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From the Publisher's Desk

Financing for Harnessing Green Power

The 2030 agenda for Sustainable Development includes a comprehensive developmental agenda for India by integrating the social, economic and environmental dimensions. The Economic Survey for FY 2020-21, which was presented in Parliament in January this year, laid emphasis on this approach and asked for achieving equity not only across nations and within the nations – but also across and within the generations, thereby countering the iniquitous impact of COVID-19 pandemic too.

The Economic Survey highlighted the importance of sustainable financing to meet the government's development priorities. It mentioned that India is the second largest Green Bond market among the emerging markets after China. With a view to giving a push to Green Bonds issuances in India, in 2017, SEBI issued guidelines on Green Bonds including listing of Green Bonds on the Indian stock exchanges.

As of 24th December, 2020, eight ESG mutual funds (funds whose asset allocation mostly includes shares and bonds of companies that are evaluated based on the factors of Environmental, Social and Governance) were launched in India.

The UK in partnership with Italy will host the 26th UN Climate Change Conference of the Parties (COP26) in Glasgow from 31st October – 12th November 2021. So, this is the right time to assess our preparation, planning and progress. In short, that is evident from a recent IEEFA research report that states, "Green Bonds have become a key financial instrument for mobilising cost-effective foreign debt capital into the Indian renewables market. Since 2016 Indian corporates and financial institutions have raised around US\$14.43bn through Green Bonds as per BNEF data. In 2021 to-date, Indian companies have attracted US\$4bn in Green Bonds, already beating the previous record of US\$3.43bn in cumulative Green Bond issuance in 2017."

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UNION MINISTER INAUGURATES NEW POWER SUB-STATION IN TRIPURA

Union Minister of Finance and Corporate Affairs, Nirmala Sitharaman has recently inaugurated the newly constructed 132/33/11 kV Mohanpur Sub-station in Tripura. Chief Minister (CM) of Tripura, Biplab Kumar Deb; Dy. CM of Tripura, Jishnu Dev Varma; and Minister of Education, Tripura, Ratan Lal Nath were present in the occasion. This Sub-station has been constructed by Power Grid Corporation of India Limited (POWERGRID), a Maharatna CPSU under Ministry of Power, Government of India for Tripura under North Eastern Region Power System Improvement Project (NERPSIP). POWERGRID has presently 172,154 ckm of transmission lines, 262 sub-stations and more than 446,940 MVA of transformation capacity.

NERPSIP is a Central sector plan scheme of the



The Mohanpur Sub-station in Tripura...

Ministry of Power, Government of India, which envisions to drive economic development of the North Eastern region of the country. The scheme is being implemented through POWERGRID, for six beneficiary North Eastern states namely, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura.

The main objective of the project is Government of India's commitment for the total economic development of North Eastern Region and to strengthen the Intra-State Transmission & Distribution Infrastructure in the North East region. Implementation of this scheme, will create a reliable power grid and improve NER States' connectivity to the upcoming load centers, and thus extend the benefits of the grid connected power to all categories of consumers of beneficiaries in North Eastern region. E1

ISSUES RELATED TO COAL SUPPLY TO THE POWER PLANTS REVIEWED

Smooth supply of coal will ensure uninterrupted operations in the Indian TPPs leading to seamless power supply...

Recently, the Secretary, Union Ministry of Power, Alok Kumar, reviewed the report of the Core Management Team (CMT). The CMT comprises representatives from Ministry of Power (MoP), Central Electricity Authority (CEA), Coal India Limited (CIL) and Railways to ensure daily close monitoring of coal stock position at Thermal Power Plants (TPPs). Based on his report a few important decisions have been taken.

It was found that the regulation of the coal to the power plants having more than 15 days' stock, would free up around 1.77 lakh tone of coal from 26 stations. This coal has been redistributed to the plants having super critical and critical coal stocks at power plants.

The second unit of NTPC Daralipali will achieve

commercial operation from 00:00 hrs of 1st Sept 2021, and thus additional 800 MW generation will be added in the total fleet.

The Damodar Valley Corporation (DVC) would be clearing dues to the tune of Rs.1200 crores to the different CIL subsidiaries, which will augment the coal supply to different plants of DVC.

The 1000 MW Kudankulam nuclear power station will be back on bar before 2nd September, 2021 and replace some portion of coal generation.

Around 6,000 MW capacity of thermal power plants at western coast at Mundra designed on imported coal have around 30 days of coal stock and are not supplying power due to PPA related issues. The issues will be addressed soon. E1

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NTPC RECRUITS AN ALL-FEMALE BATCH OF ENGINEERS ON WOMEN'S EQUALITY DAY

On Women's Equality Day, NTPC Ltd has recruited its first all-Female Engineering Executive Trainees (EETs) batch to reaffirm its stand on diversity and inclusion. NTPC received an overwhelming response of the recruitment advertisement, which was published in April, 2021. The engineering graduates were selected based on the performance in GATE 2021 in the Electrical, Mechanical, Electronics and Instrumentation disciplines.

The company envisions an all-female operated Control Room at NTPC in the near future, towards a brighter future ahead for females in the organisation. Out of 50 offers sent by NTPC, 30 Female Executive Trainees (ETs) have already joined the company between 31st July and 6th August 2021.

This special all-female EET batch is currently undergoing



A few engineers from the all-Female EETs of NTPC...

a customised induction-cum-training programme at NTPC's state of the art Regional Learning Institutes (RLIs) located at NTPC Sipat, NTPC Vindhyachal and NTPC Simhadri in the Mechanical, Electrical and Control & Instrumentation (C&I) disciplines.

NTPC is establishing the regular interaction of new

recruiters with the senior management and other employees to ensure that the youngsters are assimilated into the spirit & culture of the organization. The company has been working on improving its gender ratio wherever possible. It has always believed in providing equal opportunity to all the sections of society and has consciously promoted diversity through its hiring practices. To support the women workforce, it adheres to policies like Child Care Leave with Pay, Maternity Leave, Sabbatical leave etc.

COAL SECTOR GEARS UP TO MEET THE UPSURGE IN POWER DEMAND

In the coming days the supplies from the coal companies to the Power Plants is expected to improve further...

Ministry of Coal is all set to address the issue of stock build up at the end of the Thermal Power Plants (TPPs) during the monsoon season. It is notable that coal stocks with Coal India Limited (CIL) are adequate to meet the upsurge in power demand being witnessed in the country since July this year. The supply of coal to the Power Plants is being monitored at the highest level in the Ministry on a daily basis in coordination with the Ministry of Power, Railways and the Coal Companies.

The Secretary (Coal) has reviewed the supply scenario with the Coal Companies on 27th August as well as 30th August. He has given specific instructions to the coal companies to give priority supplies to all the TPPs having critical stock level and to focus on stock liquidation from the mines having high stock level. He has further directed that in case of availability

issue at linked mines alternative sources be allocated for smooth running of the plant. The despatches are being aligned with the advisories of Power Ministry.

CIL has stepped up its coal supplies vigorously during the last five days of August' 21 consistently clocking 1.7 million tonnes (MTs) per day. Augmenting supplies to coal fired power plants, CIL is pumping 1.36 MTs of coal per day. The last three-day average loading to power sector has touched 1.4 MTs.

All efforts are being made in cooperation with Railway authorities to enhance despatch to meet the unprecedented growth in demand for coal-based power. The subsidiaries of CIL have upped their loading commensurate with the prevailing demand scenario. Mahanadi Coalfields Limited (MCL) in a record performance has despatched 102 rakes on 30th August.



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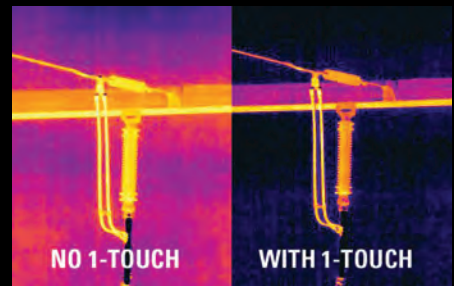
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HITACHI ABB POWER GRIDS COMMISSIONS NEW UHVDC TRANSMISSION LINE

Hitachi ABB Power Grids in India (ABB Power Products and Systems India Limited) has successfully commissioned one of India's longest Ultra-High Voltage Direct Current (UHVDC) transmission links for Power Grid Corporation of India Limited (PGCIL).



A view of a part of the project...

The +/-800 kilovolt (kV), 6,000-megawatt (MW) link has the capacity to meet the electricity needs of more than 80 million people and stretches 1,800-kilometres to connect Raigarh to Pugalur in the southern state of Tamil Nadu. Reliable power can now be transmitted in either direction depending on demand, with exceptionally low power losses and minimal environmental footprint. The link supports the Indian government's mission and the UN Sustainable Development Goal No. 7 of increasing

access to affordable, reliable, sustainable, and modern energy for all.

Hitachi ABB Power Grids worked with the customer, government agencies, local authorities and suppliers to deliver the link during the COVID-19 pandemic. Commenting on the achievement, N Venu, Managing Director

and CEO, Hitachi ABB Power Grids in India, said, "We strive to be a socially responsible business. Supporting society and protecting our people is at the centre of our operations. With the commissioning of this groundbreaking UHVDC link, we have kept our promise to enable more clean and reliable power for millions of people, helping to build a future where electricity will be the backbone of the entire energy system. During the entire project, the health and safety of our customers, employees and partners remained our top priority." 

ANDRITZ RECEIVES ORDER FOR THE COMPLETE REHABILITATION OF THE KOPILI HYDROPOWER PLANT

The award of this contract further strengthens ANDRITZ's leading position on the Indian hydropower market...

International technology Group ANDRITZ has received an order from Central Government owned utility, North Eastern Electric Power Corporation Ltd. (NEEPCO Ltd.) for the complete rehabilitation of the electro-mechanical equipment of the 200 MW Kopili hydropower plant located on the Kopili River in Dima Hasao district of Assam, India. The project is expected to be finished until third quarter 2023.

ANDRITZ's scope of supply includes detailed design and engineering, manufacture, transportation to the project site, supervision of the assembly, erection, testing as well as commissioning of the entire electro-mechanical equipment to be installed in the powerhouse of Kopili hydroelectric plant. Also, included is the training of NEEPCO's personnel in design, engineering, operation, and maintenance of the plant.

The rehabilitation works will be executed by the Indian hydro subsidiary of ANDRITZ with its state-of-the-art manufacturing facilities in Mandideep (near Bhopal) and Prithla (near Faridabad). This contract will be the second contract from NEEPCO to ANDRITZ, the first being the supply of the complete electro-mechanical equipment for the greenfield hydropower project Pare HEP (110 MW), which was awarded in 2011.

ANDRITZ's global product and service portfolio is rounded off with plants for power generation, recycling, the production of nonwovens and panelboard, as well as automation and digital solutions offered under the brand name of Metris. The publicly listed group today has around 26,700 employees and more than 280 locations in over 40 countries. 

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VEDANTA ALUMINIUM IS REWARDED FOR ITS FOCUS ON ENERGY MANAGEMENT

Vedanta Aluminium Business has bagged three 'Gold Awards' at the SEEM National Energy Management Awards (SNEMA) 2020 for excellence in energy management at its Aluminium Smelters I & II and 1,215 MW Captive Power Plant at Jharsuguda, Odisha. Vedanta



Vedanta's captive power plant at Jharsuguda, Odisha...

Jharsuguda's 1,215 MW Captive Power Plant and 2,400 MW Thermal Power Plant have also won at the Thermal Power Plant Operation & Maintenance Conference and Awards 2021 for overall operational excellence.

Speaking about Vedanta's energy stewardship, Rahul Sharma, CEO – Vedanta Aluminium Business, said, "As India's largest producer of aluminium, a 100% recyclable metal, we are cognizant of our responsibilities towards sustainable development and climate action. We are working towards it through a three-pronged strategy of ensuring judicious resource usage, energy-

efficient operations, and renewable energy sourcing. We have adopted global best-practices in energy and resource management, and deployed cutting-edge solutions to reduce our carbon footprint. We are also exploring viable options of renewable energy sourcing for producing aluminium, the green metal."

Energy management is at the heart of Vedanta Aluminium's climate action roadmap. In agreement with the recommendations made by the Task Force on Climate related Financial Disclosures (TCFD) and guided by the Vedanta Group's Carbon Forum, Vedanta Aluminium is working towards executing its carbon management practices as per the TCFD Framework. These include impactful initiatives for optimisation of specific energy consumption in production processes and a long-term focus on migrating to low carbon energy mix. **BI**

BHEL COMMISSIONS SOLAR ELECTRIC VEHICLE CHARGING STATION AT KARNA LAKE RESORT

The company is also working on upgrading other charging stations on this highway, which are expected to be completed within this year...

The Delhi-Chandigarh Highway has become the first e-vehicle friendly highway in the country, with a network of Solar-based Electric Vehicle Charging stations (SEVCs) set up by Bharat Heavy Electricals Limited (BHEL) under the FAME-1 [Faster Adoption and Manufacturing of (Hybrid) & Electric Vehicles in India] scheme of the Ministry of Heavy Industries. The state-of-the-art charging station at Karna Lake Resort was remotely inaugurated by Dr. Mahendra Nath Pandey, Union Minister of Heavy Industries, in the presence of Arun Goel, Secretary (MHI). Dr. Nalin Shinghal, Chairman & Managing Director, BHEL and other senior officials of MHI and BHEL were also present on the occasion.

