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Consulting Electrical Engineers Association of Maharashtra

CEEAMA *LiveWire*

E-NEWSLETTER

Published by Consulting Electrical Engineers Association of Maharashtra

Topic for September 2024
MOTORS

Let us dive deep in this month's topic
'Motor' through interesting articles inside..

CEEAMATECH 2024-25

CEEAMATECH 2024-25..
1st Session scheduled in October 2024

Electrical Consultants Newsletter
Volume No. 4 Issue #44
September 2024

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Chief Editor - CEEAMA LIVEWIRE

From the Editors Desk,

HAPPY MONSOON TO ALL! Repeat!!!

Indeed, the rain Gods continue to play havoc in many parts of India, esp. the deadly flooding in Gujarat in the last week of August and first week of Sept. with more such forecasts in the coming days has gripped the common-man with lots of fear. It has also strained the government machinery a lot in controlling the life and equipment damage. Let's pray for better days to Lord Ganesha who is the destroyer of all evils and protector of goodness.

Prominently, the electrical industry was put to test in these days. The dangers and accidents reiterate the significance of following Codes and Standards to the best of our knowledge and experience; STRICTLY!

Thereby, as a responsible organisation, it is eminent that CEEAMA continues to educate the society at large and Industry at specific on the various safety measures and practices to be followed in our day-to-day life.

Our efforts on membership-drive are also yielding results in the form of new members. We wish to extend our warm welcome to the new members.

CEEAMA, after its successful workshop on EV charging infrastructure last year, is proud to bring you workshop series in October, December and March, respectively, on LV Switchgear, MV switchgear and Protection Systems. We would like to encourage each one of you to participate and spread the word in your groups, amongst your colleagues, clients and vendors and make this series yet another success for our fraternity. Our CEEAMATECH organising committee has taken lots of efforts for the same. To & fro travel arrangements for early birds from Mumbai and Pune are also made. Do take advantage of the same.

Lord Ganesha and Saraswati-ma are our beloved deities in the field of education as they are rightfully called "buddhidata" – wisdom bestowers. Knowledge without wisdom is of no use. Thus, let's celebrate Ganpati festival with zeal and fervour while keeping at bay all the misdeeds such as DJ and wrongful waste of money.

GANAPATI BAPPA MORYA!!!

Subhash L. Bahulekar

Chief Editor – CEEAMA

From the President's desk:

Dear Friends,

Exciting news!

As the President of CEEAMA, I am thrilled to announce that we are organizing a full-day technical seminar at The Fern, Lonavala. Last year, the CEEAMATECH-2023 event on 'EV Charging Opportunities and Challenges' organized at Dukes Resorts, Khandala, was a huge success with 262 participants.

For the convenience of our Pune and Mumbai participants, we have carefully selected a central location at Lonavla this year also and arranged logistics support with mini buses and cars for pick-up and drop-off. Stay tuned for more details on the program from our Admin. Team.

At CEEAMA, we believe in fostering knowledge sharing and mentorship. Our focus is on empowering the younger generation to step up and lead. By joining CEEAMA, you can contribute to the growth of our community and industry.

Since 2005, CEEAMA has been active in organizing exhibitions, technical events, and evening sessions to enrich participants' technical knowledge in electrical engineering. Our upcoming event will cover LV Switchgear and LT panels, offering insights on protections, breaking capacities, discrimination, and energy management systems.

This seminar is tailored for LT panel builders, design engineers, contractors, and industry professionals. Register now and avail of discounts for multiple events!

Join us on 5th October at The Fern, Lonavala, at 9:00 AM for a morning full of learning opportunities and networking. Looking forward to seeing you there!

Mr. Veejhay Limaaye

Hon. President

CEEAMA

From the Secretary's desk:

Dear friends,

This month we celebrate "motors".

The invention of electric motors, had a profound impact on the world, transforming industries, economies, and everyday life.

The introduction of motors into manufacturing led to the development of assembly lines, allowing for mass production of goods, which significantly lowered costs and made products more accessible to the general population. The invention of electric motors paved the way for the development of electric vehicles, including trains, trams, and later, electric cars. This revolutionized transportation, making it faster, more reliable, and less dependent on human or animal power. The availability of electric-powered transportation systems, such as trams (electric buses), lifts, escalators facilitated urbanization by making it easier for people to live farther from their workplaces, reach higher floors and provide comfort. The invention of electric motors also revolutionized construction sector by powering tools like drills, saws, and grinders, making tasks easier, faster, and more precise. Motors have been essential in the development of medical devices such as ventilators, pumps, and diagnostic equipment, improving healthcare outcomes and enabling more advanced medical treatments. Motors led to the development of household appliances like washing machines, refrigerators, vacuum cleaners, and fans, significantly improving the quality of life by reducing the time and effort required for daily chores. Large pumping machinery was possible due to motors to transport water from one region to another, providing life and livelihood. Motors are proof that you don't need only a heart to keep things moving smoothly, motors can do it too!

Motors enabled the automation of various industrial processes, leading to more consistent product quality, increased production speeds, and reduced reliance on human labour for repetitive or dangerous tasks. Factories became more efficient, producing goods at an unprecedented scale and speed. The efficiency gains from using motors in production and transportation contributed to economic growth by increasing the output of goods and services and reducing costs. Approximately 60% to 70% load in the industry is motor load demonstrating our dependence on this invention.

The widespread use of motors increased the demand for electricity, which led to the expansion of power generation infrastructure. This had both positive and negative environmental impacts. The invention of motors inspired further technological advancements, leading to the development of increasingly sophisticated machinery, computers, and robotics, which continue to shape the modern world. The hard disk in the computer worked on a motor till SSD was introduced. Further, there has been no replacement to the cooling fan in your laptop / desktop as yet.

As a motor keeps running despite obstacles, the spirit of life propels us through challenges, never losing momentum. Moving on, let us meet at the AGM on 21st Sept and later for the CEEAMATECH on 5th October for some enlightening technical sessions. Till then, keep the motor running, but watch those energy bills too.

A friend of mine who got to know that the earlier cars were "electric motor cars" only to be replaced with engine driven cars, asked, "Why did the motor break up with the engine?" Another friend replied "It couldn't handle the sparks anymore!" Hope you have a great and safe festive season.

Ganapati Bappa Moraya, Mangal Murti Moraya!!

Mr. Chidambar Joshi

Hon. Secretary

CEEAMA

गणेश चतुर्थी उत्सवात विद्युत सुरक्षा संबधीत सूचना

१. **अधिकृत (परवानाधारक) इलेक्ट्रिशियन/कंत्राटदार वापरा:** मंडळात वीज कनेक्शन जोडण्यासाठी नेहमी परवानाधारक इलेक्ट्रिशियन्सना नियुक्त करा. सुरक्षितता सुनिश्चित करण्यासाठी त्यांच्याकडे ज्ञान आणि कौशल्य असते.

२. **केबल्स आणि वायर्सचा योग्य आकार:** गरम होणे आणि शॉर्ट सर्किट टाळण्यासाठी केबल्स आणि वायर्सचा योग्य आकार व दर्जा आवश्यक आहे. १.५ Sq.mm (FR Grade) च्या पेक्षा कमी ची तारा वापरू नका.

३. **केबल जॉइंट्स टाळा:** जॉइंट असलेले केबल किंवा तारा वापरू नये (अपरिहार्य असल्यास, योग्य इन्सुलेशनसह चांगले जॉइंट करणे सुनिश्चित करा).

४. **ओव्हरलोडिंग सर्किट टाळा:** एकाच आउटलेटमध्ये अनेक दिवे किंवा उपकरणे जोडून इलेक्ट्रिकल सर्किट्स ओव्हरलोड करू नका. सर्किट्सवर लोड समान रीतीने वितरित करा. एका सर्किट वर 3kW पेक्षा जास्त लोड टाकू नका.

५. **चांगल्या दर्जाची विद्युत उपकरणे वापरा:** उच्च दर्जाची विद्युत उपकरणे आणि एक्सटेंशन कॉर्ड (ISI चिन्हांकित) वापरा. स्विचगियर्स वापरण्यापूर्वी तपासले गेले आहेत आणि योग्यरित्या सेटिंग केले आहे का ? याची खात्री करा.

६. **अर्थिंग उपलब्ध असल्याची खात्री करा:** स्थापनेचे सर्व भाग ग्राउंड करा (धातूची पत्रके, पाइप इत्यादी).

७. **पाणी दूर ठेवा:** सर्व विद्युत कनेक्शन पाऊस आणि पाण्यापासून संरक्षित असल्याची खात्री करा. आवश्यक असल्यास वाटरप्रूफ आउटलेट आणि कव्हर वापरा.

८. **ओव्हरहेड पॉवर लाईन्सबद्दल जागरूक रहा:** ओव्हरहेड पॉवर लाईन्सकडे लक्ष द्या आणि धातूच्या वस्तूंशी संपर्क टाळा, विशेषतः मेटॅलिक शिडी वापरताना ओव्हरहेड पॉवर लाईन्सच्या सम्पर्कात येणार नाही याची काळजी घ्या.

