Honeywell
CCC

Building on 2 Billion Hours of Operational Experience

EXPERTISE IN TURBOMACHINERY CONTROLS™

Pioneering the industry

Over the past 40 years, CCC has been at the forefront of technical and service innovations to improve efficiency and reliability of process operations. Today, thousands of customers across the globe trust CCC's turbomachinery control solutions to drive their critical processes.

Mission

CCC partners with customers to deliver reliable solutions for critical turbomachinery control applications that result in tangible economic benefits.

Vision

It is CCC's vision to drive exciting growth as the customer's trusted advisor throughout the entire lifecycle. Service excellence, world-class execution, a growing global presence, outstanding products and expertise are the pillars of this vision.

LEADERSHIP

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Harald Stappers	EURA General Manager
Islam Fahmi	Middle East and APAC General Manager
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Emily Hoop	Director of Global Business Process
Ryan Eicher	Vice President - Finance
Cynthia Coelho	Human Resources Manager

Expertise to take on your toughest challenges

Turbomachinery trains are the heart of your process. How you operate them directly impacts the overall reliability and efficiency of your plant. From identifying opportunities to getting the system in operation, our team of experienced engineers will be with you every step of the way. CCC solves specific challenges in a wide variety of industries including the following prominent applications.

Optimize operations to meet production needs

Operational efficiency and reliability is crucial in the process of separating natural gas liquids (NGL) from "raw" natural gas fields. Optimizing feed-gas compressors, cryogenic expander-booster compressors, absorption refrigeration compression systems, and residual gas compressors is critical to maximize the production of NGLs, reducing plant downtime, and maximizing methane throughput.

Simplified solutions for complex processes

The capacity of gas processing plants has increased in the past several decades requiring many plants to operate two or more turboexpander trains in parallel. Conventional control methods for turboexpander re-compressors are based on simplistic assumptions and use over simplified control solutions. In general, the conventional control schemes are based on a split range control between the expander guide vanes and the Joule-Thompson (J-T) valve with an addition of a low signal selector to allow for independent closing of the expander guide vanes.

A simplistic control scheme poses the following challenges:

- Operation of the expander is not seamless when the speed needs to be limited
- The operation is not smooth when the turbo-expander-re-compressor unit shuts down
- Load-sharing between units
- Start-up and shutdown of parallel units
- Coordinated control with one or more JT valves

Adjusting the right variables

For most compressors, increasing the flow rate leads to increasing the power needed to drive the compressor. Since opening the recycle valve increases the flow rate through the compressor, the recycle valve can be used to vary the rotational speed of the turboexpander train. Therefore, the speed of the train can be limited by first opening the compressor's recycle valve. This will result in an increase in torque delivered by the compressor while the torque of the expander remains the same and in turn will slow down the turboexpander train. By using the re-compressor recycle valve first, the expander guide vanes can remain in a more open position.

Producing what you need

The increased condensate is due to the expansion of gas in the expander in an isentropic work producing process whereas the expansion across the J-T valve is an isenthalpic process. This means that both temperature and pressure will be lower after expansion through the expander than it would be if expanded across a J-T valve. Lower temperature and pressure allows for increased production of condensates.

Avoiding surge maintains availability

Natural gas is a major source of energy; however, users are located far from gas fields making transportation through pipelines impossible. By super-cooling natural gas to -160 degrees C (-260 degrees F), the gas consisting primarily of methane becomes a clear and odorless liquid occupying 1/600th of its volume in its gaseous state. The liquefied gas can then be efficiently stored & shipped to the various users around the world.

