



Focusing on environmental monitoring

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The global shift towards renewable energy is driven by the urgent need to address severe weather impact, reduce carbon emissions, and secure a sustainable energy future. Among the renewable energy technologies, solar power stands out for its potential to provide clean, abundant, and increasingly cost-effective energy. However, to maximize the efficiency and reliability of solar power systems, robust monitoring and performance assessment are essential. This is where solar monitoring systems and standards like IEC 61724 play a crucial role. In this article, we will explore the evolution of solar monitoring, the significance of environmental monitoring within this context, and the impact of IEC 61724 on the industry.



In the early stages of solar energy deployment, monitoring systems were rudimentary. Initial efforts were primarily focused on basic parameters such as power output, voltage, and current. Data collection was often manual, making it time consuming and prone to errors. These early monitoring systems lacked the sophistication needed to provide comprehensive insights into the performance and health of solar installations.

With the rapid growth of the solar industry, the need for more advanced monitoring solutions became apparent. Technological advancements in sensors, data acquisition, and telecommunications paved the way for modern solar monitoring systems. These systems offer real time data collection, remote monitoring, and advanced analytics, enabling operators to optimize performance, detect faults, and plan maintenance activities effectively.

‘Solar cells will in all likelihood be the single biggest source of electrical power on the planet by the mid 2030s. By the 2040s they may be the largest source not just of electricity but of all energy. On current trends, the all in cost of the electricity they produce promises to be less than half as expensive as the cheapest available today. Much of the world, including Africa, where 600m people still cannot light their homes, will begin to feel energy rich. That feeling will be a new and transformational one for humankind’, recently wrote The Economist.

Real-time data acquisition and remote monitoring

Modern solar monitoring systems are equipped with high precision sensors that capture a wide range of parameters including irradiance, temperature, humidity, wind speed, and more. These sensors provide real-time data, which is crucial for understanding the dynamic behaviour of solar power systems.

The advent of the Internet of Things (IoT) and cloud computing has revolutionized solar monitoring. Operators can now access performance data from anywhere in the world through web based platforms and mobile applications. This remote monitoring capability enhances operational efficiency and reduces downtime.

Machine learning and artificial intelligence are increasingly being integrated into solar monitoring systems too. These technologies enable predictive maintenance, fault detection, and performance optimization by analyzing historical and real time data. Advanced analytics help identify patterns and anomalies that may not be apparent through manual analysis.

Environmental monitoring in solar power systems

Environmental monitoring is a critical aspect of solar power system management. Solar installations are highly dependent on environmental conditions, and variations in these conditions can significantly impact system performance. Key environmental parameters that need to be monitored include irradiance.

Solar irradiance is the measure of the power of sunlight received per unit area. It is a fundamental parameter that directly influences the amount of electricity generated by a solar panel. Accurate measurement of irradiance is essential for performance assessment and energy yield estimation.

Solar panels are also sensitive to temperature variations. High temperatures can reduce the efficiency of photovoltaic (PV) cells, while extreme cold can affect the mechanical integrity of the system. Monitoring temperature helps in assessing the thermal performance and lifespan of solar panels.

Wind speed affects the cooling of solar panels and can also pose a mechanical risk to the installation. High wind speeds can cause physical damage to panels and mounting structures. Monitoring wind speed is important for ensuring the structural safety and optimal performance of solar installations.

High humidity levels and precipitation can lead to the accumulation of dirt and debris on solar panels, reducing their efficiency. Additionally, water ingress can cause electrical faults and corrosion. Monitoring humidity and precipitation helps in planning maintenance activities such as cleaning and inspection.

Dust accumulation on solar panels can significantly reduce their efficiency. In areas with high levels of pollution, regular monitoring and cleaning are necessary to maintain optimal performance. Sensors that measure dust levels and air quality are increasingly being integrated into solar monitoring systems.

IEC 61724: a comprehensive standard for solar monitoring

The International Electrotechnical Commission (IEC) 61724 standard, titled ‘Photovoltaic system performance monitoring – Guidelines for measurement, data exchange, and analysis,’ provides a comprehensive framework for the monitoring and performance assessment of solar power systems. First published in 1998, the standard has undergone several revisions to keep pace with technological advancements and industry needs.

IEC 61724 is divided into three parts.

IEC 61724-1: General Principles outlines the general principles for monitoring solar PV systems, including the types of data to be collected, measurement techniques, and data analysis methods. It provides guidelines for the selection and installation of sensors, data acquisition systems, and communication interfaces.

IEC 61724-2: Capacity Evaluation Method focuses on the evaluation of system capacity and performance. It defines metrics for assessing the energy yield, performance ratio, and other key indicators of system efficiency. The standard also provides methodologies for calculating losses due to shading, soiling, and other factors.

IEC 61724-3: Energy Production and Performance Ratio Monitoring** provides detailed guidelines for the continuous monitoring of energy production and performance ratio. It emphasizes the importance of environmental monitoring and defines procedures for correcting data based on environmental conditions.

The impact of IEC 61724 on the solar industry

The implementation of IEC 61724 has had a profound impact on the solar industry. By providing standardized guidelines for performance monitoring, the standard has helped to improve the reliability, efficiency, and profitability of solar power systems.

IEC 61724 provides a robust framework for assessing the performance of solar installations. By standardizing measurement techniques and performance metrics, the standard enables consistent and accurate performance evaluation across different systems and locations.

The standard emphasizes the importance of continuous monitoring and data analysis. This helps in early detection of faults

and anomalies, reducing downtime and maintenance costs. Predictive maintenance, enabled by advanced analytics, further enhances system reliability.

By monitoring environmental conditions and system performance in real time, operators can optimize energy yield. For example, cleaning schedules can be adjusted based on soiling levels, and shading issues can be identified and mitigated. This ensures that the system operates at its maximum potential.

IEC 61724 provides valuable insights into the performance and health of solar power systems. This information is crucial for making informed decisions regarding system design, component selection, and operational strategies. It also helps in benchmarking and comparing the performance of different systems.

Adherence to IEC 61724 is often a requirement for compliance with industry regulations and certification programs. This ensures that solar power systems meet high standards of quality and performance. Certification based on IEC 61724 can enhance the credibility and marketability of solar projects.

The future of solar monitoring and IEC 61724

As the solar industry continues to evolve, the role of monitoring and performance assessment will become even more critical. Future advancements in solar monitoring are likely to be driven by emerging technologies.

Artificial Intelligence and Machine Learning algorithms will play a key role in predictive maintenance, fault detection, and performance optimization. These technologies can analyze vast amounts of data to identify patterns and make accurate predictions.

Blockchain technology can enhance the transparency and security of data in solar monitoring systems. It can enable secure data sharing and verification, ensuring the integrity of performance data.

The development of more sophisticated sensors and IoT devices will enable more granular and accurate monitoring of environmental conditions and system performance. This will provide deeper insights and enable more precise control of solar power systems.

Solar monitoring systems will increasingly be integrated with smart grids, enabling better coordination and management of distributed energy resources. This will enhance grid stability and facilitate the integration of renewable energy.

The evolution of solar monitoring, driven by technological advancements and standards like IEC 61724, has significantly enhanced the efficiency and reliability of solar power systems. Environmental monitoring, as a crucial component of solar monitoring, provides valuable insights into the factors affecting system performance. By adhering to standardized guidelines and leveraging advanced technologies, the solar industry can continue to optimize energy yield, reduce costs, and contribute to a sustainable energy future.

As we move forward, continuous innovation in solar monitoring will be essential to meet the growing demand for clean and reliable solar energy.

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