PDL
THE VALVE ENGINEERING
ANALYSIS EXPERTS

VALVE CAPABILITY

"PDL's very methodical approach and their in-depth knowledge of FEA and CFD make them the ideal partner to solve even the most complicated valve-related problems."

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WHO WE ARE

PDL are the engineering analysis experts.

We provide advanced engineering design and analysis consultancy services for valve and actuator clients in safety-critical and highly regulated industries such as Oil & Gas; Nuclear; Renewable Energy; Defence and Industrial sectors around the globe.

We are world leaders in the application of advanced engineering software. We have a proven track record of delivering advanced engineering analysis to provide solutions for valve and actuator clients who rely on us to validate, understand and optimise their valves.

Our core capabilities include: Finite Element Analysis (FEA), Computational Fluid Dynamics (CFD), Global Dynamic Analysis (OrcaFlex), Pipe Stress Analysis (Caesar II) Structural Calculations, Linear Elastic Fracture Mechanics, Engineering Design and our own Engineering Automation Software platform MAXIM® tailored to the needs of our clients.

Our dedicated team of valve engineering analysts have exceptional knowledge and extensive experience of working with a broad range of valve assessments and standards and have supported clients on some of the most complex and technically challenging projects at notable regional, national and international entities.

We work closely together to help our clients and frequently collaborate with our colleagues across the Vulcain Engineering Group to deliver on challenging projects, drive innovation and share expert knowledge and best practices.

VULCAIN ENGINEERING

WHAT WE DO

We deliver technical solutions to complex problems at any point in your product lifecycle, from the design optimisation or validation of a new product, to solving an issue with an existing product that's already in the field.

We will give you solutions to problems, not just answers to questions, we will give you a competitive edge in your market and we will build your standing and credibility with your clients.

"We will do the right work and we will do the work right; no exceptions."

3000 **colleagues** across our Engineering Group

2001 the year that we were born

42 **brilliant people** currently employed

33 ENGINEERING ANALYSTS with specialist knowledge and experience

2500 **projects** successfully completed to date

91% STAFF RETENTION — 91% **staff retention** rate

90% REPEAT BUSINESS — 90% of business comes from **existing clients**

15 MENTORS to support professional development

2 **2 sides of our business**: Engineering Consultancy and MAXIM® engineering automation software

1 **1 great team** highly skilled in engineering, software and communication

WHAT MAKES US DIFFERENT

When we ask our clients why they choose us - the overriding answer is because they recognise PDL as being the best at what we do. In fact, **90% of our new work** comes from clients who have used us before because they trust us. **We always deliver.**

01	"...PDL you impress me. You do what you say in the time you say. Very good work..."	**TECHNIPFMC**
02	"...you make it so easy to do business with you; reliability and delivery and it's all done with a smile..."	**BEL VALVES**
03	"...the way you work, your flexibility and the sheer willingness to get the job done, is simply brilliant..."	**CUMMINS**
04	"...highly skilled engineers...who are comfortable to adjust their level of support as the project develops; these are features we haven't had available from elsewhere..."	**GMC**
05	"...a great level of engagement before the work was even done; you were clear and concise; you gave us a great understanding from the start..."	**VIKING SEA TECH**
06	"...after working with you, it is clear the quality and competence of your engineers is your differentiator..."	**MURPHY ENGINEERING**

Our client research shows that what sets us apart is our small but powerful team which delivers on six key areas:

RELIABILITY
PEOPLE
FLEXIBILITY
KNOWLEDGE
COMMUNICATION
QUALITY

DELIVERY WITHOUT DOUBT

THE BENEFITS THAT WE WILL DELIVER

We will **mitigate the risk of failure** in a new product by assessing the valves' code compliance and functionality before you commit to manufacture.

If an existing valve fails on test or underperforms in service, we will determine the root cause of the issue and propose validated design changes to fix the problem and **optimise performance**.

We will **shorten your time to market** on new product development by giving you a right-first-time solution at the start and eliminate the need to build and test multiple prototypes.

We will **reduce your costs** and increase your profit by extending the reach and lowering the cost of your existing products.

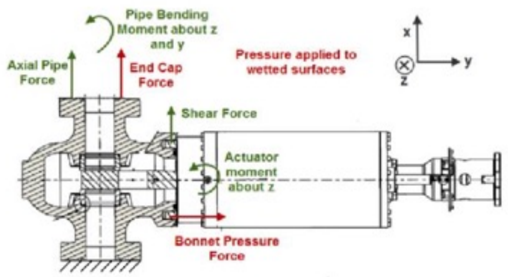

Figure 1: Force diagram of a gate valve accounting for the actuator assembly

STRUCTURAL ANALYSIS

Verification is fundamental to valve design; it can provide complete assurance of the structural integrity. We are well placed to provide all types of structural analyses in accordance with the valve related design codes.

ASME VIII DIV.2 OR 3 'DESIGN BY ANALYSIS'

The ASME BPVC VIII rules for construction of pressure vessels are often used for the validation of topside and subsea valves using stress limits either directly from ASME or from API 6A or similar design codes.

