

Vol.20 Issue 1



Get set for a transformed view of Doble Exchange!

We've decided to act on your frequent request to "Let us have our old newsletter back" and we are happy to announce a re-launch of **Doble Exchange**. This time, though, it's better, smarter, and easy to access, thanks to technology advancements, and the World Wide Web. We'll keep you up to date with highlights from all the important conferences and we'll let you in on events to come. Most important, you will get expert briefings about new tools, tips on innovative maintenance practices, diagnostic software, transformer economics, safety regulations, case studies ...and more! As you continue to trust Doble as your key knowledge broker in electric power delivery, **Doble Exchange** is our way of giving something back. To our smart working community of engineers and asset managers, we proudly say, Welcome **back** and **fast-forward** to **Doble Exchange**.



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FEATURE

[Vancouver Report: Utility Engineers Unplugged](#)



The Doble Client Committee and ProTest User Group (PTUG) fall meetings are pivotal, vendor-free events--the places to be for substation and maintenance engineers to share concerns in making power-apparatus performance as reliable as possible. For those of you who did not attend the Vancouver sessions in October, get an earful of what your peers are achieving, wanting, and demanding, with this report of highlights from Vancouver.

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TECHNOLOGY BRIEFING

[Doble Test Assistant: From Field Test to Office Action](#)



Doble Test Assistant® is an amazingly adept way to test and analyze the insulation in all high-voltage apparatus. In this briefing that brings you closer to DTA's technology and business value, you will see how its two modules, Field and Office, go beyond raw numbers to deliver real answers for on-site technicians and management engineers.



[Click](#) for scheduled conferences, seminars, user group meetings, and trade

shows on the Doble Web site.

Knowledge Exchange

Power Trends: *Industry issues and directions*



[Seminar Brain Drain](#)

There are always enough events to choose from, but often no way to decide on which industry & training events to attend in 2005. You and your team need to ask the right questions if you want to separate the career-turners from the time-burners.

Reader Survey: [Training Preferences](#)

Doble Tested: *Tips, Steps, and Procedures for Getting the Job Done*



[How To Collect a Proper Oil Sample](#)

Oil samples must be taken properly in order to obtain accurate data to assess what's really going on inside your electrical apparatus. How much do you know about what it takes to get good oil samples? Learn from these proven tips and techniques.

Safety Matters



[Arc Flash: Safety Concerns](#)

Arc-flash explosions are a dangerous occurrence. Around high-voltage apparatus, dangerous can turn to catastrophic. Being up to speed on the latest news from OSHA (Occupational Safety & Health Administration) and NFPA (National Fire Protection Association) is essential.

Reader Survey: [Arc Flash Concerns](#)

Power Talk: *Opinions on the Line*



[Exchange Then and Now](#)

The return of Doble Exchange - looking back 25 years since the launch of the first issue.

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[Front Page](#) |



Vancouver Report: Utility Engineers Unplugged

It happens every year—the Fall Meetings of the Doble Client Committees—a “utilities only” private forum. This is where electric-utility engineers share experiences in an open environment and freely voice their concerns. Some attendees are staunch veterans of 10, 20, or more of these gatherings. Also in the crowd are new faces, who having replaced retiring veterans now seek out the wisdom of their peers.

The Doble Fall Meetings are significant venues where delegates get to hear and discuss the latest information and ideas. Delegates select the topics for presentation at the Doble Client Conference in Boston. “There’s really no other industry event where utility delegates are able to voice their individual concerns on topics of interest and are empowered to create their own conference agenda,” says one veteran participant.

No matter which company or geographic area is represented, all of the delegates are united by a single mission – to further the safe and efficient delivery of electric power. The latest Fall meeting was no exception: In October, over 250 electric engineers gathered in Vancouver, British Columbia, to continue on this “knowledge expedition.”



Transmission.

Doble Engineering thanks area utilities BC Hydro and BC Transmission Corporation for their active participation in the October event, which included a keynote by Bruce Ripley, Vice President of Engineering for BC Hydro, and a field trip to [BC Hydro's Stave Falls Generating Plant](#). Producing an average of 280 gigawatt hours of electricity per year—enough to serve about 28,000 households—the original plant was turned into an electric power learning center after being replaced in service by a new plant with more efficient turbines. The Doble Client community also had the benefit of participation by many engineers from BC Hydro and BC

For the latest listing of the April 2005 Doble Client Conference presentations and schedule, go to: www.doble.com/general/eventdetail.php?id=157

Following are highlights of Client Committee Meetings:

Arresters, Capacitors and Cable Accessories (ACCA)

ACCA delegates were updated on the progress of several Committee projects.

Arrester tabulations in the works—Doble Engineering is developing an **Arrester Tabulations** document for release in 2005. Who will find these useful: MEU and M2H test set users, and M4000 users.

Coming soon in electronic formats: **Arrester Field Test Guide** and the **Reference Book on Cables and Accessories** will soon be included in electronic format of the M4000 Insulation Analyzer User Guide.

Tutorial on topic drawing serious interest—A tutorial on “Manufacturing and Testing of Surge Arresters” submitted by Steve Brewer of Ohio Brass was considered. The audience indicated serious interest in this topic. As there is no IEEE standard on these tests, this offering would be beneficial and provide useful guidance to the Client Community.

DGA poll results—Doble Engineering reported an increase in the last year in the frequency of **dissolved gas analysis (DGA) performed on cable**. The committee was polled on a question that appeared on the "Ask Doble" e-mail forum about performing **DGA on 115 kV high pressure fluid-filled cables**. Only four delegates had this type of cable of which only one performed DGA.

DGA results are based on the type of incipient fault; key gases formed are as follows:

- arcing causes production of acetylene
- high-temperature overheating causes ethylene
- overheating causes methane and ethane production
- hydrogen indicates partial discharge and moisture problems.

Careful analysis of DGA results is critical to guide maintenance.

Doble reported that one client had installed sample valves at the cable splices. DGA performed at these sample locations did reveal **cables with high combustible gas levels**. This information caused cables with the highest gas content to be inspected and repaired.

Questions on failures—Other ACCA discussions included questions and exchange on failures of Ohio Brass, type VN, surge arrester, MCOV 70kV, Voltage Rating 90kV, as well as failures of different Joslyn arresters.



Topics for Doble's Boston conference—The ACCA Committee selected five topics for presentation at the 2005 Doble Client Conference in Boston. Three of these have since been confirmed by the presenters:

- **"Maintenance Testing of Medium Voltage Cables,"** Skip Hicks, *Electrical Reliability Services, Inc. Phoenix, AZ.*
- **"Capacitor Bank Failure: Investigation of 2 700 kVAR, 13.8 kV Bank Capacitor Failure in Service,"** Jean-François Chrétien, MESAR, Ghislain Garant, Alcan, Long Pong, Doble Engineering
- **"On-line Condition Monitoring of Gapless Metal Oxide Surge Arresters,"** Stig Kyrkjeide, Oddgeir Kvien, Vegard Larsen, TransiNor

Responses are still pending from other selected ACCA presentations.

Asset & Maintenance Management (AMM)

Arc Flash safety proposals—Discussions included an Equipment Health Rating (EHR) Program on Transformers, and two proposals on topics relating to safety in regards to Arc Flash. Florida Power & Light shared their latest knowledge with a presentation on Hurricane Preparedness.



