CEEAMA Live Wire

E-NEWSLETTER

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Topic for May 2026

MONSOON PREPAREDNESS

Before immersing yourselves in this month's topic, revisit the last issue—
take the quiz at the end and see how much you remember.

Electrical Consultants Newsletter
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May 2026

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From the Editors Desk,

As we enter May 2026, the electrical engineering profession continues to navigate a landscape shaped by economic uncertainty, rapid technological advancement, and an accelerating energy transition. In such times, professional associations like CEEAMA play a vital role in fostering learning, dialogue, and preparedness among engineers.

During April 2026, CEEAMA witnessed active member participation across its technical and interactive forums. Recent engagements reflected strong interest in practical plant issues, electrical safety, reliability, and evolving technologies. These interactions reaffirmed CEEAMA's role as a platform where experience-based knowledge and contemporary engineering practices come together for collective growth.

CEEAMA is gearing up for a series of technical programs, expert talks, and interactive sessions in the coming months. These initiatives aim to address both emerging technologies and persistent operational challenges, while encouraging participation from senior professionals as well as young engineers. Our focus remains on delivering industry-relevant, application-driven learning.
Globally, cautious economic growth, supply chain realignments, and energy market volatility are influencing engineering decisions. For the electrical industry, this has increased the emphasis on energy efficiency, lifecycle cost optimization, asset reliability, and digitalization.

Simultaneously, technological progress continues at a fast pace. Smart grids, digital substations, renewable integration, electric mobility, energy storage, and AI enabled asset management are steadily redefining the way electrical systems are designed, operated, and maintained. Sustainability, safety, and compliance are no longer optional—they are fundamental engineering objectives.

The Rainy season that this country experiences by end of this month brings lots of new hopes for the whole planet; whether Plants, animals or Humans. Our industry too waits for the large amount of fresh water it brings to many types of seasonal productions including that for Hydel power plants. But the rain is no saint! It can take the form of a devil and ruin many things. Last month we saw how to tackle Lightning that this season brings the most. This month, we will talk about how much prepared we are for other challenges the MONSOON poses to Engineers.

Wishing you all an electrifying, yet always SAFE, period ahead.

Subhash L. Bahulekar
Chief Editor – CEEAMA

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From the President's desk:

As we step into May 2026, I extend my warm greetings to you and your families. The past month has once again reinforced my belief that professional bodies like CEEAMA play a vital role—not only in technical knowledge sharing, but also in building a strong, ethical, and future ready engineering fraternity.

April was an eventful month for CEEAMA. Our technical interactions and member engagement programs witnessed encouraging participation, particularly from senior professionals as well as young consulting engineers. The quality of discussions, practical insights shared, and candid exchange of field experiences clearly demonstrated the value of learning from one another. I sincerely thank all speakers, moderators, organizers, and participants who contributed their time and expertise to make these programs meaningful.

At the same time, the global environment around us continues to evolve rapidly. We are all witnessing a phase of economic realignment—driven by supply chain diversification, energy transition, infrastructure investments, and increasing emphasis on sustainability and resilience. For consulting engineers, this translates into both challenges and opportunities. Clients today expect not just compliance based designs, but solutions that are cost optimized, energy efficient, digitally enabled, and aligned with long term asset performance.

Technology is clearly becoming a strong enabler. Digital tools, simulation platforms, AI assisted engineering, smart monitoring systems, and lifecycle based design thinking are no longer optional. However, technology must complement—not replace—sound engineering judgment, safety consciousness, and adherence to standards. As consulting professionals, our responsibility is to adopt relevant technologies thoughtfully, ensuring they enhance reliability, safety, and value for our clients and society at large.

In the Indian context, continued focus on power sector modernization, renewable integration, EV infrastructure, manufacturing growth, urban redevelopment, and data centers opens up significant opportunities for electrical and multidisciplinary consultants. At the same time, issues such as skill development, quality assurance, ethical practices, and fair professional fees demand collective attention. CEEAMA remains committed to addressing these issues through structured knowledge programs, policy dialogues, and industry interaction.

Looking ahead, we have an exciting calendar planned for the coming months. These include technical seminars, panel discussions on emerging trends, practice oriented sessions for small and mid size consulting firms, and initiatives aimed at mentoring young engineers entering the profession. I strongly encourage members to actively participate, propose topics, and even volunteer as speakers or mentors. The strength of our association lies in the willingness of members to contribute beyond their individual practices.

I would also urge our members to engage more closely with CEEAMA at the regional and institutional level—by inviting non member professionals to our programs, sharing feedback, and helping us expand our outreach. A larger, more engaged membership will strengthen our collective voice with clients, authorities, and allied professional bodies.

In closing, I would like to reaffirm that CEEAMA stands for professional excellence, ethical conduct, continuous learning, and mutual respect. Let us continue to support each other, adapt to changing times, and uphold the values that define our profession.

I look forward to meeting many of you at our upcoming programs.

With warm regards,

Mr. Chidambar Joshi
Hon. President
CEEAMA

From the Secretary's desk:

Dear Esteemeed Members,

Greetings from CEEAMA.

The month of May finds the global community navigating a period of heightened uncertainty. Ongoing geopolitical conflicts and regional wars have not only impacted nations directly involved, but have also sent ripple effects across economies, energy markets, and infrastructure systems worldwide. As professionals engaged in the planning, design, and operation of electrical systems, we must remain attentive to how these global disturbances influence our own domain.

One of the most visible consequences has been volatility in energy supply chains. Fluctuations in fuel prices, disruptions in logistics, and constraints on critical raw materials—such as copper, aluminium, and semiconductor components—are affecting project costs and timelines. For consulting engineers, this underscores the importance of resilient design practices, prudent material selection, and adaptive project planning.

At a broader level, these events remind us of the strategic importance of energy security. Nations across the world are accelerating their focus on diversification of energy sources, increased adoption of renewables, and strengthening of grid infrastructure. In India too, the emphasis on self-reliance and sustainability continues to grow. As members of this Association, we have a significant role to play in supporting this transition through innovative engineering solutions and adherence to best practices.

Another critical aspect is the need for robust and reliable infrastructure. In times of global instability, the resilience of power systems becomes paramount—not only for economic continuity but also for public safety and essential services. This calls for heightened attention to system protection, redundancy, cybersecurity, and disaster preparedness in all our projects.

While global challenges persist, they also present opportunities for professional growth and contribution. Let us use this period to reinforce our commitment to quality, safety, and ethical engineering practices. Knowledge sharing, continuous learning, and collaboration within our fraternity will be key to navigating these complex times.

The Association will continue its efforts to facilitate technical discussions, training programs, and dissemination of relevant information to support our members. Your active participation and feedback remain invaluable.

Let us move forward with resilience, responsibility, and a shared vision for a stronger and more sustainable electrical infrastructure.

Warm regards,

Mr. Ulhas Vajre
Hon. Secretary
CEEAMA

Note: The recent development is that the National Building Code of India, i.e. NBC 2016 is withdrawn and substituted by National Building Construction Standard 2026. Below is a one page note on Comparison between NBC 2016 and NBCS 2026.

Brief Comparison between NBC 2016 and NBCS 2026

The National Building Construction Standards (NBCS 2026), notified on April 30, 2026, represents a fundamental shift from the National Building Code (NBC 2016). The most significant change is the move from a "Code" to a "Standard," transitioning from a prescriptive, mandatory-style regime to a performance-oriented, advisory framework. [1, 2, 3, 4, 5]

Comparison of NBC 2016 and NBCS 2026

Feature [1, 2, 3, 6, 7, 8, 9, 10, 11, 12]	NBC 2016	NBCS 2026
Nomenclature	National Building Code (NBC)	National Building Construction Standards (NBCS)
Legal Status	Often interpreted as legally binding; used the word "shall"	Strictly advisory/guidelines; uses the word "should"
Regulatory Model	Prescriptive: Fixed specifications for materials and dimensions	Performance-based: Focuses on outcomes (e.g., Fire Resistance Rating)
Fire Safety Threshold	Mandatory high-rise fire norms for buildings above 15 metres	Mandatory fire safety provisions shifted to buildings above 24 metres
Enforcement	Centralized reference with heavy standardisation	Decentralized; states/local bodies must now define their own specific rules
Structural Layout	13 parts covering 33 chapters	Consolidated structure: 12 parts collapsed into 6 major parts

Key Additions in NBCS 2026

- EV Infrastructure: Formal codification requiring 20% of parking spaces to have EV charging capabilities.
- Performance-Based Design (Annex M): Introduced as a new benchmark for fire engineering, allowing designers to prove safety through simulation rather than just fixed rules.
- Emerging Sectors: First-time formal inclusion of standards for Data Centres and Metro Station fire/life safety (Annex H).
- Smart Building Requirements: Mandatory cybersecurity for Building Management Systems (BMS) and requirements for digital fire safety records.
- MEP Modernization: Formal reference to Busbar Trunking Systems (IEC 61439-6) and specific cable assignments (FRLSH, HFFR) for safety. [8, 12, 13, 14, 15]

Key Deletions or Changes

- Absolute Height Caps: Prescriptive height restrictions based on occupancy have been largely eliminated, deferred to performance-based engineering and state bylaws.
- Direct "Code" Enforcement: The central mandate has been withdrawn, meaning the Bureau of Indian Standards (BIS) no longer frames it as a binding central "code" to avoid litigation.
- Water Curtains: Use of water curtains for basement compartmentation has been reviewed and deleted in favour of more advanced suppression techniques. [6, 8, 15, 16]

DISCLAIMER

The information in all the articles of CEEAMA LiveWire is compiled using references from various sources. Although every attempt has been made to ensure the accuracy of this material, neither CEEAMA nor any of its contributors to this publication assumes responsibility for any inaccuracies or omissions in the data presented. For use in practice, we strongly advise that, information utilized from this publication should be verified from the relevant sources and to use document of actual standard published by respective institution.

