www.alfanartechnicalservices.com

alfanar technical services

PO Box-35388, Jubail Industrial City - 31961, Kingdom of Saudi Arabia
Phone : +966 13 341 8777 | Mobile: +966 50 494 3042 | Fax : +966 13 341 5639
E-mail : atsjubail@alfanar.com

alfanar technical services

GENERATOR SERVICES

Repair :: Rebuild :: Refurbish :: Rewind
Condition and Life Assessment

At alfanar Technical Services (ATS), our Mission is to sustain our prominence as the provider of high-quality, precision-engineered repair and rewind services for all types of medium and high voltage static and rotating equipment like Transformers, Motors and Generators. ATS also manufactures Magnet Wires, Insulated Conductors and Preformed Coils for various electrical applications including medium and high voltage electrical equipments.

The use of modern technology in our factory at Jubail, Saudi Arabia, and the years of practical experience has enabled us to offer a wide array of engineering, technical services and logistical resources catering to the needs of our customers in the power, petrochemical and manufacturing sectors in the middle east region.

Our unique edge is in our conformance to international standards on quality by extending an as-new warranty for the repair works done at ATS.

alfanar Technical Services is a specialised unit of alfanar Engineering Services that provides solutions in testing & commissioning, steel fabrication, operation and maintenance, equipment calibration and technical training institute.

Highly qualified and experienced professionals ensure that a reliable and quality service is provided to all our customers.

The Generator division of ATS provides comprehensive maintenance support including rewinding, repairing and overhauling works for all kinds of Generators and Turbines ranging from 5 to 1200 MVA. Furthermore, the division also has the expertise to work on Boilers, Turbines, Pumps, Condenser & Heat Exchangers.

These facilities are equipped with up-to-date technology and our skilled personnel are highly experienced, to guarantee our clients a repair and overhaul service for their equipment of an extremely high quality.

We have technical support and supply agreement with most of the manufacturers and also provide expertise for planning and supervision of machining and refurbishing activities.

ATS is now Middle East's only SEC qualified facility to repair 1200 MVA Generators

With a best in the class facility and a team with strong technical prowess, alfanar Technical Services' has maintained its prominence as the leader in providing reengineering services to clients across the MENA region.

In yet another recognition, ATS has now been qualified to provide repair, maintenance, rewinding and testing for Generators upto the capacity of 1200 MVA. With this qualification, ATS will be the only facility in the entire Middle East capable of providing such solutions in coordination with its partner workshop National Electric Coil, USA.

The qualification will also allow ATS to provide solutions both on site and in the workshop for Generator stators and rotors.

MAINTENANCE SOLUTIONS

Maximize availability and reliability

Condition Assessment

ATS offers a complete range of test and inspection solutions for generators including life assessment and provide failure investigation and recommendation too. The test and inspection performed are linked to GAP - a solution for lifetime assessment of generators. GAP in turn is linked to the planned outage of the plant to maximize generator availability.

Refurbishment

Our refurbishment service includes minor & major overhaul, generator dismantling & reassembly, test & inspection, corona suppression treatment, stator re-wedging, generator auxiliaries, etc. Most of the refurbishment activities are performed on-site.

Repair and Spare Parts

Our solutions for minor and major repairs for generators include, part winding repairs, supply of bars, stator rewind, rotor rewind, retaining ring replacement, high speed balancing, etc. Stator rewind and retaining ring insulation replacement can be performed on-site.

Spare Parts

Moreover, ATS can also supply all the spare parts for generator like bearing, hydrogen seal, gas cooler, slip-ring, carbon brush, diode, fuse, etc.

CUSTOMERS

- Alstom Power
- Ansaldo Energia
- CEGCO Jordan
- Garri Power Plant, Sudan
- GE Energy
- GE Energy, UAE/Qatar
- Hitachi, Japan
- MARAFIQ
- Mass Global, Iraq
- SABIC Group
- Saudi Electricity Company
- Saline Water Conversion Corp

MAINTENANCE SOLUTIONS
Maximize availability and reliability

Alfanar generator maintenance solutions ranges from basic recondition to complete rebuilds both in-house as well as on-site. A brief description of maintenance solutions offered is given below.

