### Industry Issues

**Industrywide Effort to Improve Emergency Diesel Generator Performance**

The U.S. nuclear power industry has embarked on an initiative to improve the performance of emergency diesel generator (EDG) systems. This effort was initiated after the Institute of Nuclear Power Operations (INPO), through the publication of Topical Report 10-73 in October of 2010, identified a declining trend of EDG reliability and availability. Nuclear utilities asked EPRI to identify EDG issues and help the industry define what should be done to improve diesel generator system performance.

An EDG Technical Advisory Committee (EDG TAC) was formed in August 2011. Made up of industry EDG personnel and representatives from EDG owners groups, the Nuclear Energy Institute (NEI), INPO, and EPRI, this committee serves as a central body to ensure that there is a cohesive, coordinated effort to improve EDG performance. The committee chair is Mike Strait, Manager of Mechanical Engineering at Exelon. The EDG TAC has prepared an industry strategy that encompasses EDG performance improvement activities of the utilities, INPO, NEI, EPRI, and the industry’s EDG owners groups.

A common cause analysis meeting was held at Exelon offices in January 2012. This meeting was an independent review of EDG Mitigating Systems Performance Index (MSPI) failures to identify common threads and areas of concern in order to focus EDG TAC efforts.

Critical gaps identified and being investigated by the EDG TAC are the following:

- Leaks in fuel oil, cooling water, and lube oil systems (see EPRI “Fluid Sealing Brief #1025733 for a listing of EPRI created research on leaks.)
- Electrical failures in the start/control system and voltage regulator
- Maintenance failures attributable to PM program deficiencies and human performance

Selected high-priority tasks being undertaken include the following:

- Development of an EDG controls report
- An investigation into EDG leaks, being coordinated between EPRI staff and the industry’s Maintenance Manager Working Group
- A review and comparison of industry owners group maintenance programs to identify gaps and areas for improvement
- Maintenance program reviews by individual plants
- INPO EDG review visits

**2012 Joint EDG Owners Group Conference**

EPRI will conduct a Joint Emergency Diesel Generator Owners Group Conference July 17–18, 2012, at the Minneapolis Marriott City Center. The event will be coordinated with individual EDG owner’s group meetings to be held on July 19–20. This event is cosponsored by the U.S.-based EDG owners groups, including ALCO, Cooper-Bessemer, Enterprise, ESI-EMD, Fairbanks Morse, and the Diesel Fuel Oil Group. The objective of the joint EDG conference is to provide a forum for personnel who operate and maintain emergency diesel generators to share information, operational and maintenance experiences, problems and solutions, and techniques to improve EDG reliability and availability. During this conference, a review of the activities of the industry’s EDG Technical Advisory Committee will be provided.
Individuals interested in giving a presentation at the conference should contact Jim Sharkey. Information on the event can be found on the EPRI website (www.epri.com) under the “Events” tab on the Nuclear Events Calendar under July 17–18, 2012, or on the Joint EDG Owners Group Conference website.

For more information or to offer input, contact Jim Sharkey, 704.595.2557, jsharkey@epri.com.

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**Industry Issues**

**Bio-Based Lubricants: Are They On the Horizon for Power Plants?**

With the world becoming more economically and environmentally conscientious, bio-based lubricants appear to be on the horizon for power plant operators, and for some members the requirements for using them are already here. So just what are bio-based lubricants?

The U.S. federal government defines *bio-based product* as “A product determined by the U.S. Secretary of Agriculture to be a commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials.”

As we have seen with the diesel fuel oil supply, in which organic/biological materials have been used as constituents in order to minimize environmental impacts, changes have come through voluntary actions as well as in response to regulatory requirements. However, the picture could soon change, as we are now experiencing a similar movement through legislative and executive mandates for lubricants to be used for equipment/rotating machinery.

U.S. federal government emphasis on bio-based products was reflected in the Farm Security and Rural Investment Act of 2002 (Public Law 107-171—the 2002 Farm Bill) and strengthened by the Food, Conservation and Energy Act of 2008 (Public Law 110-234—the 2008 Farm Bill). This focus was further strengthened in 2007 by Executive Order 13423 and again in February of 2012 by the presidential memorandum *Driving Innovation and Creating Jobs in Rural America Through Bio-Based and Sustainable Product Procurement*. These actions effectively require government entities (including the military, utilities, and other facilities) to implement the procurement and use of bio-based lubricants.
A brief review reveals that the increased focus on the use of bio-based lubrication is not limited to the United States, but is also seen in other countries including Canada and the European Community. The motivation in these places, like in the United States, stems from both environmental concerns and interest in job stimulation.

Lubricants have a variety of purposes in power plant equipment. The table below, from the NMAC Lubrication Guide (EPRI report 1019518), delineates some of the requirements placed on our equipment lubricants.

**Oil and grease requirements**

<table>
<thead>
<tr>
<th>Properties</th>
<th>Oils</th>
<th>Greases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevent metal/metal contact</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Act as a hydraulic medium</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Act as a coolant</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Carry away contaminants</td>
<td>X</td>
<td></td>
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<tr>
<td>Protect against wear</td>
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<td>Protect against corrosion</td>
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<tr>
<td>Protect against deposits</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Resist foaming</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Remain in place</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

How the introduction of any bio-based element into greases or oils used in plant equipment can impact the above parameters and the performance of the lubrication is an important question that must be fully understood and evaluated. In the past, the NMAC Lubrication Support Program has helped to guide members through these kinds of questions when new or revised products were made available or, in some cases, when products were discontinued. The subject of bio-based lubricants was also briefly addressed in November of 2003 (in *Lube Notes*, Number 6—information now available in EPRI product 1015254), in a discussion of advantages and disadvantages known to exist in products available at that time. Advantages included low toxicity, uniform viscosity, good corrosion protection, and lubricating ability, as well as biodegradability. Some of the disadvantages cited were high costs and limited availability (at that time), along with performance profile with regard to oxidation and thermal and hydrolytic stability.

As lubrication manufacturers and suppliers adapt their products to serve a broader range of requirements, and as new regulations take effect, it is anticipated that our members will increasingly face the need to deal with bio-based lubrication products. NMAC intends to monitor this area very closely and will keep our members advised of impact on lubrication performance and equipment reliability. Additionally, we intend to continue our practice of support with application, monitoring, and testing recommendations as they evolve in this arena.

*If you would like to find out more about this subject or if you find yourself faced with a bio-lubrication implementation question or challenge, contact Mike Pugh, 919.812.5162, mpugh@epri.com, or Nick Camilli, 704.595.2594, ncamilli@epri.com.*
Industry Issues

Preventive Maintenance Basis Database Version 3.X

Equipment failures can lead to lost generation and lost revenues and can distract plant personnel from more strategic tasks. Nuclear power plant operators have successfully implemented programs to foster and maintain high reliability as plants have aged and as some have entered extended operating periods. A continuing challenge will be to maintain this reliability and then further improve the availability, as existing techniques are not expected to be fully adequate to deal with future challenges.

Several actions are necessary to improve plant and equipment reliability and address better preventive maintenance to prevent failures before they occur. These include major upgrades to the Preventive Maintenance (PM) Basis Database software that are intended to accomplish the following:

- Facilitate interactions with other information sources
- Define optimum replacement and refurbishment times
- Develop refurbishment/replacement considerations to effectively manage equipment obsolescence

The intent of this project is to develop a new web-based version of EPRI’s PM Basis Database software that is currently available as an installed Windows client/server application. The new version will be a complete redesign that will address several significant design issues that were associated with the application when it was originally converted from an Access database format to a .Net client/server application.

Development History

Here is a brief summary of the different versions of the software that have been released by EPRI over the years and the plan for future versions:

- **PM Basis Database:** This was an Access database application created for EPRI by Dr. David Worledge. It was released in 2000.

- **PM Basis Client/Server 1.0:** This version was the first Windows application version that used .Net 1.1 and MSDE 2000. It was released in 2004.

- **PM Basis Client/Server 1.5:** MSDE 2000 and .Net 1.1 were still used in this version, which was released in 2005.

- **PMBD 2.0:** This version included a significant redesign that was intended to improve the user experience by creating a more intuitive interface. It used .Net 2.0 and SQL Server Express 2005 and was released in 2007.

- **PMBD 2.1:** This version was created to address an issue that prevented PMBD 2.0 from being able to run on Windows Vista. This version continued to use .Net 2.0 and SQL Server Express 2005. It was released in 2009 and is the current version.

- **PMBD 3.0:** This is the version currently being built, which will entail the most significant design change since the software was released. It is being designed as a web application that will be capable of providing information to other systems through web services. This version will be developed as an MVC web application with ASP.Net 4.0 and SQL Server 2008.

- **PMBD 3.X:** This version is yet to be defined, but it is expected that future enhancements will be needed to further refine the software and user experience once PMBD 3.0 has been released. Moving to a web application will allow enhancements to be incorporated much faster than was possible with the Windows application strategy.
Normalizing the Database

The existing database has an unconventional data structure that was created to minimize the number of logic changes that would be required when converting the original Access database. The database stores some data as XML in text fields to compensate for the fact that each component was stored in a separate table with a varying number of columns depending on the number of maintenance tasks. This design has allowed the code base to stay close to the original Access version, but it has limited the application’s ability to scale and makes many normal database queries impossible.

