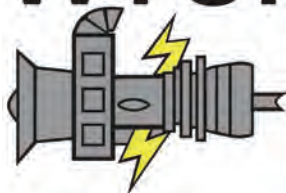




# COMBINED CYCLE Journal

## WTUI



The Western Turbine Users group welcomes GE aero owner/operators to the international organization's 32nd Annual Conference & Expo in San Diego. .... 7

## User Group Reports

### 501F Users Group.....58



The 501F and 501G Users Groups gather for their annual meetings in Reno, Nev, as

CCJ goes to press. Here's what's on the 2023 501F program and a recap of user and vendor presentations from the 2022 conference that you might have missed, given the many confusions fostered by the pandemic

### 501G Users Group.....68



Highlights of the 2023 annual meeting, in progress at press time—including an interactive workshop to Human Performance and its importance in plant performance. This was Steve Bates' last initiative (see below). Excerpts from recent 501G plant reports and abstracts of recent user presentations are the article's focus

### Remembering Steve Bates .....78

The 501G user community's unflappable technical leader, always available to help a colleague, passes suddenly at age 57

### Alstom Owners Group .....56

Here's what's on the agenda for the sixth annual meeting of the AOG. It's the organization's first in-person conference since 2020 and a prime opportunity for both users and vendors serving this challenged fleet to reconnect in a serious setting: EPRI's Charlotte (NC) campus, March 20-23

### ProEnergy Conference.....46

While this first major O&M conference conducted by ProEnergy at its Midwest headquarters location for LM2500 and LM6000 owner/operators does not qualify as a user group, it was organized like one and con-

venient to owner/operators of aero engines in the eastern half of the country. Plus it featured an instructive shop tour



## Best Practices Awards

### 501G plants

Kings Mountain Energy Center.... 95

Athens Generating Plant ..... 96

### 501F plants

CPV Valley Energy Center..... 86

MPC Generating ..... 90

Rolling Hills Generating LLC..... 91

State Line Power Station ..... 92

Whitewater Cogen Facility ..... 92

Kleen Energy Systems LLC ..... 94

### 501D5 facility

Milford Power LLC ..... 98

### 501D5A facility

Mid-Georgia Cogen ..... 100

### V84 plants

Pleasant Valley Generating Station..... 104

Walton County Power 102

## Recognition

CCUG honors Xcel Energy's Dave Such with its annual award..... 3



## Upcoming Meetings

### Alstom Owners Group Annual Conference & Vendor Fair

March 20-24  
EPRI Campus  
Charlotte, NC  
<https://aogusers.com>

### Film Forming Substances Sixth Annual Conference

March 21-23  
Monash University  
Prato, Italy  
<https://FilmFormingSubstances.com>

### 7F Users Group Annual Conference & Vendor Fair

May 15-19  
Renaissance Atlanta Waverly Hotel  
Atlanta, Ga  
<https://www.powerusers.org>

### European HRSG Forum Ninth Annual Conference

May 16-18  
Monash University  
Prato, Italy  
<https://europeanHRSGforum.com>

### Siemens Energy Gas Turbine Conference

June 5-8  
Renaissance Orlando at Sea World  
Orlando, Fla  
[dawn.mccarter@siemens-energy.com](mailto:dawn.mccarter@siemens-energy.com)

### D5-D5A Users Annual Conference & Vendor Fair

June 5-7  
Chattanooga, Tenn  
<https://www.501D5-D5AUsers.org>

### HRSG Forum Annual Conference and Vendor Fair

Renaissance Atlanta Waverly Hotel  
Atlanta, Ga

# **KinetiClean**

The most effective way  
to clean a HRSG

## **KinetiClean is safer and faster with the deepest cleaning effect**

of any method currently used to clean HRSG fin tubes.

**Before**

**After**

Groome's patented technology uses a proven Kinetic Shockwave cleaning method to remove unwanted foulant. An innovative and automated air system then distributes high-pressure, high-volume air to liberate remaining debris.

- No manual tube movement
- Minimal-to-no scaffolding
- Other projects can continue in tandem
- No additional moisture
- Highly-trained and fully-licensed professionals manage explosive process

**G GROOME**  
Industrial Service Group

[WWW.GROOMEINDUSTRIAL.COM](http://WWW.GROOMEINDUSTRIAL.COM) | (800) 505-6100



# LM2500 INSULATION SOLUTIONS AT ITS FINEST



**ACOUSTIC**



**ACOUSTIC**



**THERMAL**

ARNOLD provides advanced Noise reduction Solutions for all kinds of LM2500 Packages

We Guarantee:

- Significant Noise Reduction
- Longer Product Lifetime
- OEM Approved Installation

ARNOLD provides advanced Single Layer Insulation for the Exhaust Duct of all LM2500 Frames

We Guarantee:

- Better Vibration Resistance
- Longer Product Lifetime
- higher Thermal Performance
- OEM Approved Installation



**ARNOLD**  
GROUP





# CCUG honors Dave Such with its Individual Achievement Award

Xcel Energy's Dave Such was selected the lone recipient of the Combined Cycle Users Group's Individual Achievement Award (IAA) in 2022, the 26th person to be so honored (list below) since the award's inception in 2013. Voting is by members of the CCUG's steering committee, chaired by Phyllis Gassert of Talen Energy. Aaron Kitzmiller of Vistra Corp heads the subcommittee responsible for nominating award candidates.

Recall that the IAA recognizes individuals who have demonstrated excellence in the development, design, construction, management, operation, and/or maintenance of combined-cycle facilities throughout their careers.

The search for award candidates is ongoing. Readers are encouraged to nominate one or more individuals for the 2023 award before the June 2 deadline. The process: Complete and submit the nomination form posted on the CCUG website at [www.powerusers.org](http://www.powerusers.org). Refer questions to [aaron.kitzmiller@vistracorp.com](mailto:aaron.kitzmiller@vistracorp.com).

**Dave Such** has, throughout a 40-year industry career, unselfishly shared his deep technical expertise with the combined-cycle user community—especially that related to the operation and maintenance of GE 7F gas turbines. He has been involved with some early 7FA turbines from commissioning through full unit life extension—including one with more than 25 years of service and 180,000 fired hours.

Dave has gained a reputation for encouraging the industry to advance and pursue unique solutions to difficult problems. Example: He pioneered the use of third-party refurbishment and manufacturing of 7F turbine components at a time when the OEM was the only option. He also taught himself how to tune combustion systems and apply unique techniques to improve both engine operation and performance.

Most recently, Dave has been the technical lead for gas-turbine flexibility upgrades within Xcel Energy and has successfully installed some of the latest GE combustion and turbine hardware on several units—including DLN 2.6+ with axial fuel staging. The industry continues to benefit from Dave's passion for sharing this experience with others.

Additionally, he has been a great mentor to colleagues within Xcel Energy and has supported fellow owner/operators industry-wide by sharing turbine parts when they

find themselves in a challenging situation.

Dave is currently a leader in the user community as a member of the 7F Users Group's steering committee,

which he has been a part of for 15 years. He continues to share his experiences with others via insightful technical presentations at industry conferences.

In accepting his award, Such said, "Although this is an Individual Achievement Award, most of us realize that significant achievements in the power industry are group projects. The many user groups and conferences we have today promote collaboration and the sharing of knowledge that drives important accomplishments. I am very grateful for this particular recognition award, but also want to clarify that I am merely a product of being an active member of the community of power user groups for over 20 years. Regardless, I feel incredibly honored. Thank you very much."



## Past recipients of the CCUG award

Robert Anderson, Competitive Power Resources  
Rodger Anderson, DRS-Power Technology Inc  
J Edward Barndt, Rockland Capital  
Pierre D Boehler, NRG Technical Services  
Harry Carbone, Duke Energy  
Chuck Casey, Riverside Public Utilities  
Andrew M Donaldson, PE, WorleyParsons  
Kevin C Geraghty, NV Energy  
William J Gillis, ExxonMobil  
Michael David Hoy, TVA  
Wayne T Kawamoto, Corona Cogen  
Robert Krowech, PE, HRST  
Raymond Martens, Klamath Cogen and Peakers  
Clyde Maughan, Maughan Engineering Consultants  
Dr Robert Mayfield, Tenaska Westmoreland  
Andrew McNeil, NV Energy  
Patrick Myers, Ceredo Generating Station  
William F O'Brien, IHI Power Services  
John F D Peterson, BASF  
Steve Royall, PG&E  
Daniel C Sampson, WorleyParsons  
Rick Shackelford, NAES Corp  
Peter So, Calpine Corp  
Paul M White, PE, Dominion Resources Services  
William Wimperis, Constellation Energy (Exelon)

**Note** that the company affiliations of past recipients may have changed over the years. Plus, some individuals have retired.

## COMBINED CYCLE Journal

### Editorial Staff

#### Scott G Schwieger

General Manager  
Print and Electronic Products  
702-612-9406, [scott@ccj-online.com](mailto:scott@ccj-online.com)

#### Kiyo Komoda

Creative Director

#### Steven C Stultz

Consulting Editor

#### Clark G Schwieger

Special Projects Manager

#### Robert G Schwieger Sr

Editor Emeritus  
702-869-4739, [bob@ccj-online.com](mailto:bob@ccj-online.com)

### Editorial Advisory Board

#### Jason Makansi, *Chairman*

President, Pearl Street

#### Robert W Anderson

Competitive Power Resources

#### Robert D Threlkeld

Principal, RT Power Consulting

#### Sam Graham

Plant Manager  
Tenaska Virginia Generating Station

#### Peter So

Director of Project Management &  
Development, Calpine

#### Gabriel Fleck

Chief Engineer, Greyt Minds  
Engineered Services LLC

#### Dr Barry Dooley

Structural Integrity Associates Inc

### Marketing Services

How to access customers and prospects through the CCJ Network:

- Print advertising.
- ONline advertising
- Custom sponsorships
- Webinars
- Special promotions
- Buyers Guide
- eMarketing

#### To learn more, please contact:

Lisa Juncaj  
Advertising Sales Director  
914-774-1947, [ccjadvertising@gmail.com](mailto:ccjadvertising@gmail.com)

COMBINED CYCLE Journal is published by PSI Media Inc, a Pearl Street company. Editorial offices are at 7628 Belmondo Lane, Las Vegas, Nev 89128. Office manager: Robert G Schwieger Jr.

To cancel or change your subscription, write [scott@ccj-online.com](mailto:scott@ccj-online.com)





# ADVANCING

AERODERIVATIVE RELIABILITY, SUSTAINABILITY, AND VALUE

PREPARED  
**\$100M**  
READY-TO-SHIP  
PARTS INVENTORY

PUNCTUAL  
**120-DAY**  
MAJOR OVERHAUL  
GUARANTEE

PROLIFIC  
**90+**  
TURNKEY EPC  
INSTALLATIONS



PROENERGY offers unrivaled aeroderivative mastery to help you meet today's energy demand while creating tomorrow's evolution in power resiliency. Armed with fast, reduced-emission, sustainable peaking power, we support the energy transition with transparent aeroderivative services, standardized plant construction, and prolific facility development. Leveraging a 1-million-sq-ft campus with our independent Level-IV aero depot, we collaborate with you to maintain LM6000 reliability, sustainability, and value.

**[PROENERGYSERVICES.COM](https://www.proenergyservices.com)**

**PROENERGY**





All kinds of parts-One kind of support.

LM1600 LM2500 LM5000 LM6000 LMS100 GG4/FT4



**EATON**  
*Powering Business Worldwide*



**MEGGITT**



Aeroderivative Gas Turbine Support, Inc.  
1141 South Rogers Circle, Suite 11  
Boca Raton, FL 33487 USA

Phone: + 1 561-994-0000  
Fax: +1 561-994-3600  
Email: [sales@agtsi.com](mailto:sales@agtsi.com)  
ISO: 9001:2015

# WESTERN TURBINEUsers

SAN DIEGO  
March 2023

## 32nd Annual Conference and Expo

### President's welcome

On behalf of the board of directors, officers, breakout-session chairs, and support staff, welcome to the 32nd annual conference of the Western Turbine Users.

In the late 1980s, a handful of brave investors purchased some early model LM2500 and LM5000 gas turbines for service in California. Their O&M personnel quickly realized the common issues and advantages of the LM engine, gathering in small groups to compare experiences and provide solutions to present to the OEM.

Western Turbine Users was born. Incorporating in 1990, the small group of plant representatives grew to 50, doubled to 100, then 500, and now is over 1000 members strong. Be proud to associate with our organization's legacy, rich history, and worldwide influence as you collaborate with other industry professionals. Little did our predecessors imagine their forethought would result in something as meaningful, relevant, and influential as WTUI.

Join me in celebrating 33 years of the evolving General Electric aeroderivative gas turbine industry. Users like you have challenged equipment suppliers to improve their products, as we demand new uses and extend the lives of our gas turbines and all support equipment. As a WTUI member, your conference contribution is the root to our success. You are a vital element of the volunteer organization as we move forward.

Ed Jackson  
President, WTUI



### Highlights

#### Sunday, March 12

- 7:30 Golf tournament at the Riverwalk Golf Course
- 2:00 Conference registration opens
- 3:30 Welcome to WTUI/Conference familiarization session
- 5:30 Welcome reception, exhibit hall opens

#### Monday, March 13

- 8:00 President Ed Jackson's welcome, program updates, introductions, treasurer's report, WTUI 1990 to present
- 9:30 Presentations by the Authorized Service Providers: MTU, IHI, TCT
- 10:45 Mark Axford's worldwide gas-turbine business update with Tony Brough
- 11:45 GE Services presentation
- 12:00 Lunch/exhibits
- 1:30 Women in Power

- 2:30 Technical meetings for LM2500, LM5000, LM6000, LMS100 users

- 6:30 Monday night reception

#### Tuesday, March 14

- 8:00 Technical meetings for LM2500, LM5000, LM6000, LMS100 users
- 12:00 Lunch/exhibits
- 2:30 Special Technical Presentations on best practices, fogging, CEMS, emissions control, firm dispatchable clean power, root cause analysis, HRSG/SCR maintenance, generator monitoring, bearing health

#### Wednesday, March 15

- 8:00 Technical meetings for LM2500, LM5000, LM6000, LMS100 users
- 10:45 GE new products update
- 12:00 Adjourn

### What's inside this special section:

- |    |                                   |    |                 |
|----|-----------------------------------|----|-----------------|
| 8  | WTUI 32 preview                   | 22 | Leadership team |
| 8  | Sponsors                          | 24 | Honor roll      |
| 10 | Technical program                 | 26 | Badge rules     |
| 14 | Acronyms                          | 30 | WTUI 31 review  |
| 16 | Exhibit Hall floorplan/exhibitors | 32 | WTUI history    |





# 32nd Annual Conference & Expo

March 12 – 15, 2023

San Diego Convention Center

**W**estern Turbine Users Inc., the world's largest independent organization of aeroderivative gas-turbine owner/operators celebrates 33 years of service to the industry at its 32nd annual conference and expo, March 12-15, 2023, in the San Diego Convention Center.

The last three years have been especially challenging for the user-managed group. This is the first in-person meeting since the state of California stopped WTUI from conducting its annual event at the Long Beach Convention Center in March 2020 because of Covid-19 concerns. That would have been WTUI's 30th Annual Conference and Expo.

In its place, a brief update on the organization's activities was presented online a few months later to keep the membership informed on what the OEM and its four licensed Authorized Service Providers (ASPs)—MTU Power, TransCanada Turbines (TCT), IHI Corp, and Air New Zealand Gas Turbines—were doing. Note that ANZGT exited its LM power and marine businesses as 2022 came to a close.

**Robust virtual conferences**, simulating the group's traditional in-person meetings, were conducted in 2021 (the 30th annual, officially) and 2022 (the 31st) given the ongoing pandemic. These online events were produced in collaboration with CCJ, each over a period of three weeks, in 10 highly-focused half-day sessions (11 in 2022).

Summaries of the 2022 presentations follow the 2023 conference overview, immediately

below. The 2022 presentations, as well as those from the 2021 conference, are available at <https://wtui.com/forums> for WTUI members wanting to dig into the details. For access, email Wayne Feragen, treasurer and webmaster, at [wferagen@wtui.com](mailto:wferagen@wtui.com).

## WTUI 32 (2023)

Perhaps the most important reason for attending the San Diego conference is the opportunity to reconnect with colleagues whom you haven't seen—and, in some cases, haven't spoken to—in three years. WTUI's organizers provide plenty of time to fulfill this objective. Prime examples include a golf tournament Sunday morning at the Riverwalk Golf Club (7:30 start), the vendor-sponsored Sunday evening

welcome reception from 5:30 to 8:30 in the exhibit hall, and the Monday night reception with live entertainment, from 6:30 to 9:30, in Room 6AB of the Convention Center.

**For WTUI first-timers**, it's not necessarily about reconnecting with colleagues, but rather meeting new people with professional needs and concerns that align with theirs. The best place to begin this process is at the New Conference Attendee session (called WTUI Conference Familiarization in the technical program, p 10).

It is chaired by Andrew Gundershaug, plant general manager, Calpine

Corp, who has years of experience in the design, operation, and maintenance of GE aeroderivatives, gained both on his day job and as the organizer and discussion leader of Western Turbine's LM5000 and LM6000 breakout sessions.

Gundershaug is a patient instructor who will help newcomers maximize the benefits of participating proactively in the engine-specific technical sessions on Monday, Tuesday, and Wednesday. Plus, he will provide valuable guidance on how to assure units under their purview operate safely and at high reliability.

In his opening remarks on Sunday, Gundershaug will explain the conference arrangement, how to organize your participation, and how to navigate the 2023 sessions for maximum effectiveness. Then he will review the progression of the LM product line from the 2500 to the 5000, to the 6000, and finally to the LMS100. The philosophy of each turbine variant will be discussed and how the turbine/generators are arranged—that is, gear or direct drive. The LM2500 will be examined in detail.

A quick read of the technical program will remind you of WTUI's value to your professional growth and development. Highlights include:

- Presentations by the OEM and the ASPs focusing on shop findings and solutions. Important to have CCJ's acronyms sidebar handy (p 14) while listening to these experts because they tend to speak in shorthand—HPCR for high-pressure compressor rotor, FPI for fluorescent penetrant inspection, RPL for replaced part, etc. You don't want to disengage from the speaker to figure out what an acronym means.
- Experience with upgrades to boost output, availability, and/or reliability, and to reduce emissions.
- Technical presentations by consultants and third-party solutions providers invited by the organiza-

*Continues on p 14*

## 2023 WTUI sponsors

### PLATINUM

GE Gas Power  
IHI  
MTU Maintenance Hannover  
ProEnergy  
Umicore Catalyst USA LLC

### GOLD

Airgas Specialty Products  
AP4  
Cemtek KVB-Enertec  
GasTOPS Ltd  
EnergyLink International  
Maximum Turbine Support  
Reed Services Inc  
Turbine Technics Inc  
Woodward Inc  
Zokman Products Inc

### SILVER

Bradley Griffin LLC  
Caldwell Energy  
Gusto Gen Ltd  
Industrom Power LLC  
SISO Engineering  
SSS Clutch Company Inc  
Temisa

# Improve Your Ammonia Vaporization System

**Get Sisu's Patented FreeHeat to:**

## **Reduce Maintenance**

Eliminates:

- Hot Fans
- Electric Heaters
- Incomplete Vaporization

## **Improve Emissions Compliance**

Integral Vaporizer and Coil provide:

- Shorter time to Compliance
- Better Vaporization

## **Improve Power Production**

Saves up to 250kW by eliminating:

- Hot Flue Gas Fan Aux Loads
- Electric Vaporizer Aux Loads

## **Single-Source Responsibility**

- Engineering
- Fabrication
- Installation

Sisu will design and install a custom configuration to meet your site and performance requirements.

Sisu offers Turnkey Solutions for repair, maintenance, and system upgrades, including new and enhanced catalyst, injection systems and controls.

**FREE  
HEAT**  
BY SISU



Come see us at the 2023 WTUI Conference!



ENERGY & ENVIRONMENTAL

**Charles Lockhart**  
[clockhart@sisu-ee.com](mailto:clockhart@sisu-ee.com)  
918.859.1972  
[solutions@sisu-ee.com](mailto:solutions@sisu-ee.com)  
[www.sisu-ee.com](http://www.sisu-ee.com)



# Technical Program

As of January 9, 2023

## Where to go (see floorplan, p 4)

**Registration:** *Sails Pavilion Lobby*

**Exhibit Hall:** *Sails Pavilion*

**Breakfasts:** *Sails Pavilion*

**Luncheons:** *Sails Pavilion*

**LM2500** Breakout Meetings, *Room 6DE*  
Chair: Garry Grimwade, Riverside Public Utilities

**LM5000** Breakout Meetings, *Room 10*  
Chair: Perry Leslie, Wellhead Services Inc

**LM6000** Breakout Meetings, *Room 6CF*  
Chair: Dave Fink, Southwest Generation

**LMS100** Breakout Meetings, *Room 11AB*  
Chair: Steve Worthington, Arizona Public Service Co

## Sunday, March 12

### AFTERNOON

2:00 to 7:30 Registration

3:30 to 5:00 WTUI Conference Familiarization, *Room 9*  
Chair: Andrew Gundershaug, Calpine Corp  
**All new registered conference attendees**

### EVENING

5:30 to 8:30 Exhibitor-Sponsored Welcome Reception,  
*Sails Pavilion*  
**All registered attendees, spouses/guests**

## Monday, March 13

### MORNING

7:00 to 4:00 Registration

7:00 to 8:00 Breakfast  
**All registered conference attendees**

7:00 to 5:30 Exhibit Hall open  
**Must have name badge to enter**

8:00 to 9:30 General Session/WTUI 1990-2023,  
*Room 6AB*  
**All registered conference attendees**

9:30 to 10:30 ASP Presentations (IHI, MTU, TCT),  
*Room 6AB*  
**All registered conference attendees**

10:30 to 10:45 Break, *Sails Pavilion*

10:45 to 11:45 Gas-Turbine Business Update, *Room 6AB*  
Mark Axford, Axford Turbine Consultants LLC  
**All registered conference attendees**

11:45 to noon GE Services Presentation, *Room 6AB*  
**All registered conference attendees**

### AFTERNOON

Noon to 2:30 Lunch/Exhibits  
**Must have name badge to enter**

2:30 to 5:30 Breakout Meetings: LM2500, LM5000, LM6000,  
LMS100  
**Users, ASPs, and GE only**

### EVENING

6:30 to 9:30 Monday Night Reception, *Room 6AB*  
**All conference attendees and registered spouses, guests must have name badge, wristband and be 21 to enter**

## Tuesday, March 14

### MORNING

7:00 to 4:00 Registration

7:00 to 8:00 Breakfast

**All registered conference attendees**  
Exhibit Hall open

**Must have name badge to enter**

8:00 to 9:30 Breakout Meetings: LM2500, LM5000, LM6000,  
LMS100

**Users only**

9:30 to 10:00 Break, *Sails Pavilion*

10:00 to noon Breakout Meetings: LM2500, LM5000, LM6000,  
LMS100

**Users, ASPs, and GE only**

### AFTERNOON

Noon to 2:30 Lunch/Exhibits

**Must have name badge to enter**

2:30 to 5:30 Special Technical Presentations  
**All registered conference attendees**

2:30 to 3:30 "CCJ Best Practices," *Room 6DE*  
"Monitoring Bearing Health with Confidence,"  
*Room 11AB*

GasTOPS Ltd  
"Firm Dispatchable Clean Power," *Room 6CF*  
Industrom Power LLC

3:30 to 4:30 "Increasing Plant Performance by 10% with  
Fogging," *Room 6DE*  
ProEnergy

"Best Practices for RCA in Context of a  
Potential Dispute," *Room 11AB*  
Exponent

"Utilizing Integrated-Path Optical  
CEMS to Meet EPA Regs," *Room 6CF*  
CEMTEK Environmental

4:30 to 5:30 "Benefits of Maintaining Emissions Systems  
and HRSGs," *Room 11AB*  
Groome Industrial Service Group

Shaft Voltage and Current on Generators,"  
*Room 6DE*

Iris Power—Qualitrol  
"Gas Turbine SCR," *Room 6CF*  
Cormetech Inc

## Wednesday, March 15

### MORNING

7:00 to 8:00 Breakfast, *Hawaiian Corridor, adjacent to  
Rooms 7-11*

**All registered conference attendees**

8:00 to 10:30 Breakout Meetings: LM2500, LM5000, LM6000,  
LMS100  
**Users, ASPs, and GE only**

10:30 to 10:45 Break, *Hawaiian Corridor*

10:45 to 11:45 GE New Products Update, *Room 6AB*  
**All registered conference attendees**

11:45 to noon Wrap-up/Adjourn, *Room 6AB*  
**All registered conference attendees**

Parts Supplier to  
End-Users  
Worldwide



Excellence Built  
from 25 Years of  
Experience

## *It's our Birthday!*

MTS is celebrating **25 years** of supporting  
LM6000 and LM2500  
End-Users worldwide, and we would like to say  
**THANK YOU**  
for being our customer.

We continue to support end-  
users as a key WTUI sponsor

**WTUI**



**LM2500**

**LM5000**

**LM6000**

**LMS100**



We Look Forward to Continuing to Be Your  
Trusted Parts Supplier

**Maximum Turbine Support**



+1 (909) 383-1626



[Sales@maximumturbinesupport.com](mailto:Sales@maximumturbinesupport.com)



[maximumturbinesupport.com](http://maximumturbinesupport.com)



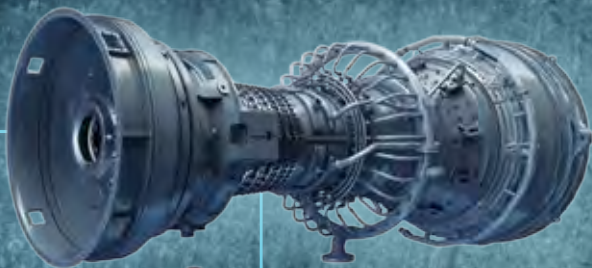
# THIS IS AERO.

## AERODERIVATIVE PRODUCTS AND SOLUTIONS FOR **POWER GENERATION**

### **LMS100\***

#### **The Adaptable**

*Part load or full load, it can lift them all.*



#### **LMS100\***

*Looking for efficiency?*

### **LM6000\***

#### **The Gourmet**

*From Ethanol to H<sub>2</sub>, its taste knows no bound.*



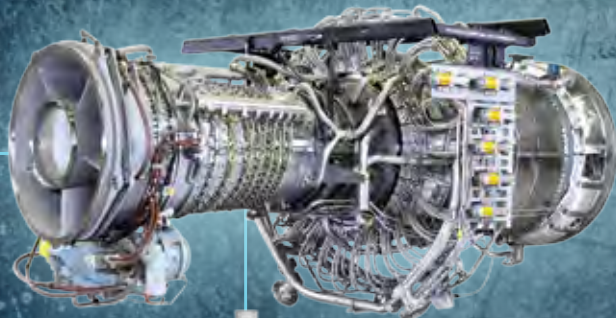
#### **LM6000\***

*50 million operating hours (OH)*

### **LM2500\***

#### **The Seasoned**

*The largest OH experience, a real trooper.*



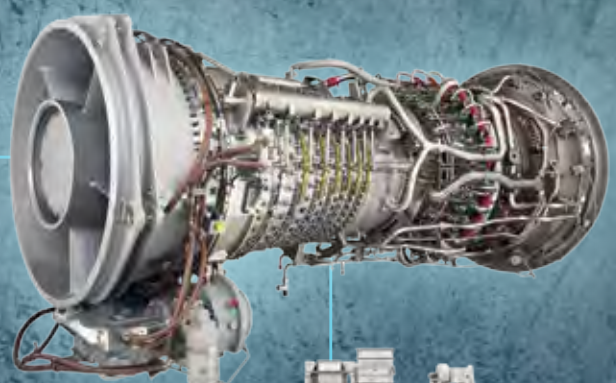
#### **LM2500XPRESS\***

*The world's most modular power plant*

### **TM2500\***

#### **The Responder**

*Shortest installation time, come rain or shine.*



#### **TM2500\***

*Power plant on wheels*





#FastFlexibleSustainable

## AERODERIVATIVE OEM SERVICE SOLUTIONS TO FIT OUR **CUSTOMER'S NEEDS**

### AERO REPAIRS LANDSCAPE

WORLD CLASS SERVICE DEPOTS TO SUPPORT ALL SERVICE NEEDS



#### **Kollsnes, Norway**

HSE for LM2500 Base/+G4 Testing for LM2500/LM1600



#### **Avenza, Italy**

MOH for LM2500 Base/+G4  
HSR for LM6000  
Testing for LM2500



#### **J-Port, Hou, USA**

MOH for LM6000, LM2500 Base/+G4 & LMS100  
Testing for LM2500/LM6000



#### **Port Klang, Malaysia**

HSR for LM2500 Base/+G4

### REPAIRS AND MAINTENANCE

Whether you're going through an event like a major overhaul or a hot section, or you have a minor repair that needs to be serviced, you can select the aeroderivative maintenance and repair solution that's just right for you.



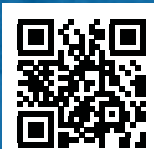
LEVEL 2 SERVICE CENTER



LEVEL 4 SERVICE CENTER

### GE CUSTOMER TRAINING

Flexible training solutions to help meet your total plant needs





Continued from p 8

tion's leadership team (p 22).

- Open discussions in user-only sessions that provide insights you'll find valuable for improving the performance of your engines.
- Access to the industry's top technical talent in the vendor fair to help you solve plant problems. Think of this as free consulting.

## The first morning

The pace of the meeting quickens after breakfast Monday as all attendees gather in Convention Center Room 6AB for opening remarks by President Ed Jackson, plant manager of Missouri River Energy Services' Exira Generating Station in Brayton, Iowa.

Recall that Jackson succeeded John Hudson, who resigned as plant manager of Orange Grove Energy Center in San Diego and left the aero world for greener pastures early in 2022. Hudson had taken the helm from Chuck Casey, utility generation manager for Riverside (Calif) Public Utilities, in April 2020. Casey served as president for seven years.

Following the introduction of officers, directors, breakout session chairs, and support staff, plus the treasurer's financial report, badge rules, and other business matters, Mike Raaker of Raaker Services LLC, the group's historian/ambassador will present on the organization's rich history of service to the industry (p 32).

Presentations by the three remaining service providers authorized by GE to work on LM engines run until the morning break.

Highlights of the first morning are presentations by Tony Brough, president, Dora Partners & Company, and Mark Axford, president, Axford Turbine Consultants. Brough will update the group on the state of the global gas-turbine market using engine-specific and geographic stats considered by many the industry's most reliable. Axford, who has presented to this group on the state of the energy industry for nearly two decades and a crowd favorite, will have his crystal ball to help attendees prepare for the future.

A short presentation by GE Services closes out the morning session.

## Engine-specific sessions

Breakout meetings for the LM2500, LM5000, LM6000, and LMS100 gas turbines, the core of WTUI's technical program, begin Monday afternoon at 2:30 and run until 5:30. Attendance is limited to users, ASPs, and GE. These sessions continue Tuesday morning from 8 to noon with a break at 9:30. However the first 90 minutes is for users only; ASPs and GE are invited to join in from 10 until lunch. Wednesday, the breakout sessions go from 8 to 10:30 for users, ASPs, and GE. Adding, that's a total of nine hours of intense information transfer from engine experts to the user community.

You can't get "training" of such high caliber anywhere else in the world.

The LM2500 program is guided by WTUI VP Garry Grimwade, who is responsible for operating and maintaining four LM6000s, four GE10s, and an LM2500-powered combined cycle at Riverside (Calif) Public Utilities. Before his involvement with land-based aero engines, he spent a decade working with "big iron," including a 700-MW merchant facility and two GE "H" frames. Grimwade, who hails from the UK, served in the US Navy as an aviation machinist's mate before investing five years at the Pacific Gas Turbine Center.

Others taking turns at the front of the room to share their knowledge include Oliver Eckert of MTU Power, Robert Smans of TCT, and Nam Tran of GE, the OEM's LM2500/TM2500 product leader. Tran will be supported by GE Gas Power's Tyler Dowty, Pedro Montiel, and Theo Sanchez, and Field-Core Service Manager Wayne Romeo. Mike Carlson, LM2500 and LMS100 program manager for the Aero Alliance joint venture between GE and Baker Hughes, also will be participating. That JV was formed to provide spare parts, repairs, and maintenance services for aero engines.

MTU's presentation is expected to address the following issues, common to all engine models in the fleet, based on plans received by the editors in January:

*Continues on p 20*

## Acronyms

Keep this list of acronyms nearby during the conference. You'll find that most speakers talk in "short-hand," using acronyms freely. If you're not up to snuff

on your aero lingo you can get lost in a hurry and possibly miss key points. The "cheat sheet" below can help you remain focused.

AGB—Accessory gearbox (also called the transfer gearbox)  
AVR—Automatic voltage regulator  
CCM—Condition maintenance manual  
CCR—Customized customer repair  
CDP—Compressor discharge port  
CFF—Compressor front frame  
COD—Commercial operating date  
CPLM—Critical-parts life management  
CRF—Compressor rear frame  
CWC—Customer web center (GE)  
DEL—Deleted part  
DLE—Dry, low emissions combustor  
DOD—Domestic object damage  
EM—Engine manual  
FFA—Front frame assembly  
FOD—Foreign object damage  
FPI—Fluorescent penetrant inspection  
FSNL—Full speed, no load  
GG—Gas generator (consists of the compressor and hot sections only)  
GT—Gas turbine (consists of the gas generator pieces with the power turbine attached)  
GTA—Gas-turbine assembly  
HCF—High-cycle fatigue  
HGP—Hot gas path

HPC—High-pressure compressor  
HPCR—High-pressure compressor rotor  
HPCS—High-pressure compressor stator  
HPT—High-pressure turbine  
HPTN—High-pressure turbine nozzle  
HPTR—High-pressure turbine rotor  
IGB—Inlet gearbox  
IGV—Inlet guide vane  
IPT—Intermediate-pressure turbine (LMS100)  
IRM—Industrial repair manual  
LM—Land and marine  
LCF—Low-cycle fatigue  
LO—Lube oil  
LPC—Low-pressure compressor (not on LM2500; just LM5000 and LM6000)  
LPCR—Low-pressure compressor rotor  
LPCS—Low-pressure compressor stator  
LPT—Low-pressure turbine  
LPTR—Low-pressure turbine rotor  
LPTS—Low-pressure turbine stator  
MCD—Magnetic chip detector  
MOH—Major overhaul  
NGV—Nozzle guide vane  
OEM—Original equipment manufacturer  
PN—Part number  
PT—Power turbine (turns a generator,

pump, compressor, propeller, etc)  
PtAl—Platinum aluminide  
RCA—Root cause analysis  
RDS—Radial drive shaft  
RFQ—Request for quote  
RPL—Replaced part  
SAC—Single annular combustor  
SB—Service bulletin  
SL—Service letter  
SUP—Superseded part  
STIG—Steam-injected gas turbine  
TA—Technical advisor  
TAT—Turnaround time  
TAN—Total acid number (lube oil)  
TBC—Thermal barrier coating  
TGB—Transfer gearbox (also called the accessory gearbox)  
TMF—Turbine mid frame and thermal mechanical fatigue  
TRF—Turbine rear frame  
VBV—Variable bleed valve (not on LM2500; just LM5000 and LM6000)  
VBVD—Variable bypass valve doors  
VIGV—Variable inlet guide vanes  
VSV—Variable stator vane  
VSVA—Variable stator-vane actuator



# We are your engine experts



Knowledge is power. So is efficiency, competence and flexibility. But above all, it is dedication and passion that make the difference. At MTU Power, we combine hands-on experience with new approaches as well as fast, global responses. And we never give up until an optimal solution has been found. This is what makes us a leading provider of cost-efficient and reliable maintenance repair and overhaul solutions for LM series turbines and their packages.