Stator service includes

- Stator partial rewind
- Stator complete rewind
- Stator re-wedging
- Stator core re-stacking
- End turns repair
- Bar abrasion repair
- Corona suppression
- Bolt tightening
- HV bushing change outs

Rotor service includes

- Rewind with old copper
- Rewind with new copper
- Rotor wedge replacement
- Retaining ring removal
- RR insulation replacement
- Replacement of main leads
- Winding distortion repair
- Low speed balancing
- High speed balancing

Generator testing includes

- Stator DC electrical test
- Stator AC electrical test
- Stator mechanical test
- Stator core electrical test
- Stator core mechanical test
- Rotor DC electrical test
- Rotor AC electrical test
- Exciter test and inspection
- Accessories integrity check

Generator field service include

- Disassembly and inspection
- Condition evaluation
- NDE of components
- Testing and inspection
- Outage management
- Cryogenic decontamination
- Infrared thermography

Exciter service include

- Test and inspection
- Condition evaluation
- Repair and refurbish
- Rewinding
- Diode integrity check
- Fuse integrity check
- Capacitor integrity check

Spare parts supply include

- Collector rings
- Bearings
- Gas coolers
- Carbon brushes
- Stator bars
- Retaining rings
- Winding kit

Alfanar also offers a comprehensive maintenance services for mechanical equipment's like turbines, compressors, pumps, diesel engines like capital overhauling, refurbishment, balancing, dry ice cleaning and more.

Please contact us for more details.

GAP

GENERATOR ASSESSMENT PROCESS

a solution to lifetime assessment of generators

The life of a generator is mainly dependent on the life of its insulation. Therefore the aging process of the generator has to be very closely monitored. Just like the pulse rate, the blood pressure, sugar level etc., of a human are indicative of his health condition, the capacitance, leakage current, dissipation factor, polarization index, surge voltage with standing strength and partial discharge factors are indicative of the insulation condition of an electric rotating machine.

Estimation of the remaining life of a generator is based on the following information:

- The life history of the generator
- A diagnostic evaluation of the generator's condition
- The operation mode planned in the future

On an average, the lifetime of the stator and rotor winding of a base loaded generator is about 35 and 25 years respectively. The lifetime will get reduced due to peak load or abnormal operating conditions. Other factors, such as, insulation abrasion, loose end-windings support and contamination may reduce the lifetime expectancy even more.

alfanar Technical Services now offers GAP - a solution to lifetime assessment of generators - addresses the problems faced during the lifetime of a generator with an aim of increasing reliability and availability. Moreover, GAP is designed to perform generator assessment linked to the planned outage of the plant and thereby minimizing downtime.

The past study and experience has shown that the availability of generator is determined largely by stator winding system, and thereby GAP methodology focus more on the stator winding compared to the rotor and other parts of the generator.

WHY ASSESSMENT ?

Sudden breakdown of the stator winding in a generator under operation can result in significant financial losses to utilities due to unplanned downtime. Failures in generator stator windings occur as a result of insulation deterioration initiated by voids created in the insulation material from the combined effects of TEAM - Thermal, Electrical, Ambient and Mechanical - of stresses during long-term operation. Therefore, GAP analyze deterioration characteristics and, ultimately, to use the analysis results for evaluating the insulation condition and remaining life of the generators.

GAP
GENERATOR ASSESSMENT PROCESS
a solution to lifetime assessment of generators

CONDITION ASSESSMENT

The generator is a critical component in the powertrain of a power plant. A failure of the generator can result in an extended outage and extensive repairs. Failure or degradation of other generator components may result in operation at reduced output or may result in catastrophic failure. While operation with a degraded condition such as aged insulation, cooler leaks or cracked structural components may continue undetected, a thorough Condition Assessment may avert a costly forced outage and can be used to justify upgrades and improvements.

Alfanar offers a wide range of services for large generators to customers in Middle East, to help ensure availability and reliability. Condition assessment of large generators is one such offering that is performed based on a well-defined methodology to help understand the actual condition. The knowledge of generator condition can prevent unscheduled outages, unplanned repair and availability. The benefits are

- Improve maintenance, outage planning and scheduling
- Identify critical spare parts and repair
- Establish base-line condition
- Reduce O&M cost
- Identify potential performance improvements

For generator condition assessment, it is recognized that the physical condition cannot be properly and sufficiently evaluated based on the visual inspections only while the results from some routine or available tests are more critical as indication of generator condition. The following eight condition parameters are considered for condition assessment of generator and generator parts:

- The Visual Condition
- The Age
- The Installed Technology Level
- The Operating Restrictions
- Stator Electrical Tests
- Rotor Electrical Tests
- Stator Core Tests
- The Maintenance Requirement

The condition of generator is assessed in an index scale of 0 to 10 based on the above eight condition parameters. Further recommended actions are given divided into three zones of severity level – low, medium and high- and condition index in seven levels among the three zones to get an appropriate evaluation about the condition of the generator and its suitability to continue in operation.

Condition index scales and recommended actions are given in the below Table.

