# WATTS UP Quarterly

TAURUS Innovative Technologies

YEAR: 4 ISSUE: 11 Jan-Mar 2024


## CHAIRMAN'S ADDRESS


**Dear Friends,**

Wishing you a joyous New Year! As we step into 2024, I am filled with optimism and enthusiasm for the opportunities that lie ahead. Despite the challenges and uncertainties, I believe this year holds great promise for all of us..

A key focus for us in 2023 has been the advancement of various Partial Discharge solutions, and we are diligently working towards becoming leaders in this segment. Our testing equipment portfolio has expanded substantially, not only catering to the power sector but also addressing the broader Energy sector.

The reception of our new releases in 2023 has been overwhelmingly positive, and I extend my gratitude to our users for their continued support.

Currently, we are excited to announce our strategic partnership with Altec to introduce hot line work technology to India.

This collaboration signifies a significant step forward in advancing our capabilities and offerings, and we are eager to contribute to the growth of this innovative field.

I am confident that these new additions will be met with the same enthusiasm and support from our valued users.

As we embark on this new year, I extend my best wishes to the team. May we collectively achieve our highest targets and continue to strive for excellence.

To all our colleagues, partners, and their families, I wish you good luck and success in the coming year. May your aspirations and dreams find fruition, and may 2024 be a year of prosperity and fulfilment for each one of you.

Thanks and Regards
**M N Ravinarayan**
Chairman

## NATURAL RESOURCES AND THE EFFICIENT UTILISATION OF COAL IN THE INDUSTRIES.

Natural resources play a crucial role in supporting various industries, including the utilization of coal. Coal is a fossil fuel that has been historically used for energy production and industrial processes. Efficient utilisation of coal involves considering both its benefits and potential environmental impacts. In India still 40% of the energy requirements can be full filled by coal.

1. **Energy Production:** Coal has been a primary source of energy for electricity generation and industrial processes due to its relatively abundant supply and energy density. It's burned to produce steam, which drives turbines to generate electricity. However, with the advancement of cleaner and more sustainable energy sources like natural gas, renewables, and nuclear power, the role of coal in energy production has been evolving.

2. **Industrial Processes:** Beyond energy production, coal has been used in various industries, such as steel and cement production. In the steel industry, coal is used as a reducing agent in the production of iron from iron ore, and it's also a key ingredient in the production of coke, a carbon-rich material used in the blast furnace process. In the cement industry, coal can be used as a source of heat in the kiln, which is necessary for the chemical reactions that convert raw materials into cement clinker.

**Efficient utilization of coal involves several considerations:**

1. **Technological Advancements:** Advancements in technology have led to the development of more efficient and cleaner coal utilization methods. High-efficiency power plants, like ultra-supercritical and advanced ultra-supercritical plants, can achieve better energy conversion and lower emissions compared to older plants. But in the exciting plant we can use some of the energy efficiency technology like Online coal and GCV Analyser, to analyse the calorific value and the GCV in real time condition and us the precious source like coal in the efficient way.

2. **Emission Reduction:** Coal combustion releases various pollutants, including sulphur dioxide (SO2), nitrogen oxides (NOx), and particulate matter. To mitigate these emissions, industries use technologies like flue gas desulfurization (FGD) systems, selective catalytic reduction (SCR) systems, and fabric filters to capture and reduce emissions.

3. **Carbon Capture and Storage (CCS):** Given the concerns about greenhouse gas emissions and climate change, technologies like carbon capture and storage (CCS) have been explored. CCS involves capturing CO2 emissions from coal-fired power plants or industrial processes and storing them underground in geological formations, preventing them from entering the atmosphere.

4. **Coal-to-Liquid (CTL) and Coal-to-Gas (CTG) Technologies:** These technologies involve converting coal into liquid fuels (like diesel) or synthetic natural gas, which can be used for transportation and other applications. While they can enhance coal utilisation efficiency, their environmental and economic viability remains a subject of debate.

5. Efforts to utilise coal more efficiently and sustainably are ongoing, but it's important to note that coal's environmental impact, particularly in terms of greenhouse gas emissions and air pollution, has led to increasing scrutiny and calls for a shift towards cleaner energy sources and more sustainable industrial processes.