24/7 services for LM2500, LM2500+, LM5000, LM6000

[power.mtu.de](http://power.mtu.de)



# EXHIBIT HALL

132	133 232	231 Baseload Power	333 432	431 Braden	533 632	631 Score	733 832	831 VBR	933
130	131 230		331 430		531 630		731 830		931
128	129 228		329		529 628		729 828		929
126	127 226	227 326		427 526	527 626	627 728		627 928	
124		225 324		425 524		625 724		625 924	925
120	121 S J Turbine	223 322	321 OEM Parts Network	423 522	521 AGTSI	623 722	721 ProEnergy	623 922	923
		221		421		621		821	921
114	113 Brush	215 314	315 412	415 514	515 ZOK/RSI	615 714	713 814	813 Chromalloy	915
112		213 310	313 410	413 508		613 712	711 812		913
110		211 209	309	409	509 IHI	611 710	709	807 Parker Hannifin	911
108	107 MTU					609			909
106									907
104			305 404			605 704			905
102	101 Woodward	201 AP4 Group	303 400	500 GE Gas Power		603 700	701 TCT	801 Ameridrives	903
100			301			601			901

← Entrance →

## Alphabetical order by company as of Feb 13

Company	Booth	Company	Booth	Company	Booth
AAF International.....	415	CleanAir Engineering.....	310	HPI Energy Services .....	527
Advanced Filtration Concepts .....	223	Conax Technologies .....	324	HRST .....	529
Advanced Turbine Support .....	823	Continental Controls .....	625	Hy-Pro Filtration.....	821
Aeroderivative Gas Turbine Support .....	521	Core Tech Industrial.....	225	IHI .....	509
Air Hygiene International .....	722	Cormetech .....	621	Industrial Air Flow Dynamics.....	106
Airgas Specialty Products.....	400	Dekomte de Temple.....	825	Industrom Power .....	108
Alta Solutions.....	228	Detector Electronics .....	104	Integrated Power Services .....	921
Ameridrives International.....	801	Doble Engineering.....	423	Iris Power-Qualitrol.....	522
AMETEK Power Instruments .....	907	Donaldson .....	404	KAAM Group .....	413
AP4 Group.....	201	Dynamis Power Solutions.....	526	Liburdi Turbine Services.....	114
APR Energy.....	915	EagleBurgmann Industries.....	724	M & C Tech Group North America.....	628
Arkwin Industries .....	100	ECT .....	712	Marioff, NA.....	729
ARNOLD Group.....	700	Electric Machinery .....	129	Maximum Turbine Support .....	508
Baseload Power Generation Parts & Services .....	231	Electrical Maintenance Consultants.....	922	Mee Industries .....	326
BASF .....	313	eLogger .....	410	Met Weld International/ CRDX .....	913
Bearing Inspection.....	613	Emerson .....	514	MFS (Mechanical Field Support).....	925
Braden Filtration .....	812	EnergyLink International.....	704	Minimax Fire Solutions International.....	714
Braden Group .....	431	Enerpac/Sweeney Aerospace Tools .....	315	Montrose Environmental Group.....	615
Bradley Griffin.....	709	Environex.....	623	MPW Industrial Services .....	215
Brownell Aeroderivative Consulting.....	711	EthosEnergy .....	713	MTU Maintenance Hannover.....	107
Brush Services .....	113	Evident Scientific .....	909	Munters.....	430
Caldwell Energy.....	605	Exponent .....	710	National Electric Coil .....	810
California Analytical Instruments.....	531	Fossil Energy Research (FERCO).....	924	National Mechanical Services.....	828
Camfil Power Systems .....	209	GasTOPS .....	609	Nederman Pneumafil.....	227
Catalytic Combustion.....	322	GE Gas Power.....	500	Nord-Lock Group .....	305
CECO Environmental .....	425	Groome Industrial Service Group.....	329	OEM Parts Network.....	321
CEMTEK KVB-Enertec.....	303	Ground Power Parts .....	630	ORR Protection Systems.....	726
ChangeOVR Filtration .....	524	Gusto Gen .....	421	Pacific Standard Environmental ....	213
Chromalloy .....	813	HILCO Filtration.....	221		



ADVANCED FILTRATION CONCEPTS

# GAS TURBINE Filtration Products & Services

## **Air Filtration Products**

Conical/Cylindrical Filters  
Composite & Vbank Filters  
GT Inlet Accessories & Filter Media

## **GT Inlet Services**

Coil Cleaning & Inlet Refurbishing  
Evaporative Media  
Drift Eliminator

## **Full Turnkey Service**

Delivery & Installation  
Removal, Disposal & Cleanup  
Emergency Services

## **Fluid Filtration Products**

Cartridge Filters  
Mist Eliminators  
Process Filters & More!



[ADVfiltration.com](http://ADVfiltration.com)

[info@advfiltration.com](mailto:info@advfiltration.com)

323.832.8316







**Brownell  
Aeroderivative  
Consulting**  
*Power Profitability*

**LMS100**  
**LM2500**  
**LM6000**

*Reliability*  
*Availability*  
*Profitability*

**30 years experience**  
**LM/LMS Product Lines**


**12 years LMS100**  
**Product Support Leader**

[www.BrownellAero.com](http://www.BrownellAero.com)

**VISIT US  
AT BOOTH  
711**

## ONLINE PARTIAL DISCHARGE TESTING FOR MV TO EHV CABLE SYSTEMS

30+ YEARS OF EXPERIENCE EMPLOYING ONLINE TESTING  
TECHNOLOGY IN ASSESSING POWER CABLES



- Patented technology
- Assessment of the complete cable system: cables, terminations, splices and connected equipment
- Specific recommendations for maintenance actions

**doble**  
DOBLE.COM/ONLINE-PD-SERVICES

Company	Booth
Parker Hannifin .....	807
Petrotech .....	611
Precision Iceblast (PIC) .....	226
ProEnergy .....	721
Relevant/Switch Filtration .....	412
Rochem Technical Services (USA) .....	814
Rotation Solutions .....	120
Rust Automation & Controls .....	112
S J Turbine .....	121
Score Energy .....	631
SISO Engineering .....	603
Sisu Energy and Environmental .....	110
SSS Clutch .....	409

Company	Booth
Strategic Power Systems .....	301
Sulzer Turbo Services Houston .....	102
SVI/Bremco .....	905
Synergy Catalyst .....	331
T2E3 .....	311
Teledyne API .....	427
Temisa .....	923
Thermo Fisher Scientific .....	626
TOPS Field Services .....	127
Toshiba America Energy Systems .....	903
TransCanada Turbines .....	701
Turbine Technics .....	309
Turbomachinery Intl .....	827

Company	Booth
Umicore Catalyst USA .....	601
Universal Analyzers .....	211
US Cleanblast .....	926
Uspei .....	830
VBR Turbine Partners .....	831
Vector Systems .....	911
Veolia Water Technologies & Solutions .....	314
ViewTech Borescopes .....	124
Waygate Technologies .....	901
Woodward .....	101
World of Controls .....	627
ZOK/RSI .....	515

## Numerical order by booth number as of Feb 13

Booth	Company
100 .....	Arkwin Industries
101 .....	Woodward
102 .....	Sulzer Turbo Services Houston
104 .....	Detector Electronics
106 .....	Industrial Air Flow Dynamics
107 .....	MTU Maintenance Hannover
108 .....	Industrom Power
110 .....	Sisu Energy and Environmental
112 .....	Rust Automation & Controls
113 .....	Brush Services
114 .....	Liburdi Turbine Services
120 .....	Rotation Solutions

Booth	Company
121 .....	S J Turbine
124 .....	ViewTech Borescopes
127 .....	TOPS Field Services
129 .....	Electric Machinery
201 .....	AP4 Group
209 .....	Camfil Power Systems
211 .....	Universal Analyzers
213 .....	Pacific Standard Environmental
215 .....	MPW Industrial Services
221 .....	HILCO Filtration
223 .....	Advanced Filtration Concepts
225 .....	Core Tech Industrial

Booth	Company
226 .....	Precision Iceblast (PIC)
227 .....	Nederman Pneumafil
228 .....	Alta Solutions
231 .....	Baseload Power Generation Parts & Services
301 .....	Strategic Power Systems
303 .....	CEMTEK KVB-Enertec
305 .....	Nord-Lock Group
309 .....	Turbine Technics
310 .....	CleanAir Engineering
311 .....	T2E3
313 .....	BASF

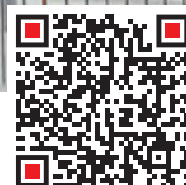
Experts in fire protection

**MINIMAX**

Protection is better than tragedy.  
Be smart. Be protected.

Spare parts, site services, maintenance, modernization for Minimax and other OEM systems. Installed firefighting systems in more than 1,000 Gas Turbines worldwide.

Join us at WTUI Conference booth 714.



[turbines@minimax.de](mailto:turbines@minimax.de) | [www.minimax.com](http://www.minimax.com)

Booth	Company	Booth	Company	Booth	Company
314.....	Veolia Water Technologies & Solutions	526.....	Dynamis Power Solutions	726.....	ORR Protection Systems
315.....	Enerpac/Sweeney Aerospace Tools	527.....	HPI Energy Services	729.....	Marioff, NA
321.....	OEM Parts Network	529.....	HRST	801.....	Ameridrives International
322.....	Catalytic Combustion	531.....	California Analytical Instruments	807.....	Parker Hannifin
324.....	Conax Technologies	601.....	Umicore Catalyst USA	810.....	National Electric Coil
326.....	Mee Industries	603.....	SISO Engineering	812.....	Braden Filtration
329..	Groome Industrial Service Group	605.....	Caldwell Energy	813.....	Chromalloy
331.....	Synergy Catalyst	609.....	GasTOPS	814.....	Rochem Technical Services (USA)
400.....	Airgas Specialty Products	611.....	Petrotech	821.....	Hy-Pro Filtration
404.....	Donaldson	613.....	Bearing Inspection	823.....	Advanced Turbine Support
409.....	SSS Clutch	615.....	Montrose Environmental Group	825.....	Dekomte de Temple
410.....	eLogger	621.....	Cormetech	827.....	Turbomachinery International
412.....	Relevant/Switch Filtration	623.....	Environex	828.....	National Mechanical Services
413.....	KAAM Group	625.....	Continental Controls	830.....	Uspei
415.....	AAF International	626.....	Thermo Fisher Scientific	831.....	VBR Turbine Partners
421.....	Gusto Gen	627.....	World of Controls	901.....	Waygate Technologies
423.....	Doble Engineering	628 ...	M & C Tech Group North America	903 ...	Toshiba America Energy Systems
425.....	CECO Environmental	630.....	Ground Power Parts	905.....	SVI/Bremco
427.....	Teledyne API	631.....	Score Energy	907.....	AMETEK Power Instruments
430.....	Munters	700.....	ARNOLD Group	909.....	Evident Scientific
431.....	Braden Group	701.....	TransCanada Turbines	911.....	Vector Systems
500.....	GE Gas Power	704.....	EnergyLink International	913.....	Met Weld International/CRDX
508.....	Maximum Turbine Support	709.....	Bradley Griffin	915.....	APR Energy
509.....	IHI	710.....	Exponent	921.....	Integrated Power Services
514.....	Emerson	711.....	Brownell Aeroderivative Consulting	922.....	Electrical Maintenance Consultants
515.....	ZOK/RSI	712.....	ECT	923.....	Temisa
521.....	Aeroderivative Gas Turbine Support	713.....	EthosEnergy	924 ....	Fossil Energy Research (FERCO)
522.....	Iris Power - Qualitrol	714.....	Minimax Fire Solutions International	925 .....	MFS (Mechanical Field Support)
524.....	ChangeOVR Filtration	721.....	ProEnergy	926.....	US Cleanblast
		722.....	Air Hygiene International		
		724.....	EagleBurgmann Industries		





**LIBURDI**  
Turbine Services Inc.

**Damaged Vane**  
(After Removal of Damaged Material)

**After Repair**

**LIBURDI TURBINE SERVICES PRODUCE THE HIGHEST YIELD RATE IN THE INDUSTRY!**

Liburdi's repair yield rate is greater than 90%, while our competitors are no greater than 50%. A higher yield rate can dramatically save your company money while reducing the need to buy new parts.

Choosing to repair your parts with Liburdi can lead to an average maintenance savings of \$400,000 - \$600,000 per engine overhaul. In other words, it pays off to keep things running smoothly with Liburdi.

[www.liburdi.com](http://www.liburdi.com) | 1-905-689-0734 | [sales@liburdi.com](mailto:sales@liburdi.com)

*Continued from p 14*

- Oil supply tube repair for the compressor rear frame (CRF), turbine mid frame (TMF), and/or turbine rear frame (TRF)—including general instructions on how repairs are made both onsite and in the shop.
  - TRF oil leakage.
  - Excessive oil mist from the package vapor separator vent.
  - Main gas strainer problem reported by a user experiencing a sudden increase in T48 spread.
  - Hot-gas-induced vibration reading traced to a crushed HP recoup gasket with material missing.
  - Water-wash automatic drain valves installed upside down causing piping to be connected to the wrong valve ports.
- TCT's program, planned at the same time as MTU's, focuses on these issues, among others:
- CRF engine mount damage attributed to a user's poor maintenance procedure.
  - Wear and tear of the lever arm for the high-pressure-compressor's (HPC) variable stator vane (VSV).
  - Update on the hinge-bracket wear associated with the dual-fuel manifold.
  - Clogging of cooling holes in high-pressure-turbine (HPT) first- and second-stage blades. Suspected gremlin: contaminated NO<sub>x</sub> water.

- Update on a LM2500+G No. 7 ball-bearing event discussed at a previous meeting. Particles observed by the D-sump chip detector increased in both size and quantity over time. Additionally, TCT will offer suggestions on (1) what constitutes a proper oil analysis, (2) best practices for preventive maintenance activities, and (3) the use of tarpaulins to protect engine shipping containers from environmental conditions.

GE is expected to begin its podium time with a review of fleet performance in terms of reliability and availability, and then review the reliability/maintainability improvements it has implemented since 2014. Next comes coverage of engine programs completed, active engine programs, best practices, package programs completed and active, and a review of product bulletins and alerts.

The OEM has extensive experience to share given the LM2500 fleet of GE power units now numbers more than 1100 engines with over 35-million service hours.

Of interest to many users will be the OEM's "How to" messages. Examples: How to avoid the four-hour lockout; reduce startup time to full load; and improve reliability and operability with a Flex 500 control system upgrade.

Attendees also will want to hear about GE's new HPT first-stage blade

and about ongoing developments in HPT second-stage-blade life extension, stiffer TMF liner axial support, reducing manifold distress in the single annular combustor, and other work.

The LM5000 session is chaired by Perry Leslie, who watches over the Yuba City Cogeneration Plant for Wellhead Services. His responsibilities there include I&C, mechanical maintenance, and operations. Leslie has served that facility since 2004 while also managing the now-shuttered Binghamton Cogeneration Plant for a brief period. Before Yuba City, he spent six years as a field service technician for GE in the Bakersfield area working on LM1600, LM2500, LM5000, and LM6000 engines. He began his career with a six-year stint in the US Navy as a GT systems technician (electrical).

Leslie's planned program encompasses the following:

- Fleet status and exit update by Air New Zealand Gas Turbines, plus the status of spare parts. Paul Humby will give a brief overview of shop repairs over the last year.
- Technical presentation by Steve Johnson of S J Turbine (Booth 121 in the Exhibit Hall).
- Sulzer is primed to present on the power turbine (Booth 102).
- Alta Solutions (Booth 228) will present on vibration analysis.
- Discussion topics include the fol-



**THE INDUSTRY'S PREMIER FUEL VALVE  
MANUFACTURER HAS MOVED TO A NEW LOCATION!**

**JOIN US FOR OUR**

# **OPEN HOUSE**

**MARCH 15, 2023 | 12:30-3:30PM**

**Lunch Served From 1-3pm**

**Refreshments and Snacks provided**

 **Free Raffle Giveaway for Attendees** 

**7710 KENAMAR COURT  
SAN DIEGO, CA 92121  
UNITED STATES**

**SCAN to RSVP or visit the link**

**[HTTPS://FORM.JOTFORM.COM/230265514696157](https://form.jotform.com/230265514696157)**



**AGV10  
TURBINE FUEL VALVE**



**ECV5  
GAS ENGINE FUEL VALVE**



# Leadership Team as of January 3, 2023

## Officers

**President**, Ed Jackson, *Missouri River Energy Services*

### Vice presidents:

John Hutson, *Anaergia Inc*

David Merritt, *Kings River Conservation District*

Garry Grimwade, *Riverside Public Utilities*

Bill Lewis, *EthosEnergy Group*

**Treasurer**, Wayne Feragen, *Noresco*

**Secretary**, Andrew Robertson, *Wellhead Services Inc*

**Historian**, Mike Raaker, *Raaker Services LLC*

## Board of directors

Todd Kutz, *Cogentrix Energy*

Dennis Johnson, *Sentinel Energy Center*

Luis Sanchez, *TransAlta Corp*

Garry Grimwade, *Riverside Public Utilities*

Andrew Robertson, *Wellhead Services Inc*

Steve Willard, *Enmax Energy Corp*

Al Van Hart, *Parkway Generation LLC*

## Conference chairpersons

**LM2500**, Garry Grimwade, *Riverside Public Utilities*

**LM5000**, Perry Leslie, *Wellhead Services Inc*

**LM6000**, Dave Fink, *Onward Energy*

**LMS100**, Steve Worthington, *Arizona Public Service Co*

**New users**, Andrew Gundershaug, *Calpine Corp*

## Support staff

**Conference executive director**: Wayne Kawamoto, *Kawamoto Power Consulting*

**Conference coordinator**: Charlene Raaker, *Raaker Services LLC*

**Webmaster**: Wayne Feragen, *Noresco*

**Golf tournament coordinator**: Jim Bloomquist

**Bowling tournament coordinator**: Tina Toburen, PE, *T2E3 Inc*



Jackson



Merritt



Hutson



Lewis



Feragen



Robertson



Raaker



Kutz



Johnson



Sanchez



Grimwade



Willard



Van Hart



Gundershaug



Worthington



Fink



Leslie



Kawamoto



Raaker



Bloomquist



Toburen

Western Turbine's leadership team consists of the officers, directors, breakout-session chairs, and support personnel who plan and execute the world's largest and most comprehensive technical meeting on GE aeroderivative engines for electric power production, gas compression, and ship propulsion. Day-to-day operations are managed by an experienced support staff.

The individuals in this army of volunteers dedicate hundreds of hours of personal time annually to keep you informed

on engine technology, operation, and maintenance.

The material presented by owner/operators, the OEM and its authorized service providers, and independent third-party providers of products and services is important and conducive to your success. Participation in WTUI meetings will help you manage your plant in a manner that maximizes revenue, efficiency, and availability/reliability, and minimizes pollutant emissions—all while maintaining the highest degree of safety.

lowing: Continuation of the megawatt-swing discussion started last year, variable geometry inspection, steam-flow-control upgrade, package component maintenance.

The LM6000 program was developed by Breakout Session Chair Dave Fink of Onward Energy with four of the industry's most knowledgeable on that

engine: Ralph Reichert of MTU Power, Robert Smans of TCT, Hiroshi Aoki of IHI, and Nasser Chraibi of GE.

Fink, an I&C technician and operator at Southwest Generation's Fountain Valley (Colo) facility, is responsible for maintenance at the six-unit LM6000 peaking plant. His power-generation career includes six years as an

electrician's mate in the US Navy and a decade as I&C technician at Calpine's Gilroy facility (1 × 1 7EA-powered combined cycle and three LM6000 peakers). Fink also spent eight years with F W Marsh LLC, supporting GE in the commissioning and field service of LM engines.

MTU's lineup of presentation topics

# Your TRUSTED ONE-SOURCE Inspection Provider.

24-Hour  
World-Wide  
Support

The Industry Leader in Experienced & Accurate  
Combustion & Steam Turbine, Generator Borescope  
& In-Situ NDE Inspections & Repairs.

## Discover the Power of Experience, Technology & Proactive Onsite Assessments.

Advanced Turbine Support has strong alliances with multiple, respected turbine and generator repair service providers. This, coupled with the knowledge and experience gained by performing thousands of inspections annually, ensures we deliver critical information to optimize your turbine's reliability and efficiency.

### Scheduling & Technical Information

Michael Hoogsteden, *Director Of Field Services*  
727.631.1467

mhoogsteden@advancedturbinesupport.com

### Business Administration & Estimates

Chris McGinley, *Operations Manager*  
352.231.5284

cmcginley@advancedturbinesupport.com

### Steam Turbine Engineering & Owners' Engineer Support

Bryan Grant, *Director Of Steam Turbine Engineering*  
207.951.6031

bgrant@advancedturbinesupport.com

### Report Reviews & Recommendations

Brett Fuller, *Field Service Manager*

404.313.0085

bfuller@advancedturbinesupport.com

### Owner Contact Information

Rod Shidler, *President/Owner*

352.302.2364

rshidler@advancedturbinesupport.com

Rick Ginder, *CEO/Owner*

352.262.5448

rginder@advancedturbinesupport.com



[AdvancedTurbineSupport.com](http://AdvancedTurbineSupport.com)

## NOW OFFERING

- ✓ Expanded In-Situ  
Aft Compressor  
Blending &  
Eddy Current
- ✓ Turbine Disk  
& Compressor  
Steam Cleaning
- ✓ Part Retrieval
- ✓ Robotic Generator  
& EICid Inspections
- ✓ Steam Turbine  
Engineering  
Services



Follow Us on LinkedIn



# HONOR ROLL

WESTERN TURBINE USERS INC  
OFFICERS AND MEMBERS OF THE BOARD OF DIRECTORS  
1990-2023

Jim Amarel  
Dan Arellano  
Bryan Atkisson  
John Baker  
Leon Ballard  
Jim Bloomquist  
Alvin Boyd  
Mark Breen  
Charles Byrom  
Bill Caldwell  
Chuck Casey  
Devin Chapin  
Jack Dow  
Don Driskill  
Norm Duperon  
Todd Emery  
Wayne Feragen  
Bob Fields  
Ken Gestel  
Garry Grimwade  
Andrew Gundershaug  
Don Haines  
Brad Hans  
Dave Hermanson  
Jim Hinrichs  
Howard Hoffmann  
Charlie Hoock  
Mike Horn  
Brian Hulse  
John Hutson  
Ed Jackson  
Dennis Johnson

Steve Johnson  
Wayne Kawamoto  
Jon Kimble  
Marc Kodis  
Thomas Koehler  
Todd Kutz  
Charles Lawless  
Joel Lepoutre  
Bill Lewis  
James Mearthur  
Bob Mccaffrey  
Ronnie Mccray  
Rick Mcpherson  
David Merritt  
Rob Nave  
Bob Nelson  
Brent Newton  
Frank Oldread  
Paul Park  
Mike Raaker  
Rich Recor  
Andrew Robertson  
Luis Sanchez  
Harry Scarborough  
Tony Skonhovd  
Richard Smith  
Ernie Soczka  
Don Stahl  
John Tunks  
Al Van Hart  
Jermaine Woodall  
Jimmie Wooten

includes these:

- Domestic object damage (DOD) caused by T48 thermocouple probes.
  - Effect of fifth-stage HPC blade event on work scope.
  - Standard service bulletins for overhaul work scope.
  - Consequences of contaminated Sprint water.
  - Service bulletin update of experiences:
    - SB349, improved HPC first- and second-stage inner shrouds.
    - SB340, improved HPT Stage 2 nozzle segments.
    - SB342/348, introduction of the 4B/5R bearing with nitride hardening.
    - SB323, improved O-rings of Aflas material in the TRF sump.
  - Failure to light off because of fuel-system fine-particle contamination.
  - Low-performance troubleshooting (eighth-stage valve issue).
  - Causes and consequences of thermal-barrier-coating (TBC) loss on B-ring heat shields.
- TCT plans to present on these topics:

- LPC corrosion. Severe corrosion was identified in 2022 on four Stage-0 discs, two Stage-1 discs, and on the forward shafts of four machines.
  - LPC Stage-0 disk inspection (SB356/357).
  - VSV actuation-ring fretting.
  - VSV lever-arm cracking.
  - Bolt-hole corrosion at the 4R bearing found on two LM6000PC engines.
  - HPT second-stage outer- and inner-band erosion and cracking.
  - Introduction to new second-stage nozzle assemblies for the HPT.
  - Variable-geometry pump gear-teeth wear.
  - Lube-oil-system chip detectors and interpretation of results, with recommended corrective action.
- IHT's lineup of presentation topics includes the following:
- Failure of the No. 5 bearing and oil shield in the CRF.
  - Failure of the No. 4 bearing in the CRF.
  - Inspection of VSV housing bolts for HPC Stages 3-5, including checking of the bolt locking feature.
  - Fretting of LPT fifth-stage disc dovetail serrations.
  - VIGV forward inner-case corrosion.
- GE is prepared to update attendees on HPC first-stage-blade mid-span shroud concerns, dovetail coating refurbishment of HPC blades in Stages 3 to 5, VSV bushing durability, 11th-stage check valves, T48 thermocouples, LPT PCC flex joint, HPC 14th-stage blade distress, HPC VSV inner-shroud bushing wear, lifting-equipment load-test certification, VBV transition-

# Smarter catalysts: two in one Better emissions compliance

Clean air is our business. The GTC-802 (NO<sub>x</sub>/CO-VOC) "Dual Function" catalyst will help your plant meet stricter emission standards while improving performance and profitability. **GTC-802 combines two catalysts in one, delivering both superior NO<sub>x</sub> reduction and outstanding CO and VOC oxidation.** Lowest pressure drop, near zero SO<sub>2</sub> oxidation and reduced ammonia slip add up to improved heat rate, increased power output and fewer cold-end maintenance issues. GTC-802 is positioned downstream of the ammonia injection grid in the same location as the current SCR catalyst. As an added benefit, the catalyst allows direct injection of liquid ammonia or urea in place of the traditional vaporized ammonia.



duct cracking, exhaust diffuser and clamshell cracks, jacking-oil hoses for Brush DAX generator.

In addition, Strategic Power Systems will present on the value of its Operational Reliability Analysis Program (ORAP®) and the impact of forced-outage incidents (number of incidents, number of plants affected, hours of outage time) during 2022. This is a session highlight.

The LMS100 session is guided by Steve Worthington with OEM input from Tim Schneck. Worthington is the facility manager of Arizona Public Service Co's Ocotillo Power Plant, with responsibility for an eclectic fleet of peaking gas turbines: five LMS100s, 10 LM6000s, four W501AAs, one GE 7EA, and one GE Frame 5. Prior to joining APS a decade ago, he held responsible positions at several eastern utilities. Worthington is a 12-year US Navy veteran.

The only attendees invited to LMS100 sessions are GE employees and users. No ASPs are licensed by GE at this time to work on the LMS100. The editors did not receive an outline of planned presentation content prior to the WTUI meeting.

## Special technical presentations

Tuesday afternoons at Western Turbine meetings are reserved for nine Special Technical Presentations, approved by WTUI leadership, to extend the meeting's content beyond the four GE aero engines on the program. The hour-long presentations (with Q&A) are arranged in three parallel sessions beginning at 2:30, 3:30, and 4:30. Highlights:

### 2:30

Best practices, *Scott Schwieger, CCJ*. Best practices submitted to CCJ as part of its annual awards program, sponsored by the periodical and WTUI, will be reviewed, with open discussion to follow. Attendees are invited to share their best practices at their seats.

Monitor bearing health with confidence, *Simon Wilson, GasTOPS*. Bearing damage events and unreliable detection technologies are leading causes of unplanned outages and unexpected costs. Damage develops gradually and may be predicted accurately with the proper detection tech-

nology—such as GasTOPS's Oil Debris Monitoring technology, available since the mid-1990s.

It combines the company's online MetalSCAN product with its offline advanced troubleshooting capabilities (oil, filter, and chip analysis) to provide an accurate picture of bearing health.

Firm, dispatchable clean power, *Paul Angel, Industrom Power*. Presenter has deep knowledge of LM products having spent more than 30

and air injection. The R&D process is discussed, along with current performance gains, and the path toward increased power and profitability in any climate.

Best practices for root-cause analysis in the context of a potential dispute, *Dr Ty Porter, PE, and others, Exponent*. Industrial failures often have the potential for a dispute between two or more parties related to liability for causation and, ultimately, responsibility to recover unexpected costs from the outage.

Unintentional improper handling of physical evidence and information can have a negative impact on the outcome of a potential dispute regardless of the technical reasons for the failure.

Focus of the presentation is best practices for plant personnel and other involved parties following an unexpected failure in the context of a potential dispute—including evidence handling and storage, provenance of email and other written communications, and information/data management. Case-study examples are included.

Utilizing integrated-path optical CEMS (IP-CEMS) to meet EPA regulations, *Mari-za Mendoza, Cemtek KVB-Enertec*. Focus of the presentation is the technology, costs, maintenance, and calibration requirements associated with the use of IP-CEMS technology. It uses cross-stack Tunable Diode Laser Spectroscopy (TDLS) and Differential Optical Absorption Spectrometer (DOAS) to monitor gas emissions for CO<sub>2</sub>, CO, NO, NO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, HCl, and NH<sub>3</sub>, in lieu of traditional extractive CEMS to meet EPA 40CFR60 regulations.

Mendoza will share the information needed to evaluate use of this technology at your plant—including a cost comparison to extractive CEMS, spare parts, maintenance, calibration, etc. Case studies of recent installations are included, plus a review of a demonstration test performed to meet EPA 40CFR75 for a gas turbine operating on natural gas.

### 4:30

Shaft voltage and current monitoring, *Sunny Gaidhu, PE, Iris Power (Canada)*. Shaft monitoring can provide early warning of rotor, stator, and bearing insulation problems, as well as grounding-brush condition, to support safe operation of large generators.

## Badge Rules

### Blue

User members who are registered conference attendees

### Yellow

Authorized Service Providers (TCT, MTU, IHI, ANZ) + GE

### Red

Exhibitors

### Black

One-day pass, Monday only (excludes dinner)

Must have membership

### Purple

One-day pass, Tuesday only

Must have membership

### Green

Press, publication companies, approved guests, SPS note-takers

Requests submitted by special interest groups/individuals which have been approved in advance by the board of directors

### Gray

Board of directors, officers, and staff

Elected members of the board of directors, appointed officers, and conference staff

years with GE Aviation and GE Power before joining Industrom Power. He was an LMS100 product line leader for the OEM and earlier had design and product-line responsibilities on the LM2500 and LM6000.

Angel will speak to a new clean-energy technology/system that recovers waste heat to produce electric power. The carrot is 20% more power and a heat-rate improvement for an LM6000 powerplant.

His presentation begins with an overview of the technology, how it works, and a demonstration timeline. Next, the components of a 10-MW product for use with LM6000 engines will be discussed—including performance improvements. An energy balance, startup times, and other operational benefits also are covered.

### 3:30

Increasing LM6000 turbine plant performance by 10% through wet fogging, *Paul DiMascio and Chris Evans, ProEnergy*. Presentation focus is on "R&D in action." Wet fogging is compared to other power-augmentation strategies—such a low-pressure water spray, evaporative cooling,

The NOXCO logo is displayed in a large, white, sans-serif font. The 'X' is stylized with a blue diagonal line through it. The background of the top banner is a dark, industrial scene with various pipes and structures.

GUARANTEED EMISSIONS.  
RISK-FREE COMPLIANCE.

# **NOXCO raises the bar with the very first LTSA for emissions compliance.**



We're removing the burden and responsibility of protecting & managing complex emission systems for power plants. We're delivering performance, predictability, cash flow, and 100% risk mitigation through a turnkey solution.

## **Turnkey solutions for:**

Independent Power Operators | Regulated Industries  
Power Plant Management Teams | Investors

---

**Contact us today to learn more.**



844-GO-NOXCO **844-466-6926**  
[www.gonoxco.com](http://www.gonoxco.com)



# Integrated Powertrain Solutions

**COMPREHENSIVE AND FULL-TRAIN SOLUTION  
PROVIDER OF ALL VARIANTS OF LM2500 (BASE, +  
& +G4) SERIES GT PACKAGE AND POWER TURBINES**

For more than 30 years, Siemens Energy has designed and manufactured more than 300 LM Series-driven gas turbine packages for mechanical drive and power generation applications. Many of these packages have utilized Siemens Energy's original equipment, including power turbines, centrifugal compressors and control systems. This packaging experience, when complemented with Siemens Energy's aero-derivative package and overhaul support capability, enables Siemens Energy to provide comprehensive support services for your entire LM package.



# State of the Art Overhaul & Repair Facility

## LM2500 (BASE, + & +G4) SERVICE OFFERINGS:

Our wide range of services includes Major Overhaul, Repair, M&U, Parts Supply, Diagnostic Studies, Leases, and exchanges (Hot sections, GG, GT). With an extensive fleet of over 850 OEM units and 38 million operating hours, we are uniquely positioned to support all your service needs while minimizing maintenance costs and maximizing unit efficiency and availability.

✉ [shivanand.manjit@Siemens-energy.com](mailto:shivanand.manjit@Siemens-energy.com)

📞 +1 (407) 758-2287



Shaft current and voltage signals are transmitted to instrumentation to facilitate continuous monitoring and processing of shaft grounding current and shaft voltage. This information can be used to do the following:

- Evaluate grounding-brush performance.
- Provide early warning of problems.
- Improve the quality of diagnostics if used in conjunction with other monitors—such as shorted rotor turns, vibration, etc.

A case study completes the presentation.

Benefits of servicing and maintaining gas-turbine emissions systems and HRSGs, *Jeff Bause, Groome Industrial Services Group*. Company's KinetiClean, EPRI-certified, is proven technology for cleaning HRSG heat-transfer surfaces to increase energy output, strengthen the bottom line, and reduce the risk of fines and regulatory action that can result from air-permit noncompliance. Presentation describes the system, discusses its installation and removal, and shares proven results.

Gas turbine SCR, *Dan Johnson, PE, Cormetech Inc.* Focus is on advancements in catalyst technology to serve gas-turbine assets in a changing world.

## WTUI 31 (2022)

WTUI's 31st annual meeting was a virtual production given lingering concerns about Covid-19 and its many variants. More than 600 owner/operators participated worldwide, with the all-participants number around 975. The increase in total attendance of about 125 registrants over the virtual 30th conference a year earlier indicated an increasing level of comfort with the online format for sharing technical information.

The program was divided into 11 half-day segments over a four-week period. The highlights:

**Day 1**, President Ed Jackson's welcome; gas-turbine market update by Tony Brough, president, Dora Partners; industry forecast and commentary by Mark Axford, Axford Turbine Consultants.

**Day 2**, LM-engine refresher workshop led by Andrew Gundershaug of Calpine; overviews of field and shop capabilities by GE and its Authorized Service Providers (MTU, TCT, ANZGT, and IHI).

**Day 3**, LM6000 with an LM5000 breakout session. ORAP® (Strategic Power Systems' Operational Reliability Analysis Program) analysis of fleet performance and Top 10 causes

of forced outages by SPS's SVP Tom Christiansen; details of shop/field findings in the last year from MTU, TCT, and IHI.

**Day 4**, LMS100. ORAP analysis of fleet performance and Top 10 causes of forced outages; GE updates of field and shop solutions.

**Day 5**, LM2500. ORAP analysis of fleet performance and Top 10 causes of forced outages; details of shop/field findings in the last year from MTU, TCT, and ANZGT.

**Day 6**, LM6000. GE updates of field and shop solutions.

**Day 7**, LM6000. User presentations and roundtable discussion.

**Day 8**, LM2500. User presentations and roundtable discussion.

**Days 9-11**, Special Technical Presentations from ProEnergy, ARNOLD Group, EMW filtertechnik, Cemtek KVB-Enertec, HRST, SISU Energy and Environmental, Woodward, Siemens Energy, GasTOPS, EnergyLink International, Nord-Lock Group, and AGT Services.

## Aero library

WTUI and GE have collaborated to make available to owner/operators recordings or PowerPoints of key presentations made at the 31st (2022) annual conference. Abstracts below highlight the topics covered to facilitate selection of the presentations of greatest value to you and others at your plant.

The Western Turbine videos are available on its Basecamp Forums by searching "2022 WTUI Virtual Conference Links." To gain access to the forums, users must request same, by email, from Webmaster Wayne Fera-gen at [wferagen@wtui.com](mailto:wferagen@wtui.com). GE's presentations on the LMS100, LM6000, and LM2500 are available through the OEM's myDashboard website. The link for GE users to register or sign on to myDashboard is <https://registration.gepower.com/registration>.

Find abstracts of the Special Technical Presentations made during the final three days of the conference in the last section of this report. If you need more detail, please contact the company directly.

**Axford's industry forecast and commentary and Brough's gas-turbine market update (2021 data).**

Talking points: US war on fossil fuels accelerates, only one large combined-cycle order in 2021, big sales rebound for LM2500s and LM6000s, federal obstruction explains much of the decline in GT orders, wakeup call in Texas after the big freeze, LNG projects (new and delayed), batteries and lithium, hydrogen, carbon capture, and

much more.

**Engine refresher workshop.** Covers engine basics; reviews acronyms; drawings abound on lube-oil system and bearings, accessory gearbox, and engine layout from variable inlet guide vanes through the turbine rear frame with valuable drawings of each section/module/component; generator and its principal components. Highly recommended by the editors to guide in-plant training.

**LM6000 ORAP analysis.** Major contributors to downtime in 2021; Top 10 contributors to forced-outage incidents. Regarding the latter, combustion was at the top of the list with more than 100 incidents at 20 plants; controllers and software were next with issues identified at 33 plants; gas fuel metering and staging valves were in the third position; vibration, fourth, led all contributors in outage hours.

**LM6000 session with IHI.** Principal topics: Fretting of LPT fifth-stage-disc dovetail serrations, SAC combustor failure, No. 3 bearing stationary oil seal, leading-edge damage on HTP second-stage nozzles.

**LM6000 session with TCT.** Topics: Rosan fittings in the accessory and transfer gearboxes, fan mid-shaft corrosion, missing/loose heat shields on DLE combustors, leaking CRF oil manifold, update on LPT first-stage nozzle distress, shipping container maintenance and upgrades, handling and maintenance considerations for package hoisting.

**Videos also are available of** MTU's LM6000 presentation and of the LM2500 ORAP, TCT, ANZGT, and MTU presentations.

## Special Technical Presentations

### GasTOPS

*Monitor bearing health with confidence*

Debris monitoring of scavenge oil



**GasTOPS's MetalSCAN sensor** detected ferrous debris in an LM6000's A-sump after the engine had been operating continuously for 12,500 hours. A lease engine was ordered while operation continued, allowing O&M personnel the time necessary to plan the overhaul and avoid what was estimated to be a 96-hr forced outage



**Shaping the future of  
gas turbine washing**

[zok.com](http://zok.com)

  
 imagination at work



  
 A Caterpillar Company



  
 A United Technologies Company









  
 MINISTRY OF DEFENCE



Before Washing





After Washing

**Zokman Products Inc.**  
 US Veteran Owned Small Business, 1220 East Gump Road, Fort Wayne, IN 46845-9794  
 PH: 1-260-637-4038 / Toll Free USA: 1-800-727-6027 / FAX: 1-260-637-5031 / Toll Free USA: 1-800-844-3227  
 Email: [zzokman@aol.com](mailto:zzokman@aol.com)  
 Cage Code: 1NCU0

alerts on the onset and progression of bearing/gear damage by detecting both ferrous and non-ferrous particles. This helps owners and operators decide how much longer than can operate an engine with incurring a forced outage. Oil debris monitoring is said to provide the earliest warning of damage. Thus, it is proactive, not reactive like chip detectors, vibration monitors, and spectrometric oil analysis.