Complex LNG facilities are at risk for process instabilities

The cooling process associated with large-scale LNG production facilities involves some of the most highly sophisticated heat exchanger and refrigeration compressor applications found anywhere in the world. The safe, reliable, and efficient operation of the multiple, multi-section compressor trains found in these facilities is critical to the profitability of the operation. Specific process challenges include:

- Unnecessary machine trips can be caused by surge and excessive recycle
- Split shaft compressor designs are susceptible to cascading trips due to interdependency between refrigeration loops and rotating equipment
- Parallel compressors can create instability in the process if not properly set up for load sharing
- Control loop interaction can drive adjacent compressor sections towards surge
- Adjustment of gas composition on mixed refrigerant compressor trains can reduce the effectiveness of the surge control system

Process expertise gets it right

Cascading Trips – Multi-section trains in split shaft arrangements must work in highly interactive configurations to ensure prevention of compressor surge and cascading trips. To avoid tripping without over aggressive tuning, CCC developed a modification to the control system to prevent surging as well as driver overload of a running compressor when the other has tripped. This is achieved by allowing the antisurge valves of the running string to temporarily open to a predefined position while the other string has tripped or is shutdown.

Load Sharing – High speed inter controller communications allow for decoupling of controller interactions. Parallel refrigeration machines can be successfully operated by controlling suction header pressure of the individual refrigeration circuits and using load-sharing control to balance the parallel compressor strings. By using proper load-sharing control, the individual compressor strings are easily and safely sequenced online and offline automatically.

Shutdown avoided

Avoiding surge of individual compressor stages is the end goal. Shutdown of the compressor string due to speed reduction caused by driver power limitations can be prevented with proper process expertise to implement the necessary control strategies.

Maximizing returns while protecting assets

One day of lost production can cost a typical refinery anywhere between $1.2M to $2M or more. To achieve the highest efficiency possible and avoid losses, it is more important than ever to ensure your process has an integrated turbomachinery control solution.

Do not let disturbances disrupt your process

The overall success of a refinery is often determined by a system's availability and reliability. A shutdown could be caused by a wet gas compressor or main air blower trip. The wet gas compressor can be one of the most challenging machine control applications in a refinery. This is due to the significant fluctuations of the inlet gas composition in addition to the need for precise pressure control.

Environmental regulations add to the challenges with stringent requirements on flaring. Furthermore, a machine trip of additional equipment, such as the hydrogen recycle compressor for the catalytic reformer, could also lead to production losses.

Stabilize your operation quickly

Minimize Process Trips – CCC advanced control solutions are designed specifically for unit optimization. Process stability can be significantly improved by integrating critical control elements.

Increase Production – Precise pressure control in the fractionator overhead receiver keeps the wet gas compressor between vacuum and flare setpoints. Reducing overhead receiver pressure will lower regenerator pressure and provide increased mass flow, thereby increasing catalyst regeneration. This additional regeneration allows for increased production.

Flareless Start-ups – CCC antisurge and performance algorithms provide a higher level of start-up automation to eliminate wet gas flaring

Start up faster and stay online longer

Automated start-up can bring your unit online up to 12 hours faster while eliminating wet gas flaring altogether. Minimized trips keep your process running safely for longer with fewer process disruptions.

Reduce waste through process optimization

As global plastic demands continue to increase, so do the pressures on ethylene production. With ever-increasing production targets and a highly competitive market, our customers are telling us that improving reliability, maximizing process yield and throughput are becoming more and more challenging.

Process changes can be costly

How your system responds during process disturbances could be costing you millions. Ethylene process challenges include:

- Increased process resistance reduces compressor speed ultimately impacting throughput
- Furnace trips creating a sudden loss of suction pressure to the cracked gas compressor (CGC) can lead to process trips or unplanned shutdowns
- Propylene refrigeration train and the interactions between front-end process changes are difficult to optimize and result in wasted energy

Balancing your needs

Increase Throughput – CCC's control system helps you maintain higher compressor speed when you would otherwise be pressure limited. Advanced algorithms limit overshoot and provide tight control allowing the system to operate at higher pressure limits and at a higher compressor speed. Throughput is maximized by optimizing the pressure set points.

Decrease Energy Costs – Optimizing the propylene compressor train's energy usage is nearly impossible without advanced and integrated controls on the compressor and its driver. CCC's full integration of suction pressure control and antisurge control systems can allow for a significantly expanded operating envelope for each compressor section without recycle.

