

# The Solution Buyers' Guide

## RSTRENG<sup>®</sup> & Pipeline Corrosion Analysis



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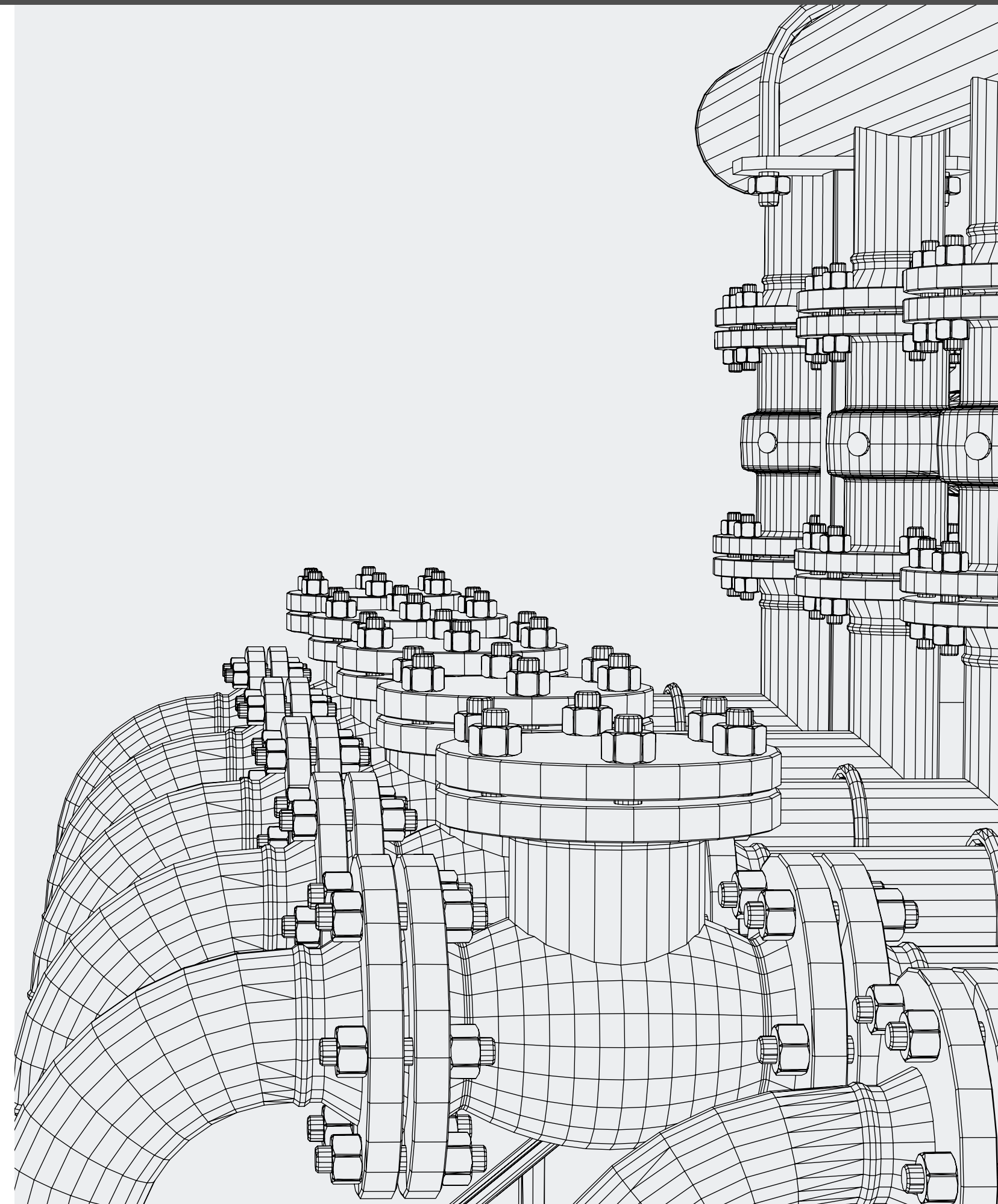
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## How to Use This Guide

Technical Toolboxes offers this guide to help decision-makers understand the use and relevance of the PRCI RSTRENG® calculation and software. It is an overview of the business case and benefits provided for pipeline engineering cases and workflows.

Pipeline operators face regulatory constraints and economic challenges. The competitive nature of the oil and gas industry demands the highest levels of quality, productivity, and compliance with standards. In a perfect world, engineers could construct pipelines from a high tensile-strength material that is impervious to corrosion, but it is a practical reality in which corrosion is an ever-present threat. Steel still offers the best balance of material strength and affordability. However, it does so at the cost of requiring eternal vigilance in the battle against corrosion. So, pipeline engineers need a computational solution for the remaining strength of pipes, as well as a way to manage the assessment cycle of multiple assets.

The Solution Buyers' Guide for RSTRENG® and Pipeline Corrosion Analysis explores and explains the factors involved that make an impact on the choice of such a solution. PRCI developed the RSTRENG® tool with the participation of the pipeline industry in 1990, and it was quickly and widely adopted. However, there have been a number of new developments since then, and expectations for usability have evolved over time. There is a myriad of options now, some free and some paid, that can leave one unsure about the differing levels of value that can be realized from each option. While the core calculations of this application are freely available, this guide explains how to get additional insight and a greater economic impact through integration with other software.

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## Business Processes for Managing Corrosion

