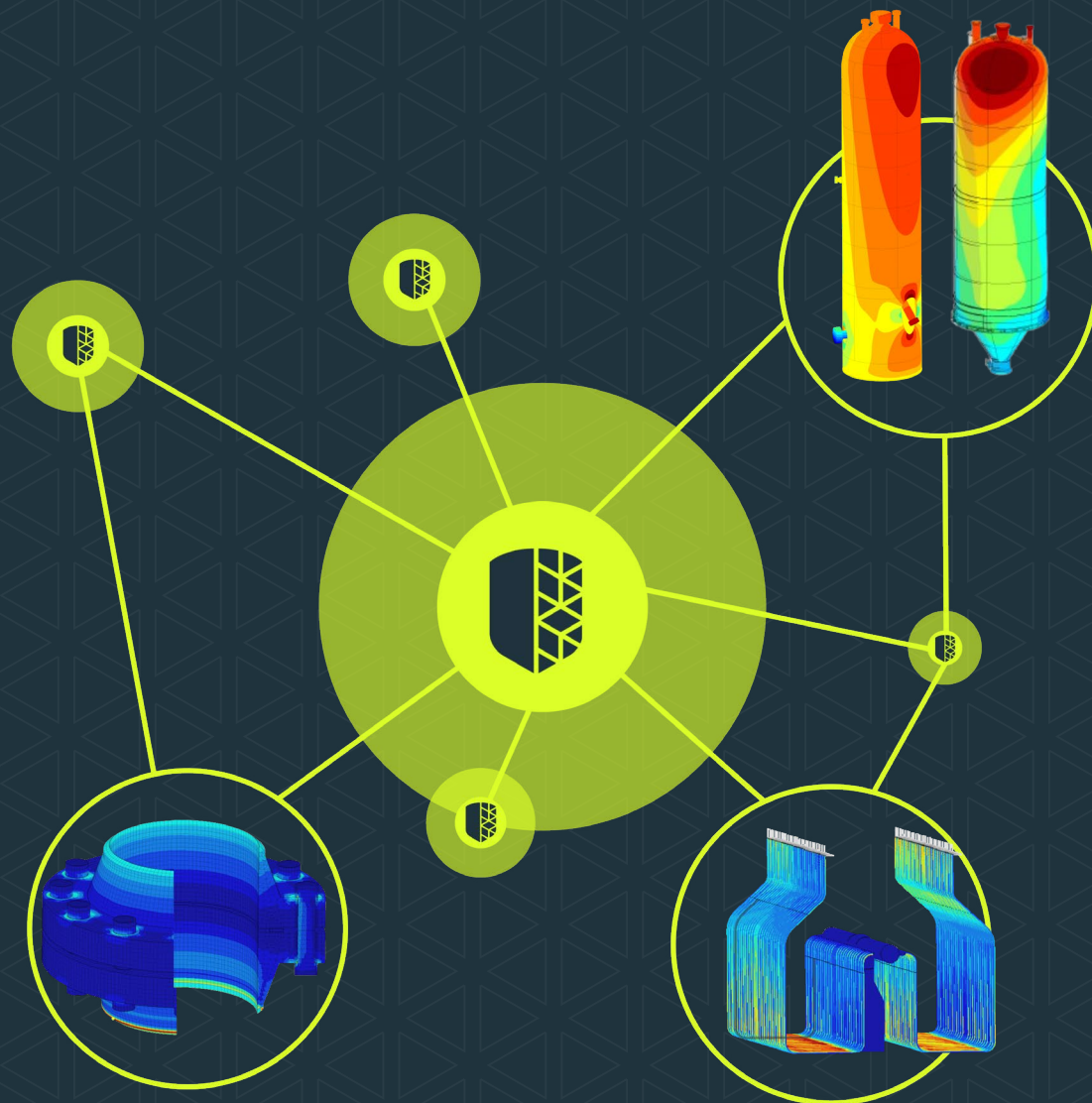




STRUCTURAL PERFORMANCE MANAGEMENT FOR DOWNSTREAM



REVOLUTIONIZING STATIC EQUIPMENT HEALTH & PERFORMANCE

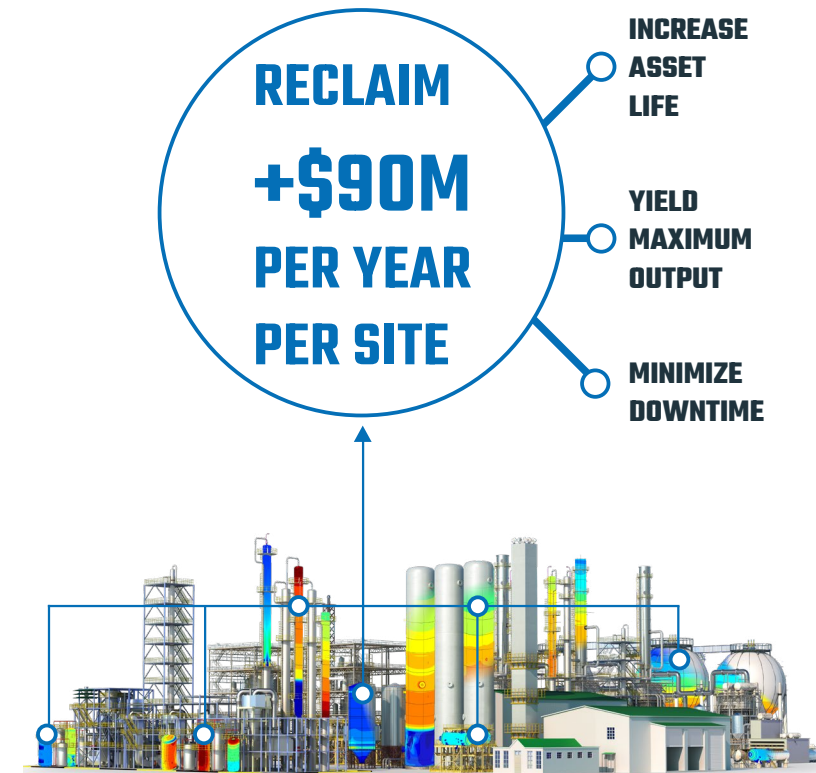
SIMPLIFYING OPERATIONS FOR MAXIMUM CASH FLOW

Your critical assets hold greater potential, often limited by fragmented insights and knowledge silos. **Structural Performance Management (SPM)** combines a high-fidelity structural twin with a patented Reduced-Basis Finite Element Analysis (RB-FEA) solver and physics-based AI to deliver actionable integrity insights, helping operators get more value from their existing steel assets.

SPM is not a point solution — **it is a site-wide performance system.**

The Global Lighthouse Network, led by the **World Economic Forum (WEF)** and **McKinsey**, is the world's benchmark for full-production scale industrial digital transformation.

