REPORT ON THE HAZARDS OF BATTERY ENERGY STORAGE SYSTEMS

RAPID INDUSTRY GROWTH OUTPACES SAFETY GUIDELINES

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ABSTRACT

An increasing number of energy companies are targeting rural Texas communities for utility-scale battery energy storage (BESS) projects. Currently the state has no standardized regulations to address the exceptional safety concerns of this relatively new industry. An administrative gap exists as many Texas Counties do not have fire codes designed to include industrial battery storage with over 0.6 megawatts of capacity. The Texas Commission of Environmental Quality does not address the numerous hazards discussed in this report.

Local governments are struggling with this problem as these projects pop up unannounced and at an unprecedented rate. County governments are often unfamiliar with this technology and the associated hazards. Energy Companies have the advantage, knowing rural communities have limited regulatory powers. Local governments are extremely limited in their capacity and are unable to adopt development regulations after these projects are approved by the Public Utilities Commission.

The current system of random safeguards adopted and designed by various energy companies is unacceptable. Energy storage developers and independent power producers such as Key Capture Energy consider public opinion to be irrelevant and continue to ignore public concerns for on-site water availability, despite evidence and the numerous case reports demonstrating that water availability is necessary to prevent the spread of fire to adjacent areas. The issue of evacuation routes is disregarded in a similar manner. Nearly thirty acres in Comfort, Texas is being developed for multiple lithium-ion battery energy storage projects simultaneously. These projects are situated adjacent to vulnerable riparian habitat, a 100-year flood plain and are located along a dead-end road which is the only form of access for 60+ properties, including numerous families and residences, and a 1,300 acre premier destination for Mountain Biking located at the Flat Rock Ranch. Once in place these lithium BESS facilities will operate for approximately twenty years. This creates long term risks to communities without emergency resources. The only opportunity to ensure optimal safety of these projects is before they are installed.

The information provided in this report will clearly demonstrate that lithium-ion battery storage accidents continue to occur, despite rapidly evolving technology. Improvements in rigorous testing, precision manufacturing and the current safety measures will never eliminate this risk entirely. The key intent of this report is to promote the health, safety, morals and general welfare of the public and communities affected by these battery energy storage systems. Safety risks to communities can be dramatically reduced by adopting reasonable development guidelines. The National Fire Protection Association has specifically addressed the hazards of lithium-ion battery storage beyond the scope of conventional fire codes. Local governments need the opportunity to research and adopt site specific regulations in order to protect life and property prior to the installation and commissioning of battery energy storage facilities.

Information and References reviewed and compiled May 10, 2024 by Alexandria Rudd, MD (Retired);
Maps, graphics and other materials provided by Dylan Buysse.

AUTOMATED SAFETY SYSTEMS CANNOT REPLACE EMERGENCY PLANNING

Multiple case studies on lithium-ion Battery Energy Storage System (BESS) failure events and the resulting fires are clear evidence that remote monitoring and automated fire suppression safety systems lack the adequate protection needed to mitigate risk and reduce accidents. Remote monitoring is limited by the function of the on-site automated safety systems which are comprised of electrical components that are prone to unexpected failure. In some cases, fires have occurred despite properly functioning fire suppression systems. Lithium-ion battery fires are consuming, uncontrollable, burn for weeks, produce toxic fumes and can force evacuations.

Preplanning and supplemental resources for these emergencies are essential to protect communities. This includes protective equipment, evacuation planning and adequate training. Water is not sufficient to extinguish battery fires alone, however, it is a viable resource needed to prevent adjacent areas from igniting. Unfortunately, current regulation does not require energy companies to provide on-site water supply or address the need for the proper training of first responders. Texas faces decades of uncertainty as battery storage facilities are continually permitted without adequate consideration of these issues. Of the 1,515 large-scale power generation interconnection projects in Texas, many of which are in rural settings with no on-site water resources and on a local level only have volunteer fire departments. Drought stricken areas in Central Texas such as Kendall County, are at exceptional risk for wildfires.

Due to market readiness and the scalability of battery energy storage systems, the industry is rapidly expanding and outpacing regulation which urgently needs assessment, as hundreds of new facilities are in development across the State of Texas and thousands are nationwide. Since the onset of the BESS industry serious accidents have taken place, including the loss of life, meanwhile accountability is lacking, and safety guidelines are underutilized. This technology is desirable for many factors, but despite the global emphasis on the exponential implementation and expansion of BESS technology this industry is still largely self-regulated. Current local, state and national level regulation allows energy companies, largely foreign based, to design their own set of standards and to conduct accident investigations of their own failures which unsurprisingly are inconclusive. Nationwide, there are growing concerns for the level of accuracy and due diligence of these private accident investigations and the simultaneous collection of data as it adheres to self-established standards which is inhibiting industry correction through trial by error.

Communities faced with lithium-ion battery energy storage interconnection proposals often have zero applicable fire codes and/or regulation to mitigate risk to the surrounding inhabitants and landscape. The purpose of these regulations is to promote the health, safety, morals and general welfare of the public. Numerous case studies demonstrate that accidents can become enormous fires lasting days-to-weeks and ultimately force residents to evacuate. Despite evidence to the contrary, communities such as Comfort, Texas, are being informed that remotely monitored automated safety systems alone are effective means for complete protection and safety. This statement is inconclusive and generally misleading, these systems are adequate per the energy companies corporate owned standards and practices. Failure to address community concerns creates unacceptable risk to life and property.

A 6-year audit of battery energy storage safety systems worldwide was conducted by Clean Energy Associates (CEA). The report entailed 320 inspections and includes 52 factory quality audits. The study revealed approximately 64% of the top-tier battery cell manufacturers were audited and 1,300 manufacturing defects were identified during the audits (16). Manufacturing errors were the leading cause of the quality control failures with a majority of the failures resulting in thermal runaway (when overheating of a single battery cell spreads throughout the battery). Despite rigorous requirements, 30% of quality issues were due to lengthy production processes leaving more room for error (16). Fire Suppression Systems had the highest frequency of system-level BESS defects with 26% of inspected units faulting in this category and 18% of temperature managing components were found to have quality issues. Based on this study, there is a 44% probability of quality control issues existing between the components that are essential to fire suppression and management and remote monitoring. CEA stated that the problems at the factory level could be caught later during project installation and commissioning. However, it is evident based on other case studies we will discuss these issues are not always caught later during the project deployment phases.

One bug in these complex components can result in complete system failure and lead to catastrophic fire. Even with rigorous testing, precision manufacturing and properly functioning components disasters have still occurred. Emergency management, evacuation planning, first responder training and other necessary resources including on-site water supply or storage are essential to minimize loss of life, injuries, and property damage.

PROJECT PROPOSALS FOR COMFORT, TEXAS

Key Capture Energy (KCE), a company based in Albany, New York, is a developer, owner and operator of energy storage projects in the United States. In September 2021, KCE was acquired by SK E&S Co. Ltd., a global clean energy and solution provider headquartered in Seoul, the Republic of Korea. KCE has plans for a large utility-scale battery storage power generation project along Flat Rock Creek Road, Comfort, Texas. The interconnecting entity for this project, KCE TX 26, LLC has acquired an 8-acre surface lease for at least one 100-megawatt (MW) BESS facility, known as the Ringtail Ridge Storage Project. An adjoining 11-acre parcel was also recently leased under the interconnecting entity KCE TX 31, LLC for a possible expansion of the Ringtail Ridge Storage Project, the amount of megawatt storage planned for this additional lease has not been disclosed. East Point Energy, a separate battery energy storage company under the interconnecting entity of Flat Rock Energy Center, LLC has acquired a 10-acre surface lease for a 250MW facility across Flat Rock Creek Rd from the Ringtail Ridge Storage project site, this project is known as the Rock Creek BESS. If these projects proceed as planned, a minimum of 350MW will be produced these BESS facilities that are located at the beginning to a dead-end road which is the only form of access for 60+ properties, including numerous families and residences, and a 1,300 acre premier destination for Mountain Biking located at the Flat Rock Ranch. Based on the energy storage potential due to the nearby Electrical Transmission Substation owned and operated by the Lower Colorado River Authority (LCRA), the storage capacity along this corridor is likely to increase in the future.

On January 29, 2024, KCE held a public forum for Comfort residents with several hundred residents in attendance, many of whom were present to voice concerns and/or oppose the project. The presentation largely focused on project benefits including temporary jobs and electrical grid stabilization. The representatives were unable to answer many of the residents' questions and reportedly did not know the chemical composition of the proposed batteries. Resident concerns about limited evacuation routes on a dead-end road were voiced but not addressed by KCE representatives.

The information presented by KCE representatives provided multiple statements which conflict with current scientific research and accident case reports. Furthermore, the project proposal they provided did not conform to the guidelines established by the National Fire Protection Association for battery energy storage systems. Statements and misinformation presented by KCE representatives included:

1. Smoke from lithium-ion battery fires does not contain additional hazards.
2. Remote monitoring and automated fire suppression systems are adequate protection.
3. Residents were told that no availability water was needed on-site, when the reality is it is needed but not required for permitting. KCE representatives failed to acknowledge that although water is not used to extinguish these fires it is needed to keep external components from overheating and to prevent nearby areas from igniting resulting in wildfire.
4. The project has no adverse environmental impact despite being nearly less than 100' from a 100-year flood plain situated in the Guadalupe River watershed.