**By Akash Anand,** Sr. Manager

## THE SPARK OF INTELLIGENCE: AI AND MACHINE LEARNING TRANSFORMING GRID OPERATIONS

The electricity grid, once a silent servant humming in the background, is facing a paradigm shift. No longer a static network of power plants and wires, it's morphing into a dynamic ecosystem fueled by the potent duo of Artificial Intelligence (AI) and Machine Learning (ML). These digital alchemists are transforming grid operations, promising an era of efficiency, resilience, and a cleaner energy future.

**Optimizing the Orchestra:**

Imagine a conductor juggling a thousand instruments-that's the challenge grid operators face, balancing supply and demand in real-time. AI and ML step in as a virtuoso assistant, predicting surges and dips in energy consumption, anticipating weather patterns that impact renewable generation, and dynamically adjusting power flows. This translates to reduced reliance on fossil fuels, decreased blackouts, and smoother operations.

**Predicting the Unpredictable:**

Grid failures due to equipment malfunction or unexpected events are costly and disruptive. AI and ML, trained on vast swathes of historical data, can detect subtle anomalies, predict equipment failures before they happen, and even anticipate natural disasters like hurricanes, enabling proactive maintenance and grid hardening. This not only saves money but also protects lives and critical infrastructure.

**Greening the Grid:**

The rise of renewable energy sources like solar and wind is fantastic, but their fickle nature poses challenges. AI and ML can smooth out their volatility, forecasting their output, integrating them seamlessly into the grid, and facilitating the transition to a carbon-neutral future. Imagine solar farms predicting their generation hours ahead, allowing grid operators to adjust accordingly, maximizing the use of clean energy.

**Empowering Consumers:**

AI and ML aren't just for big-wigs-they're empowering consumers too. Smart meters and AI-powered platforms give us insights into our energy usage, allowing us to optimize consumption, switch to green providers, and even participate in demand-response programs, where we earn rewards for reducing usage during peak hours. This democratizes the grid, creating a more informed and engaged populace.

**The benefits of using AI and ML in electrical systems are numerous:**

**Increased reliability and resilience:** AI-powered grids are less vulnerable to outages and disruptions, ensuring a more reliable power supply.

**Improved efficiency:** AI can optimize energy use, leading to cost savings and reduced environmental impact.

**Enhanced safety:** AI can help prevent accidents and improve worker safety in the electrical industry.

**Greater flexibility:** AI can make grids more adaptable to changing conditions, such as the increasing penetration of renewable energy sources.

The integration of AI and ML into electrical systems is still in its early stages, but the potential is enormous. As these technologies continue to evolve, we can expect to see even more innovative applications that will transform the way we generate, transmit, and consume electricity.

**Challenges and the Road Ahead:**

The path to an AI-powered grid isn't without its hurdles. Data security, ethical considerations, and ensuring equitable access to AI-driven solutions are crucial challenges. Nevertheless, the potential benefits are undeniable. By embracing AI and ML, we can unlock a future where the grid is not just a silent servant, but a dynamic intelligence, humming with the promise of a cleaner, brighter, and more resilient energy future.

So, let's harness the spark of AI and ML, not just to illuminate our homes, but to ignite a new era of grid operations, one that benefits humans and the planet in equal measure.

**By Rajesh Acharjee, Deputy General Manager**

## METHODOLOGIES FOR CHARGING EV BATTERIES IN THE POWER SYSTEM

Generally, EVs that need to be charged from the power grid can be divided into two categories: battery EVs (BEVs) and plug-in hybrid vehicles (PHEVs). BEVs use only the electrical energy stored in the battery for propulsion, while PHEVs can also use fossil fuels. Hence, BEVs have batteries with a higher capacity than PHEVs. Normally, 'EV-Electric Vehicles' refers to these two types of EVs.

In general, EV battery charging methods can be divided into conductive, inductive, and battery swapping methods.

### 1. Conductive Charging

Conductive charging refers to how a direct physical connection charges the EV from the power grid. In conductive charging, two types of chargers can be used to charge EVs: on-board and off-board chargers. An on-board charger is mounted on the EV itself and does not require additional equipment to connect to the grid, so the EV can be charged anywhere by plugging in an electrical outlet. However, this type of charger has a low power transfer capability, and, therefore, in this method, the EV charging operation takes longer. However, off-board chargers are not part of the EV formation and are usually installed in commercial parking lots, highways, or fast-charging stations. Since off-board chargers charge EVs with a higher power, the waiting time for charging is reduced. However, these chargers are not available in all places and are more expensive and complex.

