TAMILNADU ELECTRICAL INSTALLATION ENGINEERS' ASSOCIATION 'A' GRADE

NEWSLETTER

ISSUE NO. 195	VOL NO. 19/2024	MONTHLY ISSUE NO. 2	PRIVATE CIRCULATION ONLY	APRIL 2024

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS' ASSOCIATION 'A' GRADE (Regn. No. 211/1992)
No.7/21, Ground Floor, Aradhana Apartments, Temple Avenue, Srinagar Colony, Saidapet, Chennai - 600 015.
Phone: 044-22330601, 9710204300 Email: tnagrade@gmail.com Website: www.teiea.com

ANNUAL GENERAL BODY MEETING - 2024
TECHNICAL SEMINAR

on 9th March 2024 at Hotel Jayapushpam, Chennai.

Inauguration
Lighting of Traditional Lamp

Financial Report
(From 29.09.2022 To 29.02.2024)
Treasurer, TNEIEA

Members - Gatherings

“Association Office New Building Fund”

Voluntary contributors- Honouring

"Association Office New Building Fund"
Voluntary contributors- Honouring

TNEIEA honouring
M/s. KEI Cables Ltd., Chennai

TNEIEA honouring
M/s. Great White Electricals, Chennai

TNEIEA honouring
M/s. Sinewaves Solutions India Pvt. Ltd.,
Chennai

TNEIEA honouring
M/s. Faith Power Solutions,
Chennai

TNEIEA honouring
M/s. Power Cable Corporation,
Chennai

TNEIEA honouring
M/s. Gravin Earthing & Lightning,
Chennai

EDITORIAL

Dear Members, Fellow Professionals and Friends,

Greetings To All!

Best Wishes to all for a Bright Business Year 2024–25!!

Happy Tamil New Year's Day!!!

Keeping good habits is crucial for preventing strokes, which can have severe and long-lasting consequences on our health. Here are a few key points to consider:

1. Regular physical exercise: Engaging in regular physical activity, such as walking, jogging, or swimming, can improve cardiovascular health, reduce blood pressure, and maintain a healthy weight. Aim for at least 150 minutes of moderate-intensity exercise every week.

2. Balanced diet: Consuming a nutritious and well-balanced diet is essential in preventing stroke. Incorporate plenty of fruits, vegetables, whole grains, lean proteins, and healthy fats while limiting salt, sugar, and saturated fats. A diet low in sodium can help maintain healthy blood pressure levels.

3. Control blood pressure levels: High blood pressure is a significant risk factor for strokes. Monitor and control your blood pressure through a combination of dietary changes, regular exercise, stress management techniques, and in some cases, prescribed medications.

4. Quit smoking: Smoking significantly increases the risk of stroke. Quitting smoking is one of the most impactful steps you can take to enhance your overall health. Reach out to resources, support groups, or healthcare professionals to develop strategies to quit smoking successfully.

5. Limit alcohol consumption: Drinking excessive amounts of alcohol can raise blood pressure and increase stroke risk. Moderation is key. Men should limit alcohol to two standard drinks per day, while women should consume no more than one standard drink per day.

6. Manage stress: High-stress levels can contribute to an increased risk of stroke. Implement stress management techniques, such as regular exercise, deep breathing exercises, mindfulness or meditation practices, and maintaining a healthy work-life balance.

7. Regular health check-ups: Schedule routine check-ups with your healthcare provider to monitor key health indicators, such as blood pressure, cholesterol levels, and blood sugar. These check-ups can help identify any underlying conditions or risk factors for stroke and allow for timely intervention.

Remember, preventing strokes requires proactive efforts to maintain a healthy lifestyle. Engaging in these habits consistently and seeking medical advice when necessary can significantly reduce the risk of stroke and help promote overall well-being.

We thank all those members who have helped us by participating in the advertisement appearing for the issue February 2024 – Sakthi Transformers, Pentagon Switchgear (P) Ltd., MV Power Consultants & Engineers (P) Ltd., Galaxy Earthing Electrodes (P) Ltd., Supreme Power Equipment Ltd., Global EPC India Pvt Ltd., Indo Swiss Electricals & Enterprises, Power Cable Corporation, Gravin Earthing & Lightning Protection System (P) Ltd., Sri Bhoomidurga Marketing (P) Ltd., E Power Engineering, VSP Power Solutions, Sastinadha EPC Solutions India Pvt Ltd., Velan Infra Projects Pvt Ltd., 3SI Eco Power LLP., Sinewaves Solutions India Pvt Ltd.

EDITOR

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS' ASSOCIATION 'A' GRADE

NEWSLETTER

President : S.D. POONGUNDRAN
Secretary : V. RENGARAJAN
Treasurer : ERODE G. KANNAN

Editor : G. M. VISHNURAM

Co-Editor : N. SOBAN BABU

Printer : M. VENKATARAMAN

YOUR CONTRIBUTION TOWARDS NEWS LETTER
(A) FOR BLACK & WHITE ONLY
1. Full Page (Per Issue) Rs. 2500
(B) FOR FOUR COLOUR PRINTING
1. Full Page (Per Issue) Rs. 5000
Same Size Positives CD/Zip to be supplied by the Advertiser

Demand Draft be drawn in favour of the "Tamilnadu Electrical Installation Engineers' Association 'A' Grade" payable at Chennai

CONTENTS

8.2 System Resonance Condition

Power system study should be carried out to make sure that the Plain Capacitor Bank size selected for compensation / power factor correction does not have any resonance condition with the power system network i.e. system fault level where plain capacitor banks shall be connected. If n is the resonance frequency, Q_s is the system fault level and Q_{sc} is the plain capacitor bank rating then

$n = \sqrt{(Q_s / Q_{sc})}$

If Q_s = system fault = 600 MVA at 132kV and Q_{sc} = Capacitor Bank Size = 65 MVAr selected for compensation.

Then the resonance frequency n = 3 harmonic.

So the Capacitor bank 65 MVAr cannot be used as a plain Capacitor Bank to connect to the 132kV system, therefore it should be detuned to a 3rd harmonic filter. However, the size of the Capacitor Bank should increase in size to include a reactor in series to form 3rd harmonic filter.

$Q_{3sc} = (n^2 / n^2 - 1)\ Q_{sc}$

Where Q_{3sc} is the 3rd harmonic filter Capacitor Bank size

Q_{3sc} = (9/8) x 65 = 1.125 x 65 = 73.1 MVAr. Three single phase reactors should be designed and added to the plain capacitor to tune to a 3rd harmonic filter.

If the system fault is 1625 MVA, then the resonance will be at 5th harmonic.

Q_{3sc} = (25/24) x 65 = 1.04 x 65 = 67.7 MVAr. Three single phase reactors should de designed and added to the plain capacitor to tune to a 5th harmonic filter.

However, at system frequency 50 Hz, the generation of each filter either 3rd harmonic or 5th harmonic will be 65 MVAr.

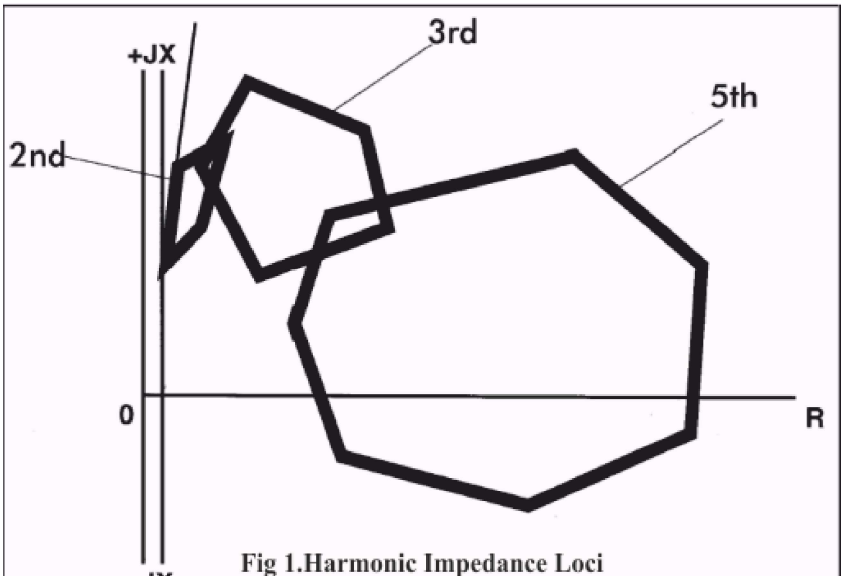


Fig 1.Harmonic Impedance Loci

Harmonic Order Max. Permissible Magnification Factor

2	3.5
3	1.2
4 to 31	1.0

8.3 Mechanically Switched Capacitor Damping Network (MSCDN)

1.**Design of the Mechanically Switched Capacitor damping Network (MSCDN)**

AREVA have designed, installed and commissioned MSCDN's for National Grid 400kV, 275kV and 132kV transmission power systems. The MSCDN's are installed at the mid-point (in the nearest substation) of a long transmission line.

The MSCDN comprises main components such as two 3 phase Capacitor Banks C1 and C2, three single phase air cored air cooled reactor and six single phase air cooled resistors (two resistors are connected in parallel per phase).

Power system study had been carried out to size the required capacitor bank ratings at system (fundamental) frequency 50Hz, to support the power systems. For a 400kV system, the 3 phase rating of the Capacitor Bank C1 of the MSCDN is 225 MVAr at fundamental frequency 50Hz and nominal voltage 400kV. For a 275kV system the 3 phase rating of the Capacitor Bank C1 of the MSCDN is 150 MVAr at fundamental frequency 50Hz and nominal voltage 275kV. For a 132kV system, the 3 phase rating of the Capacitor Bank C1 of the MSCDN is either 52.2MVAr or 45 MVAr at fundamental frequency and nominal voltage 132kV in accordance with the 132kV system requirements.

The nominal ratings of the MSCDN's are the ratings of the Main Capacitor Bank C1, at nominal voltage and at fundamental frequency. MSCDN is a 3rd harmonic filter to filter the dominant 3rd harmonic frequency in the NG system.

