

A Review of BESS Failure Incidents

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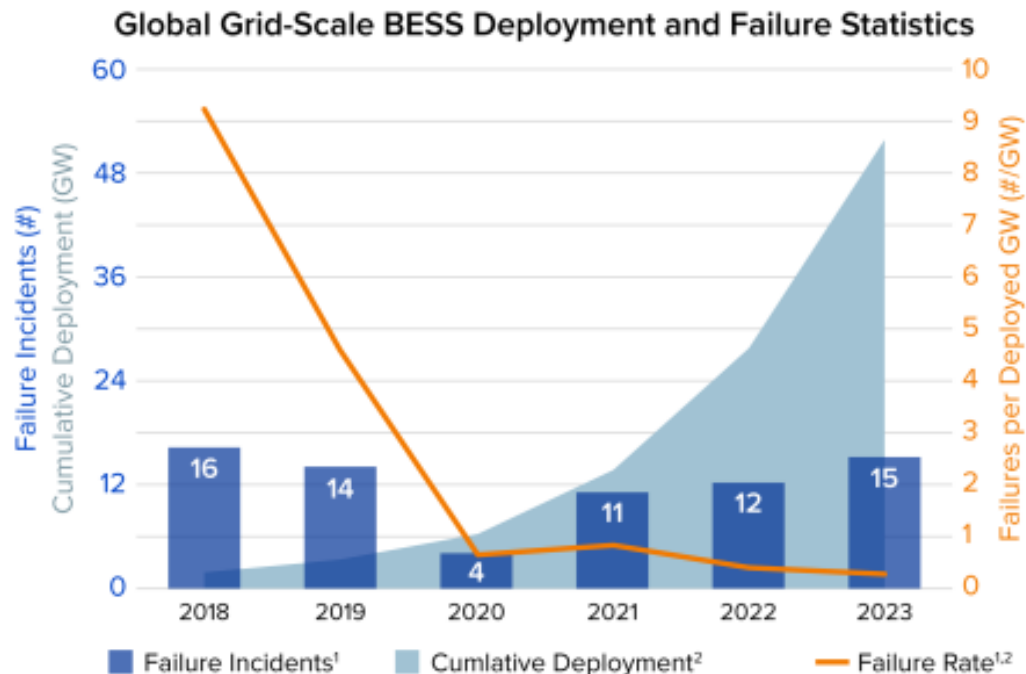
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We reviewed BESS and battery failures to understand what happens when there is an incident. (An ‘incident’ according to the Federal Emergency Management Agency (FEMA) is an occurrence, natural or man-made, that requires an emergency response to protect life or property.) We used examples documented by Electric Power Research Institute (EPRI)’s website (Accessed July 18, 2024), [BESS Failure Incident Database - EPRI Storage Wiki](https://d1gi3fvbl0xj2a.cloudfront.net/public/2021-07/Four_Firefighters_Injured_In_Lithium_Ion_Battery_ESS_Explosion_Arizona_0.pdf). Their database was initiated in 2021 as part of a wider suite of BESS safety research after the concentration of lithium-ion BESS fires in South Korea and the Surprise, AZ, incident in the US in 2020 https://d1gi3fvbl0xj2a.cloudfront.net/public/2021-07/Four_Firefighters_Injured_In_Lithium_Ion_Battery_ESS_Explosion_Arizona_0.pdf

The date of access to EPRI’s database is provided because new information is always being added.

Likelihood of incidents

According to EPRI, the rate of failure, i.e. the number of failure incidents over time against the total gigawatts of energy system storage deployment, has diminished. Their graph below tends to give a wide picture without accounting for the different variables of different systems. Such variables include the different life stages of the project, the size of the BESS facility, different companies, different battery chemistry and technology and operating parameters. EPRI attributes this reduction in rate to lessons learned from early failures being incorporated into latest designs and best practices. The following graph illustrates the reduction in rate of failures. The website does not discuss the source of the data for failure incidents prior to the start of their data gathering in 2021.



Sources: (1) EPRI Failure Incident Database, (2) Wood Mackenzie. Data as of 12/31/23.

There are no national or international regulations governing the reporting of BESS failures that we could identify. According to EPRI, the information in this database (starting in 2021) is gathered from media reports and other public documents, such as released root cause analyses (RCA) or corporate press releases. EPRI identified source documents by active searching of global English-language media, and passive collection of reports through keyword flagging on internet websites and RSS feeds¹. EPRI presents two databases – Stationary Energy Storage Failure Incidents and Other Energy Storage Failure Incidents. The above graph includes data from the first database only. The documents listed under the heading Source in the first database are only accessible with a subscription to BOX.com. This is a new addition to the website. We do not have a subscription so the information was gathered from other columns in EPRI's database and by clicking on the Location link, which brought up some useful links not hidden behind the BOX. The Source documents in the second database can be accessed without the BOX app.