९. **रात्री बंद करा:** हिटिंग टाळण्यासाठी आणि आगीचा धोका कमी करण्यासाठी रात्री सर्व विद्युत सजावट आणि प्रकाशयोजना बंद करा.

१०. **अग्निशामक यंत्रे:** अग्निशामक यंत्रे सज्ज ठेवा आणि आपत्कालीन परिस्थितीत त्यांचा वापर कसा करावा याबद्दल स्वयंसेवकांना प्रशिक्षित करा.

सुरक्षितता ही एक सामायिक जबाबदारी आहे आणि प्रत्येकाने संभाव्य धोक्यांबद्दल जागरूक असले पाहिजे आणि आवश्यक खबरदारी घेतली पाहिजे. वरील मुद्द्यांचे अनुसरण करून, आम्ही ही गणेश चतुर्थी विद्युतदृष्ट्या सुरक्षित आणि समाधानकारक असल्याची खात्री करू शकतो.

ही गणेश चतुर्थी आपल्या सर्वांसाठी भरपूर आशीर्वाद, उत्तम आरोग्य आणि आनंद घेऊन येवो.

गणेश चतुर्थीच्या हार्दिक शुभेच्छा, गणपती बाप्पा मोरया !!!

CESE Association of Maharashtra

"सनदी विद्युत सुरक्षा अभियंता" महाराष्ट्र यांची संघटना

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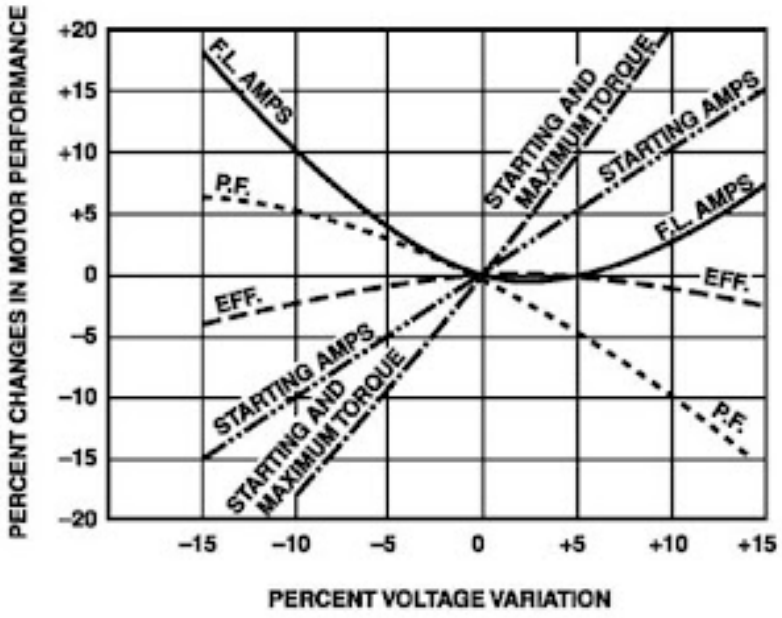
Poor power quality can have a significant impact on the performance and health of three-phase induction motors, which are essential components of industrial systems. Voltage fluctuations, both low and high, can lead to various issues affecting motor efficiency and longevity. Consistent low or high voltages, sags, swells, dips, surges as well as Harmonics can affect motor performance adversely. Hence, it is very necessary to understand the impact and asses the motor performance to get desired output.



Low Voltage:

As seen from the above graph, if input voltage dips, it results in rise of Full Load Current as Shaft Power drawn will remain constant. This will result in increase of Copper/Winding Losses and overheating. Most of the time motors can withstand under voltages to the tune of 10% but any sag below it can result in dangerously high losses as they amplify with square of current. Thus, it reduces efficiency of the motor.

Low voltage means lower starting torque and lower magnetizing currents. We need to map the load torque-curve of motor against the worst-case scenario to ensure that any drop in voltage should not pull out the load or a low voltage start does not result in locked rotor. As magnetizing current is low, motor will have better PF for lower input voltage. Motor torque drops with drop in voltage as it is proportional to square of voltage. Thus for 90% voltage, torque will be reduced to 81%. In case of heavy loads, this may result in locked rotor and winding overheating. Thus, care must be taken in case of loads with high starting torque.

In case of light loads like pumps, reduced voltage will actually reduce mechanical stresses and lower starting currents. This is a preferred starting method where auto-transformer starting or soft starter can be utilized to ensure smooth start of Motor and better performance with reduced voltage start. In case speed variation and reduced output is acceptable, low voltage start and running are a great energy saving tool.

High Voltage:
As input voltage rises, Full load current is normally expected to dip. However, higher voltages result in higher magnetizing currents and higher Iron/Core Losses. This in fact results in higher full load currents and insulation overheating. Most of the time motors can withstand overvoltage to the tune of 10% but any rise above it can result in dangerously high losses. Thus, it reduces efficiency of the motor.

Motor torque rises with rise in voltage as it is proportional to square of voltage. Thus for 110% voltage, torque will rise to 121%. It will also result in rise of starting current resulting in overheating and very high mechanical stresses. This might damage the motor and/or the load. Hence, overvoltage is very dangerous for a motor. As magnetizing current rises, motor has lower PF in case of overvoltage.

Harmonics:
Harmonics affect the motor in various ways. Firstly, it results in higher core losses where Hysteresis and Eddy current losses are proportional to the square of frequency. This results in lower motor efficiency as harmonics increase.

The additional losses also generate extra heat which can damage motor winding or change viscosity of bearing grease which will result in higher slips and higher losses. It can also introduce arcing currents in bearings. Harmonics have a high dv/dt which can cause deterioration of winding. It increases magnetization currents which results in lower PF of motor which increases the input current and losses.

The negative sequence currents introduced by harmonics can cause a negative torque of the shaft which can cause stalling of loads or locked rotor condition.

A clean and regulated power supply to the motors can ensure reliable performance, high efficiency and lower system losses. It goes a long way in terms of sustainability of the installation and improved performance. It also contributes for better profitability with lower maintenance and less downtimes.

Thanks.

Abhijeet V Limaaye
Senior Consultant
VLE Engineers Pvt Ltd,
Miraj.

MAHARASHTRA ELECTRICITY REGULATORY COMMISSION

EXPLANATORY MEMORANDUM (EM)

On DRAFT

MERC (Demand Flexibility and Demand Side Management – Implementation Framework, Cost-effectiveness Assessment; and Evaluation, Measurement and Verification) Regulations, 2024

August 2024

This explanatory memo is being shared as a part of the public commenting process along with the intended changes to the existing regulation related to demand flexibility/ demand side management activities.

SECTION 1: BACKGROUND

The Maharashtra Electricity Regulatory Commission (MERC or Commission) went through the process of drafting first generation Demand Side Management Regulations during the years 2009-10. After receiving public comments, two regulations were drafted by the Commission, which included Demand Side Management Implementation Framework and Demand Side Management Cost Effectiveness Assessment Tests. Both these regulations were notified in the Gazette of Maharashtra in April 2010 and are currently available at the following links on the MERC website: https://merc.gov.in/regulation_type/current-regulations-demand-side- management/

The Commission in Maharashtra was the first in India to issue these pioneering regulations, subsequently followed by a number of states across the country. This is a part of the emphasis placed by the Commission on promoting environmentally benign Generation, Transmission and Distribution of electricity, which would embed efficiency at its core.

The Commission in Maharashtra was also amongst the first ones to create a trajectory for renewable energy portfolio obligations and also feed in tariffs in the country to promote higher penetration of renewable energy. In the recent past, the Central Ministry of Power, as well as the state of Maharashtra have embarked on the important journey of embedding higher levels of renewable energy in the Indian Power Grid, most notably under the Panchamrit scheme announced by the central government. This scheme focuses on 500 GW of installed Renewable Energy capacity by 2030 and 50% of electricity consumed in the country to come from renewable energy sources around the same year. It is thus important to align different regulations by the Commission to support efficiency at end use consumption across all the categories of consumers, at the same time create opportunities to embed newer renewable energy capacity in key sectors.

SECTION 2: PROGRESS OF 2010 REGULATIONS RELATED TO DEMAND SIDE MANAGEMENT

As mentioned above, the Commission notified DSM regulations in April 2010. The key part of the regulations, specifically related to the implementation framework, focused on creating an opportunity for different distribution licensees to design programs promoting energy conservation, energy efficiency and load management among different categories of consumers.

All the four distribution companies actively participated in several demand side management programs that they designed for the approval of this Commission. The kinds of programs that were implemented by the four Distribution Companies included lighting initiatives in all consumer categories, efficiency improvement in air conditioning systems, appliance replacement initiatives for air conditioners and refrigerators, energy audit campaigns and load shifting opportunities through thermal energy storage

and demand response initiatives.

During the past decade all the distribution licensees combined reported approximately 50 MW of savings through energy consumption in key categories as a part of their DSM portfolio. Two distribution licensees also demonstrated a possibility of approximately 25 MW of demand response initiatives working closely with power markets and the consumer load.

SECTION 3: RATIONALE FOR NEW REGULATIONS

Given the changing context of generation profiles from different types of generation plants including the ones behind the meter (within the consumer premises) and heavy emphasis on solarization of agriculture feeders as well as households, it is now imperative to place demand side management as an opportunity in the form of a combination of demand flexibility, demand side management, demand response, energy efficiency and energy conservation.