As a part of the PMBD 3.0 project, the database is being redesigned to normalize the data structure. This new database design will result in a more flexible application that will be able to exchange data more efficiently with other systems and will allow future enhancements to be incorporated more easily. A complete database schema will be provided with the project documentation.

Internationalization

Internationalization is a design and development approach that results in an application that can be easily adapted for different geographic regions and languages. To avoid extensive code changes in the future, applications that may need to support other languages should be designed for internationalization from the beginning of the design process. There has been interest from international users of the PMBD application in having a translated version of the application and component data. To prepare for a possible translated version of the application, PMBD 3.0 will be designed to store data in a Unicode format that can support any language and will separate logic into “layers” that will ensure the application functionality is not tied to any one specific language.

Web Services

Various web services will be developed to allow other systems to request PMBD component data and interact with specific features, such as Vulnerability. The existing PMBD 2.1 application takes advantage of similar web services running on www.epri.com that allow component updates to be downloaded directly into the client database. There is an opportunity for EPRI systems to communicate with one another and with other industry systems, so it is expected that the existing web service approach may be redesigned to provide a common EPRI gateway for systems to use.

Interface Improvements

Interface mockups will be sent to end users to get feedback on design and layout ideas. Since the software is being developed as a web application, it will also be possible to provide various styles and layouts for users to try during beta testing. The goal is to simplify the existing interface by getting feedback from users on the most relevant features and ensure that those features are easy to find and intuitive to use.

Managing Components

The application will be designed to maintain multiple versions of components for historical and comparison purposes. Components will be clearly identified with a version number in addition to a visual property that will indicate whether a given version is the most current one. Since PMBD 3.0 will be a web application, there will no longer be a need to have users download or import component updates into their local databases. New and updated components will be added to the hosted database and will be immediately available for users to view. The method of adding and updating components is not yet determined, but it could be accomplished through an import feature as a part of the administrative tools.
PM Basis Database Users Group

The next meeting of the PM Basis Database Users Group is scheduled for July 24–26, 2012, in Charlotte, North Carolina. The meeting will include a one-day workshop on Maintaining the RCM Core Principles, Assessing PM Adequacy, Component Updates, How to Do Them, Interval Sensitivity Analysis, and Templates – Lite. The workshop will be followed by a two-day users group meeting that will include updates and discussions of the new version.

*If you are interested in more information about this project or would like to be part of its technical advisory group, contact Marty Bridges, 704.595.2672, mbridges@epri.com. For information on the PMBDUG meeting, contact Marty Bridges or Debbie Rouse, 704.595.2520, drouse@epri.com.*

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Industry Issues

**EPRI to Publish Guidance on Developing Specifications for Replacement or New Low-Voltage Electric Motors**

As existing nuclear power plants continue to operate, many electric motors used at these plants will require major overhaul and/or replacement. This need is evidenced by recent failure data provided by INPO, showing an increase in stator winding failures. The upward trend of stator winding failures along with a slight uptick of total failures points toward motor aging issues.

Although motors are operating well into their design lives, many plants and suppliers are experiencing a loss of expertise as the workforce ages and retires. Suppliers can be from multiple countries, and replacement personnel are still in the development mode. Plants once had a broad supply of staff and vendor personnel with broad electric motor experience, but that resource has dwindled both at utilities and with vendors.
Along with aging equipment and a reducing pool of expertise, energy efficiency requirements have been enacted to aid in the reduction of energy consumption. Electric motors are one the major consumers of electrical energy on a continuous basis. To address the issue of energy conservation, the Energy Independent and Security Act (EISA) of 2007 was passed. It mandates energy efficiency requirements for NEMA T-frame motors up to 500 hp (373 kW), which has changed the energy efficiency requirements for replacement low-voltage electric motors.

As plants face issues that require replacement motors—such as motor aging issues, the need to have critical spares to meet equipment reliability goals, or simply the need to replace a failed motor—the Large Electric Motor Users Group (LEMUG) has proposed a project to develop and publish a new specification document. This product will assist electric motor owners who find themselves in need of a low-voltage replacement motor or have decided that they should obtain a spare motor for a motor that they have deemed to be critical to their process.

EPRI has developed other guidance documents for electric motors, such as report 1008964, *Repair and Reconditioning Specification for AC Squirrel-Cage Motors with Voltage Ratings Up to 600 V*, and report 1011892, *Guideline for the Specification of Replacement and Spare AC Squirrel-Cage Induction Motors Having Voltage Ratings of 2,300 V to 13,200 V*.

The new document, *Guideline for the Specification of Replacement and Spare AC Squirrel-Cage Induction Motors Having Voltage Ratings Up to 600 V*, will be completed in late 2012 to help operators procure sound and reliable electric motors for plant use.

*If you would like to participate in the development of this product, contact Wayne Johnson, 704.595.2551, wejohnson@epri.com.*

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**Industry Issues**

**Review of Qualified Life of Environmentally Qualified Electric Motors Used in Nuclear Power Plants**

Several ongoing events in the U.S. nuclear industry have caused plants to revisit their environmental qualifications (EQ) for equipment in existing plants, especially electric motors. Those events include, but are not limited to, plant life or license extension, power uprates, and the need for critical spare motors. In addition, personnel turnover has led to a situation where current motor engineers lack experience with EQ requirements for electric motors.

Many U.S. nuclear power plants have been approved for, or are evaluating, extension of plant licensing from 40 years to 60 years. Most existing electric motors were environmentally qualified for 40 years. By extending plant operating time by 20 or more years, plants are in a situation where they have to take action to address the qualified life of EQ motors in order to remain operable.

Three options are available for EQ motors installed in plants whose operational life exceeds the EQ life:

- Replace the existing EQ motors with new EQ motors
- Rewind the existing EQ motors with an EQ insulation system (for example, see EPRI reports 1000867 and 1001036)
- Use methodology to extend EQ life as outlined in IEEE 323-2003
Many of the decisions related to EQ motors should be worked into long-range plans, and it is essential to understand the options for addressing qualified life issues. To that end, a new EPRI guide will provide proven methodology for ensuring that end of motor EQ life is addressed so as to minimize plant impacts including potential shutdown. Implementation guidance will be provided to allow EQ motor life extension up to 60 years or more. The guide will contain proven and up-to-date guidance that meets regulatory requirements and will support the understanding of motor theoretical and actual aging that occurs during a motor’s environmentally qualified life. EQ preservation and life extension will be discussed to provide guidance to the nuclear plant’s motor component engineers and allow better interface with the plant’s EQ engineers. This guide should provide a common frame of reference for the component engineer and the EQ engineer and highlight areas for each party to use to address motor availability for operation; concerns surrounding repairs; and the procurement of replacement motors if necessary.

*If you are interested in participating in the development of this project, contact Wayne Johnson, 704.595.2551, wejohnson@epri.com.*

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**Industry Issues**

**Switchyard Equipment Maintenance Guide Technical Advisory Group**

EPRI has embarked on a new project that will address the maintenance of equipment in power generating station switchyards, especially at nuclear generating stations. The first technical advisory meeting for this project was held April 24–25, 2012.

*Courtesy of FP&L*

Nuclear power plant safety- and nonsafety-related electric buses are powered by the grid, and there is a required voltage level for safety buses that is part of the license requirement for these plants to operate. The preferred power source for nuclear power generating stations is the power grid (see IEEE 765). Power generating stations, including nuclear stations, are connected to the grid through their plant switchyards. The typical pieces of equipment found in switchyards are transformers, circuit breakers, disconnect switches, bus work, and protective equipment including relaying.
By regulation, nuclear power plants have been given more responsibility for ensuring the reliability of their connection to the grid (see 10CFR50.65, also known as the Maintenance Rule). Also, the North American Electric Reliability Corporation (NERC), which in 2006 was established to be the North American electricity reliability organization, has modified and/or established standards for the interaction between nuclear-powered generators and transmission system operators (see NERC NUC-001). The Institute of Nuclear Power Operations (INPO) has developed guidance for maintaining reliability in nuclear power plant switchyards.

The reliability of the connection to the grid is dependent upon the equipment that connects a plant switchyard and vice versa. Although some equipment might be maintained by a separate company and/or contractors, plant personnel need to be familiar with the equipment in their switchyards and have knowledge about the equipment types, purpose, maintenance, and performance in order to ensure reliability.

The goal of the new project is to develop a guide that reviews typical switchyard designs and application of the equipment found in the switchyard. The guide will also provide maintenance recommendations for managing the performance and life of equipment used in typical power generating station switchyards, with the exclusion of power transformers (which are covered by the EPRI Transformer Handbook—the Copper Book). Circuit breakers, because of their importance, may require a separate effort but at least initially will be considered as part of this guide. The plan is to collect industry data, review performance, and develop guidance for maintaining reliable performance of switchyard equipment and thus ensure a reliable connection to the power grid.