Recalling the Prime Minister's speech on the country's 75th Independence day, Dr. Pandey said,

"The Hon'ble PM has clearly highlighted that environment security has the same importance as national security and that India is making all efforts towards becoming energy independent." India is a vibrant voice of environment security, which comprises climate change, energy conservation, clean energy transition efforts etc., and the nation's efforts in environment have started giving desired results. This is an important step in the direction of achieving the vision of the Hon'ble Prime Minister, he added.

The EV charging station at Karna lake resort, is strategically located at the midpoint of Delhi-Chandigarh highway, and is equipped to cater to all types of E- cars, which are currently plying in the country. **BI**

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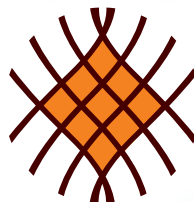
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ALASKA'S LARGEST WIND FARM BENEFITS FROM EMERSON'S SOLUTION

Emerson has completed the digital transformation project to increase the reliability of clean energy generation at Golden Valley Electric Association's (GVEA) Eva Creek wind farm. The project improves the management of Alaska's largest wind farm.

Rural Alaskan communities are on the front line of climate change, given the region's extreme weather. As the largest electric utility serving northern Alaska, GVEA and its Eva Creek wind farm supply nearly 25MW of reliable, low-cost electricity to customers, while reducing fossil fuel usage.

Emerson's sustainable grid solutions have delivered fast results, increasing the reliability of GVEA's wind turbines and contributing to a 65% reduction in operations and maintenance costs.

Commenting on the collaboration, Vice President of GVEA Frank Perkins said, "Emerson is a key collaborator



Automated Eva Creek wind farm in northern Alaska...

Image courtesy: GVEA

in our goal to increase access to clean energy for our customers in northern Alaska. Our investment in a common automation platform helps us efficiently incorporate more renewable energy and minimize our carbon footprint."

Emerson's solutions simplify management of the Eva Creek wind farm and provide more accurate equipment diagnostics

and analytics for forecasting and dispatch. The end-to-end solution incorporates Emerson's Ovation automation platform and OSI monarch software to expertly help utilities achieve a more resilient, responsible and smarter power grid.

Delivering his view, Emerson's President of Power and Water Solutions business Bob Yeager said, "Increased visibility into Eva Creek operations enables GVEA to further safeguard the reliable operation of this critical source of renewable energy for northern Alaska." 

DAIKIN INVESTS TO ACCELERATE APPLICATION DEVELOPMENT OF 'LITHIUM ION BATTERY MATERIALS'

This is the company's first investment in a chemical startup through its CVC (Corporate venture capital) activities...

Daikin Industries, Ltd. has recently invested in OCSiAl S.A., a Luxembourg startup company, by underwriting a capital increase through a third-party allocation of shares. OCSiAl is the world's largest manufacturer of single wall carbon nanotubes and a unicorn company whose valuation is circa 2 billion USD. Since 2018, Daikin Chemicals division has been collaborating with OCSiAl to develop applications in the fluorochemical business for lithium-ion battery materials as well as composite materials.

Single wall carbon nanotubes bring high expectations as additives to create new materials with greater functionality by combining with existing industrial materials. For example, by utilizing their high electric conductivity, single wall carbon nanotubes can increase the electric capacity and power of lithium-ion batteries.

In its strategic management plan FUSION 25, Daikin

looks to create new markets with product development applications centering on fluorochemicals. Through joint development with partner companies, such as customers and startups, Daikin aims to strengthen its proposal capabilities to growth markets, such as semiconductor manufacturing, automotive, lithium ion battery, and information communications, while creating new value. With this investment, Daikin will boost its cooperation with OCSiAl and accelerate the development of new products, including Lithium ion battery materials, together with the development of applications globally.

In November 2019, Daikin established the CVC Office in the Technology and Innovation Center as an organization to promote collaborations with startup companies worldwide to develop new technologies and provide advanced solutions. 



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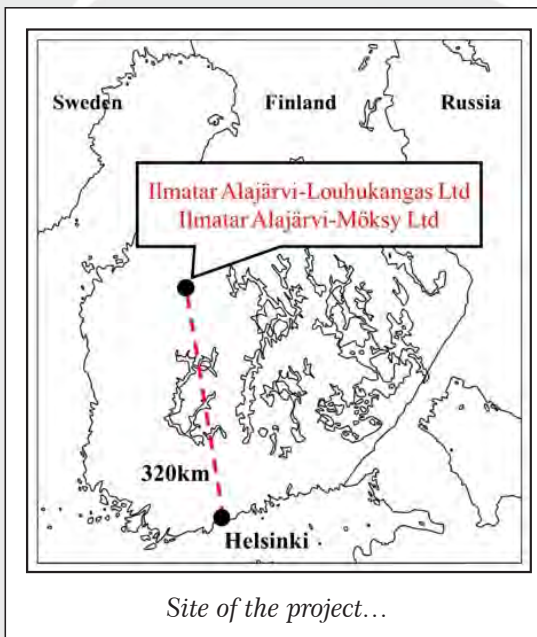


KANSAI INKS AGREEMENT WITH ILMATAR FOR ONSHORE WIND PROJECT

The Kansai Electric Power Co., Inc. (Kansai) has entered into agreements with Finnish renewable energy company Ilmatar Energy Ltd to acquire 49% of shares in Alajärvi Onshore Wind Farm Project, a utility-scale onshore wind farm in the Republic of Finland.

Finland is actively introducing energy policy to promote onshore wind development – so that the share of renewable energy would rise to more than 50% on an energy end-consumption basis during the 2020s. The Project is Kansai's second onshore wind farm project in Finland, following the Piiparinmäki Onshore Wind Farm Project, which is one of the largest onshore wind farms in Finland.

The project will be developed via its specific purpose companies namely Ilmatar Alajärvi-Louhukangas Ltd



(Louhukangas) and Ilmatar Alajärvi-Möksy Ltd (Möksy), where 36 wind turbines will be installed with a total nominal capacity of 216 MW at approximately 320 km north of Helsinki. Its commercial operation is targeted to commence at the end of 2023.

Kansai has acquired each 49% of shares in Louhukangas and Möksy, through its subsidiary, KE Alajarvi Holdco B.V. With the project, the net capacity of Kansai's renewable power overseas now reaches 1,055 MW.

As stated in the Kansai Electric Power Group 'Zero Carbon Vision 2050' and medium-term Management Plan, Kansai is firmly committed to promoting energy businesses that contribute to achieving a zero-carbon society across the world by making active use of technological strength and expertise cultivated throughout our company's history.

AIR LIQUIDE SIGNS A NEW PPA WITH TOTAL ENERGIES

Total Energies will supply the renewable energy from an offshore wind farm located in the Belgian North Sea...

Air Liquide has signed a long-term Power Purchase Agreement (PPA) with Total Energies, through Lampiris (an independent Belgian natural gas and green electricity supplier) – its energy supply affiliate in Belgium, for a total capacity of 15 megawatts of offshore wind electricity in Belgium. Earlier, the company also inked PPA agreements in the United States, Spain and the Netherlands.

According to this 15-year long-term contract that started on 1st June this year, Air Liquide will power part of its industrial and medical gas production assets in Belgium with renewable energy.

The wind-generated electricity will save up to 270,000 tons of CO₂ emissions over the contract duration. This agreement will expand Air Liquide's offer of low-carbon solutions at competitive prices,

and give customers the ability to add more renewable content in their end products.

Detailing on the move, Francois Jackow, Executive Vice President and a Member of the Air Liquide Group's Executive Committee supervising Europe Industries activities, said, "In line with its ambitious Sustainability Objectives, Air Liquide is regularly increasing the share of renewable energy in the energy mix it uses to power its operations. This enables us to decarbonize our activities and also to provide our customers with solutions contributing to the reduction of CO₂ emissions. With this new long-term contract, the Group actively supports the ongoing and unprecedented transformation of the energy sector in Europe, to foster a low-carbon economy in Europe."

M. DUGAR JOINS HPL ELECTRIC & POWER AS CHIEF FINANCIAL OFFICER



He has an in-depth understanding of the electrical industry...

HPL Electric & Power Ltd. has recently appointed Manoj Dugar as the Chief Financial Officer (CFO) of the company with effect from 13th August, 2021. In this role, Dugar will be managing the entire gamut of financial operations of the company, including aspects of fund raising, commercial, legal, taxation, secretarial, merger & acquisition and accounting operations.

Dugar is a qualified Chartered Accountant, having a rich experience of more than 26 years in Finance and Accounts side of multiple businesses and industries.

Previously, he was associated with Orient Electric Limited and was responsible for leading the financial operations. Before joining HPL, he was the CFO at ACT Infraport Limited.

Commenting on this appointment, Gautam Seth, Joint Managing Director, HPL, said, "Manoj is a highly motivated, positive and goal-oriented individual, who has an in-depth understanding of the electrical industry. I am confident that he will chart higher milestones and further strengthen our market leadership." 

C. MATHUR TAKES CHARGE AS NEW DIRECTOR GENERAL OF IEEMA



She will be working to strengthen the Indian electrical equipment industry...

Charu Mathur has taken over as the Director General of IEEMA. She will represent IEEMA in various governments and industry led fora on policy, economy and commerce. Mathur has rich experience of working with industry and industry associations, across industry sectors and with multiple stakeholders. She holds a Bachelor's degree in Economics and a Master's in Business Economics from Delhi University.

Prior to joining IEEMA, Mathur has served in strategic leadership positions in Amazon, world's leading e-commerce

player and CII, one of the apex national industry associations in India. She has been instrumental in creating models of engagement that would resolve conflict on policy matters by bringing the competing entities and stakeholders together through representations, dialogues and through well thought out papers. Her responsibility also includes building relationships with Government, Corporates at the CXO level, industry associations and media, diplomatic missions, economic and social thinkers. 

R. SETHI IS INDUCTED AS AN INDEPENDENT DIRECTOR IN THE BOARD OF MSSSL



She is also on the Boards of some leading Indian companies as an Independent Director...

The Board of Directors of Motherhood Sumi Systems Limited has approved the appointment of Rekha Sethi as an Additional and Independent Director, not liable to retire by rotation, for a period of 5 (five) years commencing from August 10, 2021 to August 9, 2026, subject to approval of the shareholders.

Rekha Sethi is the Director General of the All India Management Association (AIMA), the apex body for management in India. AIMA is a non-lobbying, not for-profit organisation working closely

with Industry, Government, Academia and students to further the cause of the management profession in India. AIMA makes a salutary contribution to management learning and practice in the country by offering various services in the areas of testing, distance education, research, publications and management development programmes. Rekha took the charge of AIMA in June 2008. Prior to that, she worked with the Confederation of Indian Industry (CII) for over 17 years. 

WE ARE ON THE TRACK



The 2021 United Nations Climate Change Conference (COP26) has been scheduled between 1 and 12 November in the city of Glasgow, Scotland under the presidency of the United Kingdom. In COP 21, our Hon. Prime Minister Narendra Modi made a big commitment to reduce our country's emission through harnessing renewable energies in a big way. Thus, it is the high time to check our progress in this regard...
- P. K. Chatterjee (PK)

It all started from the ambitious declaration of our Prime Minister Narendra Modi in COP 21 on November 30, 2015. There he said, "Democratic India must grow rapidly to meet the aspirations of 1.25 billion people, 300 million of whom are without access to energy. We are determined to do so, guided by our ancient belief that people and planet are inseparable; that human well-being and nature are indivisible. So, we have set ambitious targets. By 2030, we will reduce emissions by 33 to 35% of 2005 levels, and 40% of our installed capacity will be from our non-fossil fuels."



In his speech, he boldly declared, “Today, when the energy sources and excesses of our industrial age have put our planet in peril, the world must turn to Sun to power our future. As the developing world lift billions of people into prosperity, our hope for a sustainable planet rests on a bold global initiative. It will mean advanced countries leaving enough carbon space for developing countries to grow. That is natural climate justice.

It also means a growth path with lighter carbon footprint. So, convergence between economy, ecology and energy should define our future. The vast majority of humanity is blessed with generous sunlight round the year. Yet, many are also without any source of power. This is why this alliance is so important. We want to

bring solar energy into our lives and homes, by making it cheaper, more reliable and easier to connect to grid. We will collaborate on research and innovation. We will share knowledge and exchange best practices. We will cooperate on training and building institutions. We will discuss regulatory issues and promote common standards. We will attract investments in the solar sector, encourage joint ventures and develop innovative financing mechanisms. We will partner with other international initiatives on renewable energy. There is already a revolution in solar energy. Technology is evolving, costs are coming down and grid connectivity is improving. It is making the dream of universal access to clean energy become more real.”



(LtoR) François Hollande, President of France (May 15, 2012 to May 14, 2017) and Narendra Modi the Prime Minister of India in COP 21 (November 2015)...

Stress on increasing clean energy generation

Prior to COP 21 meet, on 17th June, 2015, the Union Cabinet chaired by the Prime Minister approved the proposal for stepping up India's solar power capacity target under the Jawaharlal Nehru National Solar Mission (JNNSM) by five times, reaching 1,00,000 MW by 2022.

The target consisted of 40 GW Rooftop and 60 GW through Large and Medium Scale Grid Connected Solar Power Projects. With this ambitious target, India would become one of the largest Green Energy producers in the world, surpassing several developed countries.