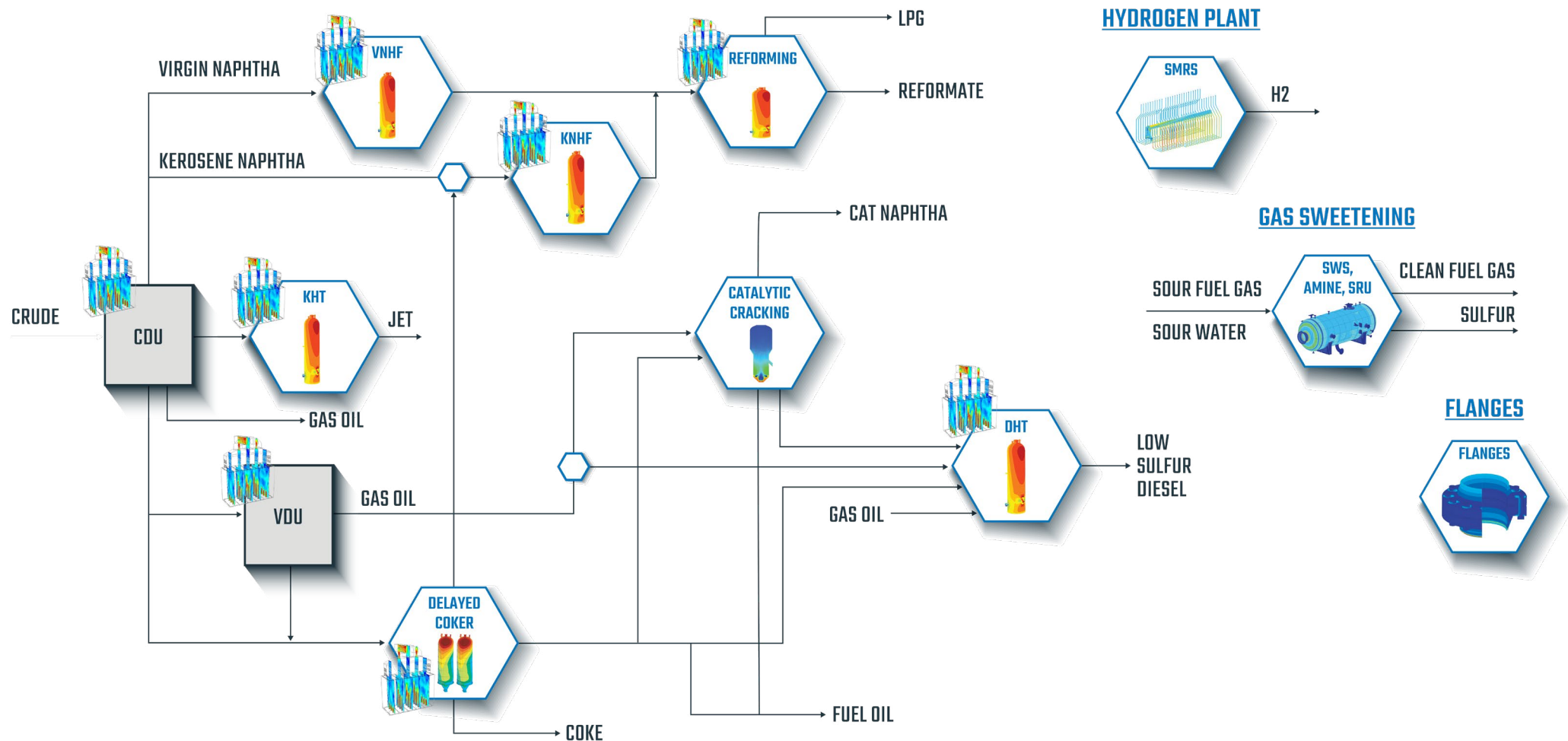
Qatar Shell Pearl GTL is one of these Global Lighthouse sites, achieving impressive results such as extending critical equipment lifetime by 6 years and reducing annualized CAPEX by 64%.



“Pearl GTL won the Lighthouse award from the World Economic Forum,
for a large part, because of what Akselos did there.”

- Tjerk Joustra, Manager Business Development, Shell Ventures -





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AKSELOS STRUCTURAL PERFORMANCE MANAGEMENT SUITE

COKER DRUMS (DELAYED COKER UNITS)

Fatigue Analysis That Moves You Forward: Your coke drums endure hundreds of intense load/unload cycles every year, leading to rapid fatigue. Without SPM's real-time or offline analysis of this constant structural impact, you're flying blind on true lifespan and efficiency.