Topics for Doble's Boston conference—The AMM Committee selected a number of presentations that will be included in the upcoming 2005 Doble Client Conference. These include:

- **"Facilitating Essential Repairs to 400kV GIS substation through the Use of Temporary Overhead Line Bypass Arrangements,"** Zac Richardson, *National Grid Transco*
- **"Reliability Centered Maintenance Program at Grant County PUD,"** Laurie Dayton, *Grand County PUD*
- **"Reliability Centered Maintenance Program at NYPA,"** John Troisi, *New York Power Authority*
- **"Equipment Health Rating (EHR) Program on Transformers,"** Mike Lau, *BC Transmission Corporation*

Additional AMM presentations were selected and confirmations from those presenters are pending.

Bushings, Insulators and Instrument Transformers (BIIT)

Discussions—The BIIT Committee discussed a variety of subjects, including Bushings problems and failures, Daytime Corona Testing of Insulators, and Gasket problems.



Tutorial for Doble's Boston conference— A tutorial on **Coupling Capacitor Voltage Transformers** (CCVTs) has been under consideration and is tentatively scheduled to be included on Sunday afternoon, April 10, at the April 2005 Doble Client Conference agenda. Ritz and Trench are two of the companies expected to participate. For a preliminary outline of the [CCVT Tutorial agenda, click here.](#)

BIIT papers for Doble's Boston conference—The BIIT Committee selected numerous papers for presentation at the 2005 Doble Client Conference. Here are a few examples:

- **"Daytime Corona Testing of Insulators Using the DayCor Camera,"** Dr. Pinhas Lindher, Ofil, Ltd.
- **"ABB Type GOB Neutral Bushing Failures,"** Richard Michaud, National Grid
- **"A Review of Past Bushing Problems,"** Eileen Duarte, Doble Engineering

Important reminder: ABB Service Advisory—Another topic planned in the April 2005 BIIT session is a presentation by ABB regarding a past Service Advisory on ABB Bushing Types O Plus C, EEMAC/CSA, and T, with Ratings of 15 kV through 69 kV, 1200 Amps and under. While the Service Advisory was originally issued in 1998, ABB feels that utilities should be reminded of the Advisory, and the proposed course of action, in order to prevent bushing failures. For further details on the [ABB Advisory, click here.](#)

Circuit Breakers (CB)

The Circuit Breaker Committee met with close to 100 persons in attendance. Of prime importance were several safety related topics concerned with very serious arc flash issues, SF₆ fault byproduct handling, and some shock issues in circuit breaker cabinets where DC terminals are not covered with a safety cover. The Committee considered some ideas for rewriting the Circuit Breaker Field Test Guide. They were updated on IEEE Switchgear committee work related to transformer failures caused by traveling waves originating in the arc of circuit breaker interruptions. Work on TRV determination and changes to standards were also noted.

On the maintenance side, the clients considered the issues of the correct overhaul intervals for breakers and disconnect switches. Problems with SF₆ gas from manufacturers, SF₆ leaks to atmosphere, and SF₆ usage monitoring systems were discussed and experiences traded. New work in the use of byproducts in SF₆ gas to diagnose issues within SF₆ switchgear were presented. The testing of vacuum bottles in low voltage breakers was discussed. The agenda included discussion of 500 kV air blast breaker failures, SF₆ high voltage interrupter failures and operating mechanism problems, as well as several issues with circuit switchers. The meeting closed with an open forum where new subjects such as important new failures of breakers and other switchgear were presented that had not been covered in the other discussions.



Topics for Doble's Boston conference—The following three presentations have been confirmed for the April Client Conference:

- **"Handling of SF₆ Containers,"** Bob Mueller, Airgas
- **"Handling of SF₆,"** Lukas Rothlisberger, Dilo
- **"Inspection, Maintenance, and Rebuilding Options for Older Circuit-Switchers,"** David Myers, John Hilgenkamp, S&C Electric Company

Insulating Materials (IM)

Committee projects—A variety of Committee projects were discussed, including an update to the Insulating Fluids Reference Guide, a Gasket Material Selection Guide for Different Fluids, Insulating Materials Identification Guide, and work on an IEEE Gas Guide regarding DGA.

Nine proposed presentations were reviewed by the group, all of which received a high level of interest. A tutorial was suggested for consideration, "Eliminating hazards with pumping oil containing combustible gases."

Oil Committee

Oil survey results—The "Doble Oil Survey," a survey of electrical insulating oils available on the market,

was reviewed for 2004 results. "Stray Gassing," which is the gassing behavior of new oils at low temperatures, was discussed and drew interest.

New research—A concern has been raised about **corrosive sulfur in transformer oils** that goes undetected in traditional tests. The Oil Committee has performed new research on this topic and expects a presentation possibly as early as the 2005 Doble Conference.

Protection Apparatus Test (PAT)

PTUG collaboration—The PAT Committee meeting was able to benefit from attendance of the ProTest User Group (PTUG) members. PAT's main focus will continue to be held at Doble's Fall event, as this has the largest number of Protection-related attendees. PAT will work closely with PTUG planners to design a program to be held in conjunction with the Fall PTUG and Fall Client Committee Meetings.

Going forward, the PAT committee will hold a committee meeting at the Spring Conference, and may offer presentations as part of the Spring Conference, in conjunction with another Client Committee.

Rotating Machinery (RM)



Proposals for Doble's Boston conference—Eleven proposals were voted as having high interest for presentation at the 2005 Client Conference. These included a high-voltage insulating system, the impact of recent IEEE standards on new windings purchases, a hydroelectric generator exciter replacement program, and problems with turbine lubrication oils used at hydroelectric plants. Of the accepted RM presentations, Doble has received confirmation on the following:

- **"Rehabilitation at Crystal Power Plant,"** *U.S. Bureau of Reclamation*
- **"System stability and Black Start Capability,"** *U.S. Bureau of Reclamation.* This paper will discuss the new requirements to demonstrate black start.
- **"Impact of Recent IEEE Stator Insulation Standards on Buying New Windings,"** *Greg Stone, Iris Power Engineering.* Iris will also present **"Trends in Stator Winding Partial Discharge Activity on Modern air-cooled Motors and Generators."**
- **"Hydroelectric generator exciter replacement program at several U.S. Army Corps of Engineer sites,"** *Steven Tanner, U.S. Army Corps of Engineers*
- **"Problems with Turbine Lubrication Oils Used at Hydroelectric Powerplants,"** *John Micetic, US Army Corps of Engineers*
- **"Visual Inspections,"** *a presentation sponsored by the RM Committee, on Tuesday, April 12.*

Transformers

The Transformers Committee meeting was well attended to review the extensive selection of proposed presentations. Topics of interest included: Electromagnetic Interference (EMI) Diagnostics of Power Transformers, and Test Result Analysis. Sweep Frequency Response Analysis (SFRA) remains of interest to the group, as the methodology continues to be developed and refined. A presentation highlight will be the application of the SFRA test equipment to perform transformer turns ratio measurements.

One client shared an experience with a 115kV, 13.2kV, 40MVA, core form transformer with high Ch power factor obtained during acceptance testing. The experience highlighted the value of the enhanced voltage factory testing and field testing. The client advised that the levels of partial discharge allowed during the enhanced voltage test should be included in the IEEE document or in the company's specifications. Also, the customer specification needs to be clear concerning what factory test failures need to be reported.