However, when it is tuned to 3rd harmonic filter, the Capacitor Bank C1 rating at fundamental frequency and nominal voltage should be increased to $\left(\frac{n^2}{n^2-1}\right) xC1$ rating (minimum), where 'n' is the harmonic number. The total Capacitor Bank ratings for 400kV MSCDN is 253 MVAr, for 275kV MSCDN is 169 MVAr and for 132kV MSCDN is either 60MVAr or 50.6 MVAr minimum.

Therefore, the rating of the 3 phase Auxiliary capacitor bank C2 of the 400 kV MSCDN is (C2 = 253 – C1) 28 MVAr minimum, C2 of the 275kV MSCDN is 19 MVAr minimum and C2 of the 132kV MSCDN is 7.5 MVAr in th4e case of the 52.5 MVAr MSCDN and is 5.6 MVAr in the case of 45 MVAr MSCDN, at nominal voltage and fundamental frequency.

Figures 1(a), 1(b), 1(c) and 1(d) in the appendix show MSC's and MSCDN's arrangement for different system voltages i.e. 400kV, 275kV and 132Kv.

2. Performance of 400kV MSCDN

The MSCDN has a nominal rating of 225 MVAr at 400kV. In order to meet the performance requirements as stated in section 4.2 of NGTS 2.21, the MSCDN has been configured as a C-type filter tuned at 3rd harmonic. This type of filter was chosen to virtually eliminate fundamental frequency loss in the resistor, whilst providing damping at the harmonic frequencies. The performance of the filter, defined as magnification of pre-existing voltage distortion, is shown in Schedule 10 (2.17) for both one and two MSCDN's. Harmonic studies were performed using AREVA's (then GEC Alsthom) harmonics penetration program (HARP) which modelled a voltage source at harmonics 2 to 31 behind the 400kV impedances defined in NGC drawings 96/29004 and 96/29005. The HARP program automatically searches each impedance area to find the impedance which maximises the voltage at the 400kV busbar.

To allow for possible detuning of the MSCDN, the following factors were taken into account:
a) system frequency variation of 49.5 Hz to 50.5 Hz; b) ambient temperature variation from -25°C to +40°;
c) component tolerances; d) capacitor temperature dependence of -0.045% / °C

In order to ensure that the MSCDN will generate the required reactive power output, the tolerance on the capacitor banks is specified as -0% to +4%. To minimise detuning the reactor tolerance is specified as -4% to +0%.

3. Rating

Rating studies were performed using the HARP program which modelled pre-existing voltage distortion as given in Section 3.4 of NGTS 2.21 behind the 400kV impedances defined in NGC drawings 96/29006 and 96/29007. These areas were searched to find the impedance which maximised the component ratings. For continuous ratings the detuning reactors are considered. All rating studies were based on a maximum continuous busbar voltage of 420kV. The studies considered both one and two MSCDN's in service, and ratings were based on the worst case condition. Details of individual component ratings are as follows:

a) Capacitors

NGTS 2.21 section 3.14 indicates that the MSCDN will be in service each day for a period of period of 12 hours. Capacitor banks designed to IEC871-1 have a prolonged overvoltage capability of 110% of rated voltage (Un) for 12 hours in 24. Section 3.5 of NGTS 2.21 requires that Un shall not be less than the maximum continuous fundamental frequency component.

For the main capacitor bank, the maximum continuous fundamental frequency voltage is 420 / “3kV = 242.5kV. This value can be chosen as Un unless the worst case maximum voltage, as given in Schedule 10 (2.18), exceeds Un by more than 10%, i.e. is greater than 266.8kV. As shown in the schedule for 2 MSCDN's connected, the maximum voltage is 263.9kV. Thus for the main capacitor bank Un = 242.5kV.

For the auxiliary capacitor bank, the maximum continuous fundamental frequency voltage is

$420/\sqrt{3}kVx\left(\frac{1}{n^2-1}\right)$, where n = 3, i.e. 30.3kV. This value can be chosen as unless the maximum voltage exceeds 33.3kV. As shown in Schedule 10 (2.18) for 2 MSCDN's connected, the maximum voltage is 33.6kV, i.e. 11% above the fundamental frequency voltage. To accommodate this maximum voltage the proposed bank rated voltage Un = 31kV.

b) Reactors

As the fundamental frequency current flow in the MSCDN is determined by the impedance of the main capacitor bank, which at extreme tolerance could be 4% below nominal, the reactor fundamental frequency current is increased by 4%. This factor is additional to the detuning effects described above.

The auxiliary capacitor bank C2 is detuned to a fundamental frequency 50 Hz by connecting a series reactor in series with capacitor bank C2 to form a L-C circuit to provide a low impedance path only for fundamental current to flow through and diverting all 3rd, 5th and 7th harmonic currents to flow into the bypass resistor circuit.

By detuning the auxiliary capacitor bank C2 with reactor to a fundamental frequency 50 Hz, the losses in the resistors due to fundamental current is zero. Refer to the single line diagram for MSCDN's components parameter values. However, the overall combination of capacitor bank C1, capacitor bank C2 and reactor is a 3rd harmonic filter. For 400kV MSCDN, main capacitor bank capacitance C1 = 4.57 µF, auxiliary capacitor bank capacitance C2 = 36.48 µF and the reactor inductance = 277.2mH.

The combined value of C1 and C2 in series = 4.061 µF.

When the reactor is in series with capacitor C1 and C2, the combination of C1, C2 and reactor forms an L-C circuit with very high resistors in parallel (connected as bypass to L-C circuit).

$$\therefore n = \frac{1}{2\pi f\sqrt{LC}} = \frac{1}{2\pi x 50\sqrt{(LC)}} = 3$$

Similar calculations can be done for 275kV and 132kV MSCDN's to establish they are 3rd harmonic filters. However, at fundamental frequency and nominal voltage 400kV, MSCDN will generate 225 MVAr, the 275kV MSCDN will generate 150 MVAr and the 132kV MSCDN will generate either 52.5 MVAr or 45 MVAr in accordance with the design. The function of the resistors is to provide damping and stability to the power system during MSCDN switching and operating. The combination of auxiliary capacitor bank C2 and series reactor tuned at fundamental frequency with resistors connected as bypass to L-C circuit is called Damping Network to Mechanically Switched Capacitor bank C1 (MSC).

Rating of the Main Capacitor bank C1 is the rating of the MSCDN.

c) Resistors

The resistor power rating is based on the sum of the small fundamental component which occurs due to detuning of the bypass L-C circuit, and all harmonic components. A maximum voltage based on the arithmetic sum of all fundamental and harmonic components is assigned for insulation design.

4. Electrical Design

As shown on the Single Line Diagrams (SLD's), the main capacitor bank is connected to the 400kV busbar. Each phase of the bank is configured in an 'H' bridge arrangement with a fully insulated mid-point current transformer used for capacitor failure detection. The bank has an insulation level of 1425kVp BIL, both HV-ground and HV-LV. The LV terminal of the main bank, and hence the HV terminal of the auxiliary capacitor bank and damping resistor, has an assigned insulation level of 325kVp. In normal steady state operation the line-ground voltage at this part of the circuit is virtually zero. The assigned insulation level is maintained by the surge arrester shown on the SLD.

The auxiliary capacitor bank is protected from transient voltages arising from switching or fault conditions by the surge arrester connected across its terminals. This maintains a BIL level across the bank of 125kVp. The LV terminal of this bank, and hence the HV terminal of the reactor, has an assigned insulation level of 550kVp BIL.

All of the capacitor units which are externally fused, internally fused or fuse-less and have inbuilt discharge resistors to reduce the voltage to less than 75V in 10 minutes following opening of the circuit breaker, as per IEC871-1. External devices such as discharge VT's are provided for rapid discharge of the capacitor banks.

The reactor is connected at the neutral end of the filter and thus is not exposed to short circuit currents simplifying the reactor design and eliminating the need for expensive short circuit testing. The neutral terminal of the reactor, which is connected to earth, is assigned a nominal 125kVp insulation level.

The damping resistors are connected to the neutral end of the filter. The insulation level across the resistor is 325kVp and the neutral terminal is assigned a nominal 125kVp insulation level.

5. Layout

All of the MSCDN equipment is ground mounted inside an interlocked safety compound.

To minimise ground area the main and auxiliary banks have been accommodated in common structures. Thus the capacitor banks consist of 2 stacks per phase.

The air-cored reactors stand on supports providing electrical and magnetic clearance. However, to a depth of 1200 mm into the concrete plinth reinforcing crossovers will need to be insulated by using fusion bonded epoxy-coated reinforcement systems. The location of the coils is chosen to avoid magnetic effects on adjacent equipment or unacceptable levels of magnetic field at the perimeter fence.

To minimise ground area the damping resistor is arranged in 2 stacks of 2 units. The resistor elements are naturally cooled within an IP23 housing with electrical connections made via through-wall bushings.

All of the MSCDN equipment, including current transformers and surge arresters, are simple and quick to assemble and disassemble for relocation. For this reason, and because of the size of the equipment, it is not considered essential to mount any of the equipment on skids for relocation.

(to be Continued)

Courtesy: ***V. Ayadurai Bsc, C.Eng, FIEE***

Engineering Expert

UPDATED CENTRAL ELECTRICITY AUTHORITY (MEASURES RELATING TO SAFETY AND ELECTRIC SUPPLY) REGULATIONS, 2023 – 4

26. Distinction of different circuits

The owner of every generating station, substation, junction box or pillar box in which there are any circuits or apparatus, whether intended for operation at different voltages or at the same voltage, shall ensure by means of indication of a permanent nature that the respective circuits are readily distinguishable from each other.

27. Distinction of the installations having more than one feed

The owner of every installation including substation, double pole structure, four pole structure or any other structure having more than one feed, shall ensure by means of indication of a permanent nature, that the installation is readily distinguishable from other installations.

28. Accidental charging

(1) The owners of all circuits and apparatus shall so arrange them that there shall be no danger of any part thereof becoming accidentally charged to any voltage beyond the limits of voltage for which they are intended.

(2) Where alternating current and direct current circuits are installed on the same box or support, they shall be so arranged and protected that they shall not come into contact with each other.

29. Provisions applicable to protective equipment

(1) Fire buckets filled with clean dry sand and ready for immediate use for extinguishing fires, in addition to fire extinguishers suitable for dealing with fires, shall be conspicuously marked and kept in all generating stations, enclosed substations and enclosed switching-stations in convenient location.

