A series of frequent and unfortunate fire incidents in COVID Hospitals has been a cause of concern since the last year. The COVID emergency is not going away soon and all the emergency infrastructure built to fight the pandemic poses serious risks given its weak foundation.

Power Systems are particularly vulnerable given the sudden increase in non-linear loads comprising of ventilators and related medical devices – a crucial defense aid in fighting COVID.

With improper electrical systems, further marred by non-compliance to electrical standards and poor workmanship, hospitals are staring at the high risk of weakening the immune systems of their electrical systems and leading to fire!
If courage is contagious, ignorance is pandemic!

The pandemic has put stress on the Hospitals like never before. Almost unprepared for the scale and nature of COVID’s medical emergency, it is natural for the Hospital’s Management to prioritize the most urgent and important objective – treatment of patients. And often, amongst all the essential tasks, it is the minor ones that generally get the least priority and lead to trouble later. Thus, poor Power Quality (PQ) and electrical safety issues are bound to receive less attention in a situation where patients are increasingly struggling for medication and treatment. But the seemingly minor electrical issues have taken a severe turn and caused a fire in the establishments. More importantly, fire incidents in hospitals cannot be dislodged as one-time exceptions, as a closer look clearly highlights the pattern and the nature of risks looming over the Hospitals.

Protecting Hospitals from failure

Hospitals have been tirelessly operating in the pandemic, constantly stressed for resources including space, medication and care. City after city has built large make-shift hospital facilities. From sports stadiums to hotels, a variety of facilities are being turned into make-shift healthcare facilities. Given the large scale of the problem and short availability of time and resources, very little can be assured for standards and underlying quality of work for the electrical systems. This only means, the risks to the safety and reliability of power systems are higher than ever before.

While the doctors, nurses, medical professionals, and researchers are working day and night, providing maximal care to the COVID-19 patients, the risks are not restricted to COVID alone. Hospitals are up against yet another hectic and exhausting challenge – ensuring uptime, safety and proper functioning of all critical devices and systems, mostly driven by electricity, in an extremely challenging situation. Any technical difficulty can become overwhelming for the hospital facility in such a stressed situation. A strong indication of the stressed and crumbling systems is the events of electrical fires in recent times in the hospital facilities that were dedicated to COVID treatment.

As Hospitals protect patients from COVID, it is also evident that the Hospitals themselves need better and proactive protection from the risks to reliability and safety of the facility.

Underlying electrical issues in Hospital fires

Power Quality issues

A Hospital’s critical nature demands extremely careful wiring. The presence of power quality issues, such as high harmonics in the electrical system, is often the root cause of overheating of cables and equipment, further leading to system failures, and in extreme cases, short circuits and instances of fire. This is further accentuated by poor workmanship or poor quality of electrical hardware being deployed under time and financial stress.
As Hospitals continually equip themselves to serve more patients, reliable electrical supply must be ensured for the seamless and safe functioning of the facility. The addition of new electrical loads, whether it is ventilators, or converting the basement to a make-shift healthcare facility, a thorough assessment to check the preparedness of the existing electrical system to function in a safe and reliable manner should always be the first priority. From minor voltage or current disturbances to the emergence of a previously undetected poor grounding issue, power quality issues can lead to a spike in risks to the facility that Hospitals may not be in a position to control swiftly.

**Poor electrical wiring and cabling**

Power-hungry electrical equipment such as MRI, CT Scans, and X-Ray machines, Ventilators and other medical devices, used in hospitals need uninterrupted power supply. A durable cable network is thus absolutely essential to carry this power supply without overheating. However, hospital authorities in India ignorantly prefer low-grade wires in order to save costs which results in overheating, and to add to this PVC used in cables creates a lot of smoke in case of a fire incident. Statistics show that more people die due to smoke than due to actual fire in a fire incident.

The ventilation system in a hospital also has a role to play in this scenario. If the hospital is air-conditioned, an efficient mechanical ventilation system must be installed to avoid electrical fires from spreading.