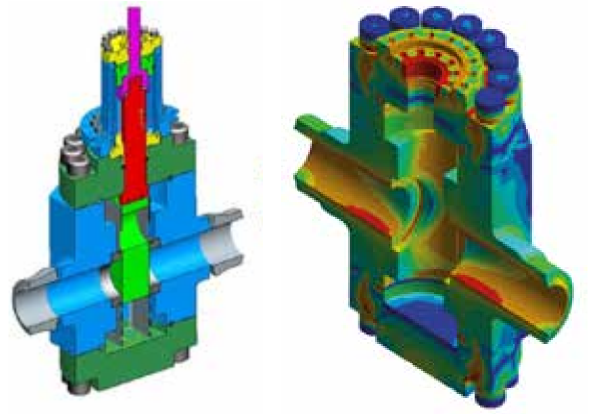

Figure 2: Slab gate valve geometry and a typical stress profile from an FEA model

ELASTIC STRESS ANALYSIS METHOD

- The linear elastic assessment methodology is typically conservative (except sometimes for thick wall sections).
- It uses stress classification lines (SCLs) to linearise stresses into membrane and membrane plus bending stresses for assessment against the linear-elastic collapse criteria.
- Allowable stress limits from ASME VIII Div.2:
    - Primary General Membrane Stress limit < Sm
    - Primary Local Membrane + Primary Bending stress limit < 1.5 Sm
- API 6A stress limits can be applied:
    - Design stress intensity limit at working pressure:
    - Sm = 2/3 Sy
      Where Sy = minimum yield strength of the material at the required temperature (ASME methods consider also the UTS for Sm)
- Protection against local failure is also assessed (typically where there are notchy features).

ELASTIC-PLASTIC STRESS ANALYSIS METHOD

- This method takes account of material deformation, allowing for stress redistribution and a reduction in unrealistic stress peaks. ASME VIII Div.2 or Div.3 are usually used.

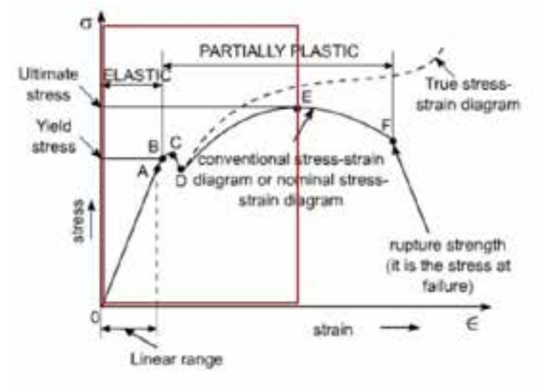

Figure 3: Elastic-Plastic model takes account of non-linear material behaviour

- Elastic-plastic material curves are generated using ASME VIII Div.2 Annex 3-D.
- Protection against plastic collapse criteria (global) require FEA model convergence at factored loads.
- Protection against local failure requires the peak equivalent plastic strain to be below a calculated limiting tri-axial strain limit.

DNV-RP-F112 (HISC)

Hydrogen Induced Stress Cracking (HISC) analyses are used for duplex or super duplex stainless steels exposed to cathodic protection in a subsea environment. Two material models can be used.
In most cases, the linear elastic stress assessment is more conservative than the non-linear strain criteria assessment.

LINEAR ELASTIC STRESS CRITERIA

- Membrane and peak surface stresses are considered in the axial and hoop directions.
- The following limit is applied where $\gamma HISC$ depends on the microstructure:
  $\sigma m < 0.8 \times \gamma HISC \times SMYS$
- The treatment of the surface stress is more complex and allows for thermal stress (separately), residual stress, proximity to welds and stress concentration factors. The acceptance formula is long (equation 5.10 of the 2018 version of the code).

NON-LINEAR STRAIN CRITERIA

- When using the non-linear elastic plastic approach, strain assessments are undertaken to ensure loading does not initiate significant cold creep and hydrogen induced stress cracking in the material.
- A material hardening curve is typically generated from DNV-RP-F112 where it is corrected for relevant temperatures. The curve should have linear elastic characteristics to 0.1% total strain, 80% SMYS corresponds to 0.3% total strain, SMYS corresponds to 0.5% total strain and the material strain hardens after 0.5% strain in line with an appropriate standard, typically ASME VIII Div.2 Annex 3-D.
- The maximum principal total membrane strain must remain below 0.3%.
- The surface maximum principal total strain depends on various material parameters, the geometry feature, residual stress and proximity to welds.

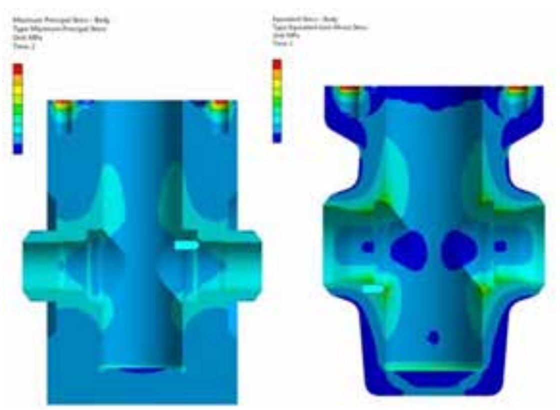

Figure 4: Typical principal stress plot of a valve body during HISC analysis

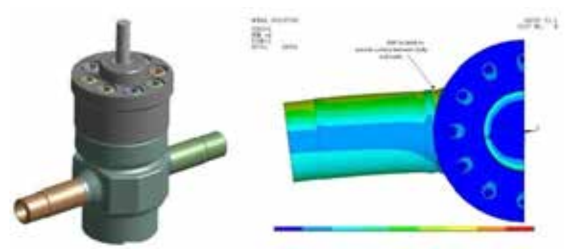

Figure 5: Principal strain during a HISC analysis

GASKET AND BOLTING ASSESSMENTS

- Gasket assessments are undertaken to provide confidence of sealing in many situations, such as during the application of preload and full working pressure, or under the application of actuator loading and external loads.
- Contact pressures are obtained and compared against the ISO-13628-7 (Annex H) factored operating pressure requirements of x1.2 and x2.0 for liquids and gases respectively. Any continuous contours of contact pressure above the factored pressure offers assurance of sealing.
- Bolting assessments are undertaken to demonstrate compliance with ASME VIII Div.2, Part 5 (Design by Analysis): service (strength), fatigue requirements.
- The strength requirements cover bolt shank membrane and membrane plus bending stresses.
- The fatigue assessment involves calculating the alternating stress for each fatigue 'bin', calculating the associated fatigue damage based on the number of occurrences and summing the damage linearly.