(2) Appropriate type of fire extinguisher conforming to the relevant standards, shall be installed, maintained, periodically inspected and tested as per the relevant standards for extinguishing and controlling fire and record of such tests shall be maintained.

(3) Sufficient number of first-aid boxes or cupboards conspicuously marked and equipped with such contents as the State Government may specify or as per the relevant standards, shall be provided and maintained at appropriate locations in every generating station, enclosed substation, enclosed switching station and in vehicles used for maintenance of lines so as to be readily available and accessible at all the times and all such boxes and cupboards shall, except in the case of unattended substations and switching stations, be kept under the charge of responsible persons who are trained in first-aid treatment and one of such persons shall be available during working hours.

(4) Two or more gas masks shall be provided conspicuously and installed and maintained at accessible places in every generating station with capacity of five megawatt and above and enclosed substation with transformation capacity of five megavolt-ampere and above for use in the event of fire or smoke:

Provided that where more than one generator with capacity of five megawatt and above is installed in a power station, each generator shall be provided with at least two separate gas masks in an accessible and conspicuous place.

(5) In every generating station, substation or switching station, an artificial respirator, fire extinguishers, first-aid boxes and gas masks shall be provided and kept in good working condition and locations of the same shall be displayed in the control room and operator cabin.

(6) Address and contact number of the nearest Doctor, Hospital with a facility for first-aid treatment for electric shock and burns, ambulance service and fire service shall be prominently displayed near the electric shock treatment chart in control room and operator cabin.

30. Display of instructions for resuscitation of persons suffering from electric shock

(1) Instructions, in English or Hindi and the local language of the District and where Hindi is the local language, in English and Hindi for the resuscitation of persons suffering from electric shock, shall be affixed by the owner in a conspicuous place in every generating station, enclosed substation, enclosed switching station, mines and inevery factory as defined in the Factory Act, 1948 (63 of 1952) in which electricity is used and in such other premises where electricity is used as the Electrical Inspector may, by notice in writing served on the owner, direct.

(2) The owner of every generating station, enclosed substation, enclosed switching station and every factory or other premises to which these regulations apply, shall ensure that all designated persons or persons engaged or appointed to operate and maintain electrical plants or transmission or distribution systems are acquainted with and are competent to apply the instructions referred to in sub-regulation (1).

31. Precautions to be adopted by consumers, owners, occupiers, electrical contractors, electrical workmen and suppliers

(1) No electrical installation work, including additions, alterations, repairs and adjustments to existing installations, except such replacement of lamps, fans, fuses, switches, domestic appliances of voltage not exceeding 250V and fittings as in no way alters its capacity or character, shall be carried out upon the premises of or on behalf of any consumer, supplier, owner or occupier for the purpose of supply to such consumer, supplier, owner or occupier except by an electrical contractor licenced in this behalf by the State Government and on its behalf under the direct supervision of a person holding a certificate of competency and by a person holding a permit issued or recognised by the State Government:

Provided that in the case of works executed for or on behalf of the Central Government and in the case of installations in mines, oil-fields and railways, the Central Government and in other cases the State Government, may, by notification in the Official Gazette, exempt on such conditions as it may impose, any such work described therein either generally or in the case of any specified class of consumers, suppliers, owners or occupiers:

Provided further that in the case of works executed for or on behalf of the Central Government and in the case of installations in mines, oil-fields and railways, an electrical contractor having licence issued by any State Government or Union Territory administration shall not require licence from other State Government in which the works are to be executed.

(2) No electrical installation work which has been carried out in contravention of sub-regulation (1) shall either be energised or connected to the works of any supplier.

32. Periodic inspection and testing of installations

(1) The periodic inspection and testing of installation of voltage above the notified voltage belonging to the owner or supplier or consumer, as the case may be, shall be carried out by the Electrical Inspector:

Provided that the electrical installation below or equal to the notified voltage shall be self-certified by the owner or supplier or consumer, as the case may be.

(2) The periodicity of electrical inspection by the Electrical Inspector or the self-certification by the supplier, owner or consumer shall be as directed by the Appropriate Government:

Provided that the periodicity of electrical inspection and self-certification shall not exceed five years:

Provided further that in respect of the electrical installation belonging to mines, oil-fields and railways, such direction shall be issued by the Central Government.

(3) The periodic inspection and testing of installation of voltage equal to or below the notified voltage belonging to the owner or supplier or consumer, as the case may be, shall be carried out by the owner or supplier or consumer and shall be self-certified for ensuring observance of safety measures specified under these regulationsand the owner or supplier or consumer, as the case may be, shall submit the report of self-certification to the Electrical Inspector in the Form I or Form II or Form III or Form IV, as the case may be, of Schedule II:

Provided that the electrical installation so self-certified shall be considered as duly inspected and tested only after the report of self-certification is duly received by the office of Electrical Inspector and if not acknowledged by the Electrical Inspector within three working days, it shall be deemed to be received:

Provided further that the owner or supplier or consumer has the option to get his installation inspected and tested by the Electrical Inspector of the Appropriate Government.

(4) Notwithstanding anything contained in sub-regulation (3), every electrical installation covered under section 54 of the Act including every electrical installation of mines, oil-fields and railways shall be periodically inspected and tested by the Electrical Inspector of the Appropriate Government.

(5) Where the supplier is directed by the Central Government or the State Government, as the case may be, to inspect and test the installation, such supplier shall report on the condition of the installation to the consumer concerned in the Form I, Form II, Form III and Form IV as provided in Schedule II and shall submit a copy of such report to the Electrical Inspector.

(6) The Electrical Inspector may, on receipt of such report, accept the report submitted by the supplier or record variations as the circumstances of each case may require and may recommend that the defects may be rectified as per report.

(7) In the event of the failure of the owner of any installation to rectify the defects in his installation pointed out by the Electrical Inspector in his report and within the time indicated therein, such installation shall be liable to be disconnected under the directions of the Electrical Inspector after serving the owner of such installation witha notice for a period not less than forty-eight hours:

Provided that the installation shall not be disconnected in case an appeal is made under sub section (2) of section 162 of the Act and appellate authority has stayed the orders of disconnection.

(8) It shall be the responsibility of the owner of all installations to maintain and operate the installations in a condition free from danger and as recommended by the manufacturer or by the relevant standards

33. Testing of consumer's installation

(1) Upon receipt of an application for a new or additional supply of electricity and before commencement of supply or recommencement of supply after the supply has been disconnected for a period of six months, the supplier shall either test the installation himself or accept the test results submitted by the consumer when same has been duly signed by the licenced electrical contractor:

Provided that in case of voltage level equal to or below the notified voltage, Chartered Electrical Safety Engineer can also test the installation on request of owner.

(2) The testing and verifications shall be carried out as per relevant standards.

(3) The testing equipment shall be calibrated by a Government authorised or National Accreditation Board for Testing and Calibration Laboratories accredited laboratory at periodical interval as per the periodicity specified by them.

(4) The supplier shall maintain a record of test results obtained at each supply point to a consumer, as per the forms provided in Schedule III.

(5) If as a result of such inspection and test, the supplier is satisfied that the installation is likely to be dangerous, he shall serve on the applicant a notice in writing requiring him to make such modifications as are necessary to render the installation safe and may refuse to connect or reconnect the supply until the required modifications have been completed.

34. Generating units required to be inspected by Electrical Inspector

The capacity above which generating units including generating units producing electricity from renewable sources of energy shall be required to be inspected by the Electrical Inspector before commissioning, shall be as per the notification issued by the Appropriate Government in this regard.

Chapter IV

General conditions relating to supply and use of electricity

35. Precautions against leakage before connection

(1) The supplier shall not connect its works with the apparatus in the premises of any applicant seeking supply unless the supplier is satisfied that at the time of making the connection cause a leakage from that installation or apparatus of a magnitude detrimental to safety which shall be checked by measuring the installation's or apparatus insulation resistance as stipulated in the relevant standards.

(2) If the supplier declines to make a connection under the provisions of sub-regulation (1) the supplier shall convey to the applicant the reasons thereof, in writing for so declining.

36. Leakage on consumer's premises

(1) If the Electrical Inspector or the supplier has reasons to believe that there is leakage in the system of a consumer which is likely to affect injuriously the use of electricity by the consumer or by other persons, or which is likely to cause danger, he may give notice to the consumer in writing to inspect and test the consumer's installation.

(2) If after such notice, the consumer fails to provide access to its installation for inspection and testing, or an insulation resistance of the consumer's installation is so low as to prevent safe use of electricity, the supplier may, and if directed so by the Electrical Inspector shall discontinue the supply of electricity to the installation but only after giving to the consumer forty eight hours' notice in writing for disconnection of supply and shall not recommence the supply until he or the Electrical Inspector is satisfied that the cause of the leakage has been removed.

37. Supply and use of electricity

(1) The electricity shall not be supplied, transformed, converted, inverted or used or continued to be supplied, transformed, converted, inverted or used unless the conditions provided in sub-regulations (2) to (8) are complied with.

(2) The following controls of requisite capacity to carry and break the current shall be installed as near as possible after the point of commencement of supply so as to be readily accessible and capable of completely

isolating the supply to the installation, such equipment being in addition to any control switch installed for controlling individual circuits or apparatus, namely:

Supplied at voltage	Control
Below 11 kV.	Switch fuse unit or a circuit breaker by consumers.
11 kV and above.	A circuit breaker by consumers.

(3) In case of every transformer the following shall be provided, namely:

(i) on primary side of transformer, a linked switch with fuse or gang operated air break switch with fuse or circuit breaker of adequate capacity:

Provided that the linked switch with fuse on the primary side of the transformer may be of such capacity as to carry the full load current and to break only the magnetising current of the transformer:

Provided further that for transformer having capacity of 1000 kVA and above, a circuit breaker shall be provided:

Provided also that the linked switch with fuse or gang operated air break switch with fuse or circuit breaker on the primary side of the transformer shall not be required for the unit auxiliary transformer and generator transformer;

(ii) on the secondary side of all transformers a circuit breaker of adequate rating shall be installed:

Provided that for supplier's transformers of capacity below 1000 kVA, a linked switch with fuse or circuit breaker of adequate rating shall be installed on secondary side.