*If you are interested in participating in the development of this project, contact Wayne Johnson, 704.595.2551, wejohnson@epri.com.*

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**Industry Issues**

**Component Specialist Guide—Safety Relief Valves**

With many experienced component engineers either retiring or planning to retire from our operating plants, there is a need for a guide that newly hired engineers can have available to provide basic information on the essentials of safety relieve valve (SRV) components as they relate to principles of SRV operation, ASME Code requirements, and other applicable specifications. In addition, this guide will also be of obvious benefit to an engineer who has acquired other plant component experience but has only recently been assigned responsibility for SRVs. Currently there are no EPRI guides that fully address this need.

It is considered essential to obtain input from experienced engineers to determine what they consider important information to be included in the guide. Also important is input from new engineers based on problems they may have encountered locating critical information from several possible sources. A draft of the basic information to be included in the guide is in preparation, and a technical advisory group (TAG) is being selected. This group will tentatively consist of approximately six individuals whose plant experience level varies from several years to only one or two years. Original equipment manufacturers will also be asked to contribute to the TAG.

A TAG meeting will be scheduled at EPRI Charlotte, North Carolina, in June, 2012, depending on members’ availability as dictated by their particular plant outage commitments.

*For more information, contact EPRI Project Manager Bob O’Neill, 508.539.3301, roneill@epri.com.*
Industry Issues

EPRI to Develop Equipment Troubleshooting Knowledge Base

Plant equipment problems can often create a chaotic environment and lead to a frantic effort by personnel to identify the reason for the problem. The ability to diagnose and troubleshoot problems quickly and accurately is vital to maintaining plant availability.

Over the years, NMAC has compiled valuable equipment troubleshooting guidance in the products that have been developed for members. This information is contained in the *System and Equipment Troubleshooting Guide* (EPRI product 1003093) and generic component troubleshooting guidelines—for example, pump guidelines (EPRI product 1000919) and motor guidelines (EPRI product 1000968)—as well as numerous component-specific maintenance guides. Since preventive maintenance recommendations are also the foundation of the recommendations contained in the Preventive Maintenance Basis Database (PMBD), that information also has potential value as a resource in troubleshooting equipment problems.

Fast, easy access to known equipment problems and solutions will benefit members dealing with plant equipment problems and facilitate return to service of affected components. Starting this year, NMAC plans to develop a troubleshooting knowledge base, using information contained in existing EPRI guidance, that will assist members in troubleshooting plant equipment problems.

The purpose of this project will be to compile all of the equipment troubleshooting guidance and failure information contained in existing NMAC products and assemble it into a searchable database that can be accessible through user interface from dropdown menus and keyword searches. The vision is that the knowledge base will be easily accessed on a desktop or mobile device (using an Android or Microsoft operating system) to facilitate equipment troubleshooting in the field.

The specific objectives of this project include the following:

- Easy, portable, and searchable access and identification of information that can aid in power plant equipment troubleshooting activities
- Compilation of all NMAC troubleshooting information into a single location
- A delivery format that can be downloaded by members from www.epri.com
- A final product that will allow mobile devices to access the data for field use
Benefits to our members are anticipated to include the following:

- The knowledge base will enable them to navigate and access existing NMAC technical information on equipment troubleshooting that exists in numerous reports and the PM Basis Database, through the use of dropdown menus and keyword searches.
- Results once identified will be easily transferable to user desktops and documents.
- The application will be capable of operating on portable computer hardware (that is, on tablets).

To find out more about this project, contact Mike Pugh, 919.812.5162, mpugh@epri.com.

Industry Issues

Transformers and Sun Spot Activity

Even though large transformers are very reliable devices, there is good reason for readers to wonder how transformers on the electrical grid can be affected by activity on the sun. These environmental and/or system events can contribute to transformer failures that can occur six months or later after exposure. These events, called solar magnetic disturbances (SMDs), can give rise to geomagnetically induced currents (GICs). GICs are a result of disturbances that occur on the sun, which then ejects energy into space. Such ejections of energy are called corona mass ejections (see Figure 1). These solar disturbances have been observed to occur on an 11-year cycle, and we will be approaching a time of solar maximum activity within the next year or so.
The geoelectric field is largest in areas of high earth resistivity near the auroral zone (55° to 70° latitude). Therefore, GIC is more pronounced in northern latitudes in areas of igneous rock with high earth resistivity. Coastal areas are another region of high susceptibility to GIC because the induced current flowing in the ocean meets a higher resistance as it enters the land.

GIC values of 130 amps in transformer neutrals have been measured. Severe GIC events can persist for periods of several hours; however, a large GIC with one polarity usually lasts for only a couple of minutes before changing polarity. GICs can occur for several days in succession and can be regional or continent-wide in scale.

Transformers are the most vulnerable components as far as grid damage from a solar storm is concerned. GICs are typically driven to or from various power system electrical ground points (transformer neutrals) by the voltages that are induced in transmission lines (see Figure 2).

Transformers are designed to handle ac currents, but GIC appears as an additional dc current, which could impact a transformer. When the dc current enters the transformer, the transformer core will saturate in one polarity, either plus or minus. The transformer will then overheat, and if dramatically overheated, the copper windings can melt as shown in Figure 3, a photograph of a “generator step up” (GSU) transformer at Unit 1 of the Salem Nuclear Plant that was damaged during the 1989 solar storm. The Nuclear Regulatory Commission published Information Notice 90-42 as a result of this occurrence.
Past experience has proven that GICs can cause the following detrimental effects on power systems and power systems apparatus:

- Transformer core half-cycle saturation, resulting in an abnormal amount of stray flux impinging on the tank walls, flux shields, leads, and core clamps
- An increased amount of transformer VAR consumption, resulting in potential system voltage collapse
- Generation of harmonics, causing substantial transformer neutral currents
- Transformer heating caused by the excess flux external to the core flowing through adjacent paths such as the tank, clamps, and leads
- Generator heating caused by harmonics and voltage unbalance from transformer half-cycle saturation
- Protective relay problems caused by the presence of harmonics
- Communications problems resulting from changes in the propagation characteristics of radio waves and from harmonics that may cause disruption to land-line systems

GSU transformers are particularly susceptible to GIC currents because they operate at close to 100% capacity, whereas many transmission system transformers operate at 50% capacity. Other equipment can also be damaged, but transformers are the most vulnerable. Also, electrical networks can typically handle the loss of one transformer because these systems usually have a double-ended station with two transformers, whereas a generating station typically has one main transformer or one bank of main transformers. During the 1989 solar storm, several network transformers in Quebec were lost simultaneously. This multiple loss of transformers brought the entire network down for 9 hours. Other problems with transformers, especially “step up” transformers, is that they are generally custom designed, very few have backup spares, and they may take up to a year to replace.

Because of the long lead time required to procure, manufacture, transport, and install a replacement transformer, utilities store a limited number of spare transformers. To address spare transformer issues, in 2002 EPRI published a list of spare power transformers for nuclear and other power plants in Appendix D of EPRI report 1002913, *Power Transformer Maintenance and Application Guide*.

The North American Electric Reliability Corporation (NERC) has proposed that utilities pool all of their spare transformers regionally or nationally, so that a larger number would be available for replacement in the event of significant GIC damage. To that end, the goal of NERC’s transformer Spare Equipment Database (SED) program is to provide a means to securely connect utilities that need replacement transformers with those that have spares available.
There are several things that a transformer owner can do to limit the effects of GIC. If replacing a transformer, choose appropriate transformer types (for example, three-phase, three-leg core, and so on) that are more immune to the detrimental effects of GIC. The auxiliary legs of such designs provide for symmetrical magnetic circuits in the core. This provides a flux sharing characteristic that allows a more uniform distribution of flux in the legs of the core. The more uniform distribution of flux provides a lower harmonic content and distributes induced currents across the full circuit.

To limit the effects of GIC on installed transformers, transformer load is typically reduced during the height of a solar storm period. Another method is to apply dc blocking circuits for existing transformers. In the simplest terms, a capacitor and/or resistor is connected between the neutral bushing and ground.

None of these recommendations can completely protect transformers and other equipment from the effects of GIC. Each transformer and transmission system operator must stay in touch with early warning systems to limit the effects on existing power delivery equipment. EPRI operates the SUNBURST system that provides warning for high levels of sun activity. NASA operates satellites that provide early warning of solar activity, which enables power system operators to take timely action.

NERC has published an interim report, *Effects of Geomagnetic Disturbances on the Bulk Power System*, that is a good resource document for the overview of SMD effects on power systems.