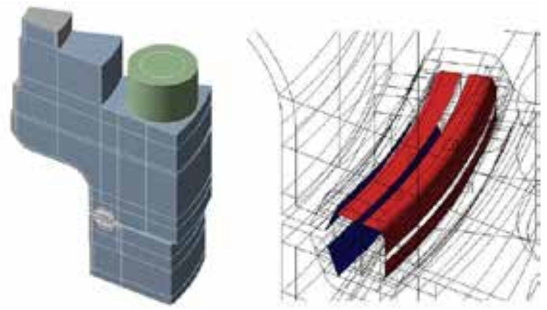

Figure 6: Cyclic - symmetry model of body, bonnet, gasket and bolt component

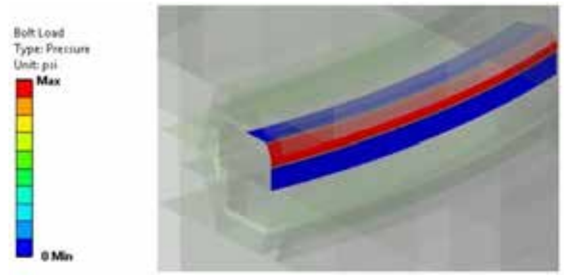

Figure 7: Gasket contact pressures during bolt pre-load and pressure application

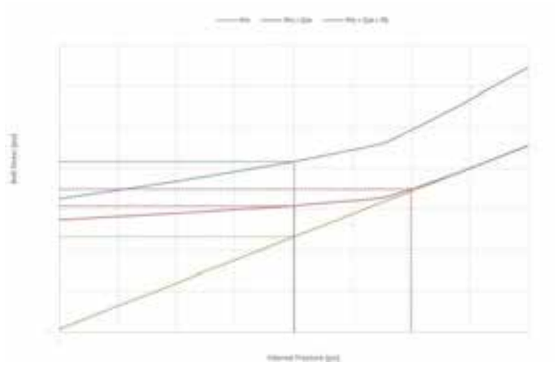

Figure 8: Bolt stress as a function of Internal Pressure

TRIM COMPONENTS AND DRIVE TRAINS

- Trim components are assessed structurally using FEA to validate design calculations.
- Drive train assessments can verify if the assembly is suitably designed for operating conditions or investigate failure modes under extreme load cases.
- Assembly models may consist of the gate, T-Nut, stem, drive threads, piston etc.
- Contact pressures between seat ring/gate/ball/disc can be extracted to determine the sealing behaviour:
- Similar to gasket sealing assessments, contact pressures are compared against ISO-13628-7 (Annex H) factored operating pressure requirements of x1.2 and x2.0 for liquids and gases respectively.
- Closed and near-open positions can be considered in order to capture potential variations in the load path or stiffness for different configurations.

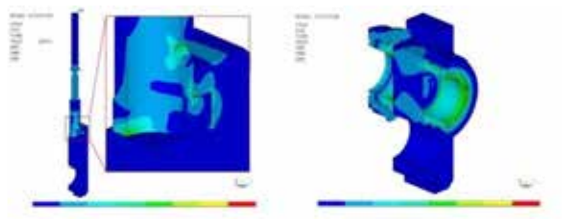

Figure 9: Equivalent stress plots of drive train and trim components

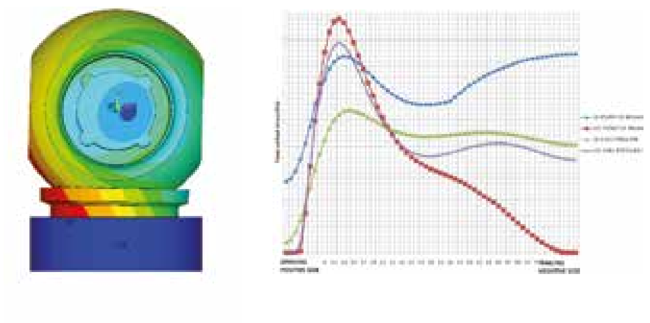

Figure 11: A ball valve contact pressures during closed and near open positions at ID and OD