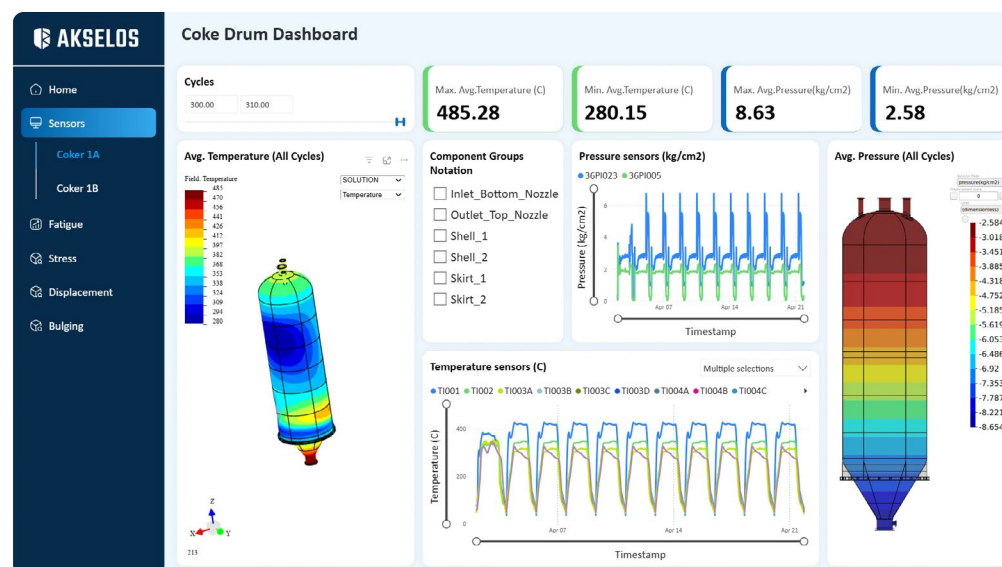


SEE
SUCCESS
STORY

INDUSTRY CHALLENGES

1. Lack of real-time correlation between operating conditions and coke drum mechanical integrity, coupled with limited insight into its current status, hinders proactive risk management and the identification of critical hotspots.
2. Uncertainty around the impact of reduced cycle times or increased throughput limits potential efficiency improvements and clear understanding of remaining safe operational life.
3. Time/risk-based inspections may be inefficient, often missing critical hotspots or failing to confirm fitness-for-service, leading to unplanned downtime.

SOLVED WITH SPM FOR COKERS



○ ↓ **SHORTEN
COKER CYCLE
TIME SAFELY**

○ ↑ **EXTEND
ASSET LIFE
SAFELY**

- **Physics-based fatigue monitoring** toolset to assess damage accumulation.
- Enables **proactive inspection** scheduling and mitigation planning.
- **Correlate operational variables** with bulge/fatigue indicators to enable safe increase of Coker throughput.

TECHNICAL FEATURES

✓ IN-DEPTH ANALYSIS WITH HISTORICAL DATA

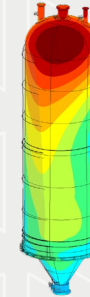
Akselos' Structural Twin pinpoints fatigue hotspots, predicts lifespan with API 579-2021 compliance, and optimizes maintenance using your historical data.

✓ REAL-TIME INSIGHTS FOR PROACTIVE DECISION-MAKING

Akselos' Structural Twin delivers near real-time fatigue assessment, continuously updating with inspection and live operational data. Get instant insights into stresses, deformations, and fatigue damage via our intuitive user interface. Seamlessly integrate our powerful analytics with your existing systems using our APIs.



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MODEL DESCRIPTION

One (01) heavy thick-walled vessel including critical locations such as skirt, nozzle, and all weldment.



AKSELOS STRUCTURAL PERFORMANCE MANAGEMENT SUITE

REACTORS

Accelerate Reactor Cycles Safely: We know reactor heat-up and cool-down cycles are critical and complex, and rely on conservative heat ramp profiles that extend downtime and limit revenue. As companies move toward the energy transition and process green molecules, reactors must cycle more frequently, causing more fatigue than they were designed for. That's why you need physics-based insights to safely accelerate these phases, which are critical for preventing fatigue and brittle fracture risks, unlocking significant operational and financial benefits.

