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News Clip
Fire at a Lithium- Ion Energy Storage Facility

VS 28.01.2025

Introduction: A catastrophic fire outbreak a few days ago at an energy storage facility in California, USA, highlights that safety regulations sometimes lag behind the development of new technologies. Additionally, despite warnings from previous fire incidents, the facility's management failed to implement robust loss-minimizing measures that might have reduced the probability of a major catastrophic event.

The Event

One of the world's largest energy storage plants, a lithium-ion battery storage plant, is located on the small harbor town Moss Landing, about 125 km south of San Francisco in California.

On January 16th, 2025, a lithium – ion battery fire broke out at the Moss Landing Power Plant, a major Battery Energy Storage System (BESS), designed to store power from renewable energy generated by nearby wind and solar farms. The premises in Moss Landing include a gas-fired combined cycle power plant.

The plant is owned and operated by Vistra Energy, a Texan Fortune 500 company, who is a major power generator in the US, utilizing diverse energy sources including natural gas, oil, carbon, wind and solar. The company is committed to reducing green house gas emissions and supporting net-zero policies.

The fire began in the afternoon of January 16th, and reignited after initially being extinguished. It was only on January 19th that authorities reported no active burning at the plant. The proximity of the gas-fired power plant on the premises initially raised concerns of a potential explosion, but it was later confirmed that the power plant remained safe. Environmental concerns persisted as heavy smoke spread over a large area, prompting evacuation orders. The famous scenic US Highway 1 had to be closed to traffic for three days in the Monterrey area.

The Energy Storage Plant

The plant's history is well-documented including information about the latest January 16th, 25 catastrophic incident:

https://en.wikipedia.org/wiki/Moss_Landing_Power_Plant

It is worth noting that two prior fire safety incidents – without major material consequences - occurred in 2021 and 2022.

Vistra's battery storage facilities at Moss Landing are of recent construction. It began commercial operations in several phases in the last 4 years. Phase 1 began operations by the end of 2020, Phase 2 in August 2022, and Phase 3 in August 2023.

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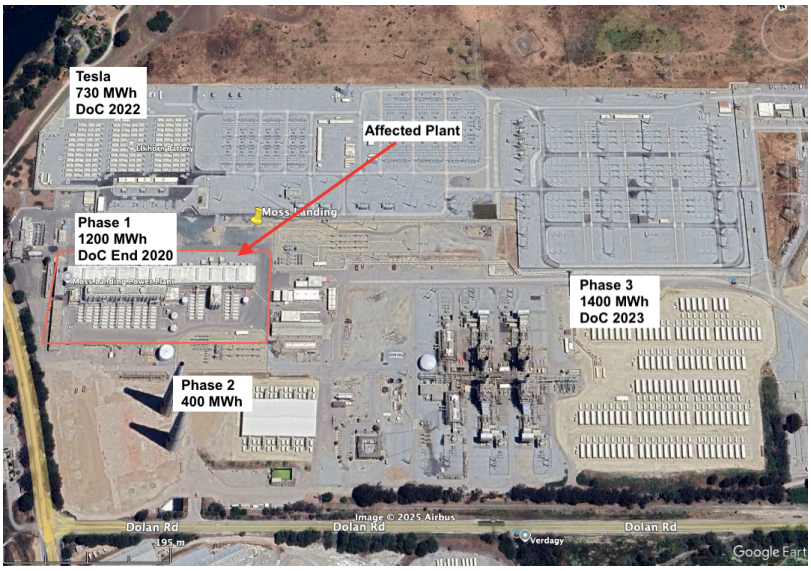
An additional battery storage facility on the premises, the Elkhorn Battery Facility, is owned and operated by Pacific Gas & Electric, the local State power provider. This plant, equipped with 256 Tesla Mega Packs, was commissioned in June 2022.

The following map shows the layout of the Moss Landing facility:



The following map shows the location of the plant and its distance to the Pacific Ocean. It is the closeness to the ocean and its wildlife that raised major concerns with respect to environmental concerns.

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Press Coverage

The event was extensively covered in the local and national media. Below are two exemplary articles describing the event:

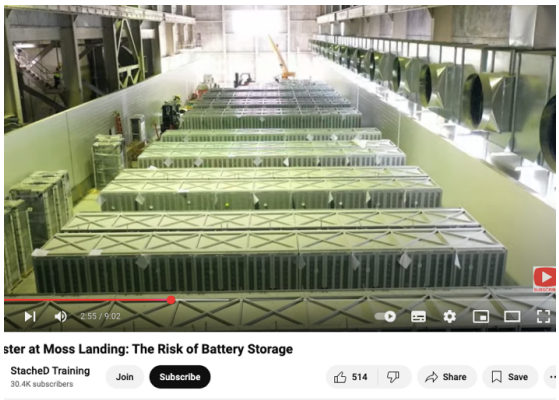
https://www.usatoday.com/story/news/nation/2025/01/23/moss-landing-lithium-battery-plant-fire-vistra/77912642007/

https://www.tweaktown.com/news/102710/worlds-biggest-lithium-ion-battery-facility-catches-fire-sparking-fear/index.html

Additional information can be found online by searching for "Moss Landing Fire". Notably no fatalities or injuries were reported.