(4) Except in the case of composite control gear designed as a unit each distinct circuit is to be protected against excess energy by means of a suitable fuse link or a circuit breaker of adequate breaking capacity, suitably located and so constructed as to prevent danger from overheating, arcing or scattering of hot metal when it comes into operation and to permit for ready renewal of the fuse link without danger.

(5) The supply of electricity to each motor or a group of motors or other apparatus meant for operating one particular machine shall be controlled by a suitable linked switch or a circuit breaker or an emergency tripping device with manual reset of requisite capacity placed in such a position as to be adjacent to the motor or a group of motors or other apparatus readily accessible to and easily operated by the person incharge and so connected in the circuit that by its means all supply of electricity can be cut off from the motor or group of motors or apparatus from any regulating switch, resistance of other device associated therewith.

(6) All insulating materials shall be as per their application and their mechanical strength shall be sufficient for the purpose so as to maintain adequately their insulating property under all working conditions in respect of temperature, moisture, salinity and pollution.

(7) Adequate precautions shall be taken to ensure that no live parts are exposed as to cause danger.

(8) Every consumer shall use all reasonable means to ensure that where electricity is supplied by the supplier, no person other than the supplier shall interfere with service lines and apparatus placed by the supplier on the premises of the consumer.

38. Provisions for supply and use of electricity in multi-storeyed building more than fifteen metre in height

(1) The connected load and voltage of supply above which inspection is to be carried out by an Electrical Inspector for a multi-storeyed building of more than fifteen metre height shall be notified by the Appropriate Government.

(2) Before making an application for commencement ofsupply or recommencement ofsupply after an installation has been disconnected for a period of six months or more, the owner or occupier of a multi-storeyed building shall give not less than thirty days' notice in writing to the Electrical Inspector specifying therein the particulars of installation and the supply of electricity shall not be commenced or recommenced within this period, without the approval in writing of the Electrical Inspector.

(3) The following safety measures shall be provided in the multi-storeyed buildings of more than fifteen metre height and other premises such as airports, hospitals, hotels, places of entertainment, places of worship, cultural centers, stadium, academic buildings, test labs, industrial installations, installation with explosive or flammable material, railway or metro stations and other public buildings, namely:

(i) the supplier or owner of the installation shall provide at the point of commencement of supply a suitable isolating device with cut-out or breaker to operate on all phases except neutral in the three-phase, four-wire circuit and fixed in a conspicuous position at not more than 1.70 metre above the ground so as to completely isolate the supply to the building in case of emergency;

(ii) the owner or occupier of a multi-storeyed building shall ensure that electrical installations and works inside the building are carried out and maintained in such a manner as to prevent danger due to shock and fire hazards, and the installation is carried out as per the relevant standards;

(iii) no other service pipes and cables shall be taken through the ducts provided for laying of power cables and all ducts provided for power cables and other services shall be provided with fire barrier at each floor crossing;

(iv) the Fire Retardant Low Smoke and Low Halogen power cables shall be used in building of more than fifteen metre height as per relevant standards:

Provided that Halogen Free Flame Retardant power cables as per the relevant standards shall be used in airports, hospitals and hotels irrespective of height;

(v) distribution of electricity to the floors shall be done using bus bar trunking system;

(vi) lightning protection of the building shall be as per the relevant standards;

(vii) verification of electrical wiring of the building shall be carried out as per the relevant standards; and

(viii) electricity meter shall not be installed in the passage of staircase.

39. Conditions applicable to installations of voltage exceeding 250 Volts

The following conditions shall be complied with where electricity of voltage above 250 V is supplied, converted, transformed or used, namely:

(i) all conductors, other than those of overhead lines, shall be completely enclosed in mechanically strong metal casing or metallic covering which is electrically and mechanically continuous and adequately protected against mechanical damage unless the said conductors are accessible only to a designated person or are installed and protected so as to prevent danger:

Provided that non-metallic conduits conforming to the relevant standards may be used for installations of voltage not exceeding 650 V;

(ii) all metal works, enclosing, supporting or associated with the installation, other than that designed to serve as a conductor shall be connected with an earthing system as per relevant standards and the provisions of regulation 43;

(iii) every switch board shall comply with the following, namely:

(a) a clear space of not less than one metre in width shall be provided in front of the switchboard;

(b) if there are any attachments or bare connections at the back of the switchboard, the space, if any, behind the switchboard shall be either less than twenty centimetre or more than seventy five centimetre in width, measured from the farthest protruding part of any attachment or conductor; and

(c) if the space behind the switchboard exceeds seventy five centimetre in width, there shall be a passage way from either end of the switchboard, clear to a height of 1.8 metre;

(iv) in case of installations provided in premises where inflammable materials including gases and chemicals are produced, handled or stored, the electrical installations, equipment and apparatus shall comply with the requirements of flame proof, dust tight, totally enclosed or any other suitable type of electrical fittings depending upon the hazardous zones as per the relevant standards;

(v) where an application has been made to a supplier for supply of electricity to any installation, the supplier shall not commence the supply or where the supply has been discontinued for a period of six months or more, recommence the supply unless the consumer has complied with the relevant provisions in these regulations;

(vi) where a supplier proposes to supply or use electricity at or to recommence supply of voltage exceeding 250 V but not exceeding 650 V after it has been discontinued for a period of six months, he shall, before connecting or reconnecting the supply, give notice in writing of such intention to the Electrical Inspector; and

(vii) if at any time after connecting the supply, the supplier is satisfied that any provision of these regulations have not been complied with, the supplier shall give notice of the same in writing to the consumer and the Electrical Inspector, specifying the defects and to rectify such defects in a reasonable time:

Provided that if the consumer fails to rectify such defects the supplier may discontinue the supply after giving the consumer a reasonable opportunity of being heard and recording reasons in writing and the supply shall be discontinued only on written orders of an officer duly notified by the supplier in this behalf and shall be restored with all possible speed after such defects are rectified by the consumer to the satisfaction of the supplier.

40. Appeal to Electrical Inspector in regard to defects

(1) If any applicant for a supply or a consumer is aggrieved by the action of the supplier in declining to commence, to continue or to recommence the supply of electricity to his premises on the grounds that the installation is defective or is likely to be dangerous, he may appeal to the Electrical Inspector to test the installation and the supplier shall not, if the Electrical Inspector intimates that the installation is free from the defect or danger complained of, refuse supply to the consumer on the grounds aforesaid, and shall, within twenty four hours after the receipt of such intimation from the Electrical Inspector, commence, continue or recommence the supply of electricity.

(2) Any test for which application has been made under sub-regulation (1), shall be carried out within seven days after the receipt of such application

(to be continued)

Courtesy: https://cea.nic.in/

HARMONICS IN POWER SYSTEM & MITIGATION - 5

HARMONICS DUE TO FERRO RESONANCE

In Ferro Resonance energy oscillating back & forth between the capacitor element and the non- linear inductive element which alternatively saturates. As a result, large over currents & over voltages occur with abnormal waveform & high harmonic content. Since the core of the inductive element is made of Ferromagnetic material the inductance is non-linear and decrease sharply in saturation which increases the magnetizing current. The magnetizing current can include both even & odd harmonics.

When the core is driven into saturation the non-linear circuits can have multiple values of Inductance so that ferro resonance can occur for wide range of system parameters (larger value of C) stages.

Various network events such as Transients, switching ON & OFF transformer & loads, switching of compensating stages, fault etc. can trigger Ferro Resonance. Ferro resonance can occur in the low voltage Detuned Reactor power factor correction system where high voltage distortion is present on low voltage Bus Bar. When Ferro resonance occurs the harmonic spectrum of Detuned reactor current & voltage becomes very rich with 5th order harmonic having highest value.

When 5th order harmonic voltage on the low voltage busbar is high the detuned reactors can be over loaded with high current harmonic

Increased voltage harmonic distortion on the low voltage busbar at same operating point where the percentage of non-linear load is increased, Switching ON the capacitor stage at these operating point triggered the ferro resonance & stages that were already switched ON, the high harmonic distortion caused the detuned reactors to be over loaded. In case of ferro resonance it is characterized by a sudden jump of voltage & current from one stable operating state to another one.

The relationship between voltage & current is dependent not only on frequency but also other factors such as

a) System voltage magnitude
b) Initial magnetic condition of Transformer iron core
c) The total loss in ferro magnetic circuit & point on wave of initial switching

It can occur when an unloaded 3ph system consisting components interrupted by single phase means

FACTORS THAT INFLUENCE TRANSFORMER NO LOAD CURRENT HARMONICS

The NO LOAD current of Transformer contains several harmonics, This primarily because of the non-linear relationship between the flux density and magnetic field strength in transformer core material. The highest THD will be 180% and the lowest will be 30%.

The THD increases with increase in High Voltage side. The increase in THD is not linear with flux density. Other factors influence the THD levels are structure of the core & presence of Air Gap.

Transformer may be drawn into saturation due to two reasons

1) Increase in supply voltage
2) Flow of DC current into Transformer

The normal flux density of transformer is 1.6 to 1.8T. If a transformer subjected to rise in voltage, then the core will operate at flux density higher than 1.6 to 1.8T. This will produce saturation

When a transformer connected to non-linear loads like Half wave rectifier or to a 3 phase converter with unbalanced firing a DC current will be injected which will lead to core saturation.

Geomagnetically Induced Current (GIC) flow on the earth surface due to SOLAR MAGNETIC DISTURBANCES enter a network through a grounded wye transformer, they bias transformer cores & cause half cycle saturation. The magnitude of the transformer magnetizing current are greatly increased & they will be rich in harmonics.