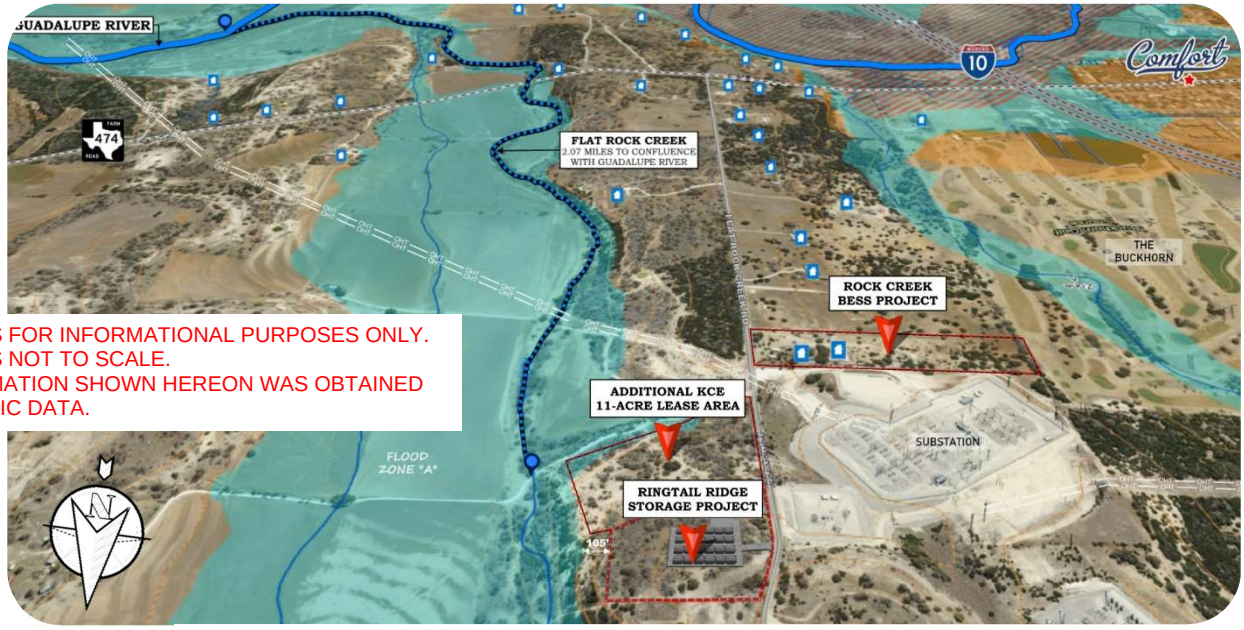


***Figure 1**: Oblique aerial image of the proposed BESS Projects located along Flat Rock Creek Road, Comfort, Texas. (see Appendix for larger detail)*

BACKGROUND ON BATTERY ENERGY STORAGE SYSTEMS

Battery energy storage systems are being installed and commissioned nationwide to decrease our energy dependence on fossil fuels and to boost electrical grid stabilization and carbon reduction. The rapid pace of this growing industry is fueled by energy storage developers and independent power producers from overseas who are eager to acquire stake in the United States market due to economic benefits made possible by the Inflation Reduction Act. This new legislation allows standalone storage systems to be eligible for a 30% investment tax credit, with a potential to increase to 70% through additional incentives. The US Energy Information Administration estimated that by the end of 2023 electrical grids within the US would be enhanced by 10,000 megawatts of battery storage. This is 10-times the cumulative capacity installed during FY 2019 (9).

Safety regulations are lagging behind the curve and many communities have no regulatory guidelines established to handle the growing pains associated with the development of these projects. Currently, communities have no nationalized standards to protect them and are forced to accept proposals for developments provided by various profit-driven energy companies that adhere only to their own corporate owned policies. Safety standards need to be standardized to force these companies to address issues such as evacuation preplanning and emergency water resources. The 2021 IFC Fire Codes adopted by Comfort, Texas only apply to smaller energy storage systems under 0.6 Megawatt hours. An example would be residential solar panels. These codes exclude industrial scale utility projects.

Conventional Fire Codes do not address the unique risks from these projects. Lithium is among the most efficient battery materials due to its chemical properties. Lithium is also a volatile element that presents exceptional hazards if these batteries are damaged or overheated. These fires are extremely hot and are nearly impossible to extinguish. These fires range in size from damaged cell phones and laptop computers to aircraft power modules and electric vehicles. In the case of battery energy storage systems (that contain many thousands of battery cells) the risks are exponentially greater. Failure of a single battery cell can trigger a fire at these facilities, as demonstrated by the following case reports.

The United States Consumer Product Safety Commission (CPSC) has recently addressed the alarming number of lithium-ion battery fires and lack of standardized safety measures. It is estimated that over 25,000 individual unit lithium-ion battery fires have occurred in the U.S. over the past 5 years, including cell phones and electric vehicles. At least 19 people died because of lithium-ion battery fires produced by small electric scooters and bicycles (12). There has been an alarming number of fires at BESS facilities since 2011 including a series of accidents in the U.S. which occurred within the past 5 years. Accident data collection and reporting has not been reliable as the industry remains largely unregulated while it expands rapidly.

The BESS Failure Event Database was recently established to improve tracking of utility-scale battery storage accidents worldwide. The most recent report lists 85 accidents events since 2011, 18% of these occurred in 2023, including 3-fires within a 3-month period in the state of New York which will be discussed in further detail in the Case Reports section (4).

The accident reporting process is problematic and not well established. Accident data collection is often still in progress or regularly incomplete because not all incident data is promptly reported. As mentioned previously industry growth has far outpaced monitoring and safety regulations. Some fire investigations are inconclusive without a clearly defined cause. There are also occasional challenges to findings; for example, a battery manufacturer may deny their product was faulty and claim another component defect caused the fire, as is the case in many scenarios.

A complicated factor is battery storage technology is extremely complex, rapidly advancing and varies widely. A growing number of energy companies design their own facilities including fire suppression systems. Various suppliers and outsourced parties are included in these projects. The list of triggers for BESS fires is extensive with several accident investigations being inconclusive. Although safety improvements have been made, more changes are needed as accidents continue to occur and technology rapidly develops. According to Brian Scholl, Deputy Fire Marshall of the National Fire Protection Association, this will be an ongoing process for years to come and fire codes will be written in blood as they change (7).

PRIMARY CONCERNS RELATED TO RAPID BESS INDUSTRY GROWTH

There are valid concerns that industry expansion without adequate safety regulations will result in more accidents, fires, and potential loss of life. The focus of battery manufacturers has largely improved overall efficiency. Federal incentives are promoting rapid growth as several energy companies (including those from overseas) seek sites for new projects. Many of these are in rural areas which are known to have no regulations in place.

WSP is a group of 250 fire engineering experts worldwide. This organization has worked to develop and improve fire safety regulations and integrate updates with local fire codes. An October 2021 article describes WSP's primary concerns with the rapid growth in the BESS industry. According to Justine Milne, a lead WSP consultant, "the development of this technology is happening so fast that testing agencies and local authorities having jurisdiction (AHJ) can't keep up with the fire safety issues" (9).

This article continues to describe three primary concerns related to battery storage systems (9):

1. Manufacturers are developing new technologies so quickly that testing firms are backlogged with demand. Relatively few testing firms are available to test larger systems.
2. Fire suppression systems may be inadequate or fail unexpectedly.
3. The National Fire Protection Association 855 standard for installing stationary energy storage systems was created in 2020. To date these safety guidelines have NOT been uniformly adopted into AHJ Fire Codes (this is precisely the case for several BESS proposals in Comfort TX).

The progress of improved and standardized safety regulations remains uncertain. Some battery manufacturers have failed to prioritize fire safety. According to Vincent Favale, another WSP consultant "they are focused on improving the power density of their batteries, which can increase fire risk without mitigation" (9).

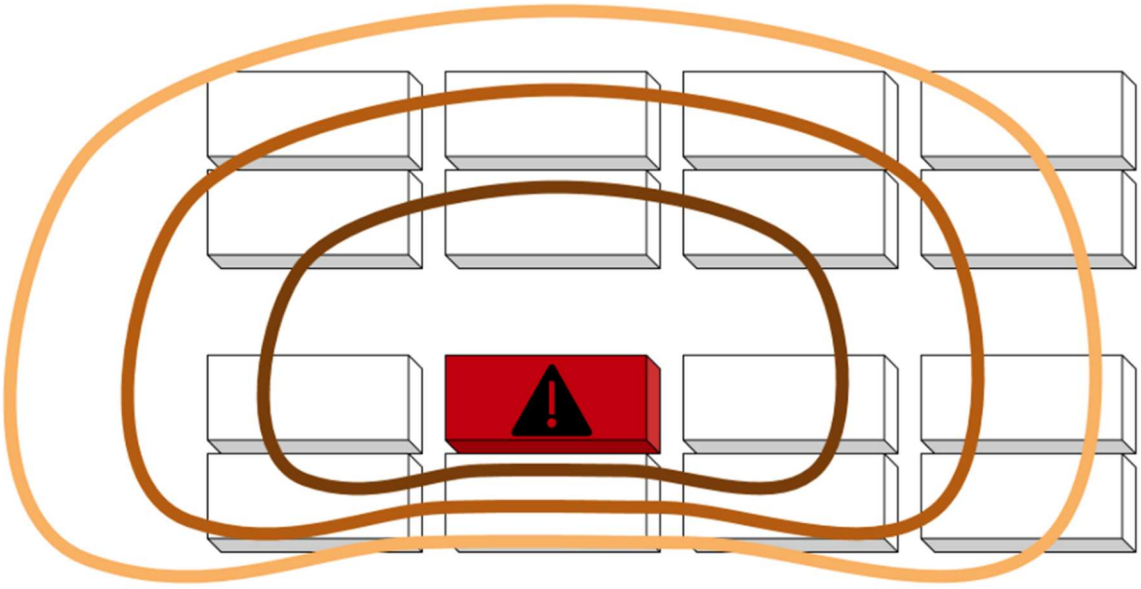


Figure 2: *Graphic depicting Battery Energy Storage Fire Suppression Proximity Monitoring System; Image Source: https://storagewiki.epri.com/index.php/BESS_Failure_Event_Database*

HAZARDS OF LITHIUM BATTERY ENERGY STORAGE FACILITIES

A lithium-ion battery storage unit contains thousands of individual battery cells stacked in racks or modules. Typically, these are enclosed in metal containers spaced several feet apart. These resemble metal shipping containers.

The number of container units varies by design and amount of energy storage. A utility scale BESS facility can have dozens of these on a tract of land. The technical details of environmental control, remote monitoring and fire suppression are very extensive and beyond the scope of this report. A typical design is each metal BESS unit having lithium batteries stacked in racks, individual heating, ventilation and air conditioning (HVAC) unit for temperature control, remote monitoring to detect off-gassing and heat with an automated fire suppression system. System details vary among manufacturers and energy companies.

In the event of an accident local fire departments are the first to arrive on scene. The response time for BESS facility experts can take several hours. Comfort residents were told it could take up to four hours for Key Capture Energy officials to respond and provide further guidance.

The National Fire Protection Association (NFPA) has been addressing safety issues with these facilities and is currently updating guidelines. A December 2021 article by Brian O'Connor, Technical Services Engineer NFPA describes hazards and failure modes that trigger accidents, fires, and release of toxic gas. This list becomes extensive. (7)

The hazards associated with battery storage units are largely attributed to lithium battery characteristics.

These systems require controlled environmental conditions to function properly. Any disruption such as physical damage, overheating, flooding, short circuit, or failure of a unit cooling system can trigger an accident or fire. Lithium batteries burn at extremely high temperatures of 3600 degrees Fahrenheit. Generally, they cannot be extinguished. Management is monitoring and preventing ignition of nearby areas. These fires can last from days to weeks.

