credit management as well. We are improving our capabilities and will shorten the settlement date to the second business day of the trade date, rather than the current 38 business days, with the introduction of congestion revenue rights.

Morgan Davies: credit manager, Calpine Corp.

To improve market confidence, factors to consider include various elements. ISO New England spoke a lot about reducing the settlement period. That's the biggest driver in reducing credit risk, as it reduces the cash conversion cycle. The shorter the cycle, the less risk of not performing.

There's a large body of empirical evidence supporting an accelerated settlement from the securities industry, the futures industry, and the energy market. Organizations such as Nymex recognize the importance of covering the settlement and cash settlement markets daily.

This requires changes in the cost transactions in the RTO markets. ISO New England is developing best-credit practices. For example, by reducing settlement periods of approximately 50 plus days to approximately 15 days initially, they've reduced the pool of credit risk by 67% and at the same time reduced collateral requirements approximately 67%, from $77 million to $15 million. These numbers can be found in the FERC policy statement.

Daniel Sarti: credit risk manager, Arizona Public Service Co.

Managing exposure to credit risks, whether buying or selling power, has long been important and is becoming more important. Today, there continues to be significantly increased possibilities of corporate defaults. Such factors have evidence of higher credit default swap premiums and higher bond swap spreads. The state of our equity markets also amplifies the importance of managing credit risk, because there is higher commodity price volatility.

Price volatility increases credit risk, as energy contracts move further into the money or out of the money. Also, price volatility increases liquidity risks, as parties to either side of the transaction may have increased contractual collateral requirements in order to securitize higher dollar levels of performance risk.

The focus of many presentations thus far has been on escalating levels of credit risk, but financial liquidity risk is, potentially, an even more serious and imminent risk to a trading operation. **CCJ**

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To clock or not to clock? It all depends. . . .

Editor's note: Brent Gregory called right after he received the 3Q/2008 issue and read "How clocking of compressor blades may impact wear in some vane rows," developed from material supplied by Rodger Anderson, manager of GT technology for DRS Power Technology Inc, Schenectady, NY.

Gregory is president of Creative Power Solutions, Fountain Hills, Ariz, an R&D engineering firm with an area of specialty in gas-turbine (GT) analysis and problem-solving (see ad, p 123). He has more than four decades of experience in the design of turbomachinery for aero and frame GTs.

Gregory

Gregory found Anderson's correlation between blade clocking and stator vane hook-fit wear interesting and didn't doubt it. But, as he says in the written correspondence below, and as he told the editors over breakfast during the recent 501F meeting in Glendale, Ariz, it would be incorrect to assume that having perfectly clocked blades in adjacent rows with the same number of rotating blades might be better than not.

An explanation of the responsibilities of mechanical engineers and specialists in the field of aerodynamics in the design of a compressor ensued. Then Gregory put some rotating and stationary blades on the breakfast table and arranged them as they would be in a compressor and showed why it's perfectly normal to have a certain clocking in one series of machines and a different clocking in another series: It's all about tweaking rotor-disk and airfoil designs to achieve top performance.

Clocked blades might reduce or eliminate hook-fit wear but adversely impact performance, he said. At the fuel cost and operating regime presented to designers, it probably cost less to pin a row of vanes (one solution) than it did to pay for inefficiency.

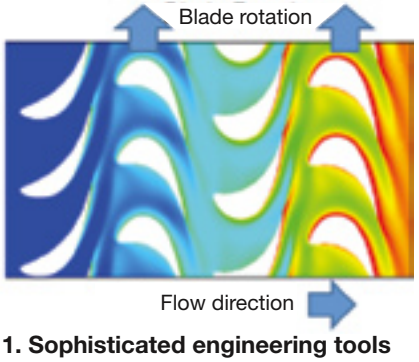
The bottom line: Clocking per se is neither good nor bad but can be both at the same time, or one or the other, or neither. Owner/operators should respect Anderson's findings and closely inspect for hook-fit wear and stator-vane movement when blades in their GE 7FAs, in particular, are not clocked.

I would like to offer my thoughts on clocking issues from the designer's perspective, provide some background on the subject of clocking, and discuss briefly why things are the way they are. Clocking is a technology whereby airfoils in multistage compressors and turbines are arranged or oriented to afford some benefit to the design or operation of a GT.

Blade count typically is determined by aerodynamicists who work with mechanical and manufacturing design groups to fix the requisite number of airfoils to input or extract energy from the working fluid. In the early days of GT development, the designer's motivation to use same blade-row count invariably was made to minimize cost. The ability to use the same tooling for as many rows as possible (at a common diameter) offers the potential for significant procurement or "first cost" reductions.