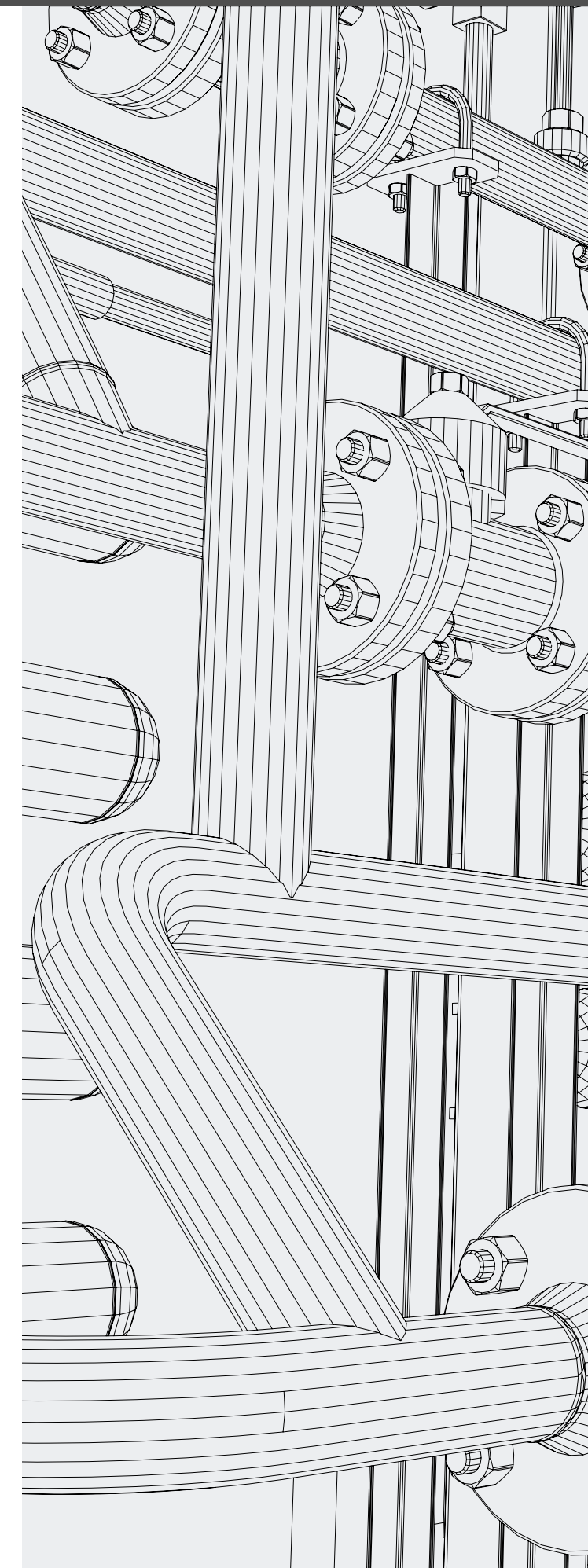
To be effective in the battle against corrosion in today's competitive market, balancing safe operation with budget constraints requires a strategic asset management plan. As corrosion proceeds, more and more metal is lost from the pipe wall. Eventually, areas of the pipe wall will be so thin that they will leak or possibly rupture, if not repaired or replaced.

Conservatism means when in doubt, repair or replace, which can create a very costly list of repair projects. Reducing conservatism while still ensuring pipeline integrity requires increased spending in tools to reduce uncertainty, costs which are offset by larger decreases in repair expenses.

Level 1 processes that screen for potential problem areas can reduce the time required to understand where more effort/focus is needed (triage). In-line inspection (ILI) runs, and unit slope plots are a typical example. For the unit slope analysis, the predictive model is created using a known corrosion rate to predict growth in existing corroded areas since the last ILI run. The results of that model are compared to the results of the next run.

Any outliers vs. acceptable deviation from unit slope require Level 2 analysis, like investigative or verification digs. Additionally, ILI indications of pitting depths greater than a certain percentage of pipe wall thickness also require Level 2 analysis. Level 2 processes are more expensive, carry more risk, and require more data to be gathered, in order to do more in-depth analysis. That means digging up and exposing the area of concern flagged by Level 1 procedure. Once the relevant portion of pipe is exposed, a NACE certified corrosion professional takes measurements, either with a manual pit depth gauge or with more expensive tools. This data is then fed into analysis tools to determine whether or not there is a need for repair.

This cycle continues throughout the life of the pipe, and knowing when the next assessment is needed will be key to optimizing the balancing act of controlling maintenance costs while delivering on a promise of flow assurance and prudent operatorship. An ideal solution will support calculations and business processes throughout the life of a pipe, as well as aid in the management of the larger group of pipes in operation.





## PRCI RSTRENG®: A Higher Level of Analysis

The US Code of Federal Regulations (CFR) prescribes metal loss analysis calculations for pipelines. While there are several solutions for Level 1 corrosion analysis, these only look at metal loss and remaining strength in localized areas in longitudinal sections of a buried pipeline. Level 1 calculations require less effort, less detail in data. They are therefore more conservative (larger safety buffer), so basing repair decisions on them results in more repairs, which creates additional resource drain/constraint.

- The ASME B31G calculation is a Level 1 analysis that represents the entire effective area as a parabola, using two-term Folias factor. This is the most conservative approved calculation, which yields lower safe operating pressures.
- Modified B31G is also a Level 1 analysis that represents the effective area as a rectangle and uses three-term Folias factor, with less safety margin requirements and higher safe operating pressures.

Level 2 calculations require more data and are a more intensive calculation. They are therefore more conservative (larger safety buffer), so using Level 1 calculation to make repair decisions results in doing more repairs, which can create a significant resource drain/constraint.

- RSTRENG® is a Level 2 calculation. It subdivides long effective areas into smaller segments, using a three-term Folias factor, which allows higher safe operating pressures than Level 1 calculations.

RSTRENG® is the only Level 2 methodology sanctioned by the CFR regulations to calculate the remaining strength along extended lengths of pipe. Studies commissioned by the Pipeline and Hazardous Materials Safety Administration (PHMSA), have demonstrated that RSTRENG® is the most accurate method for predicting failure pressure in corroded pipes<sup>[1]</sup>.

The RSTRENG® corrosion assessment tool is industry-proven and PHMSA-approved. It calculates the remaining strength of externally corroded areas of pipelines and product-carrying capacity. It provides a go/no-go assessment of safe operating pressure, given the extent, type, and configuration of metal loss on the pipe. It allows you to make data-driven decisions to safely operate the pipe longer and transport the most product. The result is improved ROI and minimized risk of rupture or leakage<sup>[2]</sup>.

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# The Dimensions That Matter

