Underground Uninterruptible Power Supplies (UPS) Provide Disaster Resilience

Presented by Nam Paik, TSI Power Corporation

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Wildfires in the United States inflict devastating economic losses by destroying or damaging homes, businesses, infrastructure, forest and cropland, and other real property. Annual economic losses are estimated at $394—893 billion.

The recent Los Angeles wildfires alone destroyed over 17,000 structures and have caused over $250 billion in estimated damages.

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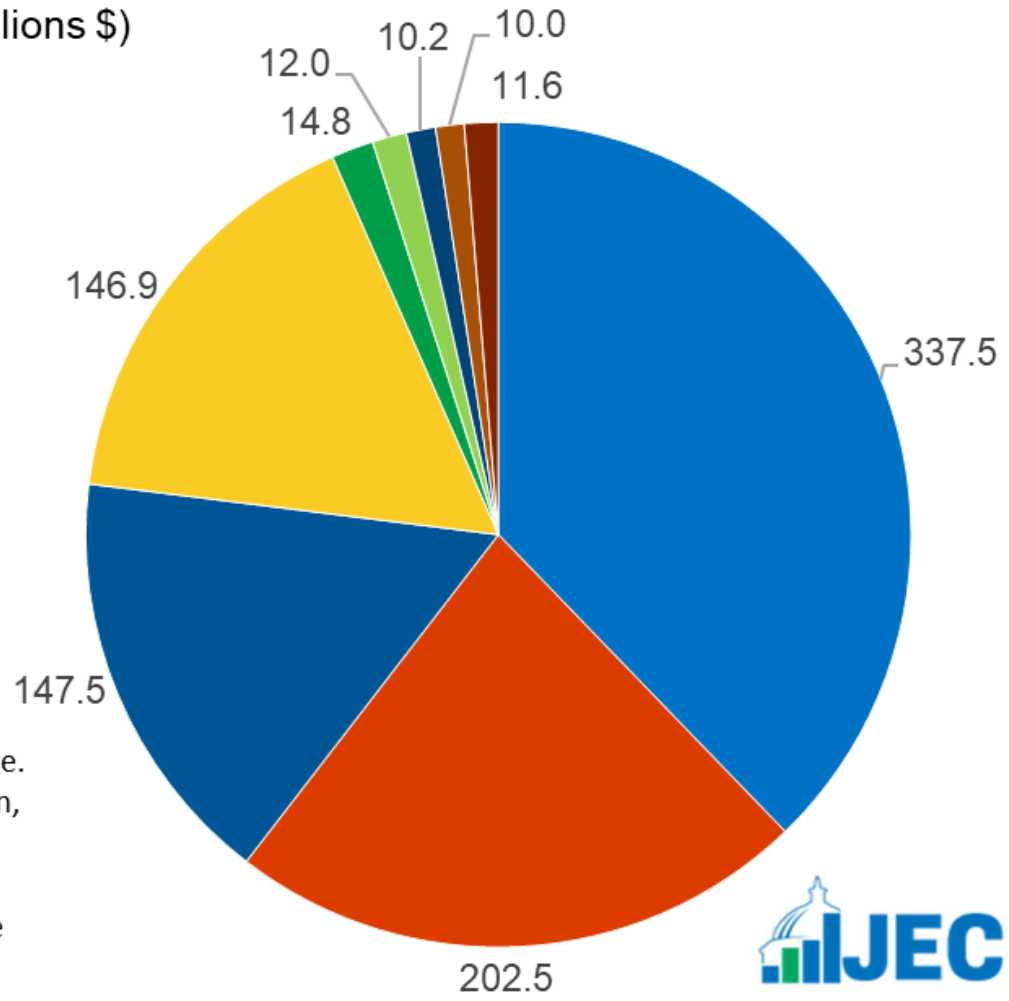
Climate-Exacerbated Wildfires Cost As Much as $893 Billion Per Year

Top-end Annual Total Costs and Losses (Billions $)



Note: Chart shows the higher end of the estimated range. Other Costs include evacuation costs, wildfire supression, direct death and injuries, insurance premium increases, learning loss, tourism loss, and psychological costs.
Source: Analysis by JEC Democratic Staff, all values were adjusted for inflation into 2022 dollars.