Sensors, which fit inline on the scavenge discharge, are said to be reliable and not produce false positives. Installation typically can be done in a day; the ROI usually is a year or less.

Advanced O&M troubleshooting

is said to include the company's MetalSCAN (online, real-time indication of damage), FilterCHECK (offline, extraction of filter debris), and ChipCHECK (offline, alloy identification of debris) components.

#### Arnold Group

*Optimized insulation for gas turbines*

Pierre Ansmann opened his presentation to point to problems with insulation systems avoided by use of his company's 3D-shaped blankets that fit perfectly to the shape of exhaust-system components—including the following:

- Interlocking steps between blankets, and use of stainless-steel foil and super-tight wire mesh, virtually eliminate vibration damage.
  - Blanket damage requiring repair/replacement every outage.
  - Surface hot spots conducive to insulation damage.
  - Overheated noise enclosure.
  - Loose fibers and dust that cause health and safety issues.
- A series of photos provides details.

#### EMW filtertechnik

*Better filtration pays for itself*

This is Part 2 of Florian Winkler's presentation; the first part was delivered at WTUI 30. A summary of that presentation appeared in CCJ No. 69, p 20.

Winkler brought attendees up to date on ISO 29461, the new test standard for air intake filter systems protecting rotary machinery. He compared lab test results versus results under real operation for initial pressure drop, efficiency values, classification and dust holding capacity.

Conclusions drawn:

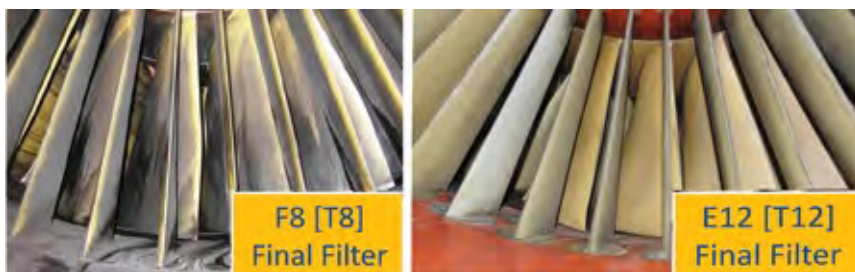
- E10 should not be considered as a final filter for gas turbines.
- Classes of filters with efficiencies higher than E10 show larger pressure drops initially but the rate of their DP increases slows over the service lifetime.
- In both the short- and long-term, E12 filters support top performance



**Arnold Group** insulation systems for LM2500 and LM6000 engines are designed for a perfect fit to the gas turbine, thereby maximizing the lifetime of the thermal shield







EMW filtertechnik tests showed the dramatic difference in the condition of compressor blades after 5000 hours for units with F8 final filters (left) relying on online and offline washing versus those with E12 filters without washing (right)

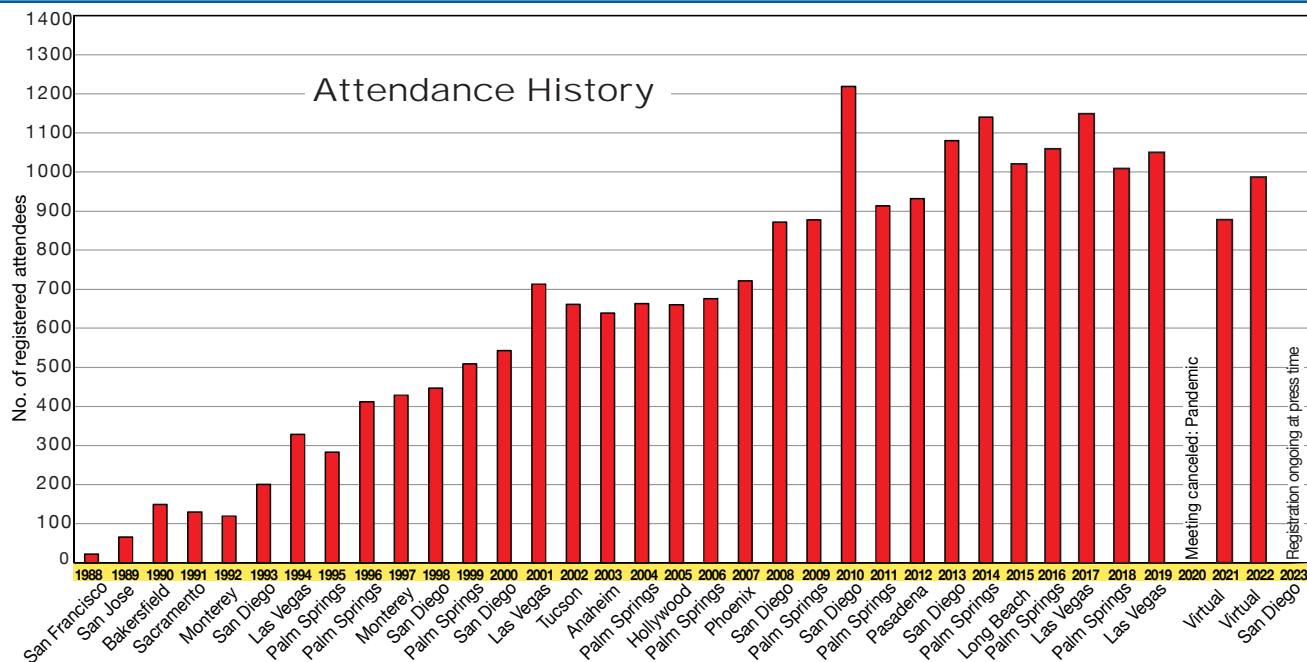
and high availability for gas turbines.

- Key performance indicators such as dust holding capacity are of relatively low significance, especially for high-efficiency HEPA filters.

#### AGT Services Inc

*Outage planning: Don't forget your moneymaker—the generator*

Jamie Clark began by urging attendees to get a baseline condition assessment of their generators as soon as possible and to fix what's required



## Western Turbine Users—a historical perspective

*Editors note: The timeline below was compiled from many contributors and is not complete by any means, but it offers a perspective on how the Western Turbine Users Inc (WTUI) came to be and the positive impact it has had on electricity supply worldwide. The organization was founded, built, and is operated by cadre of highly motivated volunteers dedicated to providing a robust forum for the exchange of technical, operations, and maintenance information and experience to improve the reliability and economic viability of GE LM-series power-generation facilities.*

**1939** The first utility gas turbine to generate electricity, rated 4 MW and developed by Brown Boveri & Cie of Switzerland, is commissioned in the town of Neuchatel.

**1967** IHI, one of the three ASPs supporting WTUI technical sessions, begins working in the areas of gas-turbine power generation equipment

and cogeneration operations.

**1969** GE launches the LM2500 engine; marine propulsion is the first application.

**1971** First industrial use of an LM2500 is in the oil and gas industry.

**1979** LM2500 is first used in power generation service.

**1982** A handful of users responsible for O&M at several West Coast LM2500 generating facilities and the first LM5000 cogen plant at Simpson Paper Co (Shasta mill) in Anderson, Calif, begin meeting every couple of months in break rooms to discuss problems/solutions, best practices, lessons learned. This is the beginning of what would become WTUI. The host plant was responsible for coffee and lunch.

IHI's first LM5000 begins operating in the US.

Stewart & Stevenson receives its first US LM2500 genset order for

the Hawaiian Independent Refinery Inc. It begins operating the following year under the watchful eye of HIRI's 20-something lead engineer, Wayne Kawamoto, later elected WTUI's first treasurer.

The first West Coast LM2500PC installed by GE's Turbine Business Operations Div (TBO) is commissioned at Procter & Gamble's Oxnard (Calif) manufacturing plant as a Purpa-qualified cogeneration package. Mike Raaker, WTUI's historian/ambassador, was the technical engineer assigned to that project by P&G.

**1983** Simpson Paper Co (Shasta mill) commissions the first LM5000 installed in the US. Steve Johnson, one of WTUI's early proactive users, has responsibility for the engine and quickly becomes expert in operating and maintaining the problematic GT model. Visit Johnson, now owner of SJ Turbine, in the Exhibit Hall, Booth 121.

**1985** The LM5000 at Simpson



to assure reliable service—even if it takes a major to do it. Clark suggested consideration of robotic inspection

**AGT Services** suggests consideration be given to robotic inspection, when possible, to avoid removal of the field

tions in lieu of field removal where possible and offered the pros and cons of using robots.

He also recommended a re-evaluation of the timeline for future inspections where there have been significant changes in operating duty.

Clark touted the value of electrical tests for the stator, focusing on the following:

- Winding copper resistance, each phase.
- 5-kVdc insulation resistance and PI, each phase.

Paper Co (Shasta mill), which went commercial in May 1983, serves as the beta test site for the development of steam injection. Tests were successful and brisk sales of LM5000 STIG80 and STIG120 gas turbines followed.

**1988** TransCanada Turbines Ltd (TCT), one of the three ASPs, is established as a joint venture between the Wood Group and TransCanada Corp.

**1989** Power Systems Engineering Inc is purchased by Dow Chemical Co and the business is renamed Destec Energy Inc.

**1990** WTUI incorporates in the fall. Bylaws are developed.

**1991** Strategic Power Systems Inc (SPS) begins collecting O&M data for GE, sharing this information with WTUI. SPS has worked collaboratively with the WTUI leadership since incorporation.

The first LM6000PA designed for NO<sub>x</sub> control by use of water or steam injection goes into service.

**1992** John Tunks resigns as president of WTUI and Jim Hinrichs is elected to succeed him.

**1994** The first LM6000PB, equipped with a dry low emissions combustion system (DLE), begins operation. It produces less than 25 ppm NO<sub>x</sub>.

**1995** Simpson Paper Co's LM5000 STIG80 in Anderson, Calif, reaches 100,000 operating hours.

**1996** California begins its first experiment in retail electricity competition. John Fintland, owner and founder, Advanced Filtration Concepts Inc, participates in his first WTUI meeting and hasn't missed exhibiting since.

Larry Flood is appointed WTUI's first webmaster. He remains in that position until Wayne Feragen relieves him in 2006. Feragen continues in that position today, among others. The first LM2500+ rolls off the production line.

**1997** The first Model PC and PD engines leave the GE factory.

Jack Dow and Mike Raaker retire from the WTUI Board of Directors. Dow was elected secretary in 1998, a position he held until 2008. Raaker was elected VP in 2002 and remained in that position until retiring in 2010. He currently serves as the organization's ambassador and historian.

The first LM6000PC (SAC) and PD (DLE) models, more powerful than the earlier PAs and PBs, achieve commercial operation.

**1998** LM6000 highlights include a variable-speed mechanical-drive option, commercial operation of the first dual-fuel DLE combustor, and first commercial operation of the Model PC Sprint™ (Spray Intercooled Turbine) system.

Stewart & Stevenson sells its gas-turbine business to GE as Mark Axford leaves S&S to launch the consulting firm that bears his name.

**2000** More than 200 LM6000s have entered commercial operation since the model was introduced in 1991.

More than 23,000 MW of GT capacity begins operating in this first year of what came to be known as the "gas-turbine bubble." From 2000 through 2004, a nominal 200,000 MW of GT capability is installed in the US. During the same period, WTUI attendance grows by nearly 30%.

Dynegy generating plants are sold to El Paso Merchant Energy, which four years later sells its powerplants to Northern Star Generation LLC, illustrating the volatile nature of the independent power business.

**2001** Base-load cogeneration contracts begin transitioning to cycling/peaking agreements.

TCT begins supporting technical sessions for the annual WTUI meetings. This effort continues today.

**2002** GE pulls its support for WTUI.

**2004** Aeroderivative Gas Turbine Support Inc exhibits only months after the company is founded by Alan

Mibab, who had been attending the show for years in another vendor's booth. AGTSI has not missed a meeting since.

GE-authorized ASPs begin providing technical support to WTUI and its membership.

**2005** Editors of the Combined Cycle Journal attend their first Western Turbine meeting. It was the beginning of a close collaboration with the WTUI Leadership Team, benefiting CCJ's coverage of LM engines as well as users and vendors in this industry sector.

**2006** First LMS100 engine, rated a nominal 100 MW and having an efficiency of 46% (LHV) in open-cycle operation, enters commercial service for owner/operator Basin Electric Power Co-op at the utility's Groton (SD) Generating Station.

**2007** A new management team at GE reinstates the company's support of WTUI.

Riverside Energy Resource Center, a four-unit LM6000-powered peaking facility managed by WTUI Director Chuck Casey, earns CCJ's Pacesetter Plant Award for the design of a zero-liquid-discharge system that has demonstrated its ability to satisfy the often-conflicting goals of regulatory compliance and affordable capital and operating costs.

Steve Johnson, a former WTUI director, makes a career change and launches SJ Turbine Inc (Exhibit Hall Booth 121).

**2008** Advanced Turbine Support LLC's President Rod Shidler and Field Service Director Mike Hoogsteden display the firm's capabilities at WTUI for the first time. They haven't missed a meeting since. Visit them in the Exhibit Hall (Booth 823).

Chuck Casey is elected secretary of WTUI, a position he retains until his election as president in 2013.

Jim Hinrichs and Jack Dow become the first WTUI officer/director retirees to earn lifetime membership in



- Dc leakage, each phase.
- 1-min dc hipot at 38.25 kV, each phase.
- Resistance check and 1-min 500-Vdc megger of all RTDs.

As for what to inspect on the stator, he listed the winding, endwinding support system, wedge system, gas-gap baffle studs, rubber baffles, bushing box, and stator core (for tightness, iron migration, damaged/overheated laminations, and vent duct blockage).

Photographs included in the pre-

sentation help users understand what to look for and how to evaluate what their level of concern should be.

Moving to the field (rotor), Clark recommended these electrical tests:

- Winding copper resistance.
- Insulation resistance and PI.
- Ac impedance test.

As for what to inspect on the field, he recommended checking the following under the retaining rings: field winding/brazes, turn insulation, migration of slot insulation, move-

ment of blocking, main lead, coil-to-coil jumper, and pole-to-pole jumper. He also suggested examining the field body for wedge/retaining ring contact, wedge movement, heating, vent blockage, and balance weights.

#### Cemtek KVB-Enertec

*Tunable Laser Spectroscopy (TDLs) for NH<sub>3</sub> compliance, inlet monitoring, and stack EPA compliance monitoring*

The motivation for Gary Cacciatore's presentation is on his sec-

the organization.

Jon Kimble succeeds Jim Hinrichs as president of WTUI and serves in that capacity until his retirement in 2012.

WoodGroup Pratt & Whitney opens a shop in Florida to overhaul LM2500s and FT4s. The business is not sustainable long-term.

**2009** Bob Nelson's battle with cancer ends at age 46. The former WTUI director was SMUD's superintendent of thermal projects, highly regarded by industry peers and well liked. Nelson's recipe for professional success: "No serial number ones."

Groome Industrial Service Group presents its capabilities in SCR and CO catalyst cleaning at WTUI for the first time. Jeff Bause, CEO, has been a regular participant since.

Terry Bundy Generating Station, powered by LM6000s and managed by WTUI Director Brad Hans, receives CCJ's Best of the Best Award for its water conservation program that includes recovery of nearly 1000 gal/hr of condensate from inlet-air cooling systems during a hot, humid summer day.

IHI partners with Reed Services Inc in the Cheyenne Service Center equipped especially for supporting LM6000 owner/operators.

**2010** WTUI's 20th anniversary celebration is held aboard the USS Midway.

**2011** Lincoln Electric System's LM6000-equipped Terry Bundy Generating Station, managed by WTUI Director Brad Hans, receives a CCJ Best Practices Award for its state-of-the-art ammonia-tank leak-suppression system. Successful demonstration of the spray system significantly reduced both risk to plant personnel and the potential for offsite exposure.

TCT opens its state-of-the-art 220,000-ft<sup>2</sup> repair and overhaul facility in Airdrie (near Calgary).

**2012** Chuck Casey replaces Jon Kimble as president of WTUI.

WoodGroup Pratt & Whitney with-

draws from its LM2500 overhaul offering.

**2013** Riverside Public Utilities' Clearwater Cogeneration Plant, managed by the then LM2500 Breakout Session Chair John Baker, contributes to an advancement in the state of the art developed by Fossil Energy Research Corp (Exhibit Hall Booth 924) for determining the remaining life of SCR catalyst in-situ.

TCT expands its testing facility to better support the LM6000 PA, PB, PC, PD, and PF engines.

Wood Group and Siemens' TurboCare form the joint-venture company EthosEnergy Group, specializing in the maintenance, repair, and overhaul of gas and steam turbines.

**2014** Alliance Pipeline shares with LM users its experience in using HEPA filters on gas-turbine air inlet systems. Details are provided in CCJ's special publication for WTUI's 24th annual meeting. The company gave HEPA two thumbs up based on four years of normal pipeline use and rigorous analysis of results.

Jim Hinrichs, past president and the face of WTUI for two decades, passes unexpectedly during a back operation.

**2015** MTU, one of the three ASPs, closes in on 20 years of participation at WTUI.

WTUI celebrates its 25th anniversary.

GE launches its LM6000PF+, said to be the most-efficient aero for combined-cycle service.

**2016** ProEnergy gains success as an independent aero depot—performing scheduled maintenance, emergency outages, and everything in between for owner/operators of LM6000 and LM2500 gas turbines. Its Level IV service facility is centrally located in Sedalia, Mo. Visit ProEnergy in the Exhibit Hall at Booth 721.

**2017** Wayne Kawamoto, Western Turbine's treasurer since incorporation in 1990, retires as plant manager of

the LM5000-powered Corona Cogen facility and resigns as an officer of the user group on the last day of the year.

**2018** Wayne Kawamoto is appointed WTUI conference executive director on the first business day of the year.

The California-based user group opens its first office at 25201 Paseo de Alicia, Ste 215, Laguna Hills 92653.

**2019** Baker Hughes emerges as an important provider of services to the LM community. Baker Hughes Co, which merged with GE Oil and Gas in 2017 to become Baker Hughes, a GE company, divests from GE and re-establishes itself as Baker Hughes Co. GE owns 38% of the new company.

**2020** The organization's 30th anniversary meeting is canceled because of the Covid-19 pandemic, just a couple of weeks before its scheduled start in the Long Beach Convention Center.

Chuck Casey resigns as president of WTUI, having served the group in that capacity for seven years. John Hutson is elected his replacement.

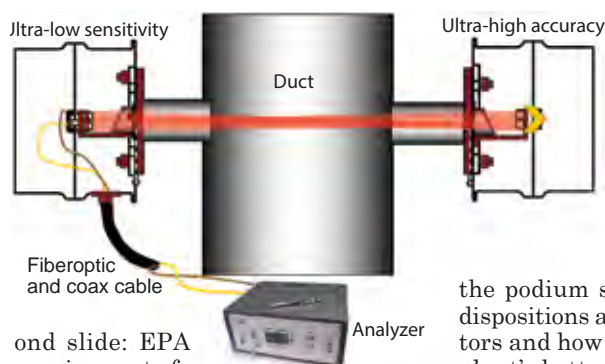
**2021** The organization's first virtual conference is conducted over 10 half-days during a three-week span. Nearly 600 owner/operators and 850 total attendees participate.

**2022** WTUI's second virtual conference draws more than 600 users worldwide and nearly 1000 total participants.

Ed Jackson is elected the organization's sixth president, replacing John Hutson, who left the aero community.

**2023** The first in-person annual meeting in three years is held in San Diego.

WTUI's online forum celebrates its 10th anniversary. The interactive LM6000 forum, launched by Webmaster Wayne Feragen and supported by the entire leadership team, is one of the most valuable prerogatives of membership. When you don't know whom to call about a current problem, posting your question online likely will provide the guidance to get you moving in the direction of a solution.



**Cemtek KVB-Enertec's Tunable Diode Laser** double-pass stack configuration for measuring emissions meets, and may exceed, EPA's Performance Specification 18 modified for  $\text{NH}_3$

ond slide: EPA requirements for  $\text{NH}_3$  measurement are changing. Those familiar with ammonia measurement will benefit most from the level of detail presented; others are sure to welcome the heads up on recent changes in air emissions regulations.

What might be news to those who have not kept up on the government's rules on  $\text{NH}_3$  measurement is that PPS-001, "Preliminary Performance Specifications for Ammonia Continuous Emission Monitors (CEMs)," has been declared "outdated from a technical standpoint" and has been removed from EPA's Air Emission Measurement Center website. This resource provides information on test methods for measuring pollutants from smokestacks and other industrial sources.

The recommendation of experts is that facilities or testers preparing to install/operate a  $\text{NH}_3$  CEMS should consider use of the principles/procedures of Performance Specification (PS) 18 and Appendix F Procedure 6, or PS 15. Reference methods to consider are Method 320 and CTM-027.

The lion's share of Cacciatore's slide deck covers the company's Tunable Diode Laser (TDL) solution (see schematic) for determining emissions compliance and for process control. It is said to meet, possibly exceed, PS 18 modified for  $\text{NH}_3$ , which is recommended by EPA. Ultra-high accuracy and sensitivity, and "immediate" response time are among TDL's attributes—as are ease of installation and maintenance, low operating costs, and an expected lifetime of more than a decade.

## ProEnergy

*Condition-based maintenance drives efficiency for LM gas turbines*

VP Aero Products Bob Bosse's theme was the economic responsibility of owner/operators in maintaining the high availability/reliability of their land-based generation assets—focusing on the LM6000—and how they might benefit from lessons learned in the aero world.

Bosse spent about half his time at

the podium speaking about the five dispositions available to owner/operators and how to use them to benefit a plant's bottom line. The five dispositions are:

- **Accept** (use as is). Prior to measurement and/or in-depth inspection, the part or component is cleaned and inspected visually—and cleared for operation.
- **Rework** eliminates any nonconformance with drawings, specifications, or contract requirements, thereby allowing continued use.
- **Repair** reduces, but does not eliminate a nonconformance which is subject to review and agreement by the engine owner or its agent. Examples illustrated have to do with coatings—their method of deposition, surface preparation, etc.
- **Reject** is a temporary disposition to allow acceptance of a part's condition provided it is corrected at a later date or by alternative repair. Simply put, the condition is beyond the current allowances for recommended repair.
- **Scrap** indicates a part is beyond repair and must be destroyed. However, the decision to scrap is the owner's or its authorized representative.

Some of the material Bosse covered—such as LM-engine component repair and replacement processes—is discussed in detail in the report on PROENERGY CONFERENCE 22 which follows the WTUI section.

## EnergyLink International

*Turnkey retrofit services—from need to low-cost finish: Building an effective project*

Presentation at the Western Turbine 2022 virtual conference was similar to that given at the ProEnergy meeting which follows this report and includes a summary of EnergyLink's work.

## Nord-Lock Group

*Wedge-locking technology that secures fasteners, prevents bolt loosening*

If you're not familiar with the company's wedge-locking technology, review this slide deck—particularly if your bolted connections keep coming

loose because of vibration, temperature changes, etc. Joint tightness is achieved by a system comprised of a pair of washers that have cam faces on one side and radial teeth on the opposite side. The bolted joint is secured with tension, not friction, and will not rotate loose.

Results of vibration test, torque/load diagrams, and other engineering data assist decision-making.

## SISU Energy & Environmental

*Increase power production and reduce maintenance with SISU's free-heat ammonia vaporization retrofit system*

The company's vaporization system eliminates electric heaters, reducing operating costs and maintenance. Installation is said to be fast and easy, payback rapid, and reliability higher.

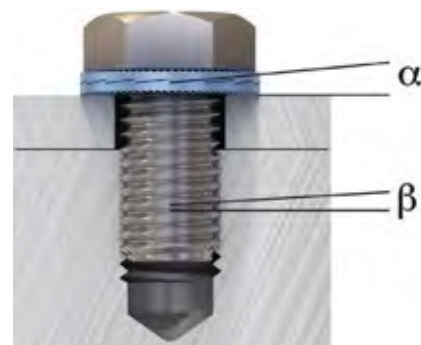
Also of possible interest is SISU's enhanced gasket retention system for CO catalyst modules which effectively confines the rope seal gasket, all but eliminating its migration. For those challenged by the shifting of SCR catalyst modules, the company has developed an integrated sealing and positioning modification to control that shifting.

## HRST Inc

*Aging HRSGs: Problems to anticipate in the second half of life*

Ned Congdon, PE, is a frequent and respected presenter at WTUI meetings, known for his practical approach to problem-solving. He discussed the following age-related HRSG problems:

- Creep/overheat damage in superheaters and reheaters.
- Duct-burner problems.
- Economizer failures from age and cycling.
- Waterside deposits in HP evapora-



**Nord-Lock.** Come up to speed on a technology that promises to keep your fasteners tight despite the presence of vibration and other loosening mechanisms. In the diagram, note that since the cam angle,  $\alpha$ , is larger than the thread pitch,  $\beta$ , a wedge effect is created by the cams and the bolt is prevented from coming loose





Our team of engineers, technicians and designers, are here to solve your HRSG and boiler related problems.

9 Regional offices located in the United States, Mexico and Vietnam

300+ HRSG Inspections conducted per year

HRST has collectively conducted over 3,700 total Inspections

**Solving Problems.  
Improving Reliability.  
Making Lives Easier.**

**HRST, Inc.**  
**www.hrstinc.com**  
**1-952-767-8100**  
**Info@hrstinc.com**



tors.

- Drain-pipe corrosion under insulation.

Congdon shares best practices that he's learned over the years. A few examples: a good flame length for duct burners is from 6 to 10 ft, duct-burner flames should only reach one-half to two-thirds the way down the firing duct, inspect regularly for indications of overheat damage to boiler tubes with assistance from view ports or furnace cameras, etc.

There's much to be gained from

experience encompasses more than 300 LM projects over the years. Its state-of-the-art overhaul and repair facility in Norway has testing capabilities for the LM2500 gas generator and corresponding power turbines (PGT-25, Vectra, DR-61, GT-61, and 6-Pack).

Presentation describes service capabilities, exhaust system life-extension program, fuel system upgrades to combat contamination and "sticky valves," air-inlet filtration upgrade, and control system upgrade. Last is

a review of the slide deck, perhaps all not new, but a valuable reminder at least.

#### Siemens Energy

*LM-series gas-turbine package solutions*

A big benefit of attending Western Turbine meetings is the opportunity they afford for identifying new products/services suppliers to add to your list of potential bidders for future projects.

Siemens Energy described its capabilities as a full-train solutions provider for the LM fleet, focusing on the LM2500, LM2500+, and LM2500+G4. Company expe-

offered in five levels to accommodate specific replacement needs to deal with obsolescence—such as HMI, fuel controller, fuel valves, and complete control system.

Beyond its service capabilities, Siemens Energy has a range of assets available for lease—short-term for planned and unplanned outages; flex or long-term lease to delay capital spending; and Siemens Energy ownership with the customer responsible for operation.

#### Woodward

*Plant performance optimization using advanced control techniques and modeling*

Presentation speaks to the opportunity for plant performance optimization during a controls upgrade. Benefits can accrue from the integration of dedicated balance-of-plant controls into the gas-turbine control system.

Case study described is the integration of SCR controls into the engine controller. Prior to the upgrade, the SCR was controlled manually by operators because the PLC logic provided with the emissions control system did not work in automatic mode. Emissions control required operator attention/focus for adjustments during startup, and changes in load, tempering air, Sprint, etc.

The simulation and modeling strategy used is described and easy to understand, with graphics enhancing the learning experience. Onsite simulation testing and commissioning complete the information package.

Post upgrade, SCR control operates in automatic mode, maintaining NO<sub>x</sub> emissions at less than 4 ppm at the catalyst exit for all steady-state load operating points. Emissions deviations experienced with manual operation have been eliminated and ammonia slip reduced. CCJ



**HRST Inc.** With the duct burner at maximum firing, use view ports to visually observe the flames for length and shape. Important to avoid flame impingement



**Siemens Energy.** The company's life extension program for the LM2500 includes field repair solutions such as the flange upgrade shown here










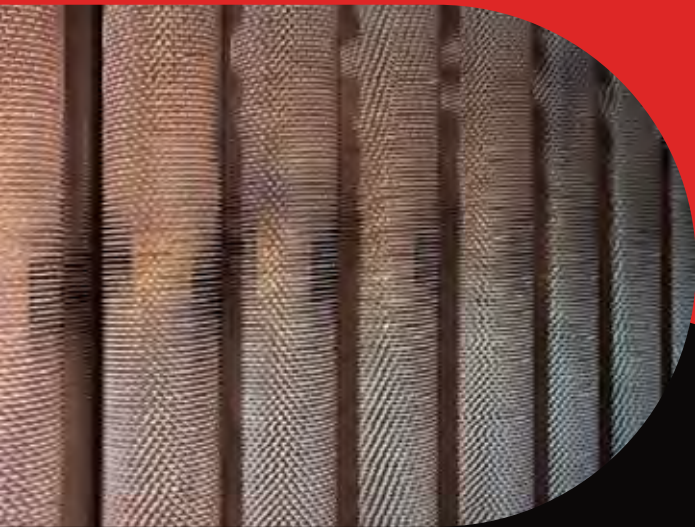
# GROOME

Industrial Service Group



# HRSG Maintenance Services

-  SCR Catalyst Cleaning & Repacking
-  CO Catalyst Cleaning & Repacking
-  Ammonia Injection Grid Cleaning
-  Ammonia Vaporizer Cleaning
-  SCR & CO Catalyst Replacement
-  HRSG Tube Cleaning
-  Inlet Filter House & Duct Refurbishment



[WWW.GROOMEINDUSTRIAL.COM](http://WWW.GROOMEINDUSTRIAL.COM) | (800) 505-6100





## Lawrence County Generating Station

Owned by Hoosier Energy Rural Electric Co-op Inc (four units) and Wabash Valley Power Assn (two units)

Operated by NAES Corp

258 MW, six simple-cycle LM6000 natural-gas-fired peaking units, located in Lawrence County, Ind, and connected to Hoosier's 161-kV transmission line

**Plant manager:** Robert VanDenburgh

## Transitioning operator rounds from paper to electronic records

**Challenge.** Regular visual inspection of plant equipment is critical to managing a safe and efficient generating station. When plant operators use clipboards and paper checklists on rounds, safety-critical and process information may not always be recorded properly. Station personnel require a reliable and accurate method of log-keeping when performing their routine duties—including operator rounds, running logs, safety inspections, and shift turnovers.

**Solution.** The Lawrence County O&M staff researched several electronic record-keeping options and selected PlantLog. The software is designed to be extensible, allowing it to serve a variety of purposes. PlantLog features universal components, allowing staff to design a data-logging workflow to meet Lawrence County's exact operational needs.

Barcodes are used to identify assets that are tracked using the Logs feature in the software. They ensure accuracy and also provide an electronic record within that asset for use in trend-

ing, thereby increasing reliability. At Lawrence County, the PlantLog app is installed on an iPad, providing operators the tools to complete each procedure/inspection.

Most data collection is completed using the iPad mobile app, which facilitates barcode scanning and offline data collection. However, log records also can be added from the web application.

**Results.** Plant supervisors developed a data-collection plan for plant operations. Personnel keep detailed electronic records of asset conditions during facility rounds or when performing maintenance/safety procedures. The PlantLog scheduling feature notifies operators when activities are due or when readings fall outside the normal range. The following workflow was implemented:

- Groups. Geographical or functional areas within the plant are defined.
  - Asset barcodes require operators to scan a physical tag to perform an activity.
- Logs were defined and organized to

represent each asset.

- Assigned unique barcode values to logs to associate with physical tags.
- Added optional details for a log, such as serial numbers and vendors.
- Activity. Specific events and procedures to be performed on an asset were defined.
  - Assigned recurring schedules for each activity to specify when the procedure must be performed based on specific dates or from when it was last performed.
  - Specified the *absolute* range permitted for any given numeric item to reduce human error.
  - Specified the *optimal* range permitted for any given numeric item. Values outside the optimal range are regarded as an exception and presented in red type.

A complete history of asset conditions can be viewed through the logs page of the web application.

### Project participants:

Matthew O'Hara, lead O&M tech  
Jared Thomas, O&M/IC&E tech  
Kevin Wildner, O&M tech

ANNUAL OVATION  
USERS' GROUP  
CONFERENCE

CELEBRATING  
**36** YEARS OF  
COLLABORATION

July 23—July 27, 2023  
The Westin, Pittsburgh, Pa

[WWW.OVATIONUSERS.COM](http://WWW.OVATIONUSERS.COM)

Intended for end-users of Ovation control systems



# EVM-I

## Energía del Valle de México I (EVM-I)

*Owned by Energía del Valle de México*

*Operated by NAES Corp*

100 MW (net), gas-fired facility equipped with three LM6000PF simple-cycle engines, located near Mexico City

**Plant manager:** Javier Badillo

data to all three engines simultaneously and hold the remaining GCs in reserve.

## Reduce cost of consumables, maintenance for gas chromatographs

**Challenge.** Each of the site's three gas turbines was equipped with a gas chromatograph (GC), hardwired to its control system, to adjust combustion continuously 24/7 and maintain air emissions within regulatory limits. The GC sends two 4-20-mA signals to the control system: the fuel's lower heating value (LHV) and specific gravity (SG).

Annual O&M cost for keeping three GCs in service amounts to nearly \$40,000—three-quarters of that

for helium and calibration gas, the remainder for preventive maintenance (consumable parts, such as filters and valve internals). Staff's challenge was to reduce this expense.

**Solution.** The economic impact of the pandemic forced a change in the dispatch profile for the plant's gas turbines, creating an opportunity to optimize operation of the GCs. Specifically: Use one GC to transmit LHV and SG

**Results.** An engineering and cost analysis confirmed that the plan put forth by staff to operate one GC and route the data from it to all three engines was indeed viable. Modifications required to allow each GC to provide data to all gas turbines cost \$26,000—including training. Note that the equipment was installed and commissioned by plant personnel. The net present value benefit over 20 years was calculated at nearly \$500,000.

### Project participant:

Carlos Moreno, plant engineer



# Worthington

## Worthington Generation LLC

*Owned by Hoosier Energy Rural Electric Co-op Inc*

*Operated by NAES Corp*

174 MW, four simple-cycle LM6000 natural-gas-fired peaking units, located in Greene County, Ind., and connected to Hoosier's 138-kV transmission line

**Plant manager:** Robert VanDenburgh

## Belt guards benefit maintenance

**Challenge.** Fan belts for the LM6000 package can be dangerous, difficult, and time-consuming to access. The heavy, bulky motor housing (a/k/a doghouse) maintenance panels must be removed to access the motor, belts,

and grease fittings (Fig 1). In addition to the maintenance challenges, personnel also strive to remove animal/bird access points to the belt area.

**Solution.** The NAES safety committee

researched and discovered pulley/belt guards are available specifically for the LM6000 Aerovent fans. Removing the bulky doghouses and installing the smaller, more streamlined pulley/belt guards would achieve the plant's goals.

**Results.** Pulley/belt guards were ordered and installed on the package fans (Fig 2). This safety improvement eliminated the pinch points introduced when lifting the heavy access panels. It also eliminated access points for animals/birds, significantly improving reliability. Also, maintenance inspections are safer and fan reliability has improved.

### Project participants:

Matthew O'Hara, lead O&M tech  
Jason Robertson, O&M/IC&E tech  
William Hooker, O&M technician  
Garett Ray, O&M technician



**1. Bulky doghouse panels** must be removed to do maintenance



**2. Pulley/belt guards** benefit safety, improve reliability





## Sentinel Energy Center

Owned and operated by DGC Operations LLC

800 MW, gas-fired peaking facility equipped with eight LMS100 simple-cycle engines, located in North Palm Springs, Calif

**Plant manager:** Dennis Johnson

# Energy control and lockout/tagout

**Challenge.** Sentinel Energy Center was tasked with keeping safety a top priority when developing energy control procedures (ECP) to protect plant personnel when they are near the hazards identified. Creating and using procedures that are easy to understand is essential to maintaining a safe working environment.

**Solution.** Staff created specific procedures for each high-risk evolution—including everything from the start of the energy control process in the control room to the return to normal state after work is completed. Key elements of the procedures include the following:

- Evaluate the system using P&IDs, walkdowns, and plant experience by an experienced operator.
  - Examples are given of things that should be considered, such as when power supplies are analyzed—including transformers, buses, and highlines—make sure downstream devices, motors, buses, etc., are included in the scope and effectively disabled, disconnected, or controlled to prevent back-feed.
  - Ensure evaluations are reviewed and approved by plant management.
- Determine a means for testing the effectiveness of isolation. Experience indicates equipment can be switched “off” and locked, and yet still start because of malfunction, mislabeling, or multiple electrical feeds. Doing a thorough hazard energy analysis provides an excellent opportunity to determine the means to verify the effectiveness of the isolation and LOTO.
- Create a specific procedural tool to identify hazards and how they are controlled using a step-by-step process.