The Indian government at that point, decided to go for a total investment around Rs. 6,00,000 crores for harnessing 100 GW of renewable energy. In the first phase, the government decided to provide Rs. 15,050 crore as capital subsidy to promote solar capacity addition in the country – targeting Rooftop Solar projects in various cities and towns, for Viability Gap Funding (VGF) based projects to be developed through the Solar Energy Corporation of India (SECI) and for decentralized

generation through small solar projects. The Ministry of New and Renewable Energy (MNRE) intended to achieve the target of 1,00,000 MW with targets under the three schemes of 19,200 MW.

Also, the government chalked out many solar power projects with investment of about Rs. 90,000 crore, which would be developed using Bundling mechanism with thermal power. Further investment had to come through large Public Sector Undertakings and Independent Power Producers (IPPs). State governments too came forward with state-specific solar policies to promote solar capacity addition.

Where are we today?

As per the latest information from the Government of India, the total installed renewable energy capacity in India, excluding large hydro, has crossed the mile-stone of 100 GW. Today India stands at 4th position in the world in terms of installed RE capacity, 5th in solar and 4th in wind in terms of installed capacity.

Our country has set ambitious targets for itself in the area of Renewable Energy (RE), which the Ministry of New and Renewable Energy is committed to achieve.



R. K. Singh, Union Minister for Power and New and Renewable Energy...

While 100 GW has been installed, 50 GW is under installation and 27 GW is under tendering. India has also enhanced its ambition to install 450 GW of renewable energy capacity by 2030. If large hydro is included the installed RE capacity increases to 146 GW.

Commenting on the achievement, on 12th August, 2021, Union Minister for Power and New and Renewable Energy, R. K. Singh has tweeted, “The achievement of installed RE capacity of 100 GW is an important milestone in India’s journey towards its target of 450 GW by 2030.”

Let us also see where we stand as far as our emission reduction target is concerned. According to a recent report from the Government of India, “India has already achieved emission reduction of 28% over 2005 levels, against the target of 35% by 2030.”

This has put our country in the list of a few countries in the world, which have kept to their Paris Climate Change (COP21) commitments along with an exponential increase in renewable energy capacity. Considering the pace of development in the energy sector, India is determined to not only achieve, but to exceed its NDC commitments well within the committed time frame.

What is next?

During delivering his keynote address at the ‘INDIA-ISA Energy Transition Dialogue 2021’ organized by the International Solar Alliance (ISA) and the Union Ministry

of New and Renewable Energy (MNRE), RK Singh, who is also the President of International Solar Alliance, stated that – from time-to-time, the Government of India has enacted favourable policies and regulations to boost the clean energy sector. India has been aggressively pushing for energy efficiency improvements for the past two decades through a combination of innovative market mechanisms and business models, institutional strengthening and capacity building, as well as demand creation measures.

He also added that – the key is to allow the regulatory and policy support to keep the sector afloat till the supply-side strengthens, technology develops and competitive market takes root resulting in a fall in prices, and the industry becomes self-sustainable.

According to him, it is anticipated that by 2050, 80-85% of India’s overall power capacity will come from renewables. India has already touched 200 GW of peak demand. The demand had crossed what it was during pre-COVID time and it is expected that electricity demand will continue to rise. This gives us the space for adding more renewables capacity, but it will call for power system flexibility and introduction of various storage technologies.

He feels that active private sector continued to strengthen the supply side through capacity building exercises. The story is expected to be repeated in the years to come with advanced technologies, such as energy storage and green hydrogen. Dedicated Green Energy Corridors initiated by the MNRE have made it easier for renewable energy developers to avail grid connectivity and evacuate up to 40,000 MW of large-scale renewable energy from renewable energy-rich parts of India. Going ahead, similar initiatives would be employed to push for adoption and installation of floating solar power plants in water bodies and reservoirs across the country.

Epilogue

We all know the old proverb, ‘History repeats itself’. We are also aware of the fact that in the last more than one year, our country has been passing through a very bad economic condition because of the COVID-19 pandemic. Still, as far as harnessing the RE is concerned, our adroit Ministry of Power has reached the 100 GW mark. Also, there is 50 GW under installation and 27 GW is under tendering... So, there is no doubt that we are definitely on the track.



The new TS-I HV 80 is
a true allstar...
(Image source: Tesvolt)

VERSATILE SOLUTION

Today energy storage has been an essential feature of the secured and reliable power system. As technology, by virtue of its dynamic nature, is advancing at a rapid pace – the storage facilities are also becoming more capable of offering many new features. Here is an exemplary product description that will guide the new investors and/or energy storage plant venturers...



The new TS-I HV 80 with an integrated inverter and energy management system...

(Image source: Tesvolt)

Recently, Germany-based global company Tesvolt GmbH has rolled out a new battery storage system, which for the first time has its own Energy Management System (EMS) and an Integrated Industrial Inverter. The TS-I HV 80 is designed to achieve exceptionally high power electricity cost savings through the use of intelligent functions. Its new power quality technology ensures high power quality that prolongs the lifespan of machines in commercial and industrial settings. The new storage system also provides reliable back-up power. The company also provides thorough training on operation of the device.

The transformation of the energy market has made long-term planning security for energy costs all but impossible. Yet every change also brings opportunities. Many have already taken advantage of the energy transition to tap into an attractive business with secure revenue streams with photovoltaic installations, biogas generation and wind power. Now battery storage systems offer the next big opportunity.

Self-consumption Optimisation

If the solar yield is greater than the current electricity consumption, the excess is fed into the battery storage system. If the solar yield dips below power

requirements, the storage system kicks in and delivers the needed electricity. When it runs out, electricity is drawn from the utility grid. In this way, the self-consumption share can be boosted to 80% or more.

Potential users: Operations with a photovoltaic installation or a suitable roof, e.g., carriers, agriculture, workshops and factories.

Physical Peak Shaving

Consumers with load profile measurement primarily pay for the utilised power. Costs are based on the moments when power consumption is the highest, i.e., the peak loads. Battery storage systems can provide stored electricity during peak loads and reduce utility grid consumption. This reduces the connected load and can save thousands of rupees per year.

Potential users: Operations with high power consumption and load profile measurement, e.g., quick charging stations, agriculture, workshops and manufacturing.

Multi-use Applications

Multi-use enables the combination of two operational management strategies: Self-Consumption Optimisation (SCO), Peak Shaving (physical or RLM) and Time of



High capacity in a small space: up to 340 kW with a footprint of just 0.5 m²...

(Image source: Tesvolt)



The TS-I HV 80 is available from 76 kWh and can be modularly expanded to several MWh...

(Image source: Tesvolt)

Use (ToU). A storage area can be defined for each of the selected applications depending on specific requirements, for maximum service life and economic efficiency.

Inexpensive Back-up Power

Battery storage systems help in ensuring a reliable power supply. The user can also optimise or completely replace a diesel generator with a battery storage system. In case of a power outage, the user's battery storage system takes over the power supply and his/her operation keeps running without interruption.

Potential users: Operations that depend on a reliable power supply, e.g., livestock farming, cold stores.

Earn Money with Ancillary Services

TESVOLT battery storage systems can also provide so-called ancillary services. On behalf of the user's distribution system operator, his/her battery storage system balances out fluctuations in the utility grid. In return, he/she is paid according to the type and scope of the available services.

Potential users: Operators of larger battery storage systems with a grid connection.

Reliable Power Supply without the Utility Grid

Suppose you need electricity, but there's no grid connection available: In conjunction with a power source such as a photovoltaic installation and/or a CHP, battery storage systems enable the creation of an off-grid system. Battery storage systems can also optimise the consumption of diesel generators.

Potential users: Properties that need electricity but lack a grid connection.

Other Potential Applications with TS-I HV 80

Generation Control

To achieve optimal utilisation of power generation capacity, the storage system controls when power sources are switched on and off. It's possible, for example, to start or stop combined heat and power units or diesel generators in addition to the renewable sources – depending on the state of charge of the battery. This ensures that only as much power as is needed at a given moment is generated, but also never too little. This, in turn, ensures that energy is neither wasted nor unnecessarily drawn from the utility grid.

Load Control

In simple terms, automatic load control means that loads are switched off when they are not needed at a given moment. For instance, unnecessary use of expensive utility grid electricity can be avoided in periods of increased power needs. Another example is power outages, when the entire system has to rely on emergency power from the battery storage system. In this case, the automatic shutdown of all unneeded loads ensures maximum utilisation of the stored electricity – or the renewable sources if the wind or PV installation is generating power at the time in question. This application can be used to control charging stations as well.

Forecast-based Charging

If more PV electricity is being produced than consumed at a given moment (e.g., on sunny days with a fully charged battery storage system), the surplus electricity can be fed into the public utility grid in exchange for payment. By law, however, the output of the PV installation must in some cases be curtailed, which results in curtailment losses: surplus solar energy is wasted. This is uneconomical.

To avoid this, forecast-based charging is useful. The TESVOLT Energy Manager evaluates weather forecast data, battery capacity and the current state of charge. The algorithm determines a strategy for the control of the storage system, for example for the following 24 hours.

With physical Peak Shaving (PS), every consumption peak that occurs is simply covered by electricity from the battery storage system, while the system involved in registering Load Profile Measurement (RLM) works at 15-minute intervals to ensure greater accuracy and therefore also greater efficiency.

The maximum consumption peak tolerated by the supplier is circumvented because the amount of electricity consumed is registered over a period of 15 minutes to permit short peak loads. The TESVOLT Energy Manager only comes into play when the average consumption is in danger of exceeding the maximum tolerated peak value within the 15-minute interval.

What Characterises a Good Energy Storage System?

Rapid Discharge (1C)

It is essential for high power levels. If the C-rate is too low, the storage system has to be very large to provide the required power. This ultimately makes the storage system unnecessarily expensive.

High Efficiency and Low Stand-by Losses

Some energy is 'lost' in each storage process. The storage system efficiency indicates how much of the energy in the storage system can be taken out of it. This value should be well over 90%, while stand-by losses should be no greater than 5 watts.

Flexible Extension and Exchange

As a rule, batteries can only be exchanged or added in the first few months after commissioning. Systems in which batteries can be added or replaced at any time are better.

Highest Safety Standards

For storage systems, make sure the battery is monitored on the cell level as this is the only way to detect the need for maintenance at an early stage. The battery cells should also come from a reputable source. Established manufacturers offer cells that will not ignite even if damaged.

Intelligent Battery Management

Monitoring each individual battery cell is essential to

ensure maximum performance, safety and durability. This ensures that all cells are optimally charged and discharged at all times and that potential errors are detected in good time.

High Cycle Stability and Lifespan

Battery storage systems are subjected to wear with each charge cycle. There is therefore a specified number of full charge cycles for a storage system – before it goes below a certain residual capacity. There is also a lifespan in calendar years that specifies the maximum lifetime in years.

What Does That Mean, Exactly?

DoD

Depth of Discharge (DoD) – indicates the maximum discharge depth of a storage system. Many storage systems cannot be fully discharged, which means that not all of the energy in the storage system is available for use. Good storage systems have a depth of discharge of 100%.

Full Cycle

A full cycle is a single instance of complete charging and discharging of a storage system. In practice, this involves totalling partial charges and discharges. One of the ways the lifespan of a storage system is specified is with a number of full cycles.

C-rate

This indicates how quickly a storage system can be charged or discharged. 1C means that a storage system can be fully charged or discharged within an hour. A storage system with 0.5C requires two hours for the same, while for 2C it takes just half an hour.

How Does Cell Balancing Work?

Cells age at different rates. These differences between the cells have a negative impact on the charging and discharging behaviour of the battery. Cell balancing attempts to minimise these differences as much as possible.

In 'passive balancing', all cells are brought to the level of the weakest cell by having the stronger ones burn off energy. In 'unidirectional balancing', stronger cells charge any weaker subsequent cells. Thanks to the 'Active Battery Optimizer', balancing is carried out between all battery cells within the battery module and even between the different battery modules.



Source: www.tesvolt.com

UNDERSTANDING THE TECHNO-ECONOMICS

Part 1



Bio Coal
or Green
coal and

Bio Methanisation are two ways of utilising agricultural waste to generate energy, both can be considered renewable since nature returns agricultural residues back through photosynthesis unlike fossil fuel use that consumes the reserves piled up over centuries in a short period of time.

The agrarian states of Punjab and Haryana have multiple crops in a year and the field has to be cleared of agricultural residue of every crop after every harvest for fresh sowing. Around mid - November, after the kharif crops, the field has to be cleared quickly and peasants burn the agricultural residue in large quantities. Large scale burning of agricultural residue has become a menace to the air quality in surrounding areas of Delhi where the wind velocity is low and smog remains entrapped for days together, playing havoc with the respiratory health of a large population. The high rise land locked urban settlement of National Capital Region has a thick boundary layer with very low wind velocity, thus the AQI of NCR around November becomes a subject of discussion every year.

In this article, the conversion process of agricultural residue to bio fuels and methanisation have been discussed in detail, and the issues with the use of these fuels are taken up and finally an economic analysis is taken up as a comparative study...