Today's sophisticated design tools—specifically advanced computational fluid dynamics (CFD) techniques—allow far more precise determination of blade counts to maximize performance and the technology is no longer ruled by the determination of a common attachment.

As CFD technology matured, the aerodynamic effects of clocking became better understood by running analyses in real time. These analyses investigated the effects of clocking on performance, heat transfer, and mechanical excitation, which were shown to be significant (Fig 1). The mechanisms for such effects are the



1. Sophisticated engineering tools enable real-time graphics like this to track how fluid flow behaves in the presence of the physical hardware. Color contours represent the increase in losses as the fluid moves through the machine. Clearly evident are the loss areas associated with trailing-edge phenomena

wake and body force interactions on the airfoils.

One result of this new technological capability: Design guidelines were put in place to obviate performance and mechanical issues and drive the maximum benefit. Some OEMs now impose far-reaching rules that impose strict guidelines on mechanical and aero designers as to blade/vane count and the subsequent use of clocking technology. This is true for frame machines, aero engines and their derivatives, and steam turbines.

Upgrades of older units may offer the opportunity to review early decisions on blade count and relative orientation when ongoing issues suggest a design review using the latest engineering tools is warranted. If beneficial changes are possible with minimum disruption to the overall design concept they can be made.

For example, it may be possible to move airfoils relative to a neighboring set of blades by orientation of the disk within the limits of the tie-bolt spacing. Given this flexibility, it might be that factory assembly orients, or did orient in the past, the blades in a random fashion—at least for some OEMs—supporting Anderson's field observations. Of course, OEMs offering solid rotors do not have the luxury of doing this.

I realize that many owner/operators are not familiar with how engineers use CFD to optimize the design of today's compressors and turbines. Fig 2 offers some insights on the impact of clocking. Looking at the top half of the illustration, the engineer can see the blue wake—essentially turbulent, relatively slow-moving fluid—being shed at the trailing edge of the stationary blade row on the left-hand side (A).

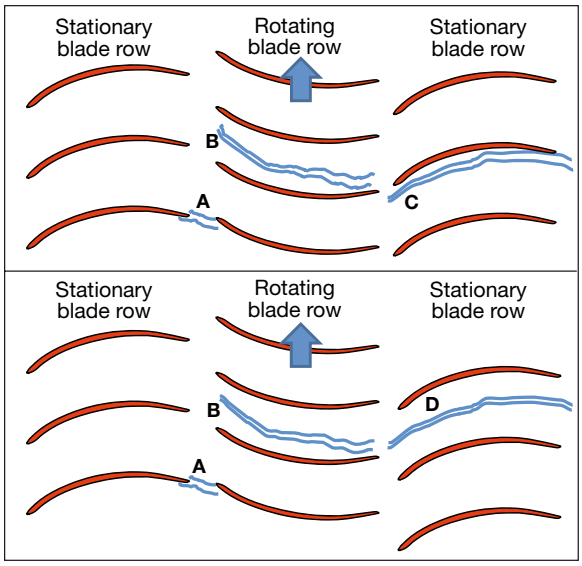
The wake is transported with some attenuation by the rotating frame (B) and enters the downstream stationary blade row. Since the passages are exactly synchronous, the low-momentum fluid scuffs the metal surfaces of the blade and end wall consistently (C). Note how the leading edge is prone to damage and the likelihood of erosion at the trailing edge—especially so if particulates are present in the flow stream.

The designer can clock the vanes relative to one another if the position of minimum interference is known, as described in the bottom half of the drawing. Here, the stationary blade row at the right is clocked half a pitch from the row at the left. Observe how the upstream wake moves through the center of the downstream row of stationary blades (D) with much less interaction than for the clocked case above.

The latest field data indicate that the secondary and tertiary effects of wake turbulence apparently also should be reviewed. Engineers now are aware that while clocking produces advantages from aerodynamic and mechanical behavior, the particulates (or cavitation) in the gas stream can damage mechanical components. Clocking maybe a technology that inadvertently focuses turbulence in the gas stream to allow particulates to scrub components and hence cause unprecedented wear. Anderson's field observations certainly imply that.

Typically, particulates and the effects of wear are not modeled in CFD for turbomachinery aerodynamics, but they could be on a limited basis. In boiler design, particulates are modeled by CFD and it would be simple to add this capability to GT analysis if the OEMs were inclined to do so.