Proposals for Doble's Boston conference—The Spring 2005 Transformers session agenda is expected to be jam-packed with relevant presentations and discussions. Here is a brief selection of just a few of the confirmed subjects:

- **"Client Case Study: Advanced Diagnostics Support Critical Decision Making,"** *Richard K. Ladroga, Doble Engineering*
- **"Field Experience with the Implementation of a New On-Line Vibro-Acoustic Diagnostic for On-Line Tap Changers",** *Claude Rajotte, Hydro-Quebec*
- **Presentations on Swept Frequency Response Analysis (SFRA)** *by Tony McGrail and Charles*

Sweetser, Doble Engineering

- **"FRA Equipment Used to Perform Percent Impedance and TTR Testing"**, Servando Sánchez, Substations Department Comisión Federal de Electricidad Morelia, Mich., MEXICO; Alberto Avalos, Graduate Dept. Universidad Michoacana de San Nicolás de Hidalgo Morelia, Mich., MEXICO

Other Activities in Vancouver: ProTest User Group Meeting (PTUG)

One-on-one clinic—A PTUG clinic kicked off the week, enabling PTUG members to get one-on-one assistance with software questions. This was followed by two full days of technical presentations by Clients, Doble Engineering, and outside presenters.

Program discussions—A PTUG "Steering Committee" meeting was held on Wednesday morning. This included very active discussions on the desired direction for future PTUG events. Delegates expressed interest in future PTUG programs to include two separate tracks: an "Introduction to ProTest" for beginner training and presentations and "Advanced" track for experienced users. This program would justify multiple delegates from PTUG user companies, and would continue to educate new Protection personnel, while expanding the knowledge of other delegates. Vancouver PTUG delegates also expressed a desire for the PTUG event to be a "Protection" Users Group, and not exclusively ProTest-related.

PTUG cheerleading—Two representatives from the "Australasian Protection Users Group" shared their own event organization process. This is a group that encompasses Protection Users Groups in both Australia and Asia. Their North American colleagues especially liked the concept of having utility client representatives share the work to solicit presentations from colleagues. It was proposed that the North American PTUG follow the Australasian process, and pinpoint client representatives with whom to work together in order to plan the 2005 agenda. These individuals would be the key contact/cheerleaders within their company regarding the Doble PTUG. Note: If you have interest in being your region's PTUG organizer, please send a message to icolby@doble.com

Client Committee—The PAT Client Committee held its meeting in conjunction with the PTUG while in Vancouver.

Training—PTUG Training Sessions on Thursday and Friday were well-attended and delegates found them to be beneficial. Topics included **"Introduction to ProTest, "Advanced Macros," "Introduction to ProTest, "ProTest Settings, and "Transducers and Meter Testing."**

Evening events—The Vancouver events provided many opportunities for delegates to network in a relaxed manner. Evening receptions were held in the Doble product room the first three evenings; on Wednesday evening, a "Casino Night" was offered for some welcome fun and games.

"Best of" rating—Many clients rated this event to be the best "Doble Fall Meetings" in years. Praise-earning factors mentioned were the hotel and city, schedule of events, and technical content of the meetings. The Westin Bayshore Hotel was indeed a wonderful site, located on the edge of the city's beautiful Stanley Park. Delegates experienced both the legendary Vancouver rainy weather, as well as gorgeous blue skies and fall colors.

Mark your calendars —The 2005 Fall Meetings of the Doble Client Committees and the ProTest/Protection User Group Meeting will be held September 25-30, 2005 at the Grand America Hotel in Salt Lake City, Utah. For more information on the [Doble Client Committees, click here.](#)



Please don't hesitate to share your thoughts on this article. Send your opinions and comments to DobleExchange@doble.com

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CCVT Tutorial Preliminary Agenda

1. **Design Basics:** Capacitor Element Construction
2. **Applications**
3. **Factory vs. Field Tests**
 1. Include troubleshooting procedures
 2. Discuss the 10kV results verses Line Voltage Results
 3. Are 10kV test results performed?
 4. Should the CAR lead be detached from its terminal for field testing?
 5. Is the position of the CAR grounding switch then irrelevant?
 6. Discussion of % Power Factor and capacitance limits
 7. Temperature sensitivity: How does temperature variation affect CCVT power factor readings?
4. **The Garton Effect**
5. **Nameplate Nomenclature**
 1. Discuss meaning of nameplate information
 2. Why are 10 kV Power Factors not included on the nameplate
 3. The C1-1 capacitance is generally not found on the nameplate as a separate capacitance, but only combined with other capacitances. Is there a reason why C1-1 is not included on the nameplate?
6. **Accuracy**
 1. Tuning/ Recalibration (manufacturing recommendations as far as metering and voltage input)
7. **Newer vs. Older CCVT Designs**
 1. Enhancements (Example: resonant rejection capability)
 2. Advantages of newer designs
 3. Modifications to older designs that should be implicated
 4. Changes in Power factors due to new designs
8. **Open Discussion/Questions**

Note: Agenda is preliminary and subject to change. Any questions for discussion that you would like to have as part of the CCVT Tutorial can be sent to mfoster@doble.com Your input would be useful to the entire Client Group.

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ABB Service Advisory

Dated August 14, 1998

Bushing Types : O Plus C, EEMAC/CSA, T

Rating: 15 kV through 69 kV, 1200 Amps and under

Problem: Low Voltage Bushings Filling with Oil

The following is a synopsis of the ABB Service Advisory, as drafted by Doble Engineering.

Details of the Problem:

- The bushings are manufactured with a threaded gasket at the joint between the top of the spring assembly and the clamping nut. This gasket is threaded into position after the bushing is compressed in the assembly operation.
- If the gasket is not in the proper orientation it results in a slow leak path between the inside of the bushing and the conductor tube.

Result:

The result is the bushing is filled with oil from the transformer and the gas space is eliminated. Under extreme thermal changes the top end seal can be compromised, which could ultimately lead to a Failure.

ABB Recommendations:

- Monitor the Oil Levels on the Subject Bushings
- Under Normal Operating Conditions, if the Oil Level is within an inch from the top of the sight glass, the bushing should be removed at the first opportunity.
- If the bushing appears to be empty or completely full of oil, it should be taken out of service immediately.

ABB Repair or Replacements:

At this time ABB will repair or replace any bushing that is filling with oil at a pro rated cost.

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Client Committee Activity 2004

For many years, Doble has assisted in the advancement of the electric industry's knowledge, by providing the forum for industry representatives to meet and work together. Doble's technical conferences are highly regarded due to the fact that they are designed "by and for" our utility and testing company clients.

The Doble Client Committees, each with a specific area of interest, work to advance the knowledge and maintenance practices in their area of expertise. Over the years, these Committees have developed reference guides and other projects which now serve as excellent reference tools.

The meetings of the Doble Client Committees serve as a valuable forum for the direct exchange of information and experience. The nine "apparatus" technical committees which comprise the Doble Client Committees meet in North America each Fall. The location for these Fall Meetings is different each year, in order to circulate the event around the North American client community. The time allotted for the each Doble Client Committee meeting ranges from four hours to nearly eight hours depending upon the level of activity scheduled. All Doble Client Committees also meet for one or two hours during the Doble Client Conference in Boston, MA USA in the Spring.

Each Committee has a Chair and Vice-Chair - both elected from Doble's utility client company delegates. Each Committee also has a Secretary, which is a position held by a representative of Doble Engineering. In some cases, there is also an Assistant Secretary. Committee officers are elected by the client committee members, and typically serve a two year term.