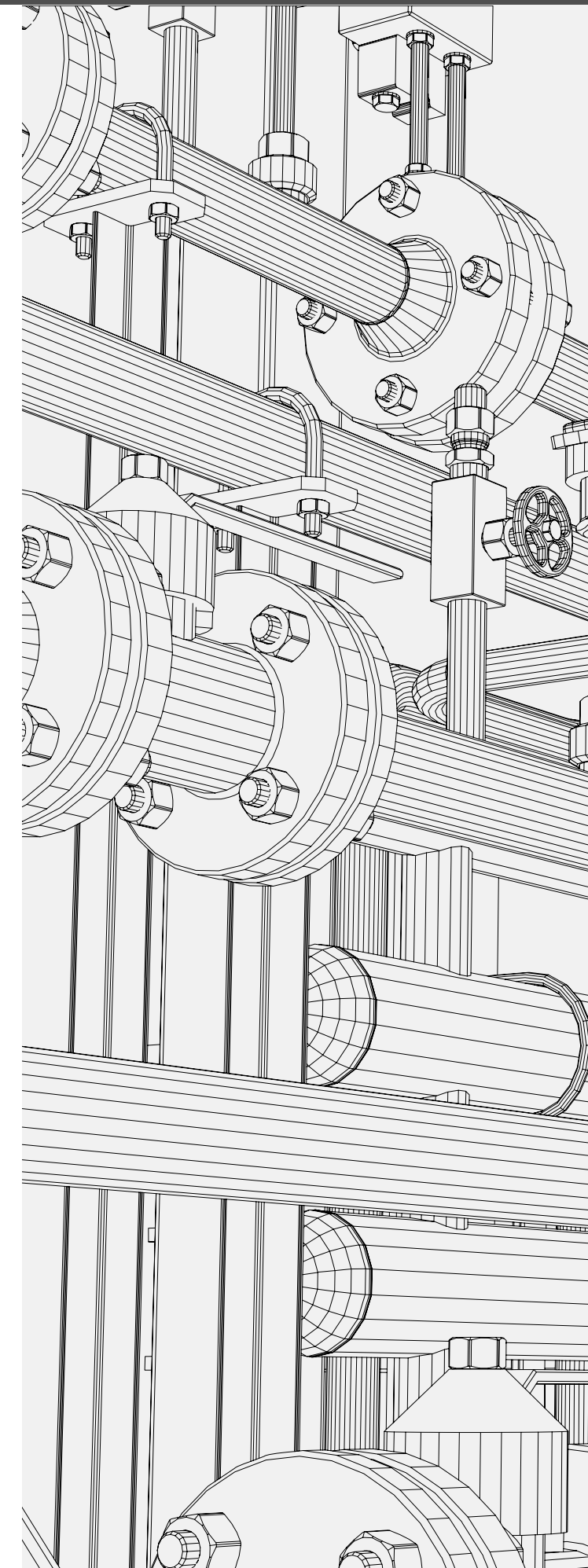
## 1. Cost Management

Pipeline repair is a fact of life in midstream oil and gas, and one to avoid when possible. Digging up pipelines to inspect them is costly regardless of the circumstances. For a single inspection, excavations cost over fifty thousand dollars as a baseline. In congested big city settings, the price quickly escalates into millions.

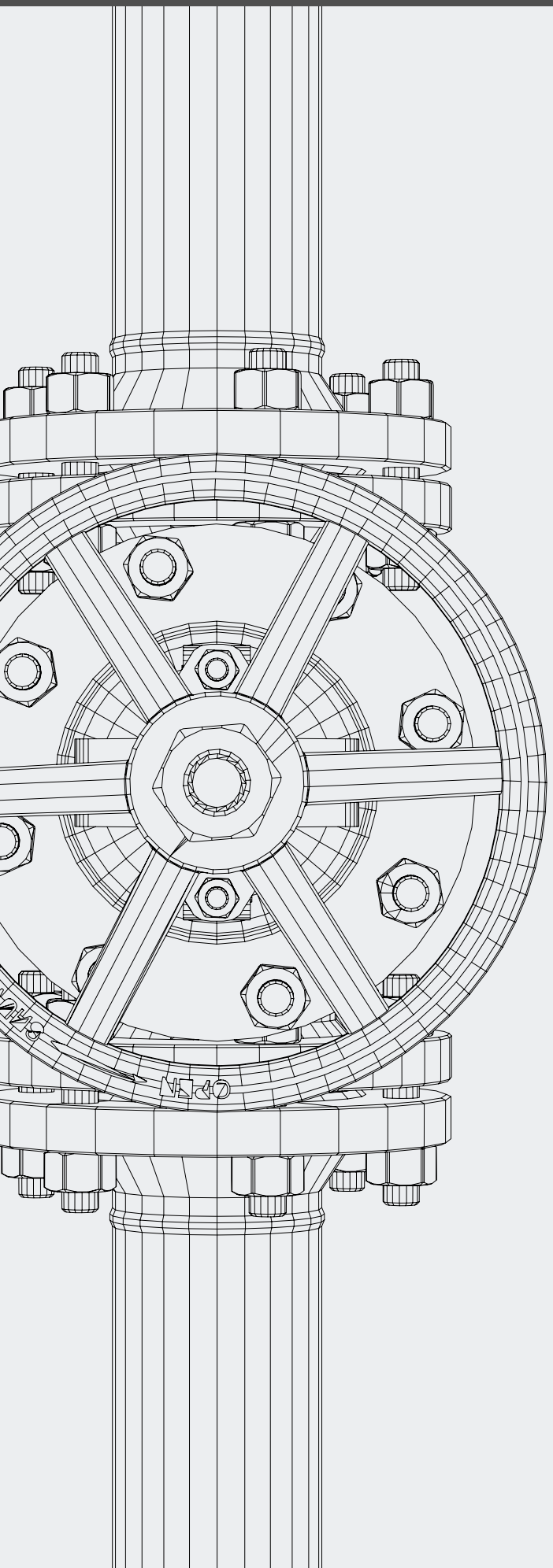
Reduction in operating and maintenance costs are ever-present pressures in today's competitive market and are the key to survival in cyclic downturns. Investigative digs are expensive. Repairs are expensive. Failures are expensive. Audit findings and engineering time are also expensive. The right tool will reduce engineering analysis hours required to ensure safe operation.

This means understanding the nuances in the underlying assumptions and facilitating knowledge transfer of leading practices to new users (the uninitiated). For example, it is important to know that the RSTRENG® calculation predicts a burst pressure higher than what would actually burst pipe grades higher than X-70. A flexible tool can meet these kinds of needs by reminding the user about proper handling of these kinds of exceptions.

Maintaining and optimizing the schedule of inspections, verifications, and repairs can be a daunting challenge for operators with hundreds, or thousands, of miles of pipe. An ideal solution will make overcoming this challenge simple and help an operator move from a reactive culture to a proactive way of doing business, which can have a huge impact on profitability.







## 2. Responding to Regulations

In midstream oil and gas, the government and industry set the standards and provide the regulatory framework for corrosion analysis. In the USA, the CFR Title 49, Sections 192 and 195 mandate RSTRENG® for Level 2 corrosion analysis in pipelines. New regulations and rules continue to emerge in response to events and spillages.

As an example, the 2010 rupture of a gas pipeline in San Bruno California is a case in point. After the accident, the California Public Utilities Commission called for extensive testing of the state's four pipeline networks<sup>[3]</sup>. ILI played a significant role in the post-event inspection process.

If you face demands for inspection by regulators, a remaining strength solution built around the RSTRENG® tool delivers accurate corrosion assessments and audit reporting. However, operations in the real-world are sometimes not that simple. As a part of the global oil and gas industry, pipelines often cross international borders. Any solution for multinational operators should account for cross-border differences with minimum friction.

