Morning Session - Reliability and Operability of Rotating Equipment in Ethylene Plants
Monday, March 31, 2014: 9:30 AM-11:30 AM
Location: Chart Room (Hilton New Orleans Riverside)

9:30 AM - Welcoming Remarks

9:35 AM - 9:55 AM
From Diagnostics to Predictive Analytics – an Evolution in Total Asset Management

David Adams, GE Intelligent Platforms and Arun Menon, GE Oil & Gas
Asset owners of critical power generation and oil & gas production equipment are faced with the eternal challenge of increasing machinery availability and performance while reducing energy consumption and maintenance costs and ensuring that the risk of failure is eliminated. Machinery diagnostics engineers with the Bently Nevada team have decades of experience in the application of machinery protection, monitoring and diagnostics and are integral to enabling asset owners realize goals listed above. Now, they are increasingly transitioning towards helping organizations be more proactive through the application of predictive analytics enabled by similarity based modeling technologies. The result is a combination of insight and foresight into systems and processes delivering unparalleled value.

This paper presents the most successful machinery monitoring and diagnostic methodologies applied in industry today, and lays out the foundation of techniques based on predictive data models, uniquely designed for individual equipment. Advisory capabilities such as equipment health and performance threats, asset KPIs, sensor problems and data infrastructure issues as well as collaborative support from remote experts are all presented. The paper also outlines various modeling and analytics technologies and reveals the essence of the robust similarity based modeling engine embedded in SmartSignal, a platform for the future, and concludes with case studies documenting tangible results from such implementations.

9:55 – 10:20 AM
The Effect of Trip Throttle Valve Pressure Loss on Steam Turbine Performance

Alan Vitalis, Dresser-Rand
The pressure loss of the inlet trip throttle valve affects the performance of the high pressure (HP) section of a controlled extraction condensing steam turbine. Optimizing the selection of the size of the trip throttle valve for a specific application will reduce the overall inlet throttling loss of the turbine and improves its efficiency.

The paper provides the change in the available energy, i.e. heat drop, of the HP section of the turbine based on a given inlet steam flow and initial steam conditions, three controlled extraction steam pressures, and three size trip throttle valves

The change in available energy determined for each valve size and controlled extraction steam pressure are used to calculate the power output of the turbine based on the following relationship between throttle flow, actual heat into work and turbine power output.

\[ \text{Throttle Flow, lb/hr} \times \text{Actual Heat in to Work, btu/lb} = \text{Power Output, hp} \times 2545 \]

The results obtained provide the performance improvement available from the HP section resulting from optimization of the size of the trip throttle valve.
New Approaches for Turn Around Planning in Petrochemical Plants

Well thought out approaches and planning, prior to execution, yield significant pay-outs on large scale turnarounds. In this paper, the author will discuss successful strategies to turnaround planning in petrochemical plants and explain why attention to detail can result in increased safety, on-time start-ups and cost savings to the end-user.

Turbine Oil Varnish Development in Rotating Equipment

This document describes the potential problems, mitigation measures, maintenance, oil health, and the state-of-the-art technological aspects of turbine oil varnish development in rotating equipment (gas and steam turbine, compressors, generators, and gear box). Lubricant formulation considerations with application specific limitations and current maintenance practices are detailed to improve turbine reliability.

API Revisions Update

The presenter will provide a short update regarding the status of planned revisions to various API specifications affecting rotating equipment.

Afternoon Session - Rotating Equipment Afternoon Session - Equipment Technology for World Scale Ethylene Plants

The steam pressure in both petrochemical plants and power generation facilities has increased though the years. Recent ethylene plant projects have been designed and build with the highest steam pressure, or super high pressure (SHP), at 1700 psig/120 bar with a superheat temperature of 960°F/515°C. The power industry has long since moved past ethylene plant SHP levels to super-critical steam systems that operate in excess of 4400 psig/300 bar. The power industry has successfully proven higher energy steam conditions increase the overall efficiency of the power cycle.
This paper addresses the application of elevated steam pressure and temperature levels to ethylene plants in the range of 2200 psig/150 bar. Improvements in overall plant specific energy are presented. The technical impact on operations and critical duty equipment, specifically the mechanical drive steam turbines and the ethylene process driven steam generation system, is discussed versus capital cost increases required to meet the elevated super high pressure steam level.