**Faulty electrical installations in an oxygen-rich environment**

Areas such as operation theaters and ICUs have a high concentration of oxygen. Any electrical short circuit in these areas, could lead to electrical shock to surgeons or patients. In the worst cases, these electrical faults may result in sparks and could lead to fires. In order to achieve uninterrupted power, or for surge control, UPS systems are used which are supported by batteries. In many cases, these batteries are installed in close proximity to the Medical equipment. These batteries often release harmful and flammable gases which adds to the threat of fire accidents. Hence, it is important to provide special attention to electrical wiring, earthing and switchboard installation.

With the addition of Ventilators, air-conditioners, high-capacity machines in the ICUs, testing facilities for COVID, the addition of more rooms, and increased use of flammable alcohol-based sanitizers or PPE kits, risks of fire are only going higher. Add to it the poorly designed power systems built with even poorer workmanship, it all works like oxygen to start an electrical fire and feed it further.
Compliance to standards and the growing extent of the problem

Hospitals are a very important element of the healthcare system. The emergence of new makeshift hospitals in the current pandemic is well justified but are they complying with the Electrical Safety Standards?

The safety and reliability of electrical networks in any building is vital. But in the case of hospitals, it is even more critical. Where most commercial facilities witness less or no human activity after closing hours, hospitals are bustling with full human presence and activity 24X7. Even so, high-power medical machinery entails the need for uninterrupted high-voltage power at hospitals. To add to this, hospitals are home to patients undergoing treatments for critical ailments. In case of an electrical fire accident, moving these patients becomes a formidable challenge. All these factors cumulatively make hospitals the most vulnerable place for electrical accidents which may prove fatal if not addressed in the right way at the right time.

Here is a summary of the news reports from recent times that highlight the nature of fire in COVID hospitals, its root causes and the damage to life and the serving facility:
<table>
<thead>
<tr>
<th>City</th>
<th>Fire Incident</th>
<th>Name of the Hospital</th>
<th>Source Link</th>
<th>Severity and Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mumbai</td>
<td>9 dead as fire sweeps through hospital inside Mumbai mall</td>
<td>Sunrise Hospital (COVID care facility), Mumbai</td>
<td><a href="https://timesofindia.indiatimes.com/city/mumbai/9-dead-as-fire-sweeps-through-hospital-inside-mumbai-mall/articleshow/81716443.cms">https://timesofindia.indiatimes.com/city/mumbai/9-dead-as-fire-sweeps-through-hospital-inside-mumbai-mall/articleshow/81716443.cms</a></td>
<td>9 patients died in the Hospital that operated on a provisional occupation certificate granted by the BMC though the building had received notices for irregularities in construction and violation of safety norms.</td>
</tr>
<tr>
<td>Nagpur</td>
<td>Fire at Covid ICU ward in Nagpur hospital leaves three dead</td>
<td>Hospital in Wadi area of Nagpur</td>
<td><a href="https://www.indiatoday.in/india/story/fire-covid-icu-ward-nagpur-hospital-death-toll-casualties-updates-1789279-2021-04-09">https://www.indiatoday.in/india/story/fire-covid-icu-ward-nagpur-hospital-death-toll-casualties-updates-1789279-2021-04-09</a></td>
<td>3 people have died in a fire that broke out in the Covid ICU ward of the hospital. The fire reportedly started from an AC unit of the ICU.</td>
</tr>
<tr>
<td>Rajkot</td>
<td>Five Covid-19 patients die in fire at ICU of Rajkot hospital</td>
<td>Uday Shivananda Covid Hospital, Rajkot</td>
<td><a href="https://indianexpress.com/article/india/five-covid-19-patients-die-in-fire-at-icu-of-rajkot-hospital-7071194/">https://indianexpress.com/article/india/five-covid-19-patients-die-in-fire-at-icu-of-rajkot-hospital-7071194/</a></td>
<td>Patients in the ICU were on ventilators and they experienced hypoxia due to smoke in the room. The staff attempted to switch on firefighting system but due to smoke, they couldn’t do it and the fire spread rapidly.</td>
</tr>
</tbody>
</table>

