



# Open AI Energy Initiative: Reliability Solutions

## Open Ecosystem of AI-Based Offerings to Improve Operational Efficiency for the Energy Industry

Shell, Baker Hughes, C3 AI, and Microsoft collaborated to launch the Open AI Energy Initiative (OAI), an open ecosystem of AI-based offerings for the energy industry. OAI initially makes available a set of reliability solutions including BHC3™ Reliability powered by Microsoft Azure and domain-specific solutions from Shell and Baker Hughes to accelerate the delivery of availability and operating cost improvements across the energy value chain. The OAI provides an open ecosystem for operators, independent software vendors and equipment providers to offer additional interoperable solutions to third parties.

OAI Reliability Solutions make available Shell’s proven and tested asset-specific AI failure detection models and scalable data connectors. The AI failure detection models have been deployed across critical equipment in full stream oil and gas processes, including rotating equipment, control valves, and subsea electrical submersible pumps. The scalable data connectors enable a robust, resilient, and low-latency integration of historical and streaming data from multiple measurement systems.

OAI Reliability Solutions include Baker Hughes’ state-of-the-art System 1 Condition Monitoring, iCenter - Turbomachinery Advanced Digital Services, and ValvAware for Valve Lifecycle Management solutions. The global health monitoring systems have been deployed to a wide range of processes and assets including offshore platforms, downstream refineries, LNG trains, turbomachinery, and ESPs. The integration of physics-based insights and codified domain knowledge into AI models provide broader applicability and increased scalability to operators through the OAI.

The foundations for OAI Reliability Solutions are the BHC3 AI Suite and BHC3 Reliability. The BHC3 AI Suite integrates enterprise-scale data from disparate data sources such as individual sensors, operational systems, third-party applications, and enterprise data historians while supporting near real-time connectivity to source systems. BHC3 Reliability is an application that provides reliability, process, and maintenance engineers AI-enabled insights to address process and equipment performance risks. BHC3 Reliability identifies anomalies across systems, provides prioritized alerts to operators, recommends prescriptive actions, and enables collaboration across the enterprise using supervised/unsupervised approaches, domain-specific failure mode libraries, predefined asset templates, and automated diagram parsing.

### Feature Summary

- **Shell Sensor Intelligence Platform** – Platform to extract and integrate historical and real-time streaming data from process historians and IoT devices with minimum latency at scale
- **Shell Predictive Maintenance Control Valves** – Rapidly deploy machine learning models to monitor the performance of thousands of control valves, irrespective of vendor or age, to identify performance issues and upcoming failures up to months in advance
- **Shell Predictive Maintenance Subsea Electrical Submersible Pumps (ESP)** – Monitor, identify and mitigate risks through AI-prioritized alerts for subsea electrical submersible pumps
- **Shell Predictive Maintenance Rotating Equipment** – Tailor-made, proven application leveraging AI to detect and identify signs of upcoming failure in centrifugal pumps, centrifugal compressors, dry gas seals and turbines

### Baker Hughes’ Reliability Solutions

- **System 1 Condition Monitoring** – Plant-wide turbomachine health monitoring and asset protection system that connects processes and assets into a holistic view and visualize performance insights
- **iCenter - Turbomachinery Advanced Digital Services** – Three global iCenters provide 24/7 monitoring, and engineering services support using advanced diagnostics and analytics, for over 1,500 assets globally
- **ValvAware for Valve Lifecycle Management** – OEM-agnostic control valve fleet maintenance prioritization application and comprehensive performance monitoring service for all valves

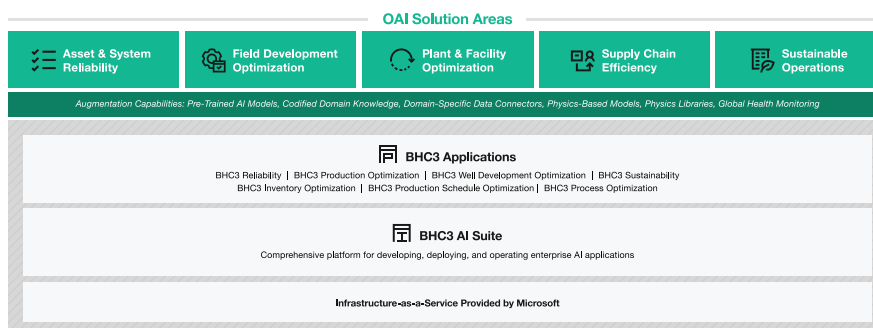


Figure 1: OAI Reliability Solutions bring together domain expertise and Enterprise AI.