(to be continued)

A. Srinivasan B.E.,MIE, CE(I), FIV, PE(I)
Clean Energy Solutions
Harmonic Auditors & Mitigation Providers
Email: cleanenergy02@gmail.com
Mobile: 98430 31816

7M MANAGEMENT FOR SAFETY AND QUALITY IMPLEMENTATION (MEN, MACHINE, MATERIAL, METHOD, MONEY, MARKET, MANAGER)

An introduction to this article:

a. Many of us in electrical field are employed within our organization to install and maintain electrical systems. And we on our behalf try to install the latest and importantly required safety and quality maintenance systems in them. But somewhere, our good efforts are pushed back by the management and good safety and quality systems are never installed.

b. With our professional acumen, we visit many factories to carry out electrical safety and quality maintenance audits. What we see is that the safety or quality in-charge are very much aware of the requirements as per the standards but look up at the sky as to why they were not implemented. Also they would indicate that the turn-over of the quality or safety minded personnel is very high in the organization mainly because the good aspects they wanted to incorporate is not at all getting implemented and out of frustration, they look to better pastures.

From the above situation, we understand a few things –

a. The reason for not implementation of the better quality and safety systems lies not with us or with the individual whom we are communicating with in our audit sites. We can infer that there are other personnel above them including the CEO, CFO, HR head, Procurement department etc. who could be said as the culprits for not implementing the better safety and quality systems.

b. Most quality and safety systems do not get implemented because budget for them is proper and pragmatic procedure to implement them is not available.

c. Even if we are responsible person in our own organization, we have not been aware of some aspects which could be jeopardizing the implementation of quality and safety systems

The purpose of this article is to take a stern and firm view of why quality and safety implementation are not happening and how to approach the same:

Key recommendations:

The following key management aspects to be reviewed to ensure safety is sustained and improved continuously:

1. What is management's planning on
   a. 'Sustenance of budget for safety and quality'?
   b. 'Plan for increase in budget year-over-year'?
   c. 'Real time and batch processing' of budget requests?
   d. 'Budget request escalation year over year or audit over audit? (When a request for budget for an particular item is made year over year or is indicated in multiple internal / external audits, what is the management's stand / support to clear the issue after due assessment. In essence, what is the response commitment of the top management to such budget requests'? ('Highest-Response-Ratio-Next' algorithm of computers).
   e. Imprest budget for safety for all departments.
   f. Percentage of budget of new project development allocated for safety and quality.

g. Providing small facilities in the machines to enable one to improvise his own safety system.

2. What is management's planning on

a. Allocation of a percentage of budget in all activities (whether it be process improvement, infrastructure improvement, allocating funds for seminars etc.) for safety?

b. Frequency and reason for attrition in safety and quality departments. Has an AIRA study been done on the same? 'AIRA Full Form – 'Attrition identification and result analysis'?

c. Reviewal of standards, operating manual and implementation of safety requirements while proceeding with any process.

d. Providing Awards and recognitions for safety, quality etc.?

e. To what extent non-process management functionaries like HR, Procurement, etc. also solicited to concentrate also on overall organization's quality and safety requirement?(International organizations solicit HR personnel to ask any future employee what would be their experience / contribution to quality, safety etc. if they are selected. Likewise Procurement department also are solicited to ask their prospective sellers also the same question to improve overall quality and safety).

f. Factor of safety in implementing safety systems? (Whether in accordance to standards, more factor of safety in implementing safety systems (as standards by consensus method only suggest for the minimum requirement) or compromise in the same is considered?).

g. Incorporation of safety and quality systems installed in client and vendor premises as a benchmark for improving one's own organization.

h. Tendering / procurement procedure – In the entire tendering / procurement procedure, are the technical personnel within the organization, external consultants appointed involved in the total process until full technical appraisal is made and then commercial negotiation is carried out internally?

i. Potential free contacts on process equipment for fire safety - Utilization and provision of similar feedback from all departments for quality and safety.

Furthering Note:

There is an important aspect called 'Iceberg of Losses'. It depicts that what we all see on the surface is only about 10% but what we do not see as the issue is 90%.

By the above article on implementing quality and safety, we are aspiring to address and implement the balance 90%!!

All the best to our readers and may the best come out of our elections!!.

Mr. Muthukrishnan Kalyanasundaram, M.E.

Proprietor – M/s HKM ENGINEERS AND CONSULTANTS

Services – Fire and Life Safety Consultancy

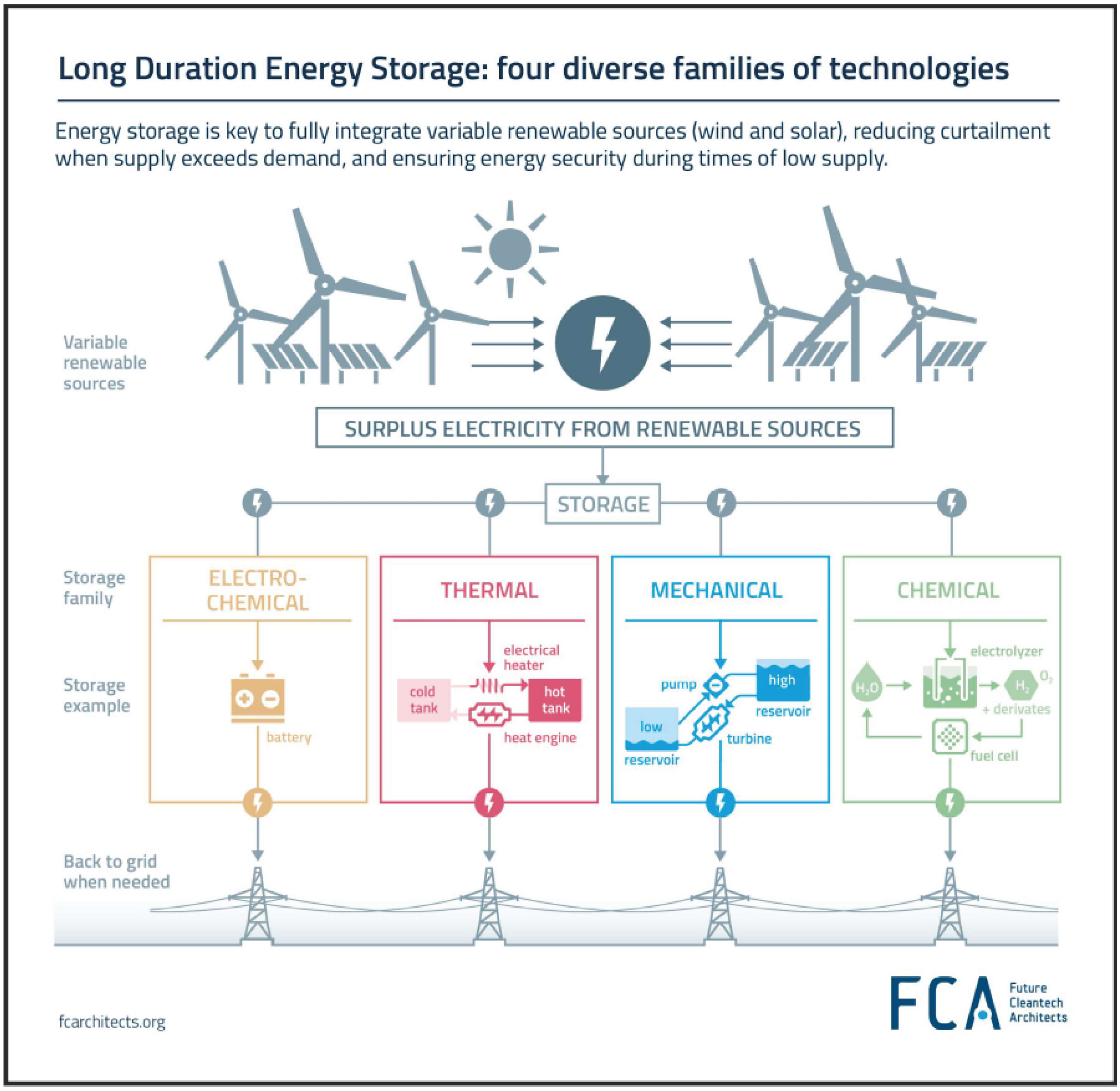
Email id – mr.k.muthukrishnan@hkmconsultants.com

Contact Number – 9930265069

(Son of Mr. H. Kalyanasundaram – Ex. Best and Crompton Engineering Limited)

WHEN AND WHY IS LONG DURATION ENERGY STORAGE TECHNOLOGY NEEDED?

As the volume of variable renewable energy (VRE) sources penetrating electricity grids increases globally, so does the need to manage the increasing uncertainty and variability in electricity supply. Grids will be relying on different solutions to manage this, which could include building of overcapacity and interconnections, but also long duration energy storage (LDES) technologies.



VRE penetration is expected to increase sooner in some key regions, given that governments have announced ambitious and aggressive VRE deployment targets. For instance, if California's VRE deployment targets are met by 2035, this could see a ~280% increase in the capacity of electricity generated by VRE on a GWh basis compared to their 2023 baseline. Other key countries and US states expected to see rapid growth of VRE deployments include Germany, the UK, Italy, Australia, India, and Texas. Increased VRE penetration will result in longer periods of time when energy is unavailable from these sources, and thus, LDES technologies will be required to dispatch energy over these longer timeframes. From IDTechEx's analysis, once a country or state's electricity generated from VRE reaches ~45%, an average duration of storage of 6+ hours of storage will be most cost-optimal for the electricity system. On average, globally, this is not expected to occur until the late 2030s, though these other mentioned key countries and states are expected to reach such percentages of electricity generated from VRE on a GWh basis before this. As such, some deployments of early commercial-scale LDES projects can be expected before 2030 and beyond in some of these key regions.

Why solutions other than Li-ion batteries are needed ?

Aside from pumped hydro, while Li-ion batteries currently dominate the global stationary energy storage market, the capital cost of Li-ion is unlikely to be low enough for LDES, and instead, alternative energy storage (ES) technologies aim to offer lower costs (on a $/kWh basis). One way to achieve this is through designs that allow for energy and power decoupling. This could apply, for example, to some redox flow batteries (RFB) and liquid-air energy storage (LAES). To increase system capacity for RFBs, electrolyte volume and the size of electrolyte storage tanks can be increased, whereas changes to the cell-stack are only needed to increase power output. For LAES, the size of liquid-air storage tanks can be increased, while turbomachinery only needs to be scaled with power output. This results in faster and non-linear decreases in CAPEX (on a $/kWh basis) for many of these LDES technologies as a function of duration of storage. While there is no strict definition for LDES, IDTechEx defines this as starting at 6 hours duration of storage. This is when many of the other competing energy storage (ES) technologies start to become, or are, cheaper than Li-ion on a $/kWh basis.

