Compressor Works

ACI Services, Inc.

Issue XIII

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GMRC Project:

High Speed Specification Development

High-speed reciprocating compressors, driven by natural gas engines or electric motors, provide the advantages of lower capital cost, shorter installation time and compactness. They have become the most common equipment type applied in the upstream and much of the midstream natural gas compression markets. However, as larger horsepower (≥2000 hp), high-speed (≥700 rpm) engine and electric motor-driven reciprocating compressor packages have been applied, especially in low ratio, high-flow, highly flexible pipeline transmission applications, concerns often arise with regard to efficiency, vibration, pulsation, controls, ancillary components and systems, pipeline throughput and diagnostics.

Higher speed compressors naturally create a broader spectrum of pulsation frequencies that must be addressed, and the lighter frames and I-beam skid mounting tend to be more flexible and reactive than traditional heavier, slow speed compressors that were block mounted. Pulsation dampening and piping system pressure losses can also be more of a concern because of the higher frequency pulsation signatures generated by high-speed compressors. This has driven the need for better and more sophisticated methods of pulsation and vibration modeling and analysis as well as additional pulsation control "tools" and best practices for damping, de-tuning, and/or cancelling pulsations.

Another important consideration is that slower speed (<700 rpm) reciprocating compressor and centrifugal compressor packages or systems were /are commonly provided by the OEM, who takes full responsibility for the systems intergration and its performance. In contrast, high-speed reciprocating compressor packages, with few exceptions, are not offered by the compressor OEM. Instead, a compresor packager is the common source, purchasing the compressor, the driver, and the other high-value manufactures content from individual manufactures and assembling them on a fabricated I-beam skid with pulsation bottles, scrubbers, gas piping, utility piping, instrumentation, controls, auxiliaries, etc. The vast majority of the compressor units that are designed and manufactured by the packagers are for upstream applications. These are smaller size units that are typically not highly engineered and for which high efficency is not a primary consideration. Some of the practices are not necessarily adequate for applications with larger, high-flow, low ratio reciprocating compressors.

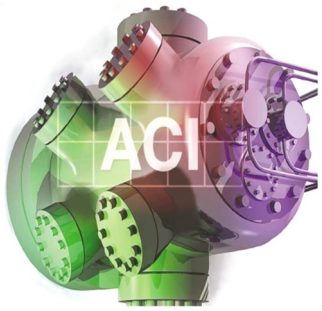
Since perceptions vary within the industry as to the nature of the problems and their solutions, there has not been a consistent learning of best practices extended across the industry to date. Existing industry specifications have been of limited value for the purpose of procuring, designing, and applying high-

Inside this issue:

Look for ACI at these events:

GMRC Vibration Course
Aug 30 - Sep 1
SynerGEE Users Group Meeting
Sept 13-15
Gas Compressor Conference
Sept 27-29
GMC 2011
Oct 2-5
Louisiana Gulf Coast Oil Expo
Oct 25-27

Compression Problem Solvers



We Optimize it
We Design It
We Build It

GMRC Project (cont.)

speed compressor packages.

For this reason, the Gas Machinery Research Council (GMRC) has selected ACI Services, Inc. to develop a High-speed Reciprocating Compressor Specification and Guideline. A principle goal of the project is to establish best practices, document them and design a practical guideline that can be referenced for selection, procurement, design and operation of high-speed compressor systems. Another goal is to identify problems for which adequate practices are lacking. This goal will be accomplished by using literature research, observation and the collective experience of the project sponsors, GMRC members, OEMs, packagers, engineering companies and other sources. This information will enable the addition of appropriate guidelines or identify the need for further specific research and development to fill gaps.

Phase I of the program, to be completed by the end of 2011, will examine recent and current problems with high-speed pipeline compressors, as well as past and current practices, to explore and identify the opportunities and potential benefits of a set of specifications and/or guidelines associated with package selection, integration, design, installation, commissioning, and operation. It will establish the detailed outline of the elements to be included in the final specification and guideline.