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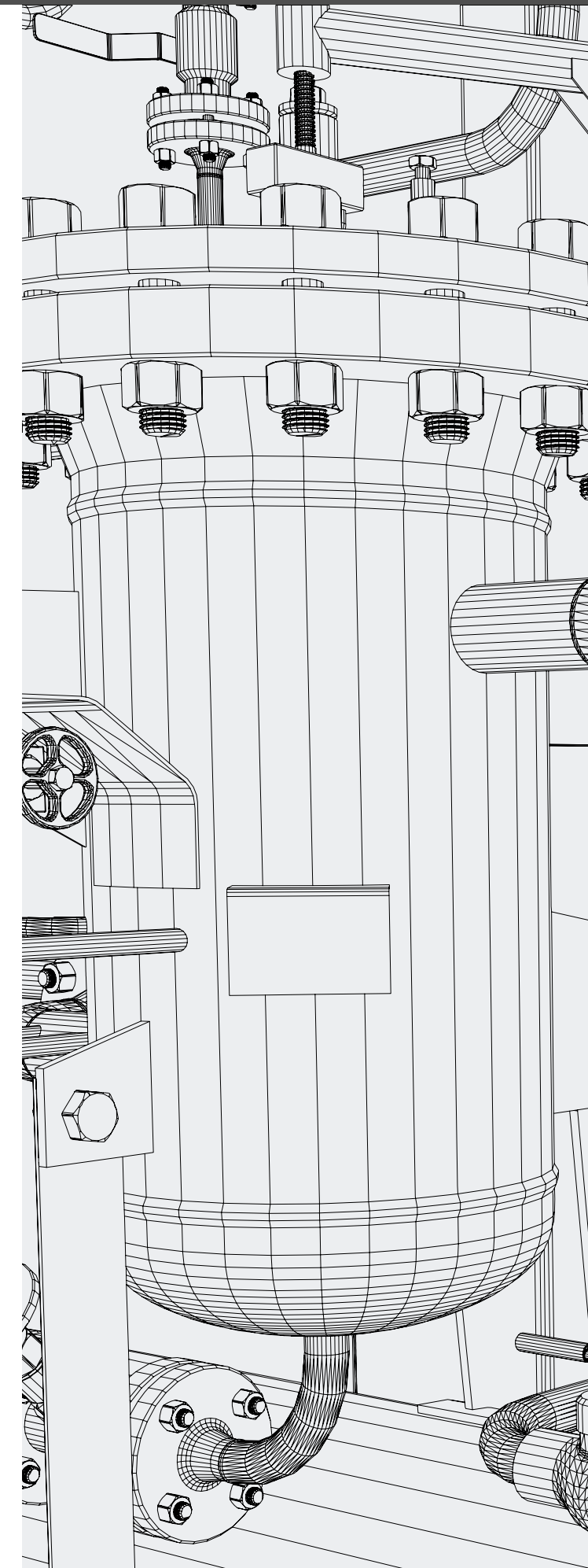
### 3. Risk Reduction

While many people think about reducing the risk of leaks and ruptures when thinking about RSTRENG®, there are inherent risks involved in many processes that support/enable the analysis. An ideal solution will aid in reducing risks in those other parts of the business, in addition to assessing the risk due to existing corrosion.

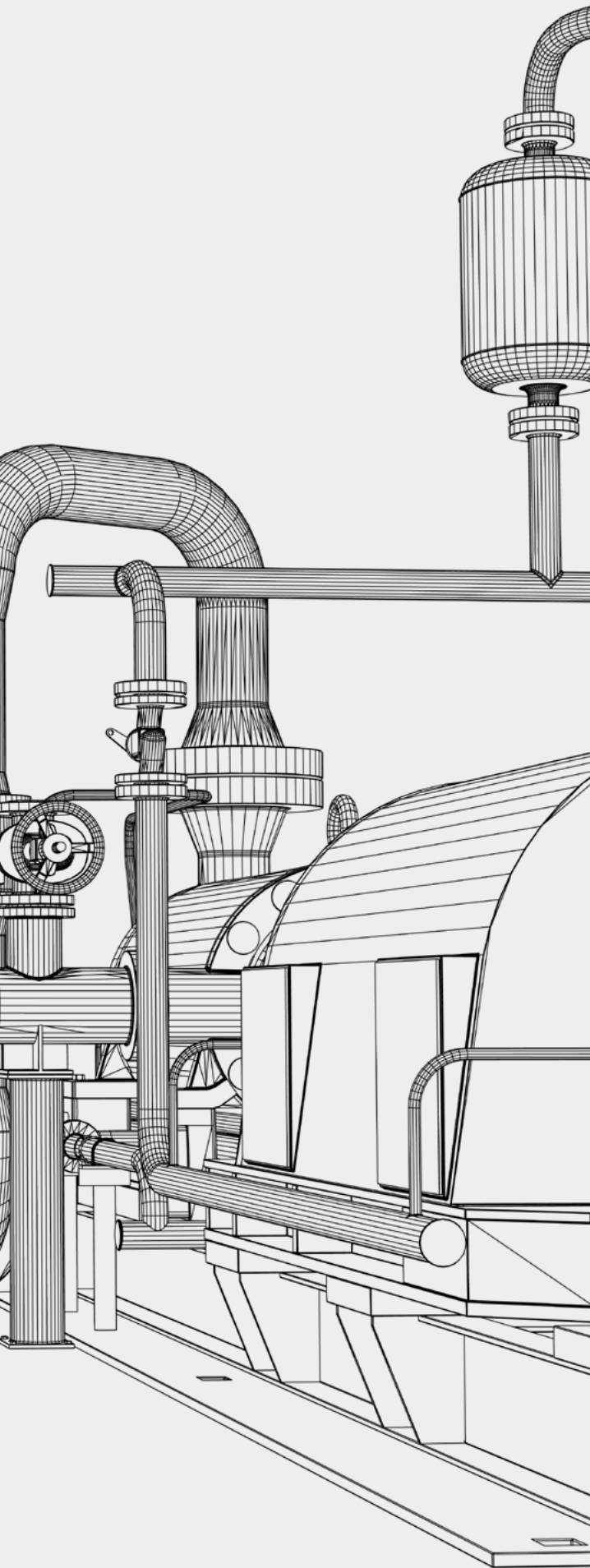
There are risks of injury, spills, and equipment damage in performing ILI pig runs, which are a typical Level 1 screening process. A smart pig is an expensive piece of equipment that could get damaged or stuck. As with all field operations, pigging is an operation that presents an opportunity for injuries to happen. For example, a pig gets stuck in the pipe, the receiver is opened, then the pig gets unstuck, and injures (or kills) a person when it blasts through the open receiver. Additionally, a pigging operation presents an opportunity for accidental releases to happen.