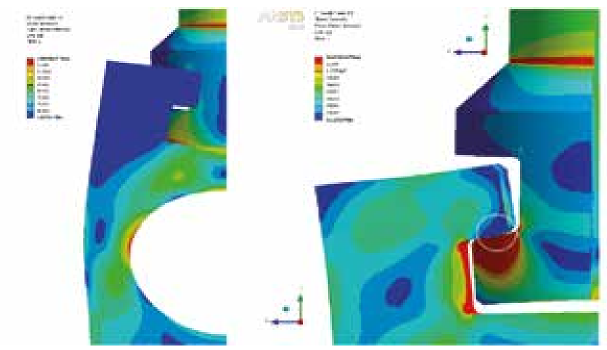

Figure 10: Exaggerated results from a gate and stem structural analysis

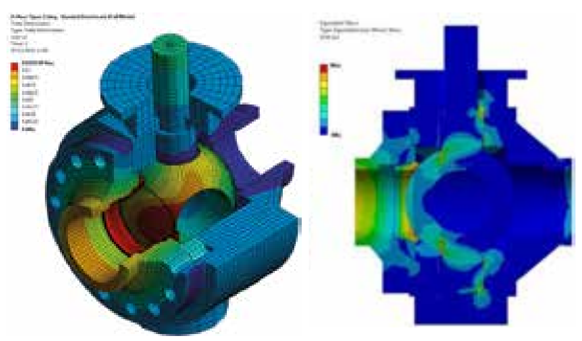

Figure 12: Deformation and equivalent stress plot of a ball valve

SEISMIC ANALYSIS

There are several ways to perform seismic analyses. These include:

- Equivalent Static Analysis (Static) – a series of (factored) loads representing ground motion is applied and the valve response is obtained.
- Full Transient Dynamic Analysis – A linear or (usually) nonlinear analysis where time-varying loading is applied to determine the system response. Equations of motion are solved where inertia, damping and stiffness forces are calculated. This is usually the most accurate method but can be very computationally expensive.
- Mode-Superposition Transient Dynamic Analysis – A linear method that scales the mode shapes obtained from a modal analysis and sums them appropriately to calculate the dynamic response of a structure to a time-varying input. Less computationally expensive than the full method and can give accurate results for linear systems.
- Spectrum (Frequency) – A spectrum is a representation of a load/acceleration /velocity etc. in the frequency domain. A time varying signal is used to produce the spectrum which envelopes the maximum responses at a particular point. The method loses some information (phase) but this may not be critical except where there are multiple spectrum inputs and significant phase shifting might be expected.

The choice of method is dependent on the project and the available data. Spectrum analysis is often the preferred method. It has the following characteristics:

- Fast and efficient, linear-only method where the focus is to obtain the maximum response quickly compared to a full transient solution.
- Single-point response spectrum or multi-point response spectra can be applied.
- Velocity or acceleration base excitation can be applied directly with the standard analysis method. Direct displacement base excitation is available via the Large Mass Method (LMM) or Effective Force Method (EFM).
- Often used for "Operating Basis Earthquake" (OBE) and "Safe Shutdown Earthquake" (SSE).
- The maximum response (deflection, velocity, acceleration, stress etc.) is computed by scaling and combining mode shapes.
- Several different combination methods are available e.g.:

    - Square Root of the Sum (SRSS)
    - Complete Quadratic Combination (CQC)
    - Rosenblueth (ROSE)

- Low frequency (rigid response effects) can be considered via the Lindley or Gupta method.

SHOCK ANALYSIS

- Marine propulsion systems incorporate resiliently mounted lubrication modules to supply lubricant to the primary drive gearboxes. The lubrication modules are complex systems integrating pipework, valves, pumps, filters and coolers. In Defence applications, the vessel must be designed to withstand shock loading from subsea explosive devices. The response of the system, including the valves, when subjected to such a load can be simulated by analysis.
- A transient dynamic shock load is applied to the geometrically simplified system in the form of a transient shock spectrum. This is typically taken from a Defence standard such as MAP-01-470.
- Outputs from this analysis could include accelerations, velocities, and stresses at all nodal locations, at all time-steps throughout the transient response.
- Peak accelerations observed by the valve (or other components) can be used as pseudo static load inputs to detailed sub-model analyses. These detailed local models can then be used to ascertain the peak response of the valve (or other components) to the shock load in terms of stress and deflections.

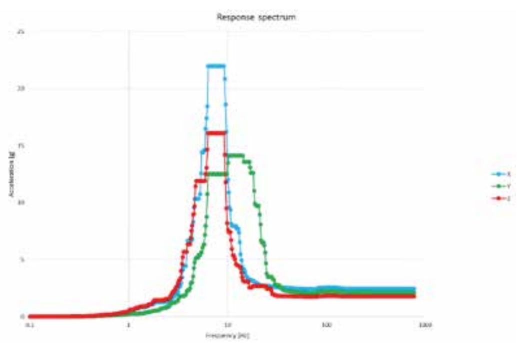

Figure 13: A typical response spectrum acceleration input curve

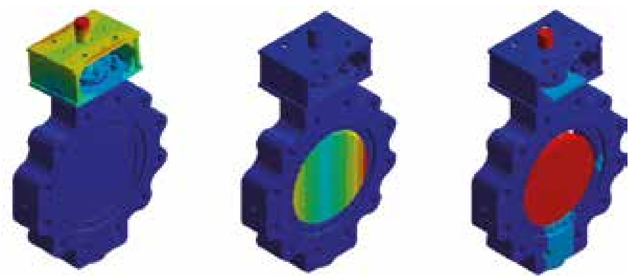

Figure 14: A selection of modal results of a butterfly valve

THERMAL STRUCTURAL ASSESSMENT

- Often within valve systems, the temperatures of the liquids or gases can vary greatly. Problems might arise when there are induced thermal stresses which might push areas close to the allowable limit. Additionally, without sufficient flexibility in the system, over constraint can cause high compressive stresses due to thermal expansion of components.
- Steady state or transient thermal analyses can provide the response of the valve when exposed to thermal gradients. The stresses and deflections induced from the thermal loading can be input into the structural assessment to obtain an overall loading response of the valve.
- Thermal assessments can be performed on seat rings, gates and seat pockets to determine the extent of axial and radial expansion. From this, any thermal clamping of the gate, or any clamping of the seat ring within the seat pocket due to radial expansions of the seat ring, can be identified. As such, clearances between these components can be assessed.