*For more information, contact Wayne Johnson, 704.595.2551, wejohnson@epri.com.*
## NMAC Meetings
### 2012 NMAC Meetings

### Users Groups

<table>
<thead>
<tr>
<th>Meeting</th>
<th>2012 Date</th>
<th>Location</th>
<th>Contact</th>
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<tbody>
<tr>
<td>Pressure Relief Device Interest Group</td>
<td>January 16–18, 2012</td>
<td>Orlando, FL</td>
<td>Bob O’Neil</td>
<td>508.539.3301</td>
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<tr>
<td>Work Planning Users Group</td>
<td>January 31–February 2, 2012</td>
<td>St. Lucie, FL</td>
<td>Lee Rogers</td>
<td>772-288-4369</td>
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<td>Maintenance Rule Users Group/WS</td>
<td>February 14–16, 2012</td>
<td>San Antonio, TX</td>
<td>Marty Bridges</td>
<td>704.595.2672</td>
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<tr>
<td>Hoisting, Rigging, and Crane Users Group</td>
<td>June 14–15, 2012</td>
<td>Milwaukee, WI</td>
<td>Merrill Quintrell</td>
<td>704.595.2530</td>
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<tr>
<td>Terry Turbine Users Group</td>
<td>July 16–19, 2012</td>
<td>San Diego, CA</td>
<td>Dave Dobbins</td>
<td>704.595.2560</td>
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<td>Combined Condition-Based Maintenance (PdMUG/IRUG/VTF/Lube and Bearing)</td>
<td>July 16–20, 2012</td>
<td>San Diego, CA</td>
<td>Tom Turek</td>
<td>484.631.5863</td>
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<tr>
<td>Work Planning Users Group</td>
<td>July 17–19, 2012</td>
<td>Charlotte, NC</td>
<td>Lee Rogers</td>
<td>772.288.4369</td>
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<tr>
<td>Maintenance Rule Users Group</td>
<td>August 2–3, 2012</td>
<td>Seattle, WA</td>
<td>Marty Bridges</td>
<td>704.595.2672</td>
</tr>
<tr>
<td>Pump Users Group/WS</td>
<td>August 13–17, 2012</td>
<td>Oakbrook, IL</td>
<td>Dave Dobbins</td>
<td>704.595.2560</td>
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<tr>
<td>Large Electric Motor Users Group</td>
<td>August 27–30, 2012</td>
<td>Minneapolis, MN</td>
<td>Wayne Johnson</td>
<td>704.595.2551</td>
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<tr>
<td>Japanese RCM-CBM User Group</td>
<td>October 2012</td>
<td>Japan</td>
<td>Jim Sharkey</td>
<td>704.595.2557</td>
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<td>Japanese Valve Users Group</td>
<td>November 2012</td>
<td>Japan</td>
<td>Nick Camilli</td>
<td>704.595.2594</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Bob O’Neil</td>
<td>508.539.3301</td>
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### Workshops

<table>
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<tr>
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<tr>
<td>Outage Management Workshop (joint meeting with INPO)</td>
<td>January 10–11, 2012</td>
<td>Atlanta, GA</td>
<td>Gary Boles</td>
<td>704.595.2781</td>
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<td>Large Electric Motor Workshop</td>
<td>January 30, 2012</td>
<td>New Orleans, LA</td>
<td>Wayne Johnson</td>
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<tr>
<td>Maintenance Rule Workshop</td>
<td>February 14, 2012</td>
<td>San Antonio, TX</td>
<td>Marty Bridges</td>
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<tr>
<td>Hoisting, Rigging, and Crane Users Group Workshop</td>
<td>June 12–13, 2012</td>
<td>Milwaukee, WI</td>
<td>Merrill Quintrell</td>
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<tr>
<td>Preventive Maintenance Basis Database Workshop</td>
<td>July 24, 2012</td>
<td>Charlotte, NC</td>
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<td>Terry Turbine Users Group Workshop</td>
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<td>Transformer and Switchyard Workshop</td>
<td>July 30, 2012</td>
<td>Rochester, NY</td>
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<td>Pump Workshop/UG</td>
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<td>Oakbrook, IL</td>
<td>Dave Dobbins</td>
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<td>Large Electric Motor Workshop/UG</td>
<td>August 27, 2012</td>
<td>Minneapolis, MN</td>
<td>Wayne Johnson</td>
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### Steering Committee Meetings

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<td>NMAC Integration Committee Meeting</td>
<td>February 14–15, 2012</td>
<td>Charlotte, NC</td>
<td>Jim Heishman</td>
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<td>NMAC Integration Committee Meeting</td>
<td>August 27–28, 2012</td>
<td>Atlanta, GA</td>
<td>Jim Heishman</td>
<td>704.595.2768</td>
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<td>NMAC Japanese Technical Advisory Committee Meeting</td>
<td>October 2012</td>
<td>Japan</td>
<td>Jim Heishman</td>
<td>704.595.2768</td>
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<td>NMAC European Technical Advisory Committee Meeting</td>
<td>TBD</td>
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### Other Meetings/Conferences

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<tr>
<td>Joint Emergency Diesel Generator Owners Group Conference</td>
<td>July 17–20, 2012</td>
<td>Minneapolis, MN</td>
<td>Jim Sharkey</td>
<td>704.595.2557</td>
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NMAC Meetings

Pump Users Group Meeting

The NMAC Pump Users Group (PUG) 2011 meeting was held in Portland, Oregon, August 8–11. Downtown Portland turned out to be an excellent choice by the PUG, providing many opportunities to enjoy Portland and Oregon sights and to tour the Sulzer facility.

The meeting again had a focus on training, with Monday dedicated to two separate workshop sessions in separate tracks: best efficiency point and pump hydraulics by Sulzer and lubrication with Jim Fitch of Noria Corp. Tours to the Sulzer repair facilities were also provided.

The Tuesday through Thursday portion of the PUG meeting covered several key issues, including the following:

- Alignment training with John Piowtrowski of Turvac
- Bearing cooling pump shaft breakage
- An update on the N9000 reactor coolant pump (RCP) seal at the Surry plant
- Testing of pump voiding at Hydro, Inc.
- Reactor heat removal pump vibration issues at South Texas
- RCP monitoring by Daya Bay Plant
- An update on advanced diamond coating R&D by EagleBrugmann
- Seal cut O-ring, testing of N9000, and failed power supply issues at Oconee
- Feedpump reliability improvements
- Testing large horizontal circulating water pumps using Robertson Technologies
- Piston pump experience at Public Service Electric & Gas
- Introduction and use of laser Doppler vibrometry

All of these presentations were placed on the PUG collaborative webpage and eventually on the NMAC PUG webpage and are available to download by logging in to www.epri.com, selecting Users Websites, scrolling down to Nuclear and Pump Users Group (PUG), and selecting the Meeting and Minutes button on the left.

The PUG members voted in the business session to plan a meeting in conjunction with Exelon Corp. at the Oakbrook/Lombard Embassy Suites Hotel in the Chicago, Illinois, area August 13–16, 2012. Also considered were potential meeting locations in Charlotte, North Carolina; Chattanooga, Tennessee; and Charleston, South Carolina. More information will be posted on the EPRI NMAC PUG website and through e-mails to all our PUG members.

For more information, contact Paula Foster, 972.556.6509, pfoster@epri.com, or Dave Dobbins, 704.595.2560, ddobbins@epri.com, or go directly to www.epri.com and search Events in Nuclear in August 2012. You do not need an EPRI ID or password to register for this meeting.
Annually, the PUG will provide a deliverable document containing the following key parts:

- PUG meeting presentations and training provided
- Selected hotline questions of high importance submitted to the PUG and all responses
- Look-ahead plans for upcoming meetings

For more information, contact Dave Dobbins, 704.595.2560, ddobbins@epri.com.

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**NMAC Meetings**

**Large Electric Motor Users Group Holds Packed January 2012 Meeting**

The Large Electric Motor Users Group (LEMUG) held its winter meeting January 30–February 2, 2012, in New Orleans, Louisiana, with over 200 persons in attendance. The event was kicked off on January 30 with a workshop on environmental qualifications (EQ) for electric motors. The workshop covered a variety of EQ-related topics such as general requirements, equipment categories, EQ applicability to electric motors, and activities to maintain environmental qualifications. The presenters for this workshop were Tom Brewington of Wyle Labs, Jerry Honeycutt of Honeycutt LLC, and Bill Newell of Schulz Electric.

The January 2012 users group meeting covered subjects ranging from electric motor stator motoring to bearing condition assessments. There were presentations on topics such as qualification testing on specimens; partial discharge monitoring for stators; coating requirements for containment motors; and rewinding and testing of specialty motors. The rewinding and testing of hermetic chiller motors was discussed during this meeting because due to lead time, it may be necessary to repair a motor rather than obtain a new one; however, the repair of hermetic motors requires special skill and attention to detail when testing that may not be provided by the typical motor repair facility that is unfamiliar with these types of motors.

The motor stator partial discharge monitoring presentation was provided by Dr. Greg Stone of IRIS Power. Dr. Stone provided the group with an historical perspective of partial discharge testing for electric motors. His presentation covered many of the problems that can be detected and the methods used for detection. He also shared some insights into the effects of pulse-width-modulated voltage source drives on insulation systems.

Since bearings are one of the items that need to be maintained on environmentally qualified motors, Dr. Lyle Branagan of Pioneer Motor Bearing Company provided a presentation on fluid-film bearing condition assessment. His presentation covered the fundamentals of fluid-film bearings and techniques for on-line and off-line bearing condition assessments.
Harry Smith, LEMUG chair, gave a presentation on behalf of Dan Cox of SCE. Dan prepared the presentation, on coating requirements for inside containment motors. Some utilities have struggled with whether to have their motors coated while in the shop or to wait until they are returned to the site. This presentation pointed out the requirements for service level 1 (SL-1) coatings and the regulations that govern these coatings.