The Society for Automatic Engineers (SAE) has defined a standard for different EV charging levels. This standard defines three charge levels for each AC and DC charge. A summary of these charge levels is given in Table 1.

| Different Power Levels | Charger Location | Typical Implementation Place | The Expected Power Level (KW) |
|---|---|---|---|
| Level 1: Convenient<br>Vac: 230 (EU)<br>Vac: 120 (US) | 1 phase on-board | Office and Home | Power: 1.4 (12A)<br>Power: 1.9 (20A) |
| Level 2: Main<br>Vac: 400 (EU)<br>Vac: 240 (US) | 1 phase/3 phase on-board | Public and Private | Power: 4 (17A)<br>Power: 8 (32A)<br>Power: 19.2 (80A) |
| Level 3: Fast<br>Vac: 208–600 | 3 phase off-board | Commercial | Power: 50<br>Power: 100 |
| DC Power Level 1:<br>Vdc: 200–450 | Off-board | Private | Power: 40 (80A) |
| DC Power Level 2:<br>Vdc: 200–450 | Off-board | Private | Power: 90 (200A) |
| DC Power Level 3:<br>Vdc: 200–600 | Off-board | Private | Power: 240 (400A) |

## 2. Inductive Charging

In the inductive charging method, which is also called wireless charging, there is no need for a physical connection between the EV and the power grid, and the power transmission is done using an electromagnetic field. One of the advantages of inductive charging is reducing the risk of electric shocks and related damages due to the power transmission through the air gap; but, on the other hand, due to the relatively large air gap and non-compliance of the windings, the charging efficiency decreases in this case. In general, inductive charging can be implemented in both static and dynamic ways. As shown in Fig 1, the EV remains stationary during the charging process in the static mode. However, the EV can also be charged while moving in dynamic charging mode. Therefore, according to Fig 2, by creating special paths for inductive charging from the road floor on highways, the EV driving range could be increased, and the size of the EV's battery may be reduced due to the ability to charge it while moving. Additionally, since a significant portion of an EV's price is due to its battery, dynamic inductive charging will help reduce the initial EV price. As a result, dynamic inductive charging will balance many of the barriers seen by users, such as a limited driving range, a long charging time, and higher EV prices compared with conventional internal combustion engine vehicles. Hence, the benefits of this charging method have attracted the attention of many researchers. However, high investment costs are one of the main challenges in developing the dynamic inductive charging method.