In the past, based on changing load profiles and consumption requirements, generation plants would follow the load. In the newer context with variations in generation capacity specifically coming from renewable energy, it is now important for the load to follow the generation as well, in order to meet the renewal portfolio obligations of distribution licensees in Maharashtra. These utilities are moving forward with newer contracts for solar photovoltaic systems as well as wind projects. In certain cases, some new bids in Maharashtra and at the Central Government level include renewables and energy storage, including battery energy storage and pumped hydro storage. In the recent past, Maharashtra State Electricity Distribution Company Ltd

launched a process to embed 9,000 MW of solarization in the agricultural sector, which would require additional loads to be created during the time when solar energy is generated. In this context, it is now important to articulate Demand Side Management in the form of demand flexibility. In order to meet the new requirements, it is proposed to rephrase demand side management regulations to a new articulation of demand flexibility and demand side management regulations. Demand flexibility is generally defined as the ability of the load to come online or go offline based on the generation at that particular time of the day.

In order to make robust and comprehensive regulations, it is proposed to notify one single regulation titled Demand Flexibility and Demand Side Management Implementation Framework Cost Effectiveness Assessment and Evaluation Measurement and Verification Regulations 2024. The regulations have three distinct components:

- Part A Implementation framework
- Part B Cost effectiveness assessment tests
- Part C Evaluation, measurement and verification

It is intended to create one single notified regulation in order to also include evaluation measurement and verification which was not present in the previous set of regulations notified in 2010.

One of the key aspects of the new proposed regulations is setting out certain targets for the distribution licensees to create portfolios of demand flexibility and demand response. Based on the initial assessments

by distribution licensee and discussions with experts in the field, in order to embed 500 GW of renewable energy into the Indian power system, approximately 10% of the current peak demand should be met with using flexible demand, which is expected to offer certain resources at costs that are much lesser than the lowest renewable energy bids as well.

As an example, consumer category wise number of consumers and connected loads for one of the licensees are presented below:

Sr No.	Category	Number of consumers	Connected load/ Contract Demand	
1	LT I -BPL	2,29,668	27,895	kW
2	LT I Domestic	2,13,13,414	2,32,28,744	kW
3	LT II Non-Domestic	20,56,116	43,74,152	kW
4	LT III PWW	56,108	1,70,143	kW
5	LT IV Agriculture	45,12,918	2,31,17,092	HP
6	LT V Power loom	56,864	3,88,889	kW
7	LT V Industrial General	3,81,297	46,61,941	kW
8	LT VI Streetlight	1,02,641	4,85,336	kW
9	LT X - Public services	1,34,260	72,437	kW
10	LT EV Charging	145	1,308	kW
11	LT Prepaid	7,454		
12	HT-I Industries	14,945	88,50,694	KVA
13	HT-II Commercial	3,076	5,58,151	KVA
14	HT III Railways	101	26,874	KVA
15	HT IV-PWW	1,027	3,18,404	KVA
16	HT V Agricultural	1,419	4,75,576	KVA
17	HT VI Bulk Supply (Housing Complex)	262	54077	KVA
18	HT Temporary	-		
19	HT-IX Public services	1,517	2,95,596	KVA
20	MSPGCL AUX SUPPLY	28	240724	KVA
21	HT EV Charging stations 11 KV	2	391	KVA
22	HT EV Charging Stations 12 KV	4	**9854**	KVA
23	**Total**	**2,88,73,266**	**6,73,58,278**	**KVA**

(Source: MERC order 226 of 2022)

This means that the total connected load of the distribution licensee is approx. 67,000 MW. Out of which 3% of the past year's peak demand of 22,000 MW (approx.660 MW) can be demand flexibility prospect. Such a flexible demand can be met through multiple end-uses such as water pumping, HVAC in C&I consumers and other bulk loads. The proposed regulations now include a demand flexibility portfolio obligation (DFPO) that is cascaded as shown in the table below:

Year	Target as share of previous year's reported peak demand
1	3%
2	4%
3	5%
4	6%
5	7%

It is also proposed that after year five, the distribution licensees shall follow the process of 7% flexible demand being made available to the grid compared to the previous year's reported peak demand, or any variation proposed by the Commission.

Distribution Licensee shall be eligible for incentive of INR 0.20 Crores for every MW achieved in excess of DFPO. Similarly, Distribution Licensee shall be subjected to dis-incentive of INR
0.20 Crores for every MW underachievement of DFPO.

Proposed regulations also suggest setting up a DF/DSM consultation committee comprising a group of experts working under the direction of the Commission, to provide reviews, suggestions and objections on the DF / DSM programme portfolio submitted by the distribution licensees and providing recommendations based on its findings to the Commission for approval.

SECTION 4: TECHNOLOGICAL INTERVENTIONS

Given the nature of changing loads and newer loads coming online, such as electric vehicles, the proposed regulations now also include electric vehicles as one of the key technologies at the end use level that can be used for demand flexibility by the distribution licensees. Other technologies that are proposed as examples in the regulations include thermal energy storage and heat pumps for residential, public sector, hospitals, hotels and commercial sectors. Based on recent experiments related to water pumping systems, the regulations also suggest including newer flexible loads such as water pumping systems for urban local bodies, Municipal corporations and Nagar parishads and bulk loads such as lift irrigation schemes that are operated by Water Resources Department and the Command Area Development structures in the agricultural sector.

Based on current tariff order analysis, anywhere between 20-25% of the load is available as flexible demand from sectors such as public waterworks, lift irrigation schemes, end-use air- conditioning systems, end use water heating and the emerging electric vehicles market. The EV charging infrastructure

market itself has a good potential to provide demand flexibility opportunities as bulk power and bulk resources that are available to the system. The electric vehicle charging infrastructure related to bus fleet, freight, fleet four wheelers, three wheelers, two wheelers is a good opportunity to be considered as flexible demand.

Part B of the proposed regulations is based on the existing cost effectiveness assessment tests regulations of 2010. All the distribution licensees routinely submit their proposals to the Commission with cost effectiveness test analysis and the rate impact tests carried out based on the regulations. As such, the cost effectiveness tests have not been changed in these regulations. However, there is an emphasis on ancillary services available that have been crafted through the new regulations by the Central Electricity Regulatory Commission. These define primary, secondary and tertiary resources available as ancillary services and envisage additional revenue flow coming to the distribution licensees when aggregated demand is made available in the tertiary ancillary services market. Any revenues that would be collected by the distribution licensees directly or through their aggregators would form a part of the revenue stream or the benefits stream in the benefit cost analysis process that has been crafted.

The distribution licensees have successfully implemented several demand side management programs in the past and submitted the evaluation reports to the commission through the Demand Side Management Consulting Committee. In order to bring all the reporting of demand flexibility and demand side management projects implemented by the distribution licensees into the new proposed regulations also into the section on evaluation measurement and verification, three types of evaluations namely Process evaluation, Impact evaluation and Market effective evaluation are proposed under these regulations. Avoided cost of power purchase for social cost test is taken as Rs. 12/kWh which is prevalent ceiling rate for Day Ahead market set by CERC. The evaluations can be carried out using independent verification agency to be appointed by the distribution licensees with expertise in designing of the programs as well as evaluating the programs and aligned with the Bureau of Energy Efficiency professional training and the certification through the certified energy auditors and certified energy managers, in addition to certified measurement and verification professionals being available through certain international certification agencies.

The Commission now invites the distribution licensees and other stakeholders to offer their comments to the proposed regulations in order to ensure a proper consultation process to be followed before the notification of the regulations.

AC Motors: Understanding the Basics and IEC Standards

Introduction

AC motors are widely used in various industries due to their high efficiency, reliability, and versatility. These motors operate on alternating current (AC) and are available in different types, including induction, synchronous, and wound rotor motors. To ensure safety, performance, and interoperability, AC motors are designed and tested according to international standards, specifically the International Electrotechnical Commission (IEC) standards for relevant countries.

IEC Standards for AC Motors

The IEC publishes several standards related to AC motors, including:
- IEC 60034-1: Rotating electrical machines - Part 1: Rating and performance
- IEC 60034-2: Rotating electrical machines - Part 2: Methods for determining losses and efficiency
- IEC 60034-3: Rotating electrical machines - Part 3: Specific requirements for synchronous machines
- IEC 60034-4: Rotating electrical machines - Part 4: Methods for determining magnetic and electric properties

These standards cover aspects such as rating, performance, losses, efficiency, and testing methods for AC motors.

Benefits of IEC Standards for AC Motors

Adherence to IEC standards ensures that AC motors meet certain performance, safety, and environmental requirements. Some benefits of IEC standards for AC motors include:
- Interoperability: IEC standards ensure that AC motors from different manufacturers can work together seamlessly.
- Safety: IEC standards cover safety aspects such as electrical and thermal protection.
- Performance: IEC standards specify requirements for efficiency, power factor, and torque.
- Environmental considerations: IEC standards address environmental concerns such as electromagnetic compatibility and noise levels.