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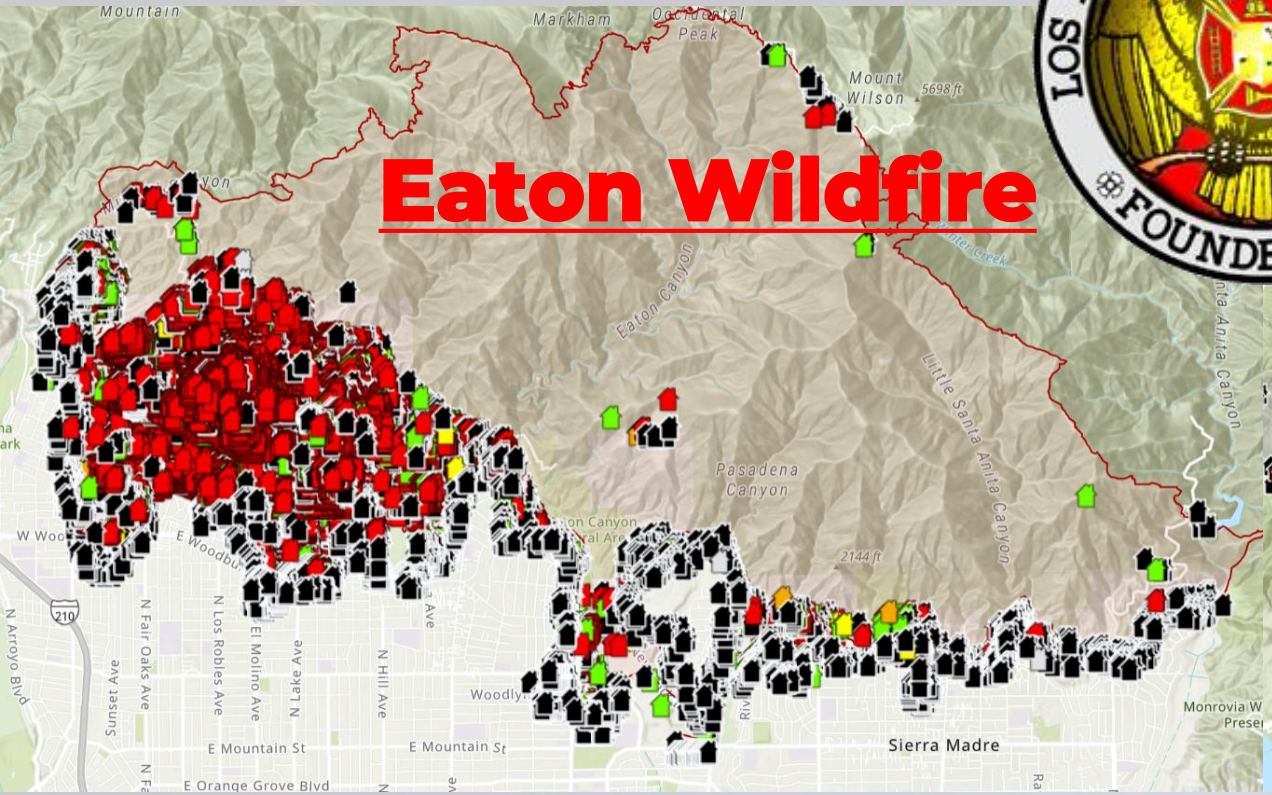
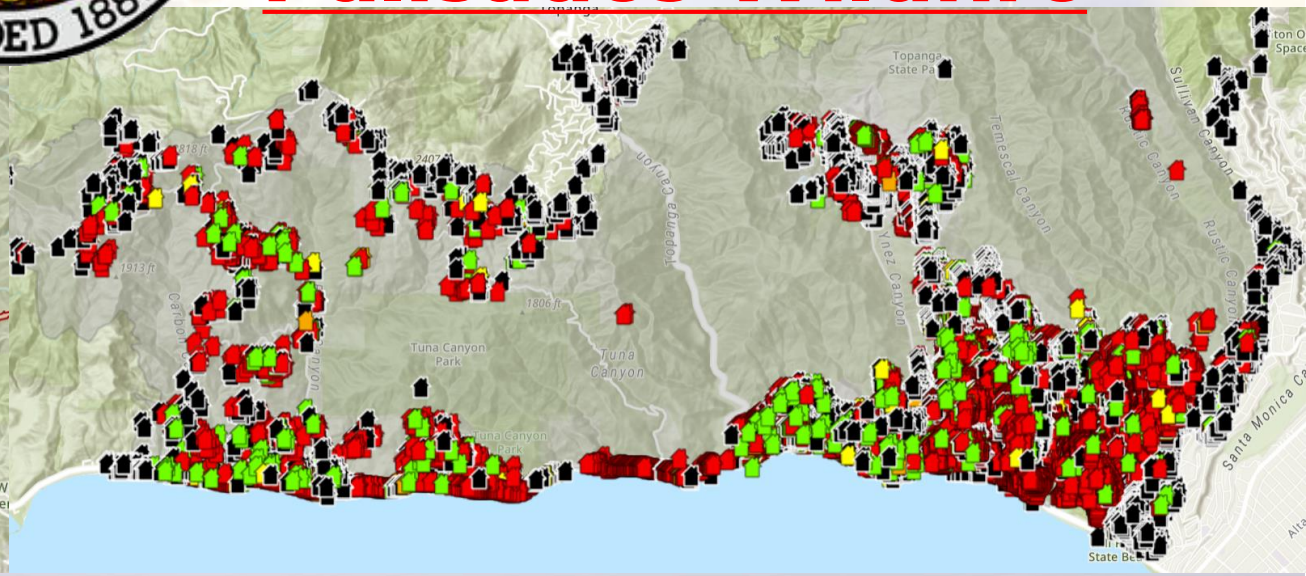
LAFD Wildfire Damage Maps