Additional pictures that we collected from public information available are shown below:

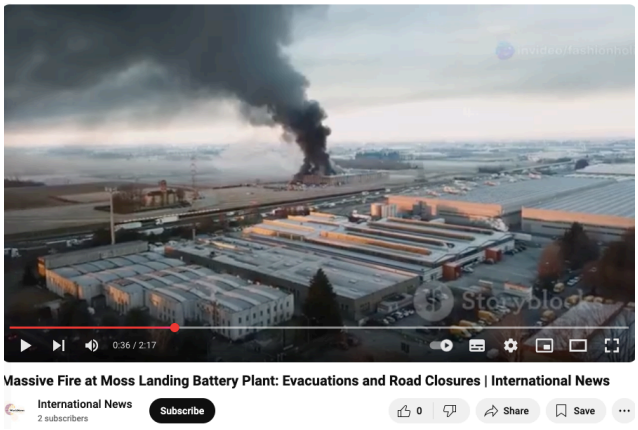
Before the event.

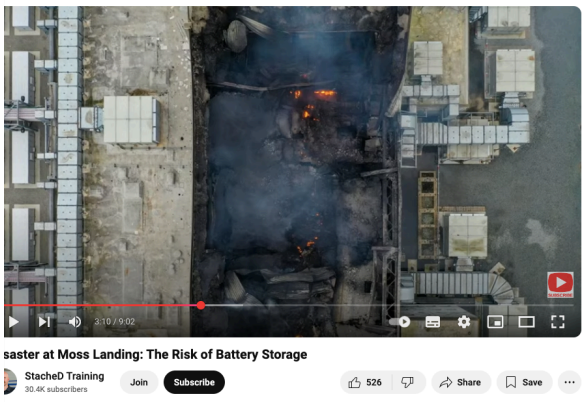


Inside the industrial building

The first night

Reignition





Inside the Storage Facility

Tesla's Self-Contained Megapacks (P&G-operated)

Previous Events

In September 2021, overheating in a battery module of Phase 1 led to a significant shutdown of the plant. Safety systems were triggered in the moment that increased temperature were detected on different modules. Targeted sprinklers aimed at the affected modules went off. A subsequent detailed investigation established as the cause a sprinkler system that became active in response to smoke coming from an air handling unit in which a bearing had failed. Thus, the root cause was not a thermal runaway. In addition it was found that the sprinklers were activated by a wrongfully setting of the temperature threshold of a smoke detector.

In February 2022 another overheating event occurred in Phase 2 of the plant. The sprinkler system released water onto the battery packs; this time the event caused visible damage to the battery cabinet. Phase 1 and Phase 2 were taken out of operation, resuming activities in July 2022. We could not find additional information on what caused the event in February 2022. It is possible though, that in both cases the overheating started after the sprinkler started spraying water on the battery packs.

These incidents underscore recurring challenges with water-based fire suppression systems.

The cause of the January 2025 fire is still under investigation.

Similar Event in Otay Mesa, San Diego, California

Another fire incident occurred May 15th, 2024 at the 250-megawatt Gateway Energy Storage Facility – also lithium-ion batteries - in Otay Mesa, near San Diego (https://thequadreport.com/big-calif-battery-storage-facility-fire-burns-for-11-days/). After controlling the fire, two days later it flared up again and smoldered for another 10 days. Evacuation orders were issued due to the potential release of toxic gases. The fact that it took almost two weeks to extinguish the fire shows the difficulties that professional firefighting crews have mastering the thermal runaway of the lithium - ion battery packages. It should be also be noticed that after two months people were still working on clean-up efforts removing the (toxic) debris.

Considerations

Battery storage facilities are essential for balancing renewable energy production, especially in times where solar and wind power gain always more space in one nation's energy generation.

Nevertheless, the above described events show that the technology is still emerging, and due to its complexity is not ripe yet from both, a technological point of view, as well as from a safety regulation point of view.

Different energy providers are working on BESS, developing major capacities but, apparently, not tackling yet the aspect of a 100% safe and secure operation. Unfortunately, as we can see, there are inherent risks involved in this emerging technology that is a pivotal part of the, nowadays, much applauded clean energy transition.