Risk (the probability of something bad happening) can be based on the likelihood of an incident occurring and the severity of the adverse effects.

¹ An RSS feed consolidates information sources in one place and provides updates when a site adds new content. With social media, all you see is the favorite stuff that people share. With an RSS feed, you see everything a website publishes. <https://www.lifewire.com/what-is-an-rss-feed-4684568>

The graph above suggests a low likelihood of failure. However, the rate of failure in relation to number of BESS installations by year is not known. Also, the completeness of the database is unknown, since systematic reporting of failures is not currently required, to our knowledge. This graph also does not include data from the second database (Other Energy Storage Failure Incidents).

We reviewed the impact by looking at some of the recent examples in the EPRI database.

BESS Incidents – Impact as documented in Stationary Energy Storage Failure Incidents – 17 incidents since January 2023 of total 88 entries in database

Date	Location	Impact
2024-May-15	San Diego, CA, USA	<ul style="list-style-type: none"> • Fire • Shelter in place order and evacuation warning issues • Fire declared extinguished the next day but reignited several times during the next 17 days • 40 firefighters required to extinguish the blaze (Recharge News)
2024-Mar-27	Isa, Kagoshima, Japan	<ul style="list-style-type: none"> • Fire and explosion • Explosion occurred when firefighters tried to use the smoke exhaust system • Four firefighters injured • Fire extinguished the next day
2023-Dec-28	Lanyu, Taiwan	<ul style="list-style-type: none"> • Fire • Fire controlled and suppressed after a day
2023-Oct-02	Melba, ID, USA	<ul style="list-style-type: none"> • Fire • Road closures • Fire contained and allowed to burn out over 3 days • The substation remained too hot to allow investigation of the fire for an undetermined period of time • The substation remained operational through the fire

Date	Location	Impact
2023-Sep-29	Saint-Esprit, Martinique, France	<ul style="list-style-type: none"> • Explosion and fire • Explosion blew out windows of nearby residential houses leading to an evacuation • Fire suppresses with powder and foam in 3 hours but firefighters remained in place to monitor • 18 firefighters responded from various locations • Loss of power
2023-Sep-26	Bouldercombe, Queensland, Australia	<ul style="list-style-type: none"> • Fire • Allowed to burn out over several days under supervision • Local residents told to stay indoors to avoid hazardous smoke • Note: In 2021, another fire affected a similar Tesla Megapack-based energy storage project near Geelong in southeastern Australia. It burned for four days, prompting local authorities to send 150 firefighters and more than 30 fire trucks to the scene.
2023-Sep-18	Valley Centre, CA, USA	<ul style="list-style-type: none"> • Fire • This is the 2nd event that this system has experienced, the first event was on April 5, 2022 • Roads were closed and an evacuation order for the surrounding 1/4 mile was issued, while a shelter in place for the 1/2 mile around the site was also issued, however these were only kept in place for at most four hours.
2023-Aug-22	Barban, Saucats, France	<ul style="list-style-type: none"> • Fire • No injuries were reported. • Local residents raised concerns about smoke affected nearby cropland and forests.
2023-Aug-19	Zuhai City, Xiangzhou District, China	<ul style="list-style-type: none"> • Fire • Fire fighters used water to extinguish the fire. Later, the battery cabinet suddenly caught fire again.

Date	Location	Impact
		<ul style="list-style-type: none"> Staff protected by fire fighters used a forklift to transfer each battery cabinet to an outdoor open area for cooling.
2023-Jul-27	Charmont, NY, USA	<ul style="list-style-type: none"> Fire The fire, the third so far this summer at energy storage facilities in New York, Residents within a 1-mile radius of the scene were told to shelter in place for several hours Susan Nichols lives one-tenth of a mile from a solar farm in the Jefferson County town of Lyme that saw its battery storage area catch fire Thursday. It's been five days of wondering what's in her air and in her water, and she's concerned. "Basically [I fear] it's in our well. Once it's in our well, you're not going to get it out," Nichols said.
2023-Jul-04	Taichung City, Longjing District, Taiwan	<ul style="list-style-type: none"> Fire
2023-Jun-26 and 27	Warwick, NY, USA	<ul style="list-style-type: none"> Fire and fumes emitted Two incidents – a days-long fire at a storage site on County Route 1 and fumes being emitted from a storage site on Church Street Extension where batteries were removed and disposed of. Hazmat crews did 20 hours of air metering over three days but found no harmful chemicals The failures appeared to occur during a large storm that affected both sites in Warwick within 24 hours of each other
2023-May-31	East Hampton, NY, USA	<ul style="list-style-type: none"> Fire, Smoldering battery A 'smoldering battery' was reported, closing down roads and stopping train service for about an hour until the fire was contained.