Eaton Wildfire



Palisades Wildfire



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Burned telecom equipment cabinet

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Hurricanes and tornadoes also cause significant economic damage annually, with hurricanes typically responsible for a larger share of the losses. From 1980 to 2024, hurricanes alone caused estimated $1.5 trillion in total damages, averaging $23 billion per event.

Hurricane damaged electrical equipment cabinet

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Flooding also results in significant annual property losses. The economic damage due to floods was the highest in 2017, at around 60.7 billion dollars, when U.S. was hit by Hurricanes Harvey and Irma.

Cellular base station equipment cabinets submerged in floodwater

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Underground equipment vaults protect equipment from dust/sand storms, hurricanes, tornadoes, floods, wildfires, vandalism, terrorism, and more.

Underground equipment vaults are commonly used by:

- Electric, gas & water utility companies
- Municipal & public works for traffic signal lighting, street lighting circuits, water management equipment
- Fiberoptic, broadband & wireless communications companies
- Industrial & commercial facilities such as manufacturing plants, airports, hospitals, and data centers
- Military bases & high-security government facilities
- Mountaintop communications, wildfire detection / surveillance cameras, and radar facilities

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Key Benefits provided by Underground Equipment Vaults

- Reduced Energy Consumption as Cooling/Heating Needs are Minimized since Underground Temperature Remains Nearly Constant (within ±4°C) Year Round
- Maximized Equipment Life due to Dust-Free and Constant Temperature Operation
- Minimized Maintenance & Repair Costs
- Increased Performance & Reliability
- Maximum Protection Against Natural & Manmade Disasters such as Wildfires, Hurricanes, Floods, Vandalism, and Terrorism