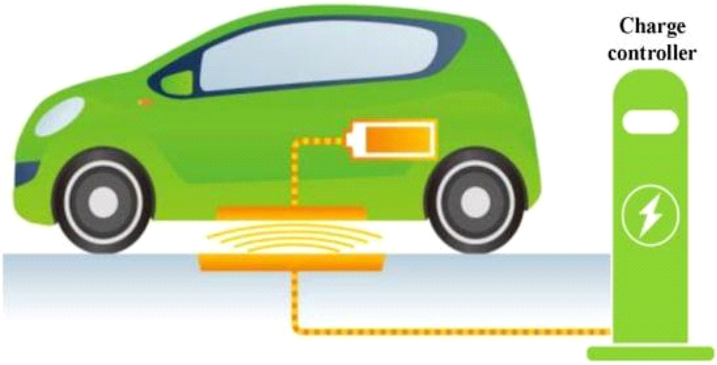



**Fig 1. Static inductive charging of an EV.**

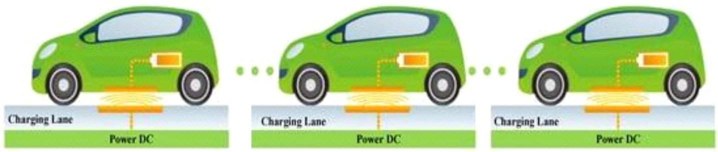



**Fig 2. Dynamic inductive charging of an EV.**

## 3. Battery Swapping

Battery swapping is one of the fastest ways to receive a fully charged battery for an EV. In this method, the EV's owner replaces the discharged battery with a newly charged battery at a battery swapping station. This method significantly reduces the charging time for the EV's owner and benefits the battery swapping station by managing charging, discharging, and battery swapping. Additionally, by optimal charge and discharge management of batteries at the battery swapping station, it is possible to improve the operation and overall efficiency of the power grid. In a battery charging schedule for a battery swapping station is proposed to flatten the voltage profile and release the network capacity. Additionally the battery swapping behaviour of EVs in swapping stations is optimized, which is a useful method for reducing the difference between peak and valley loads and further integration of renewable energy sources in the power grid. On the other hand, there are challenges for the battery swapping method, including the fact that the battery belongs to its manufacturer, the battery has its own characteristics and compatibility, and it is difficult to find a similar battery. In addition, the design of the battery should be such that it can be easily detached from the EV and replaced with a newly charged battery. Additionally, the infrastructure required for this charging method is more complex and expensive than other methods. Another issue is battery ownership, where one option is that the EV's owner buys an extra battery to use when the main battery is discharged to support it, which in turn increases the EV owner's cost. In the other case, the EV's owner has no extra battery, the charging station owns the battery, and the EV's owner must pay the battery's owner to rent the battery in addition to paying for the charge.

Table 2 compares the conductive charging, inductive charging, and battery swapping methods from different perspectives.

Table 3. Comparison between the conductive charging, inductive charging, and battery swapping methods.

| Feature | Conductive Charging | Inductive Charging | | Battery Swapping |
|---|---|---|---|---|
| | | Static | Dynamic | |
| Charging duration | Depending on power levels but relatively high | High | Does not matter due to charging in motion | Very low |
| Charging efficiency | High | | Lower than CC and BS | |
| Infrastructure required | Depending on charging power levels but relatively low | High | Very high | Very high |
| Required battery size | High | High | Lower than the other methods | High |
| Range anxiety | Depending on the state of charge of the battery | Depending on the state of charge of the battery | Lower than the other methods due to charging in motion | Depending on the state of charge of the battery |
| Battery ownership | Ev's owner owns the battery | | Ev's owner owns the battery | |
| Risk of electric shock | possible | Safer than CC and BS | Safer than CC and BS | possible |

CC, Conductive Charging; BS, Battery Swapping.

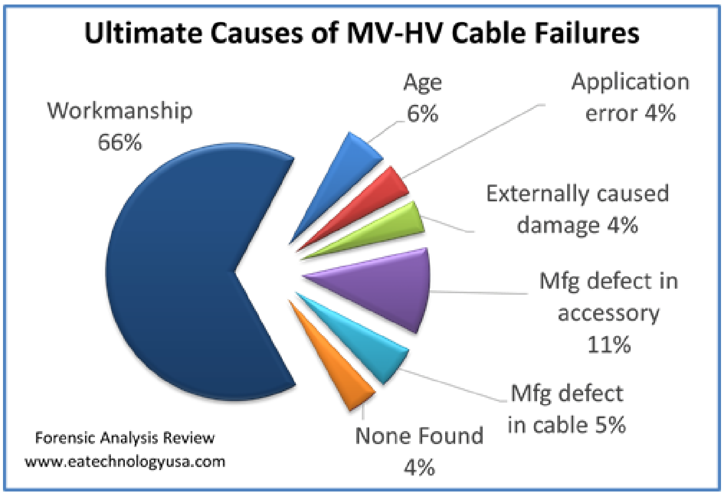
Because the conductive charging method is currently used more in practical applications than the other two methods, the features and characteristics of this type of charging method are discussed in next section of the paper, and the purpose of charging EVs in the remainder of this article is based on the conductive charging approach.

**By Alex Gerald, Deputy General Manager**

## PARTIAL DISCHARGE FROM CABLES.

Partial discharge testing of cables can be online or offline for medium to high voltage power cables. Cable PD occurs from a small insulation defect. It causes a discharge across part, but not all, of the insulation between conductors. The purpose of partial discharge testing of MV/HV cables is to find the discharge before it leads to flashover and catastrophic failure. Once PD starts, it will always grow until the insulation fails.

**Figure 1 below is an excerpt**




With 2/3 as workmanship failures, it's worth looking at further. Examples of field workmanship issues:

-Cutback errors in terminations.

