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The Decision for Santa Fe County
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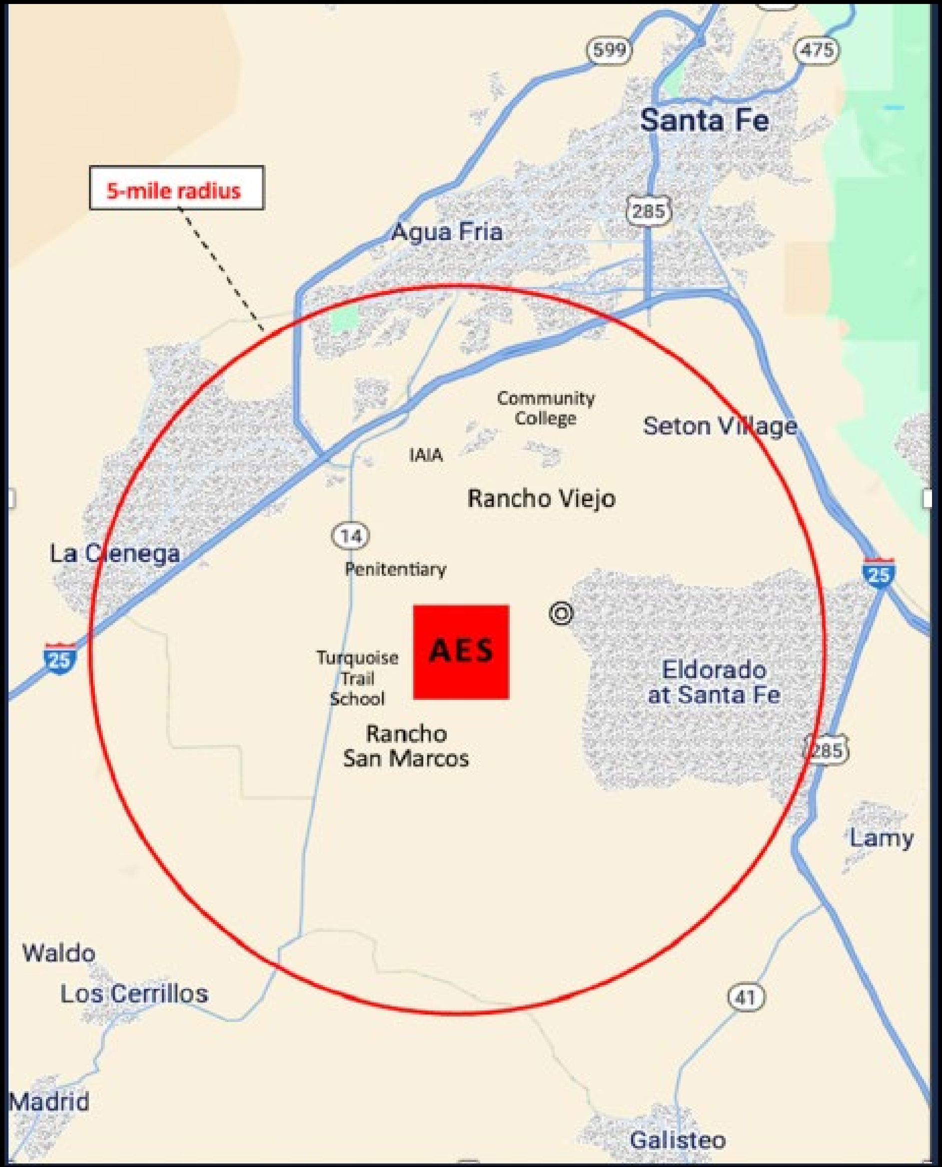
SGMP
CEC
Sustainable Growth Management Plan


SLDC
CEC
Sustainable Land Development Code

Too dangerous to be in ANYONE'S backyard!



SAFE SOLAR FOR SANTA FE

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Surprise, AZ

April 2019

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Chandler, AZ **April 2022**

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Escondido, CA **September 2024**

Moss Landing, CA January 16, 2025

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Moss Landing Toxic Plume January 16, 2025

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CLEAN ENERGY COALITION FOR SANTA FE COUNTY

WITNESS AND EXHIBIT LIST FOR

FEBRUARY 3, 2025, PUBLIC HEARING

WITNESS LIST:

Kaye Cooper-Mead: will present testimony regarding the Sustainable Growth Management Plan as it relates to the proposed Rancho Viejo Solar Project and the approval criteria for CUPs in the Sustainable Land Development Code.

Randy Coleman: will address issues regarding the design, testing and certification of the current state of the AES Rancho Viejo Project and the consequences of the site on the health, safety and welfare of the surrounding communities.

Catherine Babbitt: Catherine was CEC's representative at the December public hearing and cross-examined AES and the County. She will present some of that testimony for the Planning Commission's consideration.

Total time for witnesses – 30 minutes.

EXHIBIT LIST:

Exhibit 1 - MDPI - Li Battery Runoff

Exhibit 2 - The Guardian - How solar farms took over the California Desert - An Oasis has become a dead sea

Exhibit 3 - DOE solar definitions - Solar Power in Your Community Guidebook

Exhibit 4 - NFPA Environmental impact study on Li Fires =in progress

Exhibit 5 - AES defines project as Utility Scale to County in 2022

Exhibit 6 - Safety of Lithium=ion batteries - Power Tech Systems Analysis

Exhibit 7 - Novec 1230

Exhibit 8 - Fire Calculations

Exhibit 9 - PFAS contaminates drinking water in historic New Mexico village

Exhibit 10 - Emergency Planning - Existing Gas Line Not Shown

Exhibit 11 - 3M Stop Producing Novec 1230 due to PFAS content

Exhibit 12 - American Clean Power.org - Groundwater Contamination from firewater runoff

Exhibit 13 - Claims Journal - Li Batteries - Groundwater Contamination

Exhibit 14 - EPRI battery firewater risk assessment - not released to the public

Exhibit 15 - First Street (Climate Risk Data Provider) - SF County Major Wildfire Risk

Exhibit 16 - Journal of Energy Chemistry- Air, soil and water contamination

Exhibit 17 - Moss Landing Fire - Health Concerns

Exhibit 18 - Moss Landing Fire and Evacuation

Exhibit 19 - Orange County Fire Authority - Ember distance

Exhibit 20 - Santa Fe Ranks 12th in West for Greatest Wildfire Risk

Exhibit 21 - Travelers.com - BESS Risks - Groundwater contamination and toxic fumes

Exhibit 22 - Travelers.com - BESS Risks - Chemical release hazards

Exhibit 23 - Wildfire Risk.org - SF County High Risk of Wildfire

Exhibit 24 - Santa Fe County Community Wildfire Protection Plan

Exhibit 25 - KQED - Moss Landing Air Monitoring - Timing issues

Exhibit 26 - Monterey County website - Air Monitoring Reports from Moss Landing

Note: the handwriting on several exhibits is that of Kaye Cooper-Mead

batteries

IMPACT FACTOR 4.6

CITESCORE 4.0

Article

Assessment of Run-Off Waters Resulting from Lithium-Ion Battery Fire-Fighting Operations

Arnaud Bordes, Arnaud Papin, Guy Marlair, Théo Claude, Ahmad El-Masri, Thierry Durussel, Jean-Pierre Bertrand, Benjamin Truchot and Amandine Lecocq

Special Issue
Thermal Safety of Lithium Ion Batteries

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MDPI

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Article

Assessment of Run-Off Waters Resulting from Lithium-Ion Battery Fire-Fighting Operations

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Abstract: As the use of Li-ion batteries is spreading, incidents in large energy storage systems (stationary storage containers, etc.) or in large-scale cell and battery storages (warehouses, recyclers, etc.), often leading to fire, are occurring on a regular basis. Water remains one of the most efficient fire extinguishing agents for tackling such battery incidents, and large quantities are usually necessary. Since batteries contain various potentially harmful components (metals and their oxides or salts, solvents, etc.) and thermal-runaway-induced battery incidents are accompanied by complex and potentially multistage fume emissions (containing both gas and particles), the potential impact of fire run-off waters on the environment should be considered and assessed carefully. The tests presented in this paper focus on analyzing the composition of run-off waters used to spray NMC Li-ion modules under thermal runaway. It highlights that waters used for firefighting are susceptible to containing many metals, including Ni, Mn, Co, Li and Al, mixed with other carbonaceous species (soot, tarballs) and sometimes undecomposed solvents used in the electrolyte. Extrapolation of pollutant concentrations compared with PNEC values showed that, for large-scale incidents, run-off water could be potentially hazardous to the environment.

Keywords: Li-ion battery; fire; safety; thermal runaway; toxicity; water; firefighting; pollutants

check for updates

Citation: Bordes, A.; Papin, A.; Marlair, G.; Claude, T.; El-Masri, A.; Durussel, T.; Bertrand, J.-P.; Truchot, B.; Lecocq, A. Assessment of Run-Off Waters Resulting from Lithium-Ion Battery Fire-Fighting Operations. *Batteries* **2024**, *10*, 118. https://doi.org/10.3390/batteries10040118

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1. Introduction

The current development of Li-Ion batteries concerns numerous, application fields, and the thermal runaway hazard about those systems, often leading to fire and sometimes explosion events, remains a resilient issue. In parallel to the wide spread of Li-ion-powered consumer products in complex built environments, the increasing use of applications of LIB for e-mobility or large-scale battery energy storage systems (BESS), in the hundreds of MW power range, requires the urgent development of environmentally friendly strategies to fight lithium-ion battery fires. Considering that water remains one of the most efficient fire extinguishing agents to fight battery fires, and in many cases is the only extinguishing medium available in operational quantities to the fire-brigades, the potential impact of relating fire run-off waters to the environment should be considered and assessed carefully. Lessons of the past have primarily shown that uncontrolled release of toxic fire waters in rivers may lead to a dramatic consequence for water livestock, as primarily shown by major incidents involving large storage of toxic chemicals such as in Basle (Sandoz fire, Switzerland, 1986) [1,2] or in Tianjin (China, 2015) [3]. This is a prerequisite for establishing a clear and science-based firewater management doctrine [4]. In particular, the level of contamination of fire waters in terms of toxicity to aquatic ecosystems is needed to decide on the free release of extinguishing waters into the environment or into rainwater drain systems or on their containment in suitable systems for post-hazardous liquid waste management [5].

During the thermal runaway phenomenon—initiating stage of relating field failures—it is well-known that systems containing Li-ion batteries produce emissions or effluents which can range anywhere within the full spectrum of physical states, e.g., liquids (electrolyte leak or ejection), gases or vapors or solid aerosols [6–10], which adds complexity to both non-flaming and flaming conditions. These emissions may in turn interact with the environment and lead to pollution [11]. One of the contamination modes of both land and aquatic ecosystems is the aerosol sedimentation process arising during smoke plume dispersion, often at a stage where contaminant concentrations in the smoke plume are significantly diluted at a certain distance from the incident. Another possible and easier way of pollution is linked to the extinguishing agents used, typically water used by fire suppression systems or fire brigades, which can carry effluents emanating from the damaged battery. These various modes of contamination have been, unfortunately, largely confirmed in a significant number of fire records, as exemplified by Mc Namee et al. [12]. This shows, in particular, the diversity of influencing factors in terms of burning materials, size, and fire duration, potentially leading to environmental damage. Regarding batteries, the contaminants involved depend on the materials composing the system. These materials vary from one Li-ion battery chemistry/geometry to another and from one system to another, but the phenomena at stake and the resulting effects are close [13]. For small- or medium-isolated batteries (e.g., used for portable applications), the accidental contamination risk should be relatively low, but for more energy- or power-demanding applications leading to larger battery systems (containerized BESS, . . .) or large-scale cell and battery storages (warehouse, recyclers, . . .), the consequences might start to raise concerns in the absence—so far the usual case—of any fire water containment capacity. As a matter of fact, according to EPRI information, 64% of the BESS site owners are considering the implementation of water containment for the firefighting run-off waters [4]. Regarding fire extinguishing waters used to tackle car fires, if detailed studies [14,15] of fire water ecotoxicity had concluded that subsequent fire water run-off had a negligeable impact on the environment, as far as ICE cars are concerned, more caution is likely to be needed with EVs, given the significant differences applied from potential contaminants from the battery and the amount of water requirements.

Emissions during thermal events are directly linked to the materials constituting the battery. However, they will possibly be altered by reactions of thermal decomposition, electrolysis or even combustion that might drastically change the nature and properties of the ejected matter [8]. Carrying those substances by water will vary depending on the chosen extinguishing method. Three options are generally possible: (1) Direct watering of the batteries—when sprinklers or water fire hose are directed to the faulty system with direct contact with the batteries. (2) Fire plume watering for fire and smoke progress abatement—when water is not applied directly to the system but to its surroundings to prevent fire and subsequent damage propagation to adjacent elements and therefore minimize the impact of the root fire. (3) Water immersion—when the battery is immersed in a large volume of water, either after an incident to cool down the sample, or during an incident to try to limit it. In this last option, managing firefighting waters is relatively simple as water is already contained.