Condition Assessment

Code	Zone	Condition Index	Condition Description	Recommended Action
●	1	8.50 to 10.00	**Excellent:** No noticeable defects. Some ageing or wear may be visible	Immediate action is not required
●		7.00 to 8.49	**Good:** Only minor deterioration or defects are evident	
●	2	5.50 to 6.99	**Fair:** Some deterioration or defects are evident, but function is not significantly affected	Economic analysis of repair alternatives is recommended to determine appropriate action
●		4.00 to 5.49	**Marginal:** Moderate deterioration. Function is still adequate.	
●	3	2.50 to 3.99	**Poor:** Serious deterioration in at least some portions of the structure. Function is inadequate	Detailed evaluation is required to determine the need for repair, rehabilitation or reconstruction. Safety evaluation is recommended
●		1.00 to 2.49	**Very Poor:** Extensive deterioration. Barely functional	
●		0.00 to 0.99	**Failed:** No longer functions. General failure or complete failure of a major structural component	

4 LEVELS OF GENERATOR ASSESSMENT PROCESS

GAP1 : 1-2 Days on-line Assessment

Assessment based on historical, maintenance and operational data and of similar units. Perform thermal life assessment

GAP2 : 2-3 Days Assessment

GAP1 assessment with diagnostic tests in assembled condition. Assess healthiness of stator and rotor windings and perform diagnostic life assessment.

GAP3 : 4-6 Days Assessment

GAP1 and GAP2 assessment with rotor-in and partial dismantling. Perform visual examination and tests to the extent feasible. Life estimation

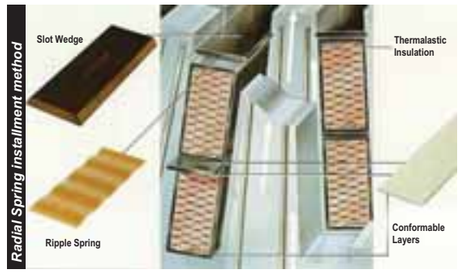
GAP4 : 5-7 Days Assessment

GAP1 and GAP2 assessments with rotor-out. Perform ELCID, wedge tightness, bump, corona and other special tests. Perform condition and life assessment.

Planned Outage

Reference

- SEC Tabuk Power Plant 2
- SEC Duba Power Plant
- SEC AL Wajh Power Plant
- SEC Makkah Power Plant
- SEC Juba Power Plant
- SWCC Jubail Power Plant
- MARAFIQ Yanbu Power Plant
- Mass Global, Iraq-Kurdistan
- SABIC - SAUDI KAYAN
- SABIC - SAFCO
- SABIC - IBN AL-BAYTAR



GAP
GENERATOR ASSESSMENT PROCESS
a solution to lifetime assessment of generators

GAP1
A desktop top running assessment based on historic and operational data

Tests and Inspection Performed
- Hot walk down survey
- Survey of similar units
- Operational and thermal profile
- Maintenance history
- Historical data
- OEM manual and other documents
- Past test and inspection data
- Discussion with Plant Engineers

Outage
- No outage
- Usually 1 – 2 days

Benefits
- Identify imminent problems
- Prep for planned outage
- Pre- and -post outage benchmarks
- Establishes a baseline for next inspection
- Remnant life based on thermal profile

Report
- PDF format provided electronically
- Life assessment on historic data
- Recommended maintenance plan
- Final report within 1 – 2 weeks

GAP2
This assessment process is designed to fit in a short turbine outage window

Tests and Inspection Performed
- In addition to GAP1
- Cold walk down survey
- Stator winding AC & DC electrical test
- Rotor winding AC & DC electrical test
- Exciter winding AC & DC electrical test
- Generator accessories integrity check

Outage
- Outage linked with minor inspection
- Usually 2 – 3 days

Benefits
- Reveals pending faults in windings
- Reveals deterioration of coil insulation
- Remnant life based on thermal profile
- Remnant life based on diagnostic tests

Report
- PDF format provided electronically
- Graphs and analysis
- Summary of all test and inspection
- Condition index in FOUR color format
- Any anomalies reported immediately
- Final report within 2 – 3 weeks
- Life assessment based on historic data
- Life assessment based on diagnosis

GAP3
This assessment is designed to fit into a major turbine outage window with rotor threaded-in

Tests and Inspection Performed
- In addition to GAP1 and GAP2
- Visual examination
- Other as appropriate

Outage
- Outage linked with major inspection
- Usually 4 – 6 days

Benefits
- Remnant life based on thermal profile
- Remnant life based on diagnostic test

Report
- PDF format provided electronically
- Phot0graphs of critical areas
- Graphs and analysis
- Summary of all test and inspection
- Condition index in FOUR color format
- Any anomalies reported immediately
- Final report within 3 – 4 weeks
- Life assessment based on historic data
- Life assessment based on diagnosis