Conclusion

AC motors play a vital role in various industries, and adherence to IEC standards ensures their safety, performance, and interoperability. By understanding the basics of AC motors and the relevant IEC standards, manufacturers, designers, and users can ensure the optimal selection and application of these motors.

Here are the different types of AC motors in single phase and three phase configurations

Single Phase AC Motors:

1. Induction Motor (Split Phase, Capacitor Start, Permanent Split Capacitor)
2. Synchronous Motor (Reluctance, Hysteresis, Permanent Magnet)
3. Stepper Motor
4. Brushless DC Motor (BLDC)
5. Permanent Split Capacitor Motor
6. Capacitor Start Induction Run Motor
7. Split Phase Motor

Three Phase AC Motors:

1. Induction Motor (Squirrel Cage, Wound Rotor)
2. Synchronous Motor (Cylindrical Rotor, Salient Pole)

3. Stepper Motor
4. Brushless DC Motor (BLDC)
5. Permanent Magnet Motor
6. Reluctance Motor
7. Hysteresis Motor
8. Wound Rotor Induction Motor
9. Synchronous Induction Motor
10. Axial Flux Motor

Note that some of these types may have sub-categories or variations, but the above list represents the main types of AC motors in single phase and three phase configurations.

DC Motors: Understanding the Basics and IEC Standards

Introduction

DC motors are widely used in various applications due to their high torque, speed control, and simplicity. These motors operate on direct current (DC) and are available in different types, including brushed, brushless, and stepper motors. To ensure safety, performance, and interoperability, DC motors are designed and tested according to international standards, specifically the International Electrotechnical Commission (IEC) standards.

IEC Standards for DC Motors

The IEC publishes several standards related to DC motors, including:

- IEC 60034-1: Rotating electrical machines - Part 1: Rating and performance
- IEC 60034-5: Rotating electrical machines - Part 5: Degrees of protection provided by enclosures
- IEC 60034-14: Rotating electrical machines - Part 14: Electrical machines for voltages up to and including 1000 V

These standards cover aspects such as rating, performance, degrees of protection, and testing methods for DC motors.

Benefits of IEC Standards for DC Motors

Adherence to IEC standards ensures that DC motors meet certain performance, safety, and environmental requirements. Some benefits of IEC standards for DC motors include:

- Safety: IEC standards cover safety aspects such as electrical and thermal protection.
- Performance: IEC standards specify requirements for efficiency, torque, and speed.
- Interoperability: IEC standards ensure that DC motors from different manufacturers can work together seamlessly.
- Environmental considerations: IEC standards address environmental concerns such as electromagnetic compatibility and noise levels.

Additionally, IEC standards for DC motors cover specific requirements for:

- Electric vehicles (IEC 62660)
- Industrial applications (IEC 60034-1)
- Medical devices (IEC 60601-1)

Conclusion

DC motors play a vital role in various applications, and adherence to IEC standards ensures their safety, performance, and interoperability. By understanding the basics of DC motors and the relevant IEC standards, manufacturers, designers, and users can ensure the optimal selection and application of these motors.

Here are the different types of DC motors

1. Brushed DC Motor: Contains brushes and a commutator to control the flow of current.
2. Brushless DC Motor (BLDC): Uses electronic controllers to switch current flow, eliminating brushes.

3. Permanent Magnet DC Motor: Uses permanent magnets as the rotor and a DC power source.
4. Shunt DC Motor: Has a shunt field winding that connects in parallel with the armature.
5. Series DC Motor: Has a series field winding that connects in series with the armature.
6. Compound DC Motor: Combines shunt and series field windings.
7. Stepper Motor: Uses electromagnetic poles to rotate the shaft in small, precise steps.
8. Servo Motor: A type of DC motor used for precise control in applications like robotics and CNC machines.
9. Gearmotor: A DC motor with an integrated gearbox to increase torque and reduce speed.
10. Linear Motor: A DC motor that produces linear motion instead of rotational motion.
11. Vibrating Motor: A DC motor used in applications like vibrating screens and conveyors.
12. Coreless DC Motor: A type of brushless DC motor without a core in the rotor.

These types of DC motors are used in various applications, including robotics, automotive systems, industrial equipment, and consumer electronics. Each type has its unique characteristics, advantages, and disadvantages.

Contributor

Veejhay B Limaaye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UNDERSTANDING BASICS OF NEMA MOTORS

NEMA electric motors meet the regulations and meet all the demands of the **US market.**

NEMA stands for *"National Electrical Manufacturers Association":* US association of manufacturers of electrical equipment with the aim of defining common standards.

NEMA regularly updates and publishes MG 1, a book that assists users in the proper selection and application of motors and generators. It contains practical information concerning performance, efficiency, safety, testing, construction and the manufacture of alternating current (AC) and direct current (DC) motors and generators.

This Washington-based US regulatory body draws up technical regulations and facilitates cooperation between manufacturers and users of electrical equipment.

NEMA (National Electrical Manufacturers Association) standards are a set of guidelines that establish standardization for various electrical equipment, including electric motor frame sizes. The NEMA standard for electric motor frame sizes defines the physical dimensions, mounting, and other characteristics of electric motor frames

The NEMA standard for electric motor frame sizes covers a wide range of motor sizes, from fractional horsepower motors to large motors used in industrial applications. The standard defines specific frame sizes, which are designated by a number that indicates the overall size of the frame. For example, a NEMA frame size 56 is a common size for fractional horsepower motors used in appliances and power tools.

The NEMA standard also defines the mounting dimensions and other physical characteristics of the motor frame. This ensures that motors from different manufacturers can be easily interchanged and that the motor will fit properly in the equipment it is being used in. In addition to the frame size, the standard defines mounting options such as foot mounting or flange mounting and specifies the shaft diameter and length.

Overall, the NEMA standards for electric motor frame sizes help to ensure that electric motors are compatible with the equipment they are being used in, and that they meet certain quality and performance standards.

There are some electric motors that are larger than the largest NEMA frame sizes. These motors are typically used in heavy industrial applications, and their frame sizes are often designated by different standards.

One common standard for larger electric motor frame sizes is the IEEE (Institute of Electrical and Electronics Engineers) standard. The IEEE standard defines frame sizes for large AC and DC motors used in industrial applications. These frame sizes range from 315 to 1000, with corresponding shaft heights ranging from 400 mm to 1600 mm.

All major manufacturers of motors and electrical equipment in the USA are members of the NEMA Association.

UNDERSTANDING MOTOR NAME PLATE TERMS

Let us look at some important terms on the motor name plate to understand NEMA standards.

1. **Voltage** – AC motors are designed to operate on standardized voltages

Standardized Voltages	
60 Hz	50 Hz
115 VAC	380 VAC
220 VAC	400 VAC
230 VAC	415 VAC
460 VAC	
575 VAC	

A small variation in supply voltage can have a dramatic affect on motor performance.
When voltage is 10% below the rated voltage of the motor, the motor has 20% less starting torque. This reduced voltage may prevent the motor from getting its load started or keeping it running at rated speed. A 10% increase in supply voltage, on the other hand, increases the starting torque by 20%. This increased torque may cause damage during startup.

2. Frequency – 60 Hz.

A variation in the frequency at which the motor operates causes changes primarily in speed and torque characteristics. A 5% increase in frequency, for example, causes a 5% increase in full load speed and a 10% decrease in torque.

3. Service Factor

a. A motor designed to operate at its nameplate horsepower rating has a service factor of 1.0. This means the motor can operate at 100% of its rated horsepower.
b. Some applications may require a motor to exceed the rated horsepower. In these cases, a motor with a service factor of 1.15 can be specified. The service factor is a multiplier that may be applied to the rated power. A 1.15 service factor motor can be operated 15% higher than the motor's nameplate horsepower.
c. It should be noted that any motor operating continuously at a service factor greater than 1 will have a reduced life expectancy compared to operating it at it's rated horsepower. In addition, performance characteristics, such as full load RPM and full load current, will be affected.

4. Insulation Class

a. NEMA has established insulation classes to meet motor temperature requirements found in different operating environments. The four insulation classes are A, B, F, and H. Class F is commonly used. Class A is seldom used.
b. Before a motor is started, its windings are at the temperature of the surrounding air. This is known as ambient temperature. NEMA has standardized on an ambient temperature of 40° C, or 104° F within a defined altitude range for all motor classes.
c. Temperature will rise in the motor as soon as it is started. Each insulation class has a specified allowable temperature rise. The combination of ambient temperature and allowed temperature rise equals the maximum winding temperature in a motor. A motor with Class F insulation, for example, has a maximum temperature rise of 105° C when operated at a 1.0 service factor. The maximum winding temperature is 145° C (40° ambient plus 105° rise). A margin is allowed to provide for a point at the center of the motor's windings where the temperature is higher. This is referred to as the motor's hot spot.
d. The operating temperature of a motor is important to efficient operation and long life. Operating a motor above the limits of the insulation class reduces the motor's life expectancy. A 10° C increase in the operating temperature can decrease the motor's insulation life expectancy as much as 50%.