Water contamination in the smoke watering scenario (#2 firefighting option) was recently studied by EMPA [16,17] while analysis of immersion water (#3 firefighting option) has been performed both by EMPA and RIVM [18]. However, more globally, published information regarding contamination of fire waters used to tackle li-ion battery fires, regardless of the application, remains quite scarce. Therefore, further investigation is needed to confirm the early trends observed [19] and to address those issues in the entire value chain of LIBs.

In the present paper, the case of direct watering of the batteries is the only scenario studied. Commercially available NMC battery modules composed of two different cell formats (18,650 and prismatic) were chosen for the experimental approach selected in this study.

2. Materials and Methods

2.1. Description of the Samples

Two types of commercial Li-ion modules were used, both composed of NMC/graphite cells.

Module A comprises 16-metal-can prismatic cells (7.5 Ah) and has an electrical energy of 500 Wh. In addition to the electrochemical cells, the module also includes metallic (aluminum plates, cells connectors) and plastic (casing cover, wire insulation etc.) parts.

Module B is an assembly of 2 cell blocks, each one composed of 45-cylindrical 18,650 cells (2.4 Ah), circled with a metallic grid to ensure its mechanical integrity. The total energy of the battery assembly is 900 Wh. In addition to the electrochemical cells, the module also integrates a thin plastic film keeping the cells tightly together and connected.

The week before the abuse tests, the modules were fully charged using a constant current profile at C/5 using a cycling bay from FEV manufacturer.

2.2. Abuse Tests Set Up

Abuse tests on modules were performed in the Ineris 80 m^3 test chamber equipped with a smoke exhaust and treatment system remotely controlled to fully extract, measure, and eventually convey gases through the gas cleaning system of the facility before their rejection to the atmosphere. The room is also connected to a water-draining system to collect all liquid effluents produced by the fire or during the fire suppression process. In the testing room, the air entrance is located on one side, near the ground; extraction is placed in the center of the roof. All tests were performed under air with an extraction flow rate in the test chamber of approximately 2 500 m^3/h.

The sample was positioned in the center of the test chamber for each test, as represented in Figure 1. Modules were positioned on a metal grid, electrically insulated, using a small support made of inert material (calcium silicate).

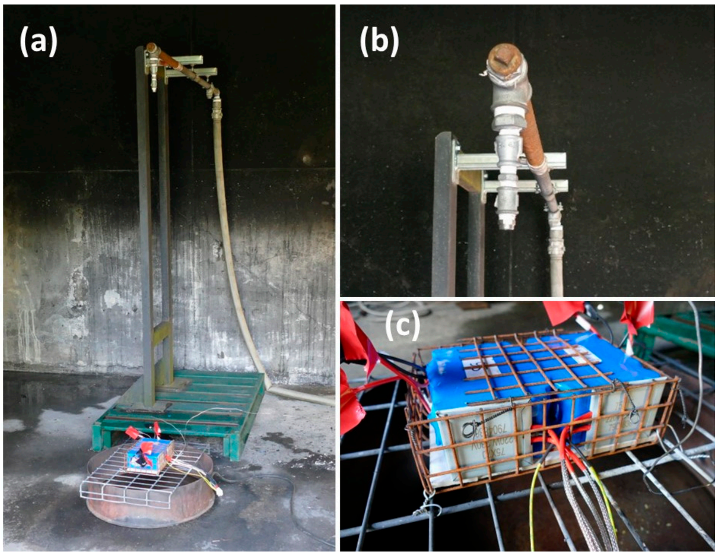

Figure 1. Pictures of the experimental set-up. (**a**) Overview, (**b**) sprinkler head, and (**c**) battery module B. White pads on the front faces of each battery block correspond to the heaters.

For module A, as the thermal pad failed to initiate a thermal runaway, a 20 kW gas burner was selected and positioned 30 cm from the sample and directed to the middle of the module. To prevent any interaction between the propane burner and the water used for firefighting, the burner was switched off as soon as thermal runaway was triggered.

For module B, two thermal pads with individual power of 220 W and a 50 cm^2 surface were put in contact with each cell block.

Since the objective of the tests was to evaluate water contamination in thermal runaway situations, the sprinkler activation was performed manually as soon as the thermal runaway was visually confirmed. As the modules were not equipped with thermocouples, the thermal runaway event was considered occurring when flames were escaping for the first time from the module. The application rate was set at 10 $L/m^2/min$. The basin surface was 0.25 m^2, and the volume of collected water was estimated by calculation using the water flow, the watering time, and the basin surface.

2.3. Water Sampling

After each test, 2 L of water was immediately sampled from the extinguishing water containment basin for chemical composition analysis. It is important to highlight that no filtration was made to keep all of the emissions in the analyzed samples, whatever the chemical or physical processes that were involved in the interactions of emissions from the battery module and extinguishing waters (condensation, dissolution, sedimentation etc.), since the objective of the test was to characterize the global composition of runoff water.

Before the test, the water receptacle was exposed to a direct flame to remove the potential traces of organic solvents. However, deposit remains possible, and a reference was then carried out by watering the same set-up, without any battery, in order to have a baseline of potential species inherently present in the water supply or due to receptacle component extraction during sampling.

2.4. Water Analysis

2.4.1. Inductively Couple Plasma Optical Emission Spectroscopy

Inductively Couple Plasma Optical Emission Spectroscopy (ICP-OES, Agilent 5110 equipment, Santa Clara, CA, USA) has been used for the analysis of major elements (Al, Fe, Li, Na, Ni, P).

2.4.2. Inductively Couple Plasma Mass Spectrometry

Inductively Couple Plasma Mass Spectrometry (ICP-MS, Agilent 7900 instrument, Santa Clara, CA, USA) has been used for the analysis of trace elements (Co, Cu, Mn). Instead of the ICP-OES used for major elements by measuring the light emitted from elements, ICP-MS uses a quadrupole to filter the ions according to their mass/charge ratio and counts each mass passed to the detector. The high sensitivity of the ICP-MS detector provides a much lower detection limit than ICP-OES.

2.4.3. Ion Chromatography

Chloride and fluoride species were measured by ion chromatography (Metrohm, 850 Professional IC, Herisau, Switzerland) with conductimetric detection. Ion chromatography is a method for separating ions (Cl^- and F^-) based upon their interactions with resin (stationary phase) and the eluent (mobile phase).

2.4.4. Liquid Chromatography

To extract polycyclic aromatic hydrocarbons (PAHs) from the water sample, a separation of the particle phase was carried out using glass wool. Aqueous phases were extracted using dichloromethane by liquid/liquid extraction and particulate phase was extracted using acetonitrile. Both extracts were evaporated and collected in 0.5 mL of acetonitrile each and recombined in the same vial before analysis.

Analysis of PAHs was performed on a liquid chromatography system, an ultimate 3000 from thermo coupled to a diode array detector (DAD) and fluorescence detector (FLD) detector. Molecules were separated on C18 column (Zorbax eclipse PAH 2.1 × 150 mm 1.8 micron from Agilent). All PAHs were quantified using the FLD detector except for Acenaphthylene that was quantified using the UV-DAD detector.

2.4.5. Gas Chromatography

Carbonates were analyzed using a gas chromatography system from Varian. Samples were diluted in methanol and 1µL was injected in split mode 1:10. Separation was performed on a capillary column from Agilent VF-5 ms 60 m, 0.25 mm internal diameter and 1 µm film thickness. A flame ionization detector was used to quantify the different compounds.

2.5. Particle Morphology Characterization

A particle size distribution analysis using the centrifugal disc method (by use of CPS Disc Centrifuge™ instrument, Tokyo, Japan) and further particle morphology study by Transmission Electron Microscopy (TEM, JEOL 1400 Plus instrument, Tokyo, Japan) were carried out on the sampled water. To enable this analysis, all particles larger than 2 µm in size were filtered beforehand.

To perform microscopic analysis of the particles, a droplet of the sample suspension was casted on a copper grid and dried at room temperature to be observed with a TEM (Transmission Electron Microscope, JEOL, 1400 Plus, Tokyo, Japan). A beam of electrons accelerated by a high voltage (120 kV) passes through a very thin sample, in this case a carbonized copper grid on which a microdrop of the sample to be analyzed was deposited. During the electron–matter interaction, the transmitted and diffracted electrons are used to form an image with high resolution in gray levels, and the X-ray photons allow for a micro or even a nano-volume of the sample to be chemically characterized.

3. Results

3.1. Test Conditions and TR Characteristics

Table 1 compiles the test conditions and reactions observed during the three successive test runs and Figure 2 gives details on the timeline of the experiments and presents pictures of the markers of significant events.

Table 1. Summary of test conditions and observations.

	Module Type	Module Energy	Heating Method	Reaction	Module State after Test	Sprinkler Flow	Amount of Water Delivered
Test 1	Prismatic cell assembly NMC (module A)	500 Wh	Gas burner	Venting + moderate fire	Upper plastic burnt Mechanical integrity conserved No module casing opening	10 $L/m^2/min$	7 L
Test 2	Prismatic cell assembly NMC (module A)	500 Wh	Gas burner	Jet fire + explosion	Module casing ejected All cells fully burnt with casing damaged	10 $L/m^2/min$	7 L
Test 3	Cylindrical cell assembly NMC (module B)	900 Wh	Thermal pad	Jet fire + explosion	All cells burnt Some jelly rolls visible	10 $L/m^2/min$	9 L

In the first experiment, the thermal runaway of module A was characterized by the emission of a large amount of white smoke followed by the appearance of flames. No jet fire was observed, but a rather moderate combustion process, as visible on the first line of Figure 2 was observed. Water was applied for 2 min 50 s, corresponding to a volume of collected water of 7 L. The flames stopped as soon as water was applied. After the test, no cells presented any side wall rupture, and their mechanical integrity was conserved.

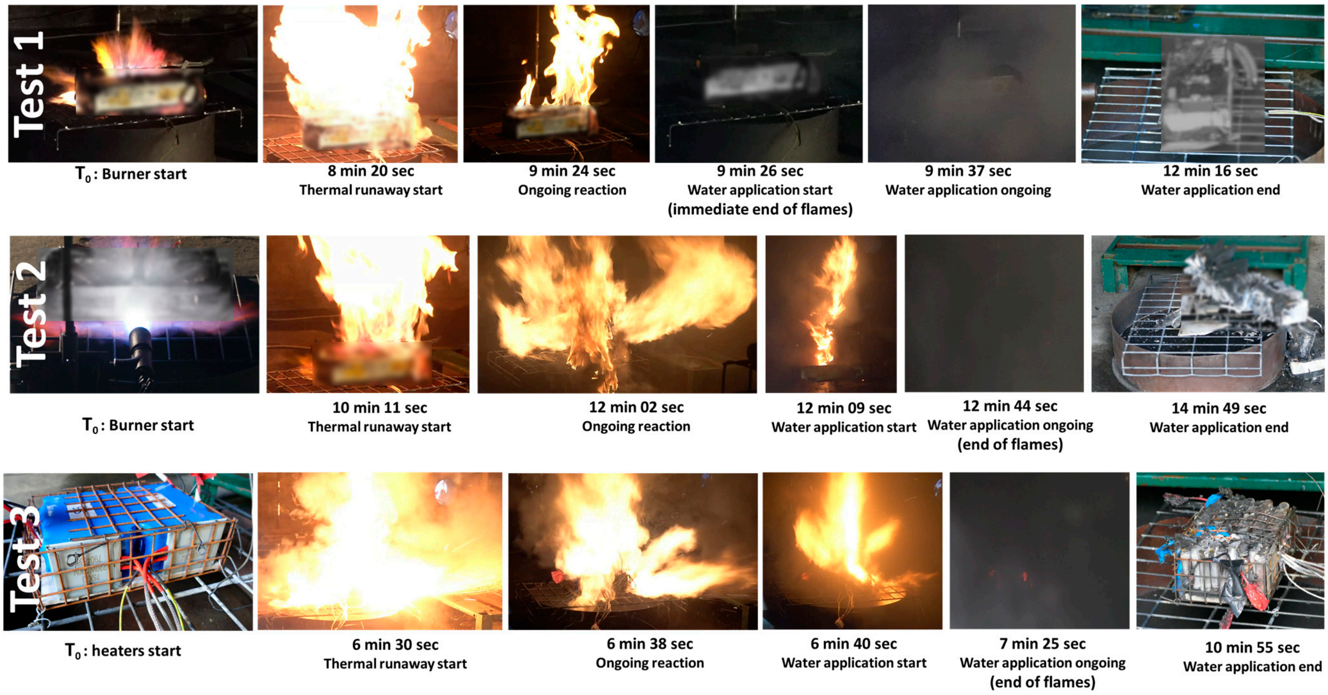

Figure 2. Extracts from the test video and timeline of the three experiments.

Test 2 was performed because module A was only moderately impacted by the first experiment. It was decided that the thermal runaway of module A should be further pushed and to restart the burner. After a few minutes of heating, the module entered again in the thermal runaway process. In this case, the reaction was much more violent since the jet fire was observed, the module casing was ejected, and all cells subsequently seemed damaged, some of them losing their mechanical integrity (casing opening). The second line of Figure 2 shows the reaction's visible effects just before water application (12 min 9 s). Water was applied for 2 min 40 s, leading to an additional volume of collected water of 7 L, i.e., a total of 12 L considering 5 L remains from test 1 (after that 2 L were sampled for analysis). Contamination levels indicated for test 2 are the values corresponding to the mix of the 5 L remaining from test 1 and the 7 L applied during test 2. The flames did not stop immediately upon water application, and an unknown portion of the water vaporized before reaching the receptacle. In the first approximation, this proportion of water vaporized was not considered for further calculation of the contaminant. The flames stopped 35 s after the application of water.