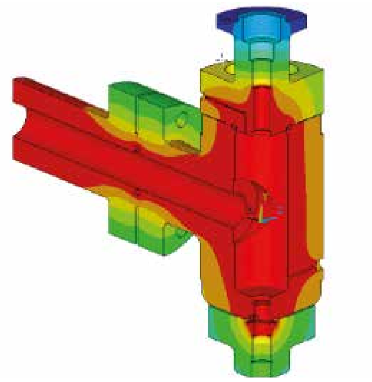

Figure 15: Thermal profile of a body, bonnet and an end connection

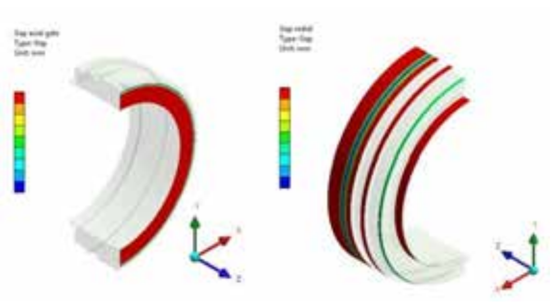

Figure 16: Axial/Radial deformation plots of a typical seat ring under thermal loading

HIGH PRESSURE HIGH TEMPERATURE (HPHT)

- There is a growing requirement for valves to operate at higher pressures and higher temperatures in the subsea industry.
- Transitioning from 15ksi to higher rated working pressure tends to change designs from 'thin-walled' to 'thick walled'.
- High internal stresses can concentrate at sharp corners, bore intersections and seal pockets, which are possible locations for crack initiation sites, and could potentially lead to fatigue failure or fast fracture.
- Potential problems with thicker-walled pressure containing equipment include difficulties with manufacture, fabrication and handling due to excess weight. It is also more difficult to maintain uniform material strength through the wall sections.
- Use of elastic stress analysis on thick-walled valves can produce non-conservative results, so use of non-linear elastic plastic analysis is recommended.
- There are several options available when developing HPHT components for the subsea industry and as such, API 17TR8 has been developed to provide guidance.
- A design flow chart is provided within API 17TR8 to help engineers develop HPHT components, with pressure, analytical complexity and quality control requirements increasing the further to the right that you go in the flow chart.
- The path within the flow chart can determine design margins, product specification level and test pressures.
- Design margins are larger for ASME VIII Div.2 compared to those of Div.3.
- However, product specification levels are higher for Div.3 where quality assurance requirements are tighter. This could include higher Charpy toughness values, limits on ovality and misalignment, NDE capability for flaw detection etc.
- Use of Div.3 could allow for the design of thinner walled valves for a given pressure and temperature and could help reduce manufacturing problems.
- Assessments to consider when verifying a HPHT design are plastic collapse analysis, local strain limit analysis, ratcheting analysis, fatigue analysis and fracture mechanics analysis; for which PDL are world leading experts.

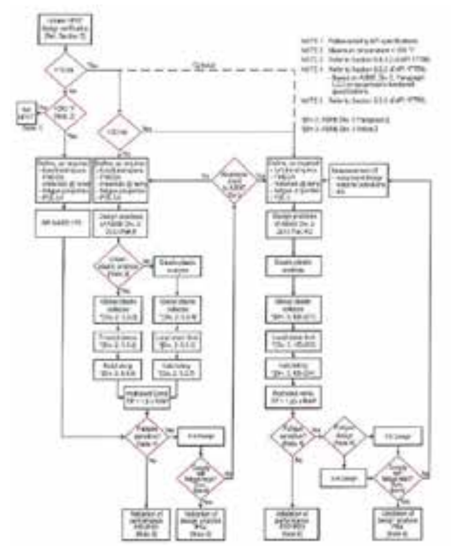

Figure 17: HPHT design flow chart (API 17TR8)

LINEAR ELASTIC FRACTURE MECHANICS (LEFM)

- Fracture mechanic assessments are performed by determining:
    - a likely crack initiation site
    - an existing flaw size based on NDT or, in lieu of available data, based on design code recommendations
    - a path along which the crack will likely propagate.

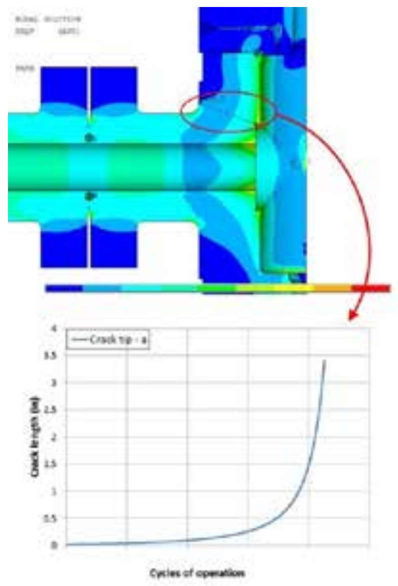

Figure 18: Crack size evolution over number of cycles for the path depicted

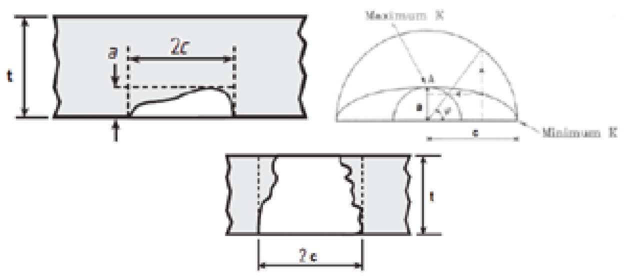

Figure 19: Semi-elliptical crack profile (DNV-OSJ101)