Following are the current Doble Client Committees:

The focus for all Committee meetings is the lifetime care of power equipment used in transmission, distribution, power and industrial plant. In order to structure our discussion, the elements of this activity are broken into separate committees. For equipment issues:

Arresters, Capacitors, Cables and Accessories (ACCA) Bushings, Insulators and Instrument transformers (BIIT) Circuit Breakers (CB) Insulating Materials (IM) Transformers (T) Protection Apparatus Test (PAT) Rotating Machinery (RM) For system performance and management of maintenance: - Asset and Maintenance Management (AMM)

In addition: There is also an Oil Committee, which undertakes oil research and a review of the oil quality of the internationally available supply. The Oil Committee is open to companies who pay an additional charge.

Who can join the Doble Client Committees?

Any Doble client from a utility, power producer or testing company can declare their interest and join as many Client Committees as they wish. In addition, any Doble utility, power producer and testing company clients are invited to attend any of the eight main Committee meetings without officially "joining" that committee.

Joining a committee does not obligate you to a significant contribution of time and effort - unless you choose to do so! Being a committee member simply implies that you plan to actively participate in the meeting discussions. Committee members are encouraged to come to meetings prepared and dedicated to making that meeting a more useful one for all.

During the Fall Meetings, a U-shaped table is located at the front of the room for committee members to have easy access to microphones. Additional seating is provided for those attendees who prefer to just "listen in". But all attendees should be aware - the more everyone can contribute, sharing their own experiences and viewpoints, the more successful the meetings are for all!

If you are interested in joining a Doble Client Committee, please send an email to events@doble.com and it will be forwarded to the appropriate Committee secretary. For more details on Committee Membership Eligibility, [click here](#).

Who cannot join the Doble Client Committees?

To promote the free exchange of information during these meetings, apparatus manufacturers, apparatus manufacturers' service divisions, apparatus suppliers, apparatus re-sellers, refiners and insurers and underwriters are excluded from Doble Client Committee membership as well as from attendance at the Doble Client Committee meetings both during the Fall Meetings and during the Doble Client Conference.

Who can attend the Doble Client Committee Meetings?

Any Doble client from a utility, power producer or testing company* is invited to attend the Fall Client Committee Meetings. Clients who meet this criteria do not have to have "officially" joined a Committee or Committees in order to come to Hilton Head this September and be part of the experience.

If you are interested in joining a Doble Client Committee, please send an email to events@doble.com and it will be forwarded to the appropriate Committee secretary.

*[*For more details on Committee Membership Eligibility, click here.](#)*

Client Committee Activity:

The **Protection, Apparatus, Test Committee** is currently working on the PAT Field Test Guide and a round table discussion on Microprocessor based Protection Relays. Several sections of the PAT Field Test Guide have been reviewed and approved. The next session to work on will be selected at an upcoming meeting. The PAT is holding a round table discussion on Microprocessor based Protection Relays, from definitions to maintenance schedules. This topic is under review by the Committee to further define the Scope.

The Rotating Machinery Committee has revised Section 6, Testing, located in The Rotating Machinery Insulation Guide. This section of the guide reviews the many insulation tests performed in the factory, acceptance and preventative maintenance/diagnostic tests performed in the field. More modern and applicable tests have been added to this section. In addition, the Committee has decided to add a new section to the guide on stator winding specifications. Lastly, the Committee is developing a compilation of generator service advisories and their contacts for client distribution.

The **Transformers Committee** is working on a Transformer Specification Guide and the Oil-Filled Transformer Processing section of the Maintenance and Test Field Guide. The Committee has also decided to restart the Load Tap Changer Dissolved Gas Analysis Project because the utilities have had sufficient experience to obtain guidelines for types of load tap changers that were not covered in the original guide. Recently the Committee has summarized the responses for two technical questionnaires. The subjects of the questionnaires concerned testing transformers after a through fault and transformer loading.

The **Circuit Breakers Committee** provides a forum for the discussion of circuit breaker and switchgear issues, new developments, problems, experiences, and general discussion. At this meeting, we plan to develop the program for the next spring meeting in Boston . The committee is looking at changes to the Field Test Guide for Circuit Breakers. In the past, it has developed a Lubrication Guide which compiled information about the uses and limitations of the numerous lubricants being promoted for circuit breaker use. Breaker failures have occurred because of improper use of certain lubricants.

The **Arresters, Capacitors, Cables and Accessories Committee** is presently working on 3 projects. The update and tabulation of arresters, the update of the Reference Book on Cables and Accessories and the update of the Reference Book on Surge Arresters .

The **Asset and Maintenance Management Committee** is currently preparing the 2004 Substation Survey. This survey will be comprised of sections relating to organization, maintenance activities, strategic issues, etc. The goal is to have this survey in electronic format and to be completed by the end of 2004.

The **AMM Committee** is also preparing a Maintenance Work Practices Guide, which will provide information regarding maintenance activities such as recommended tasks, definitions and maintenance forms. The guide is scheduled to be released by the end of 2004.

The **Insulating Materials Committee** is currently updating Section 3 of the Insulating Fluids and Materials Guide (Transformer and Circuit Breaker Oil Test Guide). Draft 2 of this materials guide has been completed and distributed. IMM has completed and distributed Draft 1 of the Production of a Gasket Material Selection Guide for Different Fluids. The IMM Committee has completed and distributed Draft 1 of the Insulating Fluid Identification Guide. This guide will help the user identify insulating fluids that are not commonly seen in the industry, aid in determining what tests are appropriate and provide tables for new and in-service limits.

The Insulating Materials committee also has a tutorial subcommittee that is continuously active developing tutorials on interesting topics for the client group

The **Bushings, Insulators, and Instrument Transformers Committee** is presently working on a project compiling an archive of older bushing outline drawings that may not be available on the manufacturers' websites. A database is being created in which Doble will be able to search for the drawings by manufacturer, type, voltage or current rating. This database has been completed and is available internally on the Doble Digital Library. We are awaiting written approval from the various manufacturers before the release of this database.

Another project the committee is working on entails developing a bushing troubleshooting guide. The guide should include all common testing issues. The goal of this project is to produce a document that testers and end users could reference to determine the condition of their bushings. It should provide guidelines for actions to be taken based on test results, and include proper test procedures and connections and what to do if data is suspect. The troubleshooting guide will be incorporated as part of the Bushing Field Test Guide.

A simple troubleshooting flow chart for bushings will also be included for the newer testers in the field. Doble has started work on the troubleshooting flow chart.

The **BIIT Committee** is also looking to host a CCVT Tutorial at the 2005 Doble Spring Conference.

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[Front Page](#) |



Doble Test Assistant: From Field Test to Office Action

Doble Test Assistant® (DTA) is an amazingly adept way to test and analyze the condition of your power-system apparatus. Here's what you need to know in order to unlock its potential as a virtual expert guide. This briefing is going to walk you through its features, functions, and business value. You'll see how DTA's two modules, Field and Office, go beyond raw numbers to deliver real answers for on-site technicians, engineers, and management.

In one year, an insurance group reported 25 substation transformer failures costing over \$100,000 each. That news gets worse: At a nuclear power plant, a transformer failed in "an eventful mode." Translation: The resulting substation fire caused weeks of production downtime. The estimated loss of revenue was \$1 million a day.

The long-term prognosis is even more dismal. A study by another insurance group indicates the operational [life cycle of transformers](#) is decreasing. They found deteriorating insulation was causing failures in equipment that had been in service an average of just 17.8 years. Yet another major insurance group predicts substation transformer failures will rise by 500% within 10 years.