For module B, a single TR/fire water suppression step was carried out when the thermal runaway was reached. The third line of Figure 2 shows that the reaction was rather violent. All of the cells seemed damaged after the test and some of them lost their mechanical integrity (casing opening or jelly roll ejection). Water was applied for 3 min 30 s corresponding to a volume of collected water of 9 L, neglecting once more the vaporizer part. Flames stopped 45 s after water activation.

3.2. Characterization of Water Contamination

3.2.1. Halogens and Metals

Table 2 shows the results of the analyses for the presence of the two anions (F^- and Cl^-) as well as a selection of metal compounds. Those species have been chosen to reflect the foreseeable pollutants considering NMC Li-ion batteries composition [20].

As expected, the levels of fluorides and metals are found in large amounts, due to the composition of the cells. In module A, phosphorus and fluoride ions are the dominant species. In contrast, in module B, lithium is the more concentrated pollutant element compared to all other metallic elements and fluorides or chlorides. All these species are found in cell electrolytes or in the electrode for Li. Transition metals contained in the cathode (Ni, Mn, Co) are found mainly when the reaction was violent (tests 2 and 3). Their ratios, across different tests vary but in the three tests, Ni is overrepresented compared with Mn and Co, which is expected as stoichiometry of the current NMC cathode favors Ni. Their presence—in undetermined metal containing chemicals (oxides ? hydroxides ? metal complexes ?) [21]—is consistent, with composition of the selected cells. In order to better understand their respective amount, further studies on their chemical state and their solubility in water are necessary.

Table 2. Analysis of anions (F^- and Cl^-) and a selection of metals in the water before application and in the three samples after extinguishing. QL = quantification limit. Uncertainty values refer to expanded uncertainties (k = 2).

	QL	Uncertainty	Reference	Test 1 (Module A)	Test 2 (Module A)	Test 3 (Module B)
			Ions			
F^- (mg/L)	0.05	8%	0.25	142	91.6	93.7
Cl^- (mg/L)	0.01	3%	24.9	33.4	36.5	203
			Metals			
Al (mg/L)	0.17	15%	0.91	74.2	29.3	73.9
Co (mg/L)	0.03	10%	<LQ	0.42	12.8	7.07
Cu (mg/L)	0.03	10%	0.04	0.30	0.26	4.18
Fe (mg/L)	0.08	9%	0.30	5.92	4.59	0.30
Li (mg/L)	1.67	15%	<LQ	44.5	27.8	360
Mn (mg/L)	0.03	10%	<LQ	1.22	17.0	5.82
Na (mg/L)	1.67	14%	13.0	15.6	16.3	26.2
Ni (mg/L)	0.08	12%	<LQ	3.25	49.0	40.1
P (mg/L)	0.17	17%	<LQ	201	113	5.80

Aluminum, copper, and iron in pristine cells are present in sheets or bulk form and as particulate matter; therefore, they are expected to be less present in particulate emission. Aluminum is, however, found in noteworthy amounts probably because of its low melting point (660 °C). Iron and copper, which have higher melting points are found in relatively low amounts in the three tests.

By comparing the two extinguishing operations on the prismatic cells (test 1 and 2), it can be observed that when the thermal runaway thermal impact is characterized by a fully developed combustion process, the interacting water collected is much more concentrated in Polycyclic Aromatic Hydrocarbon (PAHs) and cathode metals (Ni, Mn, Co). On the other hand, the concentrations of elements essentially coming from the liquid electrolyte (typically Li, P, F) are present in higher quantities (1.6 to 1.8 factor) when the reaction is not fully developed, and where the electrolyte has a chance to be dragged in the water. This observation is coherent with the higher amount of organic carbonates found in test 1 presented in Section 3.2.3.

The comparison of the results between different cell geometries also confirms the importance of this parameter, influencing, in particular, the mechanical strength of the system and, therefore, the confinement of the species.

3.2.2. Poly Aromatic Hydrocarbons (PAHs)

Another important family of water contaminants in fire situations is PAHs. While the common specification for PAHs mentions 16 substances to be analyzed [22], 23 PAHs were analyzed; the results are reported in Table 3.

Table 3. Analysis of 23 PAHs in the water before application and in the three samples after extinguishing. QL = quantification limit. (Expanded: k = 2) Uncertainty of analysis for HAPs is 15% for all species.

PAH (Polycyclic Aromatic Hydrocarbons)					
	QL	**Reference**	**Test 1 (Module A)**	**Test 2 (Module A)**	**Test 3 (Module B)**
Naphtalène (ng/L)	10.0	<LQ	1279.2	2792.2	3114.6
Acénaphtylène (ng/L)	40.0	<LQ	2421.7	2405.1	1193.4
méthyl-1.naphtalène (ng/L)	10.0	<LQ	26.8	459.4	667.1
méthyl-2.naphtalène (ng/L)	10.0	<LQ	203.2	<LQ	2058.4
Acénaphtène (ng/L)	2.0	<LQ	34.1	110.6	275.7
Fluorene (ng/L)	2.0	<LQ	74.1	752.3	1055.0
Phénanthrène (ng/L)	4.0	5.7	360.9	3026.8	2581.6
Anthracène (ng/L)	2.0	<LQ	10.6	330.5	303.3
Fluoranthène (ng/L)	2.0	10.8	57.7	1280.9	349.8
Pyrène (ng/L)	2.0	7.2	45.1	1279.8	20.5
méthyl-2.fluoranthène (ng/L)	4.0	<LQ	7.3	45.1	21.3
B(a)A (ng/L)	2.0	<LQ	24.8	185.7	131.8
Chrysene (ng/L)	2.0	<LQ	32.5	212.3	40.8
Retene (ng/L)	2.0	<LQ	104.9	170.7	19.8
B(e)P (ng/L)	2.0	<LQ	7.5	306.3	50.4
B(j)F (ng/L)	20.0	<LQ	<LQ	106.3	<LQ
B(b)F (ng/L)	2.0	<LQ	34.6	259.6	5.8
B(k)F (ng/L)	2.0	<LQ	8.3	81.0	8.2
B(a)P (ng/L)	2.0	<LQ	13.0	163.9	20.8
D(a.h)A (ng/L)	2.0	<LQ	<LQ	36.7	4.5
benzo(ghi)P (ng/L)	2.0	<LQ	13.3	169.6	4.1
Indèno (ng/L)	4.0	<LQ	35.2	162.1	11.8
Coronene (ng/L)	2.0	<LQ	4.0	54.0	<LQ

It shows the presence of numerous PAHs including naphtalene and phenantrene, the most present, which typically indicates the combustion of hydrocarbon-based products. Specific attention should be paid to B(a)P as it is class 1 on the IARC scale (proven carcinogen). According to the potential ecotoxicological impact of those products, one should pay specific attention to the potential impact of runoff water.

3.2.3. Organic Carbonates

To complete the chemical characterization of the pollutants in the extinguishing waters, a selection of organic carbonates, classically used as electrolyte solvents or critical additives (VC, FEC), was quantified. Results are shown in Table 4.

Table 4. Analysis of 7 common carbonates used as electrolytes in the water before application and in the three samples after extinguishing. QL = quantification limit.

Species	**QL**	**Reference**	**Test 1 (Module A)**	**Test 2 (Module A)**	**Test 3 (Module B)**
DMC (µg/mL)	8.8	n/a	n/a	n/a	n/a
EMC (µg/mL)	8.3	n/a	138	59	n/a
VC (µg/mL)	9.4	n/a	n/a	n/a	n/a
DEC (µg/mL)	8.1	n/a	n/a	n/a	n/a
FEC (µg/mL)	10.2	n/a	n/a	n/a	n/a
EC (µg/mL)	7.7	n/a	1082	461	n/a
PC (µg/mL)	10	n/a	n/a	n/a	n/a

The presence of such compounds is found only in tests 1 and 2. This difference between the tests could be explained by the important combustion reaction observed during tests 3; it is most likely that the high temperature reached during this test led to the total evaporation and possible thermal decomposition of those volatile and easily flammable compounds before being dragged into the wastewaters. The boiling point for EC is typically 244 °C and 100 °C for EMC, which is significantly lower than the flame temperature. For the same reason, as the reaction in test 1 was less violent than in test 2, the quantity of carbonates found is higher for test 1 than for test 2. Species identified in the water are EMC and EC which are very commonly used as electrolyte solvents. Also, the boiling point difference might explain the difference between the quantity of EC and EMC found in the liquid phase, as EMC evaporates more easily. This also means that the massive use of water to cool down a whole system as a container could lead to a higher concentration of organic carbonates since part of the cells might, in such a case, be damaged but not burnt. Hydro solubility of those compounds may also play an important role (778 g/L for EC and 46.8 g/L at 20 °C for EMC) and explain the differences in the concentrations found. These compounds must be carefully monitored because they cannot easily be filtered out or left to settle.

3.2.4. Particle Size Analysis

To complete the chemical analysis of the water, particles sizes in the water were evaluated using the CPS method. Using Stokes' law, a hydrodynamic intensity-weighted particle-size distribution of diameters is obtained and transformed into a volume-weighted or number-weighted particle-size distribution, as presented in Figure 3.

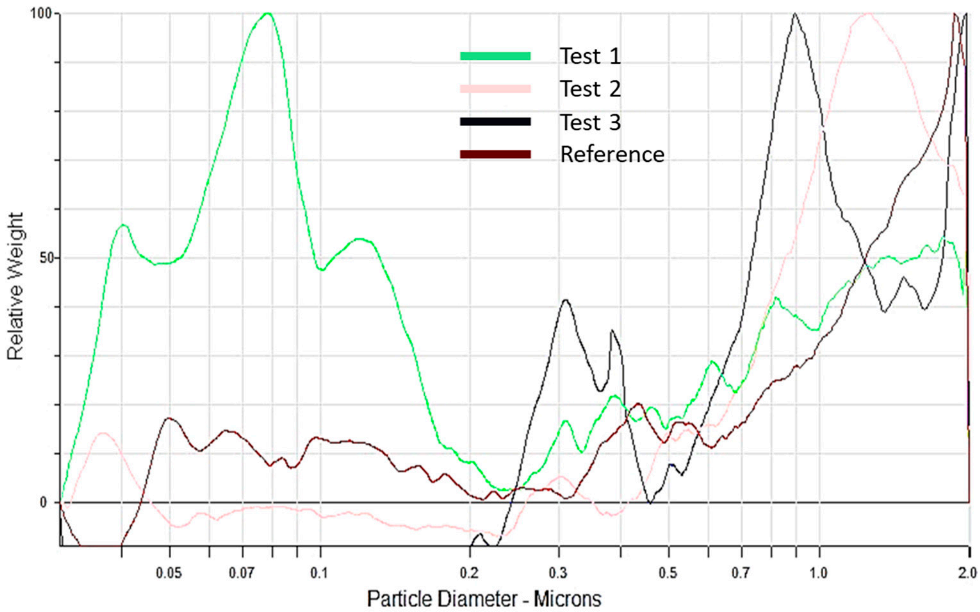

Figure 3. Number-weighted particle-size distribution of the particles presents in the water before application (reference) and in the three samples after extinguishing. Measurement was carried out by CPS.

This analysis leads to the conclusion that only extinguishing water from test 1 has a nanometric fraction, with particles around 70 nm in diameter. Other samples contain a majority of particles between 0.9 and 2 µm. This analysis confirms the possibility, mentioned in the literature [11], that extinguishing water might be loaded with nanoparticles, without being able to quantify them with the method used. Also, because nanoparticles are absent from tests where the reaction was the most developed, it can indicate that those particles might be dragged in the smoke plume before being dragged by water.

To get information on the nature of the nanometric particles in the extinguishing water of test 1, additional analysis by transmission electron microscopy were performed. Images are presented in Figure 4. Figure 4a shows a picture of a representative sample of what was observed over the entire grid. Several populations of particles of highly variable sizes are identified and presented on Figure 4b–d. The majority of particles are the finest and correspond to the smallest black dots in Figure 4a. According to Figure 4b, one can conclude that soot nanoparticles agglomerate and form nanostructured clusters. Spherical particles of intermediate size are then observed (Figure 4c) and are associated with tarballs, having a diameter around 100 nm. Finally, the largest particles (Figure 4d) have a characteristic size around one micron and are mainly metal particles, composed of iron and aluminum.