- Verify that the steps specified in the procedure have been completed. One way to do this is by way of photos of the isolation means.

After an energy control procedure has been developed for a given project, assemble staff in the control room to review the work permit and job safety analysis. Review the goal of the procedure along with any specifics, plus the potential hazards, PPE required, and any stopping points.

During this meeting, create the teams responsible for different aspects



**Safety signage** was identified as a good best practice by a third-party auditor

of the ECP. Once the teams go into the plant to start work, provide a copy of the procedure to be followed step-by-step, and initialed when completed. Normally, each team includes a member of management as a safety observer, the operator responsible for the system, and a verifier.

Communicate each step that involves the control room to the CRO before the evolution occurs. This includes venting, operation of E-stops, and pressure verifications. Work on the day of isolation is completed relatively stress-free because of the effort put into

procedure development.

The training conducted for each evolution also is important. When it can be planned, a trainee and trainer are identified for each phase of the process—including authorizer, verifier, safety observer, and the person responsible for managing the day.

Procedure reviewed and understood, the LOTO is implemented to lock equipment in the de-energized state before work begins.

**Results.** The O&M team has used the methodology described to create multiple tools (attachments to the ECP procedure) for addressing high-risk operations. Some of the specific tools that have been created or improved upon include these:

- Isolation of the 700-psig natural-gas supply systems to each of the eight gas turbines.
- Facility power-outage response.
- Generator breaker isolation from the 245-kV transmission line.

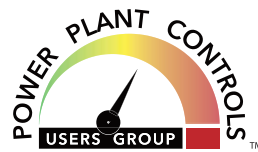
The most important aspect of the procedure is the inclusion of every participating operator and maintenance technician in the work and their ability to complete the process stress-free on a plant-only workday during the first day of the outage.

Many of the procedures include multiple revisions because recommendations are encouraged and after each evolution the process is reviewed and improved. The process has been recognized during independent third-party audits. Here's a comment from a recent audit report: “We found exceptional practices in the programs for control of hazardous energy (lockout/tagout)—including the site work-permit process, confined-space entry procedures (including the ongoing effectiveness review), safety signage, and colors for facility and pipeline markings, and hazard communication for the employee safety committee operation.”

### Project participants:

Dennis Johnson, plant manager  
Larry Wilson, maintenance manager  
Jesse Ballou, operations manager  
David Wells, EH&S coordinator  
Entire plant team

# SAVE THE DATE



## 8th Annual Combined Conferences August 28 – 31, 2023

Omni Atlanta Hotel at CNN, Atlanta, GA

*Five Individual User Group Conferences...  
Same Dates, Same Location... Shared Meals and Vendor Fair*



Scan the QR code  
to access the  
registration site







## Anson and Hamlet Generation Facilities

Both facilities owned and operated by North Carolina Electric Membership Corp

Each 360 MW, gas-fired peaking facility equipped with six FT8® Swift-pac® simple-cycle engines, Anson located in Lilesville, NC, Hamlet in Hamlet, NC

Plant manager: Shawn Fowler

## Repair of FT8 dual-fuel nozzles extends parts life

**Background.** North Carolina Electric Membership Corp's (NCEMC) Anson and Hamlet Generation Facilities have 24 P&W FT8-3 gas turbines. The sites operate primarily on natural gas, with distillate-oil backup. Both oil and gas operation use water injection for NO<sub>x</sub> control.

**Challenge.** Liquid fuel was back-flowing into the gas supply system causing coking in fuel nozzles, gas supply hoses, and headers (Fig 1), thereby preventing an unimpeded return to gas operation after liquid-fuel operation.

The root cause of the issue was thermal shock experienced during the fuel-gas startup cycle when water injection is initiated. The internal stress cracking created allows crossflow between the liquid and gas sections within the nozzle. A review of nozzle history demonstrates nozzles tend to fail at roughly 1100 startup cycles (Fig 2).

Note that the dual-fuel nozzle design is used in both single- and dual-fuel units. Water and fuel oil are premixed prior to the nozzle and share the same piping.

Issues identified after liquid-fuel operation include the following:

- Coking of fuel nozzles (gas orifices and supply port), gas supply hoses, and the gas-supply manifold.
- Inability to transfer back to gas fuel, which is conducive to forced outages.

Liquid-fuel operation and supply piping are not affected.

Although not experienced frequently at the NCEMC plants because of predictive emissions monitoring (PEMs) based on five-year testing,

high CO<sub>2</sub> readings during scheduled testing were corrected by replacing affected nozzles. It would be a reasonable assessment that prematurely mixing water and gas within the nozzle prior to combustion could result in more frequent emissions issues when measured via CEMs.

**Solution.** NCEMC asked Liburdi Turbine Services (LTS), Mooresville, NC, to evaluate and potentially develop a repair for the failing fuel nozzles. After an engineering assessment of a failed fuel nozzle, LTS felt confident it was repairable (Fig 3).

Liburdi developed and executed the repair of one fuel nozzle. To ensure the repair's viability, LTS, working with its sister company Liburdi Dimetrics, designed, engineered, and built a simulator replicating the startup conditions of an operating fuel nozzle (Fig 4). For the test, LTS used three fuel nozzles: one new, one service-run, and one repaired by Liburdi.

**Results.** The three fuel nozzles were tested simultaneously (Fig 4), replicating the startup cycle by heating

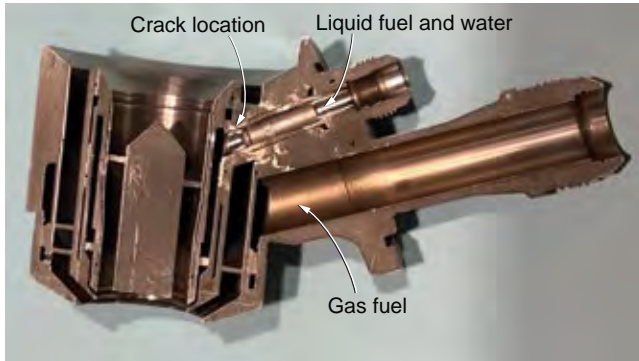


1. Coking in fuel nozzles, gas supply header, and hoses impeded transferring back to gas fuel after operating on distillate oil

POS. #	A1A	A1B	A2A	A2B	A3A	A3B
1	HGGUAH9588	HGGUAH9575	HGGUAH9531	HGGUAH9503	HGGUAH9500	HGGUAH9513
2	HGGUAH9502	HGGUAH9567	HGGUAH9524	HGGUAH9565	HGGUAH9573	HGGUAH9561
3	HGGUAH9539	HGGUAH9529	HGGUAH9548	HGGUAH9553	HGGUAH9566	HGGUAH9536
4	HGGUAH9514	HGGUAH9508	HGGUAH9550	HGGUAH9572	HGGUAH9568	HGGUAH9569
5	HGGUAH9576	HGGUAH9554	HGGUAH9533	HGGUAH9511	HGGUAH9582	HGGUAH9573
6	HGGUAH9585	HGGUAH9503	HGGUAH9504	HGGUAH9464	HGGUAH9585	HGGUAH9538
7	HGGUAH9582	HGGUAH9556	HGGUAH9505	HGGUAH9551	HGGUAH9586	HGGUAH9537
8	HGGUAH9584	HGGUAH9573	HGGUAH9507	HGGUAH9500	HGGUAH9514	HGGUAH9556
9	HGGUAH9511	HGGUAH9507	HGGUAH9504	HGGUAH9537	HGGUAH9504	HGGUAH9504
*CI Date(s)	Dec 2017 No Nozzles Replaced	Aug 2013 and Oct 2017	Nov 2015 and Sep 2017	Sep-17	Feb-18	Feb-18
*LF Hours		104	218	152	280	214
*Cycles		625	1041	1027	1105	1096
*Fired Hours		4091	6426	6133	6135	6016

2. A review of fuel-nozzle history shows nozzles tend to fail at roughly 1100 startup cycles. Numbers of hours and starts presented in the table refer to when nozzles were replaced. Black type indicates nozzle was repairable; yellow indicates nozzles that were scrapped





**3. Fuel nozzle** cutaway shows where cracking occurred, forcing replacement

and thermally shocking with induced water injection. After 250 cycles, the fuel nozzles were examined using both fluorescent penetrant inspection (FPI) and a pressure test. Upon completion, NCEMC was confident in the integrity of the repair and has installed LTS-

repaired fuel nozzles in its units.

The repaired fuel nozzles are operating normally. They would have been scrapped by the OEM using its current test criteria. FT8-3 fuel nozzles now can be repaired at a fraction of the cost of new.



**4. Tests of one new**, one service-run, and one repaired fuel nozzle were conducted simultaneously to verify the viability of Liburdi's repair process

**Project participants:**

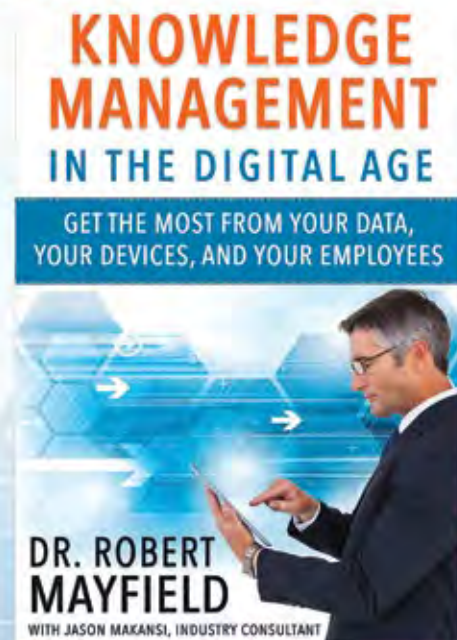
Shawn Fowler, plant manager  
Jeff Chapin, Liburdi Turbine Services  
Nathaniel Derby, Liburdi Turbine Services  
Alan Bumgardner, Liburdi Dimetrics Corp

# KNOWLEDGE DOESN'T JUST ... *HAPPEN*. IT MUST BE CREATED AND CAPTURED, SHARED AND TRANSFERRED, ORGANIZED AND INTEGRATED. **IT MUST BE MANAGED.**

Learn how to turn information  
into *actionable* intelligence.

Manage the complex systems  
of your power plant with ease,  
efficiency, and effectiveness.

Give your organization the  
competitive advantage you need  
to succeed in the digital age.



With seasoned and award-winning industry experts Dr. Robert Mayfield and Jason Makansi to lead the way, you will learn the skills necessary to take your plant assets to the next level and achieve long-lasting impact from the untapped resources at your fingertips.

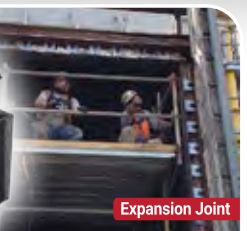




**Over 75 years  
industry experience  
to guide your repair  
or rebuild project**

- Design
- Procurement
- Fabrication
- Project Management
- Installation

## Plenum Assemblies and Diffuser Replacement & Repairs



### Inlet Systems

- *Fabric Inlet Expansion Joints*
- *Acoustical Liner Repairs and Replacement*
- *Inlet Dampers*
- *Inlet Silencer Panels & Ducts*
- *Inlet Bleed Heaters*
- *Inlet Dehumidification Skids*

### Air Filtration Systems

- *Full or Partial Filter Grid Replacement and Repair*
- *Replacement Weather Hoods*
- *Filter House Replacement*
- *HEPA Filter Grid Upgrades*

# Knowledge & Solutions for GAS TURBINES

## Exhaust Systems



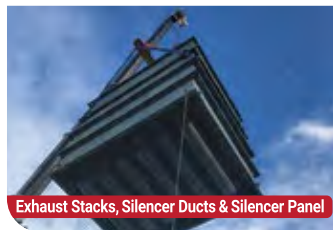
A042 Exhaust Diffuser



Fabric Expansion Joints



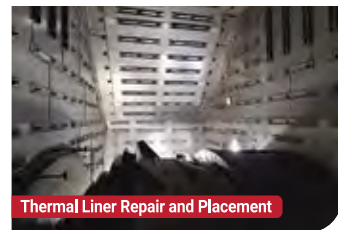
Flex Seals



Exhaust Stacks, Silencer Ducts & Silencer Panel



Exhaust Plenum Assemblies



Thermal Liner Repair and Placement

- Fabric Expansion Joints
- Thermal Liner Repair and Replacement Kits
- Radial and Axial Diffusers
- Exhaust Plenums
- Exhaust Ducts
- Exhaust Silencer Panels & Ducts
- Fully Customized Exhaust Systems



+1 978 229 5460  
sales@gaspathsolutions.com  
gaspathsolutions.com



# PROENERGY CONFERENCE 22

## Single-source services firm emerges for the LM6000 user community

**D**ecades ago, a slide popular to include in electricity conference presentations went something like this: Technology tells us what we can do; government tells us what we will do. Today, that would be called a “meme.” As applied to the peaking and load-following power market where GE aeroderivative gas turbines play, that meme also captures the essence of the ProEnergy Services (PES) inaugural user conference held Nov 1-4, 2022 in Kansas City, Mo, at least for the information delivered in the general sessions and roundtables (Fig 1).

Billed as the “premier LM-focused event,” the subtext of the content was that PES and its partner ecosystem can assist LM (Land and Marine) owner/operators, especially those with LM6000 machines, with just about anything that’s ailing their unit or the balance of plant (BOP), and even upgrade components, systems, and performance.

After all, PES operates 4900 MW of LM machines, conducts wide-ranging product R&D and applications engineering, functions as a depot with spare LM units and in-kind and upgraded parts available, and repairs units from all over the world.

The conference, and its subtext, come at an auspicious time. The industry, like the world around it, is reeling from inflationary pricing pressures, global supply-chain delays and shortages, and lack of critical materials, even as all of us recover from, or are exhausted by, the multi-year malaise of a global pandemic.

At the next level down, owner/operators are frustrated with the OEM as their machines endure ever higher numbers of starts and shrinking operating windows trying to sat-

isfy the insatiable demand for more renewables.

In short, timing may not be everything but it does tend to drive success. As if to reinforce the point, the resumes of many of the speakers were laden with decades of experience employed by the OEM.

Conference topics were wide-ranging, from general market and machine trends, the nitty gritty of single-crystal

directionally solidified turbine blade and nozzle materials, load reversals with LM units, and much in-between.

Readers are urged to review the conference program (<https://www.proenergyservices.com/PEC2022/>) and contact Chris Evans ([cevens@proenergyservices.com](mailto:cevens@proenergyservices.com)), VP, marketing, for access to the video library or individual presentation slides.

What follows here is a high-level summary and highlights of the conference material stitched together from audio recordings and slide decks, with information of likely keenest interest to the plant-level personnel coming first.

### LMs and LRs— as in “load reversals”

With respect to new information valuable to the user community, the presentation by Matt Kuffler, PE, plant engineer, Austin

Energy’s Sand Hill Energy Center (Fig 2), on “Load Following: Creating a Roadmap from Failures to Successful Operations” stands out (Fig 3).

Sand Hill experienced five separate domestic object damage (DOD)/foreign



**1. Carlos Picon**, chief commercial officer, Waldemar Brinster of Power Service Consulting, and Chris Evans, VP marketing (l to r) peruse the badges for the more than 100 participants in ProEnergy Services’ inaugural user conference



**2. Austin Energy’s Sand Hill Energy Center** was erected in stages: four simple-cycle LM6000s in 2001, a 300-MW 1 × 1 combined cycle in 2004, and two simple-cycle LM6000s in 2010. Total generating capability is 595 MW



**3. Plant Engineer Matt Kuffler** discusses operational dispatch changes for Sand Hill and proactive approaches to ensure unit reliability



**4. Edge-of-contact** crack in the aft pressure face of Blade 2 in the fourth stage of the HP compressor was the root cause of this 2017 failure. The airfoil liberated while the dovetail remained in the spool. Coating was missing at the origination point of the crack with coating depletion leading to increased stress. The OEM said this was the industry's first reported failure of a dual-intensity peened blade (introduced in 2014 and installed that December)

object damage (FOD) events through 2017, each stemming from a compressor blade edge-of-contact (EOC) failure (Fig 4). Kuffler covers what the plant/Austin Energy had to do to mitigate the impacts from these failures, then prevent them.

He referred to Service Bulletin 310 which refers to the O&M manual that calls for replacing stages 3-5 high-pressure compressor blades after 1500 starts because "load-following units are susceptible to more rapid, significant changes in HP shaft speed as the MW setpoint fluctuates"—what the OEM calls "load reversals." Units with high number of LR's will experience accelerated wear on the contact surface coating.

Sand Hill took necessary reactive and preventive maintenance steps to manage the situation, but what

is really illuminating, and worth a look for anyone else experiencing this phenomenon, is how the plant began tracking load LR's unit by unit from a data-analysis point of view.

The plant found that when comparing the OEM definitions of a load reversal to its own data, Sand Hill's load-following activities resulted in more reversals than were readily apparent. In short, the plant quickly created an LR-based maintenance strategy rather than a starts-based one to better plan the life of their HPC stage 3-5 hardware.

## Read your O&M manual!

What causes the most failures of LM machines in the field? Not following OEM guidelines, noted the Technical Roundtable panelists (Fig 5). For one, sites should conduct an external inspection every time the engine shuts down. It's in the manual.

Considering how often these machines start and stop these days, that's a lot of inspections. But if you don't follow the guidelines for peaker engines, you risk losing the lawsuit

when you face a serious O&M event and "better call Saul." Another panelist suggested more frequent borescope inspections as well.

Other content gems from the tech roundtable:

- Changes in turbine usage are posing technical challenges. At one time, one panelist reminisced, the OEM said that aero machines had no cycling limit (which kind of makes sense from their history in the aircraft market). Another panelist noted that the "stage 3-5 blade problems are not yet under control, even if many iterations of design mods have improved the situation."
- Machines with power augmentation in the 10-minute market are facing "lots of issues" pushing more water through the machine, including water getting into the lube-oil system. Also, moist ventilation air allows water to get into the oil sump when fogging and augmenting, a problem when you are shutdown, not when you are running. It was suggested that users may need to extend downtime to dry out sump areas. Another recommended prac-



**5. A panel of technical leaders** addressed a wide range of topics—including cyclic limits of aeroderivative engines and the effects of higher run time, such as increased wear and oxidation. From right to left: Mike Tulk, Rockland Capital; Bill Schoultheis, REPS Resource; Paul DiMascio, ProEnergy; Brion Patt, Chromalloy; and Rob Andrews, ProEnergy



**6. Rockland Capital's Mike Tulk** and Bill Paff (back to camera) confer before the latter's presentation on cold-weather prep. Tulk participated in the technical leaders' panel (Fig 5)

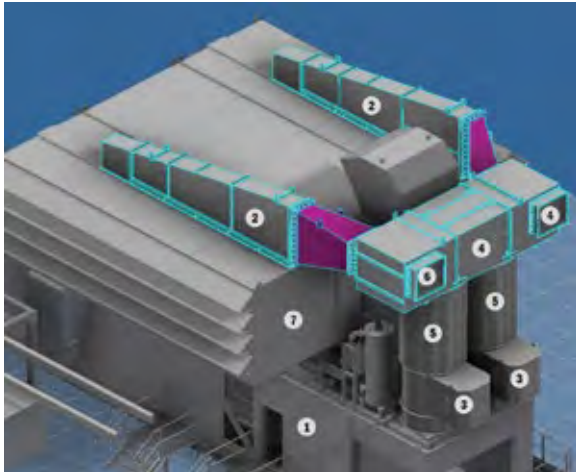
tice is to add water/oil separators.

- Perhaps a longer-term, but more pernicious issue, with high-cycling, water-injected, power-augmented machines are damage-mode changes. There is more fretting, more wear, and more cracks in hot-section components. Users need to think harder about starts-based maintenance.

## Winter is coming

Cold-weather prep has been a sizzling topic for several years now, in particular because of the February 2019





**7. ProEnergy's anti-icing system** used to protect Rockland Capital's Shelby County Energy Center was a focal point of Bill Paff's presentation. He began with descriptions of the following components recently added to the company's system: anti-icing ducting (2), plenum (4), and atmospheric exhaust vents (6). How the system works came next: Turbine inlet-air heating is accomplished by extracting air, warmed by the operating turbine, from the enclosure package (1). The heated air is recirculated via ducting (2) and injected upstream of the filter house (7), thereby promoting thermal mixing and inhibiting ice formation in downstream components. Package ventilation fans (3) discharge into the plenum above the silencers. When temperatures rise and heated air is not required it is exhausted to atmosphere.

ERCOT-wide freeze debacle. Bill Paff, VP, asset management, Rockland Capital (Fig 6), in a session on winterization, essentially laid out three options his company evaluated for a long-term strategy at a plant in Illinois.

They are (1) a water-glycol coil-based heating system for about \$1.0- to \$1.4-million per engine, (2) taking heat from the hotter compressor stages and redirecting it to the inlet for \$450k to \$1.3-million (but the necessary valves were not available), and (3) taking heat from the turbine enclosure, which penciled out to between \$450k to \$950k per engine. However, option 2 could open up a site permit review, a risk few owners likely would take.

It turns out option 3 is a package offered by PES and available as a 100% turnkey EPC installation (Fig 7). When ambient temperature drops below 40F, warm air from the turbine enclosure is redirected through ducts, added atop the enclosure roof, to the combustor air-inlet filter house before the filter cartridges.

Kevin Chaffin (Fig 8), recently named ProEnergy's O&M director, delivered the second presentation on short-term strategies, and focused on the steps his crew took to protect six peakers at the HO Clarke

Power Station in Texas one to two weeks before the ERCOT 2019 storm "Uri" event:

- Scaffolding erected around the NO<sub>x</sub> water spray system.
- 36 electric heaters ordered with two per structure.
- Plywood wind breaks built for air compressors.
- Plant staffed for 24/7 periodic rounds.
- Blankets wrapped around instrument panels.

Suffice to say, all Clarke units were 100% available during the entire event, although the site lost water supply for three days.

One audience member described a once-in-

change every other day."

Perhaps the most useful comment: "Is anyone using simple thermal cameras?" Apparently, this user found them to be a very inexpensive solution for checking heat tracing and identifying other potential problems during winter prep.

## Upgraded hot sections

Brion Patt, global director of sales, Chromalloy, and Paul Dimascio (Fig 9), VP engineering, PES, spoke on the benefits of single-crystal hardware and improving stage 2 nozzle life. Chromalloy is the "partner of choice" for parts, said Dimascio. Patt's presentation is an extended review of Chromalloy's hot-section component fabrication, repair, and upgraded parts capabilities.

Without diving too deep into the weeds of metallurgical formulations, hot-section piece identifiers, and trade names, the broader messages are that Chromalloy is a repair source



**8. Kevin Chaffin**, recently named ProEnergy's O&M director, shared the successful winterization strategies used to protect six peakers at the HO Clarke Power Station in Texas against ERCOT's 2019 "Uri" freeze event

a lifetime snow event during which cooling-tower drift laden with frozen particles entered the turbine inlet air filter. The unit got so cold, the control system went into run-back.

Other lively audience comments described how level transmitters froze up, how one site instituted a change to the control system so they could click a button and force a transmitter out of service "if it was going wacko," how another site discovered that their heat tracing stopped one inch before cabinets containing critical transmitters, and the rather glib observation that "ERCOT rules [on winterization]



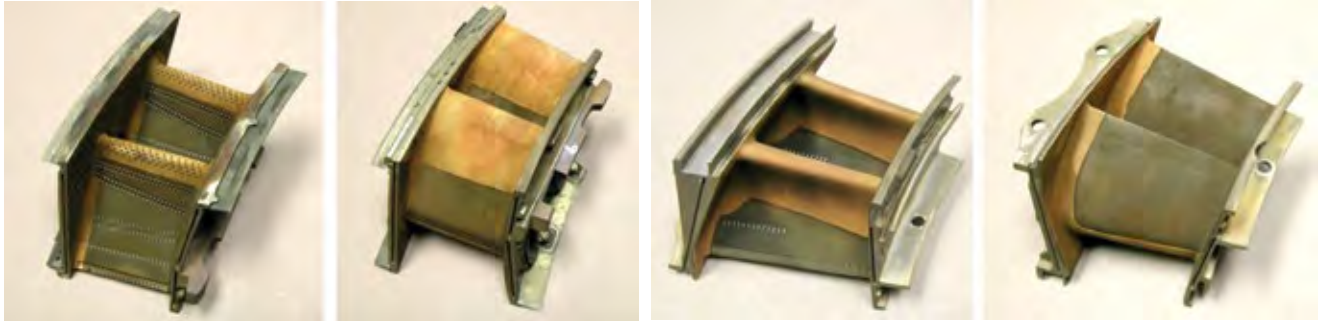
**9. Paul Dimascio**, ProEnergy's VP engineering, discusses the stage 2 nozzle wear

authorized by the OEM that also has developed its own repair techniques and upgraded parts (Figs 10-12).

Patt took pains to explain that Chromalloy's legacy business in aircraft means that, as a non-OEM, they "can't make a mistake" in order to retain Parts Manufactured Approvals (PMA) from the Federal Aviation Administration (FAA). They inspect their parts four and five times before release.

Patt went on to claim that Chromalloy parts have never been attributed to an aircraft engine failure. The company has developed thermal-barrier-coating (TBC) top coats beyond OEM-type TBC offerings and has redesigned cooling holes for extended life because "stage 1 blades and stage 2 vanes [nozzles] are showing more damage than they would like. . . ."

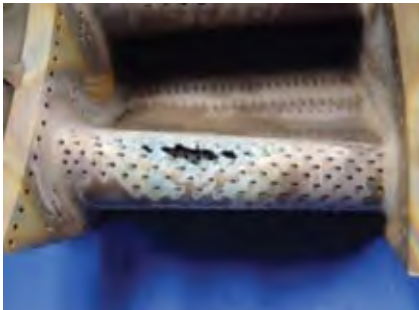
Dimascio addressed stage 2 nozzle



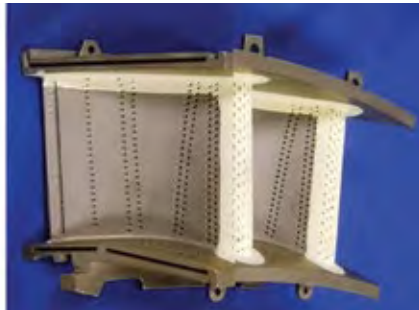
**10. Chromalloy's Brion Patt**, who tag-teamed with ProEnergy's Paul Dimascio, shared some of his company's successes in the manufacture and repair of critical HP turbine components. Above is what its LM6000 first-stage turbine nozzles with a platinum aluminide coating looked like after

operating for 8000 hours on liquid fuel

**11. Second-stage HPT vanes** with platinum aluminide coating and air-plasma-sprayed ceramic TBC after 8000 hours on liquid fuel



**12. Excessive burning and erosion** of the first-stage HPT nozzle at left was corrected with air-plasma-sprayed TBC (right)



**13. Jeff Wirt**, EnergyLink International, presents on ammonia-injection-grid optimization to maintain environmental compliance

catalyst systems, EnergyLink International (Fig 13). It proved to be a primer of sorts on SCR, with the underlying message about the importance of flows, reagent and exhaust mixing,  $\text{NH}_3$ -to- $\text{NO}_x$  ratio, and uniform distribution of  $\text{NH}_3$  to  $\text{NO}_x$  across the catalyst grid (Fig 14).

EnergyLink has a proprietary blending technique that can achieve a 5% RMS (root mean square) level blend rate. Traditional mixing design apparatus is more like 25% and higher. The way to achieve that 5% figure is better mixing at the point of  $\text{NH}_3$  injection by blending ambient air with turbine exhaust to control temperature and

increase turbulence. Blending plates create an area of low pressure which promotes mixing of ammonia and turbine exhaust.

According to EnergyLink, this technique, for which they guarantee performance, will lower the total  $\text{NH}_3$  tonnage consumption, achieve a slip level of under 5 ppm (and as low as 1.2), and allow more operating hours because of the higher removal efficiency. Indeed, one slide showed four PES turbines all measuring at average slip levels of well under 2 ppm.

One audience member pleaded with the speaker not to widely report the 1.2 slip figure, lest permit limits get ratcheted down everywhere. Another audience member asked why the process diagram called for two fans and the answer was redundancy. A third asked whether a high-temperature catalyst formulation was available for the LM2500 product and the answer was not yet, but experts are working on it.

## Quiet parts out loud

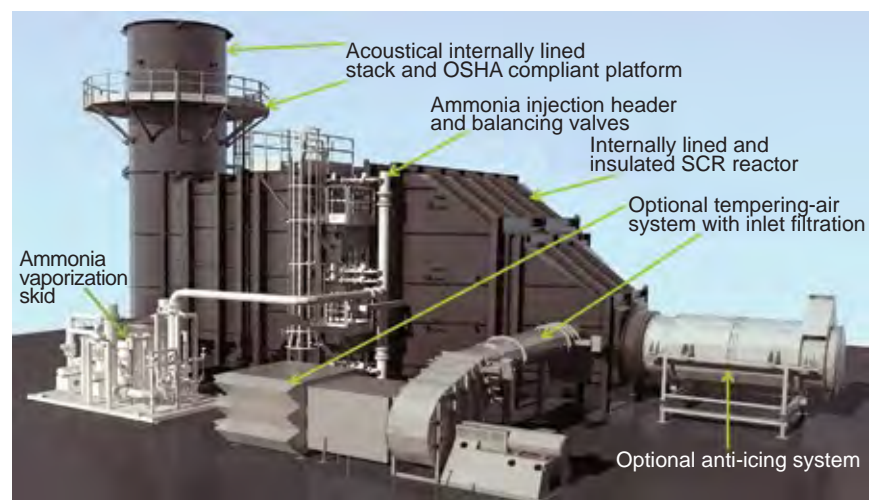
Mercifully, some presenters were willing to "say the quiet parts out loud,"

life and a competitive analysis of three solutions—improve materials, improve cooling techniques, and/or add TBC.

One audience member asked the pair to explain the recent shortage of blades for catastrophic rebuilds. Among the responses was that the war in Ukraine has caused a worldwide nickel shortage. Currently, the company has a two- to three-month time-frame for delivery of hot-section parts.

## $\text{NO}_x$ removal: Turbulence is key

The session on ammonia and flow distribution, in the Asset Management Track, was led by Jeff Wirt, director,



**14. Elements of an SCR catalyst system** was one of Wirt's "refresher" slides



# ProEnergy shop tour



ProEnergy focuses exclusively on the operation and maintenance of LM6000 and LM2500 gas turbines. The company says it operates the only *independent* Level-IV aeroderivative depot in the world at its 1-million-ft<sup>2</sup> campus in Sedalia, Mo. The LM6000 shown in Fig A is in Gate 1, “Induction and Disassembly.”

Eric Thornton, parts prep operator, is among the dozens of skilled technicians for Gates 2 and 3 in the Aeroderivative Repair and Manufactur-

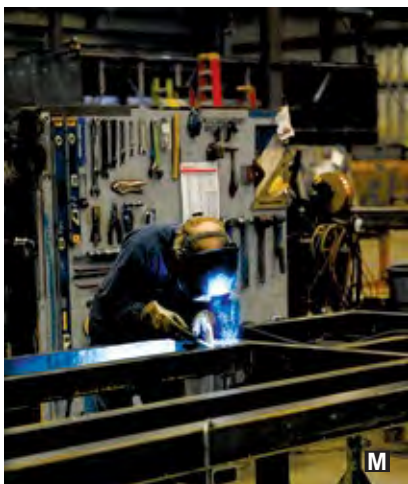
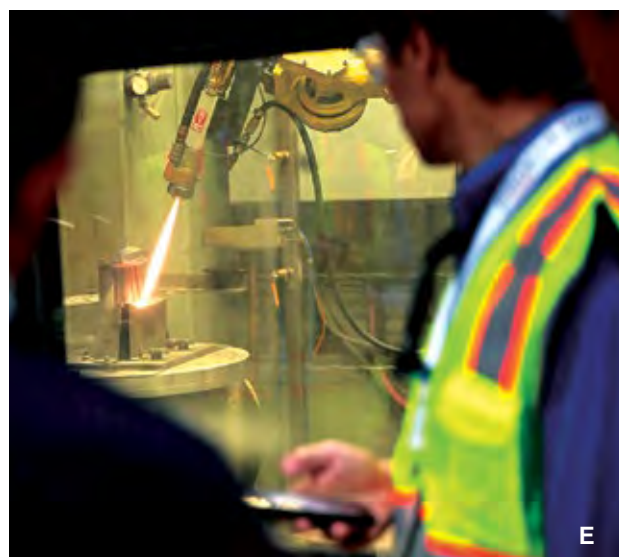
ing (ARM) Center, where assessment of piece-parts condition begins in B with cleaning, followed by an in-depth series of inspections by fluorescent penetrant, CMM, Faro arms, and more.

Daisy Gay, parts inspector, conducts detailed inspections of various components, ranging from individual piece parts—including the VSV linkage arms shown in C—to major items, including combustors. Each component, part, and piece is subject to in-depth inspection in Gate 2, which includes

the turbine vanes in D. Gate 3 is where in-house repairs E to turbine parts are made—including welding, braising, shot peen, and heat treat.

Brenton Johns, turbine technician, installs repaired components F to complete an LM6000 major overhaul in Gate 4, “Assembly.” He leverages processes that include blade grinding to eight one-thousandths of an inch to maximize power and engine longevity. Fuel nozzles G are calibrated to  $\pm 2\%$  using an exclusive 20-step repair process.





Aero Manufacturing Manager Brandon Harrison, at right in **H**, listens to an explanation of how ProEnergy mitigates shortages of critical spares, by making new parts in-house. Blue-light scanner **I** is an important component in the company's advanced manufacturing initiative, which includes a climate-controlled machining center.

Terry Fielder, panel wireman, constructs modern control systems **J** for the LM6000 gas turbine, as well as

its generator and associated auxiliary systems. A sizable portion of the ProEnergy campus is devoted to manufacture of LM6000 packages **K** under the PowerFLX name. New packages are fabricated in-house **L** from raw steel—including welding, paint, and final assembly. Dozens of skilled fabricators manufacture one LM6000 package **M**—including mechanical and electrical BOP—every two weeks, and have the capability to produce many more.

Waldemar Brinster, senior project and service engineer for Power Service Consulting in Germany, tours the package assembly area **N** where major components and skids are finalized for transport.

The test cell **O** serves as a proving ground for overhauled turbines, as well as for the future of the LM6000 platform. The site represents a \$12-million investment toward the development of a fully hydrogen-powered turbine.





**15. Executive panel offered a panoramic view of the electric-power industry's generation sector by experts representing a 40-GW fleet, small peaking operator, cooperative, and consultancy. From right to left: Randy Bird, Sky Global; Jens-Peter Schmidt, RWE; Chris Jimenez, Arizona G&T Co-op; Mark Axford, Axford Consulting; and Landon Tessmer, ProEnergy**

when it came to general trends in the industry. For example, Mark Axford, president, Axford Turbine Consultants, noted during the Executive Roundtable (Fig 15) on the opening morning that "using hydrogen to make electricity is absurd, economic nonsense." Later in the conference, Jens-Peter Schmidt, project manager, RWE (a German energy company), said during a user panel that gas-fired plants in his coun-

one panelist noted that the impact on machine heat rate from H<sub>2</sub> firing is neutral and engine control won't change, but flow into the machine will be a challenge and higher NO<sub>x</sub> production may necessitate higher water injection rates. Both can impact machine reliability.

Absurd or not, the recently passed US federal Inflation Reduction Act (IRA) includes the first subsidies for H<sub>2</sub>, said a panel-

One panelist in separate session noted that some developers are looking at producing H<sub>2</sub> as NH<sub>3</sub> with no-carbon wind energy and shipping it to Europe to meet their H<sub>2</sub> co-firing needs.

**Grid-scale batteries** were also subjected to some honest discussion. Executive roundtable panelists noted that even the subsidies in the IRA won't make solar + batteries "cheaper." New natural gas projects are still more economical, in part because "you need four to six times

more solar and batteries to make an apples-to-apples comparison to gas-fired peakers." And solar with batteries impose their own environmental quandaries. For one, birds mistake large solar paneled areas for lakes and dive into them; scrapped older solar panels are being dumped into rural areas, according to one panelist.

Battery permits often require water tanks for fire protection even though water doesn't snuff out a lithium fire. Panelists urged their listeners to work with local authorities and citizens towards a better understanding of the tradeoffs and hazards associated with large batteries.

## More starts, less time

The evidence for what these machines are now enduring is incontrovertible, at least in the aggregate. David Heatherington, president, McCoy Power Reports, reported data from the EPA Clean Air Markets program covering 2015 to 2022 on start/stops for combustion units over 20 MW, which confirm that simple-cycle peakers are gaining share of the peaking market relative to boiler units. And 88% of starts involve a run cycle less than 24 hours.



**16. Colleen Deist of Brush** shared tips on how to extend the life of generators through best practices for generator maintenance and inspections

try "must have H<sub>2</sub> [cofiring] or the project will not fly."

What you should do technologically isn't always congruent with what you will do politically.

What you can do with H<sub>2</sub> was discussed in an earlier technical roundtable. The LM6000 can do 35% H<sub>2</sub> blends and ProEnergy is leveraging a \$12-million-plus investment in the technology to "push this" beyond published limits. However, it may require modifications to the combustor as the faster H<sub>2</sub> flame speeds, and its low mass and high volume, can challenge the combustor throat area and potentially melt combustor-section parts.