As VRE penetration increases, the average duration of storage in a given country or state will need to increase to support this. Therefore, at higher penetrations of VRE, reduced system costs for many LDES technologies can be expected, highlighting their advantage over Li-ion. Moreover, suspected Li-ion material constraints coming towards the end of the decade and the safety risks of flammable electrolytes in Li-ion are expected to be other key factors driving demand for other energy storage (ES) technologies generally. A variety of LDES technologies are currently being developed and commercialized across key regions, including electrochemical, mechanical, thermal, and hydrogen storage. Ultimately, however, depending on VRE penetration, it will not be until the mid-2030s when demand for LDES technologies starts to accelerate in key regions, with wider global demand only coming after ~2040.

Courtesy: Conrad Nichols

WIND TURBINES ARE AGEING – WHAT HAPPENS NEXT?

With an average lifespan of 25 years, a high proportion of wind turbines across the world are approaching retirement.

Across the world, ageing wind turbines are nearing the end of their lifespan, which begs the question of what happens to their components after they are decommissioned.

Wind turbines have a lifespan of between 20 and 30 years. The world's first windfarm was erected in New Hampshire, US, in 1980 and was 20 turbines strong. It was followed by the first offshore windfarm in Vindeby, Denmark, in 1991, along with the first onshore windfarm in Cornwall, UK, also in 1991.

Since then, wind turbines have been erected across the world, heralded as a crucial part of the solution to the green transition. GlobalData estimates that there are currently over 329,000 active turbines worldwide, with almost 200,000 more in the pipeline.

What materials make a wind turbine?

The primary material in a wind turbine is steel, which is used for the tower, nacelle and foundation and can comprise anywhere between 66% and 79% of the materials present in the structure.

GlobalData analyst Harminder Singh explains: "Steel provides the necessary strength and rigidity to withstand substantial loads from wind and gravity, ensuring the structural integrity of the turbine."

Fibreglass-reinforced polymer is the lightweight material used for the turbine blades. This material makes up between 11% and 16% of the turbine and offers qualities essential to the capture of energy – stiffness (for efficiency), aerodynamic design (to minimise drag) and lightweight construction.

Iron or cast iron makes up between 5% and 17% of a wind turbine and is used for components within the nacelle, while copper, accounting for 1%, is used for electrical wiring throughout the turbine. Singh explains that aluminium is also sometimes used in turbines as its lightweight properties can be useful in non-critical structural components.

Wind turbines are not always decommissioned immediately after their working life. Depending on their condition and functionality, they are sometimes refurbished or allowed to continue operating (albeit less efficiently) until they become economically unfeasible.

Decommissioning a wind turbine is not a straightforward process. The turbine must be disconnected from the grid, which requires permits and approvals from the relevant authorities and stakeholders. After this, the turbine must be removed from its site.

"Once the turbine is decommissioned, cranes and other equipment are used for the removal of the systems," says Singh. "Some project infrastructure, like overhead lines, underground lines and substations, may be reused. Turbines are dismantled and the parts are removed. The blades, nacelle, or housing for components related to the generation of electricity and the tower are all fully removed from the site. Cables that are part of the collection system, as well as transformers, are also removed.

"Turbine foundations are removed so that land can be returned to an agricultural use. The majority of the turbine components, like concrete and metals, make their way to recycling plants, but many components like blades are disposed of at landfills."

Up to 95% of the materials in a wind turbine can be recycled. Steel, aluminium and copper are particularly straightforward. However, the fibreglass used in the blades is more complicated. The blades – usually over 100ft in length – are commonly disposed of in landfill sites.

Singh notes: "In the US, retired wind turbine blades are primarily sent to one of a small number of landfills that accept them in Iowa, South Dakota or Wyoming. This option is becoming increasingly less feasible with several countries, notably Germany and the Netherlands, banning the practice."

Considering alternative disposal methods for fibreglass blades, Singh adds: "Nacelles and blades are generally made of fibreglass and are ground down to be used as fuel in cement factories or filler in road construction. Innovative solutions such as repurposing blades into playgrounds or bike sheds have been shown to be effective at a local level."

Courtesy: Eve Thomas

ENHANCING POWER QUALITY : TAMIL NADU'S LEAP TOWARDS QUALITY ELECTRICITY WITH HARMONIC CONTROL REGULATIONS

Representational image. Credit: Canva

In a significant move to enhance the quality of power in Tamil Nadu, the Tamil Nadu Electricity Regulatory Commission (TNERC) is adopting innovative regulations aimed at controlling harmonic distortions in the state's power systems. Harmonic distortions, caused by the proliferation of Inverter Based Resources (IBR) and Distributed Energy Resources (DER), have been identified as a major concern for the stability and efficiency of electrical systems. These distortions result from the non-linear loads that produce currents and voltages with frequencies that are multiples of the power system's fundamental frequency, leading to inefficiencies and potential damage to the electrical network and connected devices.

The recent consultative paper by Dr. A.S. Kandasamy and Dr. K.R. Valluvan, appointed by the TNERC, sheds light on the critical need to regulate harmonic currents in generation resources, highlighting the significant role of solar and other renewable energy sources in this aspect. With solar power plants and wind turbines increasingly contributing to the grid, their inherent nature to produce harmonic distortions due to the use of power electronic converters has prompted the need for stringent control measures.

The TNERC's initiative aligns with the amendments made by the Central Electricity Authority (CEA) to the (Technical Standards for Connectivity to the Grid) Regulation 2007, which now mandates compliance with the IEEE 519-2014 standard. This standard sets forth the methodologies for limiting harmonics in the power systems, ensuring that both voltage and current distortions remain within prescribed limits to maintain power quality and system reliability.

The consultative paper emphasizes the significance of adopting updated standards and methodologies for measuring harmonics in Distributed Energy Resources (DER) and Inverter Based Resources (IBR) of 11 kV and above. This move is not just about compliance with national regulations but is aimed at ensuring quality power to all stakeholders, including households, industries, and commercial entities that are increasingly reliant on clean and renewable energy sources.

Stakeholders, including generating companies, prosumers, and individuals connected to the electrical system below 33 kV, are encouraged to control the harmonics within prescribed limits. This proactive approach by the TNERC, involving the solicitation of views and comments from stakeholders, underscores the collaborative effort required to implement these standards effectively.

Moreover, the paper outlines the ill effects of harmonics, including increased heating in electrical devices, mis-operation of protective devices, and inefficiencies in energy usage. By focusing on the control of harmonic distortions, the TNERC aims to mitigate these adverse effects, promoting a more stable and efficient power system that can accommodate the growing share of renewable energy sources.

This initiative by the TNERC represents a forward-looking approach to grid management, acknowledging the evolving nature of power systems with the increased integration of renewable energy sources. It reflects a commitment to ensuring the reliability and quality of power supply in Tamil Nadu, setting a benchmark for other states to follow in the quest for sustainable and efficient power systems.

Courtesy: Mohan Gupta

IIT GUWAHATI RESEARCHERS DEVELOP NOVEL NANO FLUID FOR EFFICIENT SOLAR-POWERED DESALINATION

Researchers at the Indian Institute of Technology Guwahati, led by Prof.Tamal Banerjee from the Department of Chemical Engineering, have achieved a breakthrough in sustainable desalination technology.

A significant advancement in sustainable desalination technology has been made by researchers at the Indian Institute of Technology Guwahati, under the direction of Prof.Tamal Banerjee from the Department of Chemical Engineering. They have created a brand-new heat transfer fluid based on nanofluids that effectively uses solar energy to solve the world's freshwater shortage problem.

The need for desalination—the process of removing saltwater from freshwater—is growing as a result of the severe water scarcity the globe is currently experiencing. Conventional desalination techniques rely on heat produced by burning fossil fuels, which presents problems for the environment and the economy. A more environmentally friendly method is concentrated solar power (CSP), which produces heat by utilizing sunlight.

The difficulty, though, is in effectively moving the heat produced by CSP systems to desalination facilities. High melting points and low heat transfer efficiency are two drawbacks of conventional heat transfer fluids like molten salts and synthetic oils. Moreover, capital expenses rise due to India's dependence on imported heat transfer fluids.

Researchers at IIT Guwahati investigated the use of nanofluids—suspensions of nanoparticles in Deep Eutectic Solvent—to address these problems (DES).

They took use of graphene oxide's remarkable heat conductivity and stability when it was distributed in DES, a solvent that is both safe and eco-friendly. Through the addition of an amine functionality to graphene oxide, scientists were able to improve dispersion stability and counteract the tendency of nanoparticles to assemble.

The study suggested a novel desalination system that makes use of heat exchangers and nanofluids, showcasing the superior thermal capabilities of nanofluids in heat transfer applications. The system can create more freshwater, as evidenced by its capacity to reach a Gain Output Ratio (GOR) of approximately 10.

The research was financed by the Department of Science and Technology, Government of India, and the results were published in the journal Sustainable Chemistry & Engineering by the American Chemical Society.

This novel strategy has enormous potential to lessen the damaging effects of desalination on the environment and solve the urgent problem of worldwide water scarcity.

Courtesy: HT Education Desk , New Delhi

MNRE AMENDS SOLAR POWER SCHEME TO BOOST ELECTRICITY ACCESS FOR TRIBAL GROUPS

Effective immediately, the amendments broaden the scope of the scheme to include the installation of solar mini-grids for household electrification.

In a bid to enhance electricity access to Particularly Vulnerable Tribal Group (PVTG) habitations, the Ministry of New and Renewable Energy (MNRE) has announced amendments to the New Solar Power Scheme under the PM JANMAN initiative.

Effective immediately, the amendments broaden the scope of the scheme to include the installation of solar mini-grids for household electrification, thereby extending its benefits to underserved communities.

The revisions, outlined in the Implementation Guidelines issued on January 4, 2024, come in response to requests from state implementing agencies.Previously, the scheme primarily focused on providing Solar Home Lighting Systems (SHLS) to individual households. The primary change allows for the electrification of households (HHs) through the installation of solar mini-grids in PVTG habitations or villages

The MNRE will provide financial support in the form of a Capital Subsidy (CFA) limited to INR 50,000 per un-electrified household covered under the mini-grid scheme.Under the amended provisions, a solar mini-grid of suitable capacity, complete with a battery bank, distribution lines, metering, and control equipment, may be installed for a cluster of households within a PVTG habitation.