There is a risk of injury, spills, and equipment damage in investigative digs, which are a common Level 2 process for corrosion areas flagged by Level 1 processes. When heavy machinery is in use, particularly around pressurized hydrocarbons, there are a thousand ways someone can get hurt. The heavy machinery could break-down. There is also an opportunity for metal-on-metal contact that damages a pipe. Additionally, if high-voltage power lines are in the area, there is a hazard of potential injury through electromagnetic fields energizing equipment and/or pipes.

There are similar risks of injury, spills, and equipment damage in performing repairs. While safety programs are a key resource for reducing TRIR in field activities, reducing field activities is also a very effective tool. Optimizing and prioritizing the schedule to reduce risk in many facets of corrosion management should be a key decision point when purchasing software.







## 4. Increasing Pipeline Asset Value

Pipeline networks are capital-intensive, with finite life-spans. You may not have much scope to change financial factors, such as equipment and construction costs. However, you may be able to increase revenue by delivering more product and minimizing the cost of repairs. Improved productivity magnifies profitability for your pipeline. If your pipeline delivers product with fewer disruptions at less cost to repair, it is worth more as a capital investment. This is a complex task for a single pipe. Yet pipeline operators have many pipes for which to apply this concept. So, a need for understanding the bigger picture and holistic asset management becomes apparent.

- Know when you need to reassess corrosion areas. How long can you go before rerunning the ILI tool? This information will help you keep your operating costs and risks down while effectively managing corrosion, which will increase the ROI on your investment.
- Keep track of assessment/reassessment schedules with a software tool to aid in keeping the complex schedule in a managed state. This will allow for effective & efficient prioritization of resources and efforts.
- Knowing remaining life (ECDA) can optimize repair/replace-ment decisions. For example, if you're digging to investigate or repair an area of corrosion and your software tells you there's an adjacent area of corrosion with little life remaining, it's a quick, efficient, effective decision to make both repairs now with minimal incremental cost, versus having to dig again next year to repair the adjacent pipe section.

Does your pipe's remaining life give you the expected ROI? You may see a need to invest more in corrosion mitigation, or change types of mitigation, in certain areas over time.

Have confidence that corrosion is well managed to generate, or exceed, the expected ROI. Have confidence that your team has the software tools to keep hydrocarbons moving inside of the pipe efficiently.

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# The Case for Technical Toolboxes

The PRCI RSTRENG® tool provides Level 2 remaining strength calculations without incurring a license fee. Technical Toolboxes supports all customers who need remaining strength analysis with additional capabilities. Technical Toolboxes supports the base PRCI RSTRENG® program and expands its value further with premium tools, such as RSTRENG+®, ECDA, AC-Mitigation solutions, Pipeline Toolbox (PLTB), and the Pipeline Hub (HUB<sup>PL</sup>) platform.

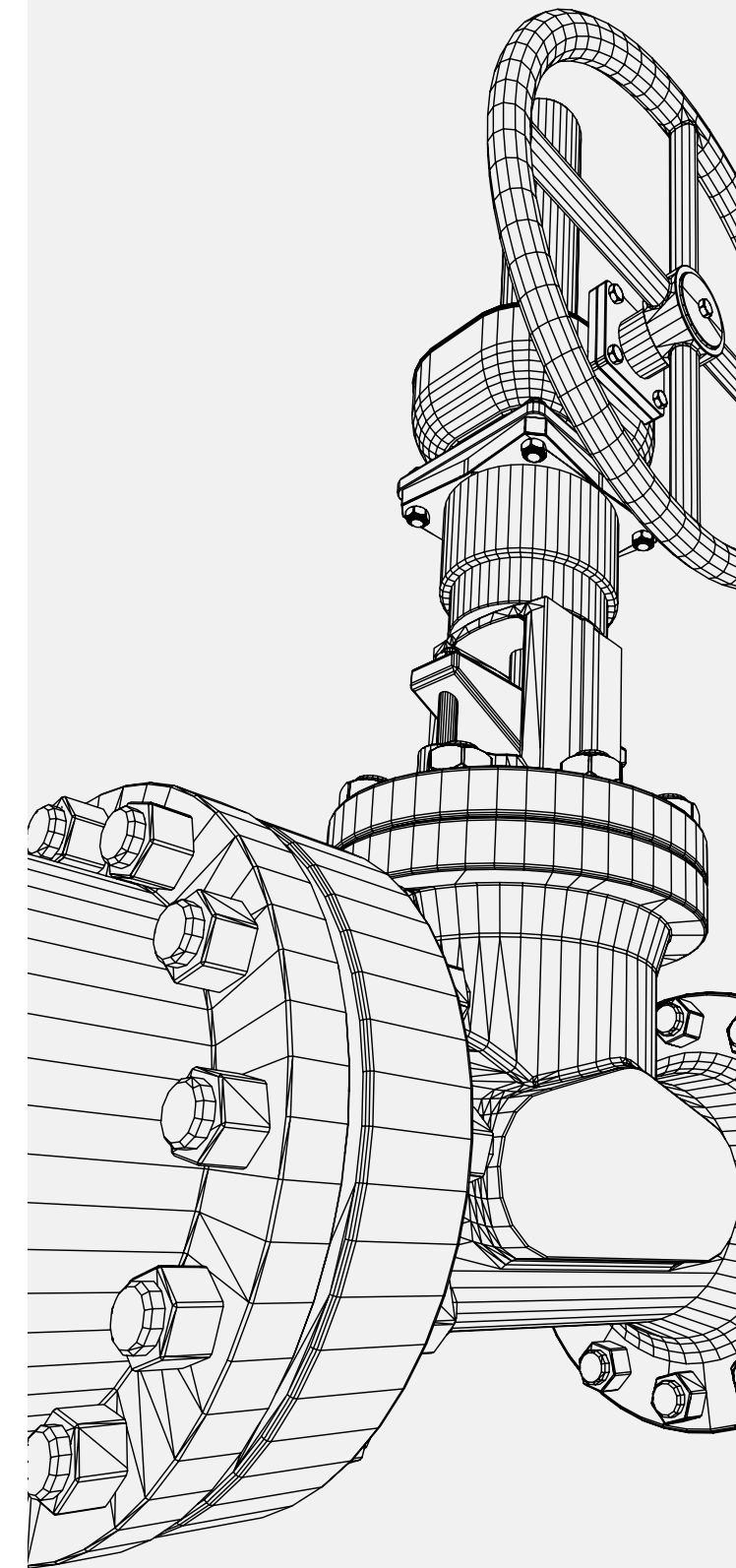
Since the ILI improvements in the late 1980s, Level-2 analysis with RSTRENG® has given oil and gas pipeline operators a better understanding of key pipeline assets. It specifies the limits so that you can operate at a maximum safe operating pressure longer. It reduces the risk of leaks and spills that result from pushing the limit too far. It allows you to increase the amount of product that you can transport through a pipeline as its estimated end-of-life approaches. This reduction of risk comes at little additional cost, and any productivity gains translate efficiently into increased profitability. RSTRENG+® more than pays for itself as a premium remaining strength assessment tool. It includes powerful workflow automation for the Zero-Out Method. This tool gives your engineers the ability to pinpoint effective areas of corrosion that need repair within miles of inspection data to locate all pipeline sections that need to be repaired in order to operate at your desired operating pressure safely. The automation of RSTRENG+® enables you to achieve these results while eliminating the manual workload that it once required.