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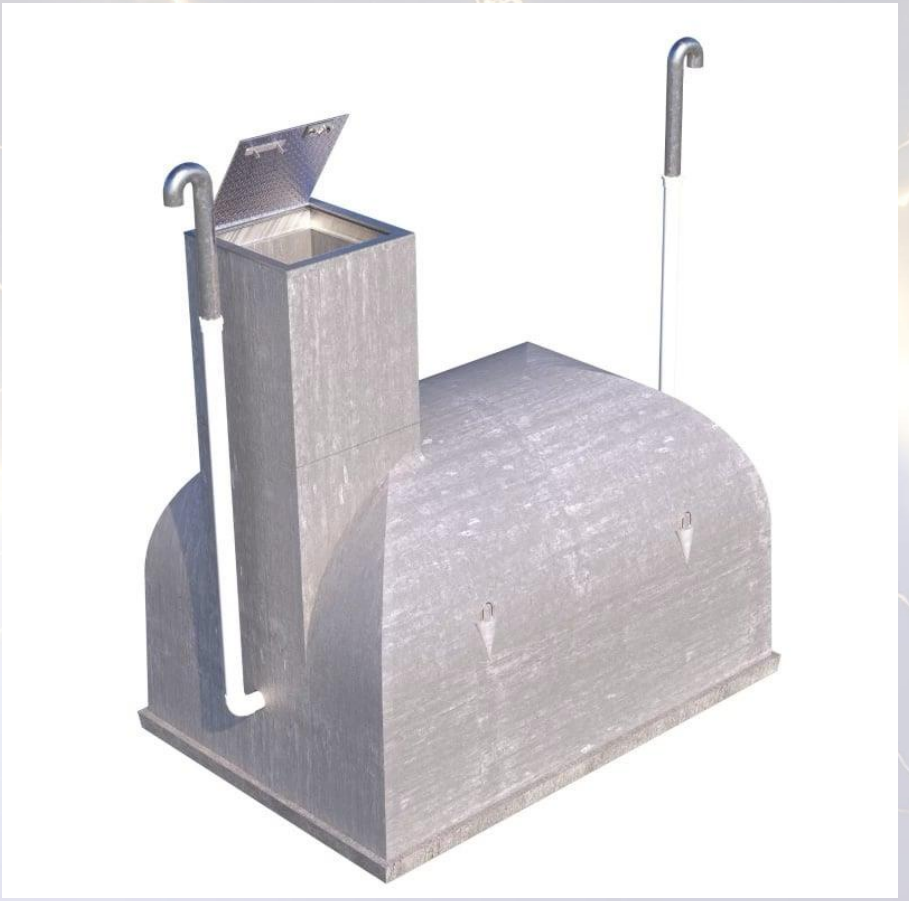

www.atlassurvivalshelters.com

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https://oc2me.com/underground-telecom-cabinet-ucab/

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Special Design Considerations for UPS (uninterruptible power supply) for Underground Equipment Vaults

- Waterproof & corrosion-resistant conformal coated boards due to high-humidity, possible condensation and water ingress.
- Line-interactive UPS is about 97~98% energy efficient.
- Double-conversion UPS is about 90% energy efficient.
- Using lithium-ion or LiFePO4 (lithium iron phosphate) batteries, UPS can be made very compact and lightweight.

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- UPS with VRLA (valve-regulated lead acid) batteries cannot be used inside sealed vaults as hydrogen & oxygen gas emission is possible.
- Lithium-ion and LiFePO4 batteries do not produce corrosive fumes or explosive gases; therefore, they are suitable for use inside sealed or limited airflow vaults.

  Caution: Although extremely rare, lithium-ion & LiFePO4 battery fires can occur.
- Lithium-ion and LiFePO4 batteries provide 12~15 years of service life (compared to 4 to 8 years of typical VRLA battery service life).
- Maintenance-free UPS with MTBF (mean-time-between-failure) of 12+ years is desirable.

Examples of UPS for use inside Underground Vaults

120 vac input & output UPS module with LFP battery, built on a metal baseplate

Output power: 60~2,000W
Battery runtime: 0.1 to 24+ hours

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90~265 vac input; 120 vac & 12/24/48 vdc output UPS module with LiFePO4 battery

Output power: 60~3,000W

Battery runtime:
0.1 to 24+ hours

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UPS built in a NEMA 3R (IP44) rated aluminum cabinet with sealed VRLA (valve-regulated lead acid) batteries. Note: This unit can be used only in vented shelters as hydrogen & oxygen gases can be produced when batteries are over-charged.