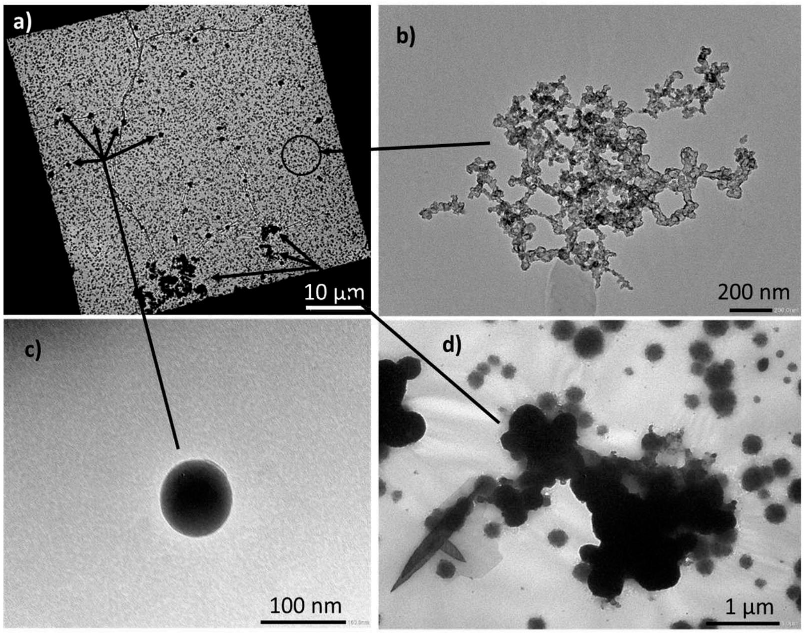

Figure 4. TEM analysis of the particles presents in the extinguished water of test 1. (**a**) Zoom-out of a representative area showing the relatives proportion of the three particles population encountered, (**b**) zoom-in of particles identified as soot agglomerate, (**c**) zoom-in of particles identified as tarballs and (**d**) zoom-in of particles identified as metallic.

Particles bellow 2.5 µm are inhalable and might pose a toxicological risk for humans [23]. In the case of this study, the particles are in water, making eco-toxicity the main risk identified. No size threshold is clearly defined in the literature nor in regulations. Some studies have nonetheless showed that particles with a size lower than 100 nm can enter the root system of higher plants and be translocated to aerial parts which demonstrate the possibility of trophic transfer [24]. In invertebrates (water flee), accumulation of several types of nanomaterials has been shown [25]. The interaction phenomenon between metallic oxide nano materials and freshwater micro-algae was also evidenced by Rivero et al. [26].

3.2.4.1. pH Measurement

Table 5 shows the pH measured in the sampled water immediately after each test.

Table 5. pH of the extinguishing water. (Expanded: k = 2) uncertainty of measurement is 1%.

	Test 1 (Module A)	**Test 2 (Module A)**	**Test 3 (Module B)**
pH	5.2	5.9	11

Depending on the test, the pH of extinguishing water is either acidic or basic. Values obtained in our tests would rate the corresponding water clearly outside recommended freshwater quality standards (6.5 < pH < 9) or limiting pH values for treatment in wastewater sewage systems (see Table 6).

Table 6. pH limit values in different local regulations.

pH Limit Values	Drinkable Water	Industrial Effluent Value for Discharge in Sewage Systems
EPA [27] (USA)	6.5 to 9	
Canada [28,29]	7 to 10.5	6–9
Switzerland [16,17]	6.8 to 8.2	6.5 to 9

Battery field failure incident reports as well as scarce pH values reported in the literature mostly report very basic contaminated water resulting from fire-fighting operations [16–18,30], although this is not always the case [31].

The basicity of the water is sometimes explained by the inner content of the cell that may contain soluble metal hydroxides. By contrast, the resulting acid fire water could be related to the interaction of the water with the acidic gases contained in the fire plume [31]. A difference in concentration in metallic species between the two tests might explain (see Table 2) the difference in pH observed. Depending on the environments in which the water will evolve (acidic or basic soils, etc.), it cannot be ruled out that these pHs are modified [32] before final pouring into aquatic ecosystems (surface of underground water resources).

4. Discussion

These tests were carried out at a small scale compared to what could occur, for example, in the event of an incident with a stationary storage container or storage warehouse. In such an event, the quantities of batteries involved, and the quantity of water used for extinction would be much higher. To estimate the orders of magnitude of water contamination values for a realistic situation (BESS container or storage warehouses), a simplistic extrapolation of the results obtained based on real incident data is proposed. In the Perles and Castelet (Ariège in France) battery stationary storage fire, which is well documented [33], and involving a stationary storage of 1500 kWh, the local authorities estimated that a volume of water of 180 m^3 was used by the firefighters, i.e., 0.12 L/Wh. This volume seems to be a good basis to extrapolate results as other feedback for other large-scale applications give similar values [34].

In the tests presented here, the volume of water used is coherent with other same-level studies [35] and, for test 1 on prismatic cells, 7 L were poured onto the 500 Wh battery (0.014 L/Wh) during test 2, and the total volume of water was 12 L (0.024 L/Wh). For the cylindrical cell, 3.9 L were poured onto the 900 Wh (0.01 L/Wh) battery. The values proposed in Table 7 correspond, for a selection of substances, to an extrapolation using a proportionality rule between the concentrations measured during the tests and the actual conditions reported during the Ariège incident (see Supplemental Material). This calculation also assumes that the normalized water flow rate (per watt-hour) does not significantly influence the mass transfer of pollutants in the run-off water.

In order to evaluate the potential environmental hazard of these wastewaters, the last column presents the "Predicted No-Effect Concentration"(PNEC) of the substance when available on the ECHA website [36]. Those values should be read with caution as they are given for a yearly average and are extracted from several sources, including industrial ones. The concentration in the wastewater was above PNEC values for all the substances studied when the data were available except for naphthalene, showing a potential environmental hazard. Two compounds show a particularly high hazardous potential: Co and EMC with concentrations, respectively, 2500 and 260 times greater than their PNEC. This means that, in a realistic scenario where two fire hoses are used to fight a fire using 1000 L/min, and the waste waters are flowing to a small river with a flow of 3 m^3/s, the concentrations of contaminants in the river are still above the PNEC for those compounds. It is also worth noting that some of the compounds' PNEC could not be found on the ECHA website but might be even more hazardous. For example, a PNEC as low as 0.0017 mg/L can be found for nickel [37] from sources other than ECHA. Another point to consider is the possible interaction between the contaminants. To assess this, the best method would be to test the particle mix directly. Few studies of this kind are available but, Yang et al. has recently shown [8] that particles from the NMC cell thermal runaway could cause inhibition of bacterial activities in the range of 25–200 mg/L and severe acute toxicity at 100 mg/L in 5 h [8] and Quant et al. showed the acute toxicity of the runoff water [19].

Table 7. Extrapolation of the experimental results to a real application and extinguishing. The last column presents the PNEC of the compound when available on ECHA website [36].

Substance	Test 1 (Module A)	Test 2 (Module A)	Test 3 (Module B)	PNEC Freshwater
Al (mg/L)	8.7	5.9	6.2	-
Co (mg/L)	0.05	2.6	0.6	0.00106
Cu (mg/L)	0.04	0.05	0.3	0.0063
Fe (mg/L)		Test 1 (module A)	Test 2 (module A)	Test 3 (module B)
Li (mg/L)	pH	5.2	5.9	11
Mn (mg/L)	0.1	3.4	0.5	0.034
Na (mg/L)	1.8	3.3	2.2	-
Ni (mg/L)	0.4	9.8	3.3	-
P (mg/L)	23.5	22.6	0.5	-
Fluorides (mg/L)	16.6	18.3	7.8	0.89
Chlorides (mg/L)	3.9	7.3	16.9	-
EMC (mg/L)	16.1	11.8	n/a	0.062
EC (mg/L)	126.2	92.2	n/a	5.9
Naphthalene (mg/L)	0.00015	0.00056	0.00026	0.0024

5. Conclusions

In the present work, the two battery modules were triggered in thermal runaway and subsequent degassing and fire. Water was applied to mock-up firefighting operations in order to analyze the composition of the extinguishing water.

The tests presented in this paper highlight that waters used for firefighting on NMC Li-ion batteries are susceptible to containing many metals, including Ni, Mn, Co, Li and Al. Those metals are mixed with other carbonaceous species (soots, tarballs). It is also important to note that particles present in the water can be nanometric or in the form of nanostructured clusters. In addition to the solid contaminants, liquid compounds can be present, especially organic carbonates coming from the electrolyte (EC and EMC in this case) and also gaseous species such as PAH. A comparison with PNEC values showed that this water could be potentially hazardous to the environment, depending on the actual situation encountered in the case of thermal runaway propagation with a Li-ion battery-based system.

These tests also make it possible to identify some trends concerning the reaction scenario. By comparing the two extinguishing operations on the prismatic cells, one can see that when the fire is developed, the water is much more concentrated in PAH and cathode metals (Ni, Mn, Co). On the other hand, the concentrations of elements coming from the liquid electrolyte (typically Li, P, F), more easily accessible, are present in equivalent quantities. Liquid organic carbonates are preferably found in the case of degassing without ignition. These low boiling point liquids are otherwise vaporized and found mainly in the gaseous phase. The comparison of the results between the prismatic cell module and the 18,650-cell module also confirms the importance of the cell and module geometry, influencing, in particular, the mechanical strength of the system and, therefore, the confinement of the inner materials.

As large Li-ion batteries are fast spreading (in so-called Battery Energy Storage Systems, BESS, for example), and only few data on the environmental impact of fires in those systems are available, it is crucial to further develop consolidated knowledge in this field. Several directions could be suggested for future tests like developing higher level (or full scale) testing to increase test representativity. Owing to field operational constraints in terms of emergency response following a fire, considering time between event initiation and water suppressant application as a parameter in futures studies also seems important. Other investigations worth being performed are, for instance, a detailed assessment of air, water and soil local impacts following Li-ion BESS significant incidents or in-depth environmental impact studies of key Li-ion substances like organic carbonate solvents (EC, EMC, etc.).

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/batteries10040118/s1.

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This article is more than **1 year old**

How solar farms took over the California desert: 'An oasis has become a dead sea'

Residents feel trapped and choked by dust, while experts warn environmental

damage is 'solving one problem by creating others'

By Oliver Wainwright in Desert Center, California

A boiler tower is surrounded by mirrors at the Ivanpah solar electric generating system in the Mojave Desert. Photograph: David McNew/Getty Images

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Deep in the Mojave desert, about halfway between Los Angeles and Phoenix, a sparkling blue sea shimmers on the horizon. Visible from the I-10 highway, amid the parched plains and sun-baked mountains, it is an improbable sight: a deep blue slick stretching for miles across the Chuckwalla Valley, forming an endless glistening mirror.

But something's not quite right. Closer up, the water's edge appears blocky and pixelated, with the look of a low-res computer rendering, while its surface is sculpted in orderly geometric ridges, like frozen waves.

"We had a guy pull in the other day towing a big boat," says Don Sneddon, a local resident. "He asked us how to get to the launch ramp to the lake. I don't think he realised he was looking at a lake of solar panels."

Solar panels in the Mojave desert, near Lake Tamarisk. Photograph: Oliver Wainwright/The Guardian

Over the last few years, this swathe of desert has been steadily carpeted with one of the world's largest concentrations of solar power plants, forming a sprawling photovoltaic sea. On the ground, the scale is almost incomprehensible. The Riverside East Solar Energy Zone - the ground zero of California's solar energy boom - stretches for 150,000 acres, making it 10 times the size of Manhattan.

It is a crucial component of the United States' green energy revolution. Solar makes up about 3% of the US electricity supply, but the Biden administration hopes it will reach 45% by 2050, primarily by building more huge plants like this across the country's flat, empty plains.

But there's one thing that the federal Bureau of Land Management (BLM) - the agency tasked with facilitating these projects on public land - doesn't seem to have fully taken into account: the desert isn't quite as empty as it thought. It might look like a barren wilderness, but this stretch of the Mojave is a rich and fragile habitat for endangered species and home to thousand-year-old carbon-capturing woodlands, ancient Indigenous cultural sites - and hundreds of people's homes.

Residents have watched ruefully for years as solar plants crept over the horizon, bringing noise and pollution that's eroding a way of life in their desert refuge.

"We feel like we've been sacrificed," says Mark Carrington, who, like Sneddon, lives in the Lake Tamarisk resort, a community for over-55s near Desert Center, which is increasingly surrounded by solar farms. "We're a senior community, and half of us now have breathing difficulties because of all the dust churned up by the construction. I moved here for the clean air, but some days I have to go outside wearing goggles. What was an oasis has become a little island in a dead solar sea."

Concerns have intensified following the recent news of a project, called Easley, that would see the panels come just 200 metres from their backyards. Residents claim that excessive water use by solar plants has contributed to the drying up of two local wells, while their property values have been hit hard, with several now struggling to sell their homes.

A large array of solar panels one hour north of Los Angeles in Kern county, near Mojave, California. Photograph: George Rose/Getty Images

“It has been psychologically gruelling,” says Teresa Pierce, who moved here six years ago. “From the constant pounding of the metal posts to the endless dust storms. I now have allergies that I’d never had before - my arms burn all day long and my nose is always running. I feel like a prisoner in my own home.”

Elizabeth Knowles, director of community engagement for Intersect Power, the company behind the Easley project, said it knew of residents’ concerns and was exploring how to move the project further from the community. “Since being made aware of their concerns, we have been in regular contact with residents to listen to their concerns and incorporate their feedback into our planning efforts.”