- Calculations are performed to determine incremental crack growth based on the stress intensity factor at the crack tip. As the crack grows the stress intensity factor changes, as such it is important that small crack size increments are considered.
- A critical crack length is determined from the assessment code. The number of cycles to reach this critical crack length can then be calculated.
- As a first approach, closed form solutions available in design codes, are used for the evaluation of the stress intensity factors at the crack tip based on the local geometry and the type of applied loading.
- For complex geometries and loading type not covered by design code provisions, FEA can be used for the evaluation of the stress intensity factor and the definition of the crack propagation characteristics.
- Where FEA is used, a crack with a semi-elliptical profile is introduced into the FEA model with an appropriate orientation. The stress intensity factor is evaluated based on the local stress field and using the J-Integral method. Through a stepped process, the crack propagation path and the corresponding number of cycles are defined. This approach should provide more realistic fatigue life predictions.

FLOW ASSURANCE

Flow assurance involves modelling fluid flow to ensure the safe and most economical fluid transfer across the system. The financial loss from asset damage and the associated interruption to production can be substantial where this is not carried out. In the oil and gas industry, flow assurance is particularly of importance for deep water oil production, where the flow conditions can be extreme (temperature, pressure and flow rate) and difficult to replicate in physical testing.

VALVE CLOSURE TIME

- Valve closure times can be critical to the safety of a piping network, ensuring that global pressures remain within system limits. Steady state and transient analyses can be undertaken to determine valve closure times for different flow rates.
- Using a swing check valve as a case study, Fluid Structure Interaction can be implemented using Immersed Solid capability within one of our core toolsets – ANSYS CFX. This applies a momentum source in the fluid domain to force the fluid to move as the angle of the disc changes.
- The valve disc position can be determined by balancing rigid body dynamics and fluid forces acting on the disc. A steady open valve flow is initially obtained, after which the flow is shut off to initiate valve closure, with different flow deceleration rates applied.
- Valve flow and deceleration rates are optimised to achieve the desired closure time.

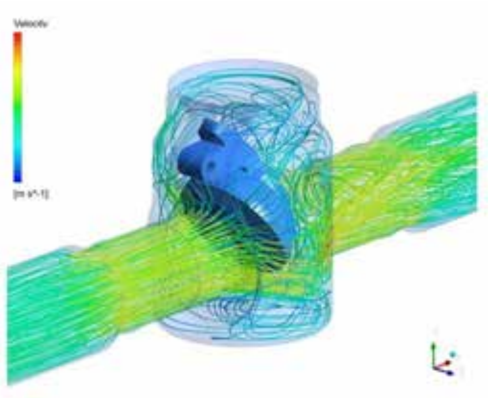

Figure 20: Flow rates and valve closure times of a swing check valve

EROSION ANALYSIS

- Pumps and valves that transfer fluids containing solids can experience significant levels of erosion, especially in areas with high velocities. Using steady-state multiphase CFD analyses, solid shear stresses can be determined on the valve walls, indicating likely places for erosion.
- Large particle size and high solid concentration requires the use of an Eulerian formulation for solid particles, as opposed to Lagrangian particle tracking which gives erosion rates directly.
- Complex mesh refinements in constricted regions are required to achieve model convergence.
- After determining erosion areas, design recommendations can be given to reduce erosion.

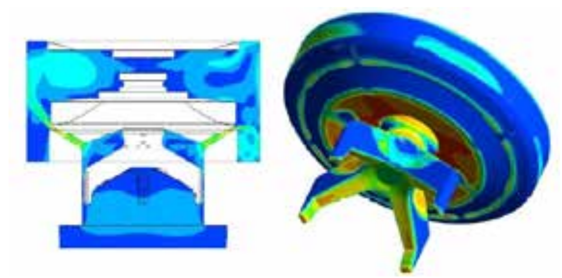

Figure 21: Erosion analysis on a check valve

JOULE THOMSON EFFECT

- CFD modelling allows for the treatment of complex compressible flow behaviour, along with the associated thermal effects.
- Real gases, where intermolecular forces are significant, exhibit the Joule Thomson effect. This is where the gas undergoes a change in temperature as a result of a throttling process, where the gas is passed through a valve or porous plug, experiencing compression closely followed by expansion.
- Typical flows which require a real gas treatment are hydrocarbon gas flows under high pressure, this is of particular relevance to the Oil & Gas industry.
- The temperature changes involved can become significant depending on the flow conditions and localised flow geometry, e.g. in valves involving small openings, such as a choke valve. It is important for valve designers to determine the extent of the temperature change in advance of manufacture to validate the safety of the valve components.
- The CFD model should incorporate the following:
  - The gas modelled as a real gas (as opposed to an ideal gas which neglects intermolecular forces); the Peng-Robinson Equation of State is a good choice of real-gas model, which is suitable for modelling the subcritical gas phase and supercritical properties, as well as providing reasonably accurate results for the subcritical liquid phase.
  - Mixture properties applied using real-gas mixing rules (for hydrocarbon gas mixtures).
  - Heat transfer between internal, external fluid and solid domains.
- High flow rates and small constrictions in the flow result in high Mach numbers, which can cause convergence difficulties with the CFD simulation. These issues can be overcome using solver relaxation parameters, which are dependent upon the Mach number. A highly resolved mesh is also required in the shock-wave region.
- These CFD projects are computationally expensive. PDL has the capability of solving on an in-house 48-core dedicated High Performance Computing Cluster. If there are larger CFD projects that require more computing power, then PDL has access to the Edinburgh University Cluster. This places PDL on the forefront of CFD valve analysis.