Adding to today's challenges in testing, statistical failure analysis shows there is a range of possible reasons causing transformer failures. These include abnormal operating conditions, over-voltages, system short-circuits, abnormal operations, improper maintenance, substandard materials, substandard manufacturing techniques, and design deficiencies.

For beleaguered asset managers trying to cope with these issues, the old rules of thumb are proving less and less effective. The best strategy is to focus on data that is first and foremost statistically significant. Therein lies the rub.

Suppose you have a transformer with an unusual test result. How can you be certain of your diagnosis, when all you have to work with are limited number of test results from a handful of similar transformers in your inventory? In all likelihood, you won't have a "statistically significant" sample for guidance

This is where Doble Test Assistant plays a critical and decisive role. Doble has that needed breadth of data. The DTA Expert System includes knowledge gained from millions of test results that were collected from hundreds of Doble clients over many years.

DTA in a nutshell is an easy-to-use "smart" software system, designed for use by apparatus maintenance, operations, and management teams. Once DTA is on the scene, the test technician is on the fast track to having **knowledge based on statistically significant data**.

The data record for an apparatus—a transformer with tertiary—centers on the nameplate. All attached equipment, such as bushings (*mouse over*) are part of the single apparatus record.

The process starts with the DTA Field Test module, with its many testing capabilities and its ability to analyze each test result. DTA's Field System module collects and processes test data. Later, the DTA Office module takes all of the test results from the Field System and incorporates that data into your company's DTA database for planning and analysis.

From the get-go, DTA makes it easy for technicians to build a useful and significant collection of test results. By enforcing strict data formats and naming conventions, DTA sets up a uniform framework that assures that all apparatus types, accessories, test plans, and test results can be accessed and analyzed universally.

To make it easy to comply with these rules when testing in the field, the DTA user interface has drop-down menus and pick lists. Automated electronic test plans reinforce standardized test methodology and test sequences for each apparatus type. In addition, DTA's Field System automates calculations required for older manual instruments.

For example, DTA applies a temperature correction factor for accurate comparison of test results, regardless of the ambient temperature when the tests were run.

What's more, the user receives a highly dependable conclusion about the condition of apparatus insulation, based on norms established by thousands of test results. DTA even tells the test technician about next steps, once the facts are in.

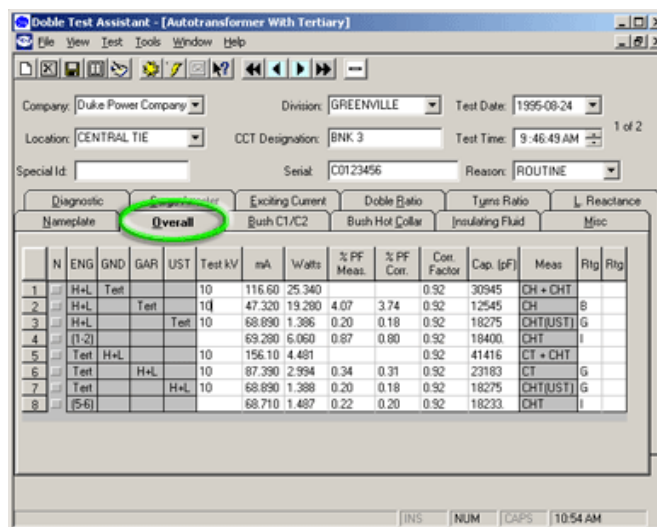
Once a questionable or unacceptable test result turns up, the DTA Field System lists recommended follow-up investigative procedures. DTA is recognized for its unique analysis, leveraging an expert system that incorporates over 3,700 rules derived from more than 10 million tests from Doble's master database. In effect, the DTA Field System provides the virtual presence of an engineering guide with over 80 years' experience.

That vast library of information continues to grow. Each year, thousands more test results are added to the master Doble Database, from which norms, rules, and expert help are formulated. Virtually no problem "stumps" the system.

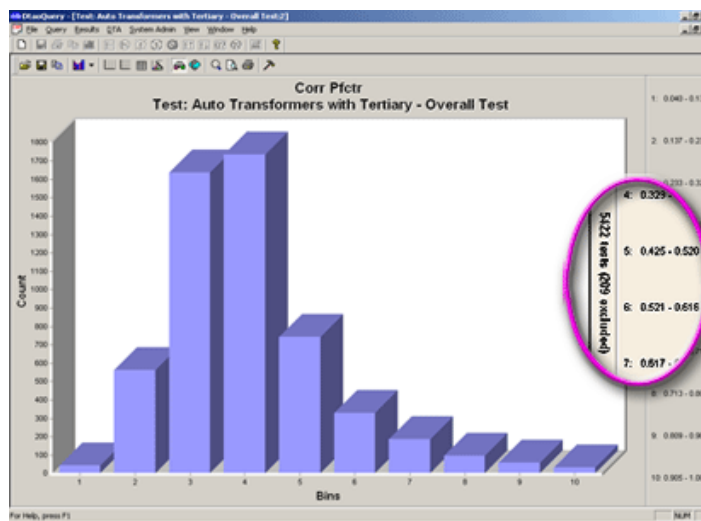
From Field to Office, DTA Power Multiplies

DTA's Office module provides a database into which all of the DTA Field data is loaded. In this database, records are structured by apparatus. The apparatus nameplate and all of the test history for the apparatus are located in one record. This provides ease of access for analysis, reporting, and maintenance scheduling.

Using DTA Office, engineering managers can compare multiple tests



When examining the test data for the transformer, the DTA expert system module can be invoked (mouse over) to provide help in the analysis of the data and recommended courses of action needed to be taken.



With DTA Office, engineering managers can query their database to reveal trends and distributions in their own data. If that sample is too limited, they can request Doble to query the entire master database for a particular apparatus. In this case, a particular transformer has over 5,200 valid data points.

DTA SNAPSHOT

Q: How long has DTA been in use?

over a period of time to distinguish emerging trends. Reports can be run on specific test results or the location of equipment.

This information supports proactive guidance of maintenance operations. More importantly, managers can minimize unplanned outages and maximize utility profits. This is where DTA literally pays.

While rules based on thousands of tests are necessary to diagnose an apparatus problem, rules alone are not sufficient to analyze a trend in multiple assets.

When results differ dramatically and your data is limited, how do you distinguish a trend from an aberration? To accomplish this task, access to a very large data sample is vital for any analysis to be statistically significant.

DTA is just as essential for the asset manager performing a trend analysis as it is for the field technician diagnosing an equipment problem. As part of the Doble Services Program, clients can ask their Doble Client Service Engineers to make queries on the master database, with its repository of results from over 10 million tests.

With DTA, engineering managers concerned about the way an apparatus is behaving can rest assured that an answer based on significant real-world data will always be readily available.

DTA has been in use for 14 years. It was first released on March 4, 1991.

Q: What are the latest versions of DTA?

DTA Field Version 5.1
DTA Office Version 4.3

Q: How do I get the new version?

All user companies may access updates via Doble's web site. Contact your client service engineer for a password.

Q: What makes DTA unique?