Thermal runaway is uncontrolled self-heating of a battery cell that occurs when energy generated heat cannot be dissipated. The overheating cell begins to generate flammable and toxic gases that can ignite. This can quickly spread to adjacent battery cells causing fire or explosion. Accidents can trigger off gassing of toxic fumes. These hazardous components vary by battery composition and present threat to first responders and nearby residents.

Stranded Energy commonly occurs after a BESS accident. Damaged battery systems have no means to release stored energy. This creates risk of shock hazard to first responders. Stranded energy conditions can also reignite fires from minutes to days after the original accident.

Failure modes describe multiple ways these complex battery systems can fail. As mentioned previously these facilities are extremely complex with varied designs and thousands of components. A typical project includes multiple suppliers, manufacturers, contractors, and outsourced services. There are many opportunities for quality control failures.

Thermal abuse describes any event causing unexpected temperature changes in the battery system. If these temperatures exceed a threshold battery failure or fire can occur. This can occur by any number of sources including external heating, overheated adjacent battery cells or elevated temperature within the BESS unit. One example is the failure of the unit HVAC cooling system. There have also been documented cases of AC coolant leaks triggering short circuits and fires.

The volatile nature of lithium-ion batteries makes them susceptible to catching fire if damaged. This includes physical damage such as being crushed, penetrated, flooding and seismic activity. Internal faults can result from poor design, manufacturing errors or material defects. It is important to note that malfunction of a single lithium battery cell can trigger a thermal runaway fire.

BESS systems depend on the proper functioning of complex integrated systems including computer software and programming. There have been multiple cases where these system failures have triggered accidents. A 2012 fire in Flagstaff, AZ was investigated, the root cause was determined to be a programming error. This program was reportedly updated more than two dozen times before the accident. For unknown reasons this was not updated after another incident involving battery overcharging. (further discussion of this provided in Case Reports).

Industry dynamics will present additional challenges as the number of battery storage facilities increases. There are projections the market will grow dramatically within the next five years, possibly tripling in value to nearly $20 Billion dollars.

Several new Energy Companies are being developed, consolidated and resold. Many are based overseas. Some have gone bankrupt. These changes will complicate accident tracking and accountability for defects.

The number of entities involved in a single BESS project is enormous including suppliers, manufacturing, engineering, assembly, maintenance and monitoring. Inevitably many of these parties will be outsourced and changed. A battery storage facility is likely to have several owners during its operation span of approximately twenty years. This creates issues of quality control and oversight as these facilities change hands. Local government has absolutely no control over these factors.

The battery storage proposals for Comfort will most likely be resold after installation. The only opportunity to ensure adequate emergency resources is BEFORE these facilities are installed.

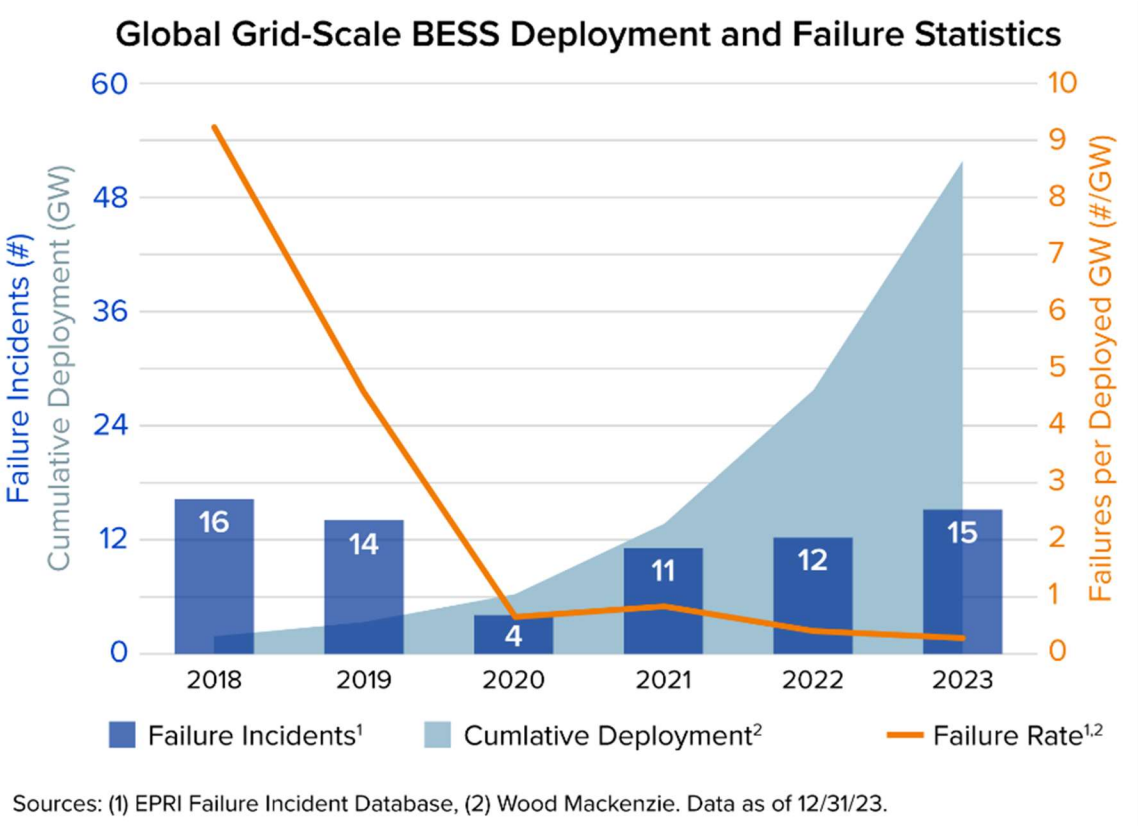


Figure 3: *Graphic depicting of the Battery Energy Storage Systems failure rate per cumulative deployed capacity, up to 12/31/2023. Image Source: https://storagewiki.epri.com/index.php/BESS_Failure_Event_Database*

FACTORS THAT MAKE LITHIUM BATTERY FIRES EXCEPTIONALLY DANGEROUS

The temperature of a lithium-ion battery fires can reach 3600 degrees Fahrenheit. Extreme heat can melt steel and composite metals. This may include damaging the metal storage units that contain the batteries (multiple photos of accident scenes demonstrate flames erupting from the battery enclosures).

These fires cannot be extinguished, management is allowing the fire to burn itself out and preventing further spread. This can take several days or longer (a BESS fire in Chandler, AZ burned for 2-weeks). These fires can also reignite unexpectedly due to continuing thermal runaway from damaged battery cells or stranded energy (batteries maintain high level of charge).

The extreme heat can easily damage or ignite adjacent structures. Although water is generally not used to extinguish the fires it IS needed to keep adjacent areas cool. Depending on the duration of the event this can amount to millions of gallons required. This used firewater is considered hazardous waste requiring sequestration and removal.

Smoke and fumes from lithium battery fires are extremely hazardous. Lithium iron phosphate batteries are widely used (and considered more chemically stable than other lithium combinations). A controlled laboratory analysis of fumes from this battery fire revealed multiple toxic compounds including hydrogen cyanide, hydrogen fluoride, sulfur dioxide, nitrogen dioxide and hydrogen chloride. (1) These are corrosive and can quickly damage lung tissue. Long term health impacts from exposure are unknown. Additional toxins may be produced from burning battery components including plastics and other materials. First responders require special protective equipment. Evacuations of nearby residents are required. There are cases where water spray was needed to redirect smoke away from residential areas. However, this is controversial as cross reactions with water may create more toxins.

Off gassing from thermal runaway can persist for days to weeks after fires appear extinguished. These sites require continuous monitoring by firefighters until the event is considered completely extinguished. Case reports from lithium BESS fires have included repeated evacuations due to prolonged release of toxic fumes. The only management is to monitor and wait for this process to self-extinguish.

The environmental impacts from a battery storage fire are significant. Debris and contaminated firewater are considered hazardous material. Case reports such as the 2022 accident in Chandler, AZ reveal that Millions of gallons of water may be required to cool adjacent areas during a prolonged battery fire. This presents significant risk to soil and groundwater resources. For this reason, battery storage facilities should not be within the limits of floodplains or groundwater recharge areas.

CASE REPORTS

It is difficult to quantify the risks of battery storage systems for several reasons. The industry is expanding rapidly while safety regulations and accident data collection are lagging. Technology is extremely complex and varies widely including differences in battery components, facility design, computer software and engineering of automated safety systems. A significant number of system failures and fires occurred worldwide as the industry expanded over the past decade. Many of these were widely publicized due to their spectacular and destructive nature.

Efforts are underway to improve accident reporting, however this will be an ongoing process. Not all accidents (or causes) are accurately reported. The BESS Failure Event Database has been established to track incidents worldwide. Statistics are expected to change as more facilities are installed, existing one's age and are eventually decommissioned. In general, accidents have prompted some improvements in engineering and safety systems.

Overall risk of adverse events appears to have been reduced, however can never be entirely eliminated. Ultimately, risk profiles do not matter as even one unexpected fire without emergency resources can result in catastrophic loss of life and property. Complete reliance on remote monitoring and automated fire suppression systems is very risky as demonstrated by the following case reports. The need for emergency evacuations and water to prevent intense heat from igniting structures nearby was frequently mentioned.

A report from the California Public Utility Commission reviewed a small sample of accidents in effort to analyze causes and management of these fires. (3) Some investigations revealed multiple factors contributed to fires. These reports are just a few examples providing insight into the extent of this problem.

It is important to note these accidents involved systems with carefully engineered safety systems. In some cases, automated fire suppression systems were determined to have functioned properly yet failed to prevent the accident from progressing. There were also multiple cases where investigations failed to determine the cause. Fires can also occur during installation before the automated safety systems are fully operational.