What might be underestimated, is the fact that the lithium – ion battery modules are energy packages with very high energetic density embedded. In case of a fire at this components we are not dealing with a traditional fire that can be extinguished by cutting of the oxygen supply (with water); instead, we have to suppress a chemical fire with inherent ongoing chemical reactions. The paradox here is that by using water to contain the fire, the modules are being damaged, thus incentivizing the chemical chain reaction within the battery cells. As a firefighter explained:

> *"You have to put water on it to keep the fire confined, but that water damages the batteries also allowing them to arc starting another fire. We're just trying to keep the public safe and keep the fire contained to the building," he said.*

With respect to the peculiarities of a BESS fire that we noted while doing our research, and what should be taken into account from a risk management point of view, we would point out the following:

- Overheating is the main cause for a lithium-ion battery fire. It may have different root causes, but finally an instable chemical reaction causes the overheating and consequential "thermal runaway", i.e. an uncontrolled and violent release of the accumulated energy.
- Water intrusion can cause a fire in the battery modules. Sprinkler malfunctions, a smoke detector activation caused by an external (not battery-related event), waterpipe leaking, are possible causes that can start a fire in a battery module.
- Even if the fire of a battery module can be controlled by initial firefighting activities, thermal runaway causes the fire to extend to other cells and modules causing the loss of a whole battery storage room. Independent battery modules appear to be less prone to a complete loss of the storage system.
- Reignition is a common pattern of a BESS fire. An initially extinguished fire keeps smoldering, and flaring up can occur due to other battery modules present in the area. The Otay Mesa event took two weeks to be declared as totally extinguished.
- We observed jet-like flames while watching the video clips of the events. Surrounding properties should be taken into consideration when assessing the risk.
- Removal of debris can be lengthy, also due to the toxic leftovers of the fire. Prolonged business interruption periods have to be taken into account.
- The environmental damage and the health impact to the population can be disastrous. In all cases we analyzed, evacuation orders had to be issued. The long-term effects to residents and fire fighters caused by toxic smoke and contaminated water are not known. The disposal of the contaminated water used to extinguish the fire is an important aspect to consider. From our perspective, under these circumstances, it is not logical BESS being installed close to urban areas.

We would like to see a rapid response from local loss prevention authorities. The pace at which we are seeing the introduction of new materials, new designs and technological developments in battery storage facilities is not matched by the parallel implementation of new safety codes and standards.

Regulatory bodies need to respond as soon as possible and update their guidelines and standards. Current BESS projects need to be understood, tested, validated and approved by independent and knowledgeable experts. New designs need to be independently reviewed. Fire extinguishing agents - other than water - need to be researched and tested.

It is of the utmost importance to avoid public mistrust of the new technologies that can ultimately improve energy management in our countries.

BESS in Mexico?

Mexico is expanding its renewable energy capacities. At the end of 2021 the installed capacity reported was 7.7 Gigawatt. However the installed battery storage capacity are still limited. The solar plant in Puerto Peñasco, a major solar project in Mexico, appears to include a BESS. In this case it is reported that the batteries are of **lithium iron phosphate** type as opposed to the **lithium nickel cobalt manganese** type, traditionally used in BESS. These batteries have a major durability, are more stable from a chemical and

thermal point of view, but have a 30% less specific energy density, reason for which they are not the preferred type in BESSs. It appears that in Puerto Peñasco the focus was more the safety and durability than the capacity of the system.

Anyhow, the further development in Mexico should be observed. Also, we don't know yet if Protección Civil is up to date with their guidelines or if national norms are up to date with certifications regarding BESS.

Conclusion

The technological development of energy storage systems is progressing rapidly. New system designs, layouts and battery materials are being developed at a rapid pace. It seems that higher capacities and higher specific energy storage are the focus of this development. Unfortunately, some recent events show that operational safety and loss prevention are lagging behind. Regulatory bodies such as NFPA, IEC, etc. are not keeping up with the pace of technical innovation.

The new developments also present a challenge to the insurance industry. Understanding the causes of fires, evaluating the different BESS layouts, understanding the different battery types and their underlying chemical processes, assessing the firefighting equipment within the plant and its reliability are some of the aspects that need to be addressed. As a first step, let's learn from events around the world.

Update 4.02.2025

A few days after the publication of this news clip, we learn that a team of scientists at Duke University is experimenting with solid-state electrolytes, also based on lithium, but with other chemical elements that allow free movement between the battery terminals in a safer, semi-solid environment. The energy density and charging speed look promising.

https://interestingengineering.com/energy/neutrons-to-develop-solid-state-batteries

The above shows that scientific and technological development is an ongoing process. We are confident that in a relatively short time we will have safer technologies to store the energy produced by renewable sources.