‘90% of the story is underground’

The mostly flat expanse south-east of Joshua Tree national park was originally identified as a prime site for industrial-scale solar power under the

Obama administration, which fast-tracked the first project, Desert Sunlight, in 2011. It was the largest solar plant in the world at the time of completion, in 2015, covering an area of almost 4,000 acres, and it opened the floodgates for more. Since then, 15 projects have been completed or are under construction, with momentous mythological names like Athos and Oberon. Ultimately, if built to full capacity, this shimmering patchwork quilt could generate 24 gigawatts, enough energy to power 7m homes.

But as the pace of construction has ramped up, so have voices questioning the cumulative impact of these projects on the desert's populations - both human and non-human.

Kevin Emmerich worked for the National Park Service for over 20 years before setting up Basin & Range Watch in 2008, a non-profit that campaigns to conserve desert life. He says solar plants create myriad environmental problems, including habitat destruction and "lethal death traps" for birds, which dive at the panels, mistaking them for water.

He says one project bulldozed 600 acres of designated critical habitat for the endangered desert tortoise, while populations of Mojave fringe-toed lizards and bighorn sheep have also been afflicted. "We're trying to solve one environmental problem by creating so many others."

Heliostats at the Ivanpah solar thermal power plant in the Mojave desert. Photograph: Ashley Cooper/Alamy

As the pace of construction has ramped up, so have voices questioning the cumulative impact of these projects on the desert's populations. Photograph: Oliver Wainwright/The Guardian

Such adverse impacts are supposed to be prevented by the desert renewable energy conservation plan (DRECP), which was approved in 2016 after years of consultation and covers almost 11m acres of California. But Emmerich and others think the process is flawed, allowing streamlined environmental reviews and continual amendments that they say trample conservationists’ concerns.

“The plan talks about the importance of making sure there’s enough room between the solar projects to preserve wildlife routes,” says Chris Clarke of the National Parks Conservation Association. “But the individual assessments for each project do not take into account the cumulative impact. The solar plants are blocking endangered species’ natural transport corridors across the desert.”

Much of the critical habitat in question is dry wash woodland, made up of “microphyll” shrubs and trees like palo verde, ironwood, catclaw and honey mesquite, which grow in a network of green veins across the desert. But, compared with old-growth forests of giant redwoods, or expanses of venerable Joshua trees, the significance of these small desert shrubs can be hard for the untrained eye to appreciate.


A Mojave desert tortoise under the desert sun. Photograph: Scott Trageser/Alamy

"When people look across the desert, they just see scrubby little plants that look dead half the time," says Robin Kobaly, a botanist who worked at the BLM for over 20 years as a wildlife biologist before founding the Summertree Institute, an environmental education non-profit. "But they are missing 90% of the story - which is underground."

Her book, The Desert Underground, features illustrated cross-sections that reveal the hidden universe of roots extended up to 150ft below the surface, supported by branching networks of fungal mycelium. "This is how we need to look at the desert," she says, turning a diagram from her book upside-down. "It's an underground forest - just as majestic and important as a giant redwood forest, but we can't see it."

The reason this root network is so valuable, she argues, because it operates as an enormous "carbon sink" where plants breathe in carbon dioxide at the surface and out underground, forming layers of sedimentary rock known as caliche. "If left undisturbed, the carbon can remain stored for thousands of years,'" she says.

Desert plants are some of the oldest carbon-capturers around: Mojave yuccas can be up to 2,500 years old, while the humble creosote bush can live for over 10,000 years. These plants also sequester carbon in the form of glomalin, a protein secreted around the fungal threads connected to the plants' roots, thought to store a third of the world's soil carbon. "By digging these plants up," says Kobaly, "we are removing the most efficient carbon sequestration units on the planet - and releasing millennia of stored carbon back into the atmosphere. Meanwhile, the solar panels we are replacing them with have a lifespan of around 25 years."

Mirrors sprawl across the desert at the Ivanpah solar electric generating system near Nipton, California. Photograph: David McNew/Getty Images

For Alfredo Acosta Figueroa, the unstoppable march of desert solar represents an existential threat of a different kind. As a descendant of the Chemehuevi and Yaqui nations, he has watched as what he says are numerous sacred Indigenous sites have been bulldozed.

"The history of the world is told by these sites," he says, "by geoglyphs, petroglyphs, and pictographs. Yet the government has chosen to ignore and push aside the creation story in the name of progress."

His organisation, La Cuna de Aztlan, acts as custodian of over 300 such sites in the Lower Colorado River Basin, many of which, he says, have already been damaged beyond repair. He claims that a 200ft-long geoglyph of Kokopelli, a flute-playing god, was destroyed by a new road to one of the solar plants, while an image of Cicimitl, an Aztec spirit said to guide souls to the afterlife, is also threatened. "The solar projects cannot destroy just one sacred site without destroying the sacredness of the entire area," he adds. "They are all connected."

He cites a 2010 report by the California Energy Commission, which includes testimony from the heritage experts Dr Elizabeth Bagwell and Beverly E Bastian stating that "more than 800 sites within the I-10 Corridor and 17,000 sites within the Southern California Desert Region will potentially be destroyed", and that "mitigation can reduce the impact of the destruction, but not to a less-than-significant level".

The Bureau of Land Management declined a request for an interview. In an emailed statement, its public affairs officer, Michelle Van Der Linden, did not directly address questions about solar plants' water use, health issues, or ecological and archeological impacts, but said the agency operated within the applicable laws and acts. "The DRECP effort was a multiple-year collaborative discussion resulting in an agreement reached between the BLM, numerous environmental groups, partners and stakeholders, in regards to the application and decision process related to renewable energy projects. Project issues were and continue to be identified and addressed through the National Environmental Policy Act process, which includes the opportunity for public engagement and input and also addresses many of the cumulative impacts and additional environmental, social and economic concerns mentioned."

'So many other places we should put solar'

Wild burros near the Ivanpah solar electric generating system. Photograph: David McNew/Getty Images

But a more fundamental question remains: why build in the desert, when thousands of acres of rooftops in urban areas lie empty across California?

"There are so many other places we should be putting solar," says Clarke, of the National Parks Conservation Association, from homes to warehouses to parking lots and industrial zones. He describes the current model of large-scale, centralised power generation, hundreds of miles from where the power is actually needed, as "a 20th-century business plan for a 21st-century problem".

"The conversion of intact wildlife habitat should be the absolute last resort, but it's become our first resort - just because it's the easy fix."

Vincent Battaglia, founder of Renova Energy, a rooftop solar company based in Palm Desert, agrees. "We've been led to believe that all solar is good solar," he says. "But it's not when it molests pristine land, requires hundreds of millions of dollars to transmit to city centres, and loses so much power along the way. It is simply preserving the monopoly of the big energy companies."

California recently reduced the incentive for homeowners to install rooftop solar panels after it slashed the amount that they can earn from feeding power back into the grid by about 75%. Forecasters suggest that, after doubling in size from 2020 to 2022, the market for residential solar installations is expected to decrease by nearly 40% by 2024 as a result.

Battaglia is optimistic that home energy storage is the answer. “Batteries are the future,” he says. “With solar panels on rooftops and batteries in homes, we’ll finally be able to cut the cord from the big utility companies. Soon, those fields of desert solar farms will be defunct - left as rusting relics of another age.”

Back in Lake Tamarisk, the residents are preparing for the long battle ahead. “They picked on a little town and thought they could wipe us out,” says Sneddon. “But they can’t just mow us over like they did the desert tortoises.

“They thought we were a bunch of uneducated redneck hicks living out here in the desert,” says Pierce. “We’re going to show them they were wrong.”

Most viewed

Solar Power in Your Community

A guide for local governments on how to increase access to and deployment of solar PV.

U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Types of Solar

There are four main types of photovoltaic solar deployment which local governments may consider in their planning. The types of solar are differentiated by their size and scale. Understanding the differences between the types of solar deployment can help local governments identify the scale of solar deployment that can best meet community needs. Although each category does not have a standard size, these definitions include the typical size range for each type.

- Residential solar: Also referred to as "rooftop solar", residential solar is a form of distributed energy with solar panels mounted on individual rooftops. Residential solar deployments can range in size from 3 kW–11 kW (Feldman et al. 2021).
- Commercial solar: Commercial solar is a larger form of distributed solar energy that encompasses rooftop and ground-mounted deployment. Commercial solar deployments can range in size from 100 kW–2 MW (Feldman et al. 2021).
- Community solar: Also referred to as "solar gardens" or "shared solar", community solar is another form of distributed energy where customers can buy or lease a portion of an off-site shared solar project. Community solar sites are typically <5 MW in size. See more information on community solar in Section 6.2.
- Utility-scale solar: Utility-scale solar deployments are ground-mounted systems that feed the generated electricity directly into the electric grid. Utility-scale solar deployments can range in size from 5–100 MW (Feldman et al. 2021).

The size estimates included here are not strict boundaries, and state or local laws may define solar deployment sizes differently. This guidebook focuses primarily on residential and community solar. Innovative applications of solar energy, like agrivoltaics or floatovoltaics, fall within these categories depending on the scale at which they are deployed. See Section 6.4 for more information on innovative solar deployment.

Low- and Moderate-Income Targets

Solar targets specific to LMI communities can help ensure more equitable solar deployment at the local level, but will require a clear definition of LMI in order to set goals. LMI-specific targets may also exist at the state level. For example, some states, such as Colorado and Oregon, have an LMI carve-out in their community solar policies that dedicates a certain percentage of community solar subscriptions to LMI households. Section 2.4 describes LMI-targeted financing options.

TIP

The following obstacles to LMI solar deployment should be considered when setting LMI-specific targets:

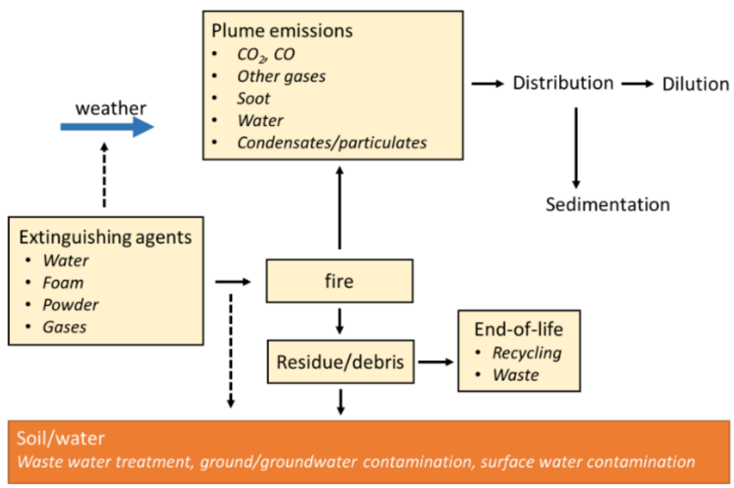
- Upfront installation costs and community solar subscription costs can be prohibitive for LMI households.

Environmental Impact of Li-ion BESS Incidents compared to other types of fires

Background

Most fires occurring in the built environment contribute to air contamination from the fire plume (whose deposition is likely to subsequently include land and water contamination), contamination from suppression water runoff containing toxic products, and other environmental discharges or releases from burned materials.

Incidents involving lithium-ion batteries are mostly focused on fires and the release of potentially toxic gases, which may pose toxicity concerns for first responders or the public. In addition to the exposure risk to first responders and spectators at, for example, a road traffic accident, there is also the broader spectrum of the environmental impact of such fires. In addition to heat, with fire or a toxic and potentially explosive vapor cloud, there is also a possibility of air transportation of substances and with time, their deposition in other, distant places.



The close surroundings are also affected by the fire debris, transportation of pollutants by fire extinguishing agents and release of remaining contamination from fire debris of burnt batteries. Following fire suppression activities, the run off into the water or soil may present concerns in terms of environmental impact. As the use and application of lithium-ion batteries continues to grow, questions remain as to how the environmental impact to air, soil and water from lithium ion battery fires compares to other common fires.

Research Goal

The overarching goal of this research program is to evaluate the environmental impact (to air, water, and soil) of a lithium-ion ESS fire (including runoff from suppression activities) compared to other common types of fires.

Research sponsored by

This project is generously sponsored by the members of the FPRF Energy Storage Research Consortium (ESRC), including: Energy Safety Response Group (ESRG), Fire & Risk Alliance, LLC, FM Global, General Motors (GM), Pacific Northwest National Laboratory (PNNL), Southern Company, Tesla, UL Research Institutes, and Wartsila Energy.