Achieve Design Yields – How your system responds during process disturbances may be the difference between keeping your process from running or causing a trip. When a single furnace trips, the suction pressure drops. CCC takes only a couple minutes to stabilize pressure under the largest of typical disturbances while a general-purpose control may take up to 15 minutes to stabilize pressure in a similar situation. Robust control algorithms minimize control margins and allow for control at lower CGC suction pressure. Reducing this suction pressure by 14kPa results in an estimated 0.5 percent increase in yield.

Exceeding your goals

Process optimization for a 600,000 MT/A ethylene plant can achieve the following gains:

- 1% increased throughput = $8,400,000/ Year
- 1.5% increased yield = $12,600,000/ Year
- Avoiding Process Trips = $2,000,000/ Day
- Shaft power savings of up to 9%

Achieve consistency and simplicity with automated control

CCC has been serving the Copper Mining and Steel Industries since the very beginning of our forty-year history. Today, nearly all of the major copper and steel producers choose to work with us to bring consistency and simplicity to their operations.

Process air compressors are the beating heart

Copper Mining – The most critical turbomachinery application in this industry is the process air compressor. These compressors work in the heart of the copper smelting process – the "converter furnaces". Various factors significantly complicate the control of these compressors:

- Substantial changes occur in the "quality" of the copper feedstock
- Many installations consist of multiple converters with shared air supply
- Most installations have multiple air blowers often with shared air flow between converters

Steel – The iron-ore blast furnace takes the critical first step in the steel making process in an integrated steel mill. These blast furnaces need a constant and reliable supply of compressed air to ensure an optimized level of oxygen for the burning process as well as enough "lift" to maintain proper circulation of the load (aka "burden") of "hot metal". The loss of air flow to a blast furnace will significantly reduce furnace efficiency and risk 'burden slumps' and the resulting furnaces trips/outages.

Simplify and stabilize

Copper Mining – CCC's advanced surge protection and specialized compressor load-sharing algorithms and solutions have proven to be extremely effective in improving the reliability and efficiency of the process.

Steel – CCC process control, turbine speed control, antisurge control, and integrated machine monitoring technology are well suited to the critical blast furnace turbo-blower application. We also have extensive experience in the control of coke oven gas exhausters and instrument air system machines. Our blast furnace experience includes many single blower, split-wind blowing, and parallel blower installations.

Energy efficiency achieved

Simplified start-up & shutdown and stabilized converter pressure & throughput are the hallmarks of our technology. Energy efficiency improvements can be dramatic – providing an even greater investment upside for our clients.

Global services within your reach

At CCC we provide global engineering services to solve your toughest turbomachinery control challenges. Our engineers have access to an extensive library of field-proven control applications and utilize robust hardware platforms to implement the solution.

Field-proven control applications for your entire turbomachinery train

CCC has an extensive library of turbomachinery control applications that can operate virtually any combination of driver, driven equipment, and process found in your plant.

Safely achieve the highest potential

CCC's field-proven control applications enable you to operate closer to machine limits without compromising the safety of operations. This is achieved through accurate modeling of the compressor performance envelope using an invariant coordinate system and the use of adaptive open-loop and close-loop responses. A wider operating envelope gives flexibility to your process engineers to optimize key process variables - resulting in increased throughput and yield.

Always maintain process variables

One of the key challenges in turbomachinery train control is to address complex loop interactions. When an unexpected disturbance is introduced into your process, a poorly designed control system will fail to contain it - risking machine and process shutdown. CCC's Total Train Control® solutions solve this challenge by integrating speed, antisurge, and performance capacity controls through advanced algorithms. Precise and stable control of critical process variables is achieved even during process upsets. This allows you to safely operate closer to process limits which provides further opportunities to optimize production.

The power of standardization

CCC control applications are configurable, not programmable. The controls can be configured for a specific application from a library of field-proven turbomachinery control algorithms. Each control application has been continuously improved and expanded over the course of 40 years. This powerful turbomachinery control library allows our customers to access best practices from over 10,000 turbomachinery trains CCC has commissioned worldwide. These control applications can easily adapt to your needs through both offline and online configuration without the need for reprogramming the controller.