Certainly, given all the boundary conditions our firm is capable of tracking, it is possible to investigate how clocking impacts virtually all parameters as well as which ones are critical—for example, erosion, aero performance, high- and low-cycle fatigue, etc. Such investigations are very much in the interests of fleet owners, who may have the opportunity to improve heat rate by taking a more detailed look at their turbomachinery and gain a more comprehensive knowledge of how their equipment operates.



2. Practical representation of wake as it passes through moving and stationary blade rows. Top half of the figure illustrates that clocked blades may not be the optimum; lower half shows result when airfoils are clocked by half the blade pitch

BRENT A GREGORY
President
Creative Power Solutions (USA)
Fountain Hills, Ariz

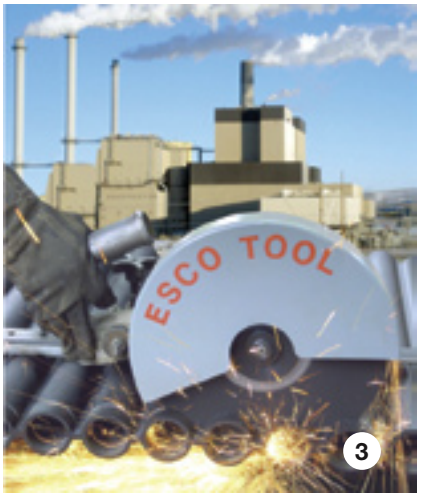
Plant news

Riverside is selected by the California Dept of Conservation as the first city in the state recognized as an "Emerald City" for its sustainable energy and water initiatives. Riverside Public Utilities was one of several municipal entities that worked together to achieve the collective success. RPU's newest plant, the Riverside Energy Resource Facility, was featured in the 4Q/2006 issue for its practical, cost-effective ZLD solution (access at www.combinedcyclejournal.com/archives.html). The plant is managed by Chuck Casey, secretary of the Western Turbine Users Inc.

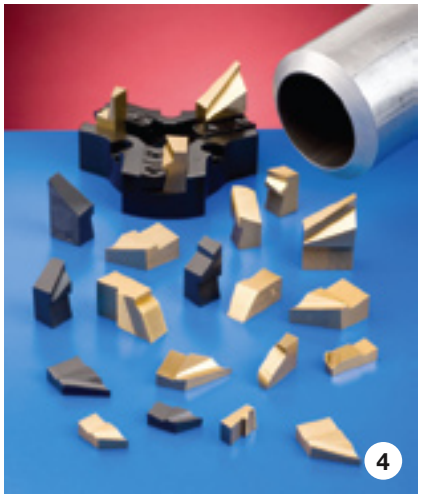
Dave Ulozas, chairman of the 7EA Users Group, was recently appointed general manager of the Walter Scott Energy Center (formerly Council Bluffs Energy Center), a four unit coal-fired facility with a nominal capacity of 1650 MW. Plant is owned by MidAmerican Energy, which also has a 7EA in its fleet. Ulozas formerly was with Nebraska Public Power District where he was the generation manager.

Product/services update

ESCO Tool, Holliston, Mass, announces an air-powered saw that facilitates cutting old boiler tube



panels as well as new panels for an exact fit-up (Fig 3). The 3-hp motor requires only 80 cfm at 90 psig to



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power the fiberglass-reinforced blade for cutting Inconel, stainless steel, and other tube materials perfectly square, within tight tolerances, and without a heat-affected zone. Carbide-tipped steel blades are available as well.

Cutter head and blade design for a complete line of welding end-prep tools offer chatter-free beveling, facing, and boring simultaneously and without cutting oil (Fig 4). EscoLock™ blade lock system holds up to three blades at once; new chip breaker helps direct the chip away from the tube surface and dissipates heat. EscoLock is standard on the Millhog® line of end-prep tools for machining tube and pipe from ½ to 18 in. Contact Matt at matt@escotool.com or visit www.escotool.com.

Mettler-Toledo Thornton, Bedford, Mass, releases a new high-temperature conductivity sensor. Ideal for industrial-boiler use, the new sensor can measure directly in the blowdown line without sample cooling (Fig 5). It enables continuous automatic blowdown control, which minimizes corrosion and scaling. Visit www.mt.com/thornton.

Olympus NDT Inc, Waltham, Mass, reports that its Epoch 1000 series digital ultrasonic flaw detectors combine the highest level of performance for conventional portable flaw detection with the power of phased-array imaging. Access www.olympus-ims.com.

