1 App. 2 and/or Div. 2 Part 4 (DBR) for internal pressure and external loading, if prescribed
- Vessel nozzles and supports
- Software: *Codeware Compress* *www.codeware.com*

C. DNV Rules for Piping
- Design reference: DNV-OS-E101 Drilling Plant, DNV-RP-D101 Structural Analysis of Piping System
- Software: *Mathcad calculators prepared by RE* and Level 3 software (see page 3 for details)
- Design reference: DNV-OS-D101 Marine and Machinery Systems and Equipment
- Equivalent von Mises Stress Theory
- Software: *Mathcad calculators prepared by RE*

D. API Specifications for Drilling Systems (API Spec. 6A, API TR 6AF, API TR 6AF2, API Spec. 16C)
- API flange stress analysis and leakage check using ASME BPVC Sec. VIII Div. 2 Part 4 (DBR) for internal pressure and external loading, if prescribed
- Software: *Codeware Compress* *www.codeware.com*
- Advanced FEA assessment of API flanges (e.g. 6BX or 17SV) using ASME BPVC Sec. VIII Div. 2 Part 5 Design by Analysis (DBA) and/or von Mises Stress Method
- Software: *Autodesk Mechanical Simulation* *www.autodesk.com/simulation-mechanical*

LEVEL 2 - CORRODED COMPONENT EVALUATION

A. Recommended Practice DNV-RP-F101 Corroded Pipelines (for cylinders)
- Part A - Load Resistance Factor Design (LRFD). *Advanced analysis reflecting probabilistic approach (partial safety factors): safety class level, inspection method, confidence level, standard deviation calculation*
- Part B - Allowable Stress Design (ASD). *Simple analysis with a global usage factor*
- Assessment scope: *carbon steel not exceeding API X80 grade, no cyclic loads and sharp defects (cracks), thickness not more than 40 mm, not recommended when fracture is likely to occur*
- Software: *Mathcad calculators prepared by RE*

B. Recommended Practice API 579-1/ASME Fitness-For-Service-1 (for heads and cylinders)
- Part 4 - Assessment of General Metal Loss
- Assessment scope: *pipelines and vessels designed in accordance with ASME B31 and BPVC Sec. VIII Div. 1, corrosion loss only*
- Software: *Mathcad calculators prepared by RE*

C. Manual for Determining the Remaining Strength of Corroded Pipelines ASME B31G
- Supplement to ASME B31 Pressure Piping
- Assessment for corroded thickness between 10 to 80% of original thickness

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RIG ENGINEERING ASSESSMENT

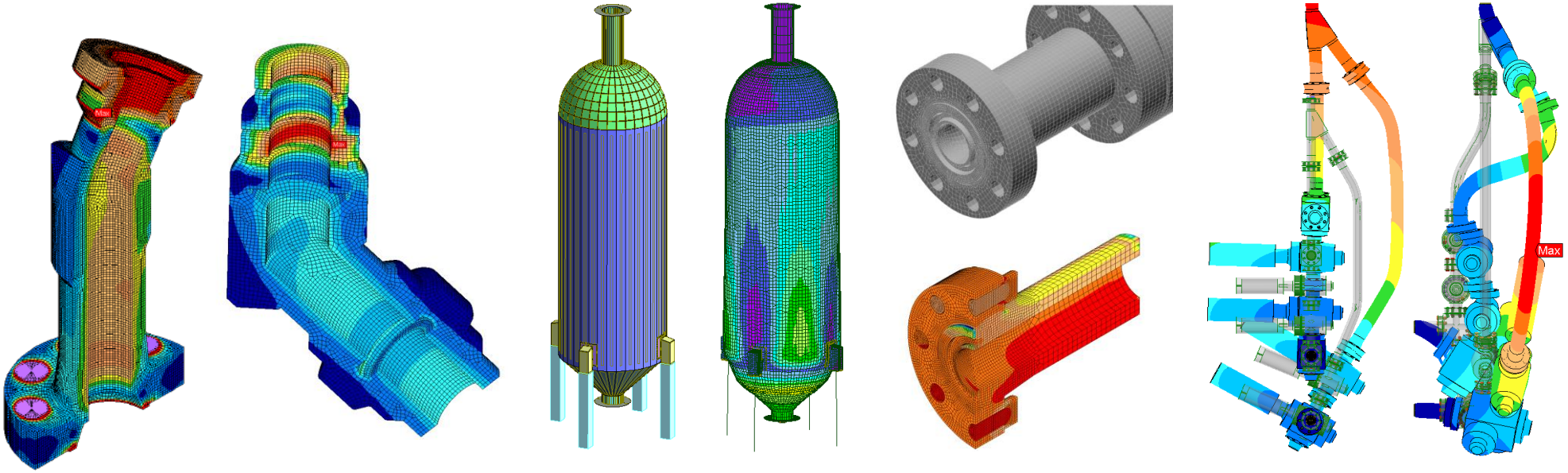
LEVEL 3 - SYSTEM EVALUATION

Finite Element Analysis (FEA) of entire piping or pressure-containing system

- Piping resistance and flexibility analysis in accordance with ASME B31.3
- Software: *Bentley AutoPIPE* *www.bentley.com/products/autopipe* and *Algor PipePak* *www.algor.com/products/algorPipePak*
- Structural analysis of pressure vessels and pressure-containing equipment (e.g. non-standard elements, valve bodies) in accordance with ASME BPVC Sec. VIII Div. 2 Part 5 Design by Analysis (DBA) and/or von Mises Stress Method
- Software: *Autodesk Robot Structural Analysis* *www.autodesk.com/robot-structural-analysis-professional* and *Autodesk Mechanical Simulation* *www.autodesk.com/simulation-mechanical*

BENEFITS:

- Fitness for Service (FFS) approach for Maintenance/Shut down
- Remaining strength assessment
- Acceptance criteria determining minimum safe wall thickness or Maximum Allowable Operating Pressure (MAOP) (also known as Maximum Allowable Working Pressure - MAWP)
- Components (straight pipe, pipe bends, pipe flanges, vessel cylinder, dome ends, body flanges and opening closures, nozzles and supports) or entire system evaluation (pressure piping, vessels and equipment)
- Thorough assessment of piping and vessels – Finite Element Analysis (FEA) including offshore specific load conditions



Key word: Rig Engineering, Pressure Piping & Vessels, ASME B31.3, ASME BPVC Sec. VIII Div. 1 & Div. 2, ASME B31G, DNV-RP-D101, DNV-RP-F101, API 579-1/ASME FFS-1, API 6A, API TR 6AF, Piping & Flange Analysis, Flange Leakage, Corroded Pipelines & Vessels Evaluation, Fitness For Service, Bentley AutoPIPE, Algor PipePak, Codware Compress, Autodesk Robot Structural Analysis, Autodesk Mechanical Simulation

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