- Uniform test methods and measurements
- Data produced in a controlled manner by Doble's test equipment
- Rigorous rules for formats and naming
- Information easily compared against similar information from within the company
- Information comparable against results from similar tests from other companies
- Best-practice gains, via work with statistically larger, more viable samples



Please don't hesitate to share your thoughts on this article. Send your opinions and comments to: DobleExchange@doble.com

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[Front Page](#) |



Seminar Brain Drain


There's always some seminar beckoning you to attend. Frequent-flyer miles, however, are no way to decide which event to choose. Here's a guide that you and your team can use. That way, you ask the right questions to get the career-turner, not the time-burner.

You've heard all about it: The electric utility industry is facing a serious challenge when it comes to **knowledge**. The talent pool is shrinking: Fewer young electrical engineers enter the industry, while experienced personnel retire. How can you put a plug in that "brain drain"?

One way is through rigorous training. Seminars and symposiums are an excellent way to sharpen skills and keep your fingers on the pulse of the industry, but which events and training sessions should you and others in your company attend in 2005? How can you make the most of your training budget? And while you're doing the numbers, remember that the right decision is not just about travel expenses. The most significant cost might just be the time spent away from the office.

✓ Making it count

- Think of the three most beneficial industry events you ever attended. What made these events so worthwhile?
- What critical knowledge is leaving your company as key people retire?
- Which new projects now planned for 2005 will likely require new levels of knowledge and skills?

Exchange Reader Survey	
I prefer events that include trade shows.	<input type="radio"/> Yes <input type="radio"/> No <input checked="" type="radio"/> No Answer
I prefer seminars and symposia that focus on specific, single-topic training courses.	<input type="radio"/> Yes <input type="radio"/> No <input checked="" type="radio"/> No Answer
My training budget for 2005 has gone (up), (down), or (not changed) from last year.	<input type="radio"/> Up <input type="radio"/> Down <input checked="" type="radio"/> No Change
<input type="button" value="SUBMIT"/>	 Click for Current Tally

At the best events, attendees leave with knowledge they can immediately put to good use. That knowledge includes practical solutions that can be readily applied to their companies' concerns.

Tip: Look for events that offer a variety of topics relevant to you and your company, with event schedules that allow you to attend the key sessions.

Do your homework, before and after the event.

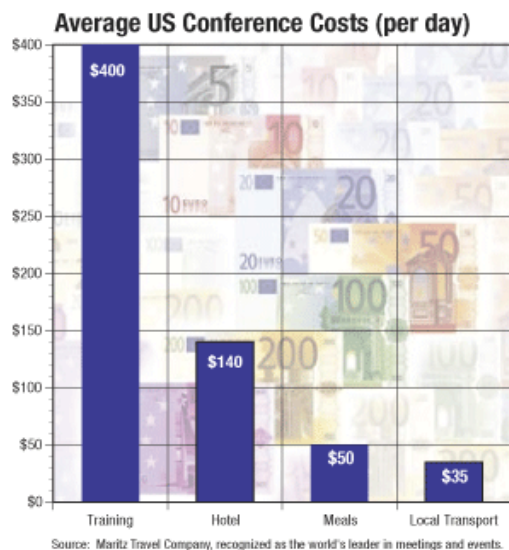
- Be prepared. What do you hope to gain from the experience?
- If you're a manager sending others, tell attendees what you expect them to gain. List anticipated learning outcomes. Make sure that the event will meet your objectives.
- If possible, submit questions in advance. That way, questions specific to your company's needs are addressed. Submitting advance questions also helps you to leverage the presenters' expertise.
- After the event, share the knowledge. Managers should arrange to have those who attended brief others in the company.

✓ Look for value-adds

Does the event offer additional benefits? Examples may include:

- Attendees gain educational credits, such as CEUs. These credits may be applied towards professional licensing and scholastic achievement, and are excellent motivators for personal advancement.
- The event provides opportunities for networking, which often turns out to be as beneficial as the presentations themselves. Make time to seek out presenters who especially draw your interest. Do you have a question that wasn't answered? Collect business cards so that you can stay in touch with colleagues for future consultation.
- The event enables you to conduct other business. Many events have a trade-show component. Even if you don't want to buy anything, these exhibits provide a learning showcase. Exhibitors are likely to be quite knowledgeable; you can use their expertise to your advantage.

✓ Is the price reasonable?



For a conference in the U.S., the average domestic flight costs \$325. On top of that will be conference fees, lodging, meals, and local transportation.

While registration and event fees are typically presented to attendees as a single lump sum, you can expect that total to be about \$400 for each full-day training session. That's roughly \$50 per hour.

Nationwide, the average daily hotel room cost is \$140 per night. Most companies also allot a \$50 per diem for meals. Some events, however, may offer meals as part of the registration fees. Finally, local transportation costs, whether for car rental or taxis, will on average add another \$35 per day toward the total.

Therefore, plan on a budget of \$625 a day plus the cost of a round-trip airline ticket. For a two-day event, that means a budget total of \$1,575. Bottom line: Attendees should take advantage of all that the event has to offer!

Which events will you attend in 2005?

One area gaining considerable attention these days is that of transformers. In this issue's article on [Doble Test Assistant](#), you'll discover findings by major insurance groups that carry sobering predictions. One insurance group predicts substation transformer failures will rise by 500% within 10 years. Another insurance-group study indicates that the operational life cycle of transformers is decreasing.

"[The Life of a Transformer](#)" seminar, Feb 21-25 in Laguna Beach, California, U.S., will provide in-depth knowledge on every aspect of large power transformers from cradle to grave. This 4.5-day seminar will be presented by 25 industry experts.

Now in its 72nd year and highly regarded as the premier industry event for electric utilities, [The International Conference of Doble Clients](#), April 10 – 15 in Boston, MA, U.S., will have over 75 technical presentations by utility engineers during this 4.5-day event. This event is offered free of charge to any Doble Client with a Services Agreement.

For more information, click on the [Doble events page](#).



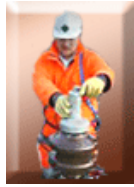
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How To Collect a Proper Oil Sample From Transformers

Techniques That Yield Accurate Data

Trying to assess the condition of electric apparatus? Oil samples must be properly taken to minimize contamination: Only then can you obtain accurate data. These instructions are intended for use with bottles and syringes in obtaining reliable oil samples in order to determine dissolved gases ([ASTM D 3612](#), IEC 60567), dissolved water ([ASTM D 1533](#), IEC 60814), and other oil-quality tests.

The following techniques should be helpful in obtaining samples either through the drain valve equipped with the appropriate reducing fittings and hose barb (recommended) or through the small sampling port that's usually mounted on the side of the apparatus drain valve.

SAMPLING PROCEDURE

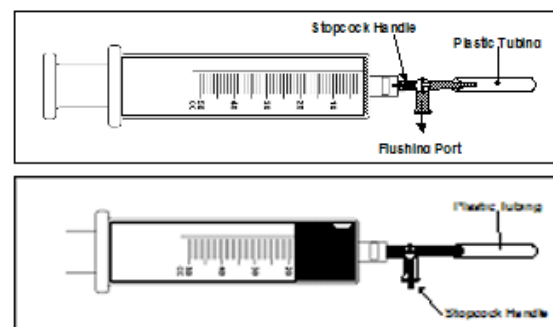
- The apparatus to be sampled must be under positive pressure.
- Clean the outside of the valve with a lint-free cloth.
- With the drain-valve plug removed, the valve through which the sample is to be taken should be thoroughly cleaned by whipping and then flushed, approximately 3 to 4 liters (quarts) of oil.
- With the plastic tubing connected to the drain valve or the small sampling port, adjust the valve for a gentle flow of oil through the tubing to minimize bubbles.