A wide range of platforms to solve a broader set of challenges

From coordinated turbomachinery control to machinery protection and monitoring, CCC's comprehensive portfolio of control platforms enables us to solve a broader set of challenges for our customers.

Designed to maximize availability

CCC products are purpose-built because turbomachinery trains are the most critical equipment in your process. From power supplies through I/O processing to system communications, modular redundant architecture of CCC hardware ensures the turbomachinery and process keep running.

Developed, tested, and supported as a system

In the turbomachinery control field, where interactions between control loops occur in a matter of milliseconds, the requirement to design and test the solution as a system is paramount. CCC's philosophy to own the lifecycle of the entire control system - including hardware, software, and control applications - enables us to develop robust control solutions with global support like no other.

Uncompromising performance

One of the most important keywords to look for when selecting your next turbomachinery control platform is deterministic loop execution. Turbomachinery control is a time-critical application where each loop must be executed precisely at a specified interval to produce fast and smooth control responses. CCC's purpose-built hardware platforms, paired with field-proven control applications, allow us to maximize operating envelopes by reducing control margins while maintaining a steady process.

A world of control capabilities — all inside the DCS

CCC Inside is a DCS-based turbomachinery control solution for industrial operators who are ready to optimize their critical machinery using industry-leading standardized controls, a flattened architecture and scalable global support.

Standardized for predictable control

CCC Inside utilizes the same turbomachinery control applications included in our Pro Built solutions. This increases operator confidence in controls functioning as they're expected, simplifies the training process and makes troubleshooting issues far less complex.

Flatter architecture with the same trusted CCC technologies

For facilities that wish to implement broader usability and a more streamlined architecture, CCC Inside delivers world-class turbomachinery controls while integrating with the on-site distributed control system (DCS).

A solution backed by decades of expertise and global support

CCC's experience in advanced turbomachinery optimization reaches back 40+ years and extends to over 14,000 installations worldwide. CCC Inside comes with the same global engineering support and field service that's made CCC an industry leader.

LEVEL 3 PROCESS CONTROL NETWORK

LEVEL 2 SUPERVISORY CONTROL

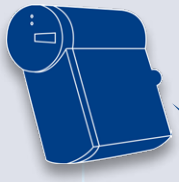
LEVEL 1 BASIC PROCESS CONTROL

LEVEL 0 FIELD DEVICES

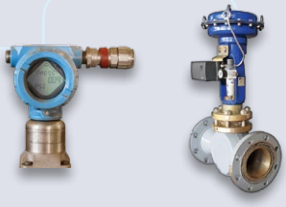
Advanced Process Control, Asset Manager, Remote Operations.

DCS Operator Stations

DCS Engineering Station



DCS Controller with required performance



HMI Libraries and Graphic Displays

Designed to provide an effective and proven interface with the control application and ultimately with the turbomachinery.

Engineering Utilities

Designed to facilitate configuration, tuning, surge testing performed through engineering and commissioning, overcoming some of the trending resolution limitations and standardizing field procedures. Common to CCC Pro Built and CCC Inside to enable scalability and standardization of field service procedures.

Control Applications

Optimized to execute in a DCS environment, CCC advanced turbomachinery control responses for compressors, steam turbines, expanders and process valves. Consistent across multiple DCS platforms and with CCC Pro Built.

Mechanical retrofit services to maximize efficiency and repeatability

Partnering with CCC to upgrade your steam turbine governor controls helps you save time and maximize efficiency by giving you the control you need to create a safe and repeatable startup.

Repeatable start-up process with automatic control sequencing

It is critical for both the longevity and safety of your turbomachinery trains that steam turbines are started in accordance with the OEM's turbine manual. In plants where legacy hydro-mechanical governor controls are prevalent, these procedures are left in the hands of experienced operators.