The following cases are just a few examples:

1. A series of 28 battery energy storage fires throughout South Korea from 2017 thru 2019 triggered a temporary shutdown of the industry. Investigations revealed primary causes as inadequate battery protective systems, faulty operating procedures, installation errors and lack of comprehensive control systems. In some cases, components from different manufacturers were not properly connected by system integration.
2. During 2021 two Tesla Megapacks (1.5 Megawatt each) in Geelong Australia caught fire during installation testing and burned for nearly four days. Response included 150 firefighters and 30 trucks. Multiple problems contributed to this accident. The initial cause was determined to be short circuits triggered by a coolant leak outside the battery storage container. Various internal monitoring systems were not fully functional. The Supervisory Control and Data Acquisition (SCADA) system required 24 hours to fully integrate with the new facility. The fire erupted after only 13 hours of testing before the system was fully operational.
3. In 2023 another 50-megawatt Tesla Megapack in Queensland Australia caught fire. Authorities warned the blaze could take several days to self-extinguish. Residents were instructed to stay indoors due to hazardous fumes. The facility owner Genex Power stated the initial cause of the fire occurred on the grid connection and electronics interface. The fault reportedly propagated back to the battery modules. A press release, dated November 7, 2023, announced the full Root Cause Analysis (RCA) is expected to be published by Tesla "when finalized." (14)

Figure 4: *Fire Rescue Victoria (@FireRescueVic) twitter post on July 30, 2021 "Eight FRV crews, including specialist hazmat crews, scientific advisors and Remote Piloted Aircraft System (drone) operators worked with @CFA_Updates to respond to a significant fire at a battery park in Moorabool on Friday afternoon." Image Source: https://x.com/FireRescueVic/status/1421040775467515904*

4. The First Wind facility in Kahuku HI was a combination wind/battery storage facility. This was a lead acid battery system (lithium batteries have replaced these due to increased efficiency). After operations began in February 2011 there was a series of three incidents within 18 months. The third accident in August 2012 was a fire that destroyed the facility. This fire burned for 13 hours then continued to smolder and release hazardous smoke for three days. Investigations revealed the first two incidents were caused by undersized capacitors. The official cause of the August 2012 fire was not publicized although visual evidence indicates the episode began within an inverter cabinet (3).

5. The Eden substation in Flagstaff, AZ was a 0.5-megawatt lithium-ion storage system installed in 2011. After 11 months of operation a thermal runaway fire destroyed the facility. Upon arrival first responders observed 15-foot flames which later grew to 75 feet. Management was preventing spread and keeping adjacent areas from igniting. One responder was injured from exposure to hazardous fumes when he removed his face mask.

   The exact cause of the fire was suspected to be a computer software issue, however multiple deficiencies were noted. A severely discharged battery cell degraded and affected a neighboring battery cell, triggering a fire. Additional causes included component failures, programming errors, hardware design deficiencies, water coolant leaks, electrical faults, inadequate monitoring and unprepared first responders.

   The computer software problem and how it occurred raises more concerns. The computer failure was determined to be an issue known as Control Logic. This is a part of the software program that controls operations, responds to user commands and performs automated tasks. The control logic for this facility had been updated more than two dozen times during the first 11 months of operations. Investigators noted a preceding event where a battery cell was damaged as the programming continuously charged the cell against the intended design. For unknown reasons this programming error was not corrected. Investigative findings were used to make improvements for future BESS designs. This did not prevent subsequent accidents from occurring including two events in Arizona (Surprise 2019, Chandler 2022).

6. On August 10, 2016, a partially assembled battery storage unit in Franklin Wisconsin caught fire within its shipping container. The fire suppression system was nonfunctional as it was not completely installed. Over 20 fire departments responded due to the severity of the blaze. Estimated damages were $3 Million dollars.

   The fire started while an employee of the battery manufacturer was working on the system. The origin was determined to be the dc power and control compartments within a battery rack (possible manufacturer defect). This quickly spread to adjacent batteries.

7. The McMicken lithium battery storage in Surprise AZ was a 2-megawatt system. After nearly two years in operation a thermal runaway event triggered a fire explosion in April 2019. The systems temperature monitor, laser based Very Early Smoke Detection Apparatus (VESDA) and Novec 1230 clean agent gas fire suppression system reportedly functioned as designed yet failed to prevent this disaster. During the event the Hazardous Materials team was called due to toxic smoke. After nearly two hours of monitoring firefighters opened the container door to assess the situation. This immediately triggered a large explosion (described as a 75-foot-long jet of flame nearly 20-feet wide). Nine first responders were seriously injured from burns and chemical exposure. Several had life-threatening injuries.

   Post event evaluation and cleanup was complicated by additional hazards. The remaining system was 90%

charged presenting electrocution risk. The cause of this event was investigated with conflicting conclusions. Arizona Public Service determined a single faulty battery cell triggered thermal runaway and the resulting fire. Exponent conducted a LG Chem analysis then disagreed, claiming a heat source external to the battery cells triggered the event. Underwriters Laboratory conducted an independent investigation focused on emergency response and design codes. Although there was no agreement on cause a series of events that exacerbated harm were identified. These included first responders opening the container door which triggered the explosion.

A concerning issue is this catastrophic event occurred years after the previously discussed 2012 BESS fire in Flagstaff AZ. Investigative findings from that 2012 incident were used to upgrade design and safety profiles of battery storage facilities. This subsequent 2019 fire and explosion still occurred.

These details demonstrate the extreme complexity and challenge of addressing industry safety issues. In simple terms these complex systems have MANY vulnerabilities that are not efficiently addressed. It is also extremely concerning that there was no agreement on the root cause of this catastrophic accident.

8. An unlicensed lithium battery storage warehouse in Morris Illinois caught fire in June 2021. Firefighters were warned the building contained approximately 100 tons of lithium batteries. Emergency evacuations were required due to toxic fumes. After being extinguished the damaged batteries continued to smolder and produce toxic fumes for several weeks. Due to high risk of hazardous contamination the site was monitored until October 2021.

   Due to risks of hazardous residues residents were instructed to wipe down all exposed surfaces with soap and water. Outdoor structures including benches and playground equipment required cleaning. The EPA determined the area as a hazardous site. The warehouse owner Superior Battery voluntarily assisted with cleanup. Two lawsuits were filed for endangering the public and environment.

9. The Elkhorn battery facility in Moss Landing CA stored 182 megawatts of energy. On September 20, 2022, a fire was detected during the early morning hours. Fire crews followed training protocol to protect nearby structures from igniting with water spray. Five hours later the flames appeared extinguished, however thermal runaway continued to release toxic gas (including hydrogen fluoride) into the community. Thermal runaway cannot be extinguished, management is monitoring until the process burns itself out. This can take hours to days.

   Local officials issued a shelter in place advisory and closed nearby roads. Residents were instructed to close windows and turn off ventilation systems. Emergency orders were lifted 12 hours later. The cause of thermal runaway and fire were not disclosed by the September 2022 California Public Utilities Report (3).

10. A 10-megawatt battery storage facility in Chandler, AZ caught fire during April 2022. This was the third BESS fire event in Arizona, preceded by accidents in Flagstaff (2012) and Surprise (2019). It is important to note that both preceding events prompted updates to improve safety.

    The Chandler BESS facility was a 10-megawatt system owned by AES Energy. The system caught fire on April 18, 2022. The automated fire detection and suppression systems functioned as designed.

    Although these fires cannot be extinguished the automated sprinkler systems were activated to keep adjacent areas from igniting due to extreme heat. During the event millions of gallons of water were used for this purpose. This used firewater was considered hazardous waste requiring sequestration and removal.

    The fire continued to burn and smolder for nearly Two Weeks. Concerns over toxic fumes prompted several evacuations including the temporary shutdown of a highway. The Chandler Fire Department remained on site to monitor the situation until the event was declared extinguished on May 1.

    The fire was initially determined to be a thermal runaway triggered by an overheating battery cell, but this was inconclusive. According to an article, dated May 4, 2022, from Energy Storage News: “Salt River Project (utility provider) has described the incident as thermal runaway in its official statement. However, Energy Storage News has heard from a source close to the project that the exact cause of the fire is not yet known and so could have originated from outside the battery system itself” No further information was provided.

11. A series of accidents in New York State triggered state intervention due to safety concerns. Three utility scale battery storage facilities caught fire within a 3-month span:

- May 31, 2023 - BESS facility fire in East Hampton
- June 26, 2023 - Two separate battery storage units activated alarms at a Warwick facility. One proceeded to catch fire.
- July 27, 2023- A BESS unit at a solar farm in Chaumont caught fire and burned for four days. Nearby communities were on alert including cancellation of public events.

As a result of these fires New York Governor Kathy Hochul initiated actions to address this issue. An interagency working group was created including representatives from the Division of Homeland Security, Office of Fire Prevention and NY Energy Research and Development. A list of draft recommendations was created including updating the State Fire Code to address the unique challenges of utility scale battery energy storage systems. At the time of the accidents utility grid battery facilities were exempt from New York State fire codes.

In response to the Governor's proposals the American Clean Power Association (ACP) recommended that state and local jurisdictions consider adopting NFPA 855. According to Noah Roberts, Senior Director of Energy Storage for ACP "Inconsistent standards across jurisdictions can make deployment of energy security and reliability boosting energy storage more difficult. It is important for policymakers to pursue the consistent and uniform adoption of the national fire standards developed by fire protection experts and fire service professionals" (11).

12. The 139-megawatt Valley Center BESS facility in San Diego County, CA experienced two incidents within 18 months (15). On April 5, 2022, smoke generated outside the facility activated the automated fire suppression system within one battery unit. A fault in the feeder line of the sprinkler system caused water to cascade over many of the batteries, damaging them. No evacuations wereneeded.

    A second incident occurred on September 18, 2023, when a fire erupted within the facility and was extinguished by the internal fire suppression system within 45 minutes. As a precaution evacuations were ordered within a quarter mile radius of the facility. Shelter in place orders were in effect for a half mile radius. At the time of this press release in October 2023 fire officials stated the cause was under investigation with a final determination expected in two months. No additional publicized information was found.

CASE REPORT ANALYSIS AND DISCUSSION

This sample of case reports was very limited including 12 accident descriptions. It is important to note that several did not specifically address the cause of the accident (in some cases only visual evidence was provided). Several accidents were attributed to multiple deficiencies. The most concerning trend in the several cases presented is that the root cause(s) were not unanimously agreed upon by the independent accident investigations or in other cases the underlying cause was deemed to be undetermined.

Based on the evidence provided in these case reports the owners / operators of BESS are responsible for their own accident investigations, often being conducted with minimal governmental or regulatory oversight. This raises concern about the reliability of reporting and the degree of accountability with regards to the BESS accidents presented in this report. There is a level of uncertainty in the accuracy of accident data and how this data is reported and shared throughout the industry. For example, to what degree are past BESS accidents being studied and how effectively are the accident reports being transmitted among energy companies and/or the regulatory agencies (if any)? The compartmentalization of accident reporting can be detrimental to the health, safety, morals and general welfare of the surrounding communities, businesses and families. Furthermore, accident investigations of such complex systems is a difficult process in terms of addressing the many points of failure that are interrelated via the multitude of components involved in BESS facilities. A public assessment of each situation is needed on a case-by-case basis with emphasis on a need for better information and training on fighting battery fires, as material data safety sheets are insufficient for many failure events (3).