BOTTLES

- Rinse each bottle 3 times (using the oil you will be sampling) with 1/3 of the volume of the bottle to prepare the bottle, then fill glass bottles (with tubing) touching the inner wall of bottle to minimize mixing of air to within 1 inch (2.54 cm) to the top and close the bottle. Plastic and metal bottles can be filled to overflowing and then capped.

SYRINGES

- Connect the syringe to the tubing with the syringe stopcock open. This is to permit flushing of the stopcock (handle toward the syringe). **NOTE:** The handle of the plastic stopcock always points to the closed port leaving the other two ports in open communication. Make sure the syringe stopcock is firmly seated on the syringe before taking the sample.
- Turn the stopcock slowly to the open position (handle in line with the flushing port) and allow 30 to 40 cc (mL) of oil to enter the syringe. Immediately close the stopcock (handle toward the plastic tube) and turn the syringe in the vertical position.



[Click image to enlarge](#)

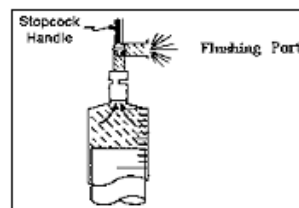
TAKE-AWAYS

- Valve through which the sample is taken should be thoroughly flushed.
- Always clean the outside of the valve with a lint-free cloth.
- The main drain valve is recommended for taking samples.
- The handle of the plastic stopcock always points to the closed port leaving the other two ports in open communication.

- With the syringe vertical (stopcock up, handle away from the syringe), eject any air bubbles and

carefully depress the syringe piston until all of the oil has been ejected from the syringe.

- Close the stopcock (handle toward the flushing port) and repeat this flushing procedure 2 to 3 more times before taking the actual sample.



[Click image to enlarge](#)

- To take the actual sample, open the stopcock (handle in line with flushing port) and allow oil pressure to push the piston back until the syringe is filled to approximately the 40-cc mark. Do not pull the piston manually since this can result in bubble formation. 50-cc syringes should be filled to approximately the 40-cc mark. 30-cc syringes should be filled to approximately the 25-cc mark.

- Close the stopcock and separate it from the tubing and inspect for air bubbles. If air is present, discharge the air immediately with the syringe vertical (stopcock up) and then close. If there are more than just a few air bubbles, empty the syringe and repeat the process until a proper sample has been taken. The filled syringe should contain no air, should be protected from light and packaged immediately. Bubbles may form after sampling, but do not attempt to remove these bubbles, as they are part of the sample.

- Fill out the Sample Identification information on the front of this form and return with the samples. Make sure to include the top oil temperature at the time of sampling.

RESOURCE KIT

Ensure accurate oil samples with the Doble Porta Sampler. The Doble Porta Sampler can be used to:

For more information on [oil sampling](#)
For more information on [test equipment](#)

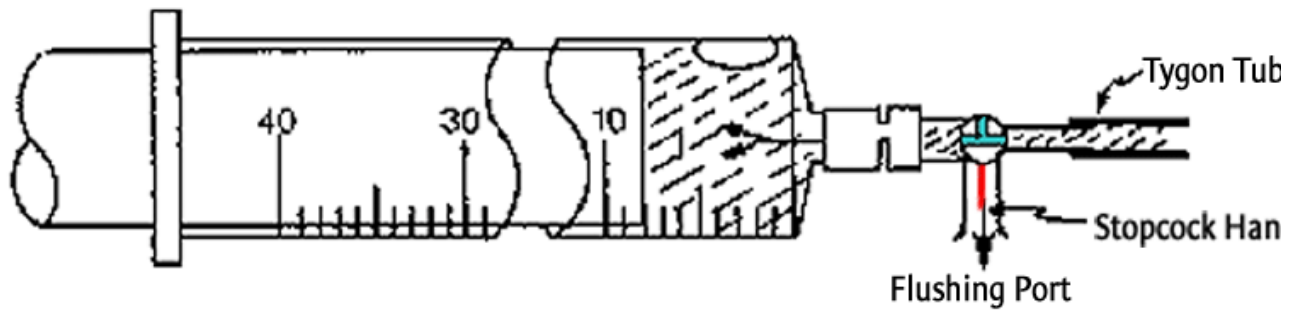
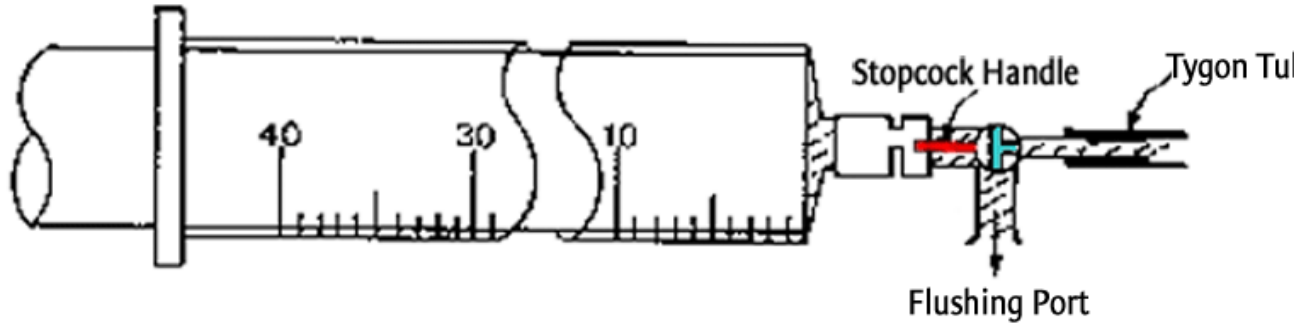
- tell when the valve has been adequately flushed
- determine the water content of the oil.

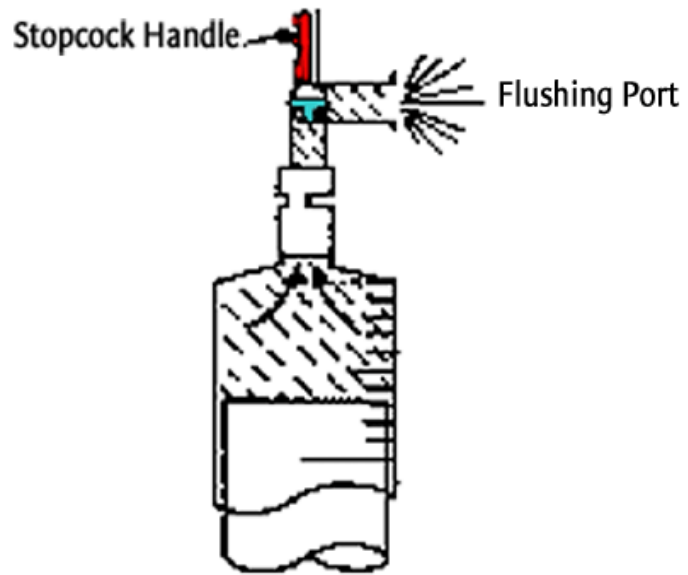


Please don't hesitate to share your thoughts on this article. Send your opinions and comments to: DobleExchange@doble.com. We are always interested in **Doble-Tested** case studies and field photographs from the Client Community. Please send these to DobleExchange@doble.com.

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Arc Flash: Safety Concerns

Arc-flash explosions are dangerous. Around high-voltage apparatus, "dangerous" can turn to catastrophic. It's essential to get up to speed on the latest news from regulatory agencies.