As a new generation of workers begins to replace these experienced veterans, the need to further digitize and automate legacy control systems has never been more expected.

CCC's turbomachinery control applications, with field-proven algorithms, enable operators to startup and shutdown your machines with a click of the button. Not only does this reduce the operator load during a plant startup by more than 75 percent, but it also contributes to improved safety and reliability through critical speed avoidance and proper warming of the steam turbine.

Tighter speed control & maximizing the operating envelope

Turbine speed is one of the key control elements that directly impacts the overall efficiency of your turbomachinery train. The inability to maintain a speed setpoint required by the process (performance) control results in wasted energy and a reduced compressor operating envelope.

Fluctuating speed can be attributed to obsolete hydro-mechanical governors that rely on antiquated technologies such as fly weight governors or varying control oil pressure governors. Due to the physical nature of these antiquated control systems, they have a very limited ability for end-users to tune the governor control responses.

Retrofitting the steam turbine from hyrdo-mechanical governors to digital governors will improve the precision of turbine speed control by up to 95 percent. Through the implementation of advanced speed control algorithms and an integration of compressor controls, turbine speed can easily be maintained within a few rpm range providing you with a wider operating envelope.

The right partnership with advanced technology providers

CCC works with a wide variety of technology providers to create retrofit solutions that meet your business requirements. These solutions are carefully designed after evaluating a variety of technologies for for steam turbine governor valve actuation and turbine speed measurement. Combined with CCC control applications, we can improve your performance regardless of which original equipment manufacturer you have. CCC engineers have over 70 years of combined experience designing mechanical retrofit solutions. These solutions are delivered as a total kit ready for installation when you need it.

Expertise you can trust from concept to reality

From FEED, through construction and commissioning, to maintenance and system upgrade, CCC works with you to keep your turbomachinery and process operating reliably and efficiently.

DNV

MANAGEMENT SYSTEM CERTIFICATE

Certificate no.: CERT-08808-2006-AQ-HOU-ANAB
Initial certification date: 01 August, 1994
Valid: 16 June, 2024 – 15 June, 2027

This is to certify that the management system of
Compressor Controls Corporation
4745 121st Street, Des Moines, IA, 50323-2316, USA
and the sites as mentioned in the appendix accompanying this certificate

has been found to conform to the Quality Management System standard:
ISO 9001:2015

This certificate is valid for the following scope:
Commercial sales of industrial process control solutions and engineering services including control system hardware, software and product spares. Design of industrial control systems. Management of supply chain and manufacturing operations. Provision of service and support activities which include technical support, training, customer applications, field support and product repair coordination.

Place and date:
Katy, TX, 02 May, 2024

For the issuing office:
DNV - Business Assurance
1400 Ravello Drive, Katy, TX, 77449-5164, USA

Sherif Makkawy
Management Representative

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.
ACCREDITED UNIT: DNV Business Assurance USA Inc., 1400 Ravello Drive, Katy, TX, 77449, USA - TEL: +1 281-396-1000. www.dnv.com

Quality policy

It is the policy of CCC to provide reliable products that fulfill our customers' ongoing needs and expectations; and to foster a work place environment that will facilitate the achievement of this objective.

Training for everyone

CCC Learning Center offers courses at every experience level for a variety of job functions. Whether courses are taken online, or through regional/on-site training classes, keeping your process safe starts with people.

Global presence

Headquartered in Des Moines, Iowa – USA and with offices located across the globe, we have strategically positioned our specialists close to our client base to provide an unparalleled level of expertise, consultation, and support. CCC also has a global network of partners to provide quality sales support.

Located in every region, CCC engineers can assist with a wide range of services including:

- Project management
- Software specifications
- Design review
- System design & documentation
- Commissioning and performance testing
- Platform migration
- Steam turbine mechanical retrofit

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The Trusted Name for Turbomachinery Optimization.

2 Billion Operating Hours

10,000+ Machines

40+ OEMs

150+ Turbomachinery Experts

14 Worldwide Offices

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