A large-scale BESS facility, such as the proposed project(s) in Comfort, Texas, are very complex with multiple vulnerabilities for failure and many unforeseen issues. The list of problematic components in BESS facilities are vast and include defects in materials, manufacturing, assembly, engineering, software programming, monitoring, human error and beyond. The degree of complexity is exponentially greater when considering the sheer number of companies involved in developing a BESS project which include energy companies, owner / operators, suppliers, manufacturers, subcontractors, and third-party outsourcing. For example, according to the proposed plan for the Ringtail Ridge Storage project in Comfort, Texas, on-site monitoring will be outsourced to a company which at the time of this report is known to be undetermined. Local officials and community stakeholders have no control over these decisions or the criterion for selection and are unlikely to be informed on the selection process or in the event of any modification to the proposal.

As demonstrated by the case reports, safety improvements are only implemented after an accident occurs and despite improvements in fire suppression systems and site-monitoring efforts, these fires continue to take place. When a failure event results in a battery fire the only suggested solution to fighting these fires is to continue to monitor them until they eventually self-extinguish, which can take days or weeks. On-site water supply is critical to mitigating the risk of the fire spreading to adjacent areas and first responders are essential to protecting nearby residents, as well as themselves, from the threat of fire, toxic fumes and facilitating evacuations of nearby inhabitants which can sometimes include livestock. A report from the Electric Reliability Council of Texas (ERCOT) dated February 2024 shows 1,515 large generator battery storage projects currently in operation or development and 96.7% of these projects do not have a water availability requirement, despite an apparent need for on-site water supply / storage to mitigate the spread of fires.

In addition to internal defects, fires can be caused by defects in the external components of BESS units. For example, a coolant leak can cause failure of a heating, ventilation, and air conditioning (HVAC) system or trigger a short in an electrical circuit. An unexpected weather event, such as a flood, hailstorm or severe windstorm could cause damage to external components and trigger a failure ultimately resulting in fire. Risk mitigation design standards have yet to be established and often times these BESS projects are constructed adjacent to floodplains as is the case for the Ringtail Ridge Storage project which has the lease area situated on the edge of the 100-year Flood Plain, Flood Zone “A”, (see Appendix for detailed map) and as shown on a Federal Emergency Management Agency (FEMA) flood map dated December 16, 2010 (FIRM Panel No. 48259C0235F). When this map is updated based on new flood models the resulting flood plain could be adjusted to extend beyond or within the limits of the proposed project. This site is near Flat Rock Creek, a tributary of the Guadalupe River. The downstream path of this watershed traverses over the Trinity Aquifer along 361 miles of waterways, including 2 bodies of water (Canyon Lake & Lake Gonzales) and passes through 8 counties, 19 cities and into the Gulf of Mexico (see streamers report in Appendix).

In addition to the batteries, the electronic components in the BESS systems can contain a variety of harmful materials, such as lead, mercury, cadmium and flame retardants, some of which are considered to be hazardous waste and all of which can be detrimental to riparian habitat, aquatic life and are poisonous to humans via contact or by consumption of tainted water sources. Despite there being an evident risk, no studies have been published on the impact that battery

energy storage systems and their components pose on riparian ecosystems and/or sources for drinking water. Proper site planning should include an environmental impact assessment and analysis of the nearby natural resources, including potential impacts on water resources. For example, it is apparent that in the case of the Bat Cave 100MW BESS project located in Mason, Texas, by inspection of pre- and post-construction aerial imagery it can be seen that there is an apparent risk of surface water drainage, possibly containing hazardous waste, flowing from the site into a nearby intermittent stream (see Figure 5).

Lastly, fires can occur before fire suppression systems are fully operational and during system installation. Accident data collection is still ongoing, and the statistics are expected to change as more BESS facilities are installed, these units age and are eventually decommissioned.

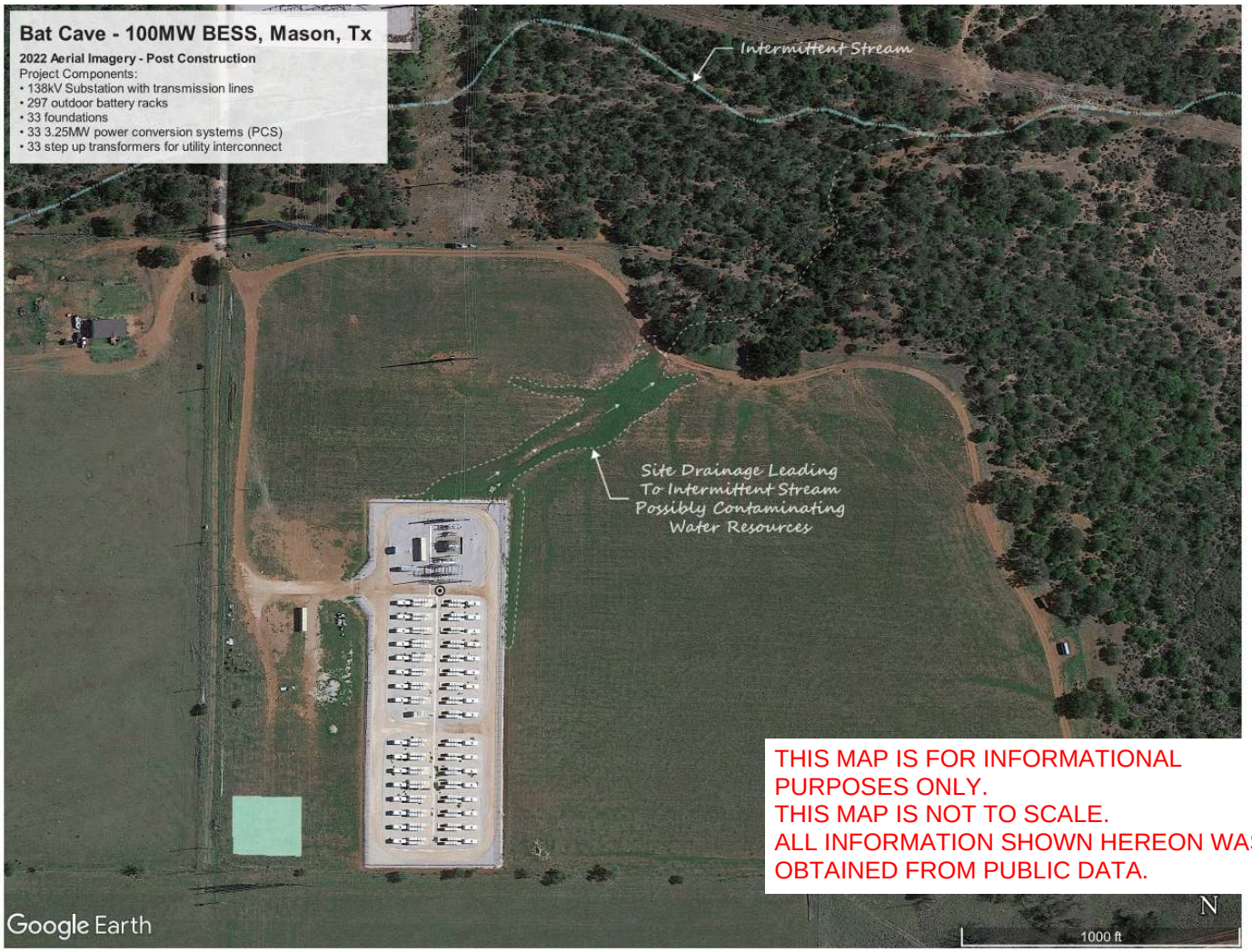


***Figure 5**: Post-construction aerial imagery from 2022 showing the Bat Cave 100MW BESS site located near Mason, Texas. Inspection of this imagery clearly shows drainage from the BESS facility flowing into the nearby intermittent stream. In a review of the pre-construction imagery from 2016 it was apparent drainage from the field existed along this same flowline, which could have been mitigated through proper planning and design. However, this apparent risk was not considered during planning and design stages which should have identified this risk and required the redirection of site drainage to a constructed retention pond instead of into riparian habitat.*

WORST CASE SCENARIO FOR COMFORT RESIDENTS

As demonstrated by case reports, even when fire suppression systems work as expected disasters can still occur. No technology is completely guaranteed to work. Improvements to automated systems may help improve safety, however, will NEVER replace the need for emergency backup planning. On site water is absolutely needed to control heat and keep adjacent structures from igniting. The ability to evacuate residents away from hazardous fumes is also critical.

The majority of Texas communities faced with BESS proposals have no fire safety regulations in place to manage them. Conventional Fire Codes do not address utility scale battery energy storage facilities.

Communities are essentially at the mercy of what an energy company decides to provide or exclude.

Key Capture Energy has no plans to ensure emergency water is available in the event their Comfort facility catches fire. They also have not addressed the evacuation problem presented with a dead-end road (the majority of residences are beyond this facility and would have no emergency exit). KCE representatives denied that smoke from lithium battery fires is hazardous.

IF a fire occurred at one of these lithium storage facilities here is what could happen:

1. The Comfort Volunteer Fire Department would arrive and must wait up to four hours for assistance from the BESS facility staff. They would not have equipment to protect themselves from toxic fumes.
2. Onsite water would not be available. The VFD would have to rely on hauled water to keep adjacent structures from overheating and igniting. The 10-megawatt BESS fire in Chandler, AZ required Millions of gallons of water to control heating of adjacent structures. How quickly can firefighters haul water from the nearest available source (reportedly the Comfort wastewater treatment plant)? Are they prepared to haul water around the clock for days?

   A lithium battery fire burns at 3600 degrees Fahrenheit. Any disruption in water supply could allow nearby structures to overheat and ignite.
3. If an accident occurred during drought conditions, there would be exceptional risk for additional fires triggered by embers. The lack of onsite water would limit the ability of firefighters to control this.
4. Residents beyond the facility have no alternative evacuation route to escape from toxic fumes or additional fires triggered by the battery accident. At best these residents would be directed to shelter in place. Case reports indicated residents unable to evacuate were instructed to shut windows and turn off ventilation systems as a precaution against toxic fumes. IF this occurs on a hot summer day how long can residents tolerate these conditions trapped in their homes without ventilation? A significant number of residents in this area are elderly or disabled.

   The most concerning issue is the risk of wildfires triggered by a battery fire. Comfort routinely becomes at extreme risk for wildfires during droughts. Firefighters would have no water to contain these if it happened. Residents would have no escape route.