## **RSTRENG+® Features and Benefits**

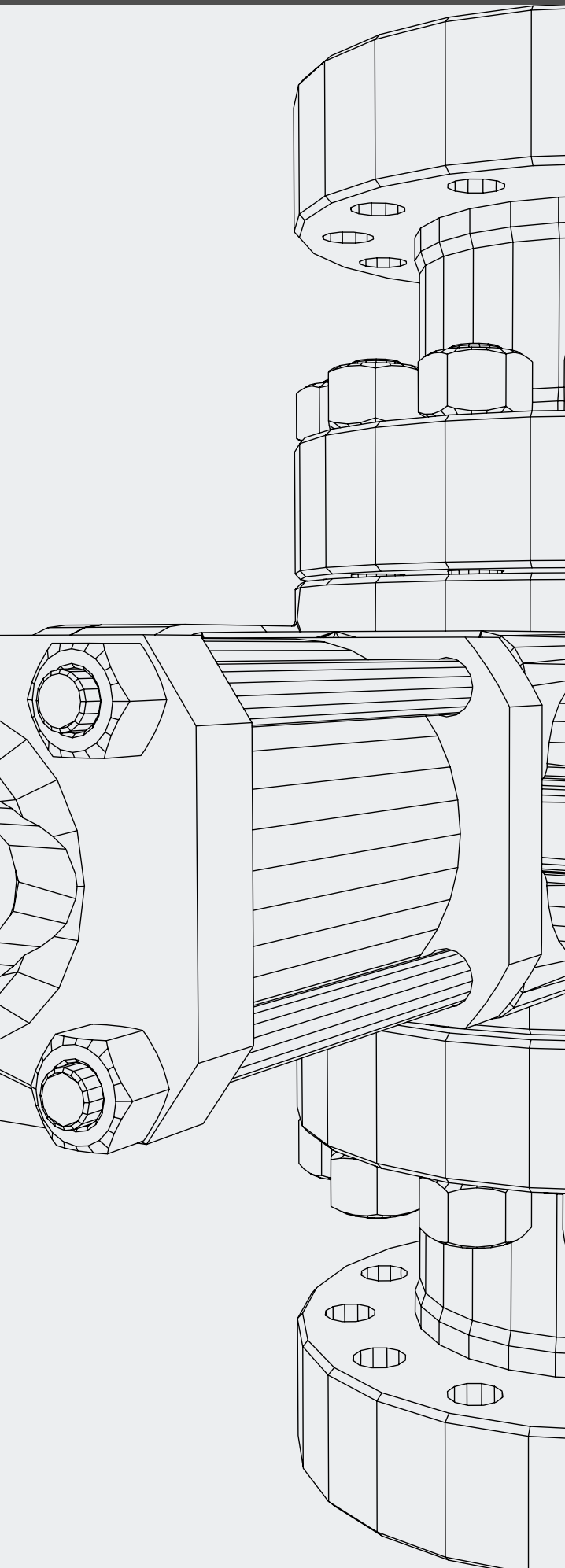
- Facilitates better integrity repair decisions, which reduces risk and improves the quality of engineering operations.
- Provides better management of pipeline metal loss defects for dramatic productivity and quality improvements.
- Accelerates project schedules via automated workflows to eliminate many hours of manual work required by base RSTRENG®, can result in dramatically faster completion of analysis projects. This module pays for itself in as little as one week of engineering time, making ROI incredibly high for a typical corrosion engineering team.

## **ECDA Module Features and Benefits**

- Offers the Reassessment Interval calculation to reduce risk and cost through optimizing the number of times a pipe is assessed while balancing integrity needs in resource-constrained environments.







- Lowers total operating costs with the Remaining Life of the pipeline so that you can optimize repair/replacement decisions, as well as understand if there's a need to adjust mitigation strategies to meet the asset's expected ROI.
- Reduces risk by offering additional remaining strength calculations (Shell-92, DNV, PCORRC, API 579) that provide flexibility to accommodate different scenarios, as well as facilitating knowledge transfer
  - Under certain conditions, higher grade steel greater than X-70 results in need to manually change the safety factor used in RSTRENG®. Alternatively, reference the Shell-92 and PCORRC calculations.
  - The pipeline with defect model in DNV-RP-F101 accounts for combined internal pressure and longitudinal compressive stress.