Harry Smith followed up the coating requirements presentation with a presentation on his own practical experience securing SL-1 coating for a motor that was sent for service. The requirements for SL-1 coatings must be covered in the purchase order, and there may possibly also be a need to call for providing a qualified inspector to approve the work.

Darius Vizireanu of Electricité de France (EdF) provided a presentation on the effects that a large motor experiences during starting. Dr. Vizireanu displayed the modeling capability that exists at EdF to display complex interactions that occur in large, high-voltage motors.

Rewinding a motor stator core requires the removal of the old winding from the core. Care has to be exercised in removing the winding, especially if the plans are to reuse the existing core. Sergion Andre, Jr., of Pump and Motor Works discussed the issues faced when removing today’s high-temperature materials and maintaining the integrity of the core and the stator frame machined fits. Excessive temperature can not only damage the core steel but could also affect the fits and trueness of the frame.

In addition to the users group workshop, case studies, and operating experience presentations that took place, the LEMUG working groups continued to work on several reports. There are three working groups within LEMUG:

- Application Working Group—Clarence Bell, Chair (GenOn Energy)
- Information Working Group—Henry Johnson, Chair (Arizona Public Service)
- Maintenance Working Group—Frank Carey sat in for Clifford Both, Chair (Public Service Electric and Gas)

The Application Working Group continued to work on the white paper “Understanding Stator Core Testing: Commercial Core Tester and the Loop Test” and the Guideline for the Specification of Replacement and Spare AC Squirrel Cage Induction Motors Having Voltage Ratings up to 600V.

The Information Working Group completed work on a document that will help people to improve their electric motor skills. This group has begun work on a project that will look at addressing the life extension of environmentally qualified motors. This project will result in a new EPRI product.

The Maintenance Working Group held a brainstorming session to look at many of the issues affecting the conduct of maintenance in a plant setting, such as on-line and off-line motor testing, testing motors from the cubicle, and arc flash issues. The group continued to work on expanding the material in the existing EPRI motor troubleshooting guide. This document provides guidance on diagnosing problems and gathering failure data.

The August 2012 meeting will feature a workshop and a tour on the Monday preceding the meeting. The topic of the workshop will be “Elements of an Effective Electric Motor Program.” The meeting will be held in Minneapolis, Minnesota, August 27–30, and will feature a tour of the Electric Machinery/WEG motor manufacturing facility.

Utility personnel are encouraged to participate in the development of the documents by contacting any of the working group chairs or the EPRI project manager, Wayne Johnson.

If you have interest in LEMUG or any of its activities, contact Wayne Johnson, 704.595.2551, wejohnson@epri.com.
NMAC Meetings

Pressure Relief Device Interest Group Becomes Safety Relief Valve Users Group

At the January 2012 Pressure Relief Device Interest Group (PRDIG) meeting in Orlando, Florida, it was determined that the future responsibilities for meeting operations, logistic arrangements, presentations, and so on will be managed by the utility members. This change is consistent with the current operations of industry groups such as the Air-Operated Valve (AOV) Users Group, Motor-Operated Valve (MOV) Users Group, and others that are not engaging EPRI in research activities.

The meeting attendees have established a steering committee to move forward and have chosen the new group name of Safety Relief Valve Users Group (SRVUG). The next meeting has been scheduled for January 8–10, 2013, in Orlando, Florida.

EPRI will continue its support by attending the annual meetings and providing information/presentations on any current and relevant information. Additional information regarding future meeting plans and other details may be obtained from Craig Shepherd (Fermi), 734.586.1621, shepherd@dteenergy.com.

For more information, contact Bob O’Neill, 508.539.3301, roneill@epri.com.

NMAC Meetings

Terry Turbine Users Group Update

EPRI NMAC has updated the three maintenance guides for auxiliary feedwater (AFW), reactor core isolation cooling (RCIC), and high-pressure coolant injection (HPCI) equipment. These updated documents will be published on the NMAC Terry Turbine Users Group (TTUG) webpage before the 2012 TTUG meeting in July. All TTUG documentation can be found on EPRI’s website (www.epri.com) under the Members tab, Subscriber Websites.

During the 2011 meeting, the following TTUG R&D issues were developed:

- Following the March 11, 2011, event at the Fukushima Daiichi Nuclear Power Plant in Japan and the INPO Level 1 Report:
  - Develop a “Fukushima database” for identifying how plants plan to go from 4-hour coping strategies to extended coping for steam-injecting (Terry) turbines.
  - Review lessons learned from Fukushima RCIC issues when available.
  - Review the root cause from Fukushima and its long-range impact on U.S. Terry turbine operations.
  - Work with the new turbine/pump vendor to determine whether the first installation in the United States in 2013 allows for added robust, severe design basis coping time.
- Evaluate an update to the maintenance guides to reflect installation, troubleshooting, startup, and testing of the new standard Dresser-Rand digital upgrade modifications for each type of AFW, RCIC, and HPCI.
- Determine if NDE/ultrasonics technology can detect pitting/corrosion defects on turbine shafts.
- Address maintenance, parts obsolescence, and site-specific replacements parts issues such as governor controls, electronic parts, high backpressure, O-ring seals, broken carbon washers, steam leakage, and EGM obsolescence. Develop plant-specific lists with part numbers, contact information, and so on.
The next meeting of the Terry Turbine Users Group is set for July 16–19, 2012, in San Diego, California. This meeting will be held with the Combined Condition-Based Maintenance (CCBM) Users Group and will provide an opportunity for both groups to discuss issues and solutions peer-to-peer. A joint workshop is planned for added cross-pollination of the technologies. Featured TTUG meeting topics that are expected include the following:

- Controls upgrades that are ongoing, and successes and issues for the industry
- Breakout working group sessions for AFW and RCIC/HPCI
- Industry operating experience (OE) review, analysis, and solutions
- Specific vendor presentations for application to needs of our members
- Lessons learned from specific OE from the past year
- Discussion/advanced planning for the 2013 meeting and refresher workshop

Additionally, NMAC will be pursuing new R&D initiatives including multimedia training involving the maintenance guides and the four days of video shot during the May 2010 Intensive Terry Turbine Training held in Charlotte, North Carolina. A prototype was demonstrated at the 2011 TTUG meeting to provide a sample of future training modules under development in 2012.

During the 2012 meeting, the Terry Turbine Users Group will be electing a new secretary, since the past secretary has become vice chair. Advance nominations and expressions of interest from individuals regarding this position are encouraged; contact Dave Dobbins at EPRI (ddobbins@epri.com). The TTUG chair Mark Hibbs of TVA will hold that position for one added year and will continue to facilitate the meeting sessions. The new vice chair is David Fischli of Duke Energy. Past officers who continue to serve on the TTUG board include Mark Miller of Duke Energy Catawba NPP and Chan Patel of Exelon Clinton NPP. We also have outside supporters for the TTUG who provide their training equipment and their expertise to our meetings and workshops: Chris Payne and Paul Feltz of ESI, Bill Stuart of ILD Power (formerly with Entergy), and Bob Shepard and Jim Nixon of Dresser-Rand. Additionally, Jim Kelso and Ken Wheeler have been a constant source of support and technical expertise to the group over the years.

The Terry Turbine Users Group conducts monthly conference calls with our officers past and present to discuss planning and industry operating experience and provide updates on initiatives. These calls typically occur on the third Wednesday of the month. All materials from the meetings are posted on the Terry Turbine Users Group EPRI NMAC website on www.epri.com.

Information on the July 2012 meeting in San Diego can be found on the EPRI website (www.epri.com) under the “Events” tab on the Nuclear Events Calendar, dated July 16–19, 2012.

For more information about the circuit breaker users groups, contact Dave Dobbins, 704.595.2560, ddobbins@epri.com.
NMAC Meetings
2012 Pump Users Group Update

In 2012, the NMAC Pump Users Group (PUG) will continue to balance learning from EPRI’s collaborative research, meeting with peers in the industry to benefit from technical exchanges, and utilizing the opportunities for training in this specific industry by experts. Exposure to these avenues in EPRI meetings provides the PUG with a strong link for its members—not only young new hires, but also more experienced workers who are in need of refresher training in specific areas including pump fundamentals, rolling element bearings, and hands-on seals. To that end, at the August 2010 PUG gathering, three separate workshops are planned on Monday morning and afternoon. The PUG meeting will feature many presentations and three focus areas:

- Pump seals—planning, expected life, and results
- Operating experience (OE) session and presentations
- PUG business session and NMAC review of R&D ranked subjects from 2011

On Tuesday afternoon, there will be a tour of the new Hydro-Aire flow test facilities in Chicago. On Thursday morning, the PUG will hold its normal business meeting, for its members only. Friday morning has been set aside as time to continue to work on and discuss NMAC guides and R&D needs (new and old) brought forward during the 2011 PUG meeting. A list and status update follows.