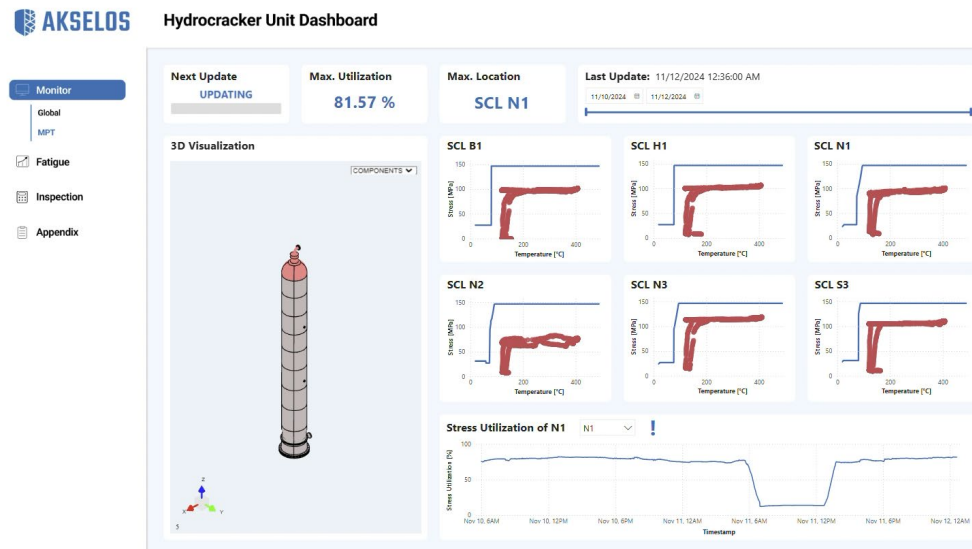


SEE
SUCCESS
STORY

INDUSTRY CHALLENGES

1. Unnecessary prolonged downtime due to conservative heat ramp profiles hinders proactive revenue optimization.
2. Lack of real-time structural insight leaves operators 'flying blind,' risking unseen damage from fatigue and brittle fracture and compromising asset safety.

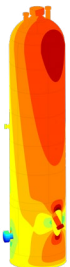
SOLVED WITH SPM FOR REACTORS



↑ ACCELERATE
REACTOR
CYCLE SAFELY

↑ EXTEND
ASSET LIFE
SAFELY

MODEL DESCRIPTION



Heavy walled reactor vessel from head to tail including the skirt, nozzles and hotbox.

- Accelerated heat-up and cool-down cycles maximize operational uptime and throughput while mitigating fatigue and brittle fracture risks.
- Proactive mitigation of structural damage and fatigue risks enhances asset reliability and safety.

TECHNICAL FEATURES

ADVANCED MPT, FATIGUE & WHAT-IF ANALYSIS

Akselos' SPM for Downstream software leverages historical and real-time data to model and visualize MPT for continuous monitoring. It also includes API 579 FFS-compliant fatigue assessments, Level 3 creep rupture life analysis, and what-if scenarios.

OPTIMIZED HEAT-UP & COOL-DOWN PHASES

Akselos delivers real-time monitoring of Minimum Pressurization Temperature (MPT) throughout all start-up and shutdown phases. This continuous insight enables proactive decision-making by providing instant visibility into stresses and fatigue accumulation. Gain the intelligence needed for optimized operational planning and risk management.

REACTORS YOU CAN MODEL WITH SPM FOR REACTORS:

- Hydrocracking reactors
- Hydrotreating reactors (HDS, HDN, HDO)
- Residue hydroprocessing reactors (e.g. ebullated bed reactors)
- High-pressure hydrogenation reactors
- Ammonia synthesis converters
- Aromatics saturation reactors



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AKSELOS STRUCTURAL PERFORMANCE MANAGEMENT SUITE

STEAM METHANE REFORMER (SMR)

SMR performance under threat? Maximize Life, Boost Hydrogen Production: Your Steam Methane Reformer (SMR) is critical for hydrogen production, but its' catalyst tubes and pigtails are constantly challenged by extreme temperatures and stress. This makes predicting component lifespan complex and crucial. Operators often rely on conservative estimates, leading to lost revenue opportunities from potential downtime or premature replacements.