#### **HUB<sup>PL</sup> Integrated Platform Features and Benefits**

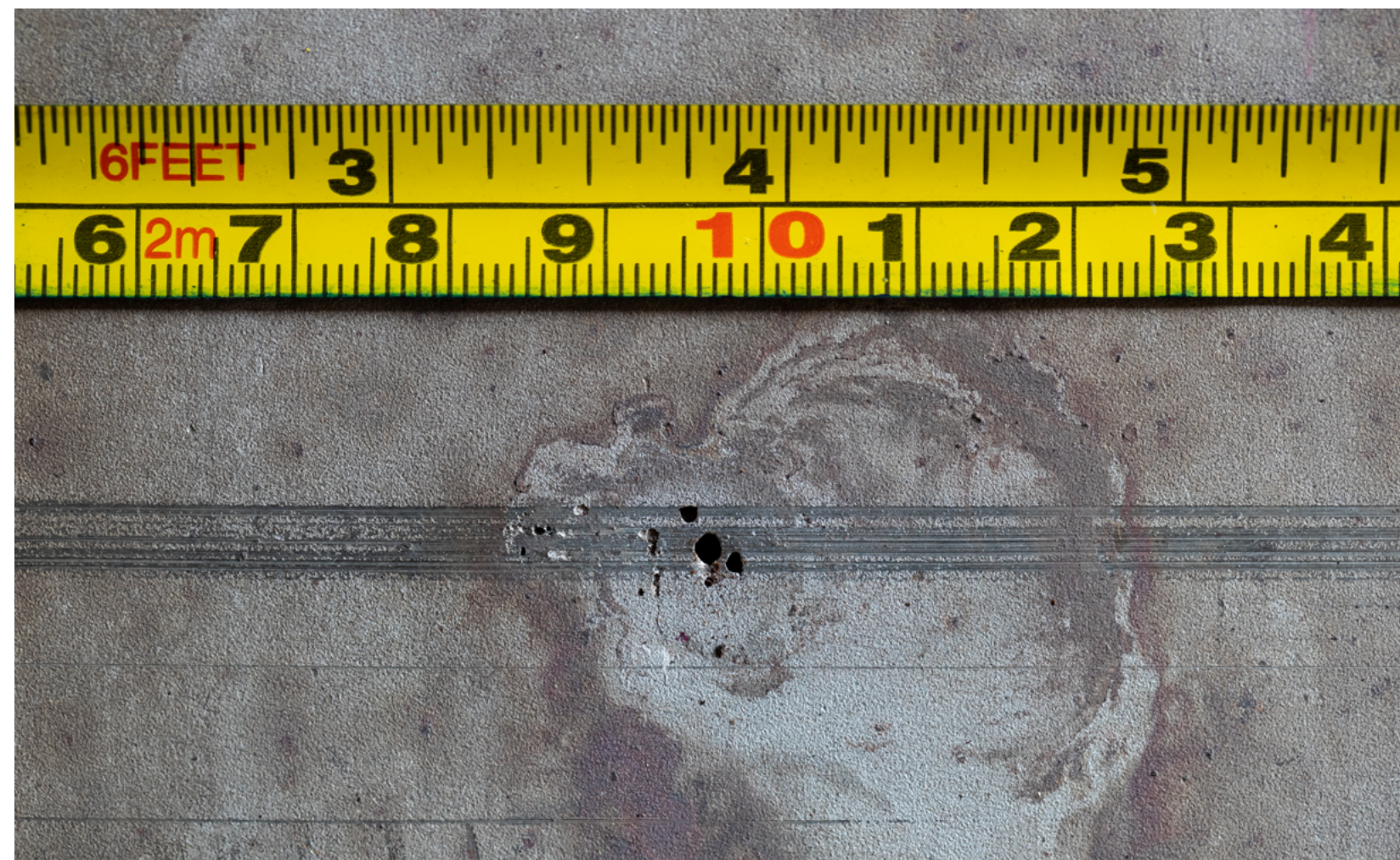
The HUB<sup>PL</sup> is an integrated data platform that leverages your asset databases across a wide variety of engineering analyses. It can develop the bigger picture for you and bring the power of many different applications and modules to bear on solving your asset's challenges. Having this additional information allows you to deploy your repair resources with optimum efficiency, with smaller allowances for contingencies. It gives you the ability to minimize your digging and data management workload, which reduces your risks, and your costs, significantly. Additionally, it integrates other applications to quickly handle the many unexpected exceptions that can occur. AC-Mitigation software: Sometimes, new power lines cause unexpected acceleration of corrosion rates that are detected by ILL runs. In these cases, PRCI AC-Mitigation Toolbox or the AC-Mitigation PowerTool is needed to diagnose and design a proper solution. Both are integrated in the HUB<sup>PL</sup>.

- PLTB's Corrosion and Cathodic Protection Modules combine to enable effective design of cathodic protection solutions for corrosion mitigation.

The combination of the asset Database Import tool, the Navigator Hierarchy, and the Map unlocks the power of asset management, bringing additional value to the technical calculations in RSTRENG® and other applications in the HUB<sup>PL</sup> platform.

- A typical investigative dig costs \$50,000-\$150,000. If you're digging to investigate or repair an area of corrosion, and your software tells you there's an adjacent area of corro-

“Technical Toolboxes supports the base PRCI RSTRENG® program and expands its value further with premium tools...”





“The HUB<sup>PL</sup> is an integrated data platform that leverages your asset databases across a wide variety of engineering analyses.”

sion with little life remaining, it's a quick, efficient, effective decision to make both repairs now with minimal incremental cost, vs. having to dig again next year to repair the adjacent pipe section.

- Saving only one dig with the HUB<sup>PL</sup> solution represents a 10 to 30x return on investment. Additionally, risk is greatly reduced by reducing the amount of fieldwork.

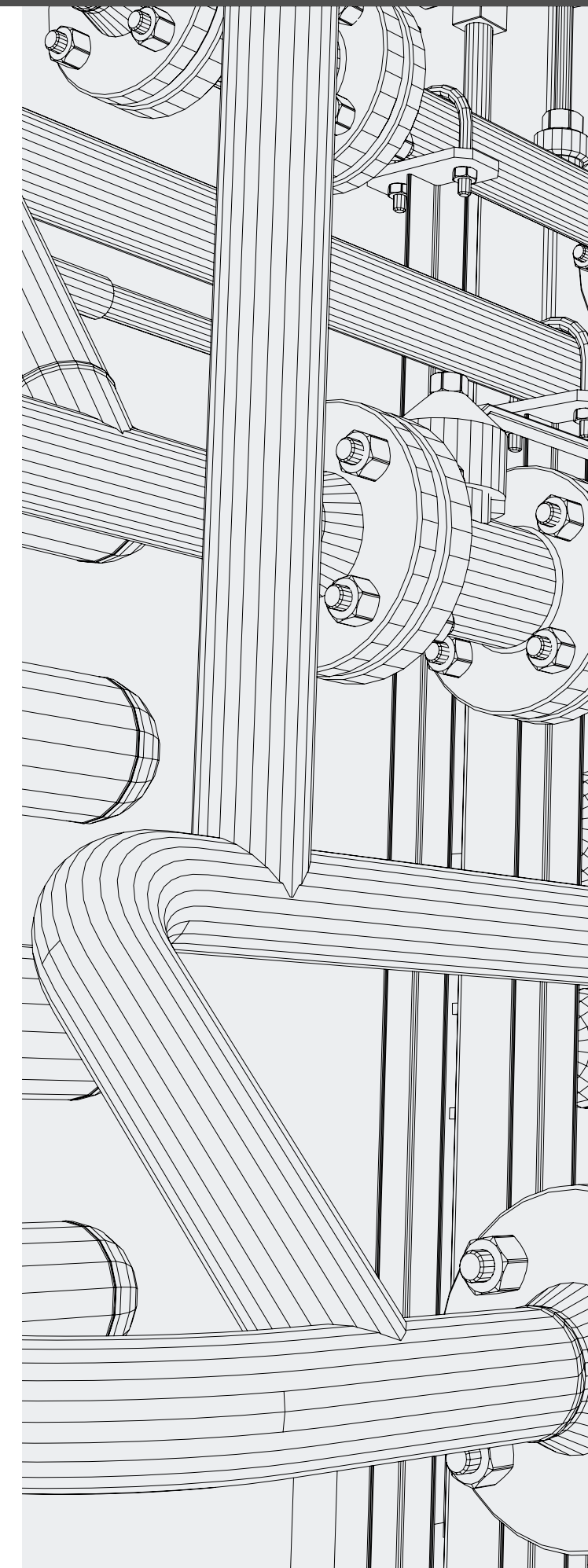
Accelerating project schedules—Time to respond to audits