In response to an audience question,



**17. David Evinrude, ProEnergy's customer service manager,** was co-leader with Chad Hall for the strategy session focusing on condition-based repairs. He presented detailed data to illustrate that expanded parts-service limits and cyclic-life management can meet the evolving LM mission profile while broadening end-user maintenance and management choices

could take advantage of existing storage and transport infrastructure. On the other hand, ammonia is easier to store onsite than H<sub>2</sub>. An additional safety factor with H<sub>2</sub> is that it rises and dissipates, while ammonia settles in low-lying areas.

In response to an audience question, a panelist noted that H<sub>2</sub> won't affect the SCR catalyst but will drive up the turbine exhaust temperature and increase NO<sub>x</sub> output, both of which will affect SCR system design and operation.



**18. Chad Hall, ROC manager,** partnered with Evinrude (Fig 17) on the condition-based-repairs strategy session, sharing how inspection, repair, and replacement options maintain or enhance LM platform reliability and efficiency standards at reduced operating cost

ist. The idea of delivering H<sub>2</sub> as ammonia (NH<sub>3</sub>) was also broached. Compressed H<sub>2</sub>

Drilling down, 74% of combined-cycle stops involve run times of less than 24 hours. Plus, 30% of simple-cycle stops deliver fewer than 100 MWh to their respective grids. To convert data science into something digestible, Heatherington's slides break out two groups of units—the resiliency group and the Big Four (PJM, MISO, ERCOT, and CAISO)—and analyzes each one's starts behavior for duration and load delivery.

Tom Christiansen, SVP, Strategic Power Systems, reported aggregate data from its ORAP database, representing 9400 LM unit-years. Utilization factors for aeros in power and cogen are up 19% in the past year. In the 1990s, an aero unit may have operated for an average of a week when started; today it is more like 10 hours. In the US, peaking units average three starts per week. There has been a 200% rise in starts frequency with an attendant reduction in hours per start.

The good news: Starting reliability for simple-cycle units is relatively high and consistent over the last 10 years, at 98-99%, even though the number of starts per unit has risen dramatically over that period. However, overall reliability and availability have declined somewhat since the early 1990s, with availability taking more of a dive than reliability over the last decade.

## What price components?

Texas, apparently, is in a class all by itself when it comes to starts. A panelist in the technical roundtable noted that some machines in that state are starting and stopping six to eight times a day! Which brings up the question of how to adjust maintenance programs for the high-starts regime. Lower-cost materials can be used but component life is shortened. Do you spend less on parts but overhaul more often?

The same question came up from the audience in a session on SCR and catalyst. Switch to a lower-cost catalyst and replace it every five years instead of 10? A PES expert responded that they could do some R&D and look into this.

## The Yellow Brick Road?

David Rhodes, SVP, Onward Energy (owner/operator of 56 generation sites comprising solar, wind, and thermal), addressed the path to net zero carbon in the conference keynote address. In short, he stated it is possible to get to 100% carbon-free grid, but many stars must align. One that isn't mentioned often in forums like this one is transmission, which is expanding at only 1.5% average per year over the last

few decades, and more like 1% annually over the past decade.

The federal IRA intends to supercharge renewables, he stressed, but without the corresponding transmission, the carbon-free megawatts can't get to the load. Already, there are huge curtailments taking pace in Texas and the Northeast, he added.

A natural-gas plant is still more economically competitive than batteries plus renewables when the regulatory preferences and public sentiment are stripped away. However, some jurisdictions are "pricing in" carbon which penalizes gas projects even more. An example quoted \$70/ton of carbon.

Rhodes also made this key point, another example of the "quiet part out loud": One way to make natural gas more sustainable is to identify and mitigate methane leaks. Just 2% gas leakage, given methane's order of magnitude higher warming capability in the atmosphere, means that gas-fired capacity is no better than coal in overall carbon footprint.

A member of the user panel, later in the conference, noted a separate challenge developing gas peakers in Texas: ERCOT is agnostic to generation type and applications are taken in the order they are received. There could be 40 solar facilities in the queue which may not ever get built holding up a gas peaker project.

Finally, to emphasize what solution won't be coming to the rescue anytime soon, Rhodes noted that the ratio of published material on carbon capture and storage to actual CCS capacity is about 10,000 to one, lots of talk but no action, in other words. That got a few chuckles from the audience.

## The balance of content

Other presentations covered the following:

- Representatives from Brush Electric (Fig 16) reviewed all the things Brush can do for generator owner/operators, which the company claims is just about everything.
- PES' Bob Bosse, VP, aero products, David Evinrude (Fig 17), customer service manager, and Chad Hall (Fig 18), manager, Remote Operating Center (ROC) reviewed condition-based maintenance, highlighting the capabilities of the strategy, especially when combined with a capable ROC.
- PES experts advocated for fogging over evaporative cooling, concluding that wet fogging could increase performance by 10%.
- PES experts delivered a half-day "refresher course" on LM6000 technology.



**Industrial  
Project Group  
s.r.l.**

## New technologies:

### • Advanced gasification process

➤ Higher process efficiency

➤ Efficiency increase with ceramic heat exchangers

➤ Good integration opportunities

### • Air Bottoming cycle

➤ Reduced process complexity

➤ Reduced water consumption

➤ Lower capital costs

### • ABC + Ammonia cycle

➤ Better performance also during summertime

➤ Competitive capital costs

## Web-site:

[www.ipgsrl.com](http://www.ipgsrl.com)

## e-mail address:

[ipg@ipgsrl.com](mailto:ipg@ipgsrl.com)

## telephone number:

011-039 -2360470



# Real Time Monitoring for Motors

## Motor Current Signature Analysis (MCSA)

Motor Current Signature Analysis enables plants to use voltage and current signals to monitor and identify motor faults. The system trends and archives the data and waveforms for future analysis.

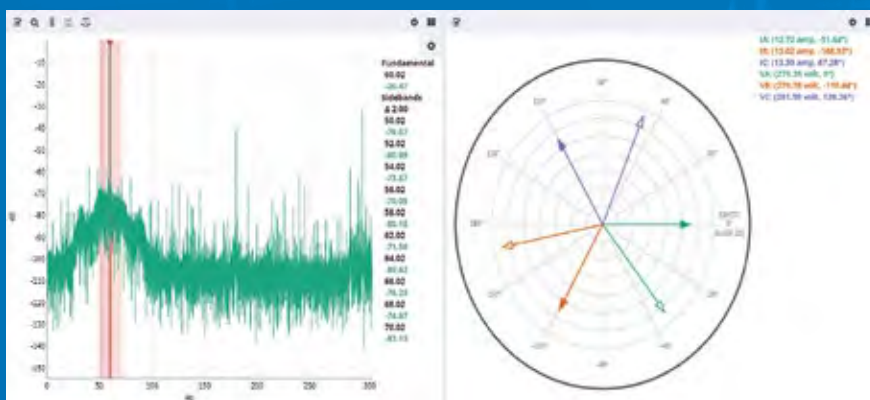
### **Monitors and trends failures:**

- ▶ Rotor Bar Damage
- ▶ Misalignment
- ▶ Eccentricity
- ▶ Mechanical Looseness
- ▶ Bearing Problems

### ▶ **Benefits of MCSA Monitoring:**

- » Early Detection Saves Money
- » Non - invasive installation - NO outage required
- » Lower costs compared to third party services
- » Fewer forced outages due to equipment failures
- » Automated data collection
- » Plants have remote access to data
- » Integrates into InsightCM™ making analytics easier

## MCSA Monitoring Screenshots:



- ▶ Trend
- ▶ Waveform
- ▶ Spectrum
- ▶ High Resolution Spectrum
- ▶ Torque Waveform
- ▶ Phasor Diagram
- ▶ Envelope (Amplitude Demodulation)





# Alstom Owners Group Sixth Annual Meeting

Reconnect with colleagues at this first in-person conference since 2020

**When:** March 20-23, 2023

**Where:** EPRI Campus, Charlotte, NC, 1200 West W T Harris Blvd, Bldg 3, Room 3-741

**Register at:** <https://www.aogusers.com> **Helpline:** [ashley@aogusers.com](mailto:ashley@aogusers.com)

## Program highlights

### Monday, March 20

- 10:00 End-user closed session
- 12:00 LUNCH
- 1:00 Introduction to the GE all-afternoon session for end-users  
*Tom Freeman*
- 1:05 Agenda and overviews of the GT11N/N2/24 fleets  
*Stefano Tartoni and Tom Stroud*
- 1:20 Technical GT update and rotor lifecycle management  
*Martin von Planta and Stefano Tartoni*
- 3:10 BREAK
- 3:30 Parts lifecycle management  
*Stefano Tartoni*
- 3:45 Excitation and SFC systems  
*Dimitrios Kokidis*
- 4:00 Repairs  
*Josh Pryor*
- 4:20 Steam/Gen  
*Ricardo Santillan*
- 4:35 Controls: Mark VIe success stories  
*Robert Turner/Sebastien Bertrand*
- 4:55 Open discussion

### Tuesday, March 21

- 9:00 How gas-turbine maintenance has changed: Innovation, quality, retirement  
*Bobby Noble, EPRI*
- 9:30 GT starts and stops: Measuring grid intermittency  
*David Hetherington, McCoy Power Reports*
- 10:00 GT26 rebuild project  
*Rocksavage Power Station*
- 10:30 Alstom slot-liner cracking and failure  
*MD&A*
- 11:00 Alstom field machining and

- outage support  
*K Machine Industrial Services*
- 11:30 Plant improvements, spare parts, and mechanical services  
*Hughes Technical Services*
- 12:00 LUNCH
- 1:00 Advanced steam turbine and HRSG warming for increased startup flexibility  
*Arnold Group*
- 1:30 GT supply-chain challenges: Component repair to reduce waste and improve turn time  
*Liburdi Turbine Services*
- 2:00 Manufacturing blades and vanes for GT11D5, N, and NM  
*SUNG IL (SIM)*
- 2:30 BREAK
- 3:00 TBA  
*Allied Power Group*
- 3:30 Recap and feedback
- 6:00 AOG meet and greet (Marriott)  
*Courtesy of AOG gold sponsors*

### Wednesday, March 22

- 9:00 How Nord-Lock Group products benefit AOG users  
*Nord-Lock Group*
- 9:30 Attenuators for modulating combined-cycle/peaker plants  
*Advanced Valve Solutions*
- 10:00 Rotor life extension  
*Doosan Turbomachinery Services*
- 10:30 Case study: Repairs of GT11 and GT13 components  
*TRS Global Services*
- 11:00 Case study: Firing temperature validation  
*AIM Power Consulting*
- 11:30 Generator cycling  
*AGT Services Inc*
- 12:00 LUNCH
- 1:00 KinetiClean HRSG tube cleaning technology  
*Groome Industrial Service Group*
- 1:30 Upgrade solutions for Advant-based control systems  
*Emerson*
- 2:00 BREAK

- 2:30 TBA  
*Camfil*
- 3:00 Lifecycle maintenance and extension of WX/WY-model generators  
*National Electric Coil*
- 3:30 Recap and feedback

### Thursday, March 23

- 9:00 End-user closed session
- 10:00 EPRI laboratory tour
- 12:00 LUNCH
- 1:00 The following four training sessions, conducted in parallel, run until 5:00:  
Session 1, Gas-turbine failure analysis  
*Kevin Weins and Doug Nagy, Liburdi Turbine Services*  
Session 2, Generational diversity  
*Wade Younger, The Value Wave*  
Session 3, P13/Blueline training  
*Tom Douglas, Hughes Technical Services*  
Session 4, Alstom generators  
*Jamie Clark, AGT Services Inc*

## Steering committee

### Brian Vokal

SVP O&M and Engineering  
Midland Cogeneration Venture

### Robert Bell

Plant Manager  
Tenaska Berkshire Power

### Ross Goessl

Senior Engineer  
We Energies

### Jeff Chapin

Manager, Business Development  
Liburdi Turbine Services

### Pierre Ansmann

Global Marketing Director  
Arnold Group

### Ashley Potts

Conference Coordinator

# TURBINE INSULATION AT ITS FINEST



**ARNOLD**  
GROUP



## Conference sponsors

OEM

GOLD



**ARNOLD**  
GROUP



**MD&A**  
Power Through Experience



**HUGHES Technical Services**  
Power Plant Commissioning and Maintenance

**LIBURDI**  
Turbine Services Inc.



**SUNG-IL TURBINE**  
|주성일터빈

SILVER



**AGTSERVICES**



**camfil** **DOOSAN**  
POWER SYSTEMS



**EMERSON**  
**NORD-LOCK**  
GROUP

**GROOME**  
Industrial Service Group



**Major**  
Tool & Machine





Owner/operators of Siemens Energy/Westinghouse Electric Corp 501F and 501G gas turbines were arriving at the Peppermill Resort and Spa in Reno, Nev., as the electronic files for this issue (CCJ No. 73) were being transmitted to the printer. While there is no report on the 2023 conferences of the 501F and 501G Users Groups here, the programs for these events are summarized below.

The two user groups were co-locating for the first time in three years. These organizations last shared the same in-person venue in February 2020 at the Hilton West Palm Beach, about a month before the pandemic changed things.

Arrangement of the 2023 conference (February 19-23) is much the same as it was before Covid-19 struck. Sunday's program features social events for all attendees. The agenda for Monday—including a safety roundtable focusing on human performance, vendor presentations (so-called Vendorama), and vendor fair—also is for both the 501F and 501G Users Groups. The organizations meet independently on Tuesday, Wednesday, and Thursday for technical presentations by owners, services providers, and OEMs.

Participants in the respected Vendorama program, which runs from the morning break until the meeting concludes about an hour before the vendor fair, are listed in sidebar on p 60 along with the titles of their presentations. User attendees registered on the 501F website can get access to the slide decks when they are posted there, about a month from now.

Another sidebar on p 60 lists participants in the vendor fair.

## 501F program for 2023

The 501F Users Group is a private community of owners and operators of 501F gas turbine/generators established to discuss the operation, maintenance, inspection, troubleshooting, repair,

and optimization of their plants and equipment.

Membership in the organization is limited to individuals who are directly involved in the construction or O&M of Siemens Energy, Westinghouse, and Mitsubishi Power 501F, 701F, and SGT6-5000F gas turbines and who are employed by companies with a direct ownership and/or operational interest in those engines.

Annual conferences are developed and moderated by the group's officers and directors (sidebar adjacent). Agenda highlights for the F frame's portion of the 2023 joint meeting are presented immediately below for Tuesday, Wednesday, and Thursday (half day), February 21-23.

**Tuesday, February 21:** First half the morning session encompasses a closed user section and generator roundtable with associated presentations by owner/operators. Siemens Energy's program follows the morning break and runs

until lunch. PSM is at the podium for the entire afternoon.

**Wednesday, February 22:** Inlet and exhaust and compressor roundtables and their associated user presentations run from the opening bell to the break. Rotor and hot-gas-section roundtables complete the morning program. Mitsubishi Power is at the podium for the entire afternoon.

**Thursday, February 23:** Morning-only program features combustor and auxiliaries roundtables before refreshments and the outage roundtable following.

## 501F 2022 conference recap

A Covid outbreak a week or so before the 2022 meeting was to start at the Hyatt Regency in New Orleans, February 20, dramatically reduced the number of attendees expected, both user and vendor. Recall that this conference was the group's return to an in-person program following a virtual meeting in 2021.

Since many owner/operators participating in the 2023 conference were not able to attend last year, the editors compiled some of that meeting's technical highlights below to help you "connect the dots" since the 2020 in-person conference.

### Officers and Board of Directors

#### President and Chairman of the Board

Ivan Kush, *principal CT and controls engineer, Cogentrix Energy Power Management*

#### Vice Chairman

Carey Frost, *program manager, Duke Energy*

#### Secretary and Board Member

Brian Berkstresser, *plant manager, Liberty Utilities*

#### Board Members:

Blaine Gartner, *principal engineer, Xcel Energy*

John Burke, *O&M manager, Cottage Grove Power Plant, NAES Corp*

Dave Gundry, *senior engineer, Xcel Energy*

Greg Dolezal, *managing director, Klamath Energy LLC (Avangrid Renewables)*

Jaime Oliveira, *O&M senior manager, Norte Fluminense, EdF*

### Conference sponsors

AGT Services  
Badger Industries  
Doosan Turbomachinery Services  
EagleBurgmann  
Falcon Crest Aviation Supply  
Mitsubishi Power  
Nord-Lock  
PSM  
Siemens Energy  
Tetra Engineering Group  
Trinity Turbine Technology

## In power, Doosan brings it all together



At Doosan, we have built some of the world's largest and most-innovative power plants. Backed by proprietary technologies in major equipment fields including boilers, turbines, and generators, our comprehensive technical expertise spans every project aspect from basic materials and equipment manufacturing to plant engineering, construction, plant life extension and post-project services. This solid technical foundation combined with a global network and decades of experience in the power business ensures our customers get optimized, integrated solutions that meet and exceed their expectations. Talk to us soon about how we can do the same for your next power project.

**Integrated solutions for a better life**



**Doosan Turbomachinery Services**  
12000 North P Street  
La Porte, TX 77571

[www.doosanturbomachineryservices.com](http://www.doosanturbomachineryservices.com)



## Vendorama presentations

Advanced Turbine Support, *Continuity planning for steam-turbine outages*  
 AGT Services, *Are you abusing your generators?*  
 Arnold Group, *Advanced steam-turbine and HRSG warming for significant startup improvement*  
 Braden Filtration, *Pulse versus non-pulse filters—when and how to choose*  
 Camfil Power Systems, *An IoT approach to predictive maintenance*  
 Camfil Power Systems, *New ISO test standard for gas-turbine inlet filtration*  
 C C Jensen, *Oil maintenance in powerplants—What about transformer oil?*  
 CECO Environmental/Peerless Mfg, *Top Five most common issues affecting your SCR System*  
 Doosan Turbomachinery Services, *Status of 501F manufacturing programs*  
 EagleBurgmann, *Extended-lifecycle*

*soft parts for Frame 501 expansion joints*  
 Environex, *Enhanced SCR and CO system management to meet today's operational challenges*  
 Environment One Corp, *Best practices for automated gas-manifold and generator purging*  
 Frenzelit, *501F upgrades for legacy units*  
 HRST, *Bigger HRSGs and the new problems they create*  
 Hy-Pro Filtration, *Lube-oil maintenance*  
 Industrial Air Flow Dynamics, *ASME B31.1 (Section VII) as it relates to high-energy and covered piping systems*  
 Industrial Air Flow Dynamics, *Gas-turbine expansion joints*  
 Marioff NA, *Protection of gas turbines using high-pressure water mist*  
 Mee Fog, *Wet compression of 501Fs*  
 Mitsubishi Power, *Product and services update*  
 National Electric Coil, *Aging generator lifecycle planning and issue*

*update*  
 Nord-Lock, *501F four-way-joint solution*  
 NRG Faist Corp, *New ISO 29461-2 and gas-turbine air inlet filters*  
 ORR Protection Systems, *Product and services update*  
 Powerflow Engineering, *Long-term wear and failure modes of torque converters in starting packages*  
 PSM, *Product and services update*  
 Shell Oil Products, *PAG-based EHC fluid—A sustainable alternative to phosphate ester for EHC application*  
 Sulzer Turbo Services Houston, *Product and services update*  
 SVI Dynamics/Bremco, *Case studies on turbine-exhaust-system gas-path upgrades to improve safety, reliability, and performance*  
 Tetra Engineering Group, *Potential for hydrogen use in GT-CC duct burners under new USA H<sub>2</sub> production tax*  
 Veracity Technology Solutions, *Advanced NDT testing methods for decreasing operational risk*

## User presentations

Just shy of a dozen presentations by owner/operators were incorporated into the seven 501F roundtables conducted in 2022: Inlet and exhaust, compressor, rotor, hot-gas section, combustors, auxiliaries, and outage planning.

Summaries of the presentations follow, each introduced by boldface type.

Get the details by accessing the PowerPoints on the group's website at <https://forum.501Fusers.org>. Find them in the "2022 Conference Materials" folder (click on the magnifying-glass symbol at the top right-hand side of the page). Only registered users are admitted to this portion of the website.

**2021 outage highlights** for this unique 2 × 1 combined cycle, described in two presentations, include a steam-turbine major, ST valve inspections, second majors and FD3 upgrades for the gas turbines, and generator inspections on the steamer and one of the gas turbines.

Planning for the outage, the largest in the plant's history, started in 2019. Given the large amount of work slated for 2021, some was moved forward to 2020 to free up crane time, reduce interferences, and level-out the workload of facility personnel.

History: First unit installed on the greenfield site nearly 30 years ago was a 501D5. A 501FC+ was added two years later. Year 2000 saw installation of a 501FD2 and a steam turbine. Upgrade of the FC+ to FD2 and conversion to the combined cycle followed immediately.

Key topics in the first presentation were implementation of (1) purge credit, to eliminate purging during startup and (2) inlet heating, to improve availability

and expand the unit's operating range. P&IDs are provided for both enhancements. Lessons learned provide valuable guidance.

## 501F/G exhibitors in 2023

AAF International  
 Accumetrics  
 Advance Turbine  
 AGT Services Inc  
 Allied Power Group  
 Alta Solutions Inc  
 American Thermal Solutions  
 Arnold Group  
 Badger Industries  
 BBM-CPG Technology  
 Bearings Plus  
 Braden  
 Bruel & Kjaer Vibro  
 C C Jensen  
 Camfil Power Systems  
 Catalytic Combustion Corp  
 CECO Environmental/Peerless Mfg  
 Conax Technologies  
 Conval Inc  
 Cutsforth Inc  
 Doble Engineering Co  
 Donaldson Company  
 Doosan Turbomachinery Services Inc  
 Durr Universal Inc  
 EagleBurgmann  
 Environex Inc  
 Environment One Corp  
 Faist Filters  
 Falcon Crest Aviation Supply Inc  
 Fisher Improvement Technologies  
 Frenzelit Inc  
 Freudenberg Filtration  
 Groome Industrial Service Group  
 Hilco Filtration Systems  
 HRST Inc  
 Hy-Pro Filtration

Industrial Air Flow Dynamics Inc  
 Iris Power-Qualitrol  
 Kingsbury Inc  
 Koenig Engineering Inc  
 Liburdi Turbine Services Inc  
 LPG Industries Inc  
 Macemore Inc  
 Marioff NA  
 Mee Industries Inc  
 Millennium Power Services  
 Mitsubishi Power  
 Moog  
 Munters Corp  
 National Electric Coil  
 Nederman Pneumafil  
 Nord-Lock Inc  
 ORR Protection  
 Parker Hannifin Corp  
 Powerflow Engineering Inc  
 PSM  
 Rochem Technical Services  
 ROMCO Manufacturing Inc  
 Schock Manufacturing  
 Shell Oil Products  
 Siemens Energy  
 Sulzer Turbo Services Houston Inc  
 SVI Industrial (SVI Dynamics/Bremco)  
 Tetra Engineering Group Inc  
 TOPS  
 Trinity Turbine Technology LP  
 TRS Services LLC  
 Vector Systems Inc  
 Veracity Technology Solutions  
 Viking Turbine Services Inc  
 Voith US

# **DON'T LET VALVE FAILURE DICTATE YOUR OUTAGE SCHEDULE!**

**IMPROVE STARTS & TRANSFERS**

**MINIMIZE TRIPS & EXHAUST SPREADS**

**REDUCE ANNUAL FUEL COSTS AND  
SYSTEM TESTING REQUIREMENTS**

**DECREASE ANNUAL SYSTEM MAINTENANCE**

JASC technology has proven successful over time with 18 years of exceptionally reliable solutions for liquid fuel, purge air and water injection systems.



**WWW.JASC-CONTROLS.COM**

Tel: +1 602.438.4400 Fax: +1 602.438.4420  
sales@jasc-controls.com



Note that the current purge procedure uses normal spin-down time at the end of a run to count as the purge credit for the next run. (Consult NFPA 85 for details.) It eliminated the air entrainment into the oil system experienced with the method replaced which was said to have damaged the torque converter wheel. Benefits of purge credit include a 10-min decrease in startup time, longer oil life, reduced stresses on the HRSG, etc.

The second presentation discusses changes to the outage plan made necessary by Covid-19 restrictions, reviews schedule and contractor laydown considerations, and profiles, by way of photos, rotor swaps and upgrades to single-piece exhaust cylinders on both gas turbines.

**GT major inspections** and exhaust replacements presentation is recommended reading by the editors, who are both familiar with the facility profiled and similar work done at other plants. Original scope of work for this 501FD2-powered  $2 \times 1$  combined cycle, planned as a 30-day effort, was the following:

- Major inspection of one gas turbine with rotor exchange and turbine upgrade, plus exhaust refurbishment. Second GT: upgrade only.
- Steam-turbine medium inspection with bearing and valve replacement.
- Pressure-wave cleaning of both HRSGs, plus floor-liner replacement on one.
- Controls upgrade for the entire plant.
- Generator robotic inspections.
- Rebuilds of one cooling-water pump and one boiler-feed pump.

The work described in greatest detail is that for the exhaust section. Inspections conducted as soon as the units had cooled found that Row 4 tip measurements in one engine were significantly different than those recorded only five months earlier. Plus, two of the unit's six exhaust struts severed during that time.

For those not familiar with exhaust sections, the presentation provides excellent drawings, complete with detailed callouts, explaining the issues and parts involved. In addition, there are summaries of both fleet and plant experiences involving the exhaust section.

Repair options to correct the major deficiencies identified included weld repair and exhaust cylinder and manifold replacement. A new plan was developed: Extend the outage from 30 to 45 days to conduct majors on both gas turbines and replace the exhaust cylinders and manifolds on both machines.

The presentation concludes with a list of additional findings and corrective actions.

**DLN to ULN conversion.** Upgrades of SCR systems incorporated in this  $2 \times 1$  combined cycle's HRSGs were not viewed as adequate to meet new rules governing  $\text{NO}_x$  emissions and expected future limits on ammonia slip. Ultra-low  $\text{NO}_x$  was selected as the preferred solution. It was believed capable of reducing  $\text{NO}_x$  from 25 ppm to 9 to 12 ppm. Pictures describe the work in progress.

Here are the results described by the speaker:

- Plant output decreased by about 5 MW.
- Plant heat rate increased by about 290 Btu/kWh.
- Combustor dynamics were virtually zero.
- Plant is meeting its  $\text{NO}_x$  requirements, but struggling with CO.
- Ammonia consumption has been reduced by about half.

**One year of experience** with FlameTOP. Presentation discusses recent modifications to one of two gas turbines at this 501FD2-powered  $2 \times 1$  combined cycle that are providing the additional power expected (and sometimes more). Here's a list of the changes:

- Retrofit of FlameSheet™ combustors to boost engine output and increase efficiency.
- Installation of PSM's GTOP system, with its hardware upgrades to increase output and extend maintenance intervals.
- Addition of inlet bleed heat to the compressor to increase turndown.
- Installation of AutoTune 3.0/PLP for tighter unit control.
- Retrofit of PSM's exhaust cylinder and manifold.
- Installation of Arnold insulation for the walls, floor, and ceiling of the exhaust transition duct to reduce performance-robbing heat losses.

FlameTOP7 from PSM is said to increase the simple-cycle output of a standard 501FD2 by 20 MW while reducing heat rate by 3.8%. Unit turndown can extend below 40% of the full-load rating with both FlameSheet and inlet bleed heat installed.  $\text{NO}_x$  emissions are less than 9 ppm across the load range.

After flipping through the slide deck, read "Desert Basin reports experience, success with first 501F FlameTOP7" in CCJ No. 66 (2021) for details.

**A second plant also reported a GTOP success**, this one involving GTOP6 mods to both engines of the 501FD2-powered  $2 \times 1$  combined cycle—including new combustion hardware, 16th-stage compressor blades, first- and second-stage turbine vanes and blades, and other improvements. The benefits: More than 22 MW of additional combined-cycle capacity and a heat-rate

reduction of 80 Btu/kWh.

This presentation is valuable for the balance-of-plant (BOP) assessment described, which was part of the process for evaluating the benefits of upgrading the gas turbines. The report for this effort highlighted safety valves and steam silencers as having insufficient capacity. Plus, the steam turbine's pressure and temperature limits were identified as a potential limitation, along with both the condensate pumps and the boiler-feed pumps. Changes to safety-valve settings were required, too. Other modifications needed post implementation also are discussed.

**Multiple gas-turbine events** experienced at a 501F4-powered  $3 \times 1$  combined cycle that occurred during a three-month period are described in this presentation. Here's a description of the events and what was done to correct them:

- Operators noted that one gas-turbine in the eight-year-old combined cycle experienced a step change in vibration (relative and seismic) and an output loss of about 1 MW. About a week later, personnel reported hearing a fast-rattle/buzz type of noise inside the exhaust end of the machine. It was accompanied by a nominal loss in unit output of about 3 MW. The engine was shut down and inspected. Initial findings: damage to Row 3 and 4 turbine blades, vanes, and ring segments. Repairs were made and the unit returned to service.
- A second gas turbine tripped along with a loud bang and high relative and seismic vibrations. Vibration levels across the unit reached trip levels and were at or above 16 mils. Inspection findings included damage to Row 3 and 4 turbine blades, vanes, and ring segments, plus the rotor, exhaust cylinder, lube-oil piping, and inlet manifold. Repairs were made and the unit returned to service.

■ A major inspection was initiated on the combined cycle's third gas turbine about six weeks after a borescope inspection of Row 3 blades and ring segments did not reveal any significant findings. However, first inspection conducted during the major revealed some distorted Row 3 blade shroud platforms and exhaust-cylinder heat erosion. Unit returned to service after a two-month outage.

Details on how cooling flows and exhaust temperatures were measured at load loads to verify model calculations. Input from Siemens Energy based on RCA results also is summarized.

**IGV history/maintenance.** The presenter walks you through inlet-guide-vane modifications made over the years to prevent sticking by improving bush-

# Having Bus Duct Issues ?

Consider Crown Electric's Circular Non-Seg  
Westinghouse developed - specifically for GT's

Up to 7,500 amp 110kv B.I.L.

- Built like Iso Phase;  
Impervious to Poor Environments and Cycling Conditions
- Evaluates competitively with traditional non-seg
- Virtually maintenance free;  
All porcelain stand-off insulators - Solidly Welded Conductors & Housing

Turn Key Engineering, Install & Field Support

513 539-7394

175 Edison Dr. • Middletown, OH 45044  
www.crown-electric.com  
sales@crown-electric.com



Fabricators to the Utility Industry

# CITADEL Generator Breakers

up to 5000Amp - No Fans

For 7E-Fleet Life Extension



Retrofit



Retrofill

National Breaker Services, LLC  
sales@nationalbreaker.com



888 8CITADEL  
2 4 8 2 3 3



HEADERS | HARPS | BUNDLES | FINNED TUBES | CUSTOM CASING AND DUCTING | IN-HOUSE MANUFACTURING

## TWO GREAT NAMES IN STEAM GENERATION: CHANUTE AND B&W



Chanute provides high-quality HRSG upgrades and replacement components such as harps, headers, finned tubing and other pressure parts suitable for a wide range of combustion turbine applications.

The HRSG experts from Chanute Manufacturing Company ("Chanute") are now part of The Babcock & Wilcox Company (B&W). Expect the same great quality products and responsive service from the same great teams of experts.

As a contractor to the major HRSG OEMs, Chanute has extensive experience fabricating HRSG pressure parts in the U.S. And with more than 40 years of experience and expertise in the HRSG sector, plus B&W's more than 155 years of steam generation experience, you can rely on quality craftsmanship delivered from Chanute's team of engineering, production and project management experts.



### CONTACT US



TO DISCUSS YOUR HRSG  
AFTERMARKET NEEDS  
▶ [www.babcock.com](http://www.babcock.com)

© 2023 The Babcock & Wilcox Company. All rights reserved.

ing lubrication—the first, for the top half of the bushing, ProdMod 98-1410 in 1998. Westinghouse modified the lower half the following year using the procedure described in ProdMod 99-0240. Siemens Service Bulletin 51004 Rev 2 is recommended reading.

**IGV seize-up/icing.** The same W501FC+ engine with the sticking problem (summary immediately above) experienced freeze-up when moisture accumulated in some of the IGV bushings (lower half in particular) and the ambient temperature dropped to minus 2F. All blades in Row 1 had ice deposits, those in Row 2 had some ice or frost. Operational information related to mitigation efforts is included in the slide deck.

Problem was resolved by installation of a torpedo heater to defrost ice followed by exercising all the bottom-half IGVs. Borescope inspection revealed no damage. A chart provided by the speaker shows first-stage icing potential at several IGV angles. Attendees were referred to Siemens Energy's TA 2005-015 Rev 1 to learn more about icing and how to avoid it.

**Generator main-lead failure** experienced by a South American owner/operator covered problem identification, steps to repair, and lessons learned. Background: Four failures

occurred: Broken B phase for the KN steam turbine/generator at this 3 × 1 combined cycle was found in December 2008 and occurred again three months later. Since that time, all main leads have been x-rayed during every turbine outage.

The NDE effort paid off: Phase A in one of the W501FD2 gas turbine/generators was found broken in November 2011 (at more than 900 equivalent starts and 38,000 equivalent baseload hours). T1 failed at the brazed joint below the main lead flange connection to the bushing; x-rays showed cracks in T2, T3, T5, and T6 in locations similar to T1. A second failure occurred in this gas turbine in April 2021 at 1327 ES and 113,453 EBH.

Photos of the first and second GT failures are provided in the presentation together with an overview of repairs, inspections, and tests conducted. Best-effort cleaning also is described.

**RCA of a 16-kV flashover.** This case history pertains to a unit in reserve shutdown. Incident overview: The GSU and isophase bus (IPB) to the generator circuit breaker (GCB) were energized at 16 kV. A flashover event occurred in the C phase of the breaker on a high-side potential transformer. Inspection revealed water/condensation only in

C phase.

Heaters in the IPB were working, but the breaker that feeds heaters inside of the GCB had tripped. Subsequent removal of isophase links at the auxiliary transformer for hi-pot testing revealed water inside of the adapter between the isophase and transformer. Cracks were found in the weld that secures the adapter to the top of the transformer. Photos are provided.

Corrective actions:

- Cleaned and sealed the weld with silicone and spray sealant and began investigating a long-term solution—including possible weld repair.
- Added GCB heater breaker status to plant rounds.
- Planned the addition of humidity sensors and thermometer in the GCB and the transmission of data back to the control system for alarming purposes.

### Vendor presentations

OEMs for the 501F gas turbine are Siemens Energy, Mitsubishi Power, and GE, with highly capable PSM and Doosan Turbomachinery Services half a step back—between the manufacturers having their nameplates on the engines and the long list of specialty products/services providers serving this fleet.



## 2nd Annual Conference

August 28-31, 2023

Omni Atlanta Hotel  
at CNN Center, Atlanta, GA

PowerUsers.org



Presentations made by Siemens Energy and Mitsubishi Power personnel at the 2022 meeting in New Orleans are not posted to the 501F Users Group website. The former had the podium for only two hours. Its presentations are posted to the OEM's customer extranet portal at <https://cep.siemens-energy.com>.

GE did not participate in the meeting.

PSM held the floor for an entire afternoon. The company's execs and top engineers participated, presenting on recent 501F projects completed and those in the pipeline, 501F FlameTOP (FlameSheet™ and GTOP7), operational flexibility, hydrogen initiatives and roadmap, supply-chain issues and mitigation, 501F repairs (focus on R1 blades and vanes), product-line update (rotors, exhaust, diaphragms), troubleshooting, and service engineering.

While these presentations also are not posted to the 501F website, you can request them from your plant's PSM representative.

**Virtual presos.** The following eight vendor presentations were made during the special 501F virtual Vendorama program conducted at the end of September 2022. Most are updates of what the vendors had to say during the in-person Vendorama program in New

Orleans earlier in the year. Access both the slides and recordings of these presos using the QR code nearby.

PSM, *Fuel and operational flexibility: Hydrogen capabilities and the latest on 501F upgrades and developments*, highlights some of PSM's 501F fleet activities and R&D projects.

Environment One Corp, *Generator condition monitor for air-cooled machines*, discusses the technology's application and contribution to higher reliability—covering principle of operation, system description, sample applications, and design considerations.

Arnold Group, *Advanced single-layer turbine warming system*. Detailed system description, operating experience, and value proposition are presented.

Braden Filtration, *Air inlet pulse filters: Are you keeping pace with the industry?* A thorough assessment of pulse-type filtration systems for maximizing gas-turbine performance. Includes details on fibers, chemical coatings, and membranes.

Catalytic Combustion, *Effects of sulfur on CO catalyst when operating at lower temperatures*, offers solutions for protecting against catalyst degradation



by sulfur contamination.

National Electric Coil, *Aeropac I generator challenges, failures, and recovery*, provides two case studies with guidance on developing a repair plan and identifying major milestone progressions.

C C Jensen Inc, *De-mistifying varnish: Why the CJC VRU varnish removal unit is the safest and most efficient technology*. A tutorial that includes varnish characterization, impacts of turbine operation on varnish formation, importance of oil analysis and tests of greatest value, methods of varnish removal, online condition monitoring, etc.

EagleBurgmann Static Sealing Solutions, *PulseBreaker™ technology for high-efficiency units and 501F/G maintenance tips*. Shares why this new type of gas-turbine exhaust joint is more capable than the company's traditional quilted design: The latter keeps insulation in place, the former offers better protection for insulation media. Focus is on design details.