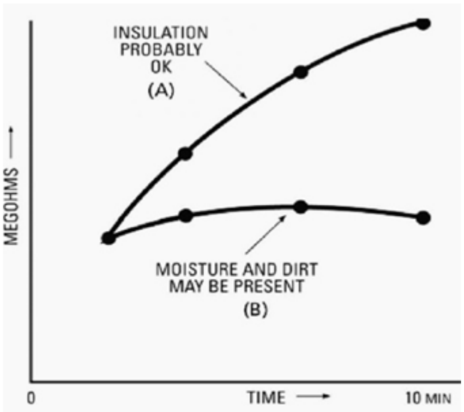
Monsoon is often celebrated as a season of renewal—bringing lush greenery, cooler temperatures, and relief from scorching heat. For industries, however, it also marks the arrival of heightened risk. Factories, offices, plants and refineries must prepare not just for rain, but for the vulnerabilities it exposes—especially in electrical systems.

During heavy rainfall, power infrastructure faces some of its toughest challenges. Water doesn't need an invitation; it seeps into enclosures, condenses within panels, and accelerates corrosion, silently damaging critical components. Even minor exposure can disrupt operations, trigger equipment failure, or create serious safety hazards.

This is why a Monsoon preparedness is not just advisable—it's essential.

The Electrical Perils of Monsoon Season

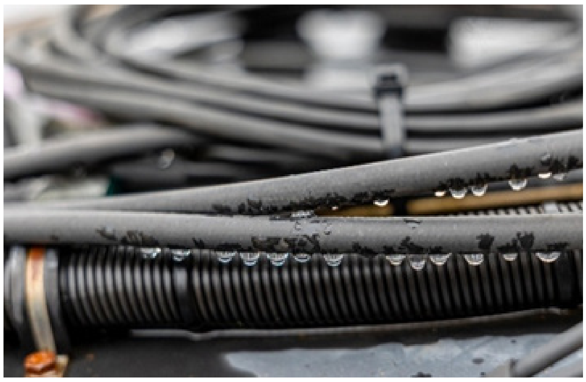
Monsoon conditions dramatically alter the electrical behavior of systems due to increased moisture, reduced insulation resistance, soil saturation, and atmospheric instability. These factors elevate the risk of fault currents, insulation failures, corrosion, and lightning-induced transients



Impact of Moisture on Electrical Insulation

1. Reduced Insulation Resistance (IR):
Moisture ingress lowers IR values significantly, leading to leakage currents.
2. Tracking & Flashover:
Water films create conductive paths → surface tracking → eventual flashover.
3. Condensation in Panels:
Temperature variation causes internal condensation in switchgear.

From a technical standpoint, insulation resistance values drop significantly in humid conditions. Periodic testing using insulation resistance testers (Meggers) is essential to ensure system health. Maintaining proper ingress protection (IP-rated enclosures) and installing anti-condensation heaters are effective mitigation measures.

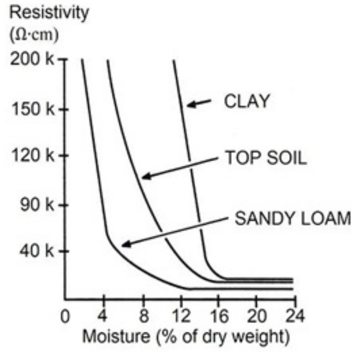


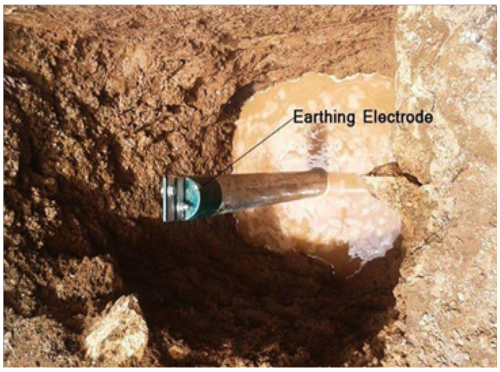
Earthing System Behavior in monsoon

Earthing plays a crucial role in ensuring electrical safety, and its behavior changes significantly during monsoon. As soil becomes saturated with water, its resistivity decreases, which may initially seem beneficial. However, this condition is not stable.

Prolonged exposure to moisture accelerates corrosion of earthing electrodes, especially in conventional GI or copper systems. This leads to deterioration of the grounding system over time, increasing the risk of unsafe fault current dissipation.

Standards such as IEEE 80 emphasize maintaining low and stable earth resistance values. To achieve this, modern practices include chemical earthing, use of corrosion-resistant materials, and periodic testing of earth resistance.



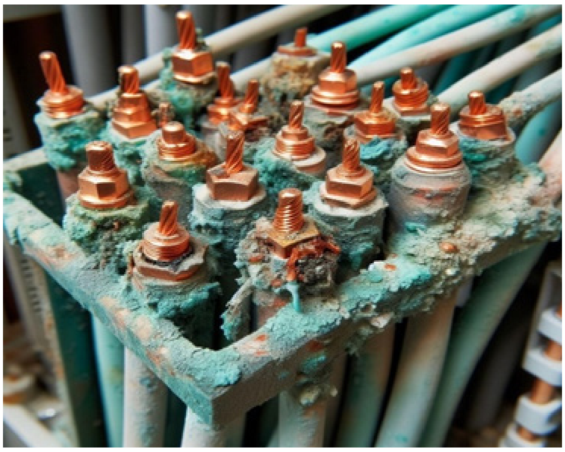


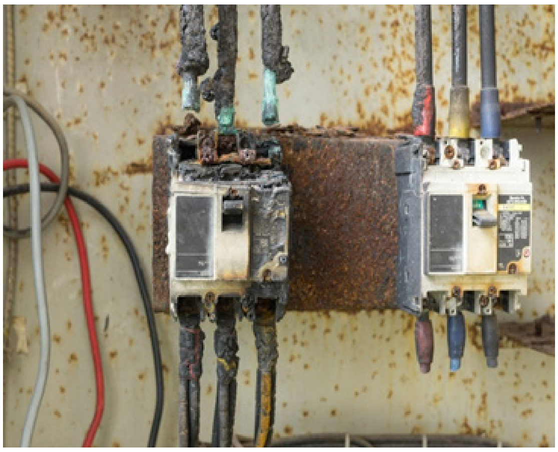
Corrosion and Material Degradation

High humidity and the presence of pollutants create an ideal environment for corrosion. Metallic components such as cable lugs, terminals, busbars, and enclosures are particularly susceptible.

Corrosion increases contact resistance, which leads to localized heating and eventual failure. In severe cases, it can result in arcing and fire hazards.

Preventive strategies include the use of tinned copper conductors, anti-corrosion coatings, and stainless-steel hardware. Regular inspection and maintenance are critical to identifying early signs of degradation.