Phase II, to be completed in 2012, will finish the development of the extensive detailed specification and guideline, with the target issue date of December 31, 2012. The tentative title for this specification is "*GMRC Design Specification and Guideline for High-Speed Reciprocating Compressor Packages for Gas Transmission and Storage Applications*". The guideline will provide the operator with more reliable procedures and references for selecting, specifying, procuring, applying and operating high-speed units with predictable and reliable results, and it will provide packagers with a more comprehensive and detailed specification for designing and building high-speed compressor packages that meet customer and equipment OEM expectations. While portions of this document may be applicable to gathering and midstream applications, the principle use will be intended for higher horsepower, low ratio, highly flexible gas transmission compressor applications.

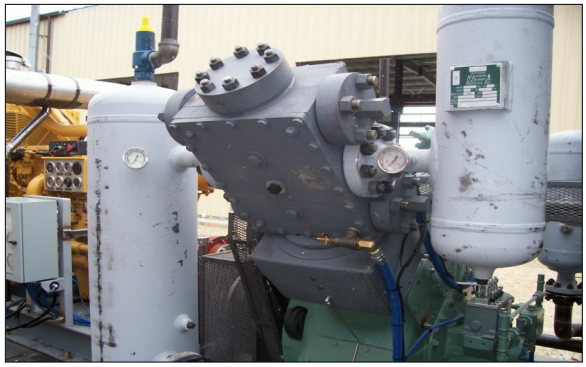
GMC Schedule

The Gas Machinery Conference (Oct 2-5, Nashville, TN) provides excellent learning opportunities for both new and seasoned professionals in the Gas Compression Industry. ACI has once again been selected to present numerous short courses and papers. These include:

- **Comprehending OEM Performance Reports:** Presenters from the major compressor OEMs will cover standard reports via highlighting key areas of interest/concern**,** and explain the latest compressor performance reports. New OEM reports include those that consolidate millions of operating conditions for quick review of unit capabilities across entire operating maps. (Co-presenting with Ariel, Dresser-Rand, GE Oil & Gas, and Knox Western.)
- **Comprehending Compressor Related Reports – Acoustic/Vibration, Torsional and Thermal Studies:** Presenters from major pulsation companies, integrators, and packagers, will cover standard reports via enlightening discussions of key areas of interest/concern. Presenters will explain how to quickly and effectively understand the latest acoustic, pulsation, and torsional reports. (Co-presenting with Beta Machinery, Basic Systems, EDI, and Valerus.)
- **Principles of Business Ethics for the Gas Compression Industry:** Discussions of ethical choices and corresponding justifications for typical issues many of us encounter in the Oil & Gas Industry. (Co-presenting with El Paso.)
- **An Improved Compressibility Model for Gas Service with High Concentrations of CO2:** Paper and presentation will detail the development of an effective modeling approach for CO2 compression (including areas near critical regions) that's mathematically simple and fast enough for straightforward incorporation into PLCs and real-time analyzers. (Co-presenting with Kinder Morgan and Windrock.)
- **Thinking Outside the Bottle! The Use of Performance Augmentation Networks to Increase Compressor Efficiency:** Why do reciprocating compressors have to have pulsation bottles? Because they effectively dampen pulsation and vibrations, but they also do so by significantly degrading system efficiency. New technologies can reduce (even eliminate) the need for pulsation bottles, orfice plates and choke tubes– and their associated pressure losses. Learn more about new acoustic dampening technologies by attending this presentation. (Co-presenting with Optimum Power Technology)
- Stop by ACI's booth and visit our team (Norm, Chad, Bob, John, Dave, Brett, and Dwayne.)

Product Spotlight - Joy Replacement Cylinders

ACI recently added another cylinder design to its ever increasing cylinder product family. This class of ACI cylinders replace the Joy "slab sided" 4.00 inch cylinder primarily used in air and natural gas compression applications. The ACI cylinder class covers the bore range from 3.50 to 4.00 inch in 0.25 inch increments. The cylinder body is manufactured from a high strength nodular iron casting (ASTM A536 Grade 80-55-06), is water-cooled, and has a maximum working pressure of 2,750 psig. The cylinder is designed for 7.00 inch stroke applications and has been applied on the Gardner Denver J-series (Former Joy WB12) and Joy WB14 compressor frames.