**Electrical Fire in Covid-19 Hospitals – A Preventable Emergency**
Fire in Covid-19 Hospitals - Prevention must be the goal

Hospitals that use several non-linear loads and sensitive electronics alongside heavy-duty air conditioners and heaters, other large or small medical testing instruments, and are therefore always at the risk of poor power quality. While the first responsibility to ensure compliance to building codes for safety and reliability rests with designers, careful maintenance and monitoring of PQ on an ongoing basis is also important. With rising number of electrical fires in hospitals, several state and regulatory agencies have ordered a fire audit of the facilities. While a proactive fire audit of the COVID hospitals is a welcome move, the fire audits are testing the ability of the facility to protect itself from the fire, if it were to occur, not prevent the fire.

Building a proactive approach to fire safety

Electrical fire in Hospitals is never a sudden phenomenon or an accident. In fact, it’s a result of a long-time alarm that has kept ringing but has gone unnoticed in the din of other important priorities. But compromised safety of Hospital facilities poses high risks to the reliable conditions for patient care, for COVID, and beyond.

Wire your electrical networks right

Poor quality cables could lead to a serious fire incident at a hospital. It is vital that attention be paid to the wiring in the entire health facility. The global norm is to use ‘Low Smoke and Zero Halogen (LSOH) wiring. However, in India, Flame Retardant Low Smoke (FRLS) wires are used widely. Reports suggest that these wires may not necessarily help avoid fire incidents completely. One good measure is to connect all the signaling devices with Fire Survival Cables. Fire Survival Cables are designed to withstand high temperatures for a certain amount of time. They reduce the threat of forming caustic acids and limit corrosion damage to equipment in case of fire incidents.

The Indian Standards (IS) for Fire Survival Cable which have been under consideration by the Bureau of Indian Standards (BIS) are now published by BIS in a Gazette notification dated 19 March 2021. In observation of a rising number of accidental deaths due to electrical fires, historically as well as in recent times, mostly caused due to short-circuits resulting from melting of cables, the Fire Survival Cable Standards hold immense importance in raising the benchmark for safety of Hospital Buildings.

Pay attention to earthing

A common practice in the Indian setup is to use separate earthing connections for all the electronic medical or non-medical equipment, but it is unjustified. If earthing is not done properly, it may damage the equipment or give electrical shocks to a surgeon or patient. All conductive metal in an equipotential area should be connected to a common equipotential earthing point with a special heavy-duty cable. This reduces the possibility of leakage currents that can cause micro-electrocution when the surgeon or patient comes into contact with the equipment.

Ensuring good Power Quality to prevent electrical fire

There are several tools to proactively identify the vulnerabilities in power systems, including power quality issues, much before they lead to extreme events of electrical fire.

- **Thermal Imaging** is highly helpful in understanding the potential overheating in the electrical network.
- **Periodic measurements and monitoring of harmonic distortion** helps in early identification and prevention of heating in the electrical cables.
- **Isolation Transformers** for sensitive imaging devices or diagnostic equipment
- **Use of 3+1 Core Cables**, owing to their larger surface area, help in reducing the hot spots, thereby reducing the risk of electrical fires.
- **Triplen Harmonic Filters** help to minimize the electrical fire risks emanating in infrastructure with heavy IT/ITeS, Building Automation with non-linear loads, Computational Infrastructure, UPS Batteries etc.

Conclusion

A proactive approach to fire safety is the only way to ensure foolproof safety of the electrical systems from instances of fire. Hospitals must invest and upgrade their knowledge and experience in resolving the urgent and growing safety concerns on priority. This calls for addressing every root cause - from following the right Standards in cables to improving Power Quality.

Proactive prevention of the PQ issues in Hospitals requires much groundwork and addressing the root causes. A course correction from the current practices is required at every stage – from design to installation and maintenance when the facility is in operation. Following high standards and not falling for savings in upfront costs must be the norm.

All the hard work, sacrifice and care in saving the lives of COVID patients cannot be at stake of an increased risk of electrical fire from underlying electrical causes that are fully preventable.

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