**In-person presentations.** Companies making the following presentations during the February in-person Vendorama program chose not to participate in the virtual Vendorama session in September. The slide decks for these presos can be accessed on the 501F website along with the user presentations.

Cutsforth Inc, *Case study on electro-*





## Premiere Turbine Generator Mechanic Training Program in the Southeast!

**100% placement rate**

**Enrolling now for  
January 2016**

**Financial assistance  
available to  
those qualified**

# FMTC

**FORT MYERS  
TECHNICAL COLLEGE**

**3800 Michigan Ave.**

**Fort Myers, FL 33916**

**(239) 334-4544**

**www.FortMyersTech.edu**

magnetic interference (EMI) monitoring illustrates the company's ability to validate an event and prevent a failure. Presentation shows how information from high-speed waveforms, spectrum scans, and data analyses captured from shaft ground monitoring and EMSA were used by SMEs to identify the source of high voltages and arcing and allow repair before the generator experienced significant damage.

EMW filtertechnik, *Better filtration pays for itself—Part 2*. This is a follow-on to the company's 2021 presentation, offering a deeper look into the main KPIs of the filter industry and updated results from several gas-turbine projects.

APG-Allied Power Group, *501FD2/3 Row 3 turbine-blade repair and life extension*, is vintage Aaron Frost, an industry leader in the subject matter presented. Reviews historical R3 blade designs, inspections, findings during those inspections, characterizations of defects and where they are located and materials affected, and much more.

Doosan Turbomachinery Services Inc, *501F Row 1 blades: Operational and historical repair experience*. Focuses on the many design differences among Row 1 blades made over the last 25 years with emphasis on OEMs, materials, and coatings.

Advantages and disadvantages from a repair-management point of view are provided, in addition to standard repair recommendations and other considerations for maximum lifecycle management.

B K Vibro America, *A method for calculating complex asymmetric distributed weight splits*. If a turbine rotor has a significant number of existing balance weights where an additional balance weight is needed, a complex asymmetric weight distribution can be used instead to help minimize the total number and mass of weights needed versus a single simple weight split.

Environex Inc, *Is your SCR/CO system ready for turndown?—Part 2* is a follow-on to the company's presentation in February 2020. Back then the focus was how higher NO<sub>2</sub>/NO<sub>x</sub> ratios in exhaust gas were increasing SCR system performance requirements. However, recent field data show another phenomenon is causing even higher NO<sub>2</sub>/NO<sub>x</sub> at the SCR catalyst inlet: Lower VOC emissions requirements. Goal of the preso is to help operations personnel better understand what to look out for when specifying SCR and CO catalysts.

Frenzelit Inc's *Expansion joint upgrades for legacy 501FD and 5000F units* brings you up to date on product improvements to eliminate the root cause of cracking and premature

expansion-joint failures.

HRST Inc's *Considerations for fast ramping and peak capacity* walks you through these topics: optimal startup procedures, gas-turbine purge time calculation, purge credit feasibility, steam-turbine considerations, HP-drum ramp rate, tube metal temperature, and nameplate capacity. Goals include helping users (1) avoid startup damage from water pooling in the reheater and superheater when offline and (2) mitigate pressure-part stress from rapid temperature changes.

JASC's *Zero-emissions equipment* provides operational readiness for liquid-fuel operation and allows the testing of the liquid-fuel system without burning oil in the turbine. Company's technology enables fuel-transfer rates approaching 100% and fuel-system flow-control functionality which only requires service at intervals of four to five years.

Nord-Lock Group, *The four-way-joint leak solution* described is said to be a robust fix which incorporates hydraulic and mechanical tensioning techniques, and internal seal with adjustable retainers, and improved bolt-hole and flange sealing system. Result: Zero leaks.

Sensatek Propulsion Technology Inc's *Turbotrack™* monitors the actual condition of rotating parts. The company's on-blade temperature/strain sensor system can be deployed without continuously dismantling the engine, rapidly accelerating testing while reducing costs.

Shell Oil Products, *Healthy machines through real-time lubricant condition monitoring*. Describes the company's program for monitoring oil and equipment condition 24/7 to give advance notice of impending mechanical failures while providing continuous remote data-gathering.

Sulzer Turbo Services Houston Inc, *Maintaining 501F rotors*, shares company's robust, repeatable repairs and solutions to the following issues, among others: broken alignment fits of forward stub shaft, compressor through-bolt failures, fretted air baffles, and significantly worn disc seal arms. Plus, how Sulzer conducts shop rotor inspections, evaluates findings, and plans steps forward.

SVI Industrial, *Repair procedures: The good, the bad, and the ugly*, shows through a series of photos how to evaluate HRSG weld repairs. Topics include how to find the leak, Code repair concerns, identifying repair methods, raising/lowering panels for tube repair, plugging tubes, jacking panels, Code requirements for stress relief, key Alloy 91 weld features, post-weld heat treatment, welding method 6, and supplement 8.



# REGISTER NOW!

## 33<sup>rd</sup> ANNUAL CONFERENCE

MAY 15-19, 2023  
ATLANTA, GA

R  
RENAISSANCE®  
ATLANTA WAVERLY HOTEL &  
CONVENTION CENTER



scan the QR  
code for more  
information







**T**he 501G Users Group is a small organization of well-connected engineers and technicians who have “grown up” together—so to speak—and very familiar with their colleagues’ plants and equipment. The first Siemens/Westinghouse 501G, installed by Lakeland Electric, began commissioning operations in April 1999, but COD wasn’t until March 2001—only one month before the second machine began commercial operation at Millennium.

Fleet size is small by industry standards—24 engines at 13 sites in the US and one in Mexico (sidebar). Four plants are equipped with one engine each; seven have two gas turbines; two are equipped with three machines each, arranged in 1 × 1 combined cycles.

User meetings typically host one-third to one-half first-timers, so many discussions are similar from year to year because newcomers have to be brought up to speed. But there’s not much turnover in the top positions at G facilities which means each meeting pretty much picks up where the last one left off. This contributes to presentation efficiency because there’s a minimum amount of repetition.

Most user groups serving GT owner/operators organize their technical programs by sections of the engine—for example, compressor combustion section, turbine, etc. By contrast, the G users generally begin with an “annual report” from each plant and follow that nominal half-day program with user presentations on emerging and significant plantwide issues of importance to the fleet.

Excerpts from plant reports and abstracts of selected presentations made during the pandemic and not previously presented in CCJ follow this year’s agenda, summarized below, based on information made available to the editors on January 17.

## 2023 program

Highlights of the 501G User Group’s 2023 conference, co-located at the Peppermill Resort and Spa in Reno, Nev, with the 501F User Group’s annual meeting, are presented here for Tuesday, Wednesday, and Thursday (half day), February 21-23. The Monday program for both groups is described in the 501F article on p 58.

**Tuesday, February 21:** First half of the morning session hosted a highly interactive workshop on Human Performance, complete with (1) an explanatory presentation by an experienced user, (2) learning teams, and (3) tips on how to avoid the Blame Game.

Presentations and discussion on retubing of rotor air coolers (RAC) and the fuel-gas heater completed the morning program. User experiences and challenges were shared by attendees.

Siemens Energy was at the podium after lunch. A technology review of the inlet and compressor sections, plus a general discussion on debris contributors and management, got the afternoon program rolling. A technology review of the combustor, turbine, and exhaust sections followed, with updates on NextGen and Row 1 vanes completing the day.

**Wednesday, February 22:** Morning ses-

### Steering committee

**Chair (acting):** Mark Winne, plant manager, *Millennium Power Partners*  
 Scott Wiley, outage manager, *Vis-  
 tra Corp*  
 Guy Taylor, plant engineer, *Lake-  
 land Electric*  
 John Wolff, technical support/com-  
 pliance manager, *Ironwood LS  
 Power*

### W501G fleet: 13 plants, two-dozen units

Ackerman Combined Cycle Plant, TVA, Ackerman, Miss  
 Athens Generating Plant, operated by NAES Corp, Athens, NY  
 Ennis Power Plant, Vistra Corp, Ennis, Tex  
 Fuerza y Energia Naco Nogales SA de CV (FENN), Gas Natural Fenosa México, Agua Prieta, Sonora, México  
 Granite Ridge Energy Center, Calpine Corp, Londonderry, NH  
 Harquahala Generating Facility, operated by NAES Corp, Tonopah, Ariz  
 Hillabee Generating Station, Constellation Energy Corp, Alexander City, Ala  
 Ironwood, operated by EthosEnergy Group, Lebanon, Pa  
 Magic Valley Generating Station, Calpine Corp, Edinburg, Tex  
 Magnet Cove Generating Station, Arkansas Electric Cooperative Corp, Malvern, Ark  
 C D McIntosh Jr Power Plant, Lakeland Electric, Lakeland, Fla  
 Millennium Power Partners, operated by NAES Corp, Charlton, Mass  
 Wise County Power Plant, Vistra Corp, Poolville, Tex

sion reviewed fleet statistics and key issues, which are incorporated into the plant reports presented by representatives of all facilities participating. Presentations on HP bypass replacement and OST valve replacement closed out the morning program.

Afternoon session featured two interactive roundtables:

1. Generators, focusing on:
  - Major maintenance.
  - Risk/reward and how it may change based on a variety of factors.
  - Major spares, rewind kits, and contingency planning.

# WHEN IS 10 TONS OF DEBRIS A GOOD THING?

Recently **Precision Iceblast Corporation** was contracted to clean a standard HRSG located in the United States after explosion cleaning methods were utilized. The client initially experienced somewhat positive results from the explosion cleaning efforts. However, within a short time frame the client's back pressure increased near gas turbine tripping points.

**Precision Iceblast Corporation** removed an additional 10 tons of debris after explosion cleaning efforts. Client experienced an additional 3.5" reduction in back pressure. Client has been able to maintain the reduced back pressure after the PIC HRSG Deep Cleaning<sup>TM</sup> process.

It was determined that explosion cleaning efforts were only able to clean to the fourth/fifth row of tubes leaving a large amount of the heating surface untouched.



**AFTER EXPLOSION CLEANING**  
(4TH & 5TH ROWS OF TUBES)



**AFTER PIC HRSG DEEP CLEANING**  
(4TH & 5TH ROWS OF TUBES)

## PIC HRSG Deep Cleaning

- ✓ No federal permitting required
- ✓ Dramatic reduction in heat rates
- ✓ Dramatic increase in Gas Turbine output
- ✓ Closest return to design back pressure possible
- ✓ No requirement to remove other contractors from the HRSG unit
- ✓ Scaffold required ensuring complete cleanliness allowing for borescope inspection of each level of the HRSG





**THE INDUSTRY'S LEADING TURBINE INLET  
AND BELL MOUTH COATING EXPERT WITH A  
PROVEN SUCCESS RATE NATIONWIDE**

- Metallizing
- UHP Water Jetting
- Abrasive Blasting
- Full FME Containments
- General Plant Maintenance Painting
- 100% Solids "Zero VOC" Proprietary Coating System
- Certified NACE Inspectors on Staff
- SSPC QP-1 Certified



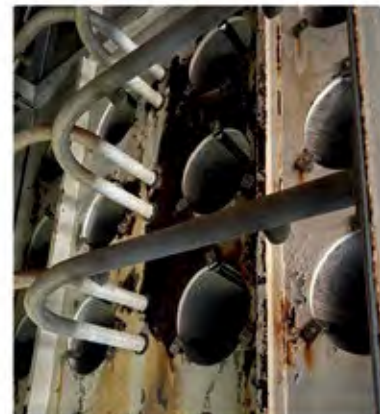
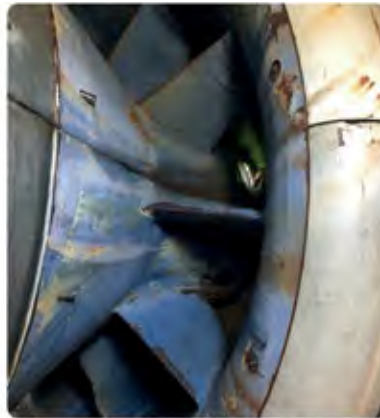
**President / CEO**

**Scott Taylor 863-528-4502**

**Power Generation Sales Manager**

**Jeremy Goff 863-232-6907**

**www.tic-coatings.com**



## 2. O&M considerations for fuel-gas heaters:

- Identifying fuel-gas leaks and operating with them.
- Alarms versus trips—prudent engineering guidance.
- Bundle replacement options.

**Thursday, February 23:** User presentations addressed Row 3 turbine-blade ring deflection, AVR upgrades, and other topics of interest.

## Excerpts from recent 501G plant reports

- Challenges getting into the market because of high gas prices.
- Two big outage events: Row 1 blade failure and generator lead failure, the latter attributed to misalignment of the lead from the generator to the isophase bus.
- L-1 steam-turbine blade failure (generator drive end) damaged the L-0 row and tubes in the condenser impingement zone. Analysis revealed stress corrosion cracking as the cause. Opened the HP/IP

turbine while the LP blades were being replaced and found some problems there as well. The distribution grid, located just ahead of the reheater in one of the HRSGs, also failed, damaging some tubes. Temporary repairs made; permanent repairs deferred a couple of months to accommodate the addition of necessary structural support.

- At a 2 × 1 plant with about 50k hours of operation on the GTs and steamer, and 1000 starts on each gas turbine and about 650 on the steamer, addressed an exhaust-casing split-line leak on one GT. Recommended fix was casing-bolt replacement at 110% of the recommended torque.
- Trunnion vibration issues on a 501G were solved by regreasing. Plant's greasing process then was updated to reflect lessons learned. Similar problem on another unit in the fleet was corrected by replacing the grease fittings. The originals were worn out and grease was not getting to where it was needed. Yet another user, similarly affected, reported that his plant's solution was to jack up the unit and remove old hard grease.
- Combined cycle with just over 100k hours on both GTs and the steamer

reported that the NextGen upgrade done a couple of years ago to permit operation at lower loads continues to perform well. However, CO is still elevated (two- or three-fold higher) during starts compared to DLN hardware. On the plus side, output increased and NO<sub>x</sub> emissions were about 20% lower than DLN.

- Flashback thermocouple failures were problematic at this plant and all t/cs were replaced on both gas turbines. Issue wasn't resolved until Siemens redesigned the thermocouples.
- Key issues reported by a user involved turbine through bolts, Row 1 blade/vane events, L-0 blades. LP economizer was replaced because of degradation caused by ammonia salts, which were attributed to early operating problems caused by tube leaks.
- Catastrophic failure of a steam turbine was described by an attendee who said the unit was rebuilt over a 250-day outage and back in operation at the time of the meeting. No one was hurt. Damage included shaft failure, generator and many condenser tubes destroyed, and HRSG casing hammered by liberated bearing parts.
- Another plant reported positive

# DESIGN/BUILD & REPLACEMENT OF INTAKE HOODS



## New Yoke Assemblies Grit Blasting & Coatings Media Change-Outs

- Cartridge filters
- Panel filters
- New 4-point mounting hardware
- New pre-filter mounting frames
- Evaporative media
- CELdek® and DRIFdek®
- New metering and setups



## Combustion Turbine Inlet Services **Filter-Doc Corp.**

Contact: Robert Murphree, Pres m: 901.734.5954 o: 901.396.3625

Robert@filter-doc.com

Greg Murphree, VP, Sales m: 901.412.1195 o: 901.396.3625

Greg@filter-doc.com

303 East Brooks Road, Memphis, TN 38109

[www.filter-doc.com](http://www.filter-doc.com)

results from a gas-turbine Next-Gen upgrade. Hardware is cleared to run 12,000 hours to HGP, but borescope inspections will continue—to track degradation. T3000 was upgraded, too, and the control system is performing well. Participants were reminded that if they upgrade their controls, set points must be reinstalled. A small hydrogen leak also was mentioned but it is actively monitored and not considered a problem.

- OST valves are believed associated with the rotor air cooler (RAC) not operating properly. Seats can stick and valve not open as intended during startup. Plant has identified a vendor that may be able to provide an alternative with a replaceable seat.
- Plant reported an issue with its Nash vacuum pumps. Steam jet ejectors believed too small for the duty so Nash pumps must run all the time and can overheat. Last time a condenser leak check was performed, the steam jets and one Nash pump were required to hold vacuum. A couple of other participants recommended doing a helium leak check and paying special attention to the integrity of the crossover pipe.
- A 2 × 1 combined cycle was operat-

ing in true peaking mode because of low gas prices. A rotor swap on one of the gas turbines forced operation in the 1 × 1 mode.

- Major on a KN steam turbine involved machining out and replacing stellite seats on valves. During the overhaul, investigation of actuator oil leaks revealed the wrong plugs had been inserted previously. Bearing oil leakage was high because a worn seal ring had not been replaced during the last overhaul. Plant struggled with vacuum leaks in the last year which were attributed to rupture discs being near end-of-life.
- Plant reported high ammonia slip, corrected temporarily by cleanout of the ammonia injection grid (AIG). Replacement and upgrade alternatives are being considered. An attendee offered that the Peerless Edge® AIG retrofit it implemented operates with ammonia slip and NO<sub>x</sub> within specifications. Prior to the retrofit, plant reduced load to control slip.
- A vibration step change on one of plant's two gas turbines was investigated with borescope inspection finding Row 4 hardware missing and several Row 1 vanes breached. Operator training was being considered.

- Leaking tubes in the fleet leader's kettle boiler were simply plugged to enable continuing operations.
- Wear and tear on this 1 × 1 plant's HRSG prompted use of thermography to identify hot spots, resulting in a partial rebuild of the boiler's walls. The floor also was rebuilt to eliminate release of insulation. Finally, ports were added on top of the HRSG for NO<sub>x</sub> traverse testing.
- Another plant reported rebabbiting and repair of its exhaust bearing, plus replacement of Row 1 ring segments, one combustion basket, and one transition piece.
- One gas turbine at a 2 × 1 plant with more than 100k hours of service completed a rotor exchange and replaced four Row 1 blades and three Row 1 vanes during that major. Its sister unit also conducted vane and blade work during the overhaul, including a few airfoil replacements.
- The representative of a 3 × 1 combined cycle discussed a DCS upgrade to T3000 Version 8.2 on the trio of gas turbines, which averaged about 70k operating hours and 2000 starts. The steam turbine, with about 100,000 hours under its belt, and one GT benefited from AVR (automatic voltage regulation) upgrades.



# POWER

## TURNKEY SOLUTIONS



**CUST-O-FAB's power generation team offers a convenient single source contact for fabrication, maintenance, and construction.**

**Contact us today to learn more about how we can help with your next power generation project:**

- Exhaust Plenum - Improved Design
- Exhaust Ductwork & Silencers - Improved Design
- Inlet Filterhouse & Cooling Systems
- Inlet Plenums, Ductwork & Silencers
- Inlet & Exhaust Expansion Joints
- Turbine Enclosures
- Power Piping Fabrication & Installation
- HRSG - Harp Repair & Replacement

**CUSTOFAB.com**



■ One gas turbine at a 2 × 1 facility experienced an expansion-joint failure, resulting in a unit trip. Other happenings: A significant forced outage was caused by the failure of a startup frequency controller. One unit suffered flash-backs on Can 3 following a low-gas-pressure event.

Plus, pieces of lockwire wire were found in combustion cans during a borescope inspection and removed; there were multiple igniter failures (some sticking after insertion); Row 1 STM (short-term mitigation) vanes were installed on both units to address the vane-distress phenomenon reported in the fleet. Regarding the last point, the modified vanes increase back-flow margin, improve impingement cooling, and supply additional film cooling to the leading-edge of concern.

■ Major inspections were conducted on both the steam and gas turbines at a 1 × 1 facility with about 100k service hours.

However, within one month of outage completion, five of six RTDs monitoring the generator had failed; ST vibrations were high during post-outage starts, increasing regularly from 8 to 14 mils;

throttle and governor valves on the steamer began sticking during starts; and the reheat stop valve was sticking—sometimes.

■ Borescope inspections on two gas turbines, each with nearly 100k hours of service and 1800 starts, revealed no issues with Row 1 mitigation vanes. Center igniters were installed on one unit; however, cables were not connected properly, causing a fired abort on startup.

Second GT experienced a full-load trip attributed to a flameout caused by initiation of steam power augmentation. Logic mod fixed that problem.

■ A 1 × 1 plant with more than 100k service hours and 2700 starts identified flow-accelerated corrosion (FAC) in the HP economizer upper headers and LP economizer. Planning for replacements during the next outage is underway.

Other issues of concern included turbine through bolts, Row 1 blades and vanes, increased intervals for blade inspections (8k to 12k hours). Plant experienced its first through-bolt failure at 20k hours, second at 30k; current set of bolts has been in service about 40k hours.

## Abstracts of recent 501G user presentations

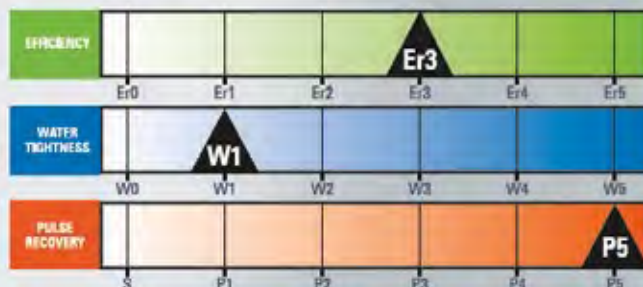
### Takeaways from safety roundtables:

- Populate your plant safety committee with motivated personnel and use corporate guidelines to ensure job safety.
- Excavations frequently are required at relatively new sites for fixing underground infrastructure. Proper barriers for personnel protection are particularly important. Know where to dig, how to dig, and how to refill to prevent collapse.
- Conduct a 10- to 15-min safety meeting before start of work and at end of day. In the morning, review what could happen given the planned activities; in the afternoon, what did happen. Make discussion topics germane to the work scheduled for the next couple of days.
- Attendees expressed concern about different procedures at different plants, particularly when changes in ownership occur. Procedures

# THE POWER OF PRECISION

Donaldson's operator-inspired ErIWIP filter rating scale makes selecting the optimal filter for your application easy.

Gas turbine operators can ensure they're using the ideal Turbo-Tek™ filter by identifying the appropriate **Efficiency**, **Watertightness** and **Pulse Recovery** ratings\* for their unique operating and environmental conditions.



\*Ratings are designed to help maximize filter life. Efficiency refers to the proportion of inlet air particulates captured by the filter. Watertightness refers to the filter's ability to withstand moisture. Pulse Recovery refers to the filter's ability to be effectively pulse-cleaned.



Donaldson.com  
FilterInfo@Donaldson.com

© 2022 Donaldson Company, Inc.

**CONTACT US FOR  
FILTERS, PARTS, OR SERVICE  
800.431.0555**

are not one-size-fits-all and unless carefully thought through can take control out of the hands of those who know the most.

- Maintain a no-blame culture. If something doesn't seem right, ask questions. After an incident, all plant supervisors and personnel should ask themselves, "What could I have done to prevent the problem from occurring?"
- Virtually every plant acknowledges that it has a "good" safety program, according to a poll of attendees. But the challenge is to make it better. Remember that complete paperwork doesn't mean the work is being done safely.
- Contract safety personnel on patrol is money well spent. These folks typically are good at "coaching," not criticizing.
- Consider implementing a "good catch" program to keep concerns in front of the group until they are corrected.
- Annual air-quality-management and respirator training are recommended for all plant personnel.

**Bearing problem?** Nah, it was a lube-oil temperature problem.

The details: Collector bearing vibrations on one gas turbine suddenly increased to more than 6 mils.

Bearing area was inspected; there were no obvious findings. Vibrations reappeared daily soon after GT restart. Corporate engineering was consulted. Vibrations reached a high of 7.7 mils, but with a trip setting of 8.5 there were concerns.

Was collector compartment temperature a cause? A portable a/c unit was installed, but the problem remained. Was something in the generator causing the problem? Nothing obvious based on a thorough inspection.

One day vibration was not a problem: Weather was cool and wet—an "ah-ha" moment. Put two lube-oil coolers in parallel to reduce oil temperature and the problem disappeared.

Staff found cooling-water temperature was higher than normal because of several failed spray nozzles in the tower; also, the collector bearing was lightly loaded. Nozzles replaced and bearing loading corrected, the unit returned to normal operation with one lube-oil cooler in service.

**A two-decade operating history** of high HRSG backpressure (BP) and derates for a 1 × 1 combined cycle provided valuable lessons learned. The plant, designed for baseload operation, was commissioned and soon pressed into cycling service for

several years. Almost from the get-go, the HRSG experienced fouling by ammonia salts from the SCR and rust accumulation, most evident in the last tube sections. Result: A gas-turbine derate of 15 MW.

After years of monitoring pressures, trying online cleaning methods (sonic horns, vibrators on lower headers) and offline cleaning (dry ice, air jets, pressure wave), and dehumidifiers on the GT inlet and LP inlet to the HRSG, plant, beginning in 2008, resorted to adding stiffeners in the HRSG. Lower baffle plates were removed in the LP and IP sections and several different baffle configurations were tried to identify the most effective alternative. Also, SCR controls, and economizer recirculation temperature controls, were adjusted to increase the allowable BP from 28 to 30 in. H<sub>2</sub>O.

In the face of continued elevated BP in 2016, the facility pursued permanent modifications beginning in 2017 (through 2020) to increase allowable backpressure to 45 in. H<sub>2</sub>O and address other issues—such as tube leaks.

These included doubling the number of stiffening plates in the roof, floor, and walls; replacing the LP economizer, LP superheater No. 1,



# SCHOCK Retrofit Systems

Gas Turbine Owners' Preferred Choice for Retrofit Upgrades

Intake & Filter Systems



Exhaust Silencer Upgrades



Exhaust Systems



Exhaust Plenums/Diffusers



From filterhouse to exhaust outlet, Schock inspects, designs, and manufactures innovative and economical GT auxiliary solutions. Experience on 1200+ GT exhaust systems, 1100+ exhaust diffusers, and 2000+ intake and filter systems.



Schedule a free site  
inspection/scope review:  
[www.schock-mfg.com](http://www.schock-mfg.com)



and LP evaporator tube bundles; and upgrading the expansion joints. Eleven tube rows in the LP economizer were replaced with 15 smaller-diameter tubes, creating a 20 in. cleaning lane between the LP economizer and the LP evaporator/superheater No. 1.

Pressure wave was by far the most effective cleaning method, being able to remove about five times as much debris as dry ice. The story may not be over, though. The unit has not been cleaned since 2020 and BP is beginning to rise again—even though the unit is now operating baseload.

**Transition-piece steam pipe failure.** During a local crawl-through inspection, plant personnel found a tube liberated from one transition piece. A full unit check found cracks in two more transition pipes in roughly the same place. Dye-pen inspections of the remaining TPs found no additional problems. Other users in attendance reported similar cracking.

RCA conclusion was that the dynamic frequency of the engine was close to the natural frequency of the transition piping. The OEM recommended increasing the exhaust temperature to create greater separation from the natural frequency of the transition piping. A logic change was made and no problems have been

reported since.

**Case study of a condenser event** may well be one of the most valuable safety briefs you'll receive if you have a combined-cycle plant with a fuel gas heater (FGH). An abridged account follows.

As a result of the failure of a main lead in the steam turbine/generator, the facility was in a steam-turbine outage in January 2022 during which the GTs remained "available" to the grid (with fuel at pressure up to the FGH stop valves). With the plant experiencing numerous issues with the FGH (for example, leaking gas isolation valves) and its leak-detection system (prone to false alarms), and other factors, natural gas found its way to the condenser via the IP water-side supply line (the source of heat for the FGH).

The plant was down for 10 days, but with cold weather in the forecast, the gas turbines were started to build up pressure to about 50 psig in the HRSG to prevent freezing. The steam pressure in the HRSG provided the motive force to move the gas that had been accumulating in the IP drum to flow down the steam piping to the condenser.

When a welder arrived to repair a 1-in. pipe connection on the outside

of the condenser, the arc ignited the gas and the subsequent explosion blew out six rupture discs on top of the unit, caused bolting threads on the LP steam-turbine cover to fail, and damaged internal structural supports. Rupture-disc parts were found all over the plant site. The explosion was heard and felt throughout the plant.

No one was injured (not even the welder), no condenser tube leaks occurred, and the LP section of the turbine suffered no internal damage.

Recommendations to avoid a similar incident elsewhere, included the following:

- Eddy current test FGH tube bundles and perform leak testing at least every six years.
- Utilize more robust inserts when plugging tubes.
- Ease plant staff access to vent valving and instrumentation.
- Establish fleet standard critical preventive maintenance guidelines for FGH systems.
- Install permanent redundant methane detectors on air ejectors with feedback to control system.

**Plant has no vacuum pumps** so steam pressure is required on a unit start to raise vacuum. Staff found the time required for a unit start creeping

## Generating Timely Repair Solutions

- **Generator Testing Services**
- **Generator Repair Services**
  - Stator – Rewinds, Rewedges, Endwinding & Core Repairs
  - Rotor – Rewinds, Retaining Ring Removal/Replacement
  - High Voltage Bushing Manufacturing

**AGTServices has the experience to perform ALL of the OEM bulletins. And the knowledge to address the issues for which there are no bulletins...YET!**

**GE 7FH2, 324 and 390H Stator Core Iron Looseness and Failures. We've been preventing and addressing these issues since 2014 (but the TIL's – 2020!) Please call 518-843-1112 for info.**

**From Robotic Inspections to full Stator and/or Field Rewinds and Core Repairs or Restacks.**



up and budgeted time for checking piping, drains, valves, etc, to find out where the leak was. One day it was not possible to get the vacuum low enough to roll the steamer. More leak checking required.

The gremlin was in the crossover pipe from the IP section to the LP. OEM's plan was to remove the 60-in.-diam pipe and re-gasket both ends. Outage time required: Six days.

Alternative plan proposed by Furmanite America: Install scaffolding, remove insulation, remove crossover-pipe bolts and clean threads, lubricate threads, and reinstall. Plus, the steam-turbine/generator enclosure was modified to allow steam/hot air to escape and cool down that area, which got hotter as the unit ran. Bolts were so loose all the way around the pipe flanges, nuts could be removed by hand. Staff believes the bolts worked loose because of unit cycling.

The bottom line: Tough working environment, but the job was completed in two days at less than 20% of the OEM's quote—including drilling required for Furmanite injection (and the Furmanite) and reinstallation of insulation.

Recommended PM: Check all bolts periodically, especially following a

change in operating regimen. If you find two bolts loose on one flange, change the gasket as well as all the bolts. Same goes for flanges on GT bleed piping and air extraction lines.

**Generator lead failure** caused unit to trip from 42% load. All auxiliary power was lost; unit coasted down on dc lube and seal oil; generator hydrogen loss was significant; electrical testing revealed winding was grounded in all three phases. Significant damage—including melted copper and other debris—was found in the lead box.

Main lead T2 cleat was blown out during the event with carbon dust and debris (molten metal) falling into the generator. Carbon dust was distributed all over the generator by the hydrogen blower. Rotor was pulled for cleaning and full rewind.

The presenter said upgraded main leads, reflecting the realities of today's operating paradigms, were installed. He recommended others consider doing the same on the advice of experts. It was his opinion that the original brazed joint failed because of years of cycling service.

This forced outage ran six months and cost \$15 million. Ownership change and other upset conditions stopped work four times during the

outage, which should have taken but 45 days. Speaker said it should take 14 24-hr days.

**NextGen CO emissions.** Speaker's experience was reflected in his "warning" to attendees that they should expect higher CO emissions on a cold start after implementing NextGen. He showed different rates of CO emissions during cold, warm, and hot starts and load changes. A slide showing old DLN emissions versus NextGen showed CO with NextGen was higher from 10 to 30 minutes after startup. By the 30-min hold point during a cold start the plant had consumed 40% of its CO allowance.

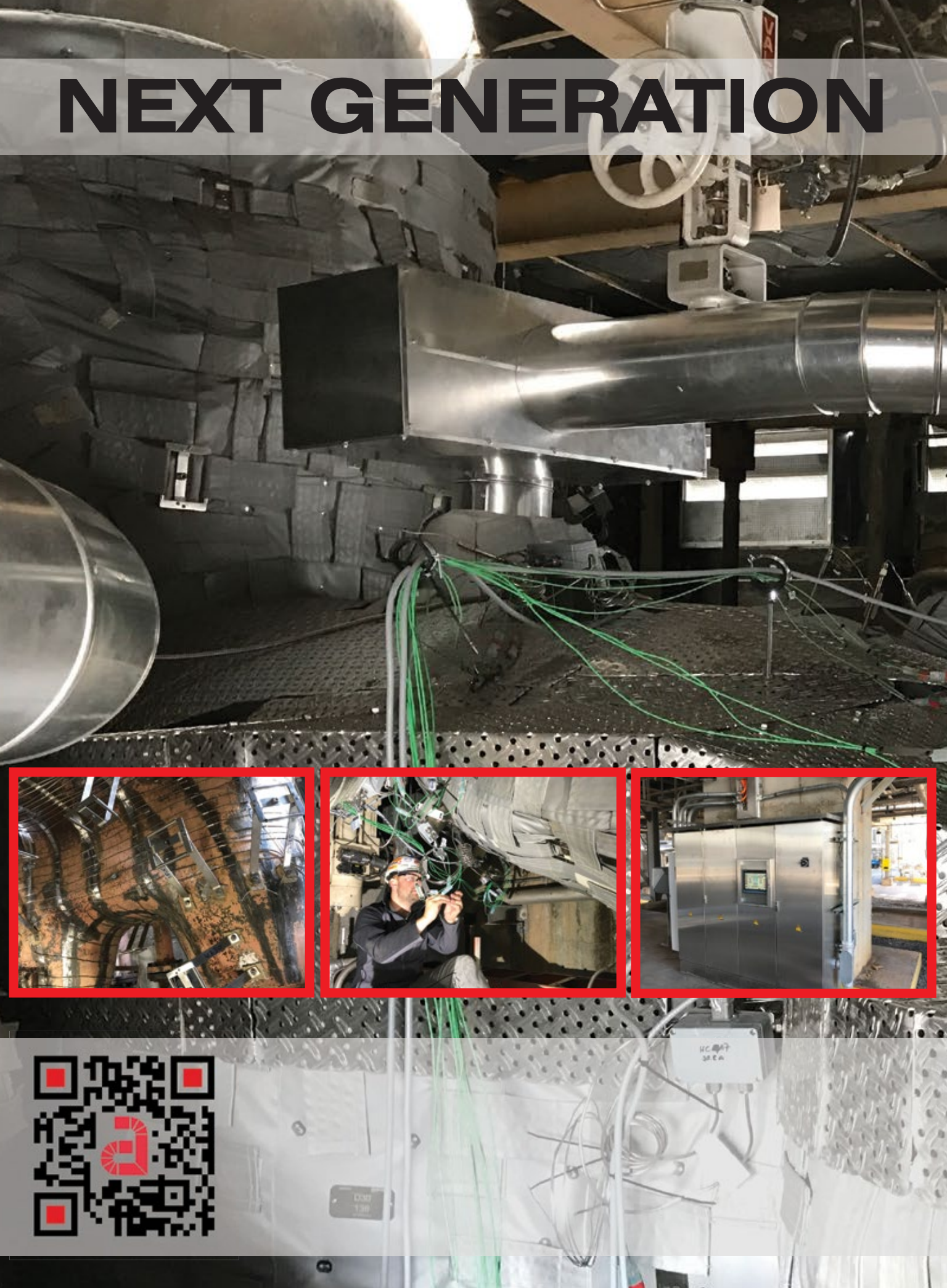
**SUBSCRIBE TODAY**  
**CCJ**  
**COMBINED CYCLE Journal**

The authoritative information resource for owner/operators of gas-turbine-based peaking, cogen, and combined-cycle plants.

Subscribe via the Internet, access:  
[www.ccj-online.com/subscribe](http://www.ccj-online.com/subscribe)



# NEXT GENERATION





# TURBINE WARMING

## **Operational Advantages**

- Eliminate Cold Starts
- Maintain Hot-Start Conditions
- Faster Starts
- Mitigate Case Distortion
- Advanced, Customizable Control

## **Maintenance Advantages**

- Easy Access to Critical Areas
- Quick & Easy Removal / Reinstall
- Enhanced Operator Safety Features

## **Economic Advantages**

- Gain Competitive Market Advantage
- Seamless Turnkey Solution
- Reduced Fuel Consumption
- Increase Profitability

**Contact: Pierre Ansmann**

[pierre.ansmann@arnoldgroup.com](mailto:pierre.ansmann@arnoldgroup.com)



# ARNOLD

GROUP





# Remembering Steve Bates

If you didn't know Steve Bates, who died suddenly November 30 (2022), at age 57, while on vacation with family, be assured it was a privilege. The plant manager of Vistra Corp's Wise County 2 × 1 G-class combined cycle in Poolville, Tex, and chairman of the 501G Users Group, Steve was a technically competent, respectful, and unflappable leader who never passed on an opportunity to help a colleague.

He was a big supporter of CCJ's mission and an industry luminary who viewed personnel safety as a top priority long before many others. Example: Most recently, and with his company's support, Steve alerted powerplant owner/operators to the potential for leakage by fuel-gas-heater stop valves and the possibility of an explosive mixture of fuel and air forming in the condenser.

He presented on this possibility at every opportunity—including meetings of the Combined Cycle Users Group, HRSG Forum (dig deeper in CCJ No. 72, p 42), and other industry organizations.

In a world that's prone to short-circuit discussions of findings in accident investigations, Steve was committed to sharing such knowledge to protect powerplant personnel and the public at large; no corners were cut on his watch. Interestingly, he did everything by the book and it didn't take longer than not.