PUG R&D Issues from the 2011 Meeting and Their Current Focus

1. Based on the March 11, 2011, event at the Fukushima Nuclear Plant in Japan, on the INPO Level 1 Report issued March 15, 2011, and on the recent Level 1 report 11-4 issued August 1, 2011, prepare for added needs stemming from regulatory effects of the Fukushima events.

   **Scope:** As documents and findings are released and changes are provided to ensure added safety, PUG will review as a group the needed operations and safety modifications with experts to provide a coordinated response for extended coping times.

2. Develop an OE database with greater organization, to facilitate identification of pump issues by type and application.

   **Scope:** With officers and members, perform a survey for input on key OE areas that have been successfully used, and try to adapt the INPO database. This must be done for specific types of pumps that our members are still operating and must include their future operations plans.

   **Planned Timetable:** In discussions with officers to determine the most pertinent pump models and data fields, INPO indicated that most of the information of interest, by pump model, would be in the new INPO database coming out in September 2012.

3. Review again the issue of chemistry effects on seals and pump life review. Look at what EPRI Chemistry has done for PUG in past and review it in terms of the present.

   **Scope:** The Westinghouse Owners Group is addressing this concern again. NMAC PUG may collaborate with the Westinghouse Owners Group to find out if there is a correlation.

4. EPRI Plant Support Engineering has created an “End of Life Guide,” and NMAC has reviewed the drafts. To support this guide, the PM Basis Database, with its eight pump models and additional enhancements, will provide users with the ability to specify operations and duty to make end-of-life calculations in the future.
5. Positive displacement pump guide update based on PSEG and ClydeUnion work at Salem NPP: Review at the PUG meeting in August and decide in the fall of 2012 if updating of the positive displacement pump maintenance guide is required.

6. Vertical pump virtual sensors development: A contract was issued in 2011 to MVI/Case Western Reserve University for 3 years of research work. The test pump for this project has been acquired, and the instrumentation has been arranged from Roberston’s for thermodynamic modeling of the pump and faults. A presentation at this year’s PUG meeting is planned by MVI and Art Miller of FirstEnergy.

7. Update the feedwater, vertical pump, and submersible pump maintenance guides. This update is on track for 2012 delivery.

Current PUG Officers are Tim Massey of TVA Sequoyah NPP (chairman), Art Miller of First Energy (vice chairman), and Tim Buyer of Dominion North Anna (secretary). Past officers who continue to serve on the PUG board include Steve Rosenau of Duke Power McGuire NP and Gerry Arzani of Duke Corporate, Raymond Green of Dominion Surry NP, Corie Colbourn of PGE Diablo Canyon NP, Craig Jennings of Exelon Corporate, James Tipton of FPL Group Seabrook NP, and Kevin Glandon of Southern Corporate.

*For more information about the Pump User Group, contact Dave Dobbins, 704.595.2560, ddobbins@epri.com.*

### NMAC Meetings

#### 2012 Transformer and Switchyard Users Group to Cover Key Issues

The EPRI Transformer and Switchyard Users Group (TSUG) endeavors to helps power plant personnel improve their knowledge of transformers and other switchyard equipment. The primarily goal of this knowledge transfer is to encourage proper maintenance and improve reliability of transformers and switchyard equipment.

![Photo courtesy of Duke Energy](image)

The 2012 TSUG meeting will be July 30–August 3 in Rochester, New York. The workshop for this year’s meeting will be Bushings and Bushing Monitoring, with an associated tour of PCORE/Hubbell bushing manufacturing factory.
The presenters are being contacted for the upcoming meeting, and it is anticipated that many noted individuals in the transformer and switchyard equipment industry will be presenters and/or participants at this meeting. In the past, the group has enjoyed presentations from experts in the field of insulation testing such as Dr. Poorvi Patel of ABB and the developer of the dissolved gas analysis tool—the Duval Triangle—Dr. Michel Duval.

There have been a number of recent events and activities that could lead to potential presentation topics at the next meeting:

- The Byron loss of offsite power (LOOP) events in January 2012
- Insulator failure modes and inspections (a possible EPRI presentation)
- Diablo experience with bushing monitors
- The North Anna LOOP
- The Brunswick power outage in February 2012

A number of topics are under consideration as items for the working groups to discuss during their breakout sessions:

- Switchyard Equipment WG—Cameron Lee (Duke), Chair
  - Review progress on the Switchyard Equipment Maintenance and Application Guide. (This group is functioning as the technical advisory group for the development of this guide.)
  - Cover recent problems with switchyard equipment (insulators, arresters, and so on)
- Grid Reliability WG—Bill Duge (First Energy), Chair
  - NERC standards
    - The group is considering whether to more closely follow NERC Geomagnetic Disturbance/Geomagnetically Induced Currents (GMD/GIC) Task Force work regarding effects on bulk electric system components (an interim report was issued in February 2012).
    - Other NERC standards on protection and maintenance
  - Degraded grid relay—it has been suggested that the group stay in contact with the IEEE group working on this topic; possible presenters include George Attarian (Progress) or Harvey Leake (APS)
- Power Transformer WG—Nick Pournaras (Southern Nuclear), Chair
  - Sudden pressure relay
  - The Copper Book—a review session will be held August 2–3. (Two chapters of this document, which is a source book for power transformer users, are planned for completion in 2012: Chapter 2—Transformer Selection, and Chapter 10—Failures, Problems, and Investigations.)
  - Consideration of a possible guide on refurbishment of transformers
  - Bushing monitors

For more information about the Transformer and Switchyard Users Group and the upcoming meeting, contact Wayne Johnson, 704.595.2551, wejohnson@epri.com.

TSUG is chaired by Kirk Robbins of Exelon and cochaired by Camilo Rodriguez of First Energy.
NMAC Meetings

Spring Update on the Hoisting, Rigging, and Crane User Group

Every summer, the Hoisting, Rigging, and Crane User Group (HRCUG) holds its annual meeting. Last year’s meeting at the Omni Hotel on Chicago’s “Miracle Mile” was an outstanding success, attracting a wide array of presenters, including members, industry vendors, and the Institute for Nuclear Power Operations. This year’s annual meeting will be held June 12–15 in the Intercontinental Milwaukee Hotel adjacent to the city’s beautiful downtown river walk. Presentations are planned on a wide range of issues, from materials handling safety to rigging for critical lifts. Of course there will be a review of the past year’s INPO Operating Experiences, giving attendees a chance to look at what could have been done better in the use of cranes, rigging, and materials handling equipment. A vendor fair is planned for Thursday night.

The Hoisting, Rigging, and Crane User Group will also be offering two workshops this year in conjunction with the summer meeting. The first workshop, on crane design and construction, will be presented by Manitowoc Crane and includes a factory tour of their facilities in Manitowoc, Wisconsin. The second workshop, presented by Konecranes, will focus on safe rigging practices and will be held at the world-famous Harley-Davidson Museum Conference Center. A special VIP tour of the museum will follow the workshop presentation.

Also of note is that the EPRI Nuclear Maintenance Applications Center will be releasing its new Mobile Crane Maintenance Application Guide this year. There will be a special preview presentation of this guide to HRCUG members during the meeting. Until now, EPRI has had no formal publications that provide its members with information regarding the operation and maintenance of mobile cranes.

Closely following the release of the Mobile Crane Maintenance Application Guide will be the release of a fully revised NMAC Material Handling Application Guide. Since the release of the original version of this guide in 2007, there have been a number of OSHA and ASME revisions, in addition to recommendations by INPO and various equipment manufacturers. A special preview of this revised guide will be offered during the summer HRCUG meeting.

*For more information about the Hoisting, Rigging, and Crane User Group and its planned activities for 2012, contact Merrill Quintrell, 704.595.2530, mquintrell@epri.com.*

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NMAC Meetings

Work Planning Users Group Actively Addressing Key Issues

EPRI hosted the Work Planning Users Group (WPUG) winter meeting January 31–February 2, 2012, in Port St. Lucie, Florida. Sixty-four planning professionals representing 46 plants attended this meeting. This WPUG meeting was chaired by Steve Johnson of INL and cochaired by Dale Shaw of Exelon.

The goals of the group are to improve maintenance effectiveness and equipment reliability by continuously improving the work planning departmental performance.

This initiative is providing consistent strategic and tactical standards by developing industry best practices, reviewing operating experience, and further defining and improving the process for work package quality, preparation, execution, and feedback.
January 2012 WPUG meeting attendees

As the figure below indicates, work instruction quality contributed to 52% of the maintenance-related scrams in 2009 and 2010.

**Maintenance Related Causes and Contributors**

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<td>Work Inst Quality</td>
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**Maintenance-related causes and contributors for scrams**

EPRI product 1022903, *Maintenance Work Package Planning Guidance*, is currently undergoing revision to address work instruction quality and other planning issues. A separate subcommittee meeting or technical advisory group (TAG) meeting was held January 23, 2012, to review the initial revision to this document and was attended by 15 WPUG members.