# Anticipate Equipment and Process Risks, Investigate Issues, Prioritize Actions, and Enable Closed-Loop Feedback

With OAI Reliability Solutions, operators can:

- **Interoperate reliability capabilities across AI/ML, data model, and user workflows** from multiple operators, independent software vendors, and equipment providers using an open framework.
- **Supercharge failure detection performance and actionability** of the reliability solutions by leveraging codified subject matter expert knowledge from leading operators and services companies such as Shell and Baker Hughes. Operators can integrate domain-specific libraries, physics-based insights, tailored workflows, and a monitoring database of more than 1,500 assets.
- **Scale swiftly across the enterprise** to large fleets and multiple types of equipment using asset-specific AI models relevant to fullstream oil and gas, pre-defined asset templates, prevalent systems data connectors, and diagram parsing capabilities.
- **Respond to risks and anomalies** in process flow and equipment performance, along with failure process upset scenarios.
- **Investigate and take action** using AI-recommended failure mode assessments for each identified risk. Conduct RCAs and failure mode effects analysis with all relevant data.
- **Assess system and subsystem health trends** over varying time intervals across configurable risk indicators.
- **Aggregate process data to view all relevant data** for interdependent process equipment. Understand how tags from independent systems correlate to distinct process steps.
- **Track, benchmark, and rank performance** of regions, facilities, systems, and equipment based on configurable health and reliability metrics.
- **Optimize operations and capital** expenditures by proactively planning reliability improvement projects and minimizing unplanned downtime.
- **Enable end-to-end ModelOps** and automate model tracking, review inference statistics, identify model drift, and monitor feature relevance over time.

## OAI Reliability Solutions Enhance the Energy Value Chain

- Improve production due to early identification, prioritization, and resolution of equipment and process risks.
- Reduce unplanned downtime by proactively addressing process and equipment reliability issues. Arm operators with prescriptive actions to change operating conditions and reduce upset risks.
- Extend equipment life by improving operating conditions and turnaround decisions with data-driven history and risk predictions.
- Improve safety with reduced high-risk emergency repairs.
- Increase sustainability with reduced waste and improved operational efficiency.

## BHC3 Reliability Features

- **System-of-systems AI approach** - Leverage AI to identify equipment and process issues that impact system-level health and operational performance. Understand how individual tags across independent systems are related to overall system health.
- **Unsupervised anomaly detection** - Leverage cutting-edge deep learning and machine learning technology to identify anomalies in process flow and equipment performance.
- **Root cause identification** - Prescribe failure mode recommendations to guide reliability engineers to enable faster, more consistent, and traceable root-cause investigations.
- **Continuous learning** - Continuously learn and improve AI models based on new data and user feedback. Increase the accuracy of failure mode recommendations and anomaly detection alerts over time.
- **Asset templates** - Leverage pre-defined templates to rapidly construct a digital representation of a facility's asset hierarchy and calculate KPIs and KOPs.
- **Diagram parsing** - Generate machine-readable asset hierarchies and sensor-to-tag mappings. Users can ingest and parse process diagrams using machine vision, NLP, and graph search to detect tags, tag names, and connections to equipment.
- **Prioritized alerting** - Focus operations on prioritized alerts and reduce the number of unnecessary alerts through AI-enabled detection and categorization of process risks.
- **Visualization across process equipment** - View and traverse unified process data at the aggregate system or facility level or drill down to understand individual equipment performance.
- **Seamless integration with existing tools** - Create work orders and launch investigation cases directly from the application. Integrate with existing systems to enable a seamless digital reliability program.

Initial Results in 8-12 Weeks

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