As a corrective measure, agricultural residues have been converted to briquettes and pellets and co-fired in coal-fired plants to the extent of 5-10%. This involves the cost of conversion of agricultural residues to briquettes/pellets besides the cost of transportation of briquettes/pellets from the point of manufacture to the point of use in coal fired plants. Alternatively, bio-methanisation of agricultural residue in the absence of air under the action of anaerobic bacteria is a well-known process. Methane as natural gas has got four-fold use, it is PNG in our kitchen, CNG on the road, fuel for Power-Plants based on combined cycle (with higher efficiency of 55% in contrast to a supercritical plant with efficiency of 43%) and raw-material for fertilizer. While transportation of briquettes could add significantly to its landed costs, natural gas can be utilized in the vicinity of its production in the kitchen or on the road. A techno-economic analysis is made in this article evaluating whether agricultural residues can be converted to pellets and briquettes or should they be bio - methanized.

Processing agricultural residues



Agricultural residues are baled by the bailers...

Agricultural residues have a large volume and a low energy density, hence they require further processing. With the help of cutters and rackers, the residue is baled by the bailers to increase the density, which further eases the handling and transportation of the residues across short distances. Hence, the baled residues are converted to briquettes and pellets.

Pellets & briquettes

- Pellet is denser than briquettes as it has lesser moisture content.
- Pellet has got 20% higher calorific value.
- Pellet is more compact in size.
- Pellet has wider instrument acceptability.
- It gives higher efficiency as a fuel when fired.

Still Briquettes are more popular than the bio pellets as conversion of agricultural residues into briquettes requires very Low Capital Investment and Technology.



Briquettes

Pellets

Both these residues can also remain in storage for a longer time without actually losing its own calorific value.

Co-firing

Co-firing biomass with coal is an attractive energy generating option from both economic and environmental points of view. Co-firing could be economic in the sense that biomass co-firing does not require major capital investments and uses the existing coal-fired power plant infrastructure with minor changes in the operating regime.

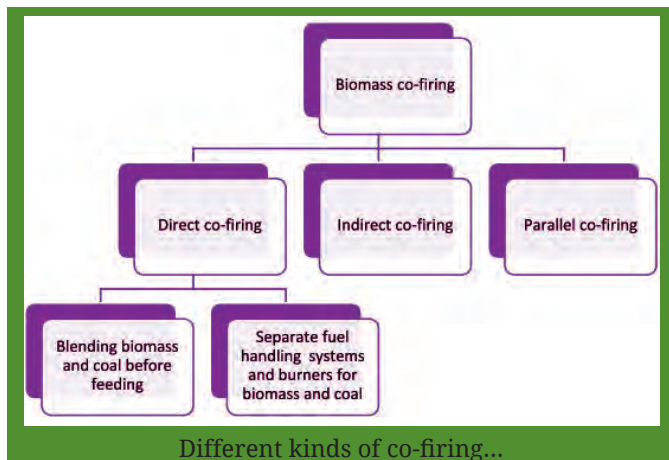
Agricultural residues when fired in the form of pellets or briquettes contain a lot of volatile matters. Hence, the mill outlet temp is to be maintained lower. This results in saving on investments due to reduced coal consumption in terms of reduction in not only mined cost of coal but also its transportation. Moreover, co-firing is a low-risk option for the production of renewable energy since the risks associated with major capital investments and raw material supplies are much smaller compared to other alternative uses of biomass (e.g., biomass to biofuel production). Additionally, direct co-firing is one of the most interesting and effective means of reducing GHG emissions from the coal fired power plants. Co-firing minimizes waste (e.g., wood waste, agricultural waste) and the environmental problem associated with its disposal. Finally, co-firing is a near term market for biomass. For the past decade, various forms of biomass fuels have been co-combusted in existing coal-fired boiler and gas-fired power plants.

Existing co-firing is driven by various co-firing technologies implemented in coal-fired power plants. Currently, there are three co-firing technologies widely used in coal plants:

- Direct co-firing,
- Indirect co-firing, and
- Parallel co-firing.

Direct co-firing: In direct co-firing, biomass is directly fed into the furnace with base fuel (e.g., coal). In this method, biomass can be milled with coal directly or separately prior to feeding them in the furnace.

The challenges associated with direct co-firing are: tendency of producing ash deposition (e.g., slagging and fouling); limited range of co-firing; and lack of flexibility to use different types of biomass.



Indirect co-firing: Indirect co-firing installs a separate gasifier to convert the solid biomass into a fuel gas commonly termed as sync gas.

It provides a number of benefits over direct co-firing that include: boiler slagging can be reduced since biomass does not directly feed into the boiler; gasification reduces gas residence time; and it has the flexibility to use different base fuels such as coal, oil, and natural gas.

Parallel co-firing: It involves the installation of a completely separate external biomass-fired boiler in order to produce steam used to generate electricity in the coal-fired power plant. This steam generated from biomass-fired boiler is used to meet the demands of the coal-fired power plant and reduce the operational risk of a coal-fired power plant due to the availability of separate and dedicated biomass burners running parallel to the existing boiler unit.

Parallel co-firing provides a unique opportunity to increase the biomass percentage during biomass co-firing and avoid biomass-related contamination issues. However, this technology is proven more expensive than the direct co-firing approach since additional infrastructure is needed to support the system.

Typical boilers used in existing coal-fired power plants are Fluidized Bed Combustion (FBC) boiler, Pulverized Coal Combustion (PCC) boiler, Packed-Bed Combustion (PBCP) boiler, and Cyclone Boiler (CB).

Bio pellet as green coal

Agricultural residues, when burnt in open in the

atmospheres, release a huge amount of ash, and unburnt carbon in the atmosphere. The unburnt carbon can cause a lot of diseases including respiratory issues.

It is also important that the amount of CO₂, which is released after complete burning of bio pellets, is absorbed by the crops for the next cycle of photosynthesis.

We know that the thermal power plants have a higher efficiency in comparison to the traditional stand-alone biomass power plants, which makes this as a Cleaner Substitute.

Both briquettes and pellets are made by high compression without use of any chemical, which makes it more eco-friendly and pollution free. Because of this reason both briquettes and pellets are together known as Bio-Coal.

BIO pellets again are of 2 types: Torrefied and non-torrefied.

Torrefaction is nothing but the process of heating up the agricultural residue at 250-300 degrees centigrade in the absence of oxygen, which makes it brittle, less volatile, and black carbon powder. which is further processed as torrefied pellets.

In short, it's nothing but roasting of wood or other biomass to remove moisture and low energy volatiles, increasing the energy density of the biomass.



Residues/ Unprocessed Wood Chips



Torrefied Wood

STEP 1:- (Receiving And Storage)

The Woodchips are collected and stored to be used as biomass fuel.



STEP 2 (Drying)

The Wood chips are dried using a closed loop belt dryer.



STEP 3 (Torrefaction)

The wood chips are heated using the microwave technology, creating a charcoal like substance.



STEP 4 (Grinding and Pelletizing)

Torrefied wood is ground up and converted into pellets that produce up to 10% more energy than wood.



Torrefied pellets

If we go through the properties, it is as good as coal. Therefore, it can be pulverized. Further, the agricultural residue, which doesn't undergo torrefication gets converted to non-torrefied pellets. Torrefied and

densified biomass has several advantages in different markets, which make it a competitive option compared to conventional biomass wood pellets.

Higher energy density: An energy density of 18–20 GJ/m³ – compared to the 26–33 gigajoules per ton heat content of natural anthracite coal – can be achieved when combined with densification (pelletizing or briquetting) compared to values of 10–11 GJ/m³ for raw biomass, driving a 40–50% reduction in transportation costs. Importantly, pelletizing or briquetting primarily increases energy density. Torrefaction alone typically decreases energy density, though it makes the material easier to break into pellets or briquettes.

More homogeneous composition: Torrefied biomass can be produced from a wide variety of raw biomass feedstocks that yield similar product properties. Most woody and herbaceous biomasses consist of three main polymeric structures: cellulose, hemicellulose and lignin. Together these are called lignocellulose. Torrefaction primarily drives moisture and oxygen-rich and hydrogen-rich functional groups from these structures, producing similar char-like structures in all three cases.

Hydrophobic behaviour: Torrefied biomass has hydrophobic properties, i.e., it repels water, and when combined with densification makes bulk storage in open air feasible. Torrefaction increases the storage period of the pellets and also increases its calorific value.

Elimination of biological activity: All biological activities are stopped, reducing the risk of fire and stopping biological decomposition like rotting.

Improved grindability: Torrefaction of biomass leads to improved grindability of biomass. This leads to more efficient co-firing in existing coal-fired power stations.

...To be continued 



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SOFT STARTER TECHNOLOGY IN THE AGE OF INDUSTRY 4.0

Amongst the various motor switching technologies available today viz: DOL and Star Delta with the conventional contactor – relay assembly, Soft starters, and Variable converters – Soft starters have gained significant popularity in the recent times thanks to the various techno-commercial benefits offered by them. Let's dwell deeper and see how advances in technology have brought about changes in soft starter technology and its offerings...

Soft starter consists of a number of anti-parallel thyristors- 2 per phase. On applying voltage across these thyristor banks and varying the firing angle the voltage at the output can be reduced. This reduced voltage is applied to the motor terminals to achieve a lower starting current and thereby lower starting torque. The firing angle is gradually changed to increase the output voltage to full voltage thereby also gradually increasing the starting current as well as the starting torque without any peaks.

Soft starters can generally be used for applications in the low to high power range (1.1 kW to 1200 kW). The modern design and state-of-the-art technology have made the new age soft starters – Stronger, Smarter, Superior, Safe and Efficient.



Benefits with the Modern, Functionally Dense Soft starters

Enhanced Safety with STO (Safe Torque Off)

The safety function “Safe Torque Off” (STO) in Fail safe variants of soft starter interrupts the current operating state immediately on activation and coasts it down to ensure Safety-related shutoff acc. to EN 61800-5-2 and stop category 0 acc. to EN 60204-1.

This thus effectively ensures that the motor no longer provides any torque-generated energy in the event of an emergency. The motor comes to a standstill and remains safely in this state until it is restarted (restart interlock). The STO facilitates risk-free working, even when the protective door is open, making it popular in process machine applications and systems such as agitators or belt conveyors.

This can be deployed for safety requirement up to SIL3 level which is the industry benchmark for machine safety.

Integrated self-learning with Auto-parameterization for Faster adaptation

Automatic parameterization simplifies the operations in 2 ways – one while commissioning and other while operation of critical applications having highly dynamic load characteristics. This is especially useful in applications like conveyors.



The built-in smart processor of soft starters automatically detects and optimizes the individual starting parameters, and also adjusts the current limiting factor in case of varying conditions for an optimal jerk free, belt start – this all without manual intervention.

Thus Auto-parameterization is very useful while commissioning and helps in auto adjustment of parameters for dynamic loads

Pump cleaning and pump stopping

Pumps are used in a wide variety of applications for distribution of liquids. There are 2 major factors that affect the pumping performance – Hammering and Clogging.

When pumps in public water supply systems such as for buildings or pumping stations are working with large volumes of water, switching them off is a challenge. Due to their design, these pumps stop immediately, which can lead to water hammering on pipes, couplings, valves and seals due to the kinetic energy of the mass of water in the piping system.

Similarly, when used in wastewater applications, dirt and particles can cause deposits to build up on the impellers of the pump and reduce flow rates and productivity. This can be avoided with

the pump cleaning function of the soft starters. With the integrated measuring systems of the state-of-the-art soft starters – detection of contamination is possible early, and by changing the direction of rotation of the pump back and forth the soft starters prevent blocking.

This function is very useful in process plant and waste management plants where there are chances of clogging.

The modern design soft starters like SIEMENS 3RW5 have a pump stopping mode that allows pumps to come to a standstill in a controlled manner thereby preventing damage to pump and pipes.

Condition Monitoring and Predictive Maintenance

No machine operator would desire unplanned downtime as it hugely impacts productivity, efficiency and wastes of time. To ensure maximum availability and reduce breakdowns the integrated condition monitoring function of soft starters monitors the status of the complete application - which is driven by the motor, in order to be able detect possible wear of the machine and plan a correspondent maintenance work in advance.

Depending on application type – a user can set different warnings and error limits.

For the plant maintenance team, sufficient time is now available to plan a schedule maintenance work.

Smooth Start with Soft torque

When motors start or stop abruptly, mechanical impacts in the machine or voltage dips in the power supply may cause serious problems. These must also be avoided in safety areas.

Soft Torque is a new function that considerably reduces the torque peak before reaching the rated speed of the motor. With this limitation on torque peaks, the mechanical stress of the machine is reduced.

Thus, the overall system availability also increases, and the maintenance intervals are reduced. Soft Torque works also during the stopping procedure, which makes it a good feature to use for pumping applications.

User Account Management (UAM) for Better Administration and control

Enhanced security is ensured when there is a possibility for the user to create various accounts in the starter with individual usernames & passwords for multiple roles having different authorization levels for access, controls, and management.

Selecting the right Soft Starter

There are multiple and readily downloadable configurators

that can help in selecting the right soft starter. Siemens Simulation Tool for Soft Starters (STS) eases out the otherwise cumbersome soft starters selection process by simulating the specific – application along with the site conditions and generating results that are easily integrable in almost all the common engineering tools. The working interface of these configurators are simple, intuitive, quick, and easy-to-use.

The major advantages these configurators offer their users are the dual benefit of integrated manufacturer's motor data and multiple load curves to pick from for the best engineered and simulated output.

Is your solution FUTURE ready?

Industry 4.0 has harbingered digital transformation across industries in full swing. With process and workspace digitalization – the need to have sustainable, communicable & cross device Integrable, efficient and a secure solution is a must.

To fully exploit the potential of digitalization we need to have data – from the field devices. And for this the modern range of devices should be Smart and Communicable.