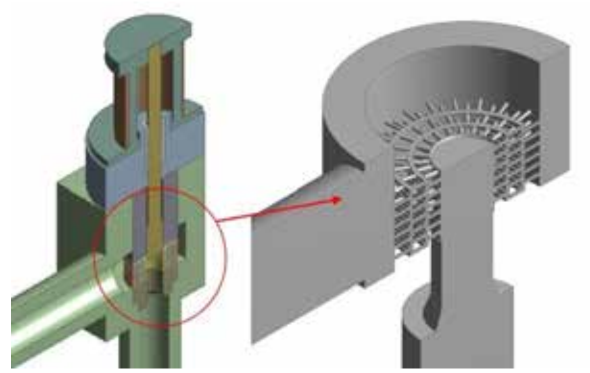

Figure 22: Modelling the fluid domain of a choke valve

MAXIM®

MAXIM offers Engineering Software Solutions that we tailor for each valve and actuator client to **simplify, integrate and automate** their engineering specification and quote processes to deliver efficient valve sizing, selection and design software tools.

MAXIM ensures accelerated time to value; increases in engineering quality, accuracy and consistency; optimisation of workflows with embedded automation and reduces the effort/capacity required for delivery.

Our MAXIM team combines experience of software development and engineering with over two decades of valve specific experience. They review each client's current engineering design processes, data sources, toolsets, technical calculations and assessments to provide a bespoke software proposal which enables consistent and right-first time engineering solutions and eliminates the need for re-engineering.

So that you can do more engineering, in less time and for a lower cost.

The MAXIM team has experience of addressing ten common issues that face our clients:

1. Engineering hours that seem to overrun
2. Bottlenecks which appear in the availability of suitably qualified and experienced personnel
3. Senior engineers who are consumed with low-value or repetitive tasks
4. Engineering workflow which are not clearly defined in the first place or strictly adhered to in practice
5. When the core understanding of the product still resides in the heads of a few
6. Existing tools and databases are too difficult to maintain and not controlled for use
7. When there is little or no integration between existing tools and databases, so a change made in one is not carried over to the next and manual errors start to appear
8. When engineering gets done twice; once to win the work and then again to deliver the work after the order lands
9. That lead times are too long
10. That profits are too low

MAXIM® solves these challenges by taking engineering off the critical path and driving the cost of poor quality towards zero.

- ELIMINATE ENGINEERING OVERRUNS
- AUTOMATE REPETITIVE TASKS
- INTEGRATE YOUR CURRENT TOOLS AND DATABASES
- ELIMINATE MANUAL ERRORS AND COSTLY REWORK
- COMPLETE 70-80% OF ENGINEERING PRIOR TO CONTRACT AWARD
- TAKE ENGINEERING OFF THE CRITICAL PATH
- ACCELERATE YOUR ENGINEERING PROCESS
- CREATE A ‘SINGLE SOURCE OF TRUTH’
- LOWER YOUR COSTS AND INCREASE YOUR PROFIT
- CREATE A BESPOKE SOLUTION FROM A STANDARD LIBRARY OF PARTS

CASE STUDY

CONTROL VALVE SIZING TOOL FOR INTERNATIONAL TOOL MANUFACTURER

SITUATION

- The client was looking to replace an existing sizing program, used during the quotation phase, which:
  - Did not support global business,
  - Was not well understood (effectively a black box)

CHALLENGES

- The calculations, logic & rules were “locked up” in the existing Sizing Tool, which contained over 50,000 lines of code.
- The Tool had “Evolved” over 20 years and was not documented.
- Original developers and engineers who built and maintained the tool had moved on.
- There was a lack of common process and an inconsistent quotation style and substance.
- The engineering calculations were complex and included an integration of Standard calculations and bespoke in-house calculations.

SOLUTION

- We reviewed their existing process and code thoroughly and defined a clear workflow.
- We created documentation for all aspects of the Sizing Calculation process which contained highly adapted Company specific interpretation of Standards (BS EN 60534, Industrial Process Control Valves).
- The calculations determined flow coefficient at given valve angles, acoustics/noise generated, iterative calculations of interdependent parameters, and more.
- The calculations were implemented in the configurable MAXIM Framework.
- This provided a "Launch-pad" for further expansion & innovation.

Figure 23: Valve Sizing Tool User Interface

BENEFITS

- The Sizing Calculation IP was secured and risk was mitigated as the expert knowledge was captured within the company.
- Errors embedded in the calculation and software were spotted and removed through the review and documentation process.
- The documentation was reviewed and is now controlled and auditable. This documentation provided a level of understanding accessible to all within the company.
- Following on from the sizing module, a costing module & GA generator could be integrated.
- The tool is easier to maintain and extend as there is clarity on the current tool process, and there is potential to explore further enhancements with the client.