Class of Insulation System	Temperature, Degrees C
A	75
B	95
F	115
H	130

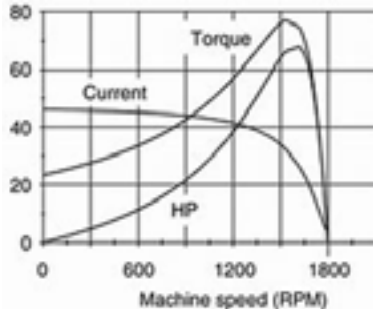
5. Motor Design

a. Motors are designed with certain speed-torque characteristics to match speed-torque requirements of various loads.

b. The four standard NEMA designs are NEMA A, NEMA B, NEMA C, and NEMA D. NEMA A is not used very often. NEMA B is commonly used. NEMA C and NEMA D are used for specialized applications.

c. A motor must be able to develop enough torque to start, accelerate and operate a load at rated speed.

d. Starting Torque



i. Starting torque is also referred to as locked rotor torque. This torque is developed when the rotor is held at rest with rated voltage and frequency applied. This condition occurs each time a motor is started. When rated voltage and frequency are applied to the stator there is a brief amount of time before the rotor turns.

ii. A NEMA B motor develops approximately 150% of its full-load torque.

iii. NEMA sets limits of starting (locked rotor) current for NEMA design B motors. When special load torque or load inertia requirements result in special electrical designs that will yield higher locked rotor current (LRA), NEMA design A may result. This designation also cautions the selection of motor control components to avoid tripping protective devices during longer acceleration times or higher than normal starting current.

iv. Starting torque of a NEMA design C motor is approximately 225%. Hard to start applications such as plunger pumps, heavily loaded conveyors, and compressors require this higher starting torque. Slip and full-load torque are about the same as a NEMA B motor. NEMA C applies to single speed motors from approximately 5 HP to 200 HP.

v. The starting torque of a NEMA design D motor is approximately 280% of the motor's full-load torque. Very hard to start applications, such as punch presses, cranes, hoists, and oil well pumps require this high starting torque. NEMA D motors have no true breakdown torque. After initial starting torque is reached torque decreases until full-load torque is reached. NEMA D motors typically are designed with 5 to 8% slip or 8 to 13% slip.

6. Altitude

Standard motors are designed to operate below 3300 feet. Air is thinner and heat is not dissipated as quickly above 3300 feet. Most motors must be derated for altitude providing the 40 deg. C ambient rating is still required.

Altitude	Derating Factor
3300 – 5000	0.97
5001 – 6600	0.94
6601 – 8300	0.9
8301 – 9900	0.86
9901 – 11500	0.82

7. Motor Efficiency

NEMA motor efficiencies are defined in MG 1 and have two levels defined as “Energy Efficient” as shown in table 12-11 of the standard and “Premium Efficient” as in table 12-12 of the standard. NEMA Premium is trademarked and the term should only be used by manufacturers who are part of NEMA’s premium motor program

To understand in comparison with IEC terminologies following can be considered.

NEMA	IEC
--	IE1
Energy Efficient	IE2
Premium Efficiency	IE3
Not Defined Yet	IE4

8. Enclosures – Majorly in use

e. Open Drip Proof (ODP)

Open enclosures permit cooling air to flow through the motor. The rotor has fan blades that assist in moving the air through the motor. One type of open enclosure is the drip proof enclosure. The vent openings on this type of enclosure prevent liquids and solids falling from above at angles up to 15° from vertical from entering the interior of the motor and damaging the operating components. When the motor is not in the horizontal position, such as mounted on a wall, a special cover may be necessary to protect it. This type of enclosure can be specified when the environment is free from contaminates.

f. Totally Enclosed Non-Ventilated (TENV)

In some cases air surrounding the motor contains corrosive or harmful elements which can damage the internal parts of a motor. A totally enclosed motor enclosure restricts the free exchange of air between the inside of the motor and the outside. The enclosure is not airtight, however, and a seal at the point where the shaft passes through the housing keeps out water, dust, and other foreign matter that could enter the motor along the shaft. The absence of ventilating openings means all heat dissipates through the enclosure by means of conduction. Most TENV motors are fractional horsepower. TENV motors are used, however, for larger horsepower special applications. For larger horsepower applications the frame is heavily ribbed to help dissipate heat more quickly. TENV motors can be used indoors and outdoors.

g. Totally Enclosed Fan Cooled (TEFC)

The totally enclosed fan-cooled motor is similar to the TENV Fan Cooled except an external fan is mounted opposite the drive end of the motor. The fan provides additional cooling by blowing air over the exterior of the motor to dissipate heat more quickly. A shroud covers the fan to prevent anyone from touching it. With this arrangement no outside air enters the interior of the motor. TEFC motors can be used in dirty, moist, or mildly corrosive operating conditions. TEFC motors are more widely used for integral HP applications.

h. Explosion Proof (XP)

The explosion proof motor enclosure is similar in appearance to the TEFC, however, most XP enclosures are cast iron. The application of motors used in hazardous locations is subject to regulations and standards set by regulatory agencies such as the National Electrical Code® and Underwriters Laboratories for XP motors used in the United States.

9. NEMA Dimensions

NEMA has standardized frame size motor dimensions. Standardized dimensions include bolt hole size, mounting base dimensions, shaft height, shaft diameter, and shaft length. Existing motors can be replaced without reworking the mounting arrangement. New installations are easier to design because the dimensions are known. Letters are used to indicate where a dimension is taken.

For example, the letter “C” indicates the overall length of the motor. The letter “E” represents the distance from the center of the shaft to the center of the mounting holes in the feet. The actual dimensions are found by referring to a table in the motor data sheet and referencing the letter to find the desired dimension.

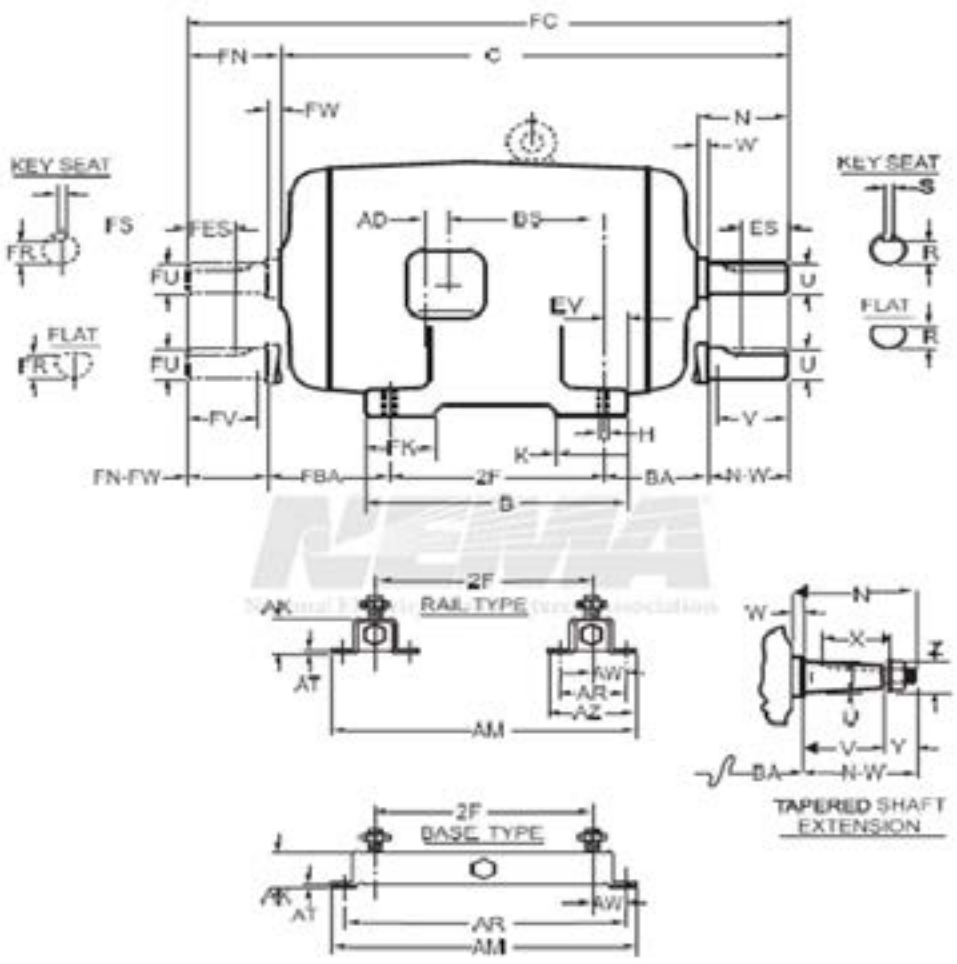


Figure 4-1
Letter Symbols for Foot-Mounted Machines—Side View

NEMA divides standard frame sizes into two categories: fractional and integral. Fractional frame sizes are designated 48 and 56 and include primarily horsepower ratings of less than one horsepower. Integral or medium horsepower motors are designated by frame sizes ranging from 143T to 445T. A “T” in the motor frame size designation of integral horsepower motors indicates the motor is built to current NEMA frame standards.