The latest generation of soft starters like SIEMENS 3RW5 - support rugged and secure industrial communication protocols like PROFINET, PROFIBUS, Ethernet, Modbus ... and can transfer data to Mindsphere and other cloud-based services, enabling flexible use both directly at the switchgear as well as at the management level.

This ensures ready availability of machine and plant data at all times, delivering greater transparency, increasing cost-effectiveness, avoiding untimely and unplanned plant downtimes and gives you as a user the benefit to access the operating data across all systems, and use it for further analysis. The results are protected against manipulation and can be used for predictive maintenance, energy data management and resource optimization.

The new generation Soft starters with the increased functionality are now ready to revolutionize the modern-day productivity and workflows. 

Spardha Gupta is a Product Manager for Soft Starters at Electrical Products, Smart Infrastructure, Siemens Limited.

“KUSAM-MECO” True RMS Digital Multimeter Model KM 60-T

KUSAM-MECO has introduced a new TRMS Digital Multimeter Model-KM 60-T. It is a 6000 counts Multimeter having 12 functions & 39 Ranges. It has a large backlight display. It measures TRMS AC Voltage up to 750V & AC Current up to 10Amps. It has function of DC Voltage up to 1000V & DC Current upto 10A. It can also measure frequency up to 10 MHz. The Resistance range is up to 40 M Ohms. Additionally it measures Capacitance up to 9.999 mF. It also has Diode & Continuity TEST. Other features include Non-Contact Voltage detection & pulse output. It also has data hold & MAX/MIN & Rel Zero function. For taking measurement in poorly lit or dark places, it is equipped with a flash light. To conserve power, the instrument will be deactivated if there is no input signal for about 15 minutes. Over range is displayed by “OL”. It is light in weight (approximately 250gms including battery). It is supplied with high quality Test lead, battery & user manual. It is warranted for 01 year.

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TAP OFF (TEE) CONNECTORS

Suitable for a range of Cables Sizes
MVT and SMVT are based on Post Type Insulators
STOC is based on Pin Type

Type Tested for **11KV** Also Available for **upto 33KV**

- Fully Insulated Porcelain (MVT)
- Fully Insulated Silicon (SMVT)
- Shrouded Type (STOC)

Photographs (in clockwise order from top right)

1. Frontec STOC Typical installation
2. Frontec SMVT
3. Frontec Porcelain MVT
4. Frontec STOC
5. Installed MVO, Kandahar
6. Typical installation use for Tap Off Connectors

KEY FEATURES
MVT and SMVT connectors offer a safe and fully insulated method for loop in/loop out from AB cable networks.
Made using Frontec Anti-Track Material
Preferred as an alternative over AB cable straight through joints
Can be provided with optionally available Resealable silicon shroud covers

LT (1.1 KV)
JOINTING KITS & TERMINATIONS

11KV, 22KV, 33KV
JOINTING KITS & TERMINATIONS

TAP OFF CONNECTORS
ABC ACCESSORIES

ANTI-TRACK TUBING

MEDIUM VOLTAGE LINE COVERS
BIRD FAULT PROTECTOR
CABLE END CAPS

NAMASTE JOINT COVERS

HEAT SHRINKABLE
MOULDED SHAPES
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Today, Frontec manufactures over 75% of the items in its kits in-house.

Imported content in our kits constitutes less than 4%

In the past 30 years, Frontec has serviced several prestigious customers (both SEB's as well as large Private Contractors) in India. Frontec has the capability to customize and develop specialized shapes/sizes of Heat Shrinkable Products for and **exports several proprietary Heat Shrinkable Components** to key customers across the globe.

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INTRICACIES OF LIGHTNING

PART-2

Earthing is primarily provided to electrical or electronic systems to offer an alternative route for the flow of leakage currents. The objective is safety. However, proper earthing is very essential to protect people and property from lightning. How to design that?

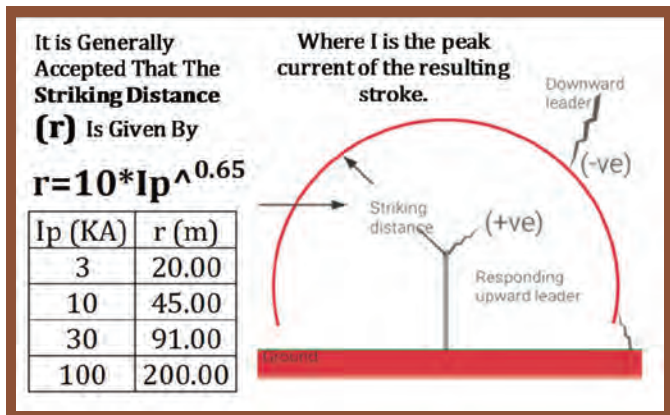
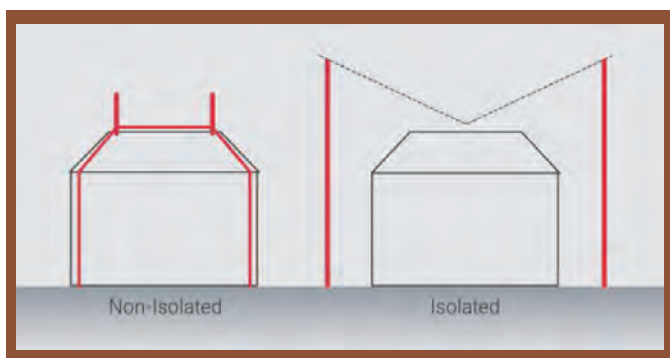
Typically LPS follows two installation approaches

Non Isolated System: Here, LPS is directly installed on the structure that needs to be protected.

Isolated System: Here, LPS is isolated from the structure under protection by a specified distance, sufficient enough that energy flowing through the LPS does not spark with the protected structure. They are mainly used for structures that store combustible materials or are parts of telecommunication sites.

Air Terminal Placement

For air-terminal placement, the main consideration is the minimum value of expected current and the ability of the LPS to intercept these smaller flashes. As described



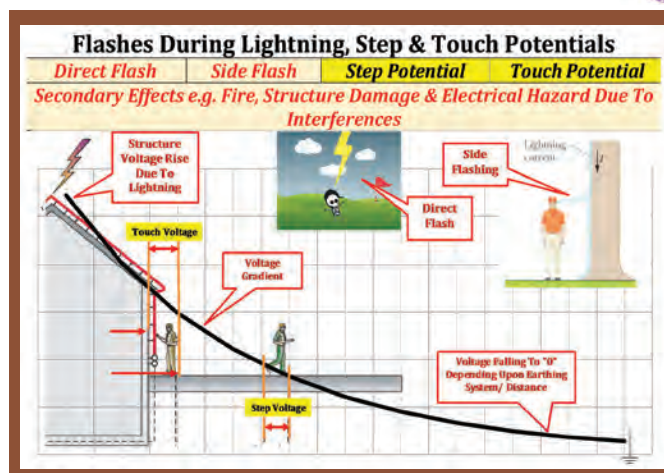
earlier, as the lightning downward leader approaches the ground or structure, the electric field increases to the point that the ground or structure launches an upward leader that may eventually intercept the downward leader. This is termed the “striking distance”.

The larger the amount of charge carried by the lightning leader, the greater will be the distance at which this happens (as the larger the charge of the leader, the larger the resulting lightning current).

This formula shows that it is more difficult for an air-terminal to intercept a smaller lightning flash than a larger flash, as the smaller flash must approach closer to the air-terminal before the upward leader is launched. To protect the structure against smaller lightning flashes, air-terminals must be spaced closer together.

For smaller lightning flashes there is a risk that an air terminal may not be close enough to intercept the down leader, thus a closer structural point releases an upward leader which intercepts the flash (i.e. the building is struck). For each of the lightning protection levels, a minimum current level to be protected against has been statistically determined along with their probability percentages that lightning may be greater – than these levels.

However, no LPS can claim to be 100% effective or safe as lightning protection is an issue of statistical probabilities and risk management. A system which is



protected by a well-designed system will statistically reduce the chances of risk, which may occur when we consider lightning hit. Some of them are:

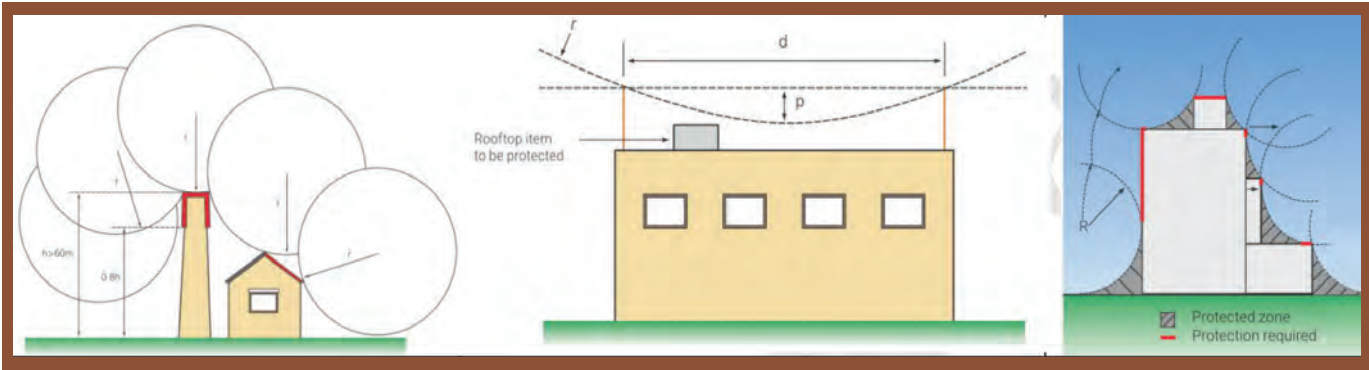
Step Potential: When lightning strikes and the lightning current flows into the earth, a large voltage gradient builds up around the earth electrode & the voltage rise is greatest near the electrode where current density is the highest. The normal “step distance” of a person is about 1 metre. At the time of discharge being close to the earth electrode means the voltage differential across this distance can be large enough to be lethal – depending upon circumstances such as condition of footwear, etc., substantial current can flow through one lower leg to the other. In the case of animals, a larger risk exists. The distance between the front and rear legs of larger animals can be in the order of 2 metres, and the current flows through the more sensitive region of the heart.

Touch Potential: Touch potential is due to a similar reason as step potential, but the voltage differential being considered is that which exists between the hand and (generally) feet. The risk of electrocution due to touch potential is greater than for step potential, as the passage of current flows close to the heart region.

Side Flashing: all down-conductors have a resistance and when lightning current flow through them, their surface voltage may rise to a level to cause a Flashover to a nearby conductive object. This can be controlled by using a number of parallel down-conductors or ensuring the separation distance between the two objects is sufficient.

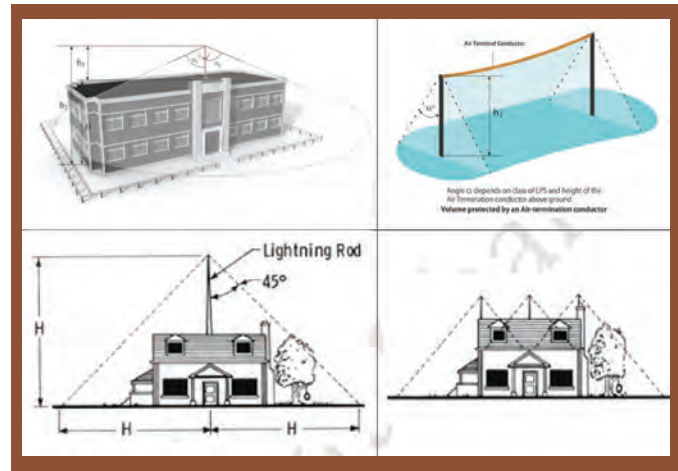
Basics of Designing Method for LPS

Rolling Sphere Method (RSM): In this method the radius of the sphere is considered as equal to the striking distance associated with the minimum current level for



the chosen lightning protection level. This imaginary sphere is rolled over the structure. The surface contact points traced out by the sphere define possible points that may launch an upward leader to intercept with the downward leader. All these points are deemed to require protection, whilst the untouched points do not. Generally, an LPS is designed such that the rolling sphere only touches the LPS and not the structure. This is the most effective way of designing LPS.