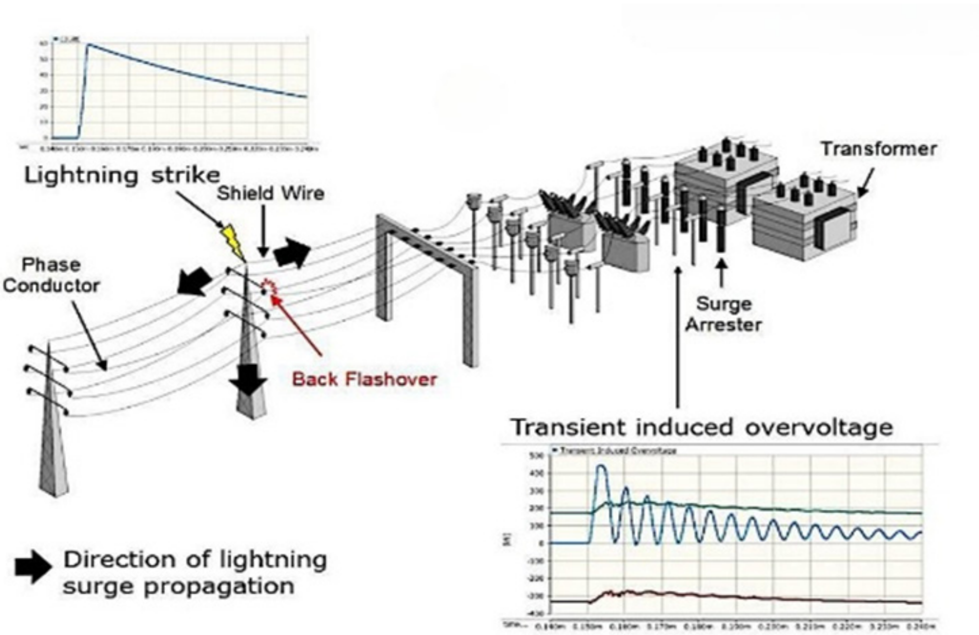




Lightning and Surge Hazards

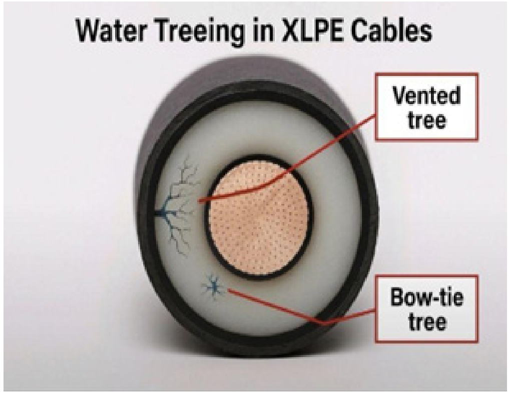
Monsoon seasons are often accompanied by thunderstorms, increasing the probability of lightning strikes. A single lightning event can inject extremely high current—often exceeding 100 kA—into electrical systems, causing catastrophic damage.

Lightning does not need to strike equipment directly to cause harm. Nearby strikes can induce high-voltage transients in cables and transmission lines, leading to insulation failure and equipment damage.



To mitigate these risks, systems must be designed in accordance with standards like IEC 62305. The use of lightning arresters, surge protection devices (SPDs), and proper grounding networks is essential to safely divert surge energy away from sensitive equipment

Cable Failures and Water Ingress



Underground and outdoor cables are highly vulnerable during monsoon. Flooded cable trenches and poorly sealed joints allow water to penetrate insulation layers. In XLPE cables, this leads to a phenomenon known as water treeing—microscopic channels that gradually weaken insulation until breakdown occurs.

Improper cable termination practices further exacerbate the issue. Once moisture enters, it is difficult to remove and continues to degrade the dielectric properties.

Using high-quality heat shrink or cold shrink terminations, ensuring proper gland sealing, and maintaining adequate drainage systems can significantly reduce these risks

Conclusion

The monsoon season presents a unique set of electrical challenges that demand careful engineering consideration. Moisture, lightning, corrosion, and grounding instability collectively increase the likelihood of failures and hazards.

A resilient electrical system is not just about design—it is about proactive maintenance, adherence to international standards, and the integration of protective technologies. By anticipating the effects of monsoon and implementing robust mitigation strategies, engineers can ensure both safety and reliability in even the harshest environmental conditions.

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Introduction

The monsoon season brings much-needed rainfall but also introduces several operational, safety, and reliability challenges for industrial plants. For plant engineers, monsoon preparedness is not merely a seasonal activity, it is a critical preventive strategy to safeguard personnel, assets, production continuity, and environmental compliance. Proactive planning and timely execution of monsoon preparedness measures significantly reduce the risk of accidents, equipment failures, and unplanned shutdowns.

This article outlines key focus areas and practical actions plant engineers should implement ahead of and during the monsoon season.

Key Areas of Monsoon Preparedness

One of the most important aspects of monsoon preparedness is drainage and water management. During heavy rains, inadequately maintained stormwater systems can lead to waterlogging, flooding of operational areas, and damage to equipment. Plant engineers must ensure that all stormwater drains, culverts, and trenches are thoroughly inspected and cleaned well in advance. Accumulated silt, debris, and vegetation must be removed to restore natural water flow. Proper slope and flow direction are essential to avoid water stagnation, which can weaken foundations and create hazardous working conditions. Rainwater harvesting pits, sumps, and collection systems should be verified for functionality, and portable pumps should be kept ready to manage emergency dewatering in case of unexpected accumulation.

Structural and Civil Readiness

Structural and civil readiness is another key area that demands attention during monsoon preparation. Industrial structures such as roofs, sheds, platforms, and walkways are continuously exposed to rain and wind loads. Any existing cracks, leakages, or weak points can worsen during monsoon, leading to water loss and structural deterioration. Plant engineers should ensure that cracks in concrete, masonry, and expansion joints are repaired promptly. Tank foundations and underground pits should be checked for signs of settlement or seepage. Walkways, ladders, handrails, and access structures must be intact, stable, and safe for use in wet conditions. Antiskid coatings are particularly important during monsoon, as slippery surfaces significantly increase the risk of slips and falls.

Electrical System Safety

One of the most critical areas requiring attention during monsoon is electrical system safety. Electrical installations are inherently sensitive to moisture, and even minor water ingress can lead to short circuits, equipment failure, or serious safety incidents such as electric shocks and fires. Plant engineers must ensure that LT and HT panels are properly sealed and protected against rainwater entry. Attention should be given to gland plates, cable entry points, and junction boxes, ensuring they are weatherproof and properly tightened. In addition, the effectiveness of the earthing system must be verified, as proper earthing plays a vital role in protecting both equipment and personnel during wet conditions. Emergency lighting systems should be tested to ensure operation during power disruptions, and the use of temporary or exposed electrical connections must be strictly controlled to avoid hazardous situations.

Mechanical Equipment Reliability

Mechanical equipment reliability is another key factor influencing plant performance during monsoon conditions. Rotating equipment such as pumps, compressors, and gearboxes are particularly susceptible to water pressure and corrosion. Plant engineers must ensure that seals are intact and lubrication systems are protected from water contamination, as the presence of water in lubricants can lead to accelerated wear and potential equipment failure. Idle or standby equipment should be covered and protected using suitable anticorrosion measures, while operational equipment should be monitored for alignment, vibration, and bearing conditions. Maintaining standby equipment in ready condition is essential for ensuring continuity in case of unexpected breakdowns during adverse weather.

Instrumentation and Control Protection

Instrumentation and control systems, which form the backbone of process automation and monitoring, also demand special protection during monsoon. Outdoor field instruments such as transmitters, analyzers, and sensors are exposed to harsh environmental conditions and must be verified for appropriate ingress protection ratings. Impulse lines and instrument connections should be inspected for moisture accumulation or blockage, which can affect measurement accuracy and process control. Ensuring the proper functioning of instrument air systems is equally important, as moisture laden air can lead to malfunction of control valves and actuators.

Utility Systems Preparedness

Utility systems, including power supply, cooling water, steam, and compressed air systems, serve as the backbone of plant operations and must remain functional even during extreme monsoon conditions. The readiness of backup systems such as DG sets must be ensured to handle power interruptions caused by storms or grid instability. Cooling towers, boilers, and water treatment facilities should be inspected for structural integrity and operational efficiency.

Storage Tanks and Piping Systems

Storage tanks and piping systems also require careful monitoring during monsoon to prevent process disturbances and environmental hazards. Tank bunds and dyke drains must be kept clear to avoid rainwater accumulation, which can compromise containment systems. Critical components such as flange joints, vents, and overflow lines should be checked to ensure proper functioning without leakage.

Safety, Health, and Environment (SHE) Measures

Safety, health, and environmental considerations become even more significant during monsoon due to increased exposure to slippery surfaces, electrical hazards, and limited visibility. Plant engineers must ensure that appropriate safety measures are in place, including regular toolbox talks focused on monsoon hazards, proper display of warning signage in high-risk areas, and availability of rain-specific personal protective equipment such as gumboots, raincoats, and insulated gloves.

Conclusion:

In conclusion, monsoon preparedness in industrial plants is a multi-disciplinary effort that requires the active involvement of all engineering functions. A well-coordinated approach that integrates electrical safety, instrumentation protection, mechanical reliability, utility readiness, storage integrity, safety practices, and structured documentation ensures that the plant remains safe, efficient, and resilient during the monsoon season. For plant engineers, this preparation is not merely a routine activity but a critical responsibility that directly contributes to operational excellence and safety culture.

"Engineering Resilience, Rain or Shine

— Safeguarding People, Processes, and Progress."

Contributed by:

Jayraj Godhani

Associate Engineer

L&T Technology Services


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Industry 4.0 Digital Twin: Monsoon Preparedness.