-Contaminants getting into terminations. Remember, field work is performed outside, unlike the controlled environment of a cable manufacture

Gaps and voids in insulation during terminations can be caused by common mistakes.

Power cable terminations are designed so voltage stresses won't exceed the insulation capability at any point. They do this by ensuring the voltage gradients across the insulation are even. The figure below shows how the electrical stress is greater in and around the void

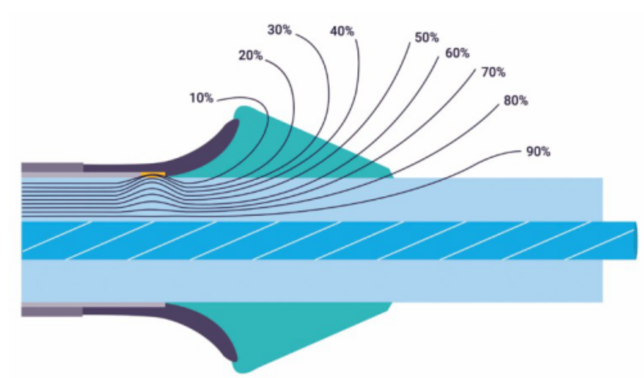



**Figure 2: Poor MV/HV cable termination creating voltage gradients that lead to PD**

Cable termination procedures are very precisely engineered and any failure to follow them closely can lead to voids, field concentration, and then partial discharge.

**Examples of application errors:**

- Not following factory recommendations on mastic and other material choices.
- Insufficient shrinkage of heat shrink layers.
- Physical placement to adjacent cable.

Most failures don't happen by surprise… they can be predicted from early warning signs, most notably partial discharge testing.

Online vs Offline Partial Discharge Testing of Cables

Offline partial discharge testing is often done at the same time as tan delta. Offline cable PD testing provides more information

Here is a comparison chart below of offline vs online PD cable testing.

| CRITERIA | OFFLINE PD | ONLINE PD |
|---|---|---|
| Outage Required? | Yes | No |
| Cost of test equipment | High | Medium |
| Skill required to run test | High | Low |
| Time per test | Long (>2 hours) | Short (<10 minutes) |
| Partial Discharge presence | Yes | Yes |
| Partials discharge severity | Yes | Yes |
| Partial discharge location | Yes | Sometimes |
| Inception/ extinction voltage | Yes | No |

**Figure 3: Offline vs Online PD Testing Comparison Table**

PD Diagnostics Requirements: PD diagnostics require a continuous evaluation of the machine's dielectric integrity throughout its service life.

**Offline Spot PD Test:**

- Offline PD testing is carried out after manufacture.
- Spot testing is conducted after any repair and/or rewind is made to a machine. This helps ensure that the repair has been successful.
- Regular spot testing should be performed throughout the design life of a machine, with increased frequency during the critical first 3 years of service and when reaching the end of their predicted life cycle (typically 20-25 years).

**ONLINE PD TESTING/MONITORING**

- Followed by on-line PD testing at commissioning provides the baseline PD measurements for the machines.
- Monitoring carried out after any repair and/or rewind.
- Regular testing /continuous monitoring carried out throughout the lifetime of the machine, including the critical first 3 years of service, when reaching the end of their predicted design life.

**Non-Intrusive Online Cable Partial Discharge Testing Method:**

Once a PD event has occurred through the electrical insulation of a cable, a set of radio frequency current pulses both equal in magnitude but opposite in polarity are seen on the line conductors and the earth conductor. In addition, if a PD event occurs between two phases, the effect of equal magnitude and opposite polarity is seen on the phase conductors that the PD event occurred. Online PD detection utilizes this effect by measuring these pulses using High Frequency Current Transformers (HFCTs) or Radio Frequency Current Transformers (RFCTs) placed on the earth sheath of the cable. The signals are of very high frequency (up to several hundred megahertz) and very small magnitude (perhaps only a few volts at most but more commonly in the millivolt range).