The frame size designation is a code to help identify key frame dimensions. The first two digits, for example, are used to determine the shaft height. The shaft height is the distance from the center of the shaft to the mounting surface. To calculate the shaft height divide the first two digits of the frame size by 4. In the following example a 143T frame size motor has a shaft height of 3½ inches (14 ÷ 4).

The third digit in the integral “T” frame size number is the NEMA code for the distance between the center lines of the mounting bolt holes in the feet of the motor. The dimension is determined by matching the third digit in the frame number with a table in NEMA publication MG-1.

10. Mounting Positions

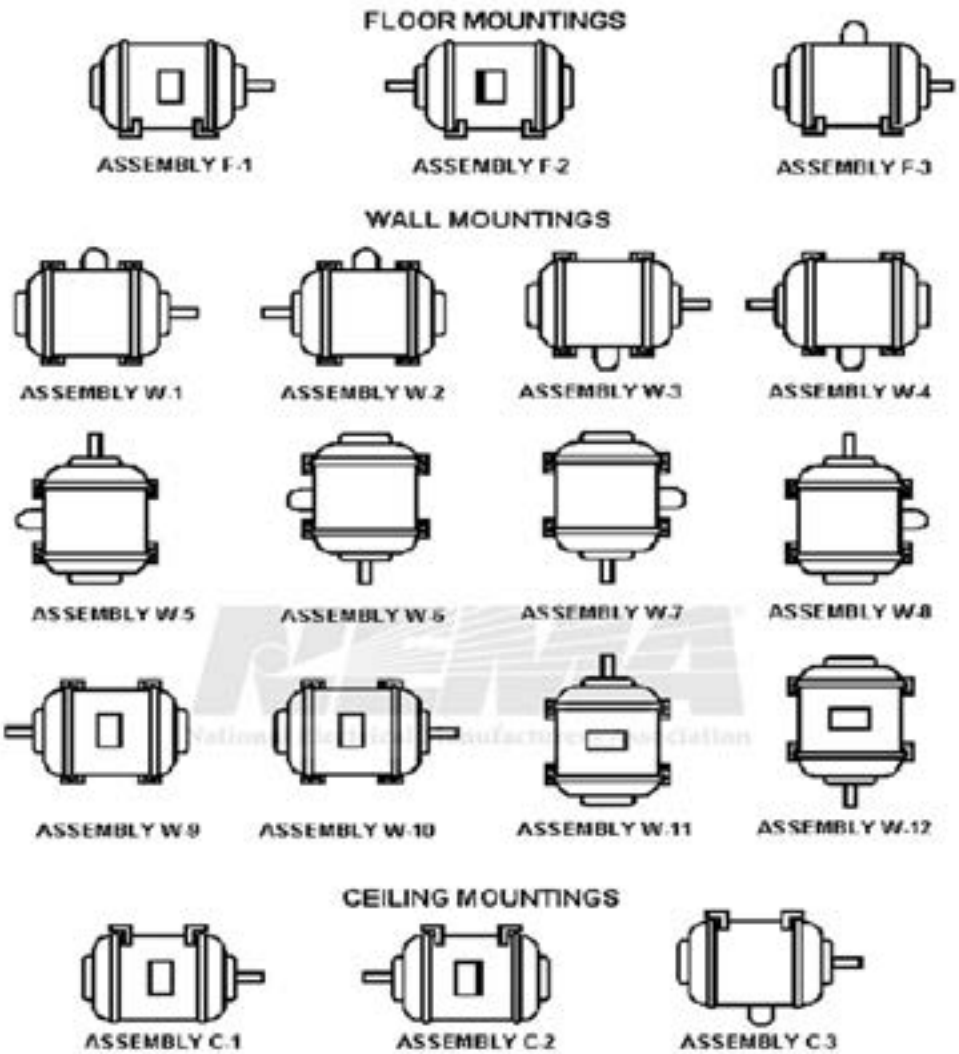


Figure 4-6
Machine Assembly Symbols

The typical floor mounting positions are illustrated in the following drawing and are referred to as F-1 and F-2 mountings. The conduit box can be located on either side of the frame to match the mounting arrangement and position. The standard location of the conduit box is on the left-hand side of the motor when viewed from the shaft end. This is referred to as the F-1 mounting. The

conduit opening can be placed on any of the four sides of the box by rotating the box in 90° steps.

Typical wall and ceiling mounts are shown in the following illustration. Wall mounting positions have the prefix “W” and ceiling mounted positions have the prefix “C”

References:

ANSI/NEMA MG1 – 2021.
Free Copy of the same can be downloaded at https://www.nema.org/standards/view/motors-and-generators

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MAHARASHTRA ELECTRICITY REGULATORY COMMISSION

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Advt No. 39/2024-25

PUBLIC NOTICE

Inviting comments, suggestions and /or objections on Draft Regulations

1. Maharashtra Electricity Regulatory Commission (MERC or Commission) has prepared the Draft MERC (Demand Flexibility and Demand Side Management – Implementation Framework, Cost-effectiveness Assessment; and Evaluation, Measurement and Verification) Regulations, 2024.
2. These Draft Regulations along with the Explanatory Memorandum. have been uploaded on the Commission's **website www.merc.gov.in,** in downloadable format
3. Any comments, suggestions or objections on the draft Regulations may be uploaded within 21 days through '**E-Public Consultation**' Tab on MERC Website (www.merc.gov.in/e-public-consultation). In case of any difficulty in accessing this feature, concerned stakeholders can contact the MERC Office Mobile No.: 8928071522 or on email id: **suggestions@merc.gov.in** between 9.30 AM to 6.00 PM on all the working days. A Person who has uploaded suggestion and objection on **'E-Public Consultation'** Tab need not file any hard copy of its submission. Persons who do not have access to electronic media can file their suggestions and objections in a hard copy addressed to **'The Secretary', Maharashtra Electricity Regulatory Commission (MERC), 13th Floor, Centre No.1, World Trade Centre, Cuffe Parade, Mumbai - 400 005,** before 5 PM on **20 September 2024**. Suggestions/ Objections filed through any other mode shall not be considered.
4. All Comments, Suggestions and objections uploaded or received on or before 20 September 2024 shall be considered by the Commission before finalizing the above Draft Regulation. All future communication on this issue will be through MERC website only (www.merc.gov.in)

(Dr. Rajendra G. Ambekar)
Secretary,
Maharashtra Electricity Regulatory Commission

Date : 27/08/2024
Place : Mumbai

Like the asynchronous motor, the synchronous motor consists of a **stator and a rotor separated by the air gap**. It differs from the asynchronous motor in that the flux in the air gap is not due to a component of the stator current.

It's created by magnets or by the field coil current provided by an external DC source energizing a winding placed in the rotor.

Construction

Fig 1: A pair of ancient Carbon Dioxide air conditioning compressors, powered by two antique 150 horsepower open frame synchronous motors. This type of A/C system dates to the 1930's.

Stator

The stator consists of a housing and a magnetic circuit generally comprising silicon steel laminations and a 3-phase coil similar to that of an asynchronous motor supplied with 3-phase AC to produce a rotating field.

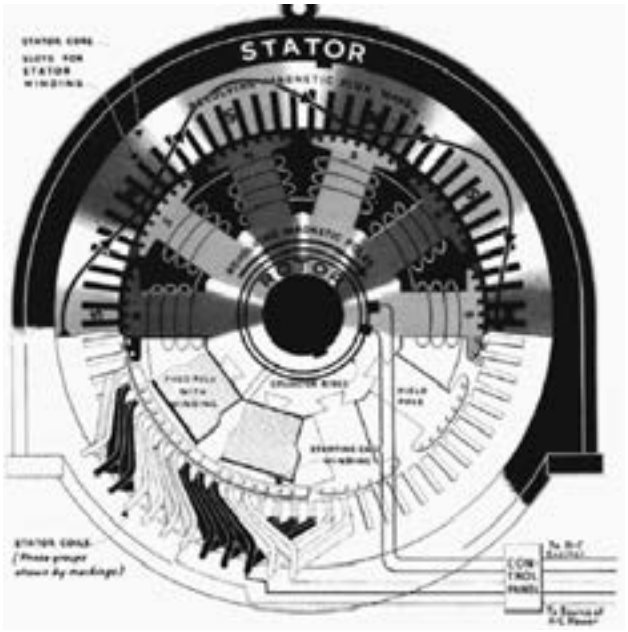

Fig. 2: Magnetic skeleton (upper half) and structural parts (lower half) of a ten pole 720 rpm 60 Hz, synchronous motor

Rotor

The rotor carries field magnets or coils through which a direct current flows and which create interposed North and South poles. Unlike asynchronous machines, the rotor rotates with no slip at the speed of the rotating field.

There are therefore two different types of synchronous motor: magnet motors and wound rotor motors.

With magnet motors, the motor rotor is fitted with permanent magnets see Fig. 3, (generally rare earth magnets), in order to achieve increased field strength in a small volume. The stator has three-phase windings.

These motors can tolerate significant overload currents in order to achieve high-speed acceleration.