Introduction

This article emphasizes the importance of adopting Digital Twin technology for improving monsoon preparedness in industrial electrical systems. In industrial plants, monsoon is not just a seasonal change; it is a critical operational phase that directly affects plant reliability, utility continuity, and electrical safety. Factors such as heavy rainfall, high humidity, water ingress, cable trench flooding, transformer overheating, earthing instability, and lightning surges create serious risks for electrical infrastructure.

With the growth of Industry 4.0, industries are moving towards smarter solutions like Digital Twin technology. A Digital Twin creates a live virtual model of plant electrical systems using real-time data and helps predict monsoon-related failures before they happen.

This shifts plant engineering from preventive maintenance to predictive reliability, making monsoon preparedness smarter, faster, and more effective.

Digital Twin Concept in Electrical System

- A Digital Twin in plant engineering is a dynamic digital representation of physical plant assets that continuously receives real-time data from the field and mirrors actual operating conditions.
- It combines physical equipment, sensors, live data, engineering simulations, and predictive analytics into a single intelligent system.
- In practical terms, if there is a transformer operating in the plant, the Digital Twin creates its virtual model.
- If there is an MCC panel, switchgear, cable trench, or DG system, it also exists digitally. These digital assets continuously receive live operational data.

For example, a transformer sends its oil temperature, winding temperature, load current, and oil moisture values through sensors. The Digital-Twin processes this information and predicts whether the transformer may overheat if humidity remains high or if loading increases. This is what makes Digital Twin fundamentally different from conventional SCADA systems. SCADA tells what is happening. Digital Twin tells what may happen next. That predictive capability becomes extremely important during monsoon.

How Digital Twin Supports Monsoon Preparedness

The most important strength of Digital Twin is predictive simulation.

If weather forecasts predict heavy rainfall, the Digital Twin can immediately simulate plant impact. It can simulate stormwater flow and identify whether the drainage network can handle the rainfall volume. It can predict sump overflow time, cable trench flooding time, and water accumulation near electrical rooms. At the same time, it monitors electrical room humidity and predicts condensation probability inside panels. It analyzes transformer load and thermal behavior under changing environmental conditions. It evaluates whether earthing performance may change due to soil saturation. This allows plant teams to act before actual failures occur.

For example, if flooding risk increases:

- Drainage pumps can start automatically.
- Panel heaters can activate.
- Standby feeders can be prepared.
- Transformer load can be redistributed.

This converts monsoon preparedness into an active engineering process.

Engineering Architecture of Digital Twin

- The Digital Twin architecture starts at the physical layer, where all actual plant assets exist. This includes transformers, switchgear panels, MCCs, cable trenches, DG systems, UPS systems, and earthing systems.
- The second layer is the sensing layer. Sensors such as temperature sensors, humidity sensors, water level sensors, oil moisture sensors, partial discharge sensors, current transformers, and leakage sensors collect operational and environmental data.
- The third layer is the data acquisition layer, where field signals are collected through PLC systems, RTUs, smart relays, and IEDs.
- The fourth layer is the communication layer, where data is transmitted through Modbus, OPC UA.
- The fifth layer is the simulation layer. This performs flood simulation, thermal simulation, humidity simulation, and electrical load simulation.
- The sixth layer is the AI analytics layer where Artificial Intelligence models analyze patterns and predict failures.
- The final layer is the visualization layer, where all operational data, alarms, and predictions are displayed on SCADA dashboards.

This complete structure creates a connected engineering ecosystem.

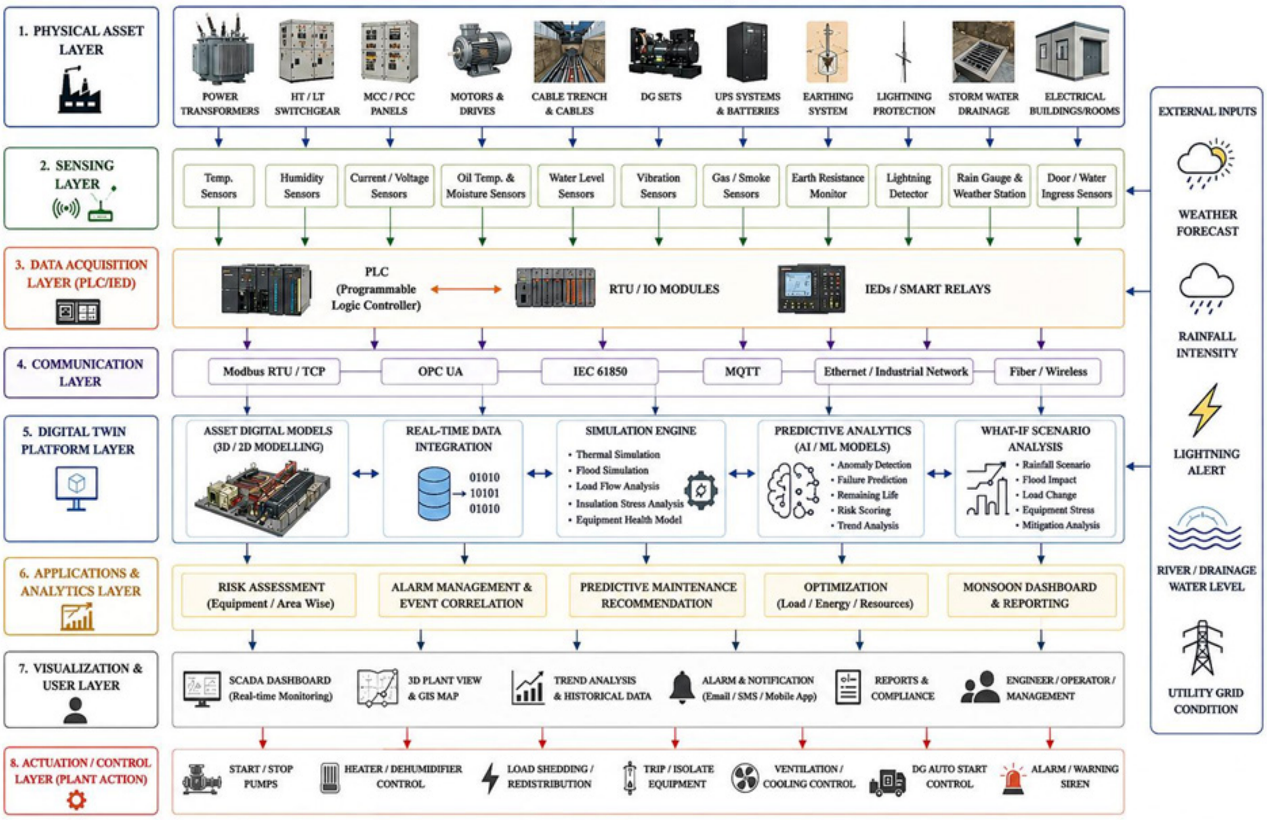

Fig 1. Digital Twin Architecture

PLC and SCADA Logic in Digital Twin-Based Monsoon Preparedness

The Digital-Twin provides prediction, but the actual field action is executed by PLC and monitored through SCADA.

For example, if panel humidity increases beyond 75%, the PLC logic activates anti-condensation heaters automatically. If humidity rises further beyond 85%, dehumidifiers start.

If water level in the cable trench reaches a high level, drainage pumps automatically start. If the level rises further, standby pumps also start.

If transformer oil temperature rises beyond a safe limit, cooling fans start automatically. If temperature reaches critical level, alarms are generated or trip commands are issued.

If water ingress is detected inside a panel, the PLC isolates the feeder to prevent flashover.

SCADA continuously displays all these conditions, allowing plant engineers to monitor the complete monsoon readiness of the plant.

This integration makes the plant both predictive and responsive.

Ladder Logic Implementation for Monsoon Protection

To make Digital Twin predictions actionable, PLC ladder logic becomes the core execution mechanism.

For panel condensation protection, humidity sensors continuously monitor panel conditions. If humidity crosses the set threshold, ladder logic energizes anti-condensation heaters.

For cable trench flood management, water level sensors monitor trench conditions. If water reaches high level, the PLC starts Pump-1. If the level continues rising, Pump-2 starts automatically as backup.

For transformer thermal protection, if transformer temperature crosses the first threshold, cooling fans are activated. If temperature reaches critical level, alarm signals are generated. If it reaches trip condition, transformer isolation is initiated.

For sump pits, water level-based ladder logic starts and stops pumps automatically based on level conditions.

For DG rooms, water detection sensors trigger drainage pumps and alarms.

For earthing systems, abnormal resistance values generate maintenance alarms.

The most advanced logic is Digital Twin predictive trigger logic. Here, if the Digital Twin predicts flooding or condensation before actual sensor thresholds are reached, PLC executes preventive actions in advance.

This is the true shift from reactive automation to predictive automation.