THE NATIONAL FIRE PROTECTION ASSOCIATION

The NFPA is a US based international nonprofit organization devoted to reducing risks of death, injury, property and economic loss due to fire, electrical and related hazards. It was founded in 1896, currently based in Quincy Massachusetts. The organization currently has 50,000 members, 9000 volunteers and 250 technical committees. Their focus is developing and improving industry standards through research, education and training. The NFPA offers a wide range of courses and certifications related to fire safety for first responders, building inspectors and other professionals.

One of the most important roles of the NFPA is to develop and publish codes and standards for fire safety. These provide guidelines for the design, construction and maintenance of structures. They also serve to standardize and improve fire protection and life safety equipment.

During the past decade battery energy storage has expanded rapidly with many communities having no safety regulations for this technology. The NFPA was among the first to advocate for standardized safety regulations applicable to utility scale BESS facilities. They recognized that the serious safety concerns presented were not addressed by existing fire codes. The NFPA 855 guidelines were developed specifically to improve the safety profile of these facilities. One critical issue is that these guidelines acknowledge the automated safety systems are themselves inadequate to protect public safety. No system is guaranteed, and emergency backup plans will always be necessary to minimize risks to the public.

A 2023 presentation by Brian School, NFPA Fire Marshal /Technical Committee summarized these guidelines (5) .Battery energy storage technology is rapidly evolving; safety codes will inevitably change. Unfortunately, part of this process will continue to be through trial and error, driven by accidents and investigative findings. Quality control testing including UL 9540 is helpful, however cannot ensure against accidents including thermal runaway.

Hazard Mitigation Analysis (HMA) is included within these guidelines. This addresses consequences of failures including automated fire suppression systems and best practices to protect life and property when this happens. The only opportunity to address these properly is BEFORE a facility is installed. These needs are site specific. For example, a residential area cannot be managed identically to a remote industrial site.

1. Plume analysis should be conducted to determine where prevailing winds would carry toxic fumes in event of a facility fire.
2. Adequate water supply must be available to keep adjacent structures from overheating and igniting. This may require an onsite hydrant or water storage tank.
3. First responders should be trained for a hazardous event including special protectiveequipment.
4. BESS fires including thermal runaway and toxic off gassing can be prolonged events lasting days to weeks. Communities need resources to manage these events.
5. Emergency response plans including evacuation routes should be established if the facility is in a residential area.

KENDALL COUNTY NEEDS TO ADOPT NFPA 855 GUIDELINES

The National Fire Protection Association (NFPA) is currently updating their 855 guidelines designed specifically for utility scale battery energy storage systems. As mentioned previously the International Fire Codes exclude utility scale battery storage facilities. IFC Chapter 12 applies to energy storage for residential structures under 0.6-megawatt capacity. An example would be residential solar panels or a home EV charging station.

Brian Scholl, Deputy Fire Marshal of NFPA and member of their Technical Committee gave a presentation on the 855 guidelines in 2023. These address the unique hazards of utility BESS systems including extreme heat and toxic fumes. A key benefit of these guidelines is they acknowledge that any automated system can fail.

BESS facility fires will still occur unexpectedly despite taking every precaution possible. Emergency backup plans will always be required to reduce risk to lives and property when this happens.

Key Capture Energy failed to acknowledge these issues with their Comfort proposal. Residents were misled to believe that fully automated remote monitoring systems were guaranteed protection. They are not. Kendall County officials have two options. They can adopt NFPA 855 guidelines to help ensure that BESS facilities are safely installed while minimizing risks to residents. The other option is trusting for profit companies such as Key Capture Energy to protect the public. This outcome is questionable as Key Capture has already misrepresented their project risks during a Public Hearing.

EMERGING SECURITY CONCERNS

In December 2023 Duke Energy made the surprising announcement they were disconnecting utility-scale batteries from a BESS facility at the US Military Marine Base at Camp Lejeune, North Carolina. The batteries were manufactured by the Chinese company CATL. Lawmakers and technology experts raised concerns about the battery manufacturer having close links to the Chinese Communist Party. Battery storage technology is heavily dependent on digital networks and automated systems proven vulnerable to security breaches. In February 2024 Duke Energy announced they would decommission the system entirely.

A press release, dated April 15, 2024, went further by announcing the U.S. Department of Defense (DoD) was proactively eliminating all Chinese battery energy storage systems from use across all branches of the military. This is according to a letter the DoD forwarded to Florida Senator Macro Rubio. There are increasing concerns that foreign countries including China, Russia and others will have more access to cyberattacks that could disrupt and damage the US power grid.

The letter to Senator Rubio stated the following, “to prevent any supply chain risks from occurring in the future the DoD will require, to the maximum extent possible, that our partners source all components from American or allied-nation sources.” The European Union is also addressing this issue as the risk of cyberattacks on critical infrastructure grows (13).

This vulnerability has been recognized for several years and is gaining attention as more power grids transition to renewable energy and digital technology. The first successful cyberattack on a utility occurred in the Ukraine in 2015. Thirty electrical substations were disabled leaving nearly a quarter million residents without power for six hours. This attack has been linked to a group of Russian intelligence criminals who breached cybersecurity at two chemical laboratories in the UK and Netherlands. The US Department of Energy considers cybersecurity in the energy sector one of the most complex and challenging national security challenges faced today.

SUMMARY

The history of battery storage failures proves that automated safety systems will occasionally fail regardless of technology improvements. Over 100 accidents and fires related to Battery Energy Storage systems are currently included in the BESS Failure Event Database. This includes 31 documented accidents since 2022. Thirteen occurred in the US. Rapid industry growth has outpaced safety regulations for over a decade.

The Electrical Power Research Institute (EPRI) acknowledges this reporting may not include ALL accidents, even going forward there may be unreported events for any number of reasons. “EPRI cannot guarantee that the database captures every relevant BESS failure incident, nor can we guarantee that all project data related to an incident is captured” (4). As previously discussed in Case Reports the root cause of some accidents remains inconclusive. The National Fire Protection Association has declared the risks of accidents can never be entirely eliminated. Emergency planning and resources are absolutely necessary to minimize risks to the public.

Failure to provide emergency resources including on site water and evacuation routes creates an unacceptable risk to residents living near lithium battery storage facilities.

1. BESS facility fires have occurred despite “functioning” fire detection and suppression systems.
2. The list of triggers for these accidents is extensive.
3. Lithium battery fires burn at 3600 degrees Fahrenheit. This is hot enough to melt their steel storage containers and ignite nearby structures.
4. These fires are impossible to extinguish and must be monitored until they burn themselves out.
5. The fire and release of extremely toxic fumes can last from days to weeks.
6. Accident sites contain hazardous materials creating risk to watershed areas.

The series of three lithium battery storage fires in Arizona demonstrates despite “lessons learned” from previous accidents these events can repeat. After two serious fires in Flagstaff (2012) and Surprise (2019) a third BESS facility fire occurred on April 18, 2022. The automated fire detection/suppression systems reportedly functioned as designed. The fire continued to burn and release toxic fumes for nearly two weeks. Several evacuations were required including shutdown of a highway. Millions of gallons of water were used to control heat and prevent nearby structures from igniting. The Chandler Fire Department remained on site until May 1 when the incident finally self-extinguished. This became a hazardous waste site requiring removal of contaminated water and debris.

This event in Chandler also exposed an ominous problem with these facilities. Similar to other cases the root cause was not officially determined. Initially the cause was declared as thermal runaway triggered by an overheating battery cell. However, this was disputed in a May 4, 2022 article in Energy Storage News: “Salt River Project (utility provider) has described the incident as thermal runaway in its official statement. However, Energy Storage News has heard from a source close to the project that the exact cause of the fire is not yet known and so could have originated from outside the battery system itself.” No further information was provided.

Texas communities are at a disadvantage as the industry accelerates and more BESS projects arrive unannounced to rural areas. There are no statewide safety policies to address the exceptional hazards from these facilities. Conventional Fire Codes do not address risks of utility scale battery energy systems with over 0.6-megawatt storage capacity.

Local governments lack the authority to minimize risks to residents from these projects. Often these proposals are approved by the Public Utilities Commission before County officials can adopt industry specific guidelines. The only opportunity to address site specific concerns is before facilities are installed.

Energy companies such as Key Capture have no incentive or mandate to provide basic emergency resources such as on-site water and evacuation planning. They are allowed to gamble with the safety of residents who are forced to live adjacent to utility scale lithium battery facilities for decades. In the case of Comfort there will be up to 30 acres of lithium battery storage at the entrance to a dead-end road. On-site water will be unavailable. Residents will be unable to evacuate. If asked to shelter in place this requires closing outdoor ventilation including HVAC systems indefinitely (intolerable during summer temperatures). Volunteer firefighters will be unable to haul water quickly enough to keep adjacent structures from overheating or igniting. If additional fires are started there will be no means to control them. If this occurs during wildfire conditions the results would be catastrophic.

The recent fires in the Panhandle provide insight to what can happen to a drought-stricken area. This event burned

over 1.3-Million acres, resulting in loss of life and massive property damage. The cause was a decayed utility pole and downed power lines.

Kendall County frequently encounters Extreme Wildfire Risk due to exceptionally dry and windy conditions. The prospect of a lithium battery storage fire WITHOUT on-site water or evacuation planning is frankly ridiculous. These simple measures could prevent a routine accident from becoming another tragedy.

In the event of accidents energy companies have no liability for loss of life or property. Added to this they face no consequences for misrepresenting project risks to residents. Key Capture Energy representatives provided misinformation that lithium battery smoke is nontoxic, water is unnecessary and automated safety systems are adequate protection. All of these are false as demonstrated by careful research.

The safety of Texas residents does not have to be sacrificed with efforts to improve the energy grid. Across the US other communities are adopting NFPA 855 guidelines specifically targeted to battery energy storage systems. The current process including random safety measures offered by various energy companies is unacceptable.