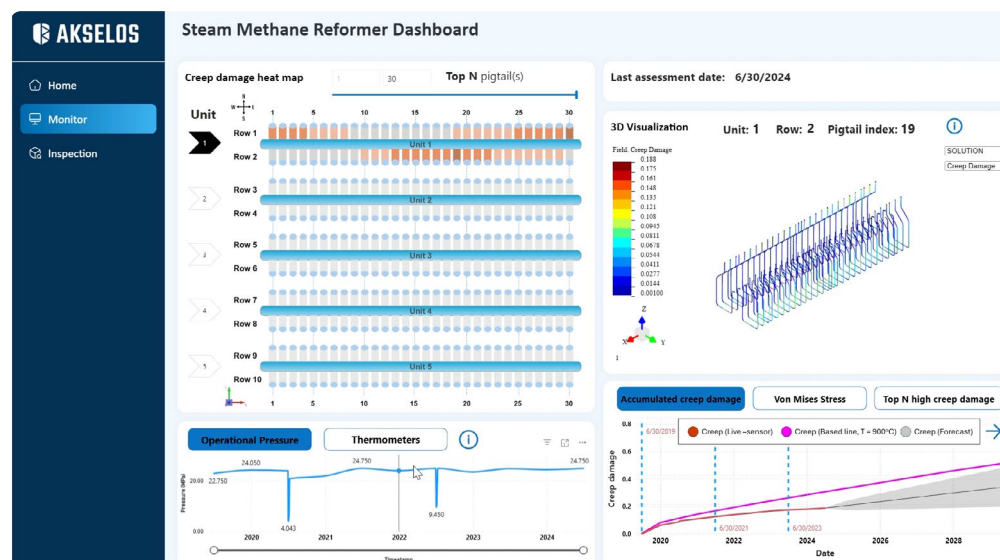


LEARN
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INDUSTRY CHALLENGES

1. Costly emergency repairs and lost production due to unpredicted catalyst tube and pigtail leaks or ruptures.
2. Reduced revenue opportunities from conservative life estimates that limit asset utilization.
3. Difficulty in predicting temperature profiles for catalyst tubes.
4. Limited efficiency improvements due to uncertainty around optimal startup procedures and operating conditions.
5. Inefficient inspections missing critical hotspots, leading to unplanned downtime and safety risks.

SOLVED WITH SPM FOR SMR



○ **↑ EXPAND
OPERATING
ENVELOPE
SAFELY**

○ **↑ EXTEND
ASSET LIFE
SAFELY**

- **Simulate structural effects** of new operating conditions for safer strategies and faster transients.
- **Extend SMR life by one or more turnarounds** by removing conservatism and safely extend pigtail/tube replacement, potentially deferring tens of millions in CAPEX.
- **Safely expand operating envelopes** to unlock incremental throughput
- **Identify structural issues** before they lead to critical failures, enabling targeted inspections and maintenance to minimize planned downtime.

TECHNICAL FEATURES

ADVANCED OFFLINE ANALYSIS: PREDICTIVE CREEP

Akselos' SPM software leverages historical operational data to model, visualize and assess Full Asset Creep, fully compliant with industry standards (API 579-1/ASME FFS-1 2021 Part 10, Level 2).

Through this analysis, enjoy proactive decision-making as you calculate thermal profiles for process inputs, identify creep/ stress patterns, and predict remaining creep life.

REAL-TIME ONLINE MONITORING: LIVE HEALTH & INTEGRITY CLARITY

With Akselos, you gain continuous, real-time feedback on critical indicators like stresses, creep damage and temperature through our Up-To-Date 3D Asset Model.

These operational health insights empowers you to prevent overheating and optimize your Integrity Operating Window (IOW).



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MODEL DESCRIPTION

Our model covers the SMR's critical pigtail section, including harp/pigtail arrays with header and sub-header structures, and catalyst tube arrays.



AKSELOS STRUCTURAL PERFORMANCE MANAGEMENT SUITE

FURNACES/ FIRED HEATERS

Unlock Hidden Capacity Safely: Your furnaces are at the heart of refining and petrochemical processes, but operators rely on conservative limits and inspection snapshots that miss localized damage. Thermal stresses and oxidation accumulate in heating tubes, leading to leaks, ruptures, and costly outages. As energy demand rises and efficiency pressures grow, you need physics-based insights to safely expand the operating envelope, prevent unplanned failures, and unlock years of additional performance and financial value.