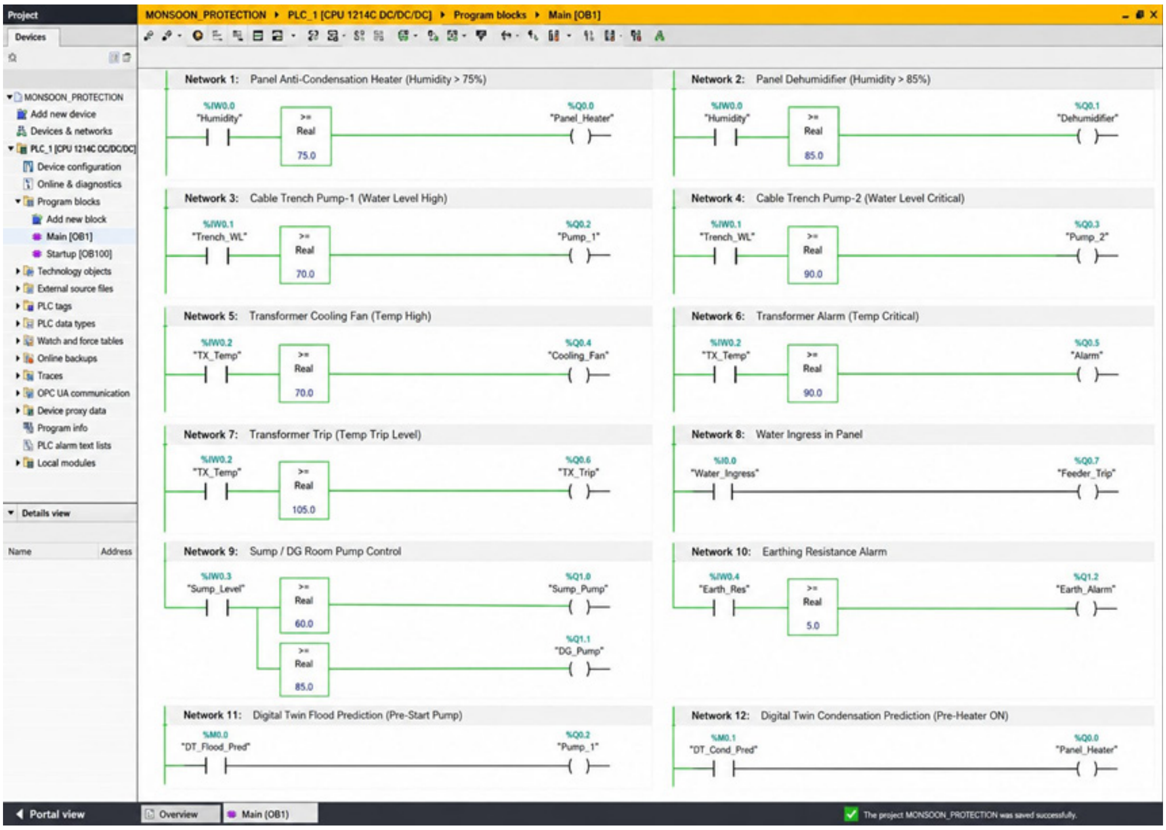

Fig 2. PLC Ladder Logic for Monsoon Protection

AI-Based Predictive Intelligence

- Artificial Intelligence improves Digital Twin accuracy by learning from historical plant behavior.
- If panel condensation has occurred in previous monsoons under similar humidity conditions, AI can identify the pattern and predict it earlier.
- If transformer overheating occurs repeatedly during high humidity and high loading, AI can recognize this trend.
- If drainage pumps show vibration abnormalities before failure, AI can predict pump failure probability.

This helps engineering teams prioritize maintenance activities based on actual risk.

Fig 3. Digital Twin with SCADA Dashboard

Future Scope

- Electrical panels will become self-healing with automatic humidity control.
- Substations will use predictive thermal modeling.
- Drone inspections will monitor outdoor substations during heavy rain.
- AI systems will optimize plant load based on weather conditions.
- Robotic systems will inspect flooded cable basements.
- Plants will gradually move toward self-protecting infrastructure.

Challenges

- High initial investment
- Data accuracy and sensor dependency
- Integration with existing PLC/SCADA systems
- Cybersecurity risks
- Need for skilled manpower
- Real-time communication reliability
- Availability of historical data for AI training

Conclusion

Digital Twin-Based Monsoon Risk Management is becoming an essential engineering strategy for industrial plants. It transforms traditional monsoon preparedness into a predictive, intelligent, and automated engineering process or electrical engineers.

In modern plant engineering, monsoon preparedness is no longer about checking whether systems are ready. It is about knowing how systems will behave when monsoon arrives and preparing before the first drop falls.

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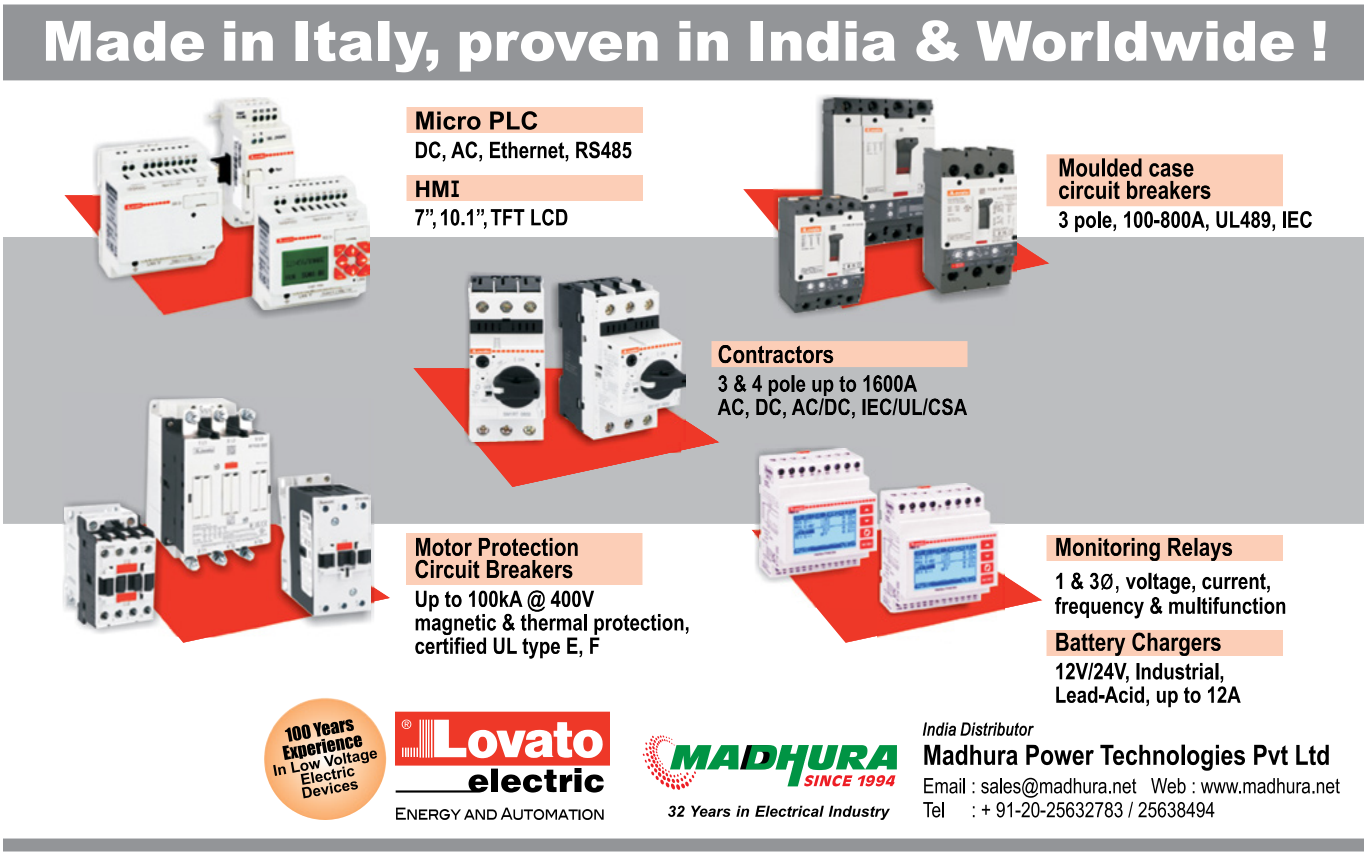


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Monsoon Impact on Civil (Preparedness in FMCG Sector)

Monsoon as a Design & Execution Condition

In FMCG sector, the monsoon season is treated not just as a weather phase but as critical design and execution condition. FMCG facilities involve continuous operations, interconnected utilities, and sensitive process areas where even minor civil or structural issues can affect overall plant performance.

During the typical 4-month monsoon period, increased rainfall, soil saturation, and high humidity influence multiple Civil aspects including foundations, drainage systems, structural durability, and site execution.