Emerson Process Management, Power & Water Solutions, Pittsburgh, Pa, announces the Scenario® Virtual Engineer. It combines the power of simulation, virtual technology, and its Ovation ® expert control system within a single desktop computer. Net result: You have the tools to easily build, test, verify, and download process graphics, control logic, and process point databases without impacting plant operation. Access www.emersonprocess-powerwater.com.

Braden Manufacturing LLC, now offers complete system capability for the design and worldwide manufacture of NO_x and CO reduction systems for simple-cycle GTs. Services and equipment include flow modeling, ammonia system, NO_x and CO catalyst, acoustic design, catalyst grid design, controls and fabrication. Visit www.braden.com.

Engineering Software Reliability Group, Virginia Beach, Va, introduces OstiaEdge™ Monitoring Suite to help powerplant owner/operators improve productivity, reduce forced outages, and increase knowledge-sharing. Visit www.esrgtech.com.

Company news

Leading Edge Turbine Technologies (LETT), Houston, adds F7FA buckets to its growing braze-repair service offerings. The company's innovative braze technology, says Jim Rice, an engineering specialist with over a quarter century of related experience, has the ability to heal small cracks while completely eliminating the heat stress or distortion which can be left following welding on nozzles or buckets. Additionally, the technology can be used to dimensionally correct expensive cast parts without the application of excess material—thereby reducing repair time.

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The braze process uses a thin layer of alloy virtually identical to the base metal of a bucket and applies that material directly to the defect area. The alloy choice allows for future weld repair which was previously not possible. Next, the buckets are processed through a precise vacuum-furnace braze cycle which has the added benefit of removing all weld-induced stresses in the part and provides the ability to repair difficult components for additional service runs.

LETT has developed proven processes for W501F Rows 3 and 4 vane segments, W251 vane segments, Frame 5 buckets, and 7FA third-stage buckets. The processes have demonstrated a wide range of repair options not available with traditional weld repair techniques. The results: lower-cost repairs and potentially longer service runs than had been experienced previously. Visit www.leturbine.com.

Strategic Power Systems Inc, Charlotte, announces the appointment of Cynthia Alicea as customer service manager. She will focus on communication and management of OEM accounts. Alicea has over 10 years of related experience with Procter & Gamble and Boeing.

GE Energy and **Mitsubishi Heavy Industries Ltd** sign a memorandum of understanding to co-develop an advanced steam turbine for com-

bined-cycle plants to enable improved performance.

Prueftechnik and its sole US distributor, **Ludeca Inc,** Doral, Fla, celebrate the 25th anniversary of laser

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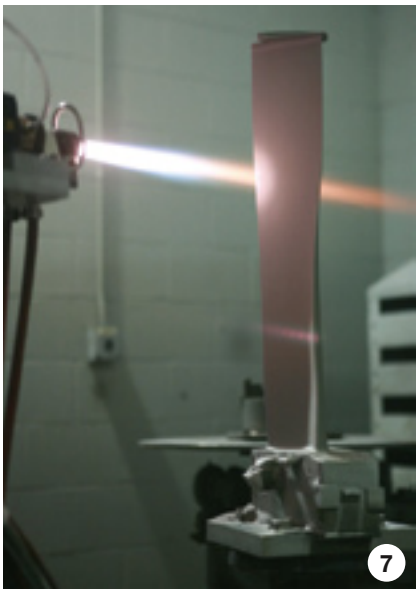
shaft alignment (Fig 6). Optalign, the world's first laser-optic shaft/coupling alignment tool was introduced in 1984, improving the accuracy and facilitating the alignment of rotating machinery.

Aviation, Power & Marine Inc, Boynton Beach, Fla, is acquired by the private equity firm Pfingsten Partners LLC, Deerfield, Ill. AP&M is said to be the world's largest independent distributor of aeroderivative GT engine parts and related services. The company also coordinates engine leases and component repair services.

Moran Iron Works Inc, Onaway, Mich, is awarded a project to design, fabricate, and install an inlet air filter house for an existing Frame 5 GT. Project includes removing and replacing deteriorated structure and sheeting, installing new insulation, sandblasting and recoating the inlet bellmouth, etc.

LETT Coating Holdings, a subsidiary of Houston-based Leading Edge Turbine Technologies is now capable of coating F-class buckets—including bond and top coat for 7EA first- and second-stage blades, 7FA third-stage blades, and 501F Rows 3 and 4 (Fig 7). The advanced coatings have a proven ability to extend the service life of a part and increase the number of maintenance cycles. The development of an in-house coating facility enables the company to efficiently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apply HVOF and air plasma coatings with robotic precision. Tests are conducted several times during the coating process to ensure the highest level of quality and repeatability.

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