Environmental Impact of Li-ion BESS Incidents compared to other types of fires

Project Tasks

This research project, with technical oversight from the project technical panel, will involve the following tasks:

Task 1: Literature review

Task 1.1: Collect and analyze the relevant literature on the topic. The analysis should consider types of environmental impact, facility/fuel types, fire impacts, etc.

a) Generally characterize ESS systems. Where information is available, identify and characterize the material composition of the components of a BESS, including the batteries, coolants, insulation, electrical components, encasement materials, etc. that may contribute to the airborne emissions or ground contamination following fire suppression activities during a fire event.

b) Scenario identification: Identify a representative number of lithium-ion battery fire scenarios to characterize and evaluate the toxic gas emissions, pathways and environmental impact.

   i. Identify a representative number of lithium-ion battery fire scenarios to characterize and evaluate the toxic gas emissions, exposure pathways and environmental impact. Also identify relevant datasets or other data sources that consider emissions and particulates from li-ion battery cells with different chemistries, state of charge, different failure modes, etc.

   ii. Identify a representative number of other common fire scenarios (e.g., other products/fuels) to characterize and evaluate the toxic gas emissions, exposure pathways and environmental impact. Also identify relevant datasets or other data sources of emissions and particulates from other common fire scenarios fires

c) Identify, review and summarize available international literature and compile available test data on toxic gas products, concentrations, emissions and particulates to the ***Air*** (airborne contamination) and exposure pathways resulting from:

   i. Li-ion battery ESS fire scenarios selected in Task 1.1.C.(i)

   ii. Other types of fire scenarios selected in Task 1.1.C(ii)

d) Identify, review and summarize available international literature and compile available test data on toxic gas products, concentrations, emissions and particulates to **Soil and Water** (e.g., contamination from water-runoff) and exposure pathways resulting from:

   i. Suppressed Li-ion battery ESS fire scenarios selected in Task 1.1.C(i)

   ii. Other types of suppressed fire scenarios selected in Task 1.1.C(ii)

e) Summarize a list of toxic products and exposure pathways resulting from fire scenarios defined in Task 1.1(c) and clarify the similarities and differences between Li-ion ESS fires and other standard fire scenarios.

Task 1.2: Summarize all information gathered in Tasks 1.1 in an interim draft report. This summary report should address all the findings from Tasks 1.1, including the impact of different li-ion battery chemistries, battery capacities, and varying states of charge and states of health.

Task 2: Update Emissions Factors Database.

Using the data found in Task 1 and building on the database of emissions factors of building materials from the past FPRF "Environmental Impact of Fire in the Built Environment: Emissions Factors" project, add data on emissions from li-ion battery ESS fires to this existing database.

Environmental Impact of Li-ion BESS Incidents compared to other types of fires

Task 3: Gap Analysis and Research Plan

- Conduct an assessment of key gaps in information reviewed in Task 1, in consideration of an overall environmental impact assessment of li-ion battery ESS fires compared to other common fires. Specifically, identify key gaps in literature, data, and emission factors, at a minimum.
- Based on the identified gaps, develop a research plan to fill the knowledge gaps, including preliminary details for needed experimental testing.

Task 4: Develop a Final Report
Develop a draft final report, summarizing the findings from Tasks 1 – 3, and review with the technical panel. After incorporating panel feedback, submit a final report for publication.

Schedule and Implementation

This project is expected to be completed within 6-months of project initiation. This research project is led by the Fire Protection Research Foundation and will be conducted in accordance with the "Research Foundation Policies for the Conduct of Research Projects". The project will be guided by a Project Technical Panel who will provide input to the project, recommend contractor selection, review periodic reports of progress and research results.

RE Meeting to discuss solar in Santa Fe County (134) Done

From: Rebecca Halford [mailto:rebecca.halford@aes.com]
Sent: Monday, May 2, 2022 9:29 AM
To: Adeline Murthy <amurthy@santafecountynm.gov>
Subject: RE: Meeting to discuss solar in Santa Fe County

Warning:
EXTERNAL EMAIL: Do not click any links or open any attachments unless you trust the sender and know the content is safe.

Hi Adeline,

Here is a bit of information about the facility:

1. Rancho Viejo Solar – 96 MW solar facility, not for the community solar program. This is a utility-scale project in response to a previous PNM procurement event.
2. We have two 5 MW solar facilities in the desktop planning stages that are intended to participate in the community solar procurement event by PNM, later this year.
   a. These projects will be in the same area as the larger, Rancho Viejo project
   b. We do NOT have anchor tenants aligned with those projects yet
   c. AES will either promote participation into the facilities directly, or will rely on a local partner to facilitate the customers.
3. Permitting and interconnection status – Rancho Viejo Solar is still early in the development stages and the team is working with partners to complete environmental and site studies, which will determine the final details of the project. Once those studies are complete, the team will pursue permits and as a result will conduct broader Open House style community meetings.
4. The development team is meeting with the Rancho San Marcos HOA in advance of applying for permits and hosting a community meeting in an effort to inform and collaborate we are still planning the project. We want to be good neighbors and hear their questions, concerns, and requests and adjust our project planning where necessary.

If you are available to meet in-person with me and two members of the Development Team, please let me know if any time during May 16 – 18 works for you.

Thanks,
Rebecca

Rebecca Halford
Stakeholder Relations Manager, WECC
The AES Corporation
AES Clean Energy I Louisville, CO 80027
rebecca.halford@aes.com
Mobile: 303-204-9348

aes

From: Adeline Murthy <amurthy@santafecountynm.gov>
Sent: Monday, May 2, 2022 8:46 AM
To: Rebecca Halford <rebecca.halford@aes.com>
Subject: RE: Meeting to discuss solar in Santa Fe County

USE CAUTION: External Sender

Hello Rebecca,

Thank you for reaching out about this development. Could you please tell me a bit more about the purpose of the array? Is it utility-scale, for community solar, or some other purpose?

Thank you,

ADELINE MURTHY
Sustainability Specialist
Community Development

RE Meeting to discuss solar in Santa Fe County (134)

Done

Stakeholder Relations Manager, WECC
The AES Corporation
AES Clean Energy I Louisville, CO 80027
rebecca.halford@aes.com
Mobile: 303-204-9348

From: Adeline Murthy <amurthy@santafecountynm.gov>
Sent: Monday, May 2, 2022 8:46 AM
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Thank you,

ADELINE MURTHY
Sustainability Specialist
Community Development
505-992-9862

From: Rebecca Halford [mailto:rebecca.halford@aes.com]
Sent: Friday, April 29, 2022 5:27 PM
To: Adeline Murthy <amurthy@santafecountynm.gov>
Subject: Meeting to discuss solar in Santa Fe County

Warning:
EXTERNAL EMAIL: Do not click any links or open any attachments unless you trust the sender and know the content is safe.

Hello Adeline,
My name is Rebecca Halford and I'm reaching out to you in hopes of scheduling a meeting to discuss a solar facility that our team has in early development stages. The Project would be located in south Santa Fe County off of Hwy 14, a preliminary map is attached. A few of us from the project development team will be in Santa Fe during the week of May 16 to meet with the Rancho San Marcos HOA Board. While in town I was hoping to meet with you and any others on your team to discuss the project and to hear from you about your thoughts on solar development in the area and what the opinions and questions from the community might be. Would you be available to meet sometime May 16, 17 or 18?

Thank you,
Rebecca Halford

Rebecca Halford
Stakeholder Relations Manager, WECC
The AES Corporation
AES Clean Energy I Louisville, CO 80027
rebecca.halford@aes.com
Mobile: 303-204-9348

Safety of Lithium-Ion batteries

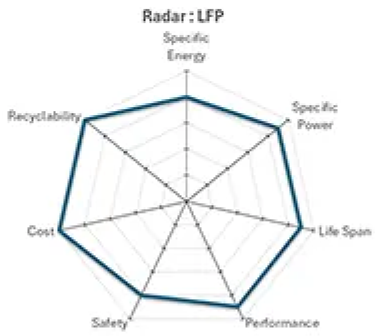
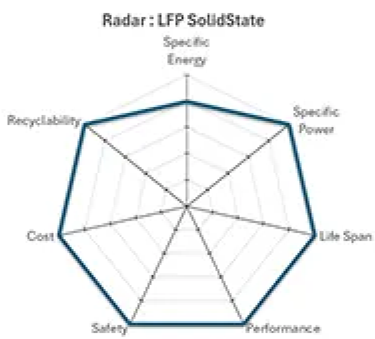
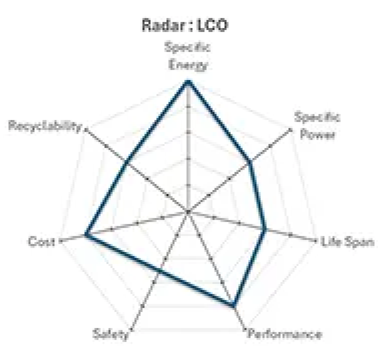
Lithium-Ion refers to a family of Lithium-based battery technology. This family includes several sub-families or technologies, such as:

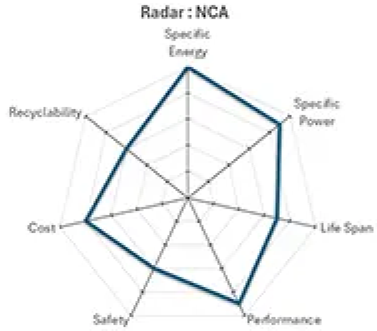
- LCO: Lithium Cobalt Oxide
- NCA: Nickel Cobalt Aluminium
- NMC: Nickel Manganese Cobalt
- LiFePO4 or LFP: Lithium Iron Phosphate
- LTO: Lithium Titanate Oxide, etc...

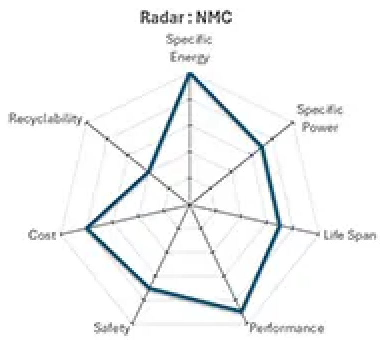
Often, we can hear that a product is equipped with **"Lithium-Ion" batteries**, this does not really have any meaning on the technology used. However, out of habit, the technology referred to as Lithium_Ion is usually **LCO, NCA or NMC**

Each of these technologies has **very different characteristics**, particularly in terms of **safety**, which can be found in the table below.

TECHNOLOGY	PROS / CONS	APPLICATION FIELD

Lithium Iron Phosphate (LFP-LiFePO4)  *LFP Radar*	• Excellent lifespan • High level of safety • Specific power • Abundant material : Iron + Phosphate • Good recyclability • Slightly lower specific energy than LCO, NMC and NCA	• Vehicle traction (EV) • high power applications • Renewable energy storage • Stationary batteries • UPS, back-up, etc.
Lithium Iron Phosphate Solid State  *LFP SolidState Radar*	• Excellent lifespan • Very low cell temperature rise during use • Extremely high level of safety • Full charge in 30 minutes • Very high power levels • Cost • Abundant material : Iron + Phosphate • Good recyclability • Slightly lower specific energy than LCO, NMC and NCA	• Vehicle traction (EV) et heavy duty traction • Marine propulsion • Robotics and AGV • High power applications • Renewable energy storage • UPS, back-up, etc.
Lithium-Cobalt-Oxyde (LCO)  *LCO Radar*	• Specific energy • Limited Lifespan • Dangerous chemistry if poorly controlled • Rare material : Cobalt • recyclability	• Low power application • Power tools
Lithium Nickel Cobalt Aluminium (NCA)	• Specific energy • Specific power • Cost • Dangerous chemistry if poorly controlled	• Embedded applications • EV • Power tools, etc.

<table>
<tr>
<td>

NCA Radar</td>
<td>Rare material : Cobalt / Nickel
recyclability</td>
<td></td>
</tr>
<tr>
<td>Lithium Nickel Manganese Cobalt (NMC)


NMC Radar</td>
<td>Specific energy
Limited Lifespan
Safety
Rare material : Cobalt + Manganese + Nickel
recyclability</td>
<td>Embedded applications
EV
Power tools, etc.
Powerwall (TESLA)</td>
</tr>
</table>

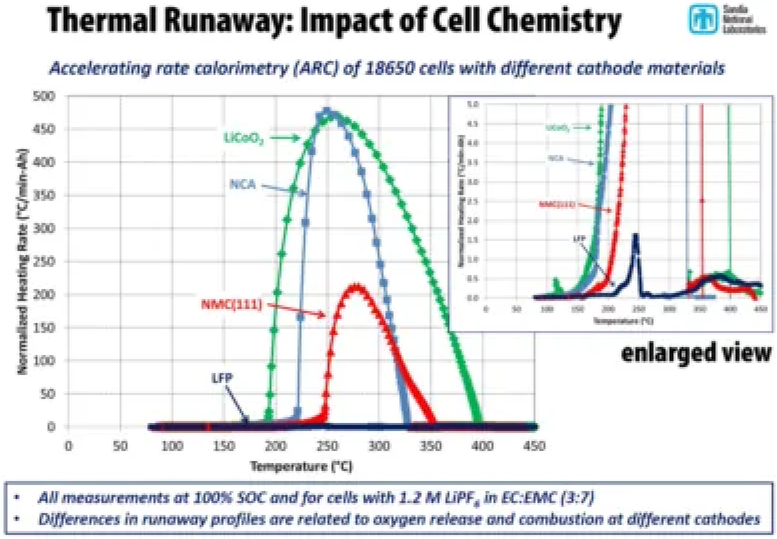
Thermal Runaway

One of the main causes of danger for lithium-ion cells is related to the phenomenon of thermal runaway. This is a heating reaction of the battery in use, caused by the nature of the materials used in the chemistry of the battery.

Thermal runaway is mainly caused by the solicitation of batteries under specific conditions, such as overload under adverse climatic conditions. The result of a thermal runaway of a cell depends on its level of charge and can lead in the worst case to an inflammation or even an explosion of the Lithium-Ion cell.