In general, this guideline is being revised to add detail, clarity, and standards with regard to work package and work instruction quality. More specific objectives are as follows:

- To develop an industry standard to address work instruction level of detail
  - Improve the process used to define the skill of the craft
  - Develop a standard to incorporate human factors into work instructions
  - Develop an industry standard for planner training
To update EPRI planning guidelines to incorporate the additional elements of the following:

- AP 928 Revision 3
- INPO 11-003
- IER L2 11-02

This revision is targeted for completion in midyear 2013.

WPUG Leadership Changes

With former chairperson Steve Johnson acknowledged for his leadership and participation over the past year, Dale Shaw (Exelon) has now taken over as chairperson and will hold that post for the summer 2012 and winter 2013 meetings. James Epps (Millstone) was nominated and has been voted in as the new vice chairperson.

The Summer WPUG meeting will be held Tuesday through Thursday, July 17–19, 2012, at the EPRI offices in Charlotte, North Carolina. Follow the link below for additional information about the next WPUG meeting and to register for the meeting.

http://www.event.com/d/1cqpy8

To learn more about the WPUG and its activities, contact EPRI Project Manager Lee Rogers, 772.288.4369, lrogers@epri.com; WPUG Chairperson Dale Shaw (INL), dale.shaw@exeloncorp.com; or WPUG Vice Chairperson James Epps (Millstone), James.L.Epps@dom.com.

NMAC Meetings

Circuit Breaker Users Group Update

EPRI has published product 1021243, which is a brief that describes the Circuit Breaker Users Group along with the primary issues the group is working to address. This brief can be found on EPRI’s website (www.epri.com). During the 2011 meeting, the primary issues described in this document were reviewed and revalidated by utility attendees. These issues are the following:

- Better define electrical bus inspection, testing, and monitoring
- Provide guidance for motor control center maintenance
- Identify lessons learned from circuit breaker replacements
- Provide guidance for training of circuit breaker specialists and program owners
- Review and update existing EPRI guidance on circuit breakers and switchgear
- Review and develop EPRI preventive maintenance basis templates

EPRI is working with the Circuit Breaker Users Group in 2012 to address bus inspection, testing, and monitoring; guidance for the development of circuit breaker specialists; and revision of guidance for ABB K-Line preventive maintenance and overhaul.
This year, EPRI plans to publish *Guidance for the Development of Circuit Breaker Specialists*. The objectives of this guideline include identifying knowledge and skill sets needed to establish and maintain a circuit breaker program, and enhancing industry and site-specific training for persons responsible for circuit breakers.

The next meeting of the Circuit Breaker Users Group will take place June 4–8, 2012, in New Orleans, Louisiana. Featured topics are expected to include the following:

- Control device issues and experiences on ABB HK circuit breakers
- Testing of GE Magne-Blast arc chutes
- Programs for overhaul of Eaton vacuum circuit breakers
- Lubrication for Eaton vacuum breakers
- Lessons learned from Exelon nonsegregated bus inspections
- Industry operating experience review and analysis
- Westinghouse tutorials on DB, DS, and DHP and DHP-VR
- Working group meetings on motor control center maintenance; K-Line preventive maintenance and overhaul; and guidance for the development of circuit breaker specialists

During the 2012 meetings, the Circuit Breaker Users Group will be electing a new chairperson and vice chairperson. Advance nominations for these positions are encouraged and should be sent to Jim Sharkey at EPRI (jsharkey@epri.com). Cochairpersons who will help facilitate the individual breaker-model-specific sessions include Paul West of First Energy, Todd Lynch of Duke Power, Nick Pournaras of Southern Nuclear, Melanie Main of Dominion, and Greg Lichty of PSE&G. Information on this meeting can be found on the EPRI website (www.epri.com), under the “Events” tab on the Nuclear Events Calendar under June 4–7, 2012, or on the Circuit Breaker Users Group Meeting website.

The Circuit Breaker Users Group conducts monthly conference calls to discuss industry operating experience and provide updates on initiatives. These calls typically occur on the third Thursday of the month. All materials from the meetings, including results of the surveys, are posted on the Circuit Breaker Users Group EPRI collaboration website and the Circuit Breaker Users Group website on www.epri.com.

*For more information, contact Jim Sharkey, 704.595.2557, jsharkey@epri.com.*

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**NMAC Meetings**

**Japanese Reliability-Centered Maintenance–Condition-Based Maintenance Users Group Update**

As a result of regulatory changes, Japanese nuclear utilities are collectively moving toward condition-based maintenance programs. To assist in this effort, EPRI sponsors the Japanese Reliability-Centered Maintenance–Condition-Based Maintenance (RCM-CBM) Users Group.

In RCM-CBM group meetings, Japanese and invited international CBM experts share plant case histories to expand their knowledge base and highlight lessons learned. In addition, the group has formed working groups that meet separately to discuss specific technologies including vibration analysis, oil analysis, and infrared thermography.
The RCM-CBM group’s list of prioritized topics includes the following:

- Extending the scope of condition-based maintenance
- Establishing and modifying acceptance criteria
- Collecting and learning from case histories and CBM examples
- Education, training, and qualification
- Obtaining management support
- Introduction of techniques other than vibration, infrared thermography, and oil analysis
- Developing databases for managing the results of CBM activities

EPRI is currently working to assist the group in addressing the issue of moving from time-based maintenance to condition-based maintenance.

The vast majority of Japanese nuclear plants are currently shut down as a result of the March 11, 2011, earthquake and resultant tsunami. Even with many plants currently in long-term shutdown, the RCM-CBM group’s mission is still considered valid, and the interest from Japanese utilities is still strong. The group held a meeting in October 2011. The focus at this meeting was equipment layup and long-term plant shutdown. Gary Boles of EPRI and Richard Peppin of Progress Energy provided presentations on these topics. Bryan Johnson of Arizona Public Service provided case studies on lubrication, and Steve Ciesla provided case studies on vibration.

Selected technology experts from U.S. and international utilities attend these meetings to provide an international exchange and share their programs, experience, methods, and case histories. In conjunction with these meetings, benchmarking trips to Japanese nuclear plant sites are attended by predictive maintenance (PdM) program and technology experts from other countries.

Utility personnel interested in sharing successful programs or unique case studies should contact Jim Sharkey, 704.595.2557, jsharkey@epri.com.

For information or questions regarding this group and these EPRI initiatives, contact Jim Sharkey, 704.595.2557, jsharkey@epri.com.

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**NMAC Meetings**

**Combined Condition-Based Maintenance Meeting**

**Mark Your Calendars**

The 2012 Combined Condition-Based Maintenance (CBM) Meeting will be held at the Crowne Plaza in San Diego, California, the week of July 16–20, 2012.

**Background**

The Combined CBM Meeting is normally the union of events for four separate groups that share a common interest: safely improving equipment reliability in the most cost-effective manner. The usual group events that usually constitute the combined meeting are the following:

- Predictive Maintenance Users Group (PdMUG) meeting
- Vibration Technology Forum (VTF) meeting
• Infrared Thermography Users Group (IRUG) meeting
• Lubrication and Bearing workshop

However, for 2012, the Lubrication and Bearing workshop will not be held. Selected programmatic lubrication-related material will be presented during the PdMUG portion of the meeting. The Lubrication and Bearing Workshop will resume in 2013, when the combined meeting takes place on the East Coast. An additional change this year is that the Combined CBM Meeting will be held concurrently with Terry Turbine User Group (TTUG) meeting. The objective of this temporary union is to bring different perspectives to our meeting and potentially identify where CBM technologies may be applied toward Terry turbine condition analysis. The presentation material from both meetings will be made available to all attendees. It is EPRI’s intent in the future to include other component groups when the temporary union would benefit our mutual members.

The objectives of these groups are to identify issues and common challenges related to safety, cost control, and equipment reliability. Equally important, the group members represent a vast body of knowledge that EPRI collectively draws from to formulate solutions and communicate those solutions to the members. While the PdMUG focuses on the programmatic issues that are challenging our industry, each technology venue (Vibration, IR Thermography, Lube Oil) focuses specifically on data collection, analysis, and equipment problem resolution.

The annual meeting provides a forum for EPRI members to exchange information, ideas, successes, problems, and experiences regarding diagnostic monitoring and condition assessment technologies used in condition-based maintenance programs. The groups accomplish the meeting objectives through EPRI updates, case studies, roundtable sessions, and workshops.

**EPRI Updates**

EPRI staff present updates that keep members informed regarding upcoming products and initiatives that would best benefit the members.

In July 2011 EPRI provided updates on the following subjects:

• The EPRI *Condition-Based Maintenance Guideline* revision
• Japanese RCM-CBM Users Group activities
• The IR Severity Criteria software
• The EPRI Lubrication website
Case Studies

Case studies are essentially plant experience reports that are presented and/or discussed by utility personnel. Case studies typically discuss current or past equipment problems; completed, planned, or potential corrective actions; cost-benefit information; and any other pertinent information that would assist attendees. Applications of new technologies and innovations are also highlighted during each of these meetings.

Roundtable Sessions

Roundtable sessions provide an opportunity for members to identify programmatic and technical issues, while other members offer beneficial insight as to the pros and cons of paths taken to resolve those issues. If a resolution to an issue is not available and there is sufficient common interest, EPRI will evaluate the merits of developing a member-sanctioned initiative to provide a solution.