From a practical standpoint, Civil is responsible for ensuring that plant infrastructure continues to perform reliably under these adverse conditions.

Soil Behavior & Foundation Performance

One of the most immediate impacts of monsoon is on soil behavior. Due to continuous rainfall, soil becomes saturated, resulting in reduced bearing capacity and increased settlement risks.

Key Observations:

- Reduction in Safe Bearing Capacity (SBC)
- Increased chances of differential settlement
- Instability of excavated areas due to sidewall collapse

Civil Considerations:

- Soil investigation as per IS 1892
- Foundation design as per IS 1904 Machine foundation checks as per IS 2974

From site experience, even small variations in soil condition during monsoon can affect foundation performance, which may later reflect in operational issues.

Drainage & Water Management in Plant Layout

Drainage is one of the most critical aspects in plant engineering during monsoon. Improper drainage planning can lead to water accumulation in process areas and utility zones.

Critical Areas Affected:

- Cable trenches (risk of water ingress)
- Utility corridors
- Low-lying zones within the plant layout

Civil Role:

- Ensuring proper grading and slope in plot plan
- Designing stormwater drainage networks
- Providing sump pits and dewatering arrangements
- Ensuring proper outflow connectivity

From an execution perspective, maintaining drainage slope across a large plant area becomes challenging during continuous rainfall, and even minor level mismatches can result in waterlogging.

Structural Systems Under Monsoon Conditions

Monsoon introduces additional loading and durability concerns for structural systems.

Key Effects:

- Water ponding on roofs increasing load
- High wind forces during storms
- Corrosion in exposed steel structures

Civil Design Approach:

- Load considerations as per IS 875
- RCC design as per IS 456
- Steel design as per IS 800

In plant environments, structural performance is directly linked to operational continuity. Any structural issue in access platforms, pipe racks, or support systems can affect maintenance and process flow.

Material Durability & Protection

Moisture exposure during monsoon significantly affects construction materials and long-term durability.

Common Issues:

- Corrosion of reinforcement and structural steel
- Moisture damage to cement and stored materials
- Reduction in concrete quality due to rain interference

Civil Measures:

- Providing adequate concrete cover as per IS 456
- Use of anti-corrosion treatments where required
- Covered storage for materials
- Controlled concrete practices

These measures are essential to maintain durability, as repeated exposure to moisture can reduce the service life of structural components.

Construction & Execution Challenges

Monsoon conditions create multiple challenges at site level, affecting both productivity and safety.

Practical Challenges:

- Delays in excavation and concrete
- Restricted movement due to muddy access roads
- Unsafe working conditions during heavy rainfall

Civil Mitigation:

- Temporary drainage and dewatering systems
- Use of gravel or temporary roads for access
- Planning critical activities in favorable weather windows

Practically, these challenges may appear manageable during planning, but on site they often lead to delays and require continuous monitoring.

Role of Civil in Plot Plan & Coordination

Civil plays a key role in integrating design with intent with site execution, especially for monsoon conditions.

Key Responsibilities:

- Ensuring proper grading and elevation control
- Avoiding low-lying water accumulation zones
- Supporting safe access and movement within plant areas

Coordination Aspects:

- Process team for layout planning
- Mechanical team for load inputs
- Electrical team for trench and cable routing

Civil essentially ensures constructability by aligning civil and structural provisions with overall plant requirements.

Conclusion

Monsoon conditions have a significant impact on FMCG projects, influencing soil behavior, drainage systems, structural performance, material durability, and site execution.

From a Civil perspective, the focus goes beyond design calculations to practical implementation. Proper planning of grading, drainage, and foundation systems becomes critical to ensure smooth plant operation.

Overall, monsoon highlights the importance of practical Civil decision-making, where even small design considerations can have a major impact on execution and long-term performance.

Contributed By:

Gautam Nandanwar **Aditi Nagare**

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Monsoon Preparedness *(Process Engineering Perspective)*

ABSTRACT

Monsoon conditions pose significant operational and safety challenges in chemical process plants, including flooding risks, equipment failures, and process upsets. From a process engineering perspective, proactive monsoon preparedness is essential to ensure plant safety, operability, and continuity. This article highlights key monsoon-related risks and outlines critical process engineering measures such as drainage readiness, equipment protection, control system reliability, and operational safeguards to minimize downtime and enhance plant resilience during the monsoon season.

INTRODUCTION

India experiences a seasonal monsoon from June to September each year. While monsoon brings muchneeded rainfall and respite from the intense summer heat, it also introduces several challenges, particularly for the chemical industry, where increased rainfall, humidity, and wet conditions disrupt operations, compromise safety and accelerate equipment degradation.

Proactive preparedness is essential to ensure uninterrupted production and compliance with safety standards.

KEY CHALLENGES

1. Water Ingress and Flooding

Heavy and continuous rainfall during monsoon often leads to water accumulation in lowlying plant areas. Flooding can submerge pumps, pipelines, and underground facilities, causing operational disruptions and unplanned shutdowns. Poor drainage further increases the risk of structural damage and equipment failure.

2. Rainwater Contamination

During initial monsoon showers, accumulated dust, oil residues, and chemical spills are washed into drainage systems. Without proper segregation, contaminated rainwater may enter stormwater drains, leading to environmental noncompliance and potential soil and water pollution.

3. Increased Corrosion and Fouling

High moisture levels and humidity accelerate corrosion of carbon steel equipment, piping supports, and exposed structures. Rainwater ingress into heat exchangers and pipelines promotes fouling, reducing heat transfer efficiency and increasing maintenance requirements.

4. Electrical and Instrumentation Failures

Moisture ingresses into electrical panels, junction boxes, and field instruments can cause short circuits, signal drift, and equipment malfunction. Lightning and voltage fluctuations during storms pose additional risks to sensitive control systems and process safety.

5. Operational Safety Risks

Wet surfaces increase the likelihood of slips, trips, and falls inside the plant. Reduced visibility during heavy rains also raises the risk of accidents during material handling, maintenance, and routine operations, directly impacting workforce safety.

6. Maintenance and Accessibility Issues

Monsoon conditions make routine inspections, repairs, and preventive maintenance activities challenging. Restricted access to equipment due to waterlogging or continuous rainfall delays corrective actions and increases downtime risk.

7. Health and Hygiene Concerns

Stagnant water promotes mosquito breeding, increasing the risk of vectorborne diseases among plant personnel. Contaminated water sources can also affect drinking water safety, impacting workforce health and productivity.

"Blueprints for Resilience — Engineering Strength Beneath Every Drop."

PRACTICAL CONSIDERATIONS

1) Drainage Design

Drainage system layout showing elevated platforms, pumps, and overflow channels for monsoon resilience

Heavy rainfall can submerge lowlying plant areas, halting operations and damaging equipment. Practical solutions include elevated platforms, sump pumps, and welldesigned drainage layouts that divert excess water into retention ponds and safe discharge channels.

First Rainwater Protocol: Implement a 50mm first-flush diversion strategy to the ETP to avoid contaminating the stormwater drain with accumulated plant dust/chemicals.

2) Rainwater Contamination

Segregated drainage systems separate clean rainwater from polluted runoff. Oil–water separators and retention ponds treat contaminated water before discharge, while rainwater harvesting tanks enable reuse of clean water for noncritical plant operations.

3) Electrical & Instrumentation Reliability

Sealed enclosures safeguard panels from moisture ingress. Surge arrestors and grounding rods protect circuits from lightning and voltage spikes. Regular sensor calibration ensures accurate readings and stable process control during monsoon conditions.

4) Corrosion & Fouling

Protective coatings and stainless steel prevent corrosion in exposed equipment. Regular cleaning of heat exchangers and pipelines before monsoon reduces fouling. Filtration systems maintain water quality and ensure uninterrupted operations.

5) Preventive maintenance

Preventive maintenance is the cornerstone of monsoon preparedness. Timely inspections, sealing vulnerable equipment, and cleaning drainage systems help prevent corrosion, electrical failures, and downtime, ensuring uninterrupted plant operations even during heavy rains.

6) Health Precautions During Monsoons

The rainy season increases the risk of water- and vector-borne diseases such as cold, flu, malaria, and gastroenteritis. Contaminated water from sewage or overflowing groundwater can spread infections, so drinking water must be boiled, filtered, purified, or bottled to ensure safety. Prevent mosquito breeding by removing stagnant water, covering wells and tanks, and keeping surroundings clean. Use repellents, disinfectants, and maintain hygiene to protect against mosquitoes, flies, cockroaches, and termites.

CASE STUDY: PREVENTING MONSOON DOWNTIME IN A CHEMICAL PLANT

A mid-sized chemical facility in Gujarat faced frequent production halts during heavy rains due to water ingress and equipment corrosion. LTTS engineers implemented elevated pump platforms, sealed electrical panels, and improved drainage systems. Within one monsoon season, downtime was reduced by 35%, maintenance costs dropped by 25%, ensuring continuous & safe operations.