However, not all types of Lithium-Ion technology, due to their chemical composition, have the same sensitivity to this phenomenon.

The figure below shows the energy produced during an artificially induced thermal runaway



Thermal Runaway Lithium-Ion – Impact of cell chemistry

It can be seen that among the Lithium Ion technologies mentioned above, **LCO and NCA are the most dangerous chemicals** from a thermal runaway point of view with a temperature rise of about **470°C per minute**. The **NMC chemistry** emits about half the energy, with an increase of 200°C per minute, but this level of energy causes **in all cases the internal combustion of materials and the ignition of the cell**.

In addition, it can be seen that **LiFePO4 – LFP technology** is **slightly subject to thermal runaway** phenomena, with a temperature rise of barely **1.5°C per minute**.

With this very low level of energy released, the **thermal runaway** of the Lithium Iron Phosphate technology is **an inherently improbable event** in normal operation, and even very difficult to artificially trigger.

More recently, with the arrival of **LFP Solid-State technology**, the level of safety now exceeds all safety standards, with a **thermal runaway that is intrinsically impossible to trigger** in normal operation.

Combined with a BMS, Lithium Iron Phosphate (LifePO4 – LFP) is currently the most secure Lithium-Ion technology on the market.

Mecanical Safety of Lithium-Ion Cells

Like thermal runaway, Lithium-ion cells have a different level of safety depending on the shocks or mechanical treatments they may undergo during their lifetime.

The nail penetration test is the most revealing way to qualify level of safety of Lithium-Ion batteries.

The test presented below is performed by perforating a Lithium Ion NMC cell and a Lithium Ion LiFePO4 cell.

We find here the same extremely stable behavior of Lithium Iron Phosphate cells while the NMC cell ignites almost immediately.

For information, the LCO, NCA, or Lithium Polymer cells have a similar behavior to the NMC in a perforation test (immediate inflammation)

Stress Tests of Lithium Chemistries Lithium Polymer (LiPo) vs Lithium Titanate (LTO) vs Lithium Iron Phosphate (LFP) :

LEAD ACID BATTERY DOWNSIDES
LITHIUM-ION BATTERY ADVANTAGES
LITHIUM-ION VS LEAD-ACID BATTERY
LITHIUM-ION VS LEAD-ACID COST ANALYSIS
SAFETY OF LITHIUM-ION BATTERIES
LITHIUM IRON PHOSPHATE (LIFEPO4 - LFP)
THE SOLID-STATE LITHIUM BATTERY REVOLUTION
LITHIUM-ION STATE OF CHARGE (SOC) MEASUREMENT

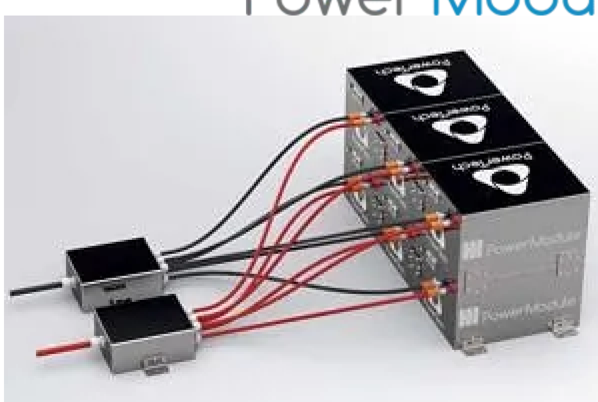
Drop-In AGM Replacement : PowerBrick®

Power Brick

Power Brick

Modular batteries for electric traction : PowerModule®

Power Module



MADE IN FRANCE

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100% electric (11) Ducasse sur Seine (2) Electric Marine (8) Exhibition (4) Fleet Management & Telemetry (3) Innovation (20) LiFePO4 (13) Lithium batteries for Robotics (3) Lithium Ion batteries system (11) Market and Key facts (5) PowerBrick (9) PowerModule (12) PowerRack (8) PowerTech Systems Company (5) Self-Consumption (3) SmartEnergies Fair (2) Speed week Bonneville (3) Technology - Engineering (21) utility grid (4)

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PowerTech is ISO-9001 certified

Français (French) English

The AES Story of why the Thermal Runaway System works and is safe:

Definition of Clean Agent - that it has no ozone depletion potential and evaporates quickly and doesn't mess up equipment. ***(Pretty limited scope of clean?)***

Novec 1230 does not burn; it is a fire extinguishing agent designed to suppress flames by removing heat from a fire, meaning it is specifically formulated to not combust itself. [1]

Key points about Novec 1230:

- Function: It works by rapidly vaporizing when released, effectively cooling the fire and extinguishing it.
- Clean agent: Considered a "clean agent" because it leaves no residue after extinguishing a fire, making it suitable for sensitive equipment.
- Environmental impact: Has a low global warming potential compared to older fire suppression agents.

AES stops the story here.

The rest of the story:

NOVEC 1230 decomposes at temperatures more than 500°C (932°F) and it is therefore important to avoid applications involving hazards where continuously hot surfaces are involved. Upon exposure to the flame, NOVEC 1230 will decompose to halogen acids.[2]

Key points about Novec 1230 decomposition:

- High temperature trigger: Decomposition primarily occurs at very high temperatures, exceeding 500°C.
- Fire exposure: When discharged onto a flame, Novec 1230 can decompose due to the intense heat.
- Decomposition products: The main concern is the creation of halogen acids as byproducts of decomposition.
- Rapid discharge importance: To minimize decomposition products, Novec 1230 should be discharged quickly to extinguish a fire rapidly.

Examples of halogen acids

- Hydrofluoric acid (HF): A weak acid that dissolves easily in water
- Hydrochloric acid (HCl): A halogen acid formed when halogen acid gases react with hydrogen
- Hydrobromic acid (HBr): A halogen acid formed when halogen acid gases react with hydrogen
- Hydroiodic acid (HI): The strongest halogen acid because iodine is the least electronegative halogen

This is possibly what happened at the latest Moss Landing Fire. It appeared the fire was being controlled by the Fire Suppression System. Reignition occurred with already hot surfaces, any subsequent Novec 1230 would then have decomposed as opposed to vaporize.

Hydrofluoric acid (HF) toxicity can cause severe burns, tissue damage, and organ failure, and can be fatal. The severity of the effects depends on the concentration of the acid, the duration and size of exposure, and the area of the body affected. [3]

HF (hydrogen fluoride) is not flammable; it is considered a non-flammable gas, meaning it will not burn under typical fire conditions. [4]

Key points about HF:

- Non-combustible: HF does not ignite easily and is classified as non-combustible.
- Corrosive hazard: While not flammable, HF is highly corrosive and can cause severe burns upon contact with skin.
- Potential for hazardous reactions: When exposed to certain metals, HF can generate flammable hydrogen gas.

One often used scenario suggesting limited ability to pollute is that any toxic components would be consumed in a fire. However, HF is not flammable.

Here is how HF combines with the external cooling spray and enters the environment as ground water pollution. HF condenses out of the flame plume when cooling water reduces the temperature of the plume to the point that the HF becomes a liquid.

HF (Hydrogen Fluoride) can be a liquid, specifically a colorless, fuming liquid at lower temperatures, while at higher temperatures it exists as a gas; it is considered a corrosive and highly hazardous substance. [5]

Key points about HF as a liquid:

- Hydrogen bonding: The ability of HF to form strong hydrogen bonds allows it to exist as a liquid at room temperature, unlike other hydrogen halides like HCl which are gases.
- Appearance: Liquid HF is clear and colorless with a strong, irritating odor.
- Temperature dependence: Below its boiling point, HF is a liquid, but above that point it becomes a gas.

Hydrogen Fluoride (HF) is lighter than air. While the gas itself is lighter than air, under certain conditions, a cloud of vapor or aerosol from HF can appear heavier than air due to its potential to form a heavier mist when released. [6]

Key points about HF and air density:

- Density comparison: HF has a lower density than air, meaning it will rise when released.
- Vapor formation: Although the gas is lighter, the vapors produced from HF can sometimes be heavier than air, creating a potentially hazardous situation.
- Important consideration: When handling HF, always take proper safety precautions due to its corrosive nature, even though it is lighter than air.

HF is combined with the water and water vapor of the cooling spray and becomes heavier than air and settles to the ground with the water or settles into lower regions of the area as combined with water vapor.

Sources:

[1] https://blog.koorsen.com/what-is-novec-1230#

[2] https://www.suppression.com/catalog/suppression/clean-agent-suppression/novec-1230/kidde-novec-fk-5-1-12#

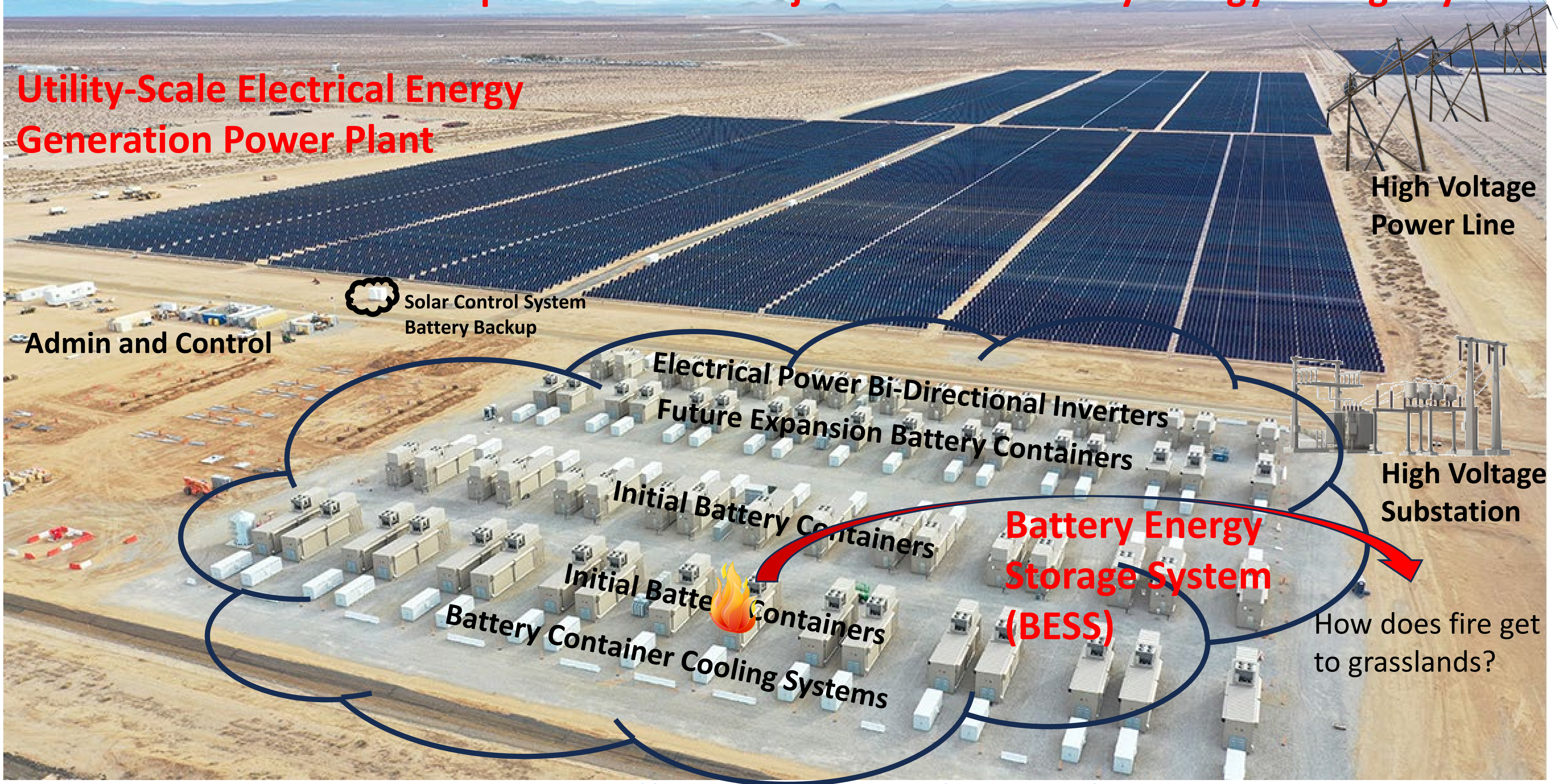
[3] https://www.ncbi.nlm.nih.gov/books/NBK441829/#