Date	Location	Impact
		NextEra reported that an internal sprinkler system contained the fire.
2023-Apr-26	Gothenburg, Vastra Frolunda, Sweden	<ul style="list-style-type: none"> • Fire, explosion of indoor container • The container was on wheels and was moved from indoors to outdoors when smoke was seen. A cutting extinguisher was used to cool the battery, but several minutes later an explosion occurred. • The nearby community was directed to stay indoors and an adjacent building was evacuated during fire fighting activities. Fire propagation to the adjacent building was limited by water from jet pipes and water cannons. • The fire was extinguished, but the batteries began smoking again the next day. The battery container was submerged by crane in water in a larger container.
2023-Mar-28	Saint-Trivier-sur-Moignans, France	<ul style="list-style-type: none"> • Fire • Data center burned down. Data center had a solar + storage system, and lithium ion battery is suspected to be the cause of fire. • Fire is to blame for a small but significant number of data-center outages including a March 28 fire that caused severe damage to a data center in France, and an analysis of global incidents highlights ongoing concerns about the safety of lithium-ion batteries and their risk of combustion. • Article on the risks of using lithium ion batteries https://www.networkworld.com/article/972090/data-center-fires-raise-concerns-about-lithium-ion-batteries.html
2023-Jan-30	Millvale, PA, USA	<ul style="list-style-type: none"> • Fire • Relatively small battery system in the basement of a commercial building. Batteries were tied to rooftop solar and used to power a kitchen on the main floor.

Date	Location	Impact
		<ul style="list-style-type: none"> System was destroyed with severe damage to the basement See video https://diysolarforum.com/threads/local-pittsburgh-solar-battery-fire.54401/

BESS Incidents – Impact of incidents as documented in Other Energy Storage Failure Incidents – 5 in 2024 of 25 entries total in database

Date	Location	Impact
2024-Jun-24	Hwaseong, South Korea	A single battery cell in the factory caught fire and spread to the 35,000 battery cells stored on the factory's second floor, producing a series of explosions. 22 workers were killed and 8 were injured in the fire.
2024-Apr-27	Neemoor, Germany	One of several lithium-ion containers located in an industrial area was observed to be smoking. The containers were not interconnected to the grid. The fire department consulted with the operator and opened the container, resulting in an explosion. Two firefighters were injured. The container was cooled and moved away from the surrounding containers with a crane to prevent propagation. The fire was extinguished in 10 hours. A highway was closed overnight for 6 hours and residents were asked to keep doors and windows closed due to the heavy smoke
2024-Apr-18	Columbus, Ohio, USA	A tractor trailer with 5900 lbs of lithium ion batteries caught fire. A bomb squad used a robot to cut a hole in the trailer during firefighting to reduce the risk of explosion. Firefighters ordered everyone within a mile radius to leave worried that the batteries could burn rapidly and explode. Roads closed. The evacuation order was lifted after three hours.
2024-Apr-8	Kilwinning, Scotland	A fire broke out at the Fenix battery recycling plant. Around 40 firefighters were required to tackle the fire at its peak and union leaders are

		concerned about the impact of their exposure to fumes over the 48 hours. Residents have been advised to keep doors and windows closed as a precaution against smoke. The cause of fire is under investigation
2024-Mar-22	Maryborough, Australia	A semi-trailer truck carrying lithium-ion batteries was involved in a multi-vehicle highway crash, resulting in a fire. The level of contribution from the batteries to the fire is unknown.

Key impacts include:

1. Fire and sometimes explosion
2. Shelter in place advisories within a mile radius and sometimes evacuation orders are issues
3. Road closures
4. Large number of emergency personnel (police, fire, etc) and equipment required on-site during and after the incidence, ranging from hours to days.
5. The impact appears to be greatest on first responders, and local residents.
6. Transportation of batteries poses a risk
7. Recycling of batteries poses a risk
8. Destruction of property, including potential contamination of rural wells
9. Injury or loss of life
10. Usual response is to contain but let the fire burn in place
11. Site remains too hot to approach even after the fire is extinguished
12. Potential of reigniting of fire requiring emergency personnel to remain on site to monitor
13. Cause often unknown

Conclusions:

Given the seriousness of the hazards from BESS projects, there should be a requirement for an accurate, publicly available database in Canada on all BESS installations, megawatt size, battery chemistry, adverse incidents, response to incident, other important parameters.

There is a need for clear and regulated plans for what happens if and when an incident occurs at any BESS facility in Canada.