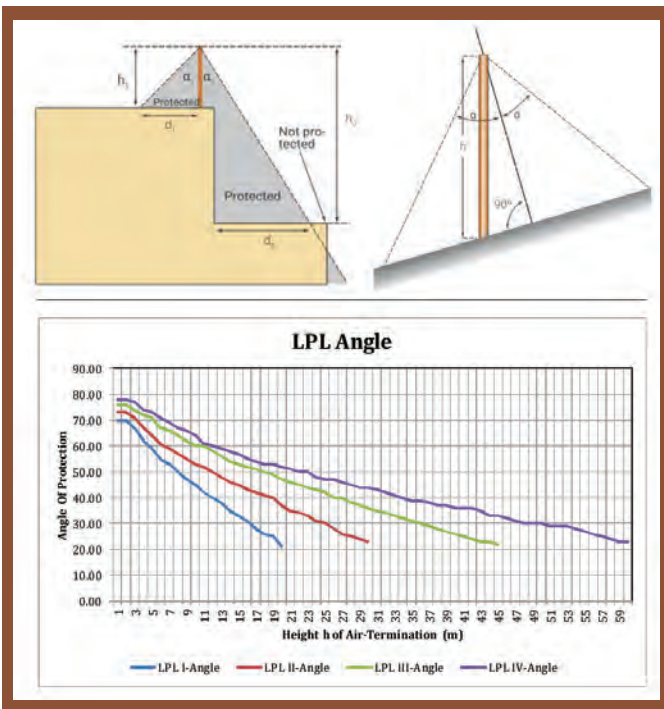
Protection Angle Method (PAM): Air-terminations (rods/masts and catenary wires) are located so the volume defined by the protection angle covers the structure to be protected. The height of the air-termination is measured from the top of the air-termination to the surface to be protected. The protection angle method is limited in application to heights that are equal to or less than the corresponding rolling sphere radius. Where the

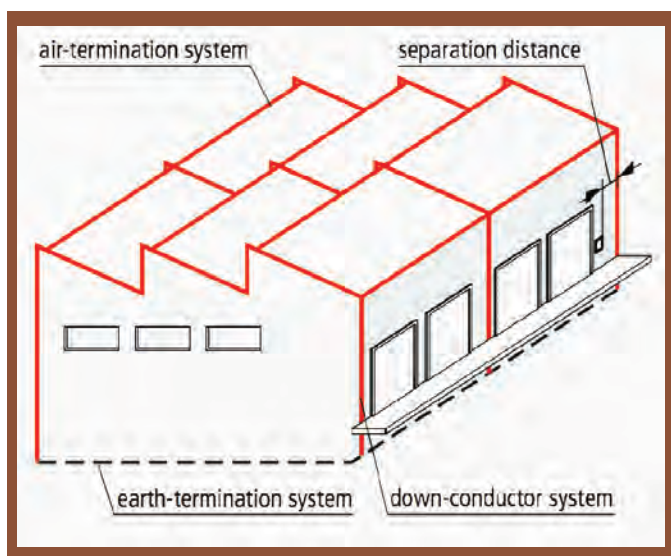


protection angle method alone is employed, multiple rods are generally required for most structures. However the protection angle method is most commonly used to supplement the mesh method, providing protection to items protruding from the plane surface. The protection angle method can be used on inclined surfaces, where the height of the rod is the vertical height, but the protection angle is referenced from a perpendicular line from the surface to the tip of the rod.

Additionally, the Protective Angle Method is only valid up to heights equal to the radius of the rolling sphere as defined by the class of LPS defined for the structure.

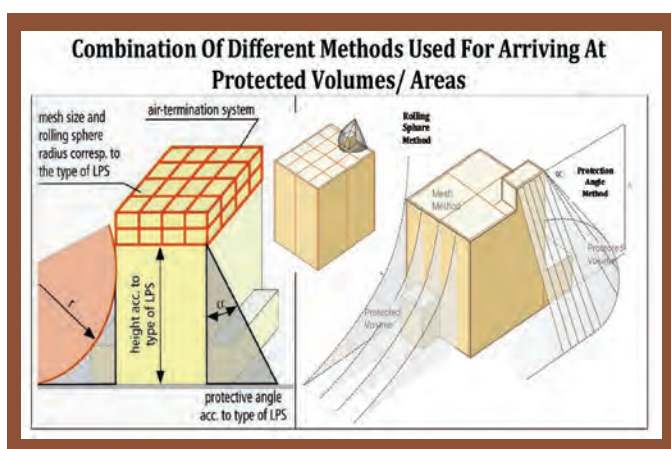
Mesh Method: The mesh method is recommended for flat roof surfaces in which meshed conductors are placed on edges as well as on surface to form a mesh & then from each edge joint, minimum two separate paths are made to direct to ground. Natural components may be used for part of the mesh grid, or even the entire grid. It is also recommended for the protection of the sides of tall buildings against flashes to the side. The mesh method should not be used on curved surfaces, but can be used on non-horizontal plane surfaces and compound surfaces e.g., on the vertical sides of tall buildings for protection against flashes to the side, or on compound





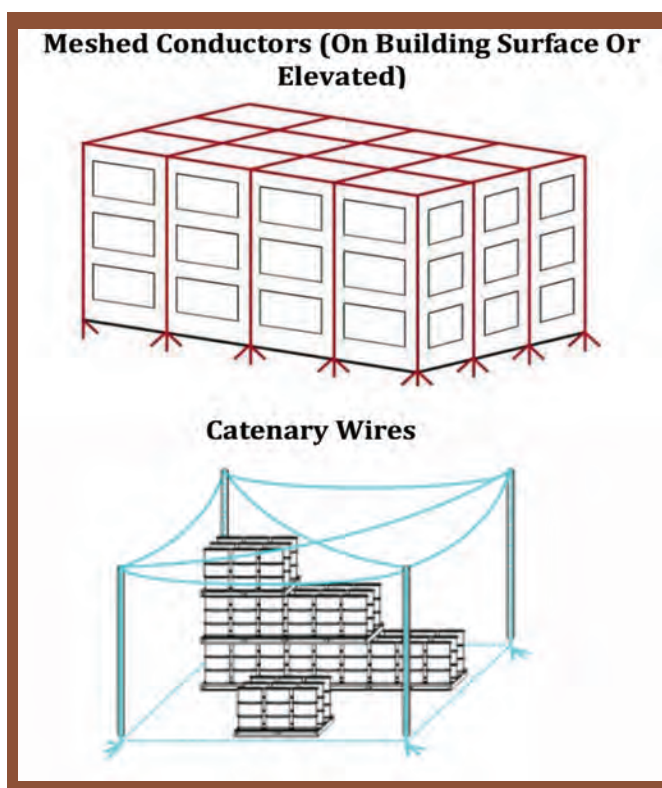
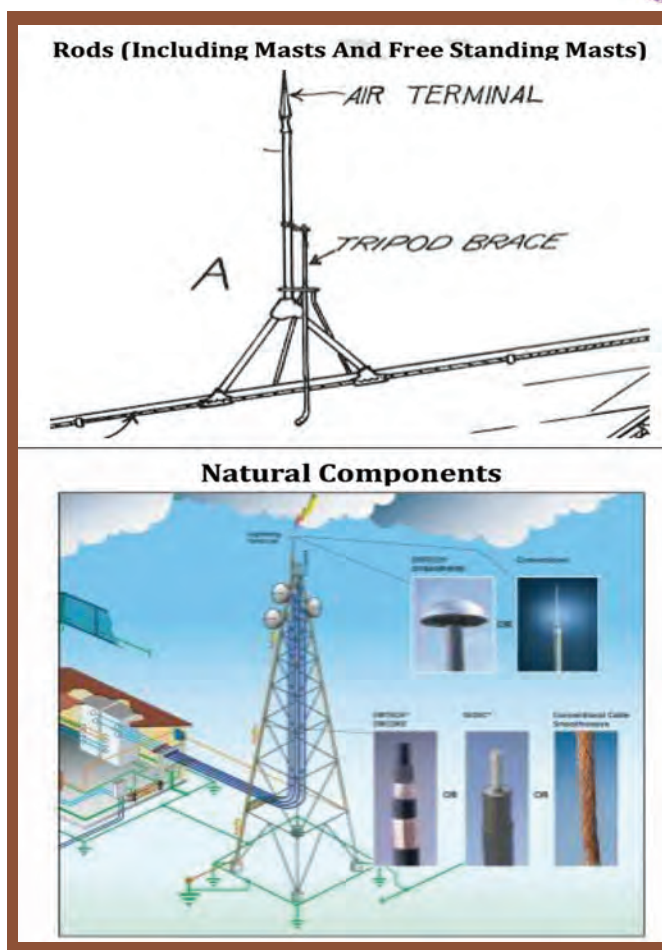
surfaces such as industrial roofs. For compound surfaces, conductors should be placed on the roof ridge lines if the slope exceeds 1/10. *Natural components are typically metallic structural items that will not be modified during the life of the structure, such as reinforcing steel, metal framework and roofing/cladding. Natural components must meet minimum material requirements and be electrically continuous with secure interconnections between sections such as brazing, welding, clamping, seaming, screwing or bolts.)*

Due to highly unpredictable nature of lightning, there is no single method that can be said to be fool proof and it is always a combination of system that is preferred for lightning protection. It is shown below with volume protected by combination of all three methods:

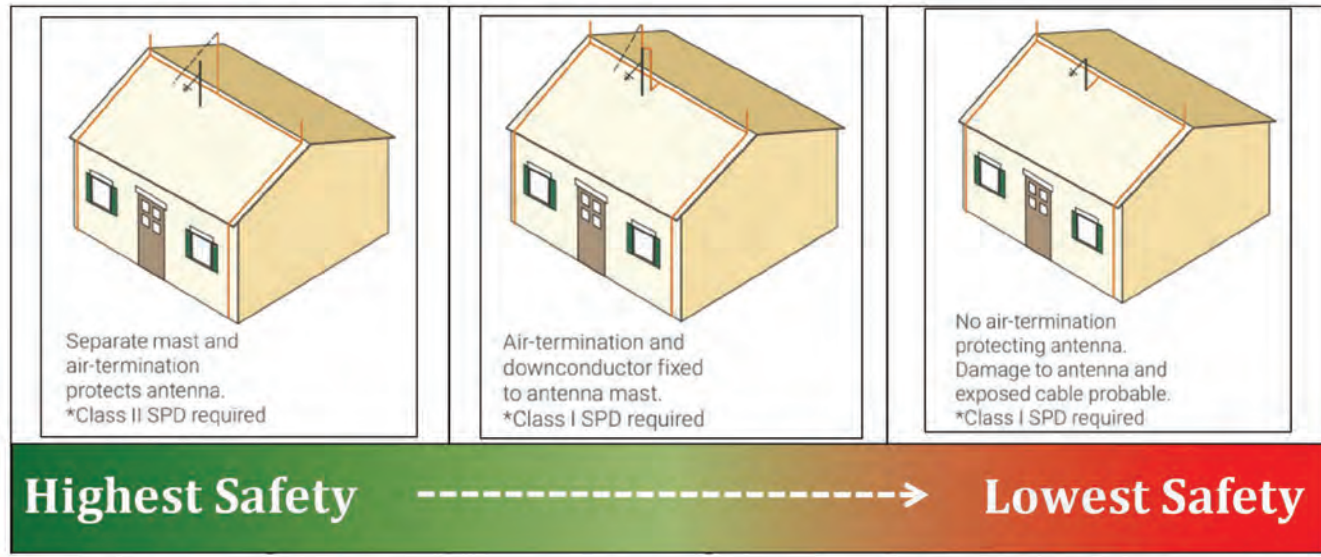


Air Terminals & Their Use

Air-terminations are the main front end devices that specifically placed at specified locations to capture the lightning flashes. Some of air-terminations types are:



Air Terminal Placement



Also, all items on the roof that contain electronic or electrical equipment require protection via air-terminations. Surge protective devices must be installed on the circuits to limit current entering into the internal environment.

Earthing & Its Importance in LPS

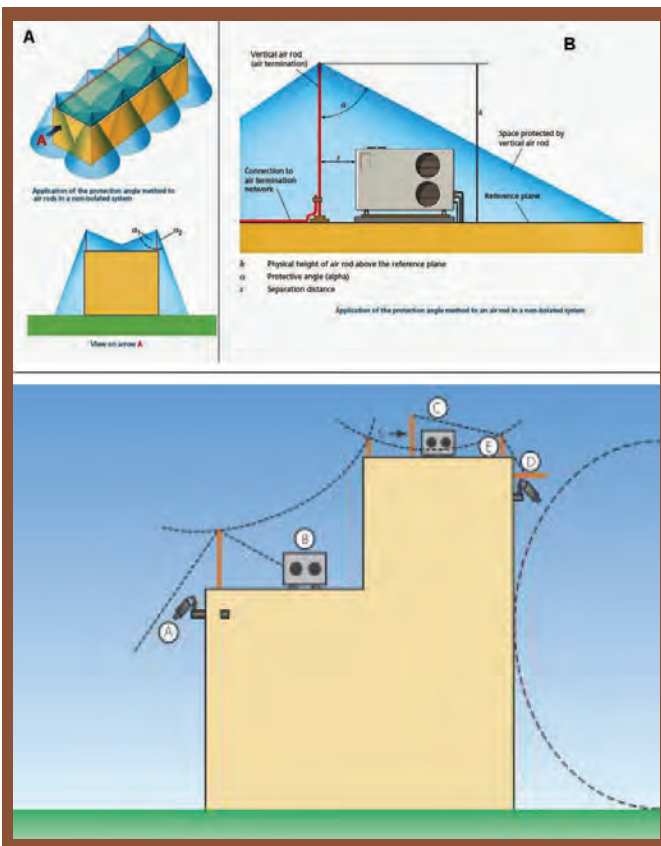
The most critical part of LPS is earthing, which if not made correctly or maintained correctly in which case lightning will cause the havoc despite, investing money on all other items. The reliable performance of the entire LPS is dependent upon an effective earthing system. Following points must be kept in mind:

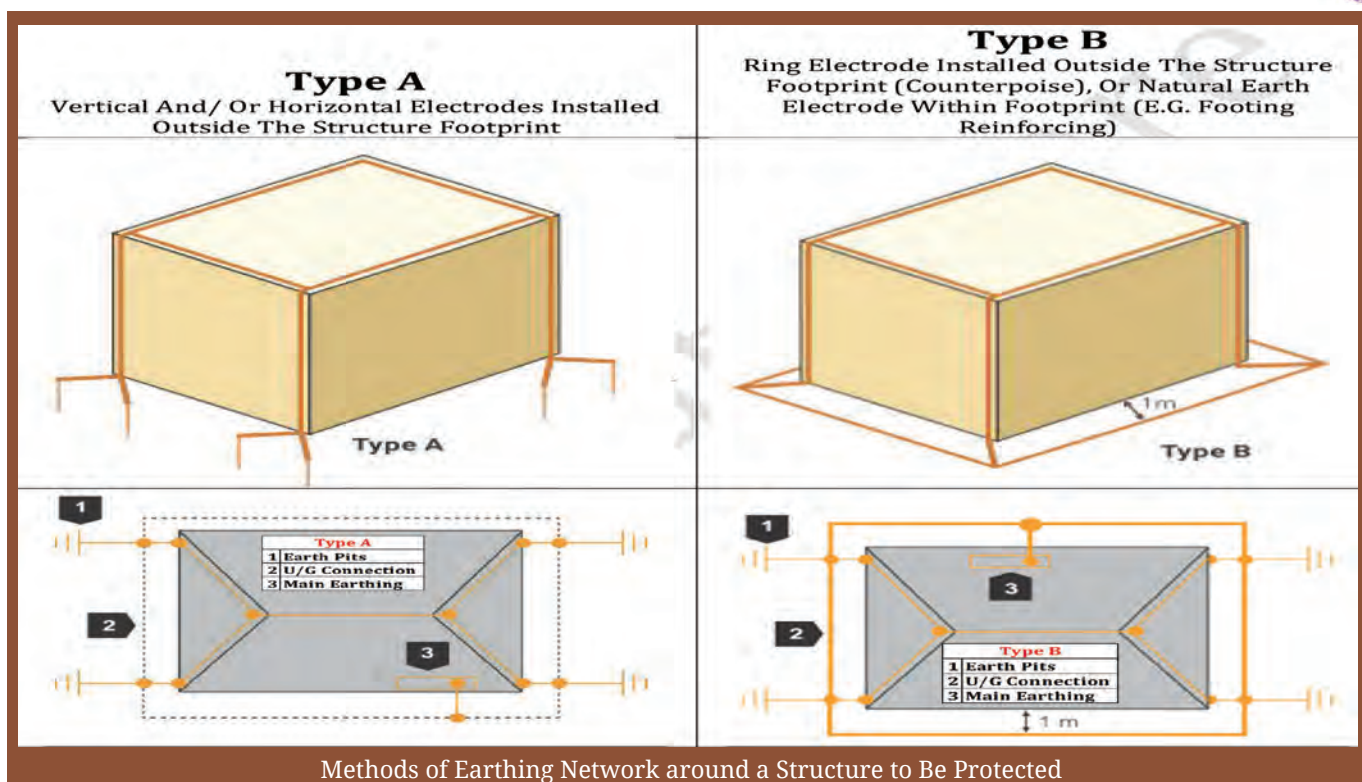
- Providing a low impedance network to dissipate the fast-rising lightning impulse
- Minimization of touch and step potential hazards
- Long term performance of the system – i.e. quality of materials and connections

While the earthing system of LPS is normally installed and tested as a dedicated system, it is required by most codes that the earthing system of any LPS must be kept separately yet interconnected with other earthing systems. Isolation from the telecommunication, power and other earthing systems is highly recommended.

The earthing system (and down-conductors) should be located away from entrances and exits of the structure and places where people may congregate. If the earthing system is in locations accessible to the public, then measures should be taken to minimize step potential risks.

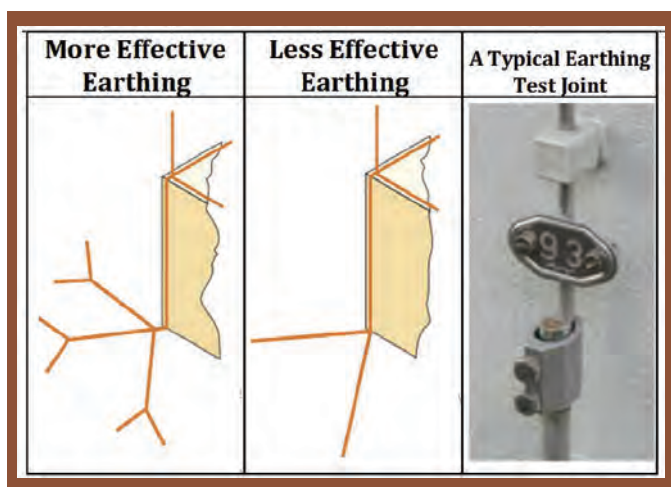
- The earthing system should be located away from other metallic buried items (e.g. bore well, Gas & water pipelines and services).
- Test joints should be installed between the local





electrode sections and down-conductor to enable isolation and measurements of sections of the system during future inspection and testing.

- It is recommended that IS: 3043 1987 must be followed while making an earth pit.
- And preferably multiple paths to multiple earth pits should be provided for diverting the Lightning current.



Earthing Resistance Requirements: The general requirement is that the earthing of LPS must have a resistance of less than 10 ohms measured at a frequency different from the power system frequency or multiple thereof.

Epilogue

When we look at a Lightning Protection System in its most elementary form, it is quite simple in which simple metal rods (air terminal) are installed to divert the striking lightning to ground by providing a low resistance conducting path. The system provides protection from lightning to the structures. The overall concept seems very simple yet considering the unpredictable nature of lightning, which till no one is able to define till date, it is very complicated. It is this unpredictability, which brings one of those very difficult challenges of designing a protection system which requires use of historical data & statistical model to forecast its behaviour & nature. Yet this statistical model is based upon a great amount of science and theoretical investigation developed over the last two plus centuries. These researches & studies have created modern theories that guide engineers to work out engineering solutions and develop LPS to provide a statistically derived protection system by optimizing the overall cost and designed to work silently 24X7 without any recurring cost. ...Concluded



Prabhat Khare possesses a BE (Electrical) degree from IIT Roorkee (Gold Medalist). Now, he is the Director of KK Consultants. He is also a BEE Certified Energy Manager and a Lead Assessor for ISO 9K, 14K, 45K & 50K.



The author, in his decades of experience, has come across a few common mistakes that people do in the design, specification, selection, procurement, installation, operation & maintenance of Energy Management Systems. This article aims to discuss a few of those mistakes...

Energy Metering, Smart Metering, Digital Metering, Energy Management System (EMS), et al., have become the buzz words in the industry today. What will happen with the Energy Conservation Act, 2001, the Energy Conservation Building Code, 2018 and the stipulations of the Bureau of Energy Efficiency? And, it has become a fancy for electrical & energy professionals that they have implemented the best energy management system in their installations. But are all these installations really 'efficient'?

Selection of the CT/PT Accuracy Class

More often than not, many energy managers & electrical engineers, dutifully specify the most modern smart energy meter, with the best class of accuracy, available in the market today (i.e.) that of Class 0.2S. The advantage of such a class of meter is that it would maintain its accuracy of an error of $\pm 0.2\%$, even at very low loadings of the order of 20% of the rated value.

But such 'pseudo-smart' engineers fail to realise that such a smartest energy meter would work accurately, only, and only if the associated Current Transformers (CT) and Potential Transformers (PT) are also of the best accuracy class available for commercial use.

That is, if the meter is of Class 0.2S, then the CT must also be of Class 0.2S and the PT, of Class 0.2. If the CT and/or PT are of a poorer

accuracy class, such as Class 0.5 of Class 1.0, then there is no point in having a Class 0.2S energy meter alone.

In many specifications, this practice of specifying a Class 0.2S Energy Meter, but a Class 0.2 or Class 0.5 or Class 1.0 CT and/or a Class 0.5 or Class 1.0 PT is prevalent. This includes specifications of many Central Government Establishments, State Electricity Boards, DISCOMs, private power utilities, leading consultants, leading industries, etc.

Lesson 1

Unless the CT, the PT and the Energy Meter are of the best accuracy class available, there is no big advantage of having only a class 0.2s energy meter.

Selection of the CT/PT Burden: In earlier days, in the era of Electro-mechanical Meters, the burden of the Current Coils and that of the Voltage Coils of the meters were of the order of 5VA to 7.5VA each. So, it was normal practice to specify CTs with a typical burden of 15VA or more, as more than one current operated meters – like Analogue Ammeters, Analogue Power Factor Meters, Analogue Power (kW) Meters, Analogue Energy Meters, etc. - were to be connected in series. Same is the case with

PT, wherein the PT Burdens were of the order of 100VA, as more than one Voltage operated meters and equipment – like Analogue Voltmeters, Analogue Frequency Meters, Analogue Power Factor Meters, Analogue Power (kW) Meters, Analogue Energy Meters, Phase Indication Lamps, etc. – were to be connected in parallel.

But now, with the advent of modern digital electronic multifunction meters, the total burden imposed by the meter on the current coil is of the order of 0.2 to 0.25VA and that of the potential coil, is of the order of 0.5VA maximum.

So, there is no point in continuing the age-old practice of specifying CTs with a burden of 15VA or more and PTs with a burden of 100VA or more.

In fact, one is doing a gross injustice to the measuring system, by such over-specification of the CTs & PTs.

Because, as per IS & IEC Standards, the accuracy of a given CT is guaranteed only between 25% to 100% of the rated burden connected to the CT Secondary. If the actual connected burden is less than 25% of the rated burden of the CT, then its accuracy will be greatly affected, and the errors would increase manifold.



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MODEL - 11KV / 33KV / 66KV / 132KV / 220KV / 400KV

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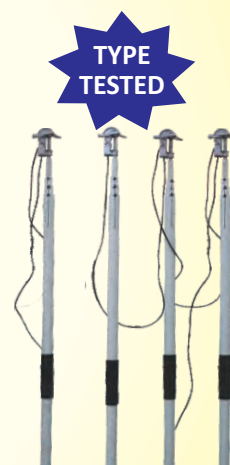
“KUSAM-MECO” has introduced Single Phase or Three Phase Fibre Glass Discharge / Earth Rod.

They are supplied in a wide range of ratings 11 / 33 / 66 / 132 / 220 / 400KV.

They are used to discharge Electrical Systems having limited fault levels.

FEATURES :

- **Rods :** Single Rod (1 Phase);
3Nos. Rod (3Phase)
- **Material :** FRP Pultruded.
- **Process :** Automatic Pultrusion Plant.
- **Surface :** Smooth and Glossy.
- **Design :** Telescopic Type.
- **Locking :** Push Button type Locking System.
- **Total Section :** 03 Section
- **Assembled Length :**
15 feet Length. (11KV, 11-33KV)
16 feet Length (33-66KV),
18 feet Length (66-132KV, 400KV)
21 feet Length (220KV-400KV)
- **H.V.Test :** 110 KV , 400 KV(132-220KV)
- **Glass Content :** 65 %.
- **Top Section Dia :** 25 mm.
- **Bottom Section Dia :** 45 mm.
- **Earthing :** Die cast Alu. Earthing instrument for 30mm
Dia (11KV, 11-33KV) Die cast Alu. Earthing instrument
for 50mm Dia (33-66KV, 66-132KV, 132-220KV)
- **Cable :** 4sq. mm copper cable 06 mtr. long. (11KV)
6sq. mm copper cable 06 mtr. long. (11-33KV)
10sq. mm copper cable 07 mtr. long. (33-66KV)
16sq. mm copper cable 08 mtr. long. (66-132KV)
25sq. mm copper cable 10 mtr. long. (132-220KV)
16sq. mm copper cable 10 mtr. long. (220KV)
35sq. mm copper cable 10 mtr. long. (400KV)
- **Clamp :** Crocodile grounding clamp.(11KV, 11-33KV)
Aluminium “C” grounding clamp. (33-66KV,
66-132KV, 132-220KV, 220KV, 400KV)
- **Cover :** including.



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Energy Metering

You may have specified & procured a CT with the best accuracy class of Class 0.2S, in the fond hope that the errors of such a CT would only be $\pm 0.2\%$.

But remember: This accuracy of Class 0.2S (error of $\pm 0.2\%$) is guaranteed only if the actual burden connected to the CT Secondary is at least 25% of the rated burden of the CT.

If you specify a Class 0.2S CT with a rated burden of (say) 10VA, and connect only a Digital Multifunction Meter, with a current coil burden of 0.2VA to this CT Secondary, and even considering the CT Secondary Winding Burden and the connecting lead burden, the total burden connected to the CT Secondary would be less than 10% of its rated burden. This is sure to increase the errors and record incorrect energy readings, thus negating the very purpose of having opted for a Class 0.2S CT and a Class 0.2S Energy Meter.

Same is the case with PT too.

Lesson 2

The rated burden of the CT and the PT secondary must be as close as possible, but, not less than, the aggregate of the actual burdens connected to the CT/PT secondary. Else, even with the best class of CT, PT and Meter, the desired results could not be achieved in the Energy Management System.

Selection of the CT Primary Current: As per the Standards, the accuracy of a Class 0.2S/Class 0.5S CT is guaranteed between 20% to 120% of the rated primary current of the CT. If the primary current is below 20%, then the error multiplies, and the given accuracy of the CT is not guaranteed. The advantage of having gone for a Class 0.2S CT/Energy Meter are lost.

It is fancy for many electrical engineers to over-specify the CT Primary Current, thinking that higher is better. Imagine one has specified a Class 0.2S CT with a primary current of 1000A, but the maximum continuous load in the feeder is 100A, then, the CT will no more be Class 0.2S and its error would increase.