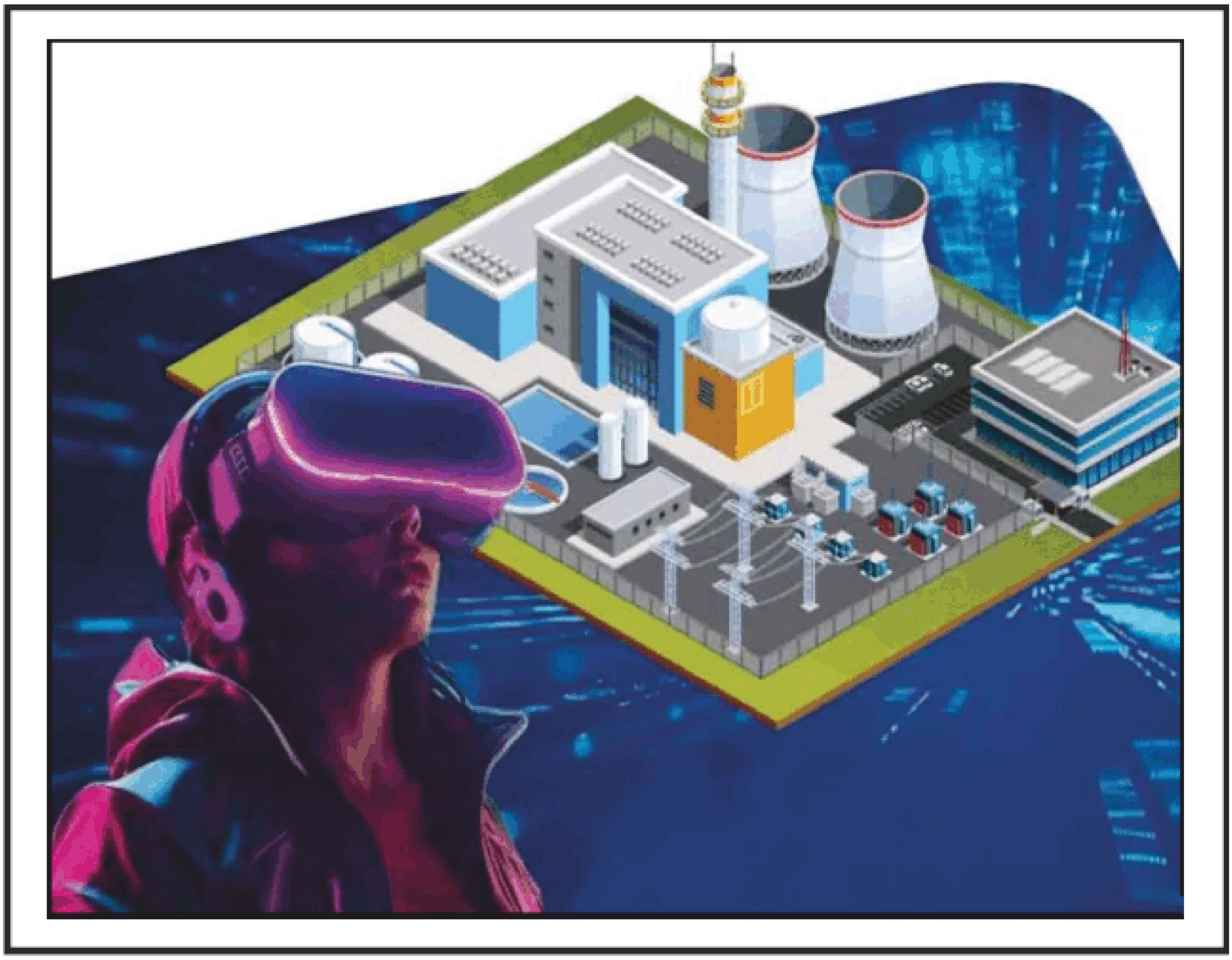
Crucially, the amendments offer flexibility in the implementation mode, allowing for either Capital Expenditure (CAPEX) or Renewable Energy Service Company (RESCO) models. In both cases, the MNRE's CFA support remains unchanged at INR 50,000 per household. However, if the CAPEX mode is chosen, the implementing agency is required to secure additional funding from the state government as necessary.

Moreover, the developer bears the responsibility for running and caring for the solar mini-grid, and they have to do it for at least five years. Along with expanding access to electricity for isolated and underprivileged populations, this action supports sustainable energy options that align with the government's targets for renewable energy.

Courtesy: Abha Rustagi

VPPS' MARKET IS ON THE GROWTH PATH

The recent report from ResearchAndMarkets.com, titled: "Virtual Power Plant (VPP) Market Report 2024-2034" states that the overall world revenue for Virtual Power Plant Market, 2024 to 2034 in terms of value market will surpass US$2.6 billion in 2024...



Virtual Power Plant is basically a network of decentralized electricity generation sources, it may include: wind farms, solar parks and combined heat and power units, which work in coordination with storage systems and flexible energy consumers. Although the sizes and combinations of VPPs may vary, they all target to reduce demand from the grid. They achieve this by supplying the power generated by individual units during peak hours.

The current report predicts a strong revenue growth through to 2034. This analysis has identified which organizations hold the greatest potential. It has discovered their capabilities, progress, and commercial prospects.

The driving force

According to the report, the propulsion of the VPP market stems from several influential factors, with the widespread deployment of Distributed Energy Resources (DERs), encompassing solar PV, wind power, and energy storage systems, standing out as a primary catalyst. A global shift toward cleaner energy sources, supported by governments and industries, encourages the seamless integration of renewable resources into the grid.

Simultaneously, the ongoing liberalization of electricity markets acts as a driving force, fostering demand for innovative solutions like VPPs that provide essential flexibility and adaptability within the ever-evolving energy landscape.

Vulnerability to cyber threats

The vulnerability to cyber threats and potential system failures stands out as a significant restraining factor for the growth of the VPP market. As VPPs rely heavily on digital technologies and interconnected systems, they become susceptible to cyberattacks, which could compromise the integrity and functionality of the entire system.

The interconnected nature of VPPs, designed to enhance efficiency and coordination, also exposes them to the risk of system failures. Any disruptions, whether caused by cyber threats or system failures, can have far-reaching consequences, affecting the reliability and stability of power generation and distribution. As a result, addressing and mitigating these vulnerabilities becomes crucial forthe widespread and secure adoption of VPP technologies.

Market driving factors

- Ongoing innovation and research fuelling VPP advancements
- Virtual power plants could be pathway to decarbonization
- VPPs as platforms for Distributed Energy Resources (DERs)

Market restraining factors

- Vulnerability to cyber threats and potential system failures rises restraining factor for market growth
- The substantial upfront costs associated with the deployment of VPP infrastructure, including smart grids and advanced control systems
- Fluctuations in energy markets, coupled with uncertainties in government policies and incentives

Market opportunities

- Continued advancements in IoT, AI, and Communication Technologies
- Countries worldwide recognize the benefits of smart, distributed energy systems
- Increasing adoption of residential solar, storage, and smart home technologies contributes to the growth of VPPs

Courtesy: Electrical India

RESEARCHERS INVENT NEW TRIPLE-JUNCTION TANDEM SOLAR CELLS WITH WORLD-RECORD EFFICIENCY

Scientists from the National University of Singapore (NUS) have developed a novel triple-junction perovskite / Si tandem solar cell that can achieve a certified world-record power conversion efficiency of 27.1 per cent across a solar energy absorption area of 1 sq.cm representing the best-performing triple-junction perovskite / Si tandem solar cells thus far. To achieve this, the team engineered a new cyanate-integrated perovskite solar cell that is stable and energy efficient.

Solar cells can be fabricated in more than two layers and assembled to form multi-junction solar cells to increase efficiency. Each layer is made of different photovoltaic materials and absorbs solar energy within a different range. However, current multi-junction solar cell technologies pose many issues, such as energy loss which leads to low voltage and instability of the device during operation.

To overcome these challenges, Assistant professor Hou Yi led a team of scientists from NUS College of Design and Engineering (CDE) and Solar Energy Research Institute of Singapore (SERIS) to demonstrate, for the first time, the successful integration of cyanate into a perovskite solar cell to develop a cutting-edge triple-junction perovskite / Si tandem solar cell that surpasses the performance of other similar multi-junction solar cells. Asst. Prof Hou is a Presidential Young Professor at the Department of Chemical and Biomolecular Engineering under CDE as well as a Group Leader at SERIS, a university-level research institute in NUS.

“Remarkably, after 15 years of ongoing research in the field of perovskite based solar cells, this work constitutes the first experimental evidence for the inclusion of cyanate into perovskites to boost the stability of its structure and improve power conversion efficiency,” said Asst Prof Hou.

The experimental process that led to this ground-breaking discovery was published in *Nature* on 4 March 2024.

Fabricating energy-efficient solar cell technology

The interactions between the components of the perovskite structure determine the energy range that it can reach. Adjusting the proportion of these components or finding a direct substitute can help modify the perovskite’s energy range. However, prior research has yet to produce a perovskite recipe with an ultra-wide energy range and high efficiency.

In this recently published work, the NUS team experimented on cyanate, a novel pseudohalide, as a substitute for bromide — an ion from the halide group that is commonly used in perovskites, Dr. Liu Shunchang, Research Fellow in Asst. Prof Hou’s team, employed various analytical methods to confirm the successful integration of cyanate into the perovskite structure, and fabricated a cyanate-integrated perovskite solar cell.

Further analysis of the new perovskite’s atomic structure provided — for the first time — experimental evidence that incorporating cyanate helped to stabilise its structure and form key interactions within the perovskite, demonstrating how it is a viable substitute for halides in perovskite-based solar cells.

When assessing performance, the NUS scientists found that perovskite solar cells incorporated with cyanate can achieve a higher voltage of 1.422 volts compared to 1.357 volts for conventional perovskite solar cells, with a significant reduction in energy loss.