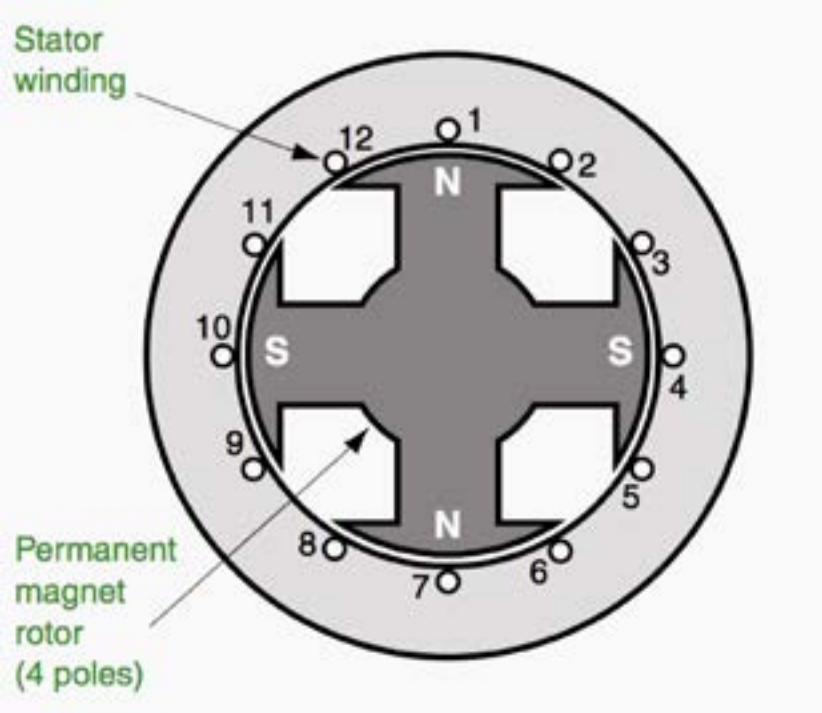

Fig.3 : Cross section of a permanent magnet motor

With Wound Coils

The second type of synchronous machine has a wound coil, and is a reversible machine that can operate as either a generator (alternator) or a motor. For many years these machines have been mainly used as alternators.

The development of direct (cycloconverters) or indirect frequency inverters operating with natural switching due to the ability of synchronous machines to provide reactive power has enabled the creation of high performance, reliable variable speed electric drives.

These drives are particularly competitive in relation to competitors' solutions for power ratings over one megawatt.

Although it is possible to find synchronous motors used industrially in **power ratings ranging from 150 kW to 5 MW**, it is above 5 MW that electric drives using synchronous motors become virtually essential, for the most part combined with variable speed drives.

The motor torque of the synchronous machine is proportional to the voltage at its terminals, whereas that of the asynchronous machine is proportional to the square of that voltage. Unlike the asynchronous motor, **it can work with a power factor equal to one or very close to it**.

The synchronous motor therefore has a number of advantages over the asynchronous motor with regard to its ability to be powered via the constant voltage/frequency line supply:

1. The speed of the motor is constant, regardless of the load.
2. It can supply reactive power and increase the power factor of an installation.
3. It can withstand relatively large voltage drops (around 50% due to its over-excitation properties) without stalling.

However, the synchronous motor supplied directly by the constant voltage/frequency line supply has two disadvantages:

1. It has starting difficulties. If the motor is not combined with a variable speed drive, starting must be performed at no-load, either by DOL starting of small motors, or using a starting motor that drives it at a speed close to synchronous speed before direct connection to the line supply.
2. It may stall if the resistive torque exceeds its maximum electromagnetic torque. In this case, the entire start process must be repeated.

Other types of Synchronous Motors:

Linear Motors

Their structure is identical to that of synchronous rotary motors: **they consist of a stator (plate) and a rotor (forcer) which are in line**. In general the plate moves along the forcer on a guide. This type of motor does away with all intermediate kinematics for converting the movement, which means there is no play or mechanical wear on this drive.

A linear synchronous motor (LSM) is a linear motor in which the mechanical motion is in synchronism with the magnetic field, i.e., the mechanical speed is the same as the speed of the traveling magnetic field (Figure 4).

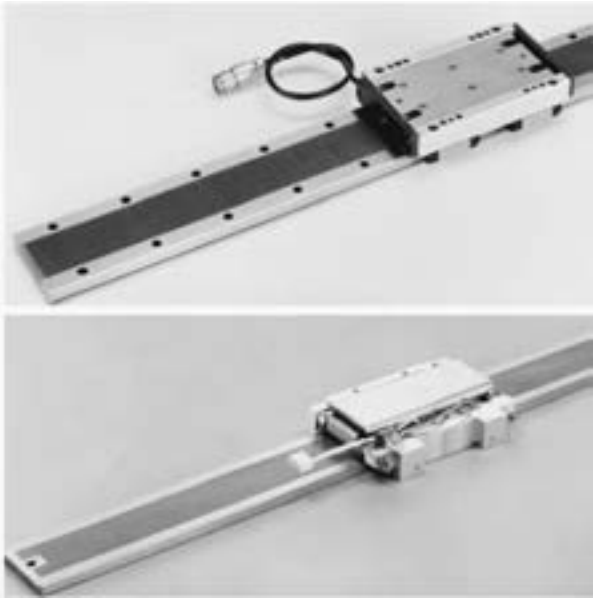

Fig.4: permanent magnet (PM) linear stepping motors

Synchronised Asynchronous motors

These are induction motors. During the starting phase, the motor operates in asynchronous mode **and when it has reached a speed close to synchronous speed, it switches to synchronous mode**.

If it has a high mechanical load, it can no longer operate in synchronous mode and returns to asynchronous mode. This feature is obtained by special construction of the rotor and is generally for low power motors.

Stepper motors

The stepper motor is a motor that operates according to the electrical pulses supplying its coils. Depending

on its electrical power supply, it may be:

1. **Unipolar** if its coils are always supplied in the same direction by a single voltage, hence the name unipolar.
2. **Bipolar** when its coils are supplied sometimes in one direction and sometimes in the other. They sometimes create a North pole, and sometimes a South pole, hence the name bipolar.

Stepper motors can be of variable reluctance or magnet type or a combination of the two.

References: Basic Electrical Engineering

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Pharmaceutical factory explosion kills 17, injures 36

23 AUGUST 2024

An explosion and fire in southern India killed at least 17 people and injured dozens more after a solvent leak on 22 August. The blast occurred at around midday at a facility owned by Escientia Advanced Sciences in the state of Andhra Pradesh. Officials said the incident happened after a chemical solvent, which was being used in the manufacture of a pharmaceutical ingredient, leaked from one floor of the factory to the floor below. A vapour cloud formed and spread to a power panel where it ignited. The solvent which leaked is reported to have been Methylene Tertiary Butyl Ether or MTBE.

Workers at the factory had been attempting to stop the chemical leak when the explosion happened. While process safety incidents are not uncommon in India, the incident is one of the country's worst in recent years.

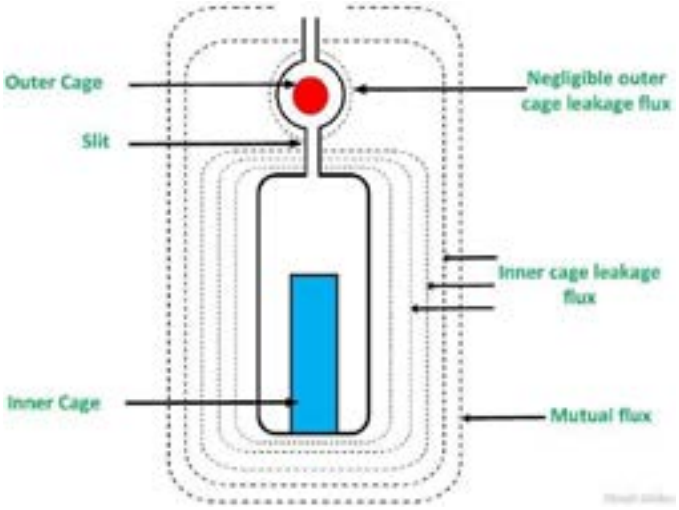
Escientia Advanced Sciences said in a statement that it was working with police to investigate the cause of the leak. Officials did not rule out human error, however smoke and fire damage prevented any preliminary inspection of the site.

Repairs to rotor of 3000V, 1850Bhp, 3000Rpm Boiler feed pump motor.

Executive Summary:

In any thermal plant the biggest motor is Boiler feed pump motor. It is operated under fullload condition. Being a high speed motor, vibration of rotor is very critical. Permissible limit is 30 micron, peak to peak. This paper deals with the repairs carried to rotor of double cage induction motor, which had erratic vibrations and sometime exceeding 120 micron. Separate oil filled bearing and pedestal supported the rotor both on driving end, and non driving end. Such high vibration was not permissible, as it might damage the white metal bearings and its pedestal. The rotor had a history of vibration earlier and sent for repairs. Things did not improve even after repairs.

Construction and operation of Double cage induction motor rotor:



Outercage

Has a high resistance to reactance ratio, and bars with high resistance and low reactance. The outer cage also has a smaller cross-sectional area than the inner cage.

Innercage

Has a low resistance to reactance ratio, and bars with low resistance and high reactance

A double cage induction motor's working principle is based on the use of two rotor windings, or cages, to produce high starting torque at low starting current. The rotor is designed with different bars in each cage.