GAP4
This assessment is designed to fit into a major turbine outage window with rotor threaded-out

Tests and Inspection Performed
- In addition to GAP 1 and GAP2
- Stator winding mechanical test
- Stator core electrical & mechanical test
- Exciter test & inspection

Outage
- Outage linked with major inspection
- Usually 5 – 7 days

Benefits
- Remnant life based on thermal profile
- Remnant life based on diagnostic test

Report
- PDF format provided electronically
- Phot0graphs of critical areas
- Graphs and analysis
- Summary of all test and inspection
- Condition index in FOUR color format
- Any anomalies reported immediately
- Final report within 3 – 4
- Life assessment based on historic data
- Life assessment based on diagnosis

TEST & INSPECTION

You ask, we do it!

Unscheduled plant stoppages, whether caused by technical or human factors, result in loss of profitability. Generators and components that have reached end-of life status cannot continue safe and reliable operation - preventive maintenance actions and well-thought out asset management are keys to productive uptime and safety for people and the environment.

alfanar offers a wide variety of test and inspection services that help to manage and optimize the life cycle of your generators. Together with our customers we can plan the best way to carry out test and inspection to get the following benefits:

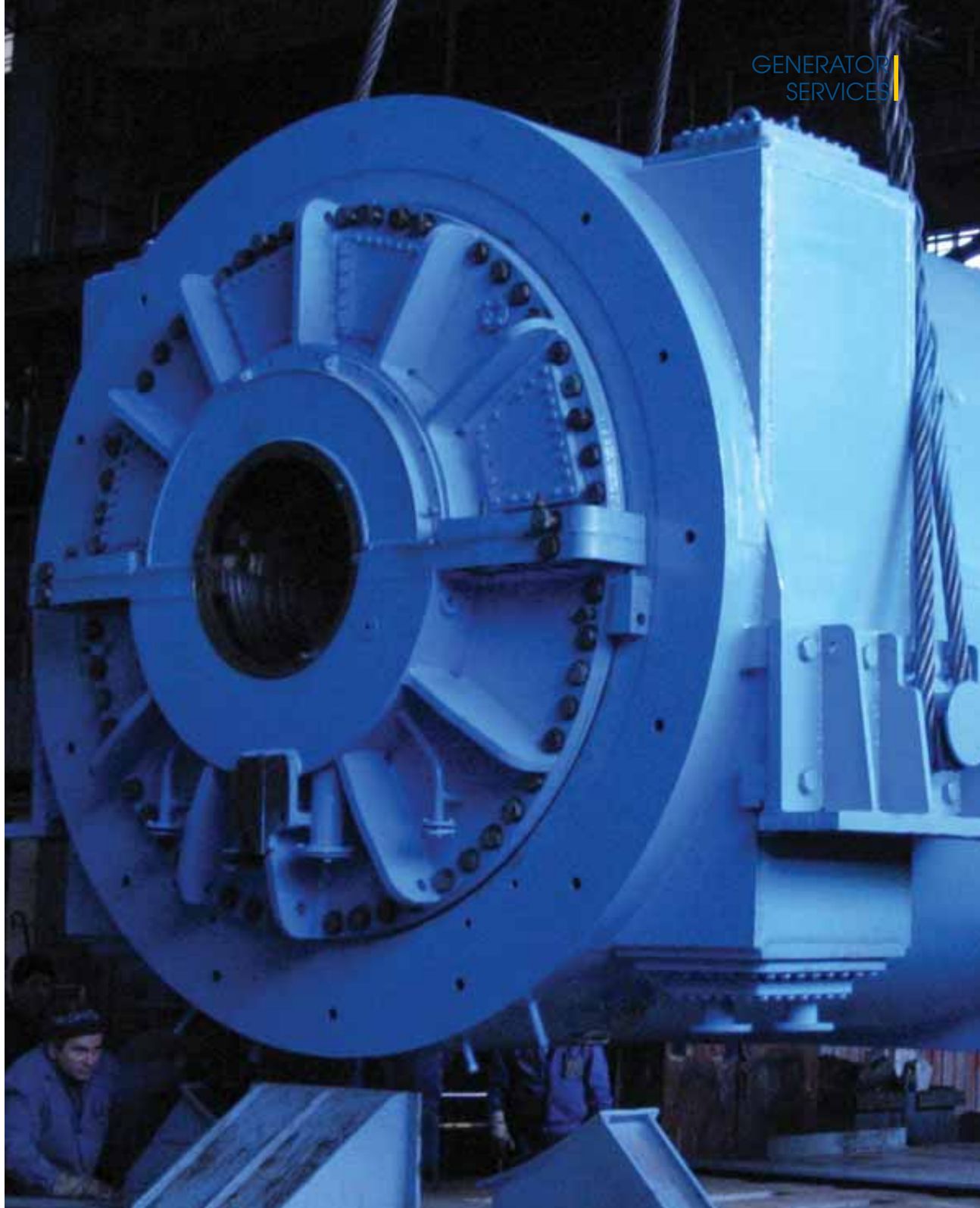
1. Increase availability and reliability
2. Increase profitability by less unplanned downtime and minimal interruptions
3. Enhance safety
4. Gives you accurate information for maintenance plans and actions
5. Evaluate the condition of your generator and its componenets, identifies most critical parts
6. Helps you to manage assets more efficiently
7. Prevents accidents that can harm people and the environment