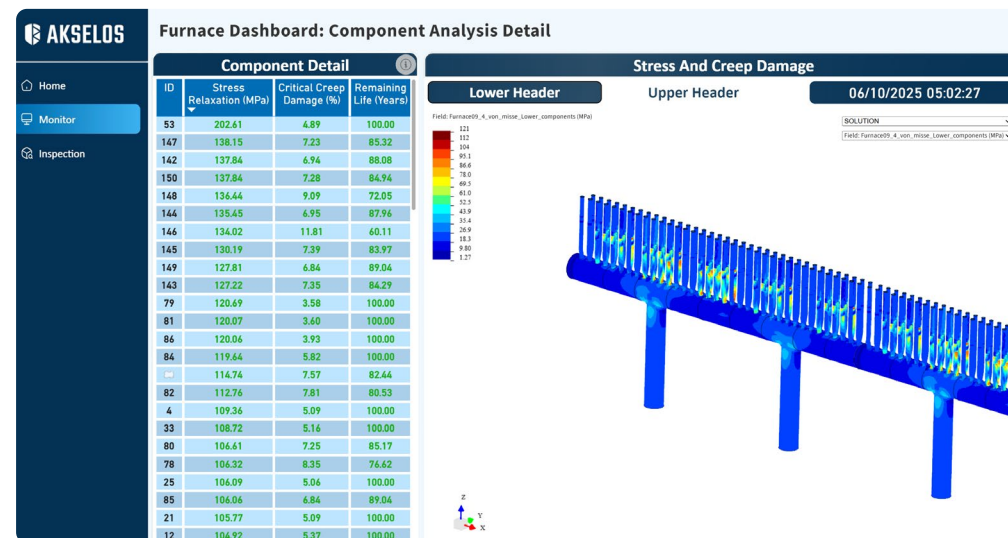


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INDUSTRY CHALLENGES

1. Hidden risks: Thermal stress, oxidation, and creep damage accumulate unseen inside fireboxes and coils.
2. Conservative limits: Reliance on static design assumptions restricts safe operating envelopes, capping throughput.
3. Inspection blind spots: Pigging and manual inspections miss localized hotspots, delaying detection of tube thinning or buckling.
4. Unplanned failures: Tube leaks or ruptures cause costly downtime, safety hazards, and expensive emergency repairs.

SOLVED WITH SPM FOR FURNACES



Akcelos' physics-based Structural Twin provides a **real-time digital replica** of furnace tubes - continuously updated with operational and inspection data.

- Integrates 3D thermal profiles with live operational data for true-to-life tube behavior.
- Identifies creep and thermal stress hotspots before they cause rupture.
- Delivers real-time monitoring of deformation and corrosion risks.
- Enables proactive inspection planning and safe life extension.

○ ↑ REVENUE
PROTECTION

○ ↑ EXTEND
ASSET LIFE
SAFELY

TECHNICAL FEATURES

ADVANCED OFFLINE ANALYSIS: PREDICTIVE CREEP

Akselos' SPM leverages historical operational data to model and assess **furnace and coil behavior**, compliant with API 579-1/ASME FFS-1 2021 Part 10, Level 2.

Operators can evaluate thermal profiles, identify stress and creep patterns, and predict remaining safe life of crude/radiant coils — with historical reviews showing how past operations shaped today's risks.

REAL-TIME ONLINE MONITORING: LIVE HEALTH & INTEGRITY CLARITY

Gain continuous, real-time feedback on tube stresses, creep damage, and temperature distribution through an **up-to-date 3D Asset Model**.

Live insights detect hotspots early, support **FLIR-based burner optimization**, and safeguard the **Integrity Operating Window (IOW)** to maximize output without compromising safety.



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MODEL DESCRIPTION

Our model covers the furnace firebox and crude/radiant coil system, including heating tubes, headers, and sub-headers.



AKSELOS STRUCTURAL PERFORMANCE MANAGEMENT SUITE

FLANGES

Keeping products sealed for operational ease of mind: Your flanges, bolts and gaskets are critical components in maintaining the integrity of a pressurized system, but 5% of hazardous pipeline leak incidents are still caused by flanges. SPM For Flanges alleviates this issue through fast, accurate and actionable insights into flange integrity and maintenance. Now, operators can enjoy less downtime, delays and leaks.