Recognizing these recurring issues, the plant engineering team initiated a structured Monsoon Preparedness Program with the objective of minimizing downtime and ensuring safe, continuous operations throughout the monsoon period.

Key Challenges Identified

- Frequent water accumulates near pumps, pipe racks, and tank farms
- Moisture ingress into electrical panels and field instruments
- Accelerated corrosion of piping supports and outdoor equipment
- Contaminated stormwater drainage due to process area runoff
- Increased safety risks due to slippery surfaces and poor visibility

Engineering Interventions Implemented

1. Improved Drainage and Flood Mitigation
   - Regrading of plant roads and equipment foundations to eliminate lowlying water pockets
   - Cleaning and desilting of stormwater drains before monsoon onset
   - Installation of portable dewatering pumps in critical areas
2. Equipment and Piping Protection
   - Inspection and reinforcement of pipe support vulnerable to corrosion
   - Application of anticorrosive coatings on exposed carbon steel structures
   - Elevation of critical rotary equipment bases above historical flood levels
3. Electrical and Instrumentation Safeguards
   - Weatherproofing of field instruments and junction boxes (IPrated enclosures)
   - Sealing of cable entries to prevent moisture penetration
   - Earthing and lightning protection system checks before monsoon
4. Process Safety Enhancements
   - Review of emergency shutdown systems for monsoonspecific scenarios

- Verification of relief systems and safe drainage paths
- Updating operating procedures to include monsoon precautions

5. Preventive Maintenance and Workforce Readiness
   - Premonsoon inspection schedules for all critical equipment
   - Clear SOPs for operating under heavy rainfall conditions
   - Safety training focusing on slips, trips, and electrical hazards

Results and Outcomes

After implementing the monsoon preparedness measures:

- Unplanned shutdowns were reduced by over 40% compared to previous monsoons
- Equipment availability improved, especially for pumps and heat exchangers
- No major electrical or instrumentation failures were reported
- Improved safety record with zero monsoonrelated losttime incidents

The proactive approach not only ensured continuity of operations but also enhanced overall plant reliability and safety culture.

Key Takeaways

- Monsoon preparedness must be treated as a planned engineering activity, not a reactive response
- Early inspections, drainage management, and equipment protection significantly reduce downtime
- Crossdisciplinary coordination between process, mechanical, electrical, and civil teams is essential
- Investing in prevention delivers measurable benefits in safety, reliability, and cost savings

CONCLUSION

Monsoon preparation in chemical plants is not just about managing rainwater — it's about engineering resilience.

Through innovative design, preventive maintenance, and integrated safety practices, LTTS demonstrates how proactive planning transforms seasonal challenges into opportunities for reliability and sustainability.

By combining technical excellence with health awareness, we ensure that every drop of rain strengthens our commitment to safe, uninterrupted operations.

Contributed By:

Mansi Wadhavane

"Engineering Resilience, Rain or Shine — Safeguarding People, Processes, and Progress."

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Monsoon Preparedness for Transformers

Monsoon preparedness for transformers in substations and industrial facilities is critical to preventing equipment failure, oil contamination, and hazardous electrical faults caused by moisture and flooding. Proper preparation focuses on sealing, drainage, and structural integrity.

Pre-Monsoon Inspection and Maintenance

A thorough audit should be conducted before the rains begin to identify vulnerabilities in the system.

- **Earthing and Grounding**: Verify the continuity and resistance of all earth pits. Proper grounding is essential to safely discharge surge currents from lightning strikes common during the monsoon.
- **Oil and Insulation Health**: Monitor transformer oil levels and test for moisture content. Moisture ingress significantly reduces the dielectric strength of the oil.

- **Vegetation Management**: Trim trees and clear vegetation around outdoor substations to prevent falling branches from damaging overhead lines or causing short circuits.
- **Physical Sealing**: Inspect and seal all cable entries, glands, and panel boards with waterproof enclosures or cabinets to prevent water ingress into sensitive electrical parts.
- **Flood Prevention and Drainage Control:** Waterlogging is a major cause of transformer failure and safety hazards in substations.
- **Clear Drainage Systems**: Ensure all storm water drains, catch water drains, and culverts in the yard are cleared of silt and debris to allow for quick water runoff.
- **Elevate Equipment**: In flood-prone areas, consider raising the height of the transformer base or platform. Utility providers like Tata Power-DDL have raised the height of over 50 substations specifically for monsoon safety.
- **Substation Integrity**: Check that control room window panes are intact and roofs are free of leaks that could drip water onto internal panels.
- **Critical Safety Measures During the Season:** Operational safety protocols protect both the personnel and the machinery during heavy rain and thunderstorms.
- **Moisture Protection**: Maintain silica gel in breathers; it should be blue and changed if it turns pink, indicating it has absorbed maximum moisture.

- **Access Control**: Keep switchyards locked and ensure all walkways are non-slippery. Use insulated rubber gloves and boots when performing any emergency work.
- **Leakage Testing**: Conduct regular leakage current testing on fencing and poles to ensure no "touch potential" hazards exist for staff or the public.
- **Emergency Response**: Designate a response team and keep an emergency kit ready, including insulated rescue hooks, first aid kits, and a stock of sandbags for sudden flooding

Contributed By

Mr. Ulhas Vajre

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MONSOON PREPAREDNESS – An Instrument Engineer's Perspective

ABSTRACT

Monsoon conditions introduce elevated humidity, persistent wet environments, and rapid ambient fluctuations that significantly affect instrumentation performance in process plants. Field instruments, signal transmission systems, and control loops are particularly vulnerable to moisture ingress, insulation degradation, and electrical instability. If not addressed proactively, these factors can lead to measurement inaccuracies, nuisance alarms, control loop oscillations, and in severe cases, complete system failure. Therefore, a structured and technically driven monsoon preparedness strategy is essential to ensure measurement integrity, process safety, and operational continuity.

CRITICAL RISK ANALYSIS DURING MONSOON

1. Moisture Ingress and Condensation Effects

High humidity and rainwater exposure lead to formation of condensation inside field enclosures, junction boxes, and transmitter housings. This results in:

- Reduction in insulation resistance of cables and terminals
- Terminal shorting due to water bridging
- PCB damage in smart transmitters and analyzers
- Long-term corrosion of contact surfaces

Condensation is especially severe in areas with temperature cycling between day and night, causing repeated moisture accumulation inside sealed enclosures.

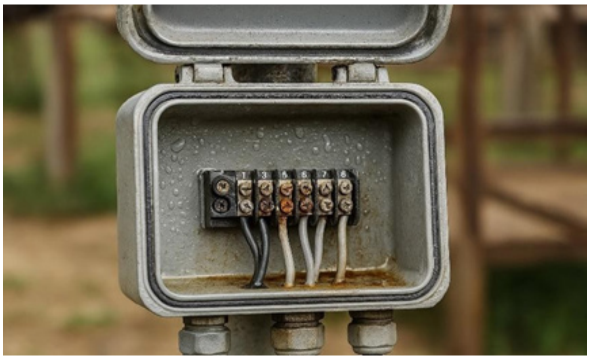

Figure 1: Moisture ingress and condensation inside field junction box leading to terminal degradation

2. Signal Integrity and Electrical Disturbances

Instrumentation signals, especially low-level analog (4–20 mA) and digital communication (HART/Modbus), are highly sensitive to environmental disturbances:

- Increased leakage current due to wet insulation
- Ground loop issues caused by unstable earthing systems
- Signal attenuation and noise pickup in water-exposed cables
- Spurious signals caused by intermittent short circuits

These issues directly affect control system reliability and may lead to incorrect process decisions.

3. Impact on Process Control and Measurement Accuracy

Instrument degradation translates into process-level consequences:

- Calibration drift in transmitters (pressure, flow, level)

- Slow or oscillatory control loop response
- False trips or unwanted interlocks
- Reduced confidence in critical process parameters

Hence, instrumentation reliability during monsoon is directly linked to process safety and quality compliance.