In the field of generator testing no single test has yet been discovered which would permit an overall evaluation of insulation condition. There are, however, a number of suitable tests which help evaluate specific properties or insulation componenets.

In applying any of these tests to a composite maintenance inspection program, the following criteria should be carefully considered:

1. The tests applied must be capable of discerning insulation weakness. The adoption of tests at too low a level is entirely misleading, as their results tend to inspire a confidence which may not be justified. Any test which does not stress the insulation at more than service potential is a waste of time and money.
2. Tests should have a direct reference to service experience. If one particular property of an insulation system has been found to be suspect, then tests which seek out this weakness should be performed.

Alfanar has extensive experience in performing condition and life assessment on motors, generators and transformers in Middle East region and work together with the customer to ensure availability and reliability of the electrical machines.



TEST & INSPECTION

You ask, we do it!

Stator Winding DC Electrical Test

- Insulation resistance test
- Dielectric absorption ratio
- Polarization index
- Dielectric discharge
- Insulation resistance prolife
- Polarization depolarization
- Insulation diagnostic analysis
- High voltage test
- Step voltage test
- Leakage current test
- Ramp test
- Coupling resistance test
- Tube-to-copper resistance
- Tube-to-tube resistance test
- Tube-to-resistor resistance
- Stator coil transposition test
- Capacitance mapping
- Surface potential test
- Winding resistance test

Stator Winding AC Electrical Test

- Capacitance test
- Capacitance yip-up test
- Tan delta test
- Tan delta tip-up test
- Nonlinear behavior of insulation
- AC current test
- AC current tip-up test
- Partial discharge test
- Corona probe test
- Surge comparison test
- AC impedance test
- AC high voltage test
- Stator black out test

Stator Winding Mechanical Test

- Visual examination
- Wedge tightness detection test
- Ripple spring compression test
- Frequency response test
- Reciprocity test
- Modal analysis
- Tube-to-tube pressure drop test
- Slot side clearance test
- Slot radial clearance test
- Stator pressure/vacuum decay
- Ionization test

Stator Core Electrical Test

- ELCID test
- Rated flux test
- Core loss test
- Stator thru' bolt IR test
- IR of flux screen

Stator Core Mechanical Test

- Visual examination
- Knife test
- Core tightness test
- Core and frame vibration test

Rotor Winding DC Electrical Test

- Insulation resistance test
- Dielectric absorption ratio
- Polarization index
- Dielectric discharge
- Insulation resistance prolife
- Polarization depolarization
- RSO test
- High voltage test
- Winding resistance test

Rotor Winding AC Electrical Test

- Rotor impedance test
- Pole balance test
- Voltage drop test
- Growler test
- Split voltage test
- High voltage test

Rotor Winding Mechanical Test

- Visual examination
- Rotor bore pressure drop test
- Nondestructive test

Exciter Stator Test

- Visual examination
- Insulation resistance test
- Dielectric absorption ratio
- Polarization index
- Dielectric discharge
- Insulation resistance prolife
- AC impedance test
- Winding resistance test

Exciter Rotor Test

- Visual examination
- Insulation resistance test
- Dielectric absorption ratio
- Polarization index
- Dielectric discharge
- Insulation resistance prolife
- AC impedance test
- Winding resistance test

PMG Test

- Visual examination
- Insulation resistance test
- Dielectric absorption ratio
- Winding resistance test

Rotating Bridge test

- Visual examination
- Diode integrity test
- Fuse integrity test
- Capacitor integrity test