Need of double cage induction motor. Conventional squirrel cage motors suffers from the disadvantage of low starting torque. So, low starting torque is the problem. But this could be achieved by increasing the rotor resistance. It will give higher starting torque as well as low starting current. Higher rotor resistance on one hand increases thestarting torque but on the other hand it reduces the full load speed , increases the losses and decreases the efficiency. Thus low rotor resistance is required for running period.

Summing up, we concludethat for good overall performance of Induction Motor, it should have high rotor resistance during starting period and low rotor resistance during running period. This is achieved by double cage induction motor.

Stator of double cage induction motor is similar to the ordinary induction motor. But the rotor consists of two windings or cages namely outer cage and inner cage.

Bars of outer cage have small cross sectional area than the inner cage bars and it is made up of high-resistivity materials.

Bars of inner cage are made up of material having low resistance.

Since outer cage is more closer to the stator hence it will have lesser leakage reactance and inner cage is more away from the stator and that's why most of its flux does not links with stator and hence inner cage has higher leakage reactance.

Hence

OUTER CAGE - high resistance, low reactance.

INNER CAGE - low resistance, high reactance.

Observation and rectification during rotor repairs for the second time:

The rotor was sent forrepairs forthe second time. Instructions were given to the repairer that after removing the end rings of the outer cage, I should be invited for investigations. On opening the outer cage end rings, *I witnessed traces of solder material from the outer cagerods to the inner cage flats and the end rings of the inner cage. Virtually the outer cage and the inner cage were shorted by these solder materials, resulting in erratic behaviour of the rotor vibration.*

To provide better gap between the outer cage and inner cage, I instructed the repairer to cut the inner cage bars on both side by 1mm. On doing this the end rings were positioned and brazed to respective bars.

Operation of motor post repairs:

When the rotor was received after repairs, we were eager to put it in service. It was a thrilling success as the motor ran smoothly with vibration of less than 20 micron peak to peak.

My out of box thinking paid rich dividends.

Contributed by:

A V Prasanna

(B. E. Electrical) CEEAMA, LFM : 87

Retired after serving for:

1.) Tata Power Trombay Thermal station (25 years).

2.) Emirates Technical associates PPD (Abu Dhabi -5years).

3.) Fichtner Consulting Engineers, Mumbai (deputed to Saudi Arabia - 3.5 years)

WINNERS OF QUIZ
JULY 2024

KIRAN MARUTI PATNE

SUDHAKAR JOSHI

SUDHANSHU SEKHAR JHA

GAJALA KURESHI

Congratulations

QUIZ SEPTEMBER 2024

1. Arc flashes can generate temperatures up to:
   A. 3500°F
   B. 1200°C
   C. 25,000°C
   D. 35,000°F

2. Major components of LT Panel:
   A. Earth wire
   B. Circuit Breakers
   C. Labels
   D. All of the above

3. Most prevalent MV voltage of 34.5kV belongs to:
   A. China
   B. Saudi Arabia
   C. India
   D. Egypt

4. PIP standards refer to:
   A. Process Inside Piping
   B. Picture In Picture
   C. Process Industry Practices
   D. Piping Industry Practices

5. ASTM, CSA, NFPA, UL, & IEEE are Industry codes and standards of:
   A. USA
   B. North America
   C. Canada
   D. All of the above

6. Temperature rating specified for LV cables:
   A. 60°C
   B. 75°C
   C. 90°C
   D. 140°C

7. Electrical Heat Tracing (EHT) is a modern substitute for:
   A. Steam
   B. Heavy Insulation
   C. Gas fired tracing
   D. None of the above

8. GIS substations are mainly provided to:
   A. Save space
   B. Address safety concerns
   C. Automate distribution
   D. All of the above

9. Type 2 co-ordination of Starters are:
   A. Better than Type 1
   B. Equal to Type 1 but sophisticated
   C. Worse than Type 1 & 3
   D. Better than Type 3

10. RCCB sensitivity of 500mA is suitable for:
    A. Residential flats
    B. Industries
    C. OEMs of Lifts and Heavy machinery
    D. Fire protection

Rules for the QUIZ:

- The Quiz will be open for 10 days from the date of EMAIL.
- Each correct answer received on DAY 1 will get 100 points
- Next days the points will reduce as 90 – 80 – 70 and on 10th day points will be ZERO even if the
- answer is correct.
- All participants will receive E certificate signed by CEEAMA President with the points earned
- mentioned on the same.

Please use following google form link to participate in the QUIZ.

https://forms.gle/tLGZUcPVQBsheHQq9

"Thank you all for the overwhelming response to the E-NEWS in general and E-Quiz in particular. MCQ based quiz is always tricky and surprisingly can take us aback when we realise our conceptions (misconceptions) about the subject / system / product.

The aim of the feature was to create inquisitiveness in your mind and help you check your technical quotient quickly. The response will also help us to present articles and webinars on subjects which are important, but which lack enough awareness / knowledge in general.

It can open a pandora box for our discussions and arguments and probable solutions. Engineering evolves with conception. It gets fuelled with community discussions and capitalist actions. All stakeholders start realising the need to take a closer look and help improve standards as we have seen in the past century. Surely it makes the world a better place.

Wish you all a better luck this time.

Do spread the word.

August 2024 Quiz Answers

1. A. Dr. Jayant Narlikar
2. C. Building Automation System
3. C. 1.8-2.4m
4. D. Both A. & C. above.
5. B. 5 Pin type
6. A. Stages of Drawing submission
7. A. Step up Voltage
8. A. ZCT
9. D. All of the above
10. C. Both A & B

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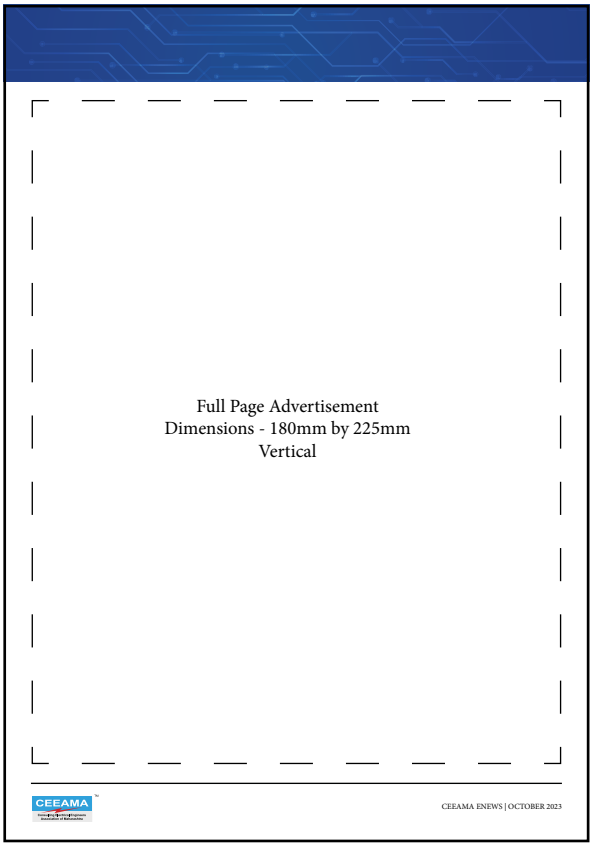

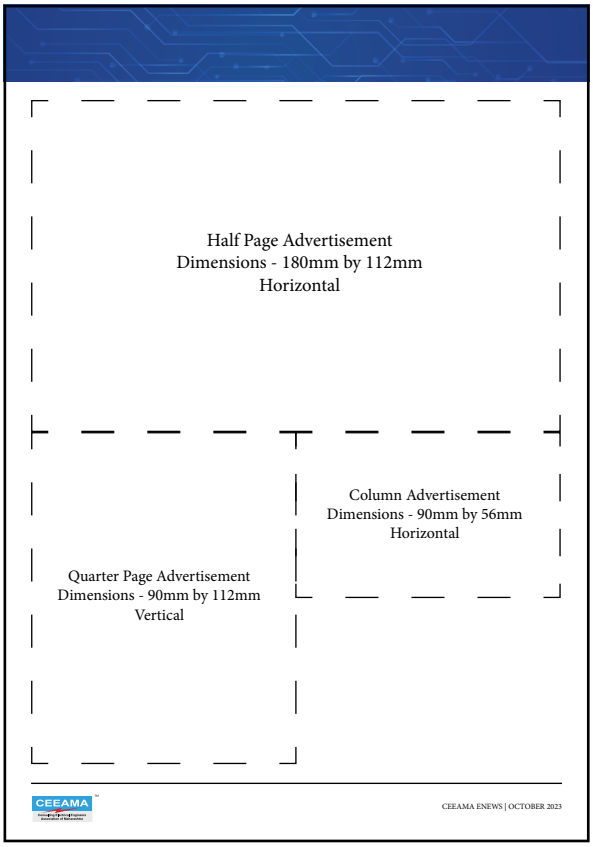

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E-NEWSLETTER

Published by Consulting Electrical Engineers Association of Maharashtra

Electrical Consultants Newsletter
Volume No. 4 Issue #44
SEPTEMBER 2024

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