Output power: 500~6,000W
Battery runtime: 0.1 to 24+ hours

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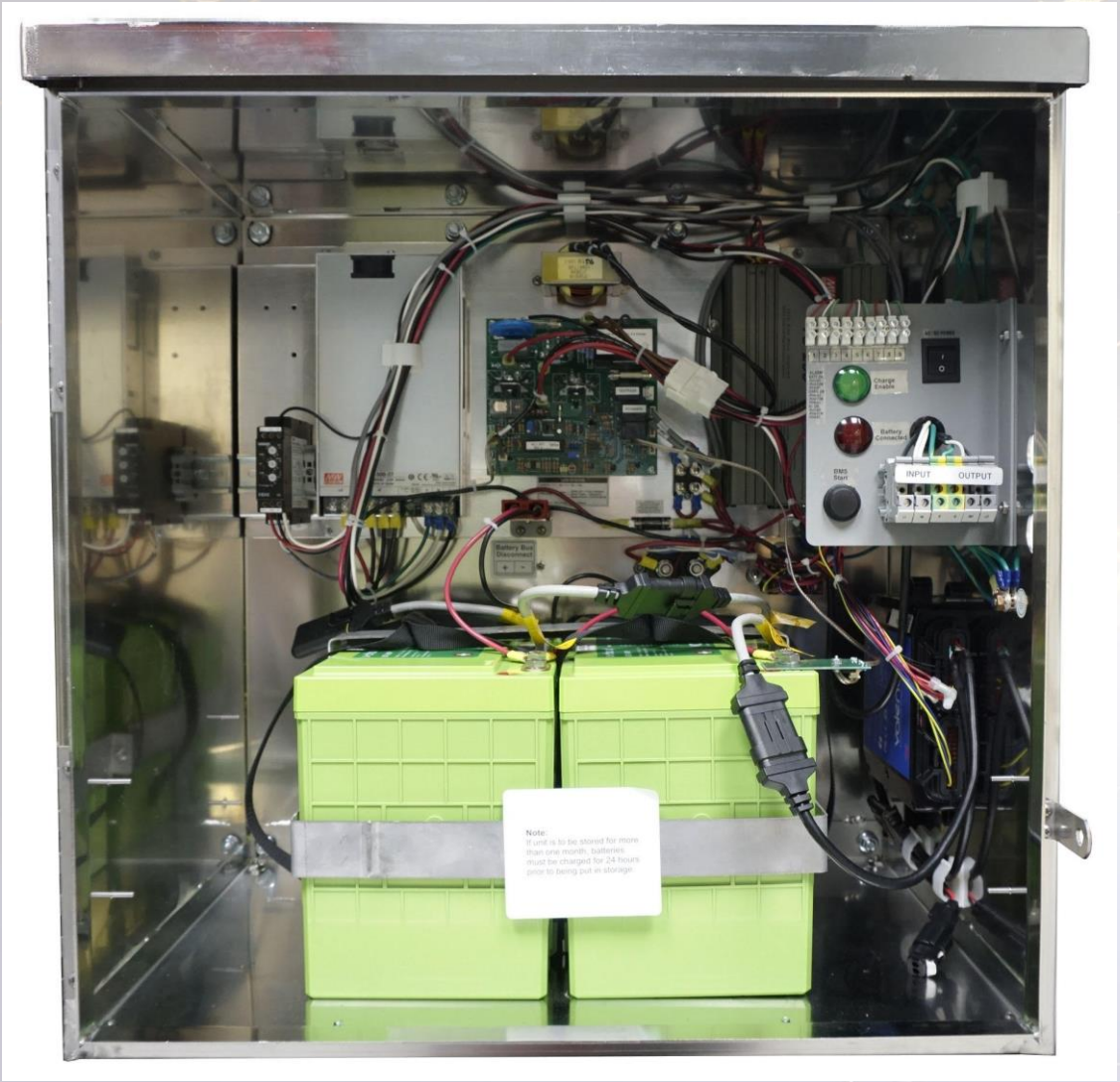

UPS system built in a NEMA 4X (IP 68) rated stainless-steel cabinet with LiFePO4 batteries.

Note: This unit can be used inside sealed shelters.