RTD Test

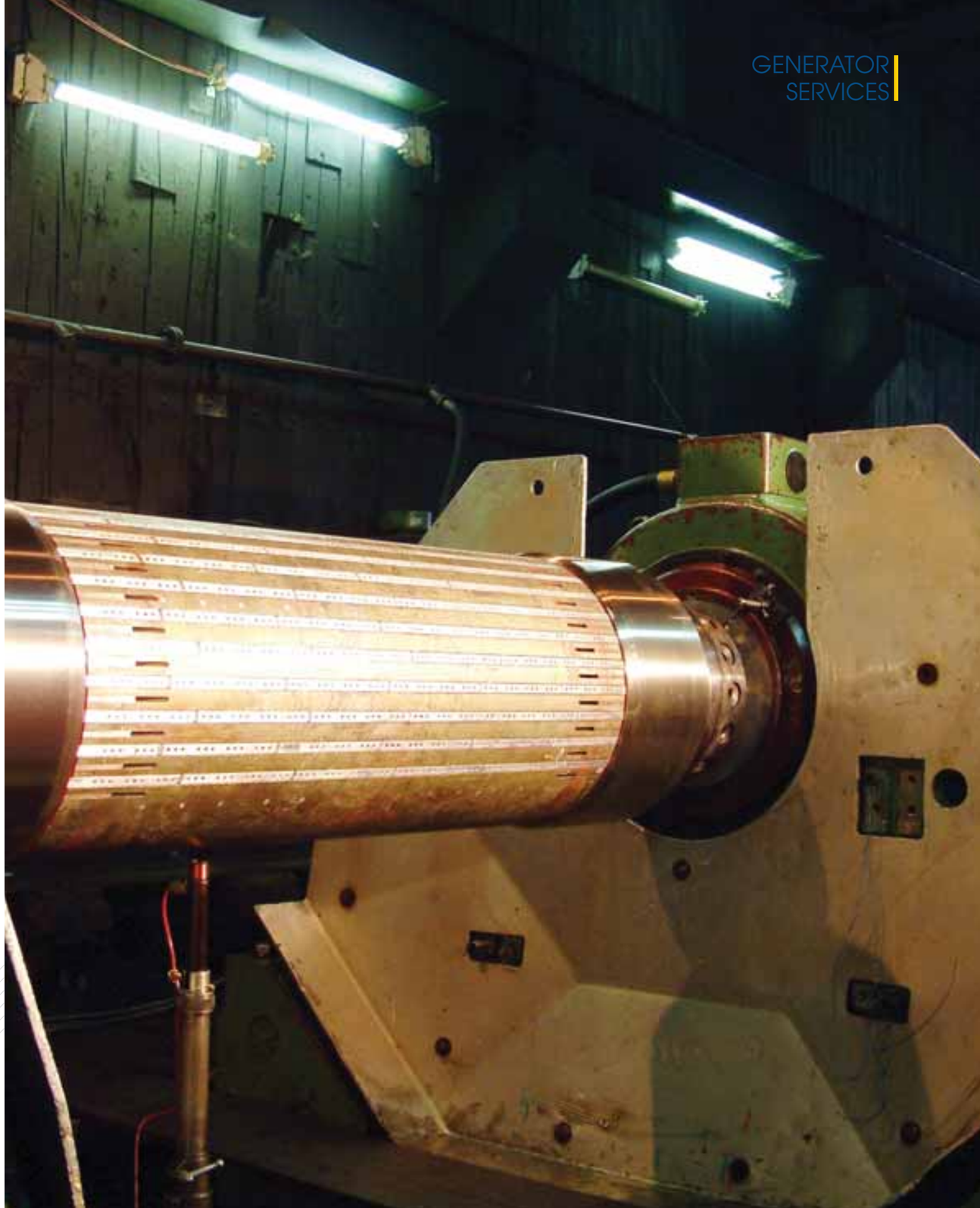
- Visual examination
- Insulation resistance test
- Resistance test
- Continuity test

Space Heater Test

- Visual examination
- Insulation resistance test
- Resistance test

Mechanical Test

- Visual examination
- Nondestructive test
- Dimensional check
- Bearing clearance check
- Hydrogen leak test
- Hydrogen cooler test & inspection



DRY ICE CLEANING

A Better Cleaning Methods

Dry Ice Blasting

Dry ice blasting is a relatively new cleaning process using solid CO_2 pellets. The pellets sublimate (convert directly from a solid blast pellet to a vapor) leaving no residue. The process has grown considerably in popularity as a replacement for common sand blasting, largely due to its environmental and production benefits.

What is dry ice?

Dry ice pellets are made by taking liquid carbon dioxide from a pressurized storage tank and expanding it at ambient pressure to produce snow. The snow is then compressed with a die to make hard pellets.