- When auditors see RSTRENG<sup>®</sup>, they know it is an acceptable method for compliance in the regulations.
- Organized case histories via the HUB<sup>PL</sup> Navigator reduce time searching for and compiling history to prove traceable, verifiable, complete records for prudent operatorship. If you spend more than eight hours per year on responding to requests for information internally, or for audits, this module more than pays for itself via time savings.

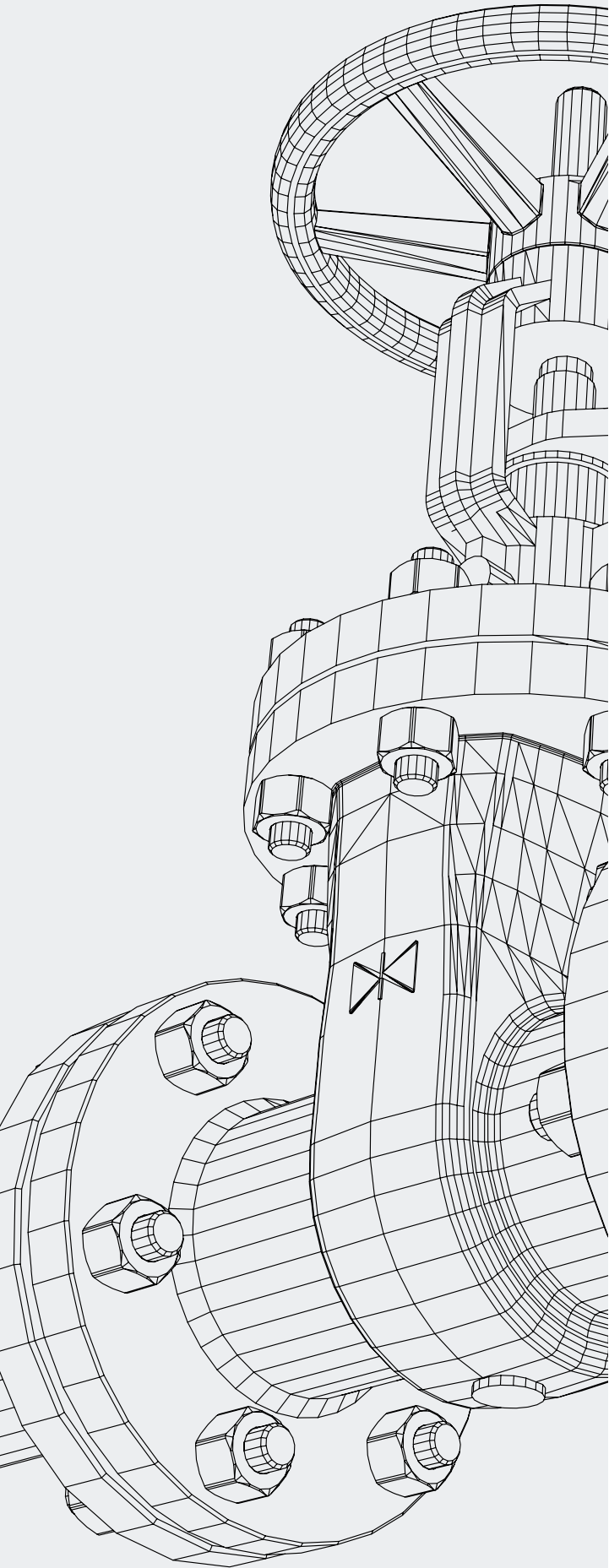
#### Pipeline Toolbox Features and Benefits

Pipeline Toolbox (PLTB) includes over 250 analyses that span design, construction, operations, and integrity of both gas and liquid pipelines. It is an industry-leading dedicated solution, ensuring that all engineers are seeing the same data and are able to make calculations at critical moments throughout all stages of the pipeline life-cycle. A couple of corrosion-related modules include:

- PLTB Corrosion Module offers additional calculations for evaluating MAOP in corroded areas, maximum allowable longitudinal length of corrosion, as well as electrical properties of corroded pipes.
- PLTB Cathodic Protection Module offers calculations for design and placement of cathodic protection anodes, anode beds, and rectifiers.







# The Technical Toolboxes Remaining Strength Solution in Summary

A remaining strength solution from Technical Toolboxes gives users the ability to build workflows and implement standard formulas to achieve high-quality results consistently. At the same time, you will have the peace of mind to know that, should the unexpected occur, you will have the right tools at hand to respond promptly and effectively.

RSTRENG+® is an inclusive product that rapidly pays for itself in operational savings. It delivers massive value by eliminating the risks and costs associated with long-length corrosion.

- Reduce the risks of simplifying assumptions that could lead to catastrophic errors
- Increase asset value directly through pipeline life-extension and indirectly through maintenance savings

## Next Steps

If you are seeking the best remaining strength software solution, contact Technical Toolboxes today. We will answer your questions, arrange a no-obligation software demo, or set up a free trial.

[1] <https://www.prci.org/Research/KeyResults/18832.aspx>  
[2] <https://www.prci.org/Research/KeyResults/18832.aspx>  
[3] <https://www.socalgas.com/documents/news-room/fact-sheets/In-LinePipelineInspection.pdf>







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## About Technical Toolboxes

Technical Toolboxes is a leading provider of integrated desktop and cloud-based pipeline software, online resources, and specialized training for pipeline engineering professionals around the world. The integrated software products developed by Technical Toolboxes provide engineering software productivity tools and we deliver oil and gas industry training courses covering a breadth of topics with industry-recognized instructors.