Some of the people who knew Steve best share their thoughts below.

Steve was such a nice guy. When I heard the coroner revealed that Steve had a large heart, I laughed—as it wasn't surprising. Everyone knew Steve had a large heart. You knew it from every interaction you had with him. Steve cared! He cared a lot!

Steve cared about me and my fam-



**A citizen of England, Canada, and the US,** Steve was generous, kind, compassionate, and highly respected for his ability to make those around him feel seen and appreciated

ily, he cared about my plant and my team, and he cared about my turbine. He cared about all of our turbines! For more than 10 years Steve selflessly led the 501G Users Group, painstakingly tracking and working diligently to manage a multitude of issues to resolution. Steve was a great listener and worked hard to ensure our voices were heard and our issues were brought forward.



**Steve and Lynn Bates** sit alongside Arnold Group's Pierre Ansmann at a Dallas Stars ice-hockey game. The couple was married 38 years and raised two daughters—Cynthia and Amanda

It was a joy to watch Steve wrestle with Siemens. His intimate knowledge and understanding of the 501G, his tenacious grasp of current issues, along with his calm demeanor and good humor made him a formidable foe in any debate or discussion. Steve would hang on to an issue like a pit bull, unwilling to let go until Siemens understood and acknowledged his viewpoint. The drama of watching/waiting for his opponent to capitulate was always entertaining. Steve fought for all of us, because he cared, he cared a lot.

After a tumultuous start to 2022 [the Texas deep freeze], Steve turned his focus to Human Performance and the influence it can have both in our success and in the adversity we face. By allowing the 501G users access and insight into a significant event at his plant, and specifically how human interaction influenced several contributing causes, he gave us an understanding of why it is important that we improve our understanding of Human Performance and strive to integrate human-performance tools and processes into our daily lives.

Again, Steve did this because he cared. He cared a lot. His caring and support will be profoundly missed.

*Mark Winne*

I am privileged to have worked for Steve for over 14 years. He was a great mentor and friend. Steve showed me the ropes and gave me the tools to be a successful manager. He had a wonderful personality and was deeply engaged with every team member at the plant. Steve's dedication, knowledge, kindness, and loyalty to the team was key in developing a great culture and family atmosphere at Wise County.

I loved being able to walk in Steve's office, sit down, and brainstorm ideas





**Steve was a fun-loving guy** who lit up the room



**Steve's thirst for knowledge** was never-ending. Here he participates in the first meeting of the Generator Users Group, founded by Consultant Clyde V Maughan at age 89

to improve plant performance, or even to just share thoughts on recent events. Everyone at the plant has a deep void with the loss of Steve and we will never forget all that he brought to each of our lives.

He will be forever in our hearts.  
*Michael Coffman*

I met Steve many years ago through the 501G Users Group. As Chairman for more than 10 years, Steve was very approachable and inviting for anyone to participate. He provided strong leadership for our group with his industry knowledge, and his ability to establish great relationships



**A group of ORGs** (old retired guys) and hopeful candidates gathered to salute Steve and celebrate his life the evening before his funeral. Seated are Corky Ranallo, Jon Rice, Ramiro Cerecer, Bill Tyus, Robert Stevens, Mike Knisely, Scott Wiley, John Stuart, David Blackshear, Neal Coffey, Rodney Kapavik, and John Shue



**No better pastime than fishing**



**Food—the best way to bring people together.** Third-place team at a recent plant cook-off, an annual event at Wise County: Maintenance Manager Oscar Rich, Steve, Production Manager Mike Coffman, and Outage Manager Scott Wiley (l to r)



# DEKOMTE de Temple LLC

## Expansion Joint Technology

### Gas Turbine and Combined Cycle Power Plants



High quality, reliable solutions, for the power generation industry.



DEKOMTE de Temple LLC,  
Marietta, GA 30067, USA  
1-678-214-6544  
info@dekomte.us  
www.dekomte.com

#### Services

Inspection and assessment  
Installation & Maintenance.

#### GT and HRSG Applications

Hot and Cold casing high cycling frame and fabric  
Encapsulated and integrated insulation  
Formed durable fabric composition.

#### HRSG Penetration Seals

Complete integrated fabric solution  
Formed durable fabric composition  
Metallic bellows.

#### Additional Technical Support

Online hot spot repair with pumpable insulation  
Casing and insulation repairs  
Access doors and Insulation pillows.

with all 501G frame owners, vendors, and Siemens. Steve was an open book, always willing to share for anyone who wanted to learn more. He was professional and had a great moral compass. I did not work with Steve as closely as those who interfaced with him on a daily basis; however, he has left quite an impression on me. Steve will be greatly missed.

*Kevin B Robinson*

Whether on a fishing boat or in the corporate boardroom, you knew that friendly smile and outgoing personality were always going to be there to greet you. I met Steven Bates while working as a contractor in Arkansas. He was managing the Tractabel facility just outside of Malvern and had a small job for us to do that turned into a very big job and eventually me going to work for him full time—an invitation I always will be grateful for.

Steven was a study of many things and always on top of recent activities, not only in the power business, but anything that piqued his interest. Steven's leadership with the 501G Users Group is one of the reasons why the G frame has been so successful. He always brought the skills of team-building and inclusion to the table, and doing so with the Siemens team,

made our user group's effort a great environment as well as very productive. We were able to work together to solve many problems in this frame as it was being developed.

Steven was a tri-citizen of the world. Born in England, he moved to Canada and then to the United States; he had citizenship in all three countries. I was working with Steven as he studied for his US citizenship test, learning a few things myself in that process. He and wife Lynn worked hard, passed the test, and were awarded citizenship. Flags of the three countries draped the table displaying the urn with Steven's ashes.

But above all, Steven's relationship with his god, wife, children, and grandchildren were always something to aspire to, and as in many other things, Steven led by example in all of these areas. Our industry will miss Steven Bates; I will miss him for his friendship and camaraderie.

*Neal Coffey*

Having known Steve for the past dozen or so years and working directly with him on the 501G Users Group steering committee for the last decade, words cannot describe the personal and professional loss that we are all feeling. Steve was always willing

to help and share his knowledge and experience with anyone needing it. As the committee chair, he worked tirelessly to promote a culture of respect, openness, and integrity among users, vendors, and OEMs.

Although Steve will be missed by all, his legacy will live on through the memories, accomplishments, and friendships made throughout the years. I will personally miss his friendship and camaraderie, in addition to all of the other outstanding character traits that made him the person he was.

*John R Wolff*

Steve Bates was an exceptional person who will be dearly missed by the Vistra family and the 501G Users Group. He became chairman of the 501G steering committee in 2011 and has provided years of dedicated service. Steve's leadership on the committee was what drove the 501G users to become a very close-knit family that was well informed of all the issues we were dealing with on the G frame. When I think of Steve, I see a family man, a leader, a communicator, a friend, and a mentor that I will miss.

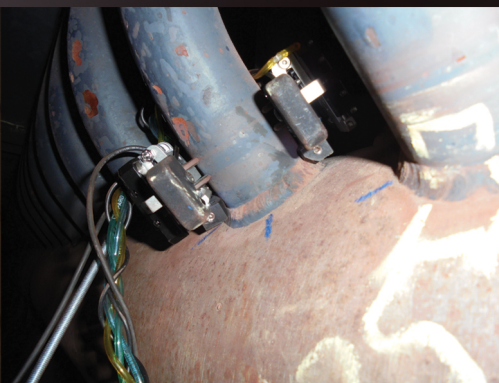
*Scott Wiley*

Many years ago, while attending my first 501F and 501G Users

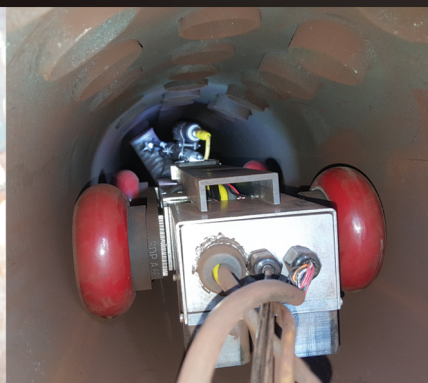
Keeping your HRSG in running order is your business.  
Finding better ways to inspect them so they stay in running order is ours.



Through Fin Tube  
Scanning for Wall Thinning



Tube to Header Weld  
Examination for Cracking



Internal Inspection,  
Collecting Tube Video  
& Measuring Wall Loss



Better Tools,  
Better Inspections,  
Better make it TesTex



Group conferences, I noticed a few guys sitting off to the side of the podium and, based on their looks and my read on their demeanor, I was quickly wondering what I had gotten myself into. One of them was someone I worked with, Pete Sobieski, but the vibes the other two gave off was scary. Turns out they were Mark Winne and Steve Bates, and oh how wrong my read was.

Fast forward almost two decades and I dare say I was barely tapping into the deep well that was Steve Bates. While the last few years have been filled with uncertainty, loss, and changes to the status quo, I consider myself privileged to have grown closer to Steve and wife Lynn during that time.

I feel very fortunate to have vivid memories of what turned out to be our last in-person evening together at Dezerland. Steve, Lynn, myself, and a few others were enjoying some beverages and desert and Steve was laughing harder than I had ever seen. Turns out he found the idea of me on a little Vespa hilarious. That was a wonderful evening and I will always have that memory of him happy and jovial.

Over the last year, the 501G Users Group, which Steve was chairing, got

very involved in working with us on the upcoming conference and in that light Steve had just finished working with a Human Performance organization and you could tell it had really kindled a flame for him. He was so excited he brought it to the Boards of both user groups and we decided to include it in the upcoming conference.

Steve was a man of commitment, honor, and grace. His passion for what we do, and how we do it, was awesome to see after such a distinguished career, when some folks are just riding the wave. Steve was full-steam-ahead and just as passionate before his vacation as he was when I met him all those many years ago.

I will miss his unassuming nature, the roles that he filled so well, and the counsel he offered. More importantly, I will miss the person that he was. The author, A A Milne (Winnie the Pooh) summed up so much in the following sentence: "How lucky am I to have something that makes saying goodbye so hard." I offer, in closing, that all of us who knew and worked with Steve were indeed lucky.

*Ivan Kush*

I still don't know what to say. When I heard the news, the first thing I thought was that we still owed Steve

a lube-oil pump that we had borrowed.

When we were at the 501G Users Group meeting in Orlando this past May, I ended up in the hospital. Steve called and wanted to come spend time with me so I wouldn't be alone. He then reached out to ensure I made it home, and reached out again a few days later to see how I was doing.

Steve was one of the most genuine people I have ever met. He had a very calming way about him and no matter what subject I called to discuss, I always came away with a completely different perspective. Knowing and working with Steve has made me a much better person, and I will forever miss him.

*Steve Cole*

Steve Bates was my friend and a role model for more than 10 years. Steve's passing hit me really hard because only a few hours earlier I was commenting on his Facebook post about spending holiday time in Hawaii.

As plant manager, Steve was at all times very knowledgeable, calm, and relaxed. He always had a smile on his face—even during the toughest negotiations. I visited him at Wise County annually and spent quality time with Steve at the many turbine confer-



# NATIONAL ELECTRIC COIL

*The Total Generator Solution Begins With NEC!*

800 King Avenue, Columbus, Ohio 43212 • 3330 East 14th Street, Brownsville, Texas 78521

**ISO 9001**  
**Certified Quality**  
**Management**  
**Systems**

## EMERGENCY OR PLANNED OUTAGE?

National Electric Coil's Generator Services Group will be at your site day or night, helping you get your generator back online as quickly as possible.

Our team of generator engineers, project managers, logistics expeditors and experienced site technicians are ready to help you determine the best short- and long-term options for returning your unit to service.

### Stators

Inspections & Testing  
Winding Manufacturing  
Rewinds & Overhauls  
Core Restacks  
Rewedges  
Repairs

### Rotors

Inspections & Testing  
New or Refurbished Windings  
• Copper or Aluminum  
• Any Cooling Design  
• Any Profile: C, E or other  
Full-Service Balance Pit  
• Overspeed Testing  
• Running Electrical Tests  
• Thermal Sensitivity Testing  
• Vibration Analysis

### Generator Engineering Design

• OEM TILs  
• Uprates  
• Upgrades

Call Us Today! 614-488-1151x105 or 724-787-4967  
Email Us at [necservice@national-electric-coil.com](mailto:necservice@national-electric-coil.com)  
See [www.national-electric-coil.com](http://www.national-electric-coil.com) for more about NEC and its services and products.

ences we both attended. He was highly respected in the industry, inspiring, and a caring person who always put family and friends first.

*Pierre Ansmann*



Leading a user group is no small task: There are many aspects of that role most don't see. Being a good leader takes a lot of knowledge, professionalism, interpersonal skills, and tact. Steve Bates was a great leader and helped build a solid framework for cooperation and engagement that helped solve many concerns for the W501G fleet that has benefited both the users and Siemens Energy.

I had the privilege of working with Steve and truly believe we would not have been as successful without his involvement. When we first met, the fleet really needed attention and a different approach to tackle some of the tough challenges present in the fleet. He helped pioneer a new way of working with Siemens Energy, and while holding us accountable, was fair in his approach and used his collaboration skills to bring both sides together for the benefit of the fleet.

His engagement allowed us to amplify our interface with better ways to communicate and resolve some of the toughest issues facing the frame. For a period of time, we executed four face-to-face customer meetings annually—including "deep dive" technical meetings as well as monthly net meetings to help everyone stay on top of the rapid pace of development of solutions.

Steve helped bring the customers together and was instrumental in creating an atmosphere of cooperation and inclusion that was key to solving some of the most difficult tasks. He was firm and truthful, but also open-minded and accepting of others' inputs and ideas. This leadership made him stand out in the crowd and brought us all together. We are all better today because of the way Steve facilitated positive engagement while building solid working partnerships and friendships. God bless Steve Bates.

*Mark Carter, SGT6-6000G product manager*



## STOP SCHEDULING DELAYS DUE TO TUBE FITTINGS

KnechtionRepair thread chasing tools can quickly repair those damaged threads in minutes! Our tools are designed to repair all 5 major brands of industry standard 2 ferrule type Swaged compression fittings.

[WWW.KNECHTIONREPAIR.COM](http://WWW.KNECHTIONREPAIR.COM)



Introducing our new repair tools for AERO Engines/AVIATION (AN-MS) & HYDRAULIC (JIC) Fittings. Kits come w/ a 37° Seat Lapping Tool.



Our industrial standard 2 ferrule type repair kits are available in sizes for 1/4" through 1" tube fittings.



**REGISTER NOW!**  
**2023 ANNUAL CONFERENCE**

JUNE 12-15, 2023  
ATLANTA, GA



**RENAISSANCE®**  
ATLANTA WAVERLY HOTEL &  
CONVENTION CENTER



For more information scan  
or visit [powerusers.org](http://powerusers.org)





# Best Practices Awards

## Owner/operators of 501 and V engines share best practices

**T**his compendium of award-winning best practices recognized by industry peers in 2022 focuses on the 501G, 501F, 501D5A, 501D5, V84, and V94 fleets. Six plants powered by 501F gas turbines received Best Practices Awards (photos), plus three equipped with 501Gs, two with V84s, and one each with 501D5, 501D5A, and V94 engines. The best practices:

### 501G:

- Athens Generating Plant (A potpourri of plant safety improvements; Change in chemical treatment reduces environmental impact, cuts cost).
- Kings Mountain Energy Center (Remote-user cybersecurity; Conditioning system extends useful life of steam-turbine EHC fluid).

- McIntosh Power Plant (HRSG mod allows an increase in backpressure to boost power output). This best practice received a Best of the Best Award and was profiled in the last issue (CCJ No. 72), p 79.

### 501F:

- CPV Valley Energy Center (Steam-turbine fast-cooldown logic and procedures reduce outage time;



CPV Valley Energy Center



MPC Generating



Rolling Hills Generating

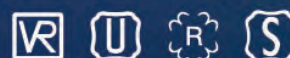
A FAMILY OF COMPANIES PROVIDING  
PRODUCTS AND SERVICES FOR  
**TURNKEY ENGINEERED OUTAGE SUPPORT**  
FOR YOUR INLET AND EXHAUST / HRSG

**BREMCO**  
AN SVI INDUSTRIAL COMPANY

**SVI**  
INDUSTRIAL

**SVI**  
DYNAMICS  
AN SVI INDUSTRIAL COMPANY

+1 866-792-4874 | [SVI-INDUSTRIAL.COM](http://SVI-INDUSTRIAL.COM)





Mitigating effects of severe winter weather events; Mobile electronic logging benefits operations, maintenance, and compliance; Lighting enhancements).

- MPC Generating (Automate back-up source of hydrogen to maximize generator availability).
- Rolling Hills Generating (Monitor humidity in your excitation-transformer termination cabinet).
- State Line Power Station. (Forget the sewer, reuse RO reject water).
- Whitewater Cogeneration Facility (Operational Tag Program advises on why equipment is in its current state).
- Kleen Energy Systems. (Eliminate generator-breaker weather intrusion).

#### 501D5A:

- Mid-Georgia Cogen (New logic prevents GT trip caused by DP transmitter failure).

#### 501D5:

- Milford Power (Repurpose “old” parts/products to support a new functional need).

#### V84:

- Pleasant Valley Station (Modify fuel-oil piping to unload faster, increase resiliency in cold weather).
- Walton County Power (Better ventilation improves availability of fuel-gas valves; Water-wash system upgrade improves operations and safety).

#### V94:

- Genelba Thermal Power Plant (Identify, correct combustion-chamber issue using methodology created by plant personnel). This best practice received a Best of the Best Award and was profiled in CCJ No. 72, p 63.

CCJ’s annual Best Practices Awards program, supported by user groups, has as its primary objective recognition of the valuable contributions made by owner/operator personnel to improve the safety and performance of generating facilities powered by gas turbines. Looking ahead, you might want to begin considering what success stories to share with colleagues in 2023. Entries are due March 31 (details at <https://www.ccj-online.com/best-practices>).

To prime your thought processes, know that subjects of greatest interest generally are fast starts, new skills/workforce development, water management, performance improvements, plant safety, outage management, O&M, and predictive analytics.



State Line Power Station



Whitewater Cogeneration Facility



Kleen Energy Systems



**Quality Robotically Applied Thermal-Sprayed Coating Solutions for the Power Generation, Oil & Gas and Petrochemical Industries**

- Aluminum Slurry Compressor Coatings
- HVOF MCrAlY Coatings
- TBC Coatings
- DVC TBC Coatings
- Chrome Carbide Coatings
- Abradable Coatings
- Diffused Aluminide Coatings
- Coating and Grinding
- Industrial Coatings

**Let us help you minimize your maintenance costs by safely extending the life of your turbomachinery.**

Trinity Coatings • 25225 Highway 288 • Rosharon, TX 77583 • [trinity-coatings.com](http://trinity-coatings.com) • [sales@trinity-coatings.com](mailto:sales@trinity-coatings.com) • 281-845-0022













Follow us on





# CPV Valley



## CPV Valley Energy Center

Owned by CPV/Diamond Generating Corp (DGC)

Asset managed by Competitive Power Ventures Inc (CPV)

Operated by DGC Operations LLC

680 MW, gas-fired facility equipped with a SGT6-5000-powered 2 x 1 combined cycle, located in Middletown, NY

**Plant manager:** Ben Stanley (former), Michael Baier (current)

## Reduce outage time by implementing steam-turbine fast-cooldown logic, procedures

**Challenge.** The steam turbine (ST) at Valley Energy Center typically was taking up to eight full days for proper cooldown prior to removal from turning gear. This delayed any inspections, tests, or other items requiring access to the unit, extending outage durations.

It also delayed any balance-of-plant (BOP) work requiring the shutdown of station power for periods that would interfere with proper lube-oil cooling, etc.

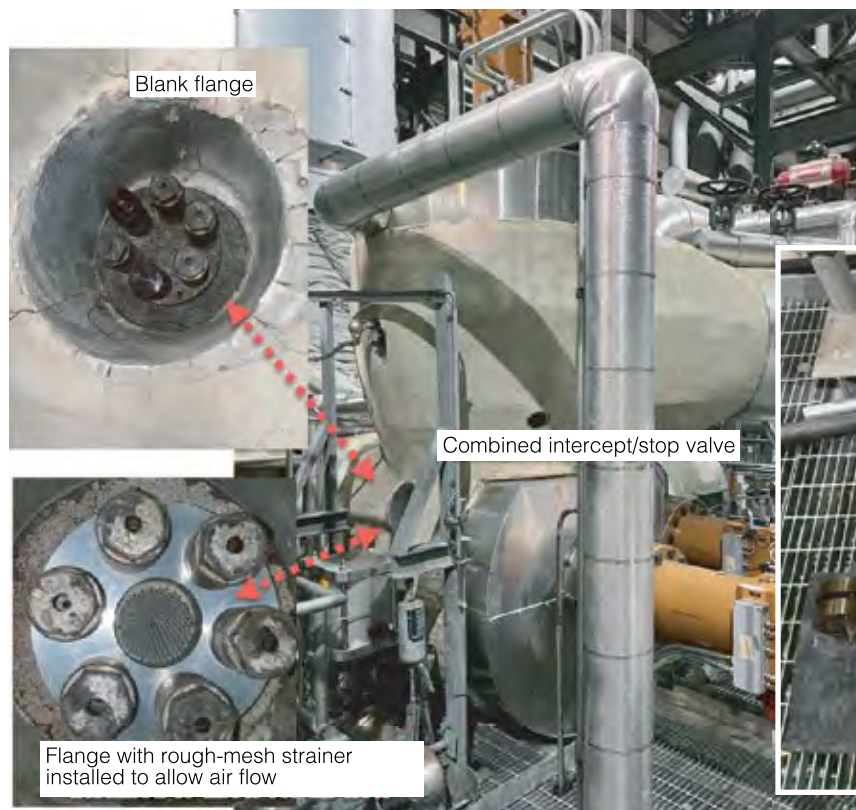
**Solution.** Plant personnel worked

with the turbine OEM to implement fast-cooling logic and procedures to reduce the required ST cooldown time. This made necessary a combination of controls changes, testing, temporary mechanical changes to the system during cooldown, and training of O&M staff.

Operators can start the ST cooldown process several hours before shutdown while producing power at reduced levels of output. When operating at minimum load, attemperators slowly ramp down the HP- and reheat-steam temperatures from about 1050F to 750F. Once the ST is offline, an adequate amount of natural cooling is allowed (usually about eight hours).

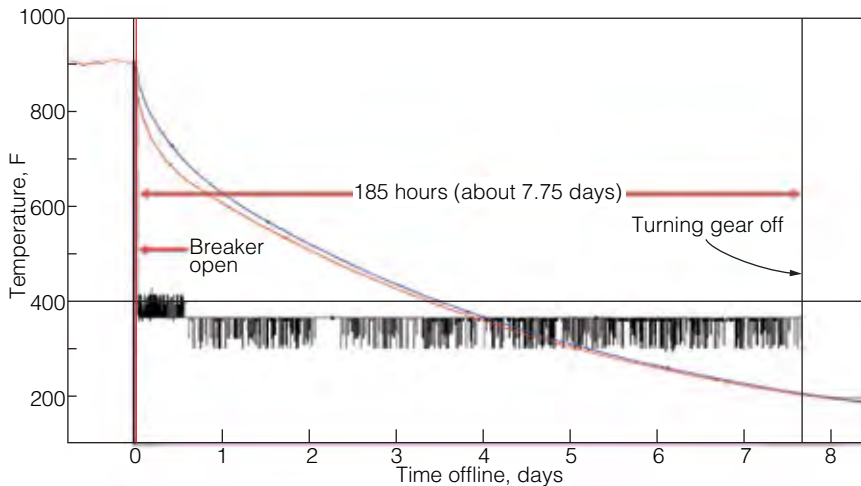
LOTOs then are put in place to remove several inspection flanges on the ST control valves to allow air to flow into the system (Fig 1). Also of note, the maintenance department set up specific toolboxes (Fig 2) so all tools and necessary parts are staged and ready to use for this purpose—thereby saving time assembling all of these items for each cooling event.

When the fast-cooling system is started following a shutdown, it auto-

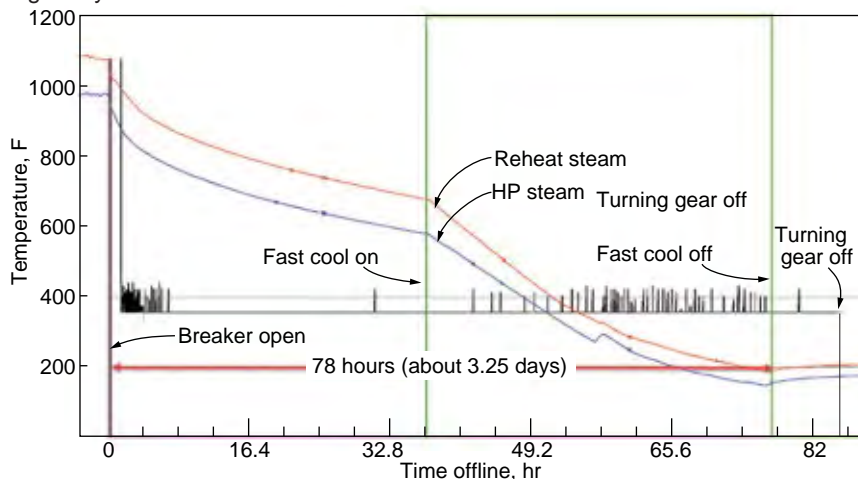


**1. Blank inspection flanges** on the steam-turbine control valves were replaced with flanges having rough mesh strainers to allow air to flow into the system

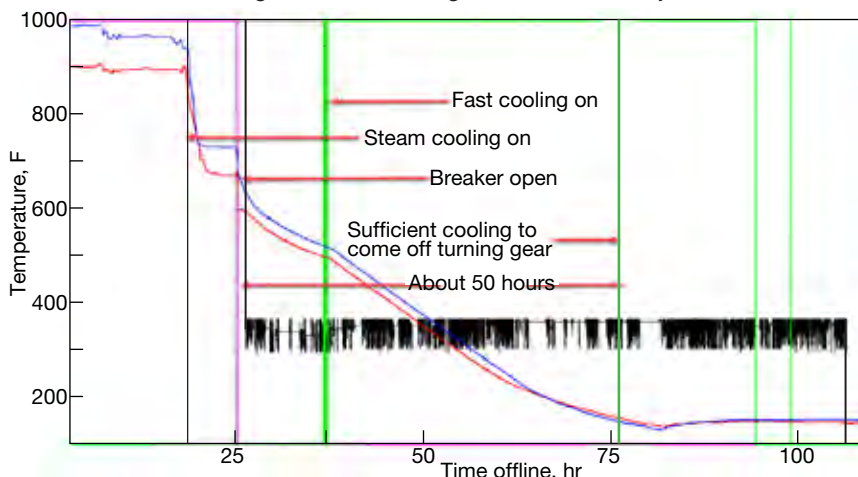
**2. Toolbox is equipped** to allow rapid replacement of blank flanges with the so-called fast-cool flanges shown



**3. Outage time required for natural cooldown** of the steam turbine was nearly eight days



**4. Fast cooldown** using the offline cooling method exclusively



**5. Fast cooling** using both online steam cooling and offline cooling

matically controls the BOP vacuum pumps to draw air into the system through the inspection ports while the control valves adjust air flow to maintain the appropriate cooldown rate.

During this process, the control system (along with the operator) monitors the turning-gear speed, casing temperatures, and other critical parameters. The process is terminated

if the turbine starts to slow down; this would indicate that the internal clearances are going out of tolerance.

The entire process is captured in the plant's Engineering Change Management (ECM) system.

**Results.** Use of the fast-cooling system saves as much as 135 hours of outage time, all while maintaining the appropriate cooldown rates issued

by the OEM. Here are the results for the different cooldown scenarios at CPV Valley:

- No cooling (natural cooldown rate), about 185 hours (Fig 3).
- Fast cooldown using only the offline cooling method, about 78 hours (Fig 4).
- Fast cooldown using both online steam cooling and offline cooling, about 50 hours (Fig 5).

#### Project participants:

Don Atwood, asset manager  
Dave Engelman, operations manager  
Ed Peters, maintenance manager  
Efrain Morales, lead shift operator  
Ernie Hill, lead shift operator  
Chris Mahoney, lead shift operator  
Vic Polesel, lead shift operator  
Tom Viertel, lead mechanic

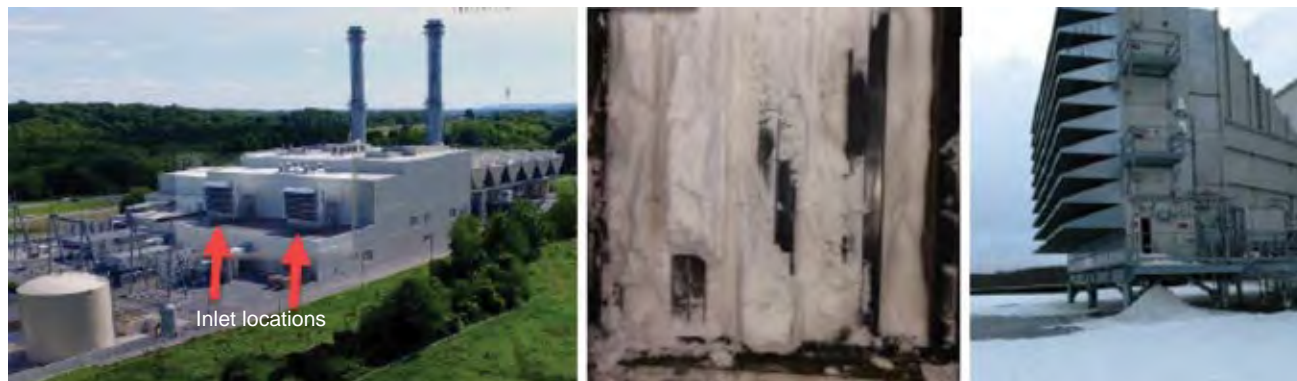
## Meeting the operational challenges caused by severe winter weather

**Challenge.** Valley Energy Center's gas-turbine inlet filtration system employs static filters with no automated means of cleaning, debris removal, or heating. During certain severe winter weather and wind-driven snow events, the filters clog-up (Fig 6), forcing an auto unload and/or complete shutdown. This typically happens during periods of high load and market demand, which creates system vulnerability and lost revenue for the project.

**Solution.** After some trial and error, the following actions were implemented to mitigate issues during severe winter weather events:

- Upgraded the prefilters to a "reverse pocket" design that allows the snow to fall off without significant manual action.
- Worked with the filter manufacturer to mitigate installation and fit-up issues to minimize filter clogging. Several design changes were made—including filter clips, sealing-material thickness, and hardware.
- Plant personnel developed a tiered severe-weather protocol that outlines actions needed prior to and during the event, plus recovery methods to minimize the potential impacts and downtime. This





**6. Design of the gas-turbine inlet filtration system** (left) was conducive to filter plugging (right) during wind-driven snow events (center)

includes weather-forecast alerts, revised market bidding strategies, resource planning, and plant-operations planning and recovery.

- The O&M team developed strategies to ensure onsite support was available to monitor the weather impacts and to remove snow from the filter inlet houses safely and as quickly as possible.
- Staff is working with a third-party engineering firm to evaluate inlet heating solutions for future application.

**Results.** While severe weather still can be a challenge for the facility, it has operated successfully at minimum load or in a 1 × 1 configuration during several recent snow events. Outages that typically took a day or two to recover from have been reduced to just a few hours while the storm passes—thereby minimizing weather impacts on system reliability and revenue generation.

Additionally, and probably most importantly, personnel safety has

been improved with less manual action needed for snow removal.

#### Project participants:

Ed Peters, maintenance manager  
Don Atwood, asset manager  
Tom Viertel, lead mechanic  
Preston Patterson, CPV's director of reliability and asset management

## Mobile electronic logging benefits operations, maintenance, compliance

**Challenge.** It has taken years to move from paper log sheets and forms to electronic methods in the field. Filing and storing or scanning thousands of pages annually takes time. It also requires that the paper be touched several times as it passes from field to supervisory personnel, and then to administration staff and others, before being physically filed away. Plus, it can be difficult to locate a physical document when required by an audit or other review process (especially as the documents age).

**Solution.** Staff implemented an integrated electronic software system with the following purposes:

- Operator rounds. Operators enter data in the field and it is available for immediate review.
- Compliance inspection checklists. Prefilled checklists are in the system and O&M personnel are prompted to ensure they are fully completed.
- Critical notifications. Certain events trigger email notifications to key staff.
- Work-order submittals from the



**7. Equipment visibility improved dramatically** following lighting enhancements

# TURBINE INSULATION AT ITS FINEST



field. O&M technicians can generate a work order from the field directly into the computerized maintenance management system (CMMS).

- Safety observations are entered directly into the system. Results are uploaded in seconds and emailed automatically to plant personnel for review.
- Vendor chemical delivery requests are entered into the log and email notifications are sent automatically to the suppliers' customer service departments.
- All data are available from any mobile device with an internet connection and the appropriate security credentials.

#### Results:

- Reduction of paperwork and onsite storage.
- Instant access to all data in a searchable and filterable database.
- Increased employee knowledge of digital processes.
- Increased awareness of safety inspections and issues from instant electronic notifications.

Valley Energy Center personnel submitted with their entry samples of the plant's inspection log, truck unloading checklist, and safety

inspections, together with in-service photos of the ruggedized tablet selected, but they were not conducive to meaningful display in the printed magazine.

#### Project participants:

Dave Engelman, operations manager  
Jamie Longhenry, EHS coordinator

## Lighting enhancements improve personnel safety, boost morale

**Challenge.** Valley Energy Center is in the Northeast, where winters are long and very cold, so designers located the entire plant inside a building. The indoor location demanded more lighting than usual. Third-party lighting assessments, performed after construction was completed, indicated there was (and still is) room for improvement. Many places in the plant are shaded by equipment, or the

lighting isn't focused into the areas needed (Fig 7).

**Solution.** Through employee and management observations, key areas were identified for additional lighting, as the photos illustrate. Work orders were generated in the CMMS for installation. Lighting additions also were evaluated by engineering to ensure that all circuit components met the required conditions for hazardous atmospheres—if necessary.

#### Results:

- Improved safety conditions in dark areas.
- Better view of areas for inspections and work activities.
- Reduced the need for temporary lighting, flashlights.
- The brighter workplace increased employee morale.

#### Project participants:

Ed Peters, maintenance manager  
Bob Arraiz, lead IC&E technician  
McKenzie Slauenwhite, plant engineer

**SUBSCRIBE TODAY**  
**COMBINED CYCLE Journal**

Subscribe via the Internet, access:  
[www.ccj-online.com/subscribe](http://www.ccj-online.com/subscribe)



# MPC Generating

## MPC Generating

Owned by Mackinaw Power LLC  
Operated by Cogentrix Energy  
Power Management

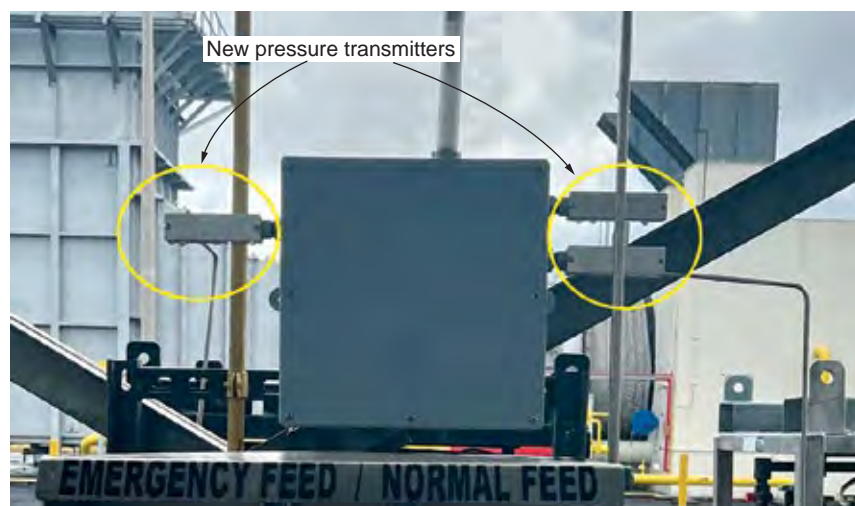
386 MW, gas/oil-fired simple-cycle facility equipped with two 7FA gas turbines, located in Monroe, Ga

Plant manager: Mike Spranger

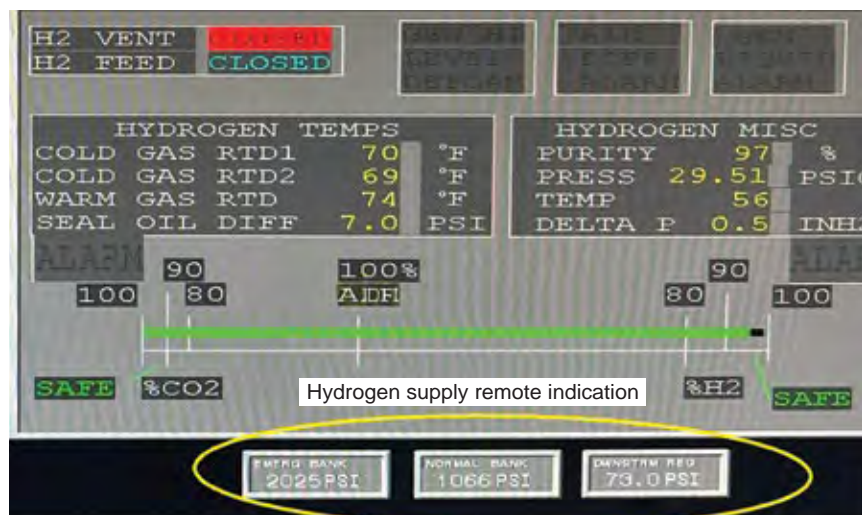
**Challenge.** MPC Generating's hydrogen-cooled generator historically had experienced unavailability events because of empty hydrogen supply cylinders. The low-hydrogen supply issues resulted from high consumption attributed to large ambient-temperature swings and piping leaks. With the plant typically staffed during normal business hours Monday through Friday, events that occurred

after hours or on a weekend would not necessarily be identified in a timely manner.