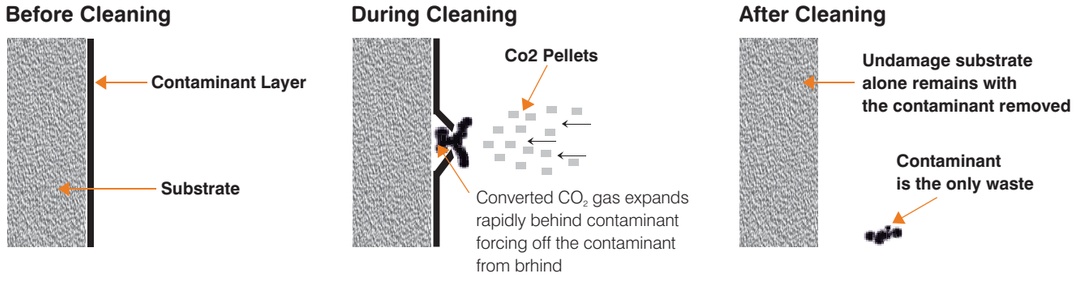
The process

With the dry ice blasting process, CO_2 particles are propelled at supersonic speed, impacting and thus cleaning a given surface. The particles are accelerated by compressed air, just as with other blasting methods. There are three specific steps involved in dry ice blasting.

Benefits

- Decreased downtime through cleaning in-place
- Faster and more thorough cleaning
- Elimination of equipment damage
- Reduction or elimination of solvents
- Reduction in waste disposal
- Increased safety

Cleaning Process



Blast Cleaning Comparison Chart

Blasting Cleaning Technique	Waste for Disposal	Abrasive	Toxic	Electrically Conductive	Performance Comparison
Dry Ice	**No**	**No**	**No**	**No**	**Excellent**
Sand	Yes	Yes	No*	No	OK
Glass Beads	Yes	Yes	No*	No	OK
Walnut Shells	Yes	Yes	No*	No	Limited
Steam	No	No	No	Yes	Poor
Solvents	Yes	No	Yes	Yes	Limited

** Each of these blast cleaning materials becomes contaminated upon contact if used to clean hazardous objects. When that happens, these materials are then classified as toxic waste requiring safe disposal.*

Dry Ice Blasting - A General Comparison Chart

ISSUE	TRADITIONAL	DRY ICE BLASTING
Equipment Downtime	Cleaned in dedicated cleaning area: Disassembly/reassembly; Drying time requiredce	Equipment can be cleaned in place; Dry process - equipment restart immediately after cleaning
Hazardous Waste	Cleaner becomes and treated as a secondary contaminant	No additional contaminant; Dry ice sublimates with contact with targeted surface
Labor Hours	Intensive hand scrubbing; Lengthy cleanings; Follow-up cleaning-up can be lengthy	Dramatically reduced - often completed in a quarter of the time or better
Quality of Cleaning	Poor to average	No equipment damage; Preventive maintenance very realistic as labor hours are significantly less
Potential Equipment Damage	Grit abrasions; Grit contamination; Movement of equipment to and from cleaning area	Excellent
Safety	Health threats from solvents; Water-based cleaning pose hazards around electrical equipment; Threats to environment	Standard safety precautions; Dry process - safe around electrical equipment
Cost	Cleaner becomes additional hazardous waste; Expensive solvents; Additional labor	Minimal - cost of dry ice

CO_2 BLASTING BENEFITS

Co_2 blasting benefits can be broken down into six general areas. Following each benefit is discussed:

Benefit #1 - Decreased Downtime through Cleaning In-Place

Typical cleaning procedures require that equipment be disassembled and moved to an assigned area for proper cleaning. That is not the case with CO_2 blast cleaning. Equipment can be cleaned in-place and hot in most situations. Because of that, many time-consuming, labor-intensive steps which were required with other methods such as sand blasting can be eliminated including:

- Cool down
- Disassembly
- Transport of the equipment to and from a dedicated cleaning area
- Reassembly
- Reheating time
- CO2 blasting can shorten the downtime for cleaning from days down to hours.

Benefit #2 - Faster and More Thorough Cleaning

With CO_2 blast cleaning, a superior clean can be achieved while reducing hours when compared to scrubbing with abrasive pads or wire brushes. A tremendous labor savings is accomplished. In addition, the dry ice blast method cleans in crevices that can't be reached by hand. As a result, equipment runs more efficiently and potential leaks are revealed possibly preventing major system failures.

Benefit #3 - Elimination of Equipment Damage

Cleaning methods such as sandblasting leave an aggressive and abrasive effect on the surface. hey can actually remove part of the surface, changing the surface structure considerably. CO_2 is on-abrasive to surfaces and does not change a surface's structure. It lifts the contaminants away. Secondly, because equipment can now be cleaned in place, potential damage from moving equipment to and from a dedicated cleaning area is eliminated.

Benefit #4 - Reduction or Elimination of Solvents

No solvents are used when using dry ice pellets. This can be a critical need for certain companies in order to comply with environmental regulations or to improve worker safety. There are no issues pertaining to toxicity.