So, the primary current rating of the CT must also be as close as possible to the normal anticipated continuous current in the feeder.

If one wants to cater to future expansions too, then one may go for multi-tap CTs, say, 250-500-1000A, so that, when the load is less, prior to expansion, a lower tap can be selected. And, as and when the load increases, appropriate higher taps may be selected. This way, the accuracy of the CT would be guaranteed and at the same time, provision is available for future expansions too.

Lesson 3

The rated primary current of the CT must be as close as possible to the maximum anticipated continuous current in the feeder in which the CT is proposed to be installed. Else, given CT accuracy would not be guaranteed and errors would increase, defeating the very purpose of an efficient energy management system.

Selection of PT Accuracy Class: On more than one occasion, I have come across specifications, even from reputed consultants, specifying the Accuracy Class of the PT Metering Secondary as Class 0.2S / Class 0.5S.

This is ridiculous, to say the least. As per the Standards, there is no Class 0.2S or Class 0.5S for PTs.

The 'S' Class is mentioned only in the Standards for CTs, to get the guaranteed accuracy even at 20% rated primary current. This is logical, as the load current in a feeder is a variable phenomenon.

Whereas, whether the load is 0% or it is 100%, the system voltage is almost constant.

So, it is not logical to specify an 'S' Class for PTs. That is why the Standards have not specified the same.

But, some pseudo-intellectual electrical professionals, thinking that they are smart, specify Class 0.2S/Class 0.5S PTs too. If any specifications call for a Class 0.2S or a Class 0.5S PT, then it is a gross violation of Standards and such a PT cannot be offered at all as such a PT cannot be manufactured & tested.

Lesson 4

There is no class 's' in PTs. Specifying such PTs, would only highlight the incompetency of the specifying engineer.

Conclusion

As seen in the above paragraphs, it is not just enough to have a partially efficient Energy Metering System. For the Energy Metering System to work effectively, all the constituent components also have to be cautiously chosen, avoiding any of the above mistakes.

Hope that this article serves as an eye opener and concerned energy professionals avoid such mistakes in the implementation of their Electrical Energy Metering System. 



K. Sivakumar is a Technical Advisor at Sriwin Electric, Salem.

ALL INDIA INSTALLED CAPACITY (IN MW) OF POWER STATIONS (As on 31.07.2021)

Region	Ownership/ Sector	Mode wise breakup								Grand Total
		Thermal					Nuclear	Hydro	RES * NRE)	
		Coal	Lignite	Gas	Diesel	Total				
Northern Region	State	16659.00	250.00	2879.20	0.00	19788.20	0.00	5888.25	725.51	26401.96
	Private	22425.83	1080.00	558.00	0.00	24063.83	0.00	2961.00	19415.54	46440.37
	Central	15662.48	250.00	2344.06	0.00	18256.54	1620.00	11484.52	379.00	31740.06
	Sub Total	54747.31	1580.00	5781.26	0.00	62108.57	1620.00	20333.77	20520.05	104582.39
Western Region	State	21500.00	900.00	2849.82	0.00	25249.82	0.00	5446.50	569.28	31265.60
	Private	32847.17	500.00	4676.00	0.00	38023.17	0.00	481.00	29674.35	68178.52
	Central	20144.92	0.00	3280.67	0.00	23425.59	1840.00	1635.00	666.30	27566.89
	Sub Total	74492.09	1400.00	10806.49	0.00	86698.58	1840.00	7562.50	30909.93	127011.01
Southern Region	State	20322.50	0.00	791.98	159.96	21274.44	0.00	11774.83	592.88	33642.15
	Private	12747.00	250.00	5340.24	273.70	18610.95	0.00	0.00	44089.86	62700.81
	Central	11835.02	3390.00	359.58	0.00	15584.60	3320.00	0.00	541.90	19446.50
	Sub Total	44904.52	3640.00	6491.80	433.66	55469.99	3320.00	11774.83	45224.64	115789.46
Eastern Region	State	7450.00	0.00	100.00	0.00	7550.00	0.00	3537.92	275.11	11363.03
	Private	6153.00	0.00	0.00	0.00	6153.00	0.00	209.00	1422.41	7784.41
	Central	14287.56	0.00	0.00	0.00	14287.56	0.00	1005.20	10.00	15302.76
	Sub Total	27890.56	0.00	100.00	0.00	27990.56	0.00	4752.12	1707.52	34450.20
North Eastern Region	State	0.00	0.00	466.36	36.00	502.36	0.00	422.00	233.25	1157.60
	Private	0.00	0.00	24.50	0.00	24.50	0.00	0.00	219.32	243.82
	Central	770.02	0.00	1253.60	0.00	2023.62	0.00	1522.00	30.00	3575.62
	Sub Total	770.02	0.00	1744.46	36.00	2550.48	0.00	1944.00	482.57	4977.04
Islands	State	0.00	0.00	0.00	40.05	40.05	0.00	0.00	5.25	45.30
	Private	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.66	27.66
	Central	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10	5.10
	Sub Total	0.00	0.00	0.00	40.05	40.05	0.00	0.00	38.01	78.06
ALL INDIA	State	65931.50	1150.00	7087.36	236.01	74404.86	0.00	27069.50	2401.27	103875.64
	Private	74173.00	1830.00	10598.74	273.70	86875.45	0.00	3651.00	94849.14	185375.59
	Central	62700.00	3640.00	7237.91	0.00	73577.91	6780.00	15646.72	1632.30	97636.93
	Total	202804.50	6620.00	24924.01	509.71	234858.22	6780.00	46367.22	98882.72	386888.15

Figures at decimal may not tally due to rounding off

Source: CEA



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3 YEARS	18	2000.00	2900.00	3500.00	2000.00	3900.00	4500.00
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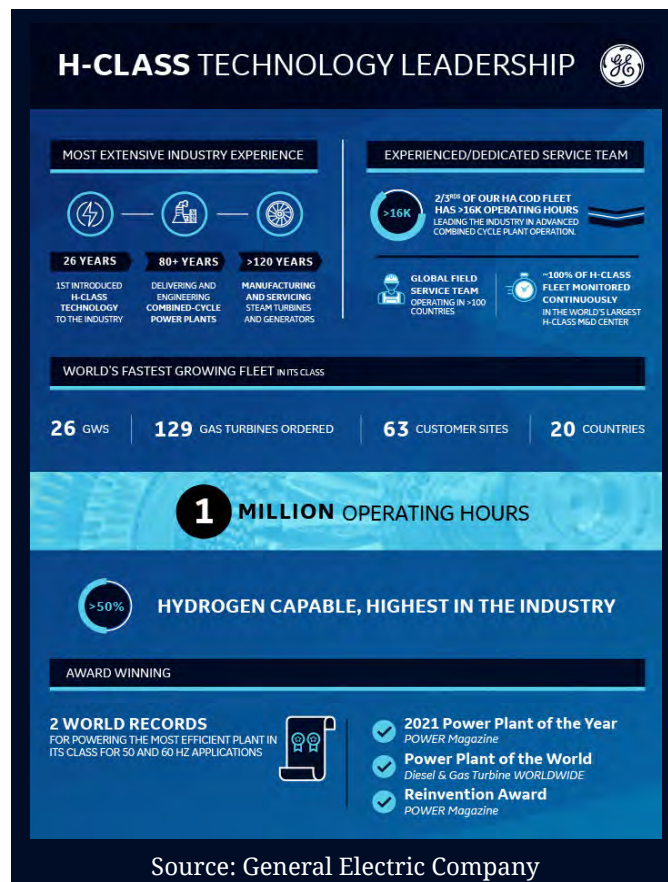
Award Winning Projects

GE's H-Class supports shift to producing more sustainable power, including pathways to near-zero carbon operations through these new gas turbines that can use pre-combustion hydrogen fuels and post-combustion carbon capture, utilization and sequestration...

GE has recently celebrated its record-setting H-Class heavy duty gas turbine fleet – the fastest growing fleet in its class – has secured more than 50 customers across 20 countries, generated more than 26 Giga Watts (GW) of power, and accumulated more than 1,000,000 commercial operating hours. Since the launch of its flagship HA gas turbine in 2014, followed by the first unit in commercial operation in 2016 with record-setting combined cycle efficiency, GE's HA gas turbine has helped power plant operators reduce emissions, increase efficiency, retire coal-fired facilities, and integrate greater levels of renewable energy.

Detailing on the development, Amit Kulkarni, Head of Product Management for Heavy Duty Gas Turbines of GE Gas Power, said, "GE meticulously engineered our H-Class turbines to be an industry leader and help power plant operators thrive in the complex world of the energy transition, providing reliable and sustainable power today and being well-positioned as a destination technology for years to come. GE is advancing flexible, efficient, and reliable gas power generation solutions as gas is best-suited to complement renewable energy. We are proud of the momentum, progress, and collaboration with our HA customers as we celebrate this 'One Million Hours' milestone with them."

In 2021, Southern Power Generation's 1.4-GW Track4A Power Plant, a natural gas-fired power plant in southern Malaysia that is equipped with the first commercial GE 9HA.02 gas turbines – one of the world's largest and most efficient power-generating models – was recognized by POWER Magazine as their '2021 Power Plant of the Year' and by Diesel & Gas Turbine Worldwide as 'Power Plant of the World' for "a meaningful model for balancing climate awareness, energy affordability, and reliability in power-hungry Southeast Asia." In addition, the role of GE's HA technology adopted at China Huadian Corp's Juliangcheng plant was recognized for its accelerating role to retire existing coal-fired capacity and



replace it with new, high efficiency combined cycle with POWER Magazine's 'Reinvention Award'.

Additionally, GE has recently announced new HA-powered pilot projects focused on demonstrating power plants capable of operating on hydrogen. GE's H-Class gas turbine portfolio currently has the capability to burn up to 50% by volume of hydrogen when blended with natural gas. This capability is enabled by the DLN2.6e combustion system that is standard on current 9HA.01, 9HA.02 and 7HA.03 gas turbines offerings. Hydrogen is not the only path for decarbonizing gas turbines. GE's H-class Combined Cycle Plants can also be configured with a post-combustion capture system to reduce CO₂ emissions by up to 90%. E1

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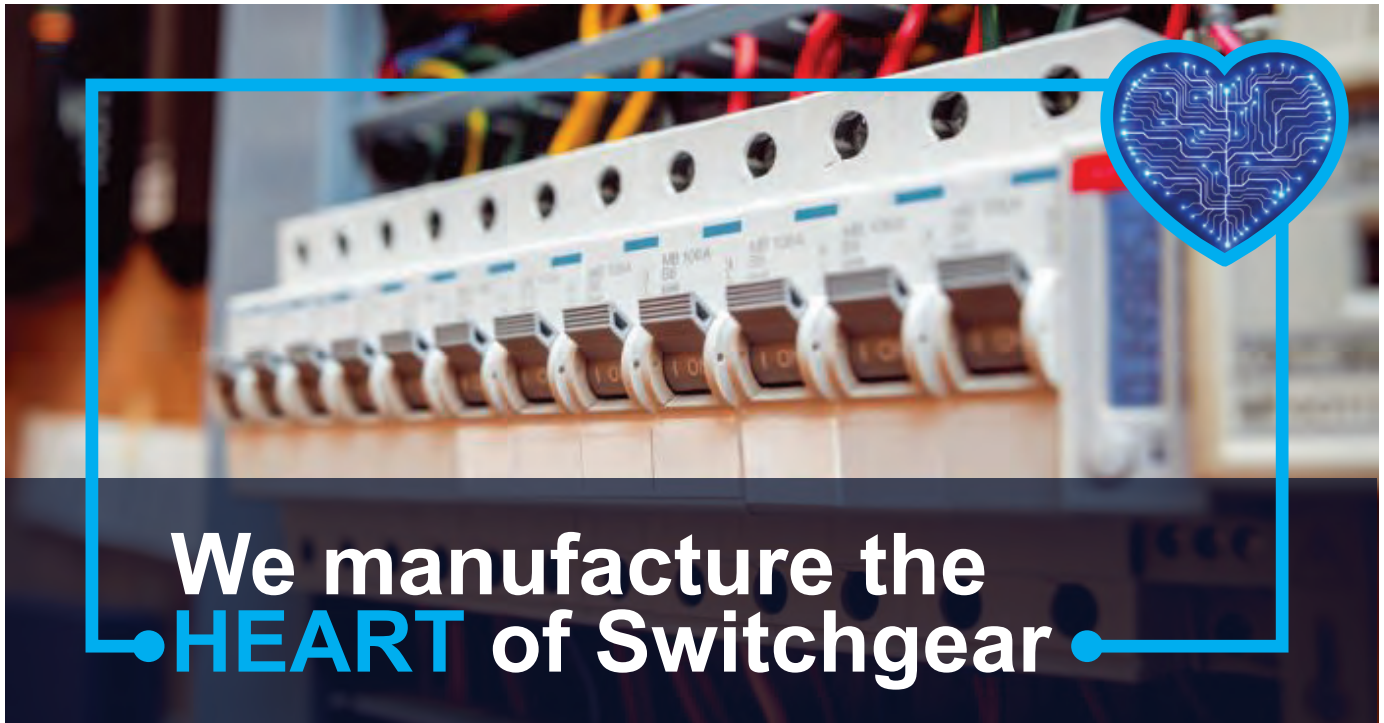


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