REFERENCES

1. "Comprehensive investigation on the thermal and toxic hazards of large format lithium-ion batteries with LiFePO4 cathode", Peng et al., Journal of Hazardous Materials, Volume 381, 5 Jan 2020, 120916; URL: https://www.sciencedirect.com/science/article/abs/pii/s0304389419308696

2. BESS Failure Event Database; URL: https://storagewiki.epri.com/index.php/BESS_Failure_Event_Database

3. CPUC Energy Storage Procurement Study Safety Best Practices 9-20-2022 Attachment F; URL: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/energy-storage/20 3-05-31_lumen_energy-storage-procurement-study-report-attf.pdf

4. BESS Failure Event Database; URL: https://storagewiki.epri.com/index.php/BESS_Failure_Event_Database

5. NFPA 855 Standard for the Installation of Stationary Energy Storage Systems April 2023, Brian Scholl Deputy Fire Marshal NFPA/ Technical Committee; URL: https://youtu.be/rlpnl8w1oDQ?si=k68tlKt_2b_5zlA

6. US Codes and Standards for Battery Energy Storage Systems (residential)

7. Battery Energy Storage Hazards and Failure Modes, Brian O'Connor, Technical Services Engineer NFPA, December 3, 2021; URL: https://www.nfpa.org/news-blogs-and-articles/blogs/2021/12/03/battery-energy-storage-hazards-and-failure-modes

8. International Fire Codes 2021, Chapter 12 Energy Systems; URL: https://codes.iccsafe.org/content/IFC2021P1/chapter-12-energy-systems

9. "Reducing Fire Risk For Energy Storage Systems and Electric Vehicles" WSP, Oct 8, 2021, Milne, J., Lead Consultant; URL: https://www.wsp.com/en-us/insights/2021-reducing-fire-risk-for-battery-energy-storage

10. "AES Investigating Cause of Thermal Runaway at Arizona Site" Energy Storage News May 4, 2022

11. "New York Proposes 15 Safety Recommendations for Battery Energy Storage Facilities", Balaraman, K., Utility Dive, Feb 8, 2024; URL: https://www.utilitydive.com/news/new-york-battery-energy-storage-lithium-ion-safety/706947/

12. "Push for New Product Safety Regulations on Lithium-Ion Batteries as Fire Concerns Grow, Susan Hogan, News 4 Washington, Feb 16, 2024; URL: https://www.nbcwashington.com/investigations/push-for-new-product-safety-regulations-on-lithiu m-ion-batteries-as-fire-concerns-grow/3546109/

13. "US Department of Defense proactively eliminating Chinese battery energy storage systems from use due to foreign threat risks", Notebook Check Press Release, April 15, 2024; URL: https://www.notebookcheck.net/U-S-Department-of-Defense-proactively-eliminating-Chinese-bat tery-energy-storage-systems-from-use-due-to-foreign-threat-risks.827400.0.html

14. "Study shows grid behind recent large-scale battery fire in Australia", PV Magazine, November 7, 2023;

15. "Battery Storage is a key piece of California's clean energy transition. But there's a problem with Fires", San Diego Union Tribune, Oct 11, 2023;

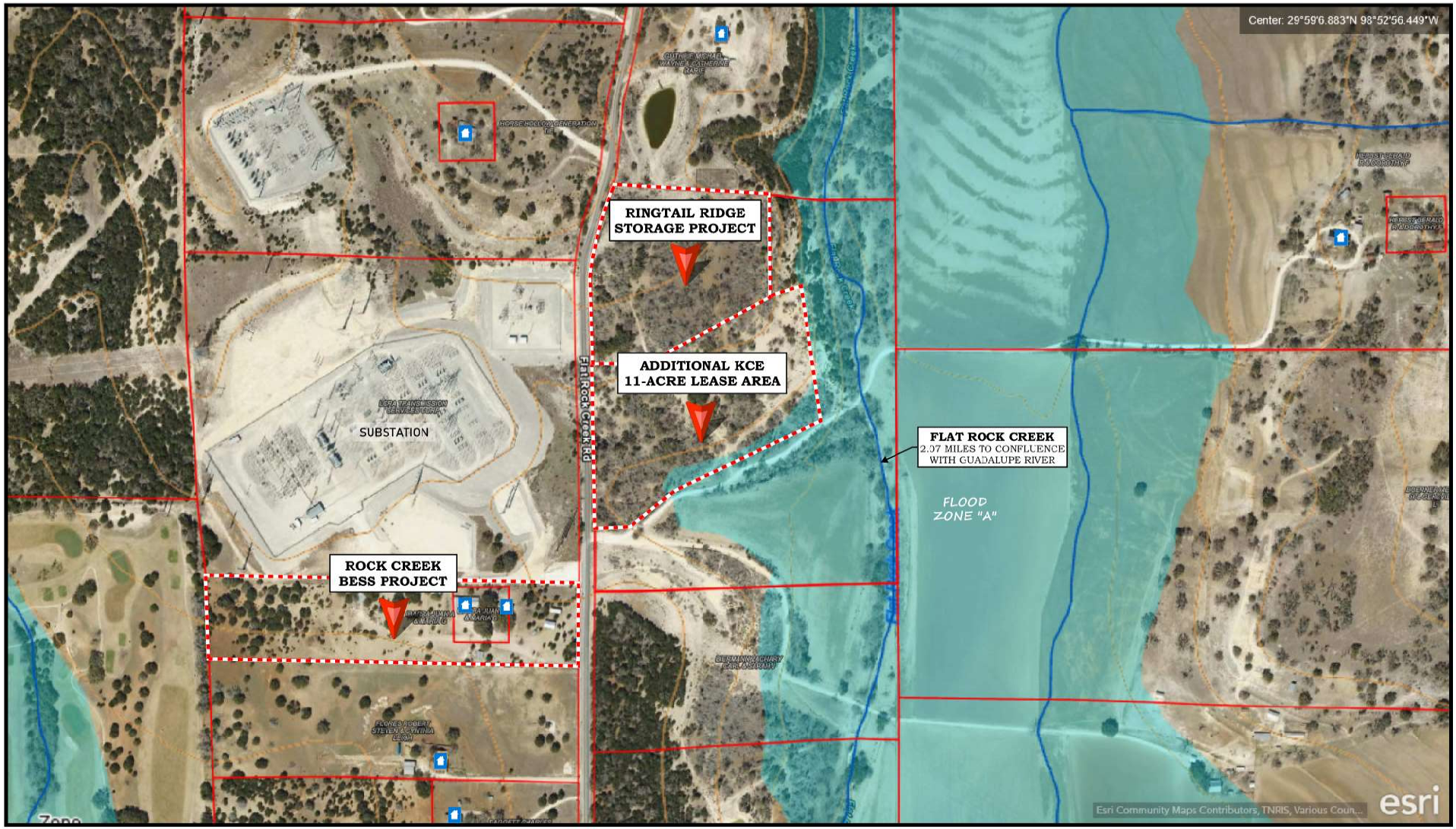
16. "Fire safety tech manufacturing defects in more than a quarter of grid battery storage systems: study", Recharge Global News and Intelligence for Energy Transition, 5 March, 2024;

A P P E N D I X

Proposed Battery Storage Facility

Location: Flat Rock Creek Road, Comfort, Texas

0 1,000 2,000 Feet



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Proposed Battery Storage Facility

Location: Flat Rock Creek Road, Comfort, Texas

N

0 1,500 3,000 Feet

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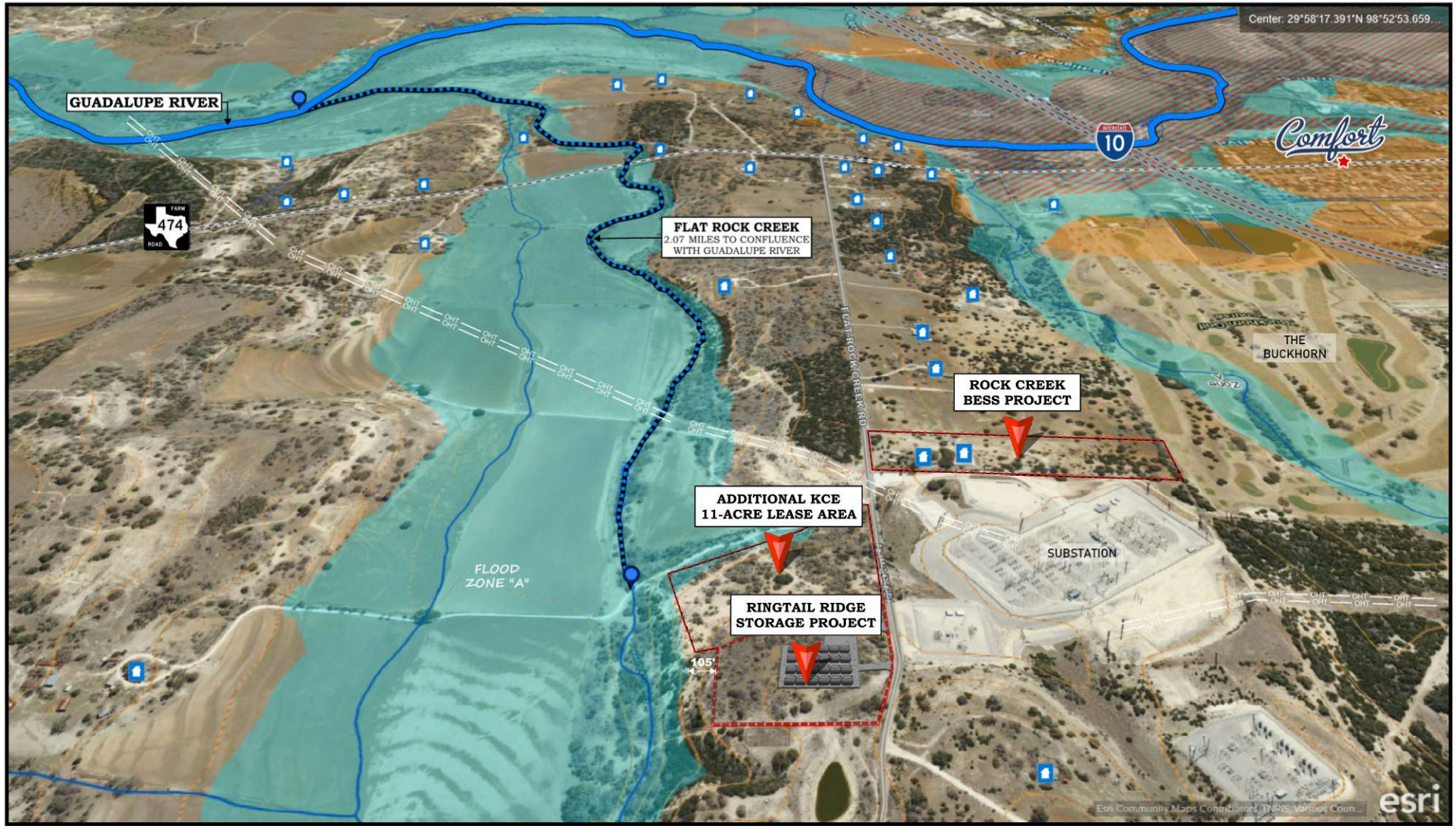


USGS science for a changing world

Streamer

Stream Trace Detailed Report

About This Report

This report provides information about the water bodies, streams, and streamflow gaging (measuring) stations along the routes that you trace using Streamer. It also identifies places (states, counties, and cities) your trace encounters as it moves downstream or upstream. Streamer uses one million-scale map layers from The National Map Small-Scale Collection.