Output power: 100~360W Battery runtime: 0.1 to 24+ hours

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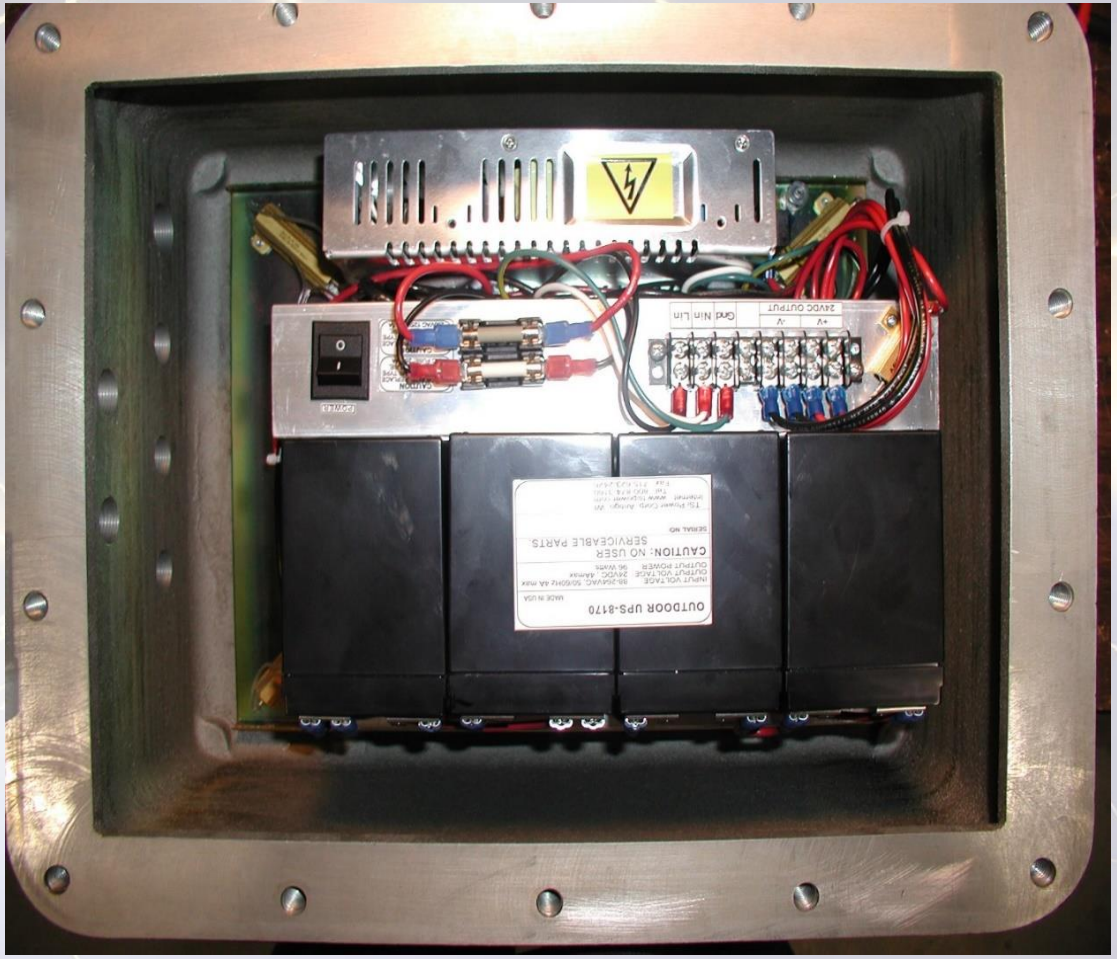

90~265 vac input & 12/24/48 vdc output UPS with LiFePO4 battery designed for use inside NEMA 7 (explosion-proof) rated enclosure

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Summary

Mission-critical equipment placed in underground vaults can be protected from wildfires, hurricanes, tornados, floods, vandalism and terrorism.

Specially designed UPS can provide uninterrupted AC or DC power during AC mains outages lasting from seconds to several days with sufficiently large batteries.

Applications include electric / gas / water utility, 5G / broadband telecom, industrial, surveillance, security & military control / command / communication systems.

About the Author

Nam Paik is the Vice President of Sales at TSI Power.

He has over 35 years of experience as designer of UPS, AVR (automatic voltage regulator) & ATS (automatic transfer switch) products.

Since 1999, he implemented several hundred power protection and backup systems for various industrial, telecom & security projects around the world.

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About TSI Power

Since 1998, TSI Power is a Wisconsin, USA-based manufacturer of AC line conditioner, automatic voltage regulator, automatic transfer switch, and UPS products for protecting mission-critical electrical & electronic equipment used in harsh industrial, commercial & outdoor environments.

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