Benefit #5 - Reductions in Waste Disposal

With other cleaning methods, whether it be with solvents, sand blasting or some other means, the cleaning agent becomes a secondary contaminant and must be disposed of as toxic waste along with the primary contaminant. However, with CO_2 blast cleaning because the dry ice pellet vaporizes upon contact, the only waste created is the contaminant itself. This alone can result in significant waste reduction.

Benefit #6 - Increased Safety

Dry ice blasting pellets are non-toxic, non-hazardous creating advantages to the environment, your employees, and production facility:

- No secondary waste
- Safe for the environment
- Safe for employees
- Safe for end products
- Safe for equipment

CLEANING SOLUTIONS: ELECTRIC MOTOR WINDINGS

Since CO_2 blasting provides moisture less cleaning, servicing electrical equipment has tremendous advantages. From electric motors, various contaminants can be removed from:

- Housings
- Stators
- Wiring
- Windings

Electric Motors: Three Methods for Cleaning in Place

1. Pressure washing and/or steam cleaning

- This method can be successful in thoroughly cleaning electric motor windings in place.
- This method requires a fairly time consuming process to dry the windings sufficiently.
- Depending on the size of the windings, it can take days or weeks to thoroughly dry the windings.
- Care must be taken to not exceed 200 Deg. F when drying out.
- If the windings are not thoroughly rinsed, the soap residue can serve as a contaminant and cause premature loss of insulation integrity.
- The washing solution must be disposed of properly.

2. Solvent based cleaning

- This method also can be successful in thoroughly cleaning electric motor windings in place.
- The drying time is considerably quicker than the pressure washing method. Sometimes hours.
- Care must be taken that the person applying the solvent not be overcome by fumes.
- Care must be taken that others in the vicinity are not adversely effected by solvent fumes.
- Care must be exercised around rubber products, especially rubber based lead wires.
- The solvent solution must be disposed of properly. Improper disposal can result in significant environmental consequences.

3. Dry Ice blast cleaning

- This method is very successful in thoroughly cleaning electric motor windings in place.
- This method uses pellitized dry ice that is accelerated by a specially designed machine to very high velocity. The dry ice instantly freezes the contaminant and breaks the bond with the substrate. The hyper velocity air removes the dirt and the dry ice instantly sublimates into a gas.
- There is no drying process required.
- There are no disposal issues.
- There is no potential damage to any components.
- In short, this method is quicker and safer than either of the previous methods.

Note: Is there a correct method for cleaning windings of electric motors in place? The quick answer is YES. The problem is, many times on-site cleaning is attempted when it shouldn't. Electric motors are complex rotating machines. We strongly recommend that the disassembly and reassembly should be handled by trained technicians. Otherwise, damage to components may occur, resulting in loss of production and unexpected cost overruns.

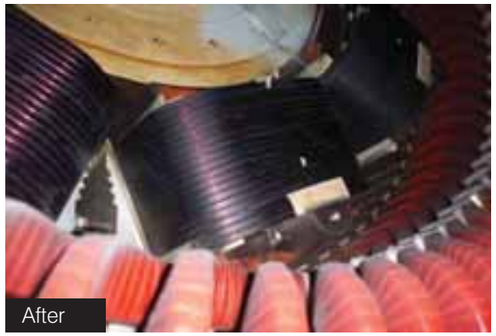
DRY ICE CLEANING
A Better Cleaning Methods

CLEANER GREENER SOLUTION

Dry ice cleaning is a cleaner and greener solution for decontamination of industrial equipment both electrical and mechanical. The photograph shows few examples of before and after dry ice cleaning for motors and generators winding.

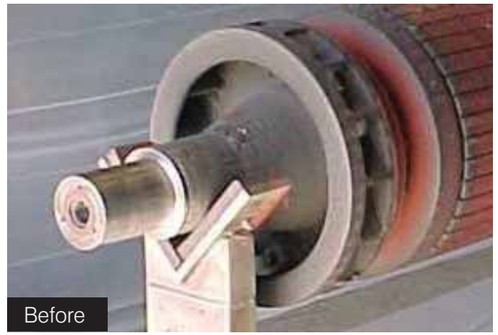
In addition to motors and generators, dry ice cleaning can be effectively used for equipment such as pre shutdown cleaning, turbine cleaning, compressor cleaning, HRSG and boiler tubes, tanks, transformers, sub stations, HV switch gear, control cabinets, heat exchangers and host of others.

DIESEL GENERATOR ROTOR



STATOR WINDING

SQUIRREL-CAGE ROTOR



DIESEL GENERATOR

ASYNCHRONOUS MOTOR