**2:30 – 2:55M**

**Turbo Expanders – High Enthalpy Wheel Design**

**Gabriele Mariotti, GE Oil & Gas**

Turboexpander Systems are widely used in ethylene plants to optimize cryogenic recovery and optimize the recompression of residue gas. The light hydrogen rich residue gas, in particular if produced by ethane or E/P cracker, challenges the design of the Turboexpander System as the machines would need to handle very high enthalpy drop per stage.

Turboexpanders for residue / tail gas are designed mainly with two types of loading devices: generator load and compressor load.

This paper will focus mainly on Turboexpander systems with recompressor load. A cascade of units are typically used to meet the required efficiency and to providing a reliable solution mechanical solution.

Wheel design and rotordynamics are very important in the optimization process, particularly when active magnetic bearings are used. Active magnetic bearings are characterized by very low losses thus loading more the recompressor than traditional oil bearing units where mechanical losses can brake significantly the expander wheel. The recompressor loading is often the main constraint for residue gas expander aerodynamic optimization.

A new patented wheel design is presented; this design allows the compressor to run at very high tip speed with minimal centrifugal stresses. This solution eventually can reduce the number of stages or vice versa to improve significantly the efficiency of the expander. Technology limits for the new solution as well as for traditional recompressor wheel design are compared with other different loading devices.

**2:55 – 3:20PM**

**Recent Trends and Applications of Dynamic Simulation in Ethylene**

**Greg Berry, Jack Kramer and Jeffrey Feng, KBR**

The scale of economics has resulted in larger compressors and more complex flowsheets in an ethylene plan. This article presents several areas where dynamic simulation can support the design, commissioning and operation over the entire life cycle of an ethylene plant.

In the conceptual phase, dynamic simulation has often been used to address startup, turndown, trip, recycle valve sizing and other design issues that cannot be fully defined by steady state calculation. Examples are given in the paper on several dynamic simulation applications during the conceptual design and the detailed engineering.

In recent years, dynamic simulation has been used in applications beyond the initial design work. For example, the simulation model developed in the design phase can be linked with a compressor control system to support commissioning from home office. Specific examples are presented in the paper to illustrate how the dynamic model is linked with a compressor control system to perform case studies and tune controllers. Operator training simulator is another area whether the dynamic model can be
leveraged as a centerpiece of a high-fidelity training simulator where extensive training can be provided to the operators before the commissioning.

BREAK (3:20 – 3:40 PM)

3:40 – 4:05 PM
Design and Implementation of a Reliable and Cost-Effective Surge and Choke Control System on Centrifugal Compressors

Sterling Smutz and Krishnan Narayanan, Energy Control Technologies, Inc.

The proposed oral presentation will review the steps involved in the design and implementation of a reliable and cost-effective surge control system for centrifugal compressors. Additionally, it will review the design requirements for a performance control and choke control system. The paper will highlight the basics of surge control system design, instrumentation, and guidelines for a controls retrofit and field testing. Surge and choke control as they pertain to the Cracked Gas Compressor, Propylene Compressor, and Ethylene Compressor will be addressed. Special attention will be given to process upsets that can cause surge events in the compressors, and how a properly-designed control system can ameliorate the impacts caused by these upsets. Events such as a furnace shut-down can cause the Crack Gas Compressor to shut-down if the surge and performance control system is not adequately designed. A trip of the Propylene Compressor can cascade to the Ethylene Compressor and shut it down unless its Compressor Control System can use appropriate feed-forward signals to prevent that occurrence.

Actual design and implementation of surge control systems will be illustrated with two successful field installations: 1) A surge control system for a refrigeration application in a gas fractionation plant, and 2) A surge control and performance control system for two compressors in series. Final mention will be made about choke control that was implemented for a pipeline compressor to illustrate the different means for preventing a compressor from choke.

This tutorial content is meant to target rotating equipment, reliability and instrumentation engineers, and process engineers working in ethylene plants as well as other industries that make use of centrifugal and axial compressors. The material covered will be technical in nature, and it will be a good source of training material for new engineers, and a refresher for experienced engineers.

4:05 – 4:55 PM
Panel Discussion

4:55 PM - Concluding Remarks