## Automate backup source of hydrogen to maximize generator availability



1. Three pressure transmitters were installed in the hydrogen supply system



2. Hydrogen supply pressure, ambient temperature, and other plant parameters are displayed to assist in troubleshooting efforts

**Solution.** Goals were to improve generator availability and provide more efficient troubleshooting capability. Three Dwyer pressure transmitters were installed in the hydrogen system, one for each supply bank (normal and emergency) and one for system pressure (Fig 1). Pressure readings are sent to the DCS and recorded in both the DCS and OSI PI historians. Two hydrogen supply alarms were added to the DCS: Normal hydrogen supply low-pressure alarm at 400 psig and emergency hydrogen supply low-pressure alarm at 1000 psig.

Note that if an alarm condition occurs when technicians are offsite, they are notified by text message.

Additionally, a graphic displaying the hydrogen supply pressures was added to the generator screen in the DCS (Fig 2). Hydrogen supply pressure, ambient temperature, and other plant parameters now can be compared in trend analysis to better improve operational availability, training, and troubleshooting efforts. The idea for the modification, and installation work, were by plant operators with oversight provided by the O&M manager.

**Result:** Unavailability events attributed to low hydrogen supply have not been experienced since this best practice was implemented.

### Project participants:

Chris Harris, O&M lead technician  
Chaz Gibson, O&M lead technician  
Nick Sanz, O&M lead technician  
Rich Ramocan, O&M technician

# Rolling Hills



## Monitor humidity in your excitation-transformer termination cabinet

**Challenge.** Rolling Hills Generating has five excitation transformers, each tied to the 18-kV isophase bus at ground level through a dry bay shroud (Fig 1). In April 2021, a flashover event occurred in one of these shrouds, caused by tracking on the A-phase seal-off bushing which was attributed to moisture buildup.

The shrouds are equipped with strip-style heaters to keep those spaces dry. There is no remote or local monitoring of the space heaters, just an annual PM verifying operation. But a space heater failed to operate, allowing moisture buildup, and ultimately, the flashover event.

**Solution.** With the evidence of what happens when a shroud has no mitigation strategy against moisture, the decision to monitor the atmosphere inside the shroud made the most sense. The plant researched several options before deciding to purchase a sensor that would monitor both the humidity and the temperature of the space. The sensor chosen was an EE210 from Instrumart. It displays temperature and the humidity on the screen at the same time so the operator knows whether the space is cooler than expected or has unusually high humidity.

**Result.** Sensor readings have been added to daily walkdowns, performed

### Rolling Hills Generating LLC

*Owned by Eastern Generation LLC*

*Operated by Consolidated Asset Management Services*

850 MW, gas-fired simple-cycle facility equipped with five 501F gas turbines, located in Wilkesville, Ohio

**Plant manager:** Corey Lyons

by a technician. The sensor (Fig 2) provides “eyes” to see what’s going on inside a shroud without having to go through the clearances to open up the space. The monitor has done a good job proving space integrity. The plant plans to develop a similar method for the isophase duct itself to help aid the forced air in preventing any possible flashover events.

**Project participant** was Tyler Legg.



**1. Excitation transformer** is tied to the isophase bus through a dry bay shroud, where the flashover occurred



**2. Sensor monitors** both space temperature and humidity





## State Line Power Station

*Owned by Liberty Utilities and Evergy*

*Operated by Liberty Utilities*

613 MW, gas-fired, consists of a 501FD3-powered 2 × 1 combined cycle and a simple-cycle 501D5 engine, located in Joplin, Mo

**Plant manager:** Brian Berkstresser

reduced sewer bills and less water purchased for the cooling-tower cycle.

### Project participant:

Curt Kennedy, maintenance manager

## Forget the sewer, reuse RO reject water

**Challenge.** Liberty Utilities' charge is to be a responsible steward of the environment. As a result, plant personnel underwent a complete review of the water systems at their site to identify potential environmental benefits. One possible source of water saving: Reuse

reject water from the reverse-osmosis (RO) system instead of dumping it to the city sewer.

**Solution.** Staff tested, and a third party confirmed, that RO reject water, while not suitable for some uses, was an acceptable source of makeup for the cooling tower. To facilitate this change, the state water agency had to give its approval (which it did) and then the process changes could begin.

**Results.** The site is now reusing over 9-million gal of water yearly. Annual cost savings are over \$50,000 between



Reject water from the RO system is reused in the cooling tower, saving on sewer and raw-water costs



## Whitewater

## Whitewater Cogeneration Facility

*Owned by LSP Whitewater Cogen*

*Operated by NAES Corp*

250 MW, gas/oil-fired facility equipped with a W501FC-powered 1 × 1 combined cycle, located in Whitewater, Wisc

**Plant manager:** Mark Scholl

## Operational tag program advises on why equipment is in its current state

**Challenge.** There are times in the life of a powerplant when a piece of equipment is retired in place, infrequently used, or just needs some field information.

Whitewater Cogen developed an identification program to notify O&M teams on why a device or system is in its current state.

**Solution.** The plant uses Instamation Systems Inc's RedTag Pro software for its LOTO program. With a majority of the facility's devices (valves, breakers, etc) already in its RedTag LOTO database, Whitewater also uses this database for its Operational Tag Program, at no additional software expense.

An operational tag was developed so

it can be produced using the same printer that makes the plant's LOTO tags. This tag is of the same size, shape, and material as the LOTO tag, eliminating the need for an additional printer.

Operational tags are orange and have the word "Operational" printed at the top (Fig 1). They are considered a consumable and can be disposed of when no longer needed. Information on the operational tag is the following: log number, sequential tag number, identification number associated with the equipment, equipment description, the state the equipment is in, plus any direction an operator may need in the field as to why the equipment is in that state.

An Operations Log also was developed using the RedTag Pro software (Fig 2). The log relies on sequential entry to track the number of operational-tag entries there are at the plant.



1, 2. Operational tag is at left, tag log at right. Highlights confirm information on the tag has been recorded in the log

#### OPERATIONAL TAGS

Date Issued : 3/8/2022

Equipment : DCS

Reason For Operational Tags :

Un-Plug Cord in a Cyber-Security Event

Operational Tag Log # : 3

Issued By : Harmeson, Scott

Equipment ID : DCS-691

Page 1 of 1

#### Comments :

Tag #	Device Description	Device Location	Device ID	Tagged Position
1	Maintenance Shop Router Power Cord	Maintenance Shop	1-721-CORD-001	Plugged In
2	Maintenance Shop Router Ethernet Cord	Maintenance Shop	1-721-CORD-002	Plugged In
3	Plant DMZ Router Power Cord	MCC-023 CT Electrical Package	1-691-CORD-001	Plugged In
4	Plant DMZ Router Ethernet Cord	MCC-023 CT Electrical Package	1-691-CORD-002	Plugged In

The operational-tag form is similar to a LOTO form, identifying dates the individual who issued the tags, the equipment, equipment IDs, reason for the tags, comments section, and sequential tag list with the information that has been printed on the tag. This form also was developed using the RedTag Pro software.

#### Results:

■ When Whitewater's fuel-oil forwarding system is idle, the operations department isolates system components. The Operations Tag

Program identifies these components and why they are in their current state. Tags support the lineup when the equipment is placed back in service.

■ Operational tags are used to support critical actions in the field to reduce the chance of human error. For example, they give all technicians onsite the ability to accurately and confidently pull the correct plug during a chaotic or stressful event. An illustration: Whitewater Cogen has placed operational tags on ethernet and power cords that

should be pulled in the event of a cybersecurity event.

■ The Operational Tag Program also is used when a system is retired in place. Tagging equipment thusly can track changes over a facility's lifetime and help staff remember when and why the equipment was removed from service. It also is used to identify equipment removed from service but still in place.

#### Project participants:

Larry Moorman, O&M manager  
Scott Harmeson, O&M lead



<https://hrsgforum.com>

## Now meeting monthly online

Invited participants: Powerplant owner/operators and consultants and vendors with an interest in heat-recovery steam generators.

Follow CCJ ONsite (at [www.ccj-online.com](http://www.ccj-online.com)) for announcements of session content, dates, and times, and registration link.



# Kleen Energy

## Kleen Energy Systems LLC

Owned by EIF Kleen LLC

Operated by NAES/Kleen Energy Systems LLC

620 MW, gas-fired facility equipped with a SGT6-5000FD3-powered 2 x 1 combined cycle, located in Middletown, Conn

### Plant manager:

John O'Rourke

to interrupt that surface adhesion while capturing the moisture and physically directing it away from the breaker.

**Results.** While the long-term repair is replacement of the BX connectors, this interim repair has been successful in mitigating moisture infiltration of the breaker circuitry. Since completion of the combined panel and gutter system, there have been no ground-fault-related occurrences.

## Eliminate generator-breaker weather intrusion

**Challenge.** Kleen Energy was experiencing moisture infiltration into the generator breaker controls circuitry resulting in ground conditions. This infiltration was attributed to aging of the BX connectors and the breakdown of sealing components. Multiple actions were implemented in efforts to re-establish adequate sealing. The long lead-time for BX connectors was an additional challenge and emphasized the need for a solution. The goal was to mitigate water infiltration to reduce the occurrence of ground conditions.

**Solution.** To block New England weather effects, such as driving rain and snow melt, from impinging on the breaker coffin covers, a plexiglass panel was installed (Fig 1). While this eliminated some of the weather effects, there was also moisture running from the top of the breaker covers. As this moisture flowed down, the surface adhesion acted as a conduit for it to enter the circuitry. The action taken to interrupt this occurrence was the installation of another panel with a gutter (Fig 2)



1. A plexiglass panel was installed on the breaker to protect against inclement weather



### Project participants:

Kevin Caldwell  
plant engineer  
Jeff Erksa  
maintenance supervisor  
Gary Thibodeau  
maintenance technician  
Kenny Duffy  
IC&E technician

**2. Gutter collects water and directs it away from the breaker**



# Kings Mountain



## Kings Mountain Energy Center

Owned by Carolina Power Partners

Asset management by CAMS

O&M by NAES Corp

475 MW, gas-fired facility equipped with one M501GAC-powered 1 x 1 combined cycle, located in Kings Mountain, NC

Plant manager: Sean Spain

## Cybersecurity for remote users

**Challenge.** In an effort to maintain business continuity and generation reliability (especially during the Covid-19 pandemic) it was necessary to allow employees/users remote access to Kings Mountain's (KMEC) local business network for budget information, plant historical trends, CMMS, etc. Several instances occurred that required extended periods of remote work.

Importantly, separation of the plant control system from outside access had to be maintained to com-

ply with cybersecurity policies and industry best practices.

**Solution.** Allow users access via a preassigned VPN connection using multifactor authentication (MFA). KMEC employed a Watchguard SSL application for VPN access in conjunction with Duo Mobile for MFA verification. The users sign into the VPN client using their network log-in credentials. Following a successful log-in, the users are prompted on their mobile devices by Duo Mobile

to confirm the log-in attempt. Once approved, the users are granted remote access.

**Results.** Given previous design considerations for network architecture and layout, no segregation of the business and control networks was needed to execute the VPN policy. Verification of firewall rules and air-gapped equipment confirmed previously engineered business and control network segregation prior to VPN implementation.

KMEC was able to successfully maintain generation reliability and business continuity while also maintaining a secure network through the cybersecurity policy described above.

### Project participants:

KMEC O&M and IT support teams

## Retrofit conditioning system restores health of steam-turbine EHC fluid

**Challenge.** While electrohydraulic control (EHC) fluids deliver excellent performance, they are viable only when properly maintained. In the presence of unscavenged moisture and particulates, sludging and etching can occur. Slit-lock (a result of micron-size particles lodging between valve spool and bore) in typical spool-bore tolerances can cause valve sticking and unsatisfactory system performance—the former conducive to catastrophic failure of the steam system.

The EHC system commissioned at KMEC was unable to handle acid scavenging filters. Through the plant's oil analysis program, staff observed a linear trajectory of

Acid Number, such that after three years of operation the halfway point of the EHC fluid's recommended useful life was reached.



Conditioning skid keeps EHC fluid in good health

**Solution.** A side-stream oil-conditioning skid, with one particulate filter and one acid scavenging filter, was purchased and installed (photo). The

system was designed to return the Acid Number to that near the properties of new oil, thereby extending its useful life.

**Results.** Improved EHC fluid health, oil-replacement scope pushed outside of current forecasts, and steam-turbine valve control system reliability all were impacted positively by this improvement project. Engineering and installation work was done internally, making this an extremely low-cost solution with an ongoing benefit.

### Project participants:

KMEC O&M team



# Athens

## Athens Generating Plant

Owned by Kelson Energy

Operated by NAES Corp

1080 MW, gas-fired facility equipped with three 501G-powered 1 x 1 combined cycles, located in Athens, NY

**Plant manager:** Steve Cole

## Plant safety improvements increase level of personnel protection

**Challenge.** Athens Generating Plant continuously strives to create and promote a safe working environment. In 2021, many procedures and plant structures were re-evaluated and staff identified several areas that could be made safer.

Safety Compliance Services was engaged to perform a working and walking-surface audit to identify trip hazards. Areas where improvements were recommended included the following: (1) Curbs were insufficient when located in areas where workers walk; (2) Low protruding objects with no indication can be difficult to see; (3) High-vis paint is insufficient for drop-offs; (4) Steps with unequal rises do not conform to OSHA 1910.25.

Other concerns identified by staff included the following:

- The condensate building has an upper platform, accessible only by ladder, that operators check at least twice daily, placing an unnecessary strain on personnel.
- During shutdowns, operators were required to open rotor-air-cooler (RAC) drain valves. This involved crawling under several pipes and presented a hazard.
- Many plant doors had no windows. Thus, swinging open a door quickly could possibly hit something or someone on the other side.
- An exterior HRSG platform was accessible only by using a ladder for access via a small confined-space hatch.
- The fire protection system had valves which protruded outward and could easily be walked into.

- The hydrogen purge procedure for gas turbine/generators had some language changes that made it unclear, and it did not have minimum time limits.

- The starting package for the gas turbine was up high and had no railings to prevent a fall.

**Solution.** Athens worked with multiple vendors to tackle the safety concerns identified. Staff followed the advice of Safety Compliance Services to correct trip hazards. Examples: Curbs around containment dikes in areas where workers walk were fitted with guardrails to prevent a person from walking into the curb (Fig 1); Drop-offs had guardrails installed or extended for the entire length of the drop (Fig 2); Posts were installed adjacent to low protruding objects that could not be removed, to prevent people from walking into them (Fig 3); Steps were redesigned such that they had rises and runs in conformance with OSHA 1910.25.

In addition to the vendor-recommended changes, Plant personnel made other safety improvements to address concerns previously noted. Examples:



**1. Guardrail protects** against curb trip hazard



**2. Guardrail protection** should extend the length of the drop



**3. Posts help** prevent people from walking into protruding objects



**4. Stairs replaced ladder**

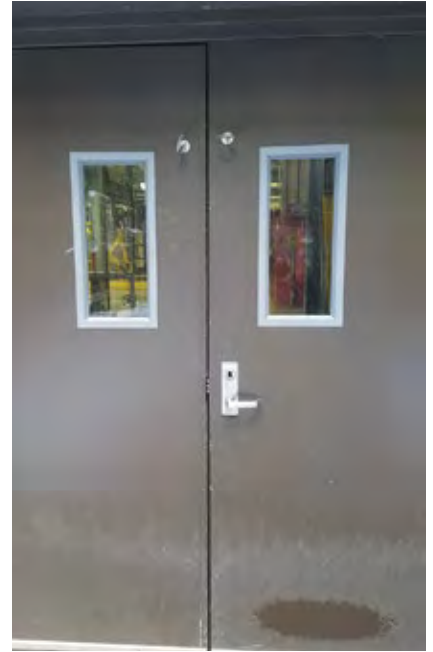
- The ladder to the upper platform in the condensate building was replaced with stairs to mitigate the strain on operators (Fig 4).
- The RAC drain valves were modified so operators didn't have to crawl under pipes to access them (Fig 5).
- Windows were installed on all high-traffic doors and turbine-hall doors (Fig 6).
- A small staircase and platform were installed to ease access to the HRSG exhaust; the confined-space hatch was made larger.



**5. Valve operator extension eliminates crawling under piping**

- A guardrail was installed around the fire protection system so someone couldn't walk into a protruding valve.
- The generator hydrogen purge procedure was revised to include more specific details involving the hydrogen supply-line purge. Minimum purge time was established at 24 hours.
- Guardrails were installed around the starting package to eliminate a fall hazard.

**Results.** The improvements have been



**6. Windows installed in doors without them**

well-received by operators and other plant personnel and have greatly reduced the chance of a workplace accident. The stairs and RAC valve mod greatly reduce the strain on operators. The stairs and platforms added have facilitated access and reduce the potential for injury. Trip-hazard improvements have proven extremely useful in preventing trips and falls.

**Project participants:**

Chris Mitchell, O&M manager  
Kyle Kubler, O&M manager

## Water-treatment improvement reduces environmental impact, cuts cost

**Challenge.** Athens Generating used ferric chloride, a corrosive chemical with safety concerns, as a coagulant for solids removal in the clarification process for water supplied from the Hudson River (Fig 7). Its use as a flocculant has been phased out in most water-treatment processes because of its hazardous nature. Use of ferric chloride also introduced iron into the outfall to the FFWT, burdening downstream water-treatment equipment.

**Solution.** Athens switched to Klaraid-IC1172—a polymer aluminum chloride (PAC)—which is considered non-hazardous under OSHA 29CFR 1910.1200. It eliminates the use of ferric chloride, and based on tests conducted by the plant, also eliminates the need for sodium hydroxide, another corrosive and hazardous chemical.

**Results.** Use of Klaraid-IC1172 has been very successful. By reducing the iron residual from using Klaraid in place of ferric chloride, conductivity of the effluent to the FFWT also was



**7. Ferric chloride has been eliminated as a coagulant in treating river water**

reduced. Plus, PAC helped reduce the amount of product needed for water treatment.

PACs have little effect on pH, allowing Athens to maintain proper water specs, and helping the water-treatment vendor eliminate sodium hydroxide. In turn, conductivity was reduced by 200 to 300 ohms.

A cost analysis determined that the price per month to use ferric chloride was just north of \$10,000, while Klaraid cost less than half that. By switching to Klaraid, Athens also has eliminated the hazards associated with transporting, handling, and disposing of ferric chloride.

**Project participants:**

Chris Mitchell, O&M manager  
Kyle Kubler, O&M manager  
Jon True, compliance manager  
Bernard Freeza, operations coordinator



# Milford



## Repurposing old parts, materials

**Challenge.** People tend to retain in storage unused or unwanted items that have either been replaced with a better product or a newer model. Why don't they just throw them away?

Many powerplant employees believe these items may have value as emergency spares—assuming they are in relatively good condition. This thought process works well for parts, but unfortunately it is carried over to most anything that is no longer used. Thus, the creation of the proverbial “bone yard.”

**Solution.** Years after placing an item

in storage you may have need for something that may not exist in a catalog or is not readily available. Using the power of employee collaboration and a little Yankee ingenuity, a team member remembers an old something stored away that with a little modification may fit a current need. This best practice is about how Milford Power repurposed some old, unwanted items to support a new functional need.

**Results.** The three examples below illustrate the viability of repurposing old parts and materials and the cost-

### Milford Power LLC

*Owned by Starwood Energy Group Global*

*Operated by NAES Corp*

210 MW, gas-fired facility equipped with a 501D5-powered 1 × 1 combined cycle, located in Milford, Mass

**Plant manager:** William Vogel

savings and the professional pride that result from problem-solving.

### Project participants:

James Blackwell, maintenance technician

William Vogel, plant manager



**1. Milford staff** found a potential hazard in moving high-pressure gas bottles in and out of a storage shed. The overhead door provided ample space for bottle access, but the step up/down from this area presented a potential bottle handling hazard (Fig.1).

The idea of forming up a concrete ramp in the front of the door would provide a safer method of moving the bottles for sure, so plans began to identify the materials and time needed to complete this project.

But during the planning process, a maintenance mechanic remembered a ramp at the old truck unloading area serving the warehouse. The ramp was cleaned up and test-fitted in front of the overhead door serving the bottle storage area. With a coat of paint and some concrete fasteners, the ramp was ready for service as shown in the photo.



**2. Another item** that required attention was the location of the plant's utility-cart battery chargers. For years the chargers were left on the floor in the area where the carts were parked for charging. Given the amount of traffic in the turbine building during outages, the chargers would be moved to provide contractors room for their tooling and materials.

The simple solution would be to purchase a charging station and have it installed, but staff found an old metal table in one of our out-buildings previously used for an analyzer. It was repurposed as the plant's new charger table (center photo). A coat of paint and a few concrete lag bolts were all that was needed. The new arrangement met all expectations during a recent outage.



**3. Plant personnel** using the back door of the warehouse to facilitate access to/from the power block noticed the original concrete stairs and platform had deteriorated over time. Reason: Heavy use of sand and salt in winter to prevent slips and falls.

As a result, the platform would no longer support the railing anchor bolting. Staff's plan was to chip out the platform area and repour with new concrete. However, a maintenance mechanic observed that the plant was no longer using a support skid for the gas-turbine's wet compression system. So, he removed the unused equipment and resized the skid to match platform dimensions. Once installed, the base of the handrails were welded to the steel plate and the entire unit painted yellow (photo, right). Problem solved.



## Conferences

Visit <https://www.powerusers.org/home/annual-conferences/> for the most updated conference dates for each group.

## Forums

Visit <https://www.powerusers.org/forum/> for a full list of User Group discussion forums. Users must be logged in to have access to the forums.

Power Users is the umbrella organization for managing and coordinating the technical programs for the industry's leading User groups. Power Users Group is a non-profit company managed by Users for Users. It is designed to help Users share information and get solutions to power-production problems.

[www.PowerUsers.org](http://www.PowerUsers.org)





## Mid-Georgia Cogen

Owned by Rockland Capital

Operated by IHI Power Services Corp

300 MW, gas-fired facility equipped with a 501D5A-powered 2 × 1 combined cycle, located in Kathleen, Ga

**Plant manager:** Keith Charles

## GT trip attributed to failed transmitter

**Challenge.** A gas turbine tripped during startup on A-stage over fuel. After troubleshooting, staff determined a failed fuel-gas differential-pressure (DP) transmitter was the cause. Investigation revealed the transmitter had failed a few days prior to the restart,

when the unit was offline. The fuel-gas valve DP did not generate an alarm with the unit offline; logic was such that an alarm would be generated only if the unit were in service.

**Solution.** Staff developed and implemented logic to detect DP across all GT fuel-gas valves with the valves closed, even with the unit offline, to provide a DCS alarm.

**Results.** The new logic will detect a failed transmitter when the unit is offline, thereby allowing time for repairs before causing a failed start or forced-outage event.

**Project participant:**  
Josh Jones

## Modify evaporative-cooler water supply system to reduce waste

**Challenge.** The OEM-installed evaporative-cooler water supply system incorporated a float valve which routinely failed in the open position, causing the cooler basin to overflow. At Mid-Georgia Cogen, the overflow drain is routed to ground and there is no instrumentation on the basin for high-level notification. Thus, someone

had to visually identify an overflow condition.

**Solution.** Staff purchased and installed solenoid valves to replace the float valves. They are NEMA 4X and the power supply is protected with GFCI. Solenoids provide better control of make-up water and prevent basin overflow.

**Results.** The solenoids provide better control of water supplied to the evaporative cooler and prevent basin overflow. Their reliability has reduced evaporative-cooler downtime and reduced water consumption.

**Project participant:**  
Josh Jones

## Annual Meeting Chattanooga, Tenn June 5-7, 2023

The D5-D5A Users maintains its independence with the organization's 24th annual meeting in Chattanooga, June 5-7.

Gas-turbine owner/operators consider this one of the most

valuable independent, boutique turbine conferences.

Participation with newcomers and returning members is always lively and beneficial. The forum is completely open;

honesty prevails in every discussion.

Vendor support is very much embedded into the group, thereby helping attendees quickly find solutions to their issues.



Questions? Contact Gabriel A Fleck, PE, at [Chairman@501D5-D5AUsers.org](mailto:Chairman@501D5-D5AUsers.org)

<https://www.501D5-D5AUsers.org>



Connect with us on the User Forum to get access to the following discussions:

- ◉ Frame 5 Combustion Turbines
- ◉ Frame 6B Combustion Turbines
- ◉ 7EA Combustion Turbines
- ◉ 7F Combustion Turbines
- ◉ 7HA & 9HA Combustion Turbines
- ◉ Combined-Cycle Users
- ◉ Generators
- ◉ Heat-Recovery Steam Generators  
(moderated by Bob Anderson)
- ◉ Power Plant Controls
- ◉ Siemens V Fleet Turbines
- ◉ Steam Turbines
- ◉ Low Carbon Peer Group

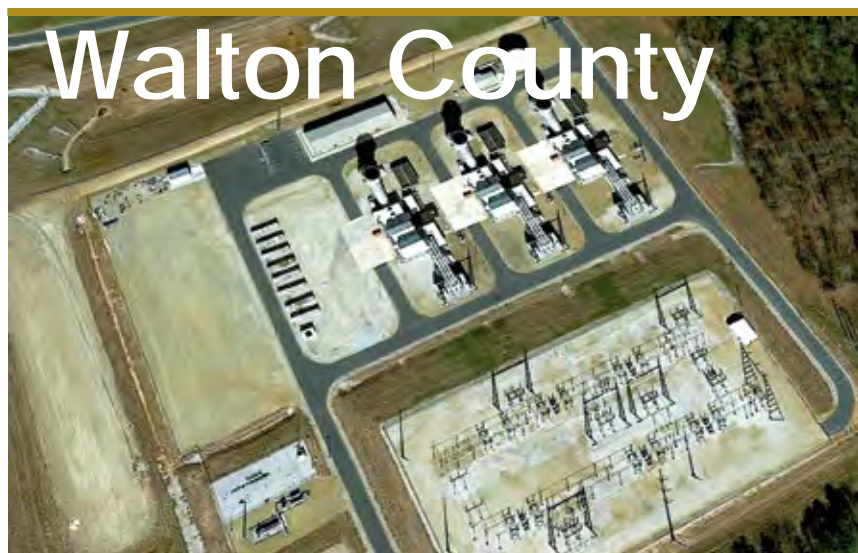
Apply for  
User Forum  
Membership at  
**PowerUsers.org**

Access to additional resources:

- ◉ Conference Presentations
- ◉ GE Library
- ◉ TTP Training







# Walton County

## Improving ventilation in the fuel-gas valve room

**Challenge.** Prevent ambient temperature swings from affecting the operation of gas-valve actuators.

### Walton County Power

*Owned by Mackinaw Power*

*Operated by Cogentrix Energy Power Management*

450 MW, gas-fired simple-cycle facility equipped with three V84.3 gas turbines, located in Monroe, Ga

**Plant manager:** Mike Spranger

**Solution.** At Walton County Power, fuel-gas isolation valves are located



**1. Natural ventilation** to atmosphere is provided via stationary louvers



**2. Open area to atmosphere** is regulated by adjusting the position of the aluminum plate



THE MOST TECHNOLOGICALLY ADVANCED  
POWER AUGMENTATION SYSTEMS.  
**PERIOD.**

CALDWELLENERGY.COM

in a room separate from the gas system. This room is naturally ventilated to atmosphere through a set of stationary louvers (Fig 1). When not operating, the gas turbines were receiving “not ready to start” alarms because of a mismatch in the gas valves’ set point and indication. Technicians determined that dramatic changes in ambient temperature were causing the mismatches.

A 0.125-in. aluminum plate mounted

in an adjustable track was installed inside the louver opening to stabilize room temperature (Fig 2). The opening to atmosphere is determined by ambient temperature, with the plate is positioned accordingly and held in place by set screws along the track.

**Results.** Since the plates were installed, the plant has not had any alarms triggered by mismatches in gas-valve

position and indication. Stabilizing the gas-room temperature has contributed positively to unit availability. Success was achieved at minimal cost by using materials left over from other projects.

#### Project participants:

James Goins Jr, O&M manager  
Chris Harris, Chaz Gibson, Nick Sanz,  
and Scott Hobbs, O&M technicians  
Rich Ramocan, lead technician

## Upgrade of GT water wash system improves operations, safety

**Challenge.** Gas-turbine compressors are water washed as needed and during maintenance outages. The water wash system consisted of a 100-gal tank and pump/motor assembly mounted on a portable cart. Technicians faced several problems when performing washes, including these:

- Cart was difficult to move because of its size, weight, and deteriorated plastic wheels.
- Limited space around the cart made it difficult to operate.
- The reservoir had to be filled with a water hose from a spigot over 100 ft away, making it difficult to

turn the water on/off as needed during the procedure.

These discrepancies resulted in slip hazards from spilled water and a much longer period of time to conduct the operation than expected.

**Solution.** Upgrades made to the water wash system to improve operator safety and reduce the time to conduct the operation included these:

- Permanently mounted the water tank on a sloped frame.
- Plumbed a water fill line with isolation valve on the tank.
- Added a water hose and squeegee

for cleaning.

**Results.** The amount of time needed to conduct the water-wash procedure was reduced by 40%, and minimal cleanup was required after the operation was completed. Plus, the number of technicians required for water washing was reduced. Safer working conditions was a result.

#### Project participants:

James Goins Jr, O&M manager  
Chris Harris, Chaz Gibson, and Scott  
Hobbs, O&M technicians  
Rich Ramocan, lead technician








**Indeck Heat Recovery Steam Generators**

**www.indeck.com**  
**800.446.3325**













# Pleasant Valley



## Pleasant Valley Generating Station

*Great River Energy*

423 MW (summer), gas/oil-fired simple-cycle facility equipped with two V84.3A2 gas turbines and one 501D5A unit, located in Dexter, Minn

**Plant manager:** Tye Stuart

V84.3A engine is 192 gpm, 165 gpm to the D5A—a total of 548 gpm for the site. Given the capacity of each unloading pump is 216 gpm, the maximum offload rate is 432 gpm, leaving a shortfall of 116 gpm.

Capacity of the fuel-oil tank is 600,000 gal, meaning a full tank will empty in a little more than 18 hours with all three gas turbines running baseload. Continuing, tank capacity will support 30 additional hours of operation with one pump running while the three engines are in service and 86 more hours when using both pumps to unload. The increased run time of 56 hours with two pumps translates to more than \$426,000 in additional revenue at \$25/MWh, given the ability to generate 436 MWh for each of those hours.

**Project participants:** Mike Herman, Chuck Condon, Tyler Felix, Kevin Beske, Craig Birkett, Michelle Anderson, Mike McVetty, and Mike Altmann.

## Fuel-oil pipe mod speeds unloading, increases resiliency

**Challenge.** Pleasant Valley's fuel-oil unloading skid was designed with two pumps—one main, one backup. Each, rated 210 gpm, is severely undersized to keep up with consumption by the plant's generating units.

**Solution.** A project was developed to reduce unloading time when fuel oil is burned. This need typically occurs when natural gas is curtailed and ambient temperature is well into the negative range—such as during polar vortices.

But instead of procuring new pumps and motors, piping was modified to run both pumps at the same time, thereby doubling flow and halving the unloading time. With all three gas turbines operating baseload, this modification allows the engines to run an additional 56 hours compared to having one pump in service. During extreme weather events this provides added load support for at least 2.3 days.

**Results.** Baseload fuel flow to each



**Mobile Excitation Services LLC "MOBEX"** has been proudly serving the generation industry with emergency static excitation systems since 2003. If your generator is in a forced outage due to exciter failure, or your scheduled start up is severely delayed due to an exciter emergency, don't panic and call MOBEX. We can rent you an temporary exciter for installation or a standby situation.

We have successfully developed innovative out of the box solutions that have been proven to help our customers meet generation deadlines for years. Our temporary excitation systems keep you generating until you can get your current exciter repaired or replaced. We can support any manufacture from 25 amps-to-6000-amp systems, we are available 365 days a year and always ready to help.

**mobileexciter.com | 1-800-510-4006 | contact@mobileexciter.com**

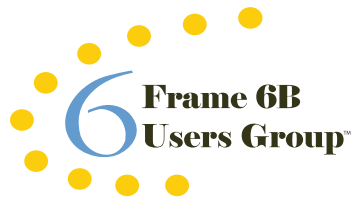
**MOBEX, offers installation services, engineering, and spare parts and specialized test equipment.**

- Westinghouse, WMA, MGR, WTA, WDR-2000, PRX-400, WTA-M300
- High Current power drawers for WTA's and WTA-300s
- Cutler Hammer ECS-2100
- Basler DECS125-15, DECS 200s, DECS-300s, DECS 400
- General Electric, Buss Fed, GE EX2000, EX2100
- Complete Spare Alterrex Rotating Exciter
- TCSA
- **BASLER DECS-2100 STATIC EXCITER, NEW FOR SALE**





# LEGACY TURBINE USERS GROUP



## 2nd Annual Conference

**July 17-20, 2023**

Sheraton Grand At Wild Horse Pass  
Phoenix, AZ

*Three Individual User Group Conferences...  
Same Dates, Same Location... Shared Meals and Vendor Fair*



Scan the QR code  
to access the  
registration site







7HA & 9HA USERS GROUP

# 2023 ANNUAL CONFERENCE

**SAVE THE DATE**  
**August 7-10, 2023**  
**Location TBD**



Visit [powerusers.org](http://powerusers.org)  
for updates

## COMBINED CYCLE Journal

CCJ No. 73 (2023)

Index to advertisers	Doosan Turbomachinery Services.. 59	Mobile Excitation Services..... 104
7EA Users Group..... 105	Filter-Doc Corp ..... 71	MTU Power..... 15
7F Users Group ..... 67	Fort Myers Technical College ..... 66	National Breaker Services ..... 63
7HA Users Group ..... 106	Frame 5 Users Group..... 105	National Electric Coil ..... 82
Advanced Filtration Concepts..... 17	Frame 6B Users Group ..... 105	Noxco ..... 27
Advanced Turbine Support LLC ..... 23	Gas Path Solutions..... 44-45	PIC (Precision Iceblast Corp) ..... 69
AGT Services Inc..... 75	GE Gas Power..... 12-13	Power Plant Control Users Group (PPCUG)..... 41
AGTSI ..... 6	Generator Users Group (GUG) ..... 41	Power Users..... 41, 67, 99, 101, 105-106
Arnold Group ..... 2, 57, 76-77, 89	Groome Industrial Service Group... 37	Power Users, Forum..... 101
B&W ..... 64	HRSG Forum..... 83, 93	Power Users, Umbrella Organization ..... 99
Brownell Aeroderivative Consulting 18	HRST Inc..... 36	ProEnergy..... 4-5
Caldwell Energy..... 102	Indeck Power Equipment..... 103	Schock Manufacturing..... 74
Combined Cycle Users Group (CCUG)..... 41	JASC ..... 61	Siemens Energy ..... 28-29
Continental Controls ..... 21	KinetiClean (Groome)..... 108	SISU Energy & Environmental ..... 9
Chanute Manufacturing ..... 65	Knechtion Repair ..... 82	Steam Turbine Users Group (STUG) ..... 41
Crown Electric ..... 63	Knowledge Management..... 43	SVI Industrial ..... 84
Cust-O-Fab Specialty Services ..... 72	Legacy Turbine Users Group (LTUG) ..... 97	Taylor's Industrial Coatings ..... 70
Cutsforth Inc ..... 54-55	Liburdi Turbine Services ..... 20	TesTex ..... 81
D5D5 Users..... 100	Low Carbon Peer Group..... 41	Trinity Turbine Technology..... 85
Dekomte ..... 80	Maximum Turbine Support ..... 11	Umicore Catalyst USA Inc ..... 25
Doble ..... 18	MD&A ..... 107	Zokman Products Inc..... 31
Donaldson Company Inc ..... 73	Minimax Fire Solutions ..... 19	



# Gas Turbine Parts Lifetime Extension Clinic

Read three case study examples at [www.MDAturbin.com/Clinic](http://www.MDAturbin.com/Clinic)

Mechanical Dynamics & Analysis (MD&A) can extend the service life of gas turbine components whose OEM service limit has passed or whose configuration is no longer suitable to operate. Significant savings can be realized by opting for lower-cost repaired spares instead of new parts.

Our experts at the San Antonio Service Center combine years of experience with state-of-the-art equipment to deliver the right solutions to you.

## MD&A's San Antonio Service Center

6948 Fairgrounds Pkwy

San Antonio, TX 78238

Ph: +1-210-256-5000

[www.MDAturbin.com](http://www.MDAturbin.com)



**Follow Us!**

**in** /MD&A

**f** MDAturbin

**▶** MD&A Turbin

PARTS | SERVICES | REPAIRS