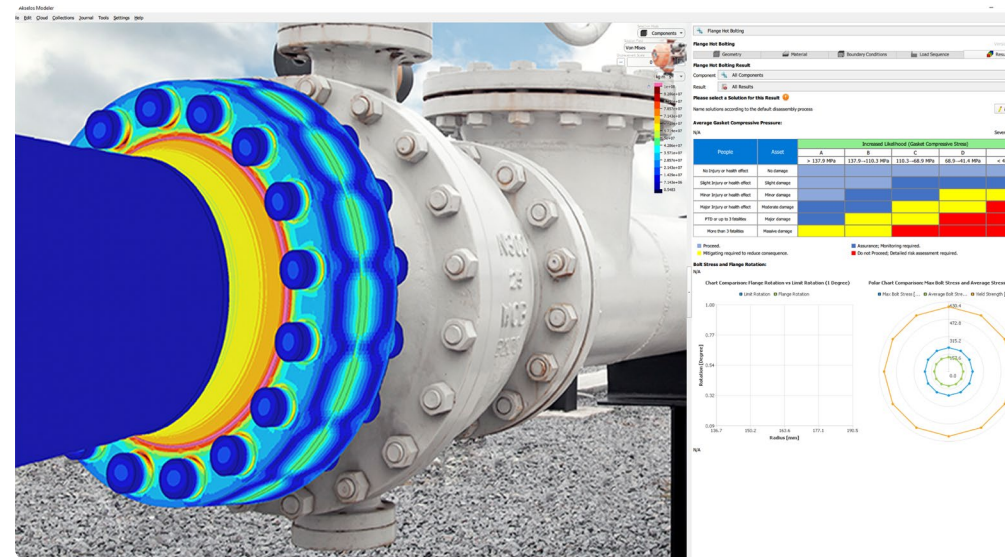


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INDUSTRY CHALLENGES

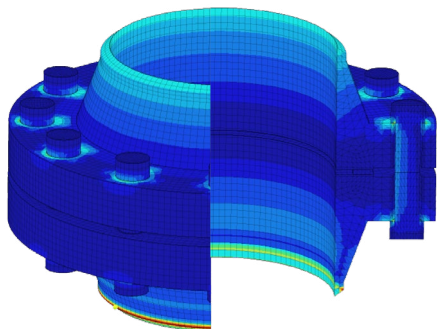
1. Leakage from improper sealing or gasket degradation
2. Bolt damage due to inaccurate torqueing
3. Misalignment from thermal or mechanical stresses
4. Structural failure from poor design or overloaded joints

SOLVED WITH SPM FOR FLANGES



⬤ ↑ ACCELERATE
FLANGE
ANALYSIS

⬤ ↓ REDUCE
HSSE
EXPOSURE



- Accelerate flange maintenance by providing insights on bolt torque, tightening sequence and bolt tension strategies.
- Simulate hot and half bolting procedures to minimize downtime while maintaining safety standards.

TECHNICAL FEATURES

✓ ADVANCED FLANGE & BOLT ANALYSIS FOR HOT/ HALF BOLTING OPERATIONS

Find the right torque range, test different bolt tightening methods and get better load control for your maintenance operations through our fast and accurate modelling software.

✓ PREDICTIVE ANALYSIS & MONITORING: LIVE HEALTH & INTEGRITY CLARITY

Go beyond standard ASME PCC-1 tables to assess bolt stress limites for non-standard pipe sizes.

Estimate the likelihood of leaks by analyzing gasket contact stress and test different scenarios to support smarter maintenance planning.



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MODEL DESCRIPTION

With SPM For Flanges, you can model and analyze flanges, bolts, gaskets, pipes & welds. This comprehensive analysis helps you assess the risk of leaks by giving you full insight into your flange integrity.



AKSELOS' GLOBAL PRESENCE

 LAUSANNE

 HOUSTON

 DUBAI

 AMSTERDAM

 HO CHI MINH CITY

 BOSTON

 PORTO

 LONDON



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