The researchers also tested the newly engineered perovskite solar cell by continuously operating it at maximum power for 300 hours under controlled conditions. After the test period, the solar cell remained stable and functioned above 96 per cent capacity.

Encouraged by the impressive performance of the cyanate-integrated perovskite solar cells, the NUS team took their ground-breaking discovery to the next step by using it to assemble a triple-junction perovskite/Si tandem solar cell. The researchers stacked a perovskite solar cell and a silicon solar cell to create a dual-junction half-cell, providing an ideal base for the attachment of the cyanate-integrated perovskite solar cell.

Once assembled, the researchers demonstrated that despite the complexity of the triple-junction perovskite/Si tandem solar cell structure, it remained stable and attained a certified world-record efficiency of 27.1 per cent from an accredited independent photovoltaic calibration laboratory.

“Collectively, these advancements offer ground-breaking insights into mitigating energy loss in perovskite solar cells and set a new course for the further development of perovskite-based triple junction solar technology,” said Asst. Prof Hou.

Next steps

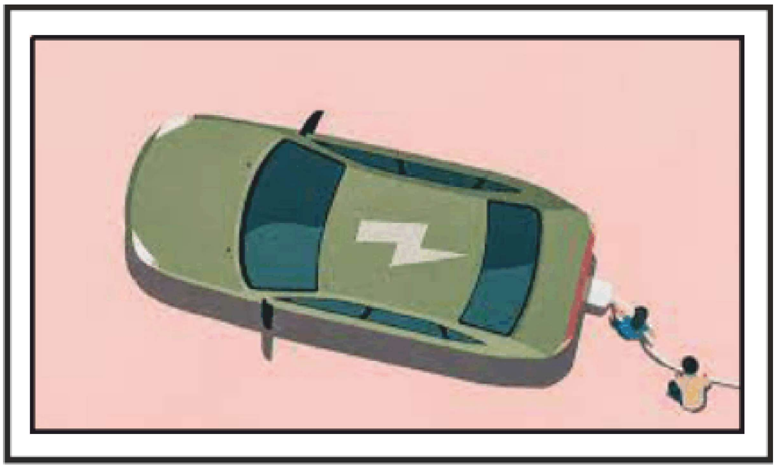
Theoretical efficiency of triple-junction perovskite/Si tandem solar cells exceeds 50 per cent, presenting significant potential for further enhancements, especially in applications where installation space is limited.

Going forward, the NUS team aims to upscale this technology to larger modules without compromising efficiency and stability. Future research will focus on innovations at the interfaces and composition of perovskite — these are key areas identified by the team to further advance this technology.

Courtesy: National University of Singapore

BUDGET 2024: HOW AUTO SECTOR REACTED TO GOVT'S NEW EV PUSH

Finance Minister Nirmala Sitharaman announced the government's plan to expand and strengthen the EV ecosystem by supporting manufacturing and charging infrastructure



Electric Vehicle EV

The Interim Budget 2024 has brought a wave of optimism for the auto sector, particularly for the electric vehicle (EV) industry. Finance Minister Nirmala Sitharaman announced the government's plan to expand and strengthen the EV ecosystem by supporting manufacturing and charging infrastructure. The move has been welcomed by industry stakeholders and experts.

Maulik Manakiwala, Partner, Indirect Tax, BDO India, sees this as a positive shift towards EVs. He said, "The focus on expanding the EV charging network continues. This will also increase opportunities for a large number of small vendors for manufacturing, installation, and maintenance of EV charging networks."

MayureshRaut, Co-founder & Managing Partner, Seafund, believes that the scheme for deeptech in defence will not only help the government start addressing the Make in Bharat initiative through indigenous technologies in defence but also unlock these technologies to other civilian uses. He added, "The solar rooftop schemes will be a big boost to not only meet our goals for clean energy, but will also set up India to start addressing the EV charging infrastructure that is currently holding back wider adoption of EVs."

Anmol Singh Jaggi, Co-founder and CEO, BluSmart said "The 2024 Interim Budget has reiterated the government's firm belief in the positive impact of promoting electric vehicle (EV) adoption and boosting the charging infrastructure. This aligns with our vision for sustainable mobility and the growth of the overall EV ecosystem. As we move ahead, the adoption of cleaner and green transport alternatives, rationalising the GST tax structure on EV charging and batteries, coupled with the reinforcement of existing EV policies and the introduction of new ones, will play a critical role in promoting electric mobility and achieving India's climate goals. India's target of a 45% reduction in emissions intensity by 2030 requires concerted efforts, and we are eager to contribute to this transformative journey as refreshed by the FMs speech."

Hyder Khan, CEO of Godawari Electric Motors, praised the government's commitment to advancing sustainable development by enhancing and strengthening the EV ecosystem. He said, "These efforts will enhance EV adoption, paving the way for a cleaner, more interconnected future. The details of this announcement in the forthcoming budget will play a crucial role in steering the country's net-zero agenda in a positive direction."

Nitin Gupta, Co-Founder & CEO of Attero Recycling, also welcomed the government's focus on strengthening EV manufacturing and charging infrastructure. He said, "The push for e-buses adoption backed by a payment security mechanism will help in accelerating the transition to cleaner and more sustainable public transportation systems."

Saurav Kumar, Partner, INDUSLAW said, "Push for electric vehicle ecosystem has been a priority for Government. Adoption of Fame II came with some challenges such as only 10 percent of the total incentive outlay was reserved for charging infrastructure. The Budget emphasis on manufacturing and charging infrastructure provides hope that a larger portion of FAME III incentives will be focused towards charging infrastructure development."

Kartikeya Prakash, Partner at Khaitan & Co lauded FM's bold vision for India's EV future. He said, "The focus would be on fostering entrepreneurship in the sector, with plans to approve numerous vendors for supplying and installing EV charging points. This would not only encourage EV adoption and build public confidence but also create surge in jobs, particularly for technically skilled youth in manufacturing of components for EV charging infrastructure, along with employment for semi-skilled labour in the deployment and maintenance of these charging stations."

Courtesy: www.businesstoday.in

Danny D'Cruze

WAYS TO CHARGE YOUR EV (ELECTRIC VEHICLE) EASILY

India is running towards a new automobile revolution: the electronic vehicle. While everyone knows that EVs are much more efficient and beneficial to the environment, in this article we will be discussing some ways to charge your EV easily.

The automobile sector in India is on the verge of disruption because of the introduction of EVs into the market. Various big automobile players, such as Hyundai, Tata, Vespa, MG, etc., are now in the market, competing very heavily against each other. The recent EVs launched by each brand promise better performance and even better efficiency. With time, it is expected that EVs will be much cheaper compared to what they are today. Another problem that is holding back customers from buying an EV is its complex and time-consuming charging process.

Several automobile experts consider that it is one of the most challenging tasks that companies will be facing, but the brands believe that they will surely find a way out of it. Furthermore, currently, on average, an electric two wheeler runs around 150 km on one single charge. On the other hand, a four-wheeler EV, which comes with a bigger battery pack on average, can drive around 300 km.

However, if you already have an EV and are tired of wandering around everywhere to charge your vehicle, this article will tell you some of the best ways to charge your EV easily. Using these methods, you can easily charge your EV before going out for a long drive in your car or bike.

Ways to Charge EV

- **Level 1:** The easiest and simplest way to charge your EV is to plug in the DC level 1 charger installed in your home or in your vehicle. You can easily install the 120volt socket that comes with this charger in your home. Through this method, you can charge your vehicle without going anywhere.
- **Level 2:** Level 2 charging is reportedly 10 times faster than level 1 DC charging. This charging setup needs to be specifically installed in your house or office. This setup is exclusively for charging your vehicle and cannot be used for other purposes. The level 2 DC charging method is also considered to be the best for your EV battery health.
- **Level 3:** If you are in a hurry and you want to quickly charge your vehicle is dedicated charging station that offers DC Fast charging. Most cars now-a-days are equipped and compatible with DC fast charging, and it is surely one of the best ways.

Courtesy: The Times of India, dt. 09.03.2024

HOME FESTIVALS - 4

சித்திரை - Chitrai (April/May)

This month begins with the completion of Ram Navami, the nine days of celebration of Lord Rama's birth ages ago, which started in the previous month. At the upper left we see a decorated picture of Lord Rama's coronation. Next (Proceeding clock wise) comes a Vaishnava priest telling the stories of Lord Rama's birth and life; behind him are great parts of *paanagan,* a delicious drink of sugar and ginger, and a basket of *sundal*, spiced chickpeas, served to the storyteller's guests, who also receive palm fans, as this is the hot season. Tamil New Year often falls on April 14 (as does the New Year of several other communities). The lady at upper right is shown with the new clothes and jewellery which are part of the celebration, as well as bananas, mangoes and the ingredients for *vepon pu pachadi*, a combination of bitter neem blossoms, sugar and mango – a reminder to face the unpleasant in life with a sweet smile. At lower left is the marriage of Siva and Parvati, Meenakshi Kalyanam, with brother Vishnu pouring the sacred ganga water on the earth joined hands. At lower right is the dark form of Yama, Lord of Death, who figures in three stories associated with this month; that of Savitri, who won her husband back from Yama in a battle of wits; Nachiketas, the boy who extracted three boons from Him and Markandeya, who won eternal youth from Lord Yama through the worship of the Sivalinga.

HOME FESTIVALS - 5

வைகாசி - Vaikasi (May/June)

This month is devoted to the worship of Lord Murugan, who is honoured on Vaikasi Vishakham (above). He is shown at far left as Palani, the renunciate, dressed in loincloth, wearing a necklace of rudraksha beads, sacred ash covering His body and holding the sannyasin's staff. To the right He is shown as a prince, with His peacock, and farther to the right as the six-headed Arumugam. Devotees approach Him doing penance by piercing their bodies with small spears and carrying various offerings, including pots of milk and a *kavadi,* a kind of portable arched shrine. At lower right is depicted Naga Chathurthi, celebrating an ancient story in which a young boy bit by a cobra was saved from death when his sister's prayers caused the sands of the cobra's anthill to counteract the poison.

(To be continued)

Printed and Published by 'Tamilnadu Electrical Installation Engineers' Association "A" Grade, Chennai - 15.
Editor : G.M. Vishnuram