STRUCTURED MONSOON PREPAREDNESS STRATEGY

1. Junction Boxes and Enclosure Management

- Verify ingress protection rating (minimum IP65, preferably IP66/IP67 for exposed areas)
- Inspect all gaskets for cracks or compression loss
- Ensure proper tightening of covers with uniform torque
- Install anti-condensation solutions:
  - Silica gel breather units
  - Space heaters or anti-condensation heaters for critical panels
- Avoid cable entry from top direction wherever possible

2. Cable Routing and Gland Integrity

- Ensure all cable glands are double compression for outdoor installations
- Check for proper crimping, sealing rings, and gland tightening
- Provide drip loops before gland entry to prevent water runoff into enclosures
- Replace cracked, loose, or improperly installed glands immediately
- Use UV-resistant and weatherproof cables in exposed conditions

Figure 2: Proper cable gland installation with drip loop and double compression sealing

3. Field Instrument Protection

- Install weather protection hoods for exposed transmitters
- Ensure transmitter housing is tightly sealed and undamaged
- Verify vent and drain plugs are positioned correctly (as per manufacturer)
- For pressure systems:
  - o Ensure impulse lines are sloped and free-draining o Remove any water logging in impulse tubing
- For level instruments (radar/ultrasonic):
  - o Ensure antenna surfaces are clean
  - o Avoid water film accumulation affecting signal reflection

4. Earthing and Shielding System Reliability

- Measure earth resistance and ensure it is within acceptable limits
- Check earthing continuity for all field instruments and panels
- Inspect for flooded or damaged earth pits
- Ensure proper shielding and grounding of instrumentation cables
- Avoid multiple grounding points that can cause noise loops

5. Control Panel and Control Room Conditions

- Maintain controlled temperature and humidity in control rooms
- Ensure panels are dustproof and moisture-proof
- Use panel space heaters or dehumidifiers where required
- Check panel door seals and cable entry points
- Avoid condensation formation inside PLC/DCS panels

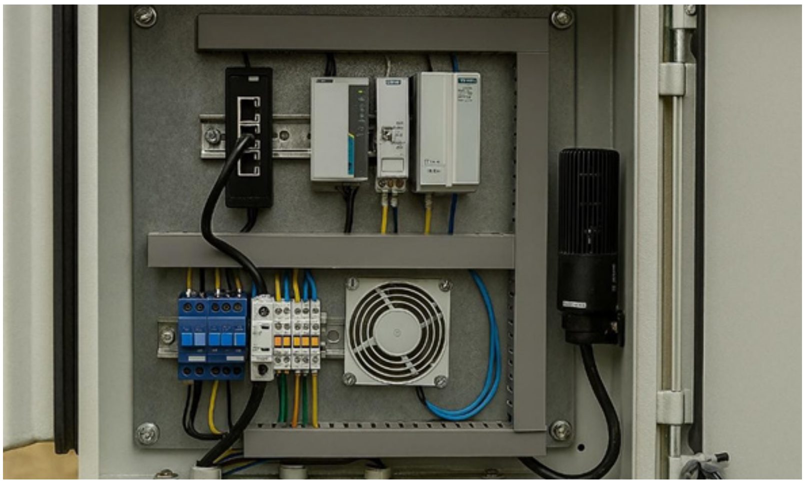

Figure 3: Control panel with internal heater/dehumidifier to prevent moisture accumulation

CONCLUSION

Monsoon preparedness is not limited to basic protection measures but requires a detailed understanding of how environmental conditions affect instrumentation physics, signal transmission, and control system behavior.

A structured engineering approach involving proper sealing, grounding, environmental control, and proactive monitoring ensures that instrumentation systems remain accurate, reliable, and responsive during monsoon conditions.

Such preparedness directly contributes to safe plant operation, reduced downtime, and sustained process efficiency.

Contributed By

Mudassir Aminuddin Goriya

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QUIZ - MAY 2026

1. Which factor most affects the short-circuit current level in a plant distribution system?
    - A. Power factor
    - B. Transformer impedance
    - C. Cable length
    - D. Ambient temperature

2. For critical plant loads, dual power supply with automatic changeover primarily improves:
    - A. Energy efficiency
    - B. Power quality
    - C. Reliability and availability
    - D. Earthing performance

3. What is the main purpose of a harmonic filter in an industrial electrical system?
    - A. Reduce starting current
    - B. Improve motor efficiency
    - C. Limit voltage and current distortion
    - D. Increase system impedance

4. Which maintenance approach uses real-time equipment condition monitoring?
    - A. Preventive maintenance
    - B. Corrective maintenance
    - C. Predictive maintenance
    - D. Breakdown maintenance

5. In MCCs, Type 2 coordination between starter and protection devices ensures:
    - A. No damage to cables
    - B. No damage or only minor contact welding
    - C. No short-circuit current
    - D. Higher efficiency

6. Which instrument is typically used for detecting partial discharge in HV equipment?
    - A. Megger
    - B. Clamp meter
    - C. Ultrasonic detector
    - D. Power analyzer

7. An abnormally high neutral current in a 3-phase 4-wire system generally indicates:
    - A. Unbalanced linear loads
    - B. Harmonic-rich non-linear loads
    - C. Overvoltage
    - D. Earthing failure

8. Which parameter is most important when selecting a circuit breaker for motor feeders?
    - A. Rated voltage
    - B. Breaking capacity
    - C. Frequency
    - D. Insulation class

9. In emergency power systems, diesel generator load testing is performed mainly to:
   A. Reduce fuel consumption
   B. Check cooling system
   C. Verify DG capability under actual load
   D. Improve synchronization

10. Which of the following practices best improves electrical safety in plants?
   A. Increase transformer capacity
   B. Periodic arc flash risk assessment
   C. Oversizing cables
   D. Operating at lower voltage

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- 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 this month's QUIZ.
https://forms.gle/sD5YReTnsoRhgoBZ8

"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.

April 2026 Quiz Answers

1. C. Ensure only the faulted section is isolated
2. B. Earth fault current limitation
3. B. Moisture or insulation degradation
4. D. Rotor earth fault relay
5. C. Condition of current-carrying contacts
6. B. Harmonics and overcurrent
7. B. IEEE 80
8. B. Prevent inrush current to DC capacitors
9. C. High voltage (HV) test
10. C. Internal faults causing rapid oil pressure rise

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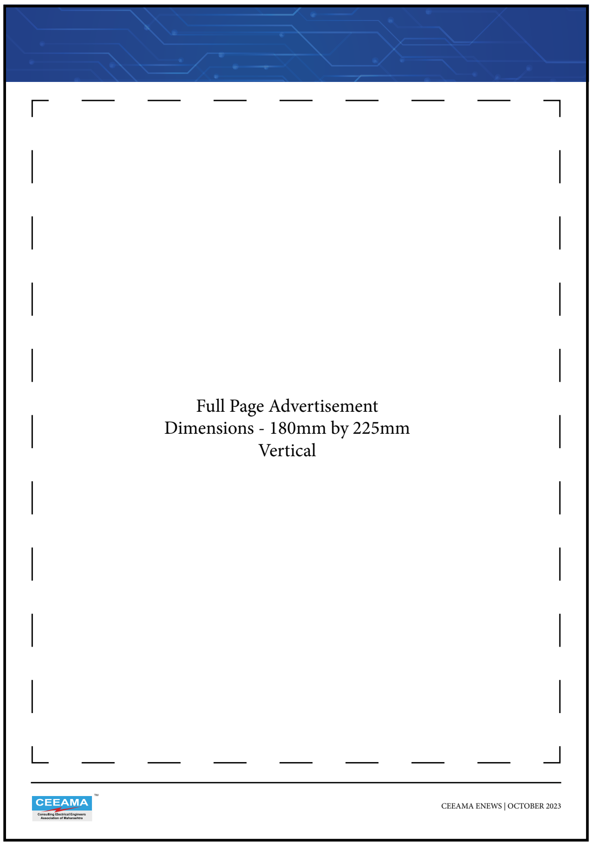

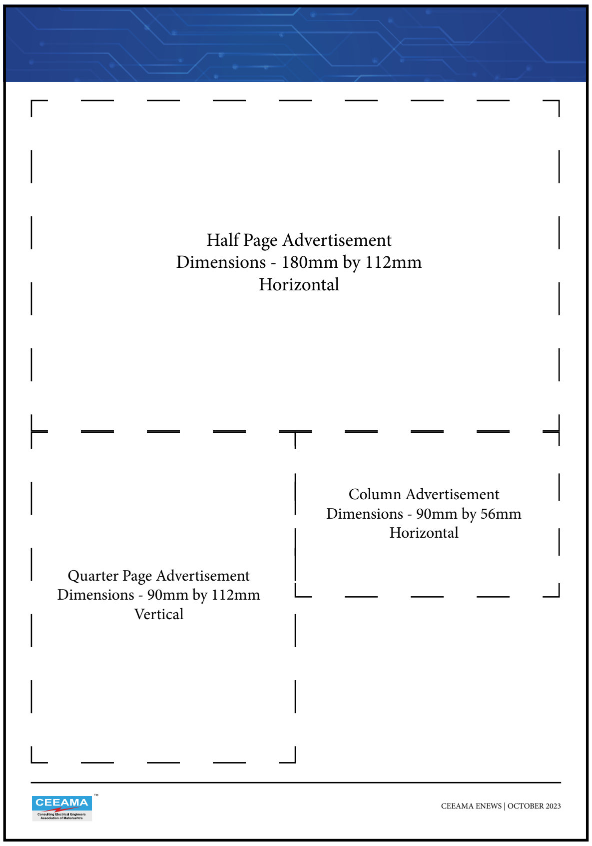

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