Chad's Return

As many of you know I have been serving our country as a member of the best Navy in the world as a reservist. I have been proudly serving our country since 1992 when I enlisted in the Army at the age of 17. Over the years I migrated to the Navy and received my commission as an officer and currently hold the rank of Commander. Recently I had the opportunity to serve and protect our great nation when I was called to serve in support of Operation Iraqi Freedom and Operation Enduring Freedom in December 2009. As I write this it was one year ago that I left ACI and headed to Norfolk, VA to be processed for Active Duty Service. After a week of processing, I was shipped out to Ft. Dix in charge of a group of 140 ready to begin what amounted to 5 weeks of crawling through the sand and mud, riding in convoys, learning how to detect and evade improvised explosive devices, and what it means to fight insurgents. After 6 weeks I was ready for the next step.

Not knowing exactly where I was heading, there was some apprehension as training closed out and I began the process of preparing to ship out.

About a week prior to shipping out in early October I found I was heading to either Kuwait or Iraq and would know for sure once on the ground in Kuwait. Plus, I had no idea of exactly what I would be doing.

I came to find out I was slated to lead a team of 120 sailors to fulfill an Army mission related to Security, Protection, and Customs of people, cargo, equipment, and vehicles moving into and out of the theater. I was located at Camp Arifjan near Kuwait City, Kuwait. Although this was our central point of operations, I had teams fulfilling missions in Pakistan, Iraq, Jordan, Saudi Arabia, UAE, and Kuwait.

It was interesting serving with the Army after being indoctrinated in the Navy Way. The Army operates considerably different than the Navy. There was quite a learning curve to understand how the Army does things. It was actually rather frustrating as there were layers of beauracracy we had to deal with on a daily basis.

With a team operating 7 days a week 24 hours a day the time went by quickly. Although I spent much of my time in Kuwait supporting the main contingent of the team, I travelled to Jordan, Saudi Arabia, and throughout Kuwait. My most interesting trip was to Saudi Arabia supporting the South Carolina National Guard as they conducted a field exercise with the Royal Saudi Land Force. Actually never knew Saudi Arabia had mountains and monkeys.

After 9 months I was ready to come home, not to mention my wife and kids were ready for me to get home as well.

Thanks for all the kind support which I received throughout the year. I look forward to doing business with you again this year.

ACI Services, Inc.

125 Steubenville Ave.
Cambridge, OH 43725

Phone: (740) 435-0240
Fax: (740) 435-0260
E-mail: rpainter@ACIServicesInc.com

The Innovation Resource for Reciprocating Compressors

www.ACIServicesInc.com

Norm's Notes

Thanks to the efforts of Brandi Perkins and others, this is our third issue of CompressorWorks in 2011. Our big news this issue is the return of Chad Brahler from a year of active military duty in the Middle East! Chad is a Commander in the US Naval Reserve. Last year he was called up to lead a command in support of the wars in Iraq and Afghanistan. We appreciate his patriotism and service and are delighted by his safe return.

ACI just completed a major office addition and renovation project at our Cambridge headquarters. This gives us more office space, another conference room, a large air-conditioned break room, a fire-proof document room, and more space for our growing team. We appreciate everyone's patience for the past five months as we completed this project. We also recently acquired more property adjacent to our current campus.

Welcome to Tyler Clark for another summer internship after graduating with a BSME from Wright State University in Dayton. This fall, Tyler will continue his mechanical engineering education in the graduate program at Ohio State, focusing his research on a project sponsored by ACI. We also welcome Jesse Kolakowski to our Cambridge manufacturing team.

Our thoughts and prayers continue to be with Lauren Sperry, who continues to deal with on-going health problems that have slowed his recovery from a serious stroke in December of last year. Lauren is now home and continuing physical therapy three days a week.

W. Norm Shade, PE, President

"In any moment of decision the best thing you can do is the right thing, the next best thing is the wrong thing, and the worst thing you can do is nothing."

- Theodore Roosevelt

Brain Teaser

Be the first to submit the correct answers to both Brain Teasers to Brandi Perkins (bperkins@aciservicesinc.com) and win.

1. At a garage sale Smitty bought 20 baseball cards at $5 apiece. He took them to a dealer who said "Some are forgeries. I'll pay you $25 for each good one and you pay me $10 for every forgery." Even so, Smitty walked away with a profit of $295 on the whole deal. How many forgeries were there?
2. Name the nine states whose names never use the same letter twice. HINT: Virginia fails since it uses "i" three times.

Congratulations to Jeanna S., last issue's Brain Teaser Winner. Thanks again to all who participated.