The following roundtable topics were discussed in July 2011:
- CBM development plans
- The Equipment Exception List
- EPRI IR documents
- EPRI lubrication updates and resources

Workshops

Workshops address the issues that most greatly affect equipment reliability and challenge safe generation. EPRI staff study utility operating experience, issue and review member surveys, and identify industry trends that may be potentially problematic for members. Subject matter experts present informed solutions to resolve the issues or at least minimize the members’ exposure to generation or financial risk.

In July 2011, workshops on the following topics were presented by industry-recognized technical leaders:
- Fluid film bearings (Pioneer Motor Bearing Co.)
- Field balancing (Luminant/Entergy)
- NFPA-70E and IR inspections (Infraspection Institute)
- Selection, approval, and installation of sampling ports (OPG)

2011 Proposals and Accomplishments

The Predictive Maintenance Users Group has identified the need to develop a CBM guide that addresses the roles and responsibilities of a CBM program coordinator, including meaningful performance indicators that measure CBM program performance. If you would like to know more or are interested in participating in the project, contact Tom Turek, 484.631.5863, tturek@epri.com.

The combined efforts of all the CBM users groups were collectively responsible for the issuance of the Condition-Based Maintenance Guideline (EPRI product 1022957) in November 2011. This document updated and replaced the four volumes of TR-1033374.

The Vibration Technology Forum (VTF) identified the need for monitoring components that are inaccessible at power, such as containment fans. To that end, the VTF proposed that EPRI pursue a project to correlate motor casing vibration data to motor control center (MCC) motor torque spectra of (motor) bearing frequencies. The benefit to the members is that now they will have actionable criteria to apply to the MCC torque spectra where none existed previously.
The Infrared Thermography Users Group continues to make progress on the Infrared Thermography Severity Criteria software. If you would like to know more or are interested in participating in this project, contact Gary Noce, 484.432.9251, gnoce@epri.com.

For information on each of the specific groups, contact the following EPRI staff:

- **Predictive Maintenance Users Group (PdMUG)**  
  Tom Turek, 484.631.5863, tturek@epri.com

- **Vibration Technology Forum (VTF)**  
  Tom Turek, 484.631.5863, tturek@epri.com

- **Infrared Thermography Users Group (IRUG)**  
  Gary Noce, 484.432.9251, gnoce@epri.com
NMAC Members and Personnel

NMAC Domestic Membership

AmerenUE
American Electric Power
Arizona Public Service
Constellation
Detroit Edison
Dominion Energy
Duke Energy
Energy Northwest
Entergy
Exelon
FirstEnergy
Florida Power & Light
INL (NA)
Knolls Atomic Power Labs (KAPL)
Luminant
Nebraska Public Power
NNSA Oak Ridge (ORNL)
Omaha Public Power
Pacific Gas & Electric
PPL Susquehanna
Progress Energy
Public Service Electric & Gas
South Carolina E&G
South Texas Operating Co.
Southern California Edison
Southern Nuclear Operating Co.
Tennessee Valley Authority
Wolf Creek
Xcel Energy Services
## NMAC Members and Personnel
### NMAC International Membership

| British Energy (UK) | Cernavoda (Romania) | CFE (Mexico) | Chubu (Japan) | Chugoku (Japan) | Cofrentes (Spain) | Daya Bay (China) | Electrabel (Belgium) | Electricité de France | Electronuclear (Brazil) | Eskom (South Africa) | Hokkaido (Japan) | Hokuriku (Japan) | Hydro Quebec | JAPCO (Japan) | J-Power (Japan) | Kansai (Japan) | KHNP (Korea) | KRSKO (Slovenia) | Kyushu (Japan) | Leibstadt (Switzerland) | NASA (Argentina) | New Brunswick (Canada) | Ontario Power (Canada) |
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# NMAC Members and Personnel

## Personnel

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<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Phone</th>
<th>E-Mail</th>
<th>Coverage Area</th>
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</thead>
<tbody>
<tr>
<td>Jim Heishman</td>
<td>Program Manager, NMAC</td>
<td>704.595.2768</td>
<td><a href="mailto:jheishman@epri.com">jheishman@epri.com</a></td>
<td>Maintenance, engineering, operations</td>
</tr>
<tr>
<td>Gary Boles</td>
<td>Consulting Employee</td>
<td>423.870.5979</td>
<td><a href="mailto:gboles@epri.com">gboles@epri.com</a></td>
<td>Mechanical component, component engineering, maintenance processes, work planning</td>
</tr>
<tr>
<td>Marty Bridges</td>
<td>Sr. Project Manager</td>
<td>704.595.2672</td>
<td><a href="mailto:mbridges@epri.com">mbridges@epri.com</a></td>
<td>Preventive maintenance programs, Preventive Maintenance Basis Database, equipment reliability, maintenance assessments, condition-based maintenance programs, main condensers, maintenance engineering</td>
</tr>
<tr>
<td>Nicholas Camilli</td>
<td>Sr. Project Engineer/Scientist</td>
<td>704.595.2594</td>
<td><a href="mailto:ncami@epri.com">ncami@epri.com</a></td>
<td>Lubrication, mechanical support, valves and bolting, power uprates</td>
</tr>
<tr>
<td>Lee Catalfomo</td>
<td>Sr. Project Manager</td>
<td>813.996.3357</td>
<td><a href="mailto:lcatalfo@epri.com">lcatalfo@epri.com</a></td>
<td>Equipment reliability, maintenance process improvement, operations support</td>
</tr>
<tr>
<td>Dave Dobbins</td>
<td>Project Manager</td>
<td>704.595.2560</td>
<td><a href="mailto:ddobbins@epri.com">ddobbins@epri.com</a></td>
<td>Pumps, Terry turbines</td>
</tr>
<tr>
<td>Alan Grunsky</td>
<td>Sr. Program Manager, NSTI</td>
<td>704.595.2556</td>
<td><a href="mailto:agrunsky@epri.com">agrunsky@epri.com</a></td>
<td>Nuclear Steam Turbine Initiative</td>
</tr>
<tr>
<td>Wayne Johnson</td>
<td>Sr. Project Manager</td>
<td>704.595.2551</td>
<td><a href="mailto:wejohnson@epri.com">wejohnson@epri.com</a></td>
<td>Electrical components, electrical systems, motors</td>
</tr>
<tr>
<td>Bob O’Neill</td>
<td>Consulting Employee</td>
<td>508.539.3301</td>
<td><a href="mailto:roneill@epri.com">roneill@epri.com</a></td>
<td>Valves: motor-operated, solenoid-operated, pressure-reducing, and air-operated</td>
</tr>
<tr>
<td>Mike Pugh</td>
<td>Consulting Employee</td>
<td>919.812.5162</td>
<td><a href="mailto:mpugh@epri.com">mpugh@epri.com</a></td>
<td>Condensers, circulating water systems, mechanical components, lubrication</td>
</tr>
<tr>
<td>Merrill Quintrell</td>
<td>Sr. Project Manager</td>
<td>704.595.2530</td>
<td><a href="mailto:mquintrell@epri.com">mquintrell@epri.com</a></td>
<td>Hoists, rigging, and cranes</td>
</tr>
<tr>
<td>Lee Rogers</td>
<td>Sr. Project Manager</td>
<td>772.288.4369</td>
<td><a href="mailto:lrugers@epri.com">lrugers@epri.com</a></td>
<td>Maintenance processes, work planning, power uprates</td>
</tr>
<tr>
<td>Name</td>
<td>Title</td>
<td>Phone</td>
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</tr>
<tr>
<td>Deborah Rouse</td>
<td>Sr. Administrative Assistant</td>
<td>704.595.2520</td>
<td><a href="mailto:drouse@epri.com">drouse@epri.com</a></td>
<td>Program administration</td>
</tr>
<tr>
<td>Jim Sharkey</td>
<td>Sr. Project Manager</td>
<td>704.595.2557</td>
<td><a href="mailto:jsharkey@epri.com">jsharkey@epri.com</a></td>
<td>Circuit breakers, main generators, emergency diesel generators</td>
</tr>
<tr>
<td>Tom Turek</td>
<td>Sr. Project Manager</td>
<td>484.631.5863</td>
<td><a href="mailto:tturek@epri.com">tturek@epri.com</a></td>
<td>Condition-based monitoring with a focus on rotating equipment, foreign material exclusion</td>
</tr>
<tr>
<td>David Ziebell</td>
<td>Sr. Project Manager</td>
<td>404.316.9823</td>
<td><a href="mailto:dziebell@epri.com">dziebell@epri.com</a></td>
<td>O&amp;M processes and practices, clearance and tagging, change management</td>
</tr>
</tbody>
</table>
About EPRI

The Electric Power Research Institute, Inc. (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, health, safety and the environment. EPRI also provides technology, policy and economic analyses to drive long-range research and development planning, and supports research in emerging technologies. EPRI’s members represent more than 90 percent of the electricity generated and delivered in the United States, and international participation extends to 40 countries. EPRI’s principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass.

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