At the Fall Meetings of the Doble Client Committees in Vancouver, it's significant that no less than four of the technical committees had discussions about electrical arc-flash safety. Why the focus on arc flash? Its nature and aftermath speak for themselves.

An arc flash is a short circuit through the air. It occurs when insulation or isolation between electrified conductors is breached or can no longer withstand the applied voltage.



The flash is instantaneous. As electrical energy supplied to the arc is converted into intense thermal radiation, temperatures can reach around 1000°C (1832°F) and vaporize electrodes and metal components in the vicinity of the arc. The aftermath can be long and catastrophic for all involved as an arc flash can result in severe injury or death.

Further complicating matters, equipment failure is not the only cause for concern. Employees working with energized conductors or circuits can cause a phase-to-ground or a phase-to-phase fault through movement near or contact with an apparatus. An arc flash can result in severe injury or death.

Research has determined that, in the United States, an arc-flash explosion occurs in electric equipment between five and 10 times a day that sends the victim to a special burn center. For electric utilities, the costs of these incidents are staggering. A 1999 Electric Power Research Institute (EPRI) study pegged total direct and indirect costs at \$15.75 million per incident.

These arc-flash dangers are much on the minds of the utilities industry due to requirements recently established in the Occupational Safety & Health Administration (OSHA), the National Fire Protection Association (NFPA), and IEEE documents. What's more, NFPA and the IEEE in September announced the creation of an initiative to fund research and testing into arc-flash phenomena. This research will provide information to enhance electrical safety standards that predict the hazard and provide practical safeguards for employees in the workplace.

In the United States, workplace safety is governed by the U.S. Department of Labor's OSHA, which has adopted a consensus standard for electrical safety: This standard is the NFPA 70E, Standard for Electrical Safety in the Workplace, 2004 Edition. In addressing the electrical safety requirements needed to safeguard employees in the workplace, NFPA 70E requires a nine-step procedure, designed to protect personnel from the possibility of being injured by an arc flash. Along with tagging, testing for the presence of voltage, and safety grounding, utilities must perform a flash-hazard risk analysis before work can be performed on energized equipment. This risk assessment must be done in accordance with [OSHA 29 CFR 1910.132\(d\)\(1\)](#), which requires that employers select acceptable equipment and require employees to use appropriate personal protective equipment.

Training Is Critical

As part of the nine steps, employers must formalize procedures and practices, such as the qualification of employees to work in hazardous areas. The procedures must include tasks they may perform and steps needed to secure management's approval for work to be done. Employers must provide training for employees in the skills and techniques needed to work with electrical equipment, equipment details, and emergency procedures. Employees must then implement the practices according to the training.


Implementing NFPA requirements is an important but complicated task that requires considerable effort. Many of the utilities represented at the Doble Client Fall Meetings in Vancouver needed information on such matters especially with regard to regulatory issues. Who is responsible for making sure the safety concerns are implemented? What hardware and protective clothing are required?

When it comes to calculation methods for determining the incident energy level to which a worker could be exposed in calories/cm², NFPA 70E offers the same incident energy-level equations that appear in IEEE Std. 1584, but doesn't specify that the IEEE Std. 1584 method has to be used. The incident energy level could be determined using one of the several arc-flash software programs currently available.

The Duke Power Heat Flux Calculator is a free Windows software program created by Alan Privette of Duke Power. The program calculates the heat flux received at a surface some distance from an electric arc in calories per square centimeter. A free copy can be downloaded from the [Electrical & Utilities Safety Association](#) (EUSA), which is Ontario's oldest health and safety association.

Due to a show of considerable interest in the topic of arc flash, Doble is planning to organize a tutorial on the subject at the Fall meetings this year. In turn, your feedback would be most helpful. Please take a moment to answer the questions in the accompanying Exchange Reader Survey.

Also, if you know of any individuals who are experts on the subject of arc flash, please send an email to: DobleExchange@doble.com with their name and contact information.

Exchange Reader Survey	
Would you be interested in a tutorial about arc flash?	<input type="radio"/> Yes <input type="radio"/> No <input checked="" type="radio"/> No Answer
Has your company established a program to implement the requirements for arc flash?	<input type="radio"/> Yes <input type="radio"/> No <input checked="" type="radio"/> No Answer
Have you used outside contractors to implement arc-flash safety requirements?	<input type="radio"/> Yes <input type="radio"/> No <input checked="" type="radio"/> No Answer
<input type="button" value="SUBMIT"/>	 Click for Current Tally



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Exchange Then and Now

The return of Doble Exchange - looking back 25 years since the launch of the first issue.

Welcome to the premiere issue of the *new Doble Exchange!* **Doble Exchange** was first issued in January 1983—Ronald Reagan was enjoying his first term of office...the cost of a first class stamp was 20 cents...more than 125 million viewers had tuned in to see their last episode of *M*A*S*H*...the consumer marketplace was being introduced to their first noise-free compact discs ...*Gandhi* was named Best Picture...and the record of the year was "Rosanna" by Toto.

Through the years you came to know the Doble Exchange as a vehicle for exchanging ideas and information on the maintenance of electrical power systems. Probably most memorable were the "Notes from Bill McNutt." Talk about cut-to-the-chase useful information. In one issue of **Doble Exchange**, Bill discussed Transformer Drying. He took on the on-the-job situations that really mattered to readers, answering questions such as "How dry can you get the insulation?" "How fast can the insulation be dried?" and "How do I know when the insulation is dry?"

Hundreds of topics have been discussed in past issues including: Transformer Audible Noise, Conductor Hot Spot Temperature Limits, Tank Rupture from Internal Faults, Anomalous Failures of Transformers, Lower Dielectric Loss Measured in New Metal Oxide Surge Arresters, Relaying Operations, and Maintenance. In 1987, a discussion began on test methods and results for SF6 Puffer-Type Circuit Breakers. Maintenance practices that became popular in the 90's including Reliability Centered Maintenance (RCM) and Condition Based Maintenance (CBM) were discussed in multiple issues of Doble Exchange.

The new **Doble Exchange** is going to continue that tradition. We're committed to bringing you the kind of information you depend on from Doble. You'll read about manufacturer-service advisories, safety issues, testing tips, Client Committee updates, and technical briefings.

To make sure you land in easily navigable territory, each issue will have a **Feature Article**: This issue read all about the Fall Meetings in Vancouver. We will also carry a **Technical Briefing**: this issue, discover the value of Doble Test Assistant. We'll have something for all interests, too, with our regular "Knowledge Exchange" columns. These include **Power Trends**, which is a brief issues-and-trends item of interest to Doble clients, and **Doble Tested**, which will be a client case study or a testing tip. Be sure to read this issue's Doble Tested column for advice and guidelines you can use to draw proper oil samples. **Safety Matters** is the section to access for informative reports on safety-related topics and safety issues affecting your organization and job.

"Exchange" is the operative word!

It's the last word of **Doble Exchange**. Make this newsletter be what you need it to be by contributing your ideas and requests. If you have a story to tell, an experience to share, or just a comment, simply e-mail us at DobleExchange@doble.com.

Doble is the information broker you can trust and turn to for advice. In that spirit, we truly look forward to making **Doble Exchange** a community forum, for exchanging ideas and information.

And feel free to forward **Doble Exchange** to your company colleagues. They can easily sign up too by visiting our home page and clicking on "Subscribe to Doble Exchange."

Enjoy!

Wayne A. Bishop Jr.
Managing Editor