The U.S. Geological Survey (USGS) maintains a national network of gaging stations that measure streamflow and other water characteristics.

Click here for more information about this report and how to download The National Map Small-Scale Collection data.

Trace Details

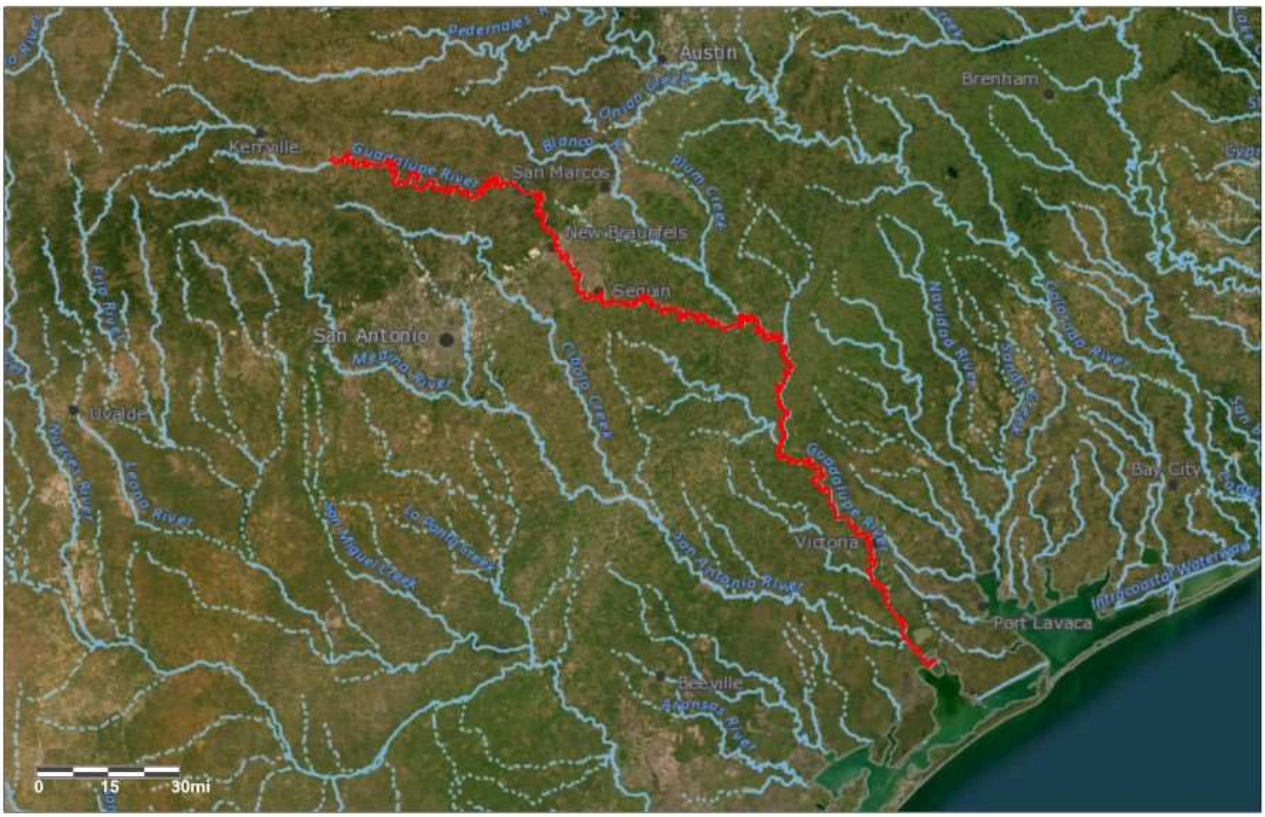
Trace Direction: **Downstream**
Trace Origin Stream Name: **Guadalupe River**
Trace Origin (latitude, longitude): **29.964**, **-98.898**
Trace Origin Elevation (feet): **N/A**

Water Features

Total Length of Traced U.S. Streams (miles): **361**
Outlet Waterbody: **Gulf of Mexico**
USGS Stream Gages (count): **14**
Stream Names (count): **2**
Waterbody Names (count): **2**

Political Features

U.S. States (count): **1**
U.S. Counties (count): **8**
Total County Population (2010): **428,876**
Cities (count): **19**



USGS Stream Gages

08166500 Guadalupe River near Comfort, TX

08169792* Guadalupe River at Farm to Market Road 1117 near Seguin, TX

08167000* Guadalupe River at Comfort, TX
08167500* Guadalupe River near Spring Branch, TX
08167700* Canyon Lake near New Braunfels, TX
08167800* Guadalupe River at Sattler, TX
08168500* Guadalupe River above Comal River at New Braunfels, TX
08169500* Guadalupe River at New Braunfels, TX
08173900* Guadalupe River at Gonzales, TX
08175800* Guadalupe River at Cuero, TX
08176000 Guadalupe River below Cuero, TX
08176500* Guadalupe River at Victoria, TX
08177520* Guadalupe River near Bloomington, TX
08188800* Guadalupe River near Tivoli, TX

* *Indicates a USGS real-time stream gage*

Stream Names

Guadalupe River
South Guadalupe River

Waterbody Names

Canyon Lake
Lake Gonzales

US States

Texas

Counties

Calhoun County, TX
Comal County, TX
DeWitt County, TX
Gonzales County, TX
Guadalupe County, TX
Kendall County, TX
Refugio County, TX
Victoria County, TX

Cities

Belmont, TX
Canyon Lake, TX
Clear Springs, TX
Comfort, TX
Concrete, TX
Cost, TX
Cuero, TX
Gonzales, TX
Gruene, TX
Hochheim, TX
McQueeney, TX
New Braunfels, TX
Nursery, TX
Oak Forest, TX
Seguin, TX
Spring Branch, TX
Tivoli, TX
Victoria, TX
Waring, TX

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Bat Cave - 100MW BESS, Mason, Tx
2016 Aerial Imagery - Pre Construction
Project Components
• 138kV Substation with transmission lines
• 297 outdoor battery racks
• 33 foundations
• 33 3.25MW power conversion systems (PCS)
• 33 step up transformers for utility interconnect
Proposed Site
Pre-Construction
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ALL INFORMATION SHOWN HEREON WAS OBTAINED FROM PUBLIC DATA.
Google Earth
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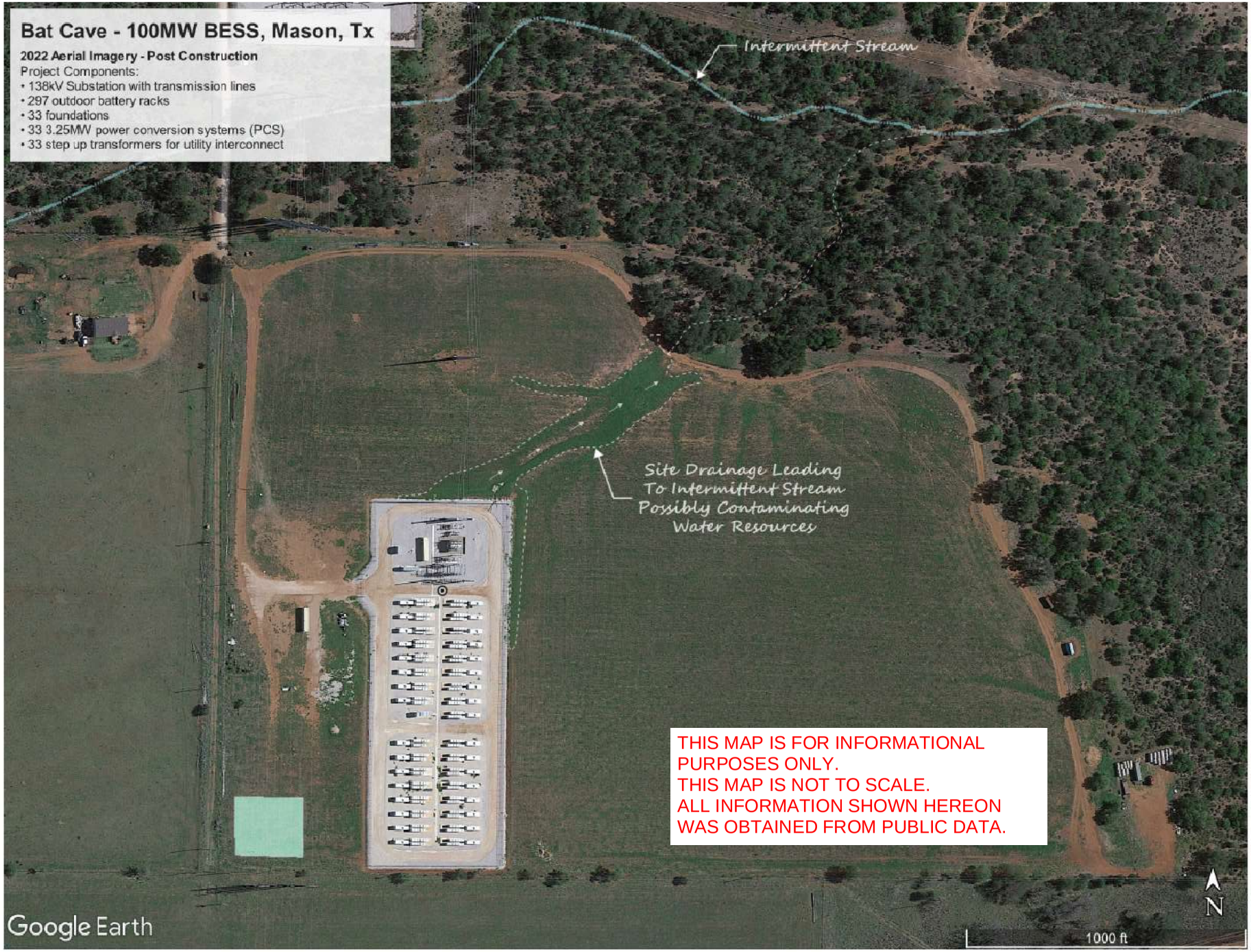
Bat Cave - 100MW BESS, Mason, Tx
2022 Aerial Imagery - Post Construction
Project Components:
• 138kV Substation with transmission lines
• 297 outdoor battery racks
• 33 foundations
• 33 3.25MW power conversion systems (PCS)
• 33 step up transformers for utility interconnect
Intermittent Stream
Site Drainage Leading To Intermittent Stream Possibly Contaminating Water Resources
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Google Earth
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N