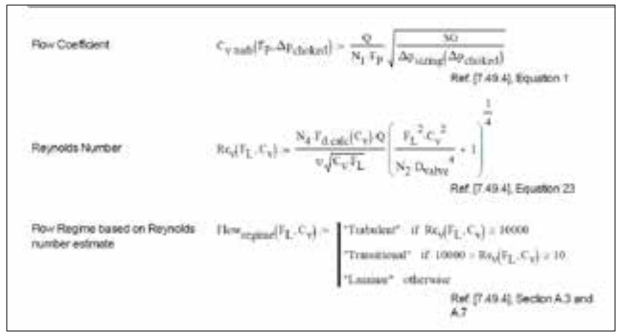

Figure 24: Snippet of the Flow Coefficient Calculation from the Scoping Document

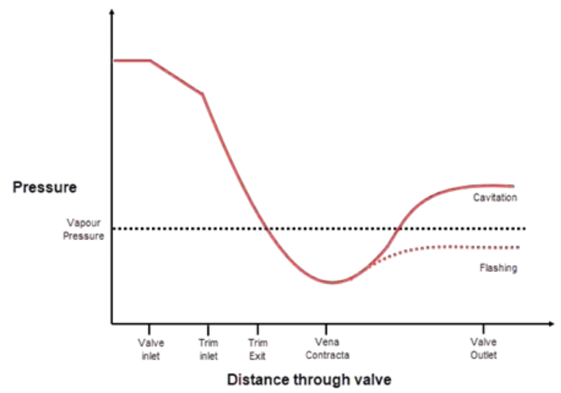

Figure 25: Cavitation and Flashing through a Control Valve

CASE STUDY

ACTUATOR SELECTION TOOLKIT AND DATA MANAGEMENT FOR GLOBAL ACTUATOR MANUFACTURER

SITUATION

- The client was migrating from Ax 2009 to D365 and needed to develop a new version of their Existing Actuator Selection Tools and Actuator Performance Database in a supported technology.

CHALLENGES

- The logic & rules were "locked up" in existing Ax Selection Tools & the Database Processes.
- There was limited developer resource to modify the existing tools, and the existing tools would not be supported by D365.
- All aspects required scoping, documentation and implementation.
- There was a range of data sources, and the existing solution had limited integration with other internal systems.
- To support the migration to D365, the company wanted to bring the database in-line with the current product offering, and to de-risk the deprecated nature of the existing database. (The key stakeholders were not aware of the location of the database, or how to access the data)

SOLUTION

- A fully Azure cloud-based solution was provided along with a (data-based) configurable rules engine, database and data administration and the solution was implemented with rules defined between PDL and the client
- Extract Transform Load (ETL) layer was used to process data from multiple sources
- The rules engine was developed as a service (as it is called by multiple systems).
- There was a common user interface for all use cases.
- The phased delivery for the selection tool & database was in line with D365 Roll-out.
- PDL developed a database administration utility. The database design was reviewed and revised to bring it in line with the latest product offering, and to ensure maintainability and extensibility in the future.
- Where possible, data was sourced from other systems within the client's organisation, resulting in a reduced data administration workload.

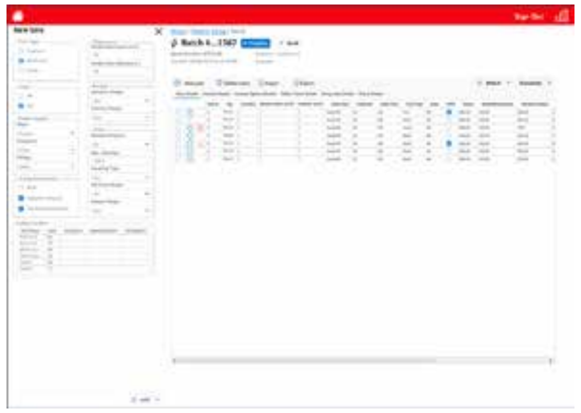

Figure 26: Selection Tool User Interface

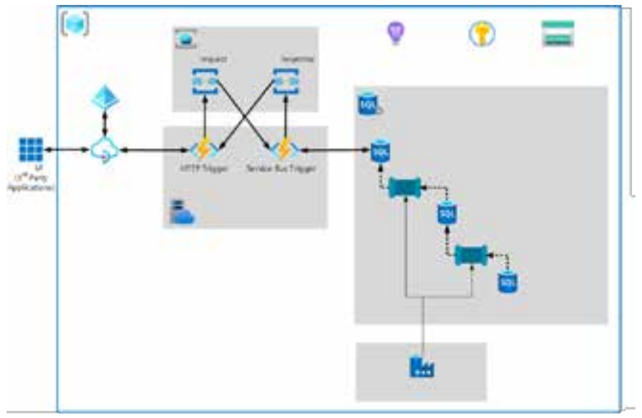

Figure 27: Selection Tool Cloud Based Architecture

BENEFITS

- An integrated solution was provided which interfaces with several data sources & seamlessly forms part of the D365 workflow.
- The solution allowed the engineers to manage the rules through data, removing the reliance on developers.
- The business rules applied are visible to (appropriate) users, which provides transparency to those using the tool.
- The single system provides internal & externally facing functionality and the Azure based solution easily provides required scalability & performance.
- There are minimal on-going development and maintenance costs to integrate new products.
- The risk of running a database on third-party deprecated hardware was removed.
- The data administration overhead was reduced by 20% through sourcing data externally.

Figure 28: Spring Return Actuator

"

...within Rotork, we recognised the need to standardise key parts of our engineering software. PDL have delivered well beyond our initial expectations...

"

...we were impressed by the overall methodology, development skill and project management from the team and are excited to see how PDL can help us deliver more of our future strategic improvements...

"

THE VALVE ENGINEERING
ANALYSIS EXPERTS

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