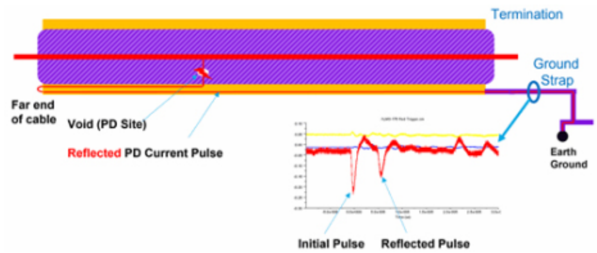



**Figure 4: Online Cable PD Testing using the cable ground strap**

Current through ground strap results from PD down cable. An entire length of cable can be tested from one end.

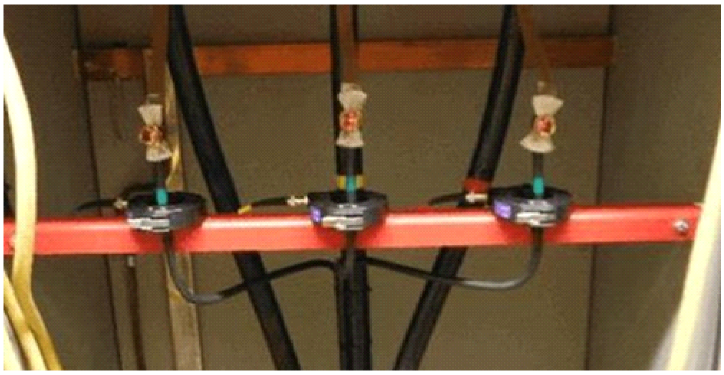


**Figure 5: RFCT/HFCTs Installed in the field on each phase**

Cable PD testing can be performed on live, energized, cables. The RFCT / HFCT can be installed on live cable ground straps with the appropriate PPE clothing and precautions

**By MD AMIM SHAHBAZ, Manager**

## BIRTHDAY WISHES

| | |
|---|---|
| GOURAV KHATRI | 04 Jan |
| H M Ravi | 11 Jan |
| Anurag Soni | 09 Feb |
| Bikesh Kumar Roy | 05 Mar |
| SRINIVAS S | 18 Mar |
| Srinivasa | 18 Mar |
| Alex Gerald | 22 Mar |

## WELCOME NEW TAURUS COLLEAGUES

**Achut Giriyappa Radder**
Digital Marketing Executive

**Kamala D**
Sr. Bid Engineer

**Narottam Das**
Application & Sales -Enecon Product

**Amir Eqbal**
Sr. Sales Engineer - North

**MD Zeeshanullah Ansari**
Engineer - Technical

**Rupankar Gogoi**
Area Sales Manager - North East

**Shubha K**
Sr. HR Executive

**Sitesh Chandra Mishra**
Sales Engineer

## FROM EDITOR'S DESK

**Dear Readers,**

I extend a warm welcome to each of you to the 11th edition of the Watts Up magazine, a digital initiative by Taurus Powertronics Private Limited.

This quarterly magazine is designed to keep you informed about the latest innovations, inventions, and research in the dynamic field of power.

Your unwavering support has truly been a blessing to our company! We appreciate your dedication and contributions that have played a significant role in our success.

As we wrap up this year, let's look forward to our continued collaboration and the growth of our teamwork.

Happy New Year to all! Congratulations on a remarkably productive year! We take pride in witnessing your personal and professional growth within our company. Here's to unlocking even more potential in the upcoming year, filled with exciting challenges and milestones.

As you reflect on the experiences of 2023 and set resolutions for the New Year, consider extending meaningful wishes to the people who matter in your life.

I'm delighted to share that IEEMA is organizing the Distribulec event, scheduled from 16th to 18th Jan 2024 at Bombay Exhibition Center, Mumbai, India.

I invite all readers to visit our stall at Stall No. H3A32 during this event. Explore our latest innovations in the Distribution sector featuring the latest technology.

Wishing everyone a Happy New Year! See you soon at Distribulec. 2024

**By Shridhar U G,** Sr. General Manager

**TAURUS POWERTRONICS PVT LIMITED**

No. 26, "Mahadimane", 12th Main, 1st Block, Rajajinagar, Bengaluru - 560 010. INDIA.

**Tel :** + 91 80 23012301, **WhatsApp :** +91 73496 44344, **Email :** info@tauruspowertronics.com

**BENGALURU | DELHI | KOLKATA | MUMBAI | GUWAHATI**