[4] https://cameochemicals.noaa.gov/chemical/2013#

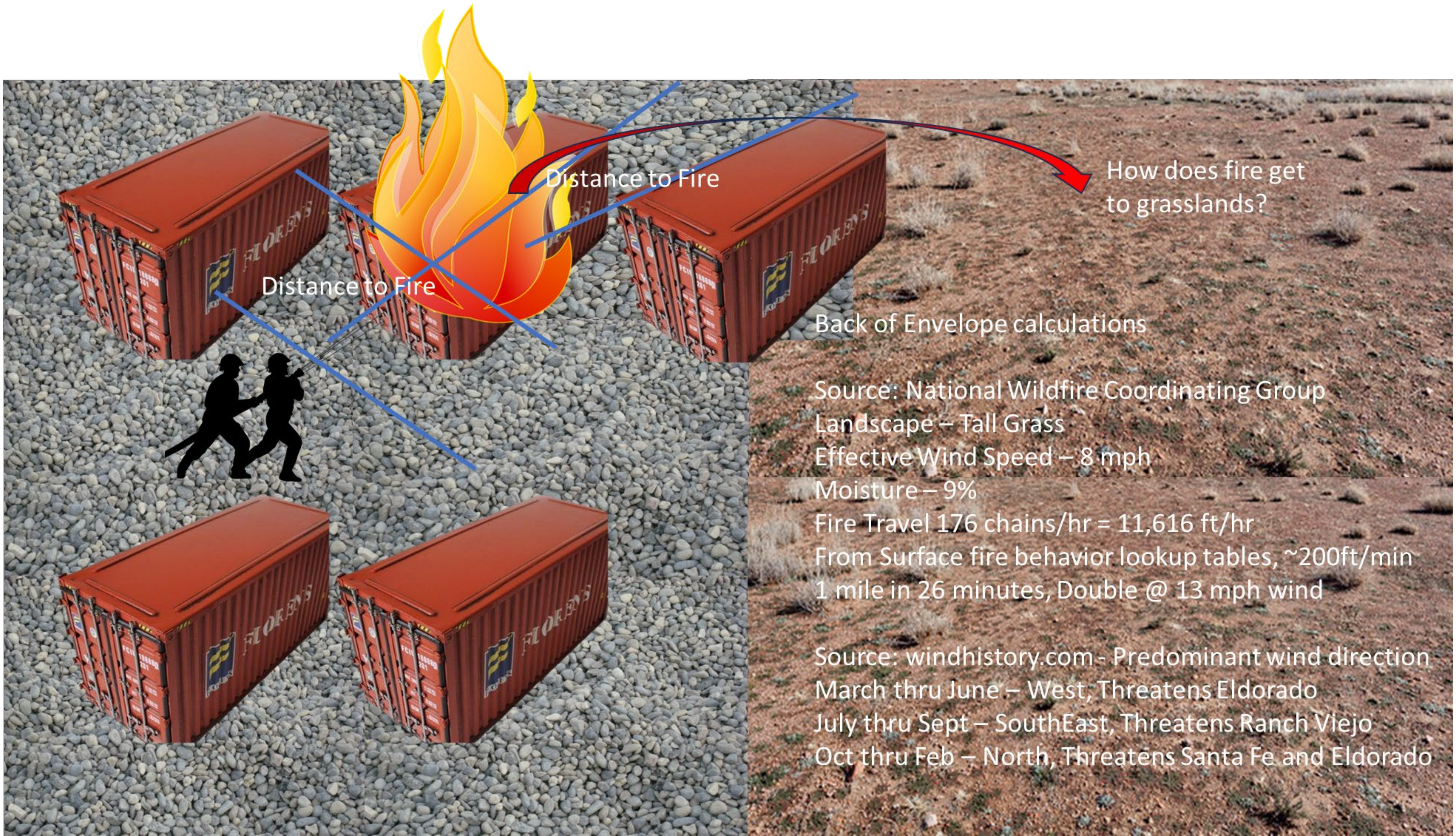
[5] https://www.cdc.gov/chemical-emergencies/chemical-fact-sheets/hydrogen-fluoride.html

[6] https://www.ivhhn.org/information/information-different-volcanic-gases/hydrogen-fluoride#

Simulated View of AES Proposed Rancho Viejo Solar and Battery Energy Storage System



Base Image Source: https://www.mortenson.com/newsroom/battery-energy-storage-solutions
Notations by Clean Energy Coalition for Santa Fe County: https://www.cleanenergycoalitionsfc.org


Distance to Fire
Distance to Fire
How does fire get to grasslands?
Back of Envelope calculations
Source: National Wildfire Coordinating Group
Landscape – Tall Grass
Effective Wind Speed – 8 mph
Moisture – 9%
Fire Travel 176 chains/hr = 11,616 ft/hr
From Surface fire behavior lookup tables, ~200ft/min
1 mile in 26 minutes, Double @ 13 mph wind
Source: windhistory.com - Predominant wind direction
March thru June – West, Threatens Eldorado
July thru Sept – SouthEast, Threatens Ranch Viejo
Oct thru Feb – North, Threatens Santa Fe and Eldorado

Fuel Model 3 (Tall Grass – 2.5 ft)

Surface Fire Behavior Lookup Tables (NWCG.GOV)

Fires in this fuel are the most intense of the grass group and display high rates of spread under the influence of wind. Wind may drive fire into the upper heights of the grass and across standing water. Stands are tall, averaging about 3 feet (1 m), but considerable variation may occur. Approximately 1/3 or more of the stand is considered dead or cured and maintains the fire. Wild or cultivated grains that have not been harvested can be considered similar to tall prairie and marshland grasses.

SPREAD Ch/hr		Effective Windspeed(EWS), mph *Use 20ft/FCST wind only if EWS = MFWS and assumes unsheltered wind adjustment (0.4)												
*20ft/FCST		NWNS/0	Back - ½	Flank - 1	5	10	15	20	25	30	35	40	45	50
EWS					2	4	6	8	10	12	14	16	18	20
1-hr Moisture, %	1	8	18	32	68	157	261	377	502	636	776	923	1076	1234
	3	6	14	25	52	121	201	290	387	490	598	712	829	951
	5	5	11	20	42	97	162	234	312	395	482	574	669	767
	7	4	9	17	36	82	137	198	264	335	409	486	566	650
	9	4	8	15	32	73	122	176	234	296	362	430	501	575
	11	3	8	14	29	67	111	161	214	271	331	393	458	526
	13	3	7	13	27	62	103	149	198	251	306	364	425	487
	15	3	6	12	25	57	95	137	182	231	282	335	391	448
	17	3	6	10	22	51	85	122	163	207	252	300	350	401
	19	2	5	9	19	43	71	103	137	174	212	253	294	338
	21	2	4	7	14	32	53	77	103	130	159	189	194	194
	23	1	2	4	8	18	30	43	54	54	54	54	54	54

Low	*Moderate*	<u>High</u>	Very High	Extreme


View from 53 Camerada Rd. showing general wildfire fuel potential. Grass and shrubs, a mix of short and tall grasses depending on seasonal conditions.
KOP 1: View from Camerada Road looking west - Simulated Condition

2017-03-28

Vehicle Fires Resulting from Hot Surface Ignition of Grass and Leaves 2017-01-1354

One potential fire ignition source in a motor vehicle is the hot surfaces on the engine exhaust system. These hot surfaces can come into contact with combustible and flammable liquids (such as engine oil, transmission fluid, brake fluid, gasoline, or Diesel fuel) due to a fluid leak, or during a vehicle collision. If the surface temperature is higher than the hot surface ignition temperature of the combustible or flammable liquid in a given geometry, a fire can potentially ignite and propagate. In addition to automotive fluids, another potential fuel in post-collision vehicle fires is grass, leaves, or other vegetation. Studies of hot surface ignition of dried vegetation have found that ignition depends on the type of vegetation, surface temperature, duration of contact, and ambient conditions such as temperature and wind speed. Ignition can occur at surface temperatures as low as 300 °C, if the vegetation is in contact with the surface for 10 minutes or longer. At surface temperatures of 400 °C, ignition can occur in 3 minutes, and at surface temperatures of 500 °C, ignition can occur in a few seconds. We made measurements of the surface temperature at various locations along the exhaust system of a passenger vehicle, including on the catalytic converter, under different transient conditions. The temperatures were measured using thermocouples welded to the exhaust system. The tests show that the maximum external surfaces temperatures occur under transient conditions after the vehicle comes to a sudden stop. Thus, testing that only measures steady-state temperatures or temperatures while the vehicle is moving will not necessarily capture the worst-case temperatures. For the vehicle tested, exhaust system components can reach temperatures of 400 °C and these temperatures can be sustained for minutes after the vehicle stops, and thus are capable of igniting dried vegetation.

Hiller Report, page 4/5 states Theoretical complete fire engagement of enclosure would result in external wall temperature of approximately 1241-degree C. This represents an external distance to grass fuel of 0 feet. With a design basis wind of 9 mph, the surface temperature of a first responder at 6.5 feet would intermittently be 1110-degree C. A reasonable assumption is that the decrease in resulting surface temperature would be proportional to the gradient of the Heat Flux. The Heat Flux gradient can be plotted from the data in the Hiller Report, page 34, Table 2. Once the data is plotted the gradient plot is used to plot a similar linear gradient for temperature over distance. The estimated intermittent temperature at 30 feet from the radiating enclosure is on the order of 500-degree C or less.

Distance (feet)	Heat Flux (Kw/m2)	Temperature
0		1241
6.5	1148	1110
10	939	
20	589	
30	348	500
40	235	
50	170	

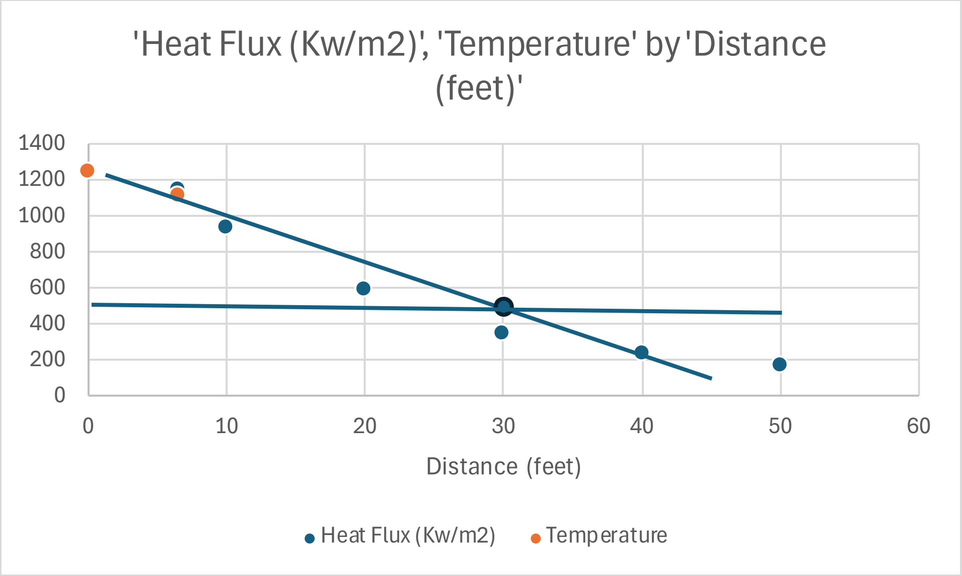


Table 2: Theoretical Momentary Heat Flux as a Function of Distance

Distance	Momentary Maximum Theoretical Heat Flux (kW/m^2)
10’	939
20’	589
30’	348
40’	235
50’	170
60’	127
70’	98
80’	77
90’	62
100’	51

The estimated intermittent temperature at 30 feet can be combined with the SAE Technical Paper estimations for dry grass ignition. Even if you apply a large confidence interval on the intermittent temperature below 500-degree C. It can be established that at 30 feet, dry grass could ignite from the radiated energy of an enclosure fire engagement in the range of 5 – 8 minutes.

SEARCHLIGHT NEW MEXICO
INDEPENDENT INVESTIGATIVE JOURNALISM

Jose Villegas, a National Guard chaplain, was one of the first in La Cieneguilla to find out his well water was contaminated with PFAS. Credit: Nadav Soroker/Searchlight New Mexico

When PFAS hits home: Poisoned wells in La Cieneguilla

Unable to drink their water, residents want action — and answers from the New Mexico National Guard.

by **Ed Williams**
February 15, 2024

During the decades that he's lived in his home southwest of Santa Fe, Jose Villegas was oblivious to the toxic chemicals that were seeping through the aquifer, slowly spreading under his house in the historic village of La Cieneguilla and into the well that supplied his family with drinking water.

His neighbors were also drinking the well water, unaware that the New Mexico National Guard had discovered **more than a year earlier** that the groundwater and soil on its site by the Santa Fe airport were contaminated with PFAS, a class of chemicals linked to cancer and other illnesses — and present in everything from household products to firefighting foams at military sites.

That changed in August 2023, when a groundwater specialist with Santa Fe County knocked on Villegas's door and asked if he would allow his water to be tested. The results came back at 14 parts per trillion (ppt), nearly four times higher than a proposed federal safety standard to protect human health. Blood tests would later confirm that the chemicals were in his body at high levels.

"I thought this water was pure and clean," Villegas said, adding that his family had potentially been drinking contaminated water for years. "Now I got this PFAS, this firefighting foam, in my *sangre,* in my blood. I have a right to be upset, right? I'm 65, I'm supposed to be going on my golden years. And then I have to deal with this shit?

"They need to declare an emergency over here, because nobody can use their wells," he said.

As a chaplain in the National Guard, Villegas is quite familiar with the facility that he and others in the community feel is primarily responsible for the water contamination: the National Guard's Army Aviation Support Facility on the Santa Fe airport property some 2.5 miles to the north, where firefighting foams were stored and potentially used for training until the early 2000s, according to the National Guard.

Jose Villegas, an official with the Texas Band of Yaqui Indians, stands by his garden in La Cieneguilla, where he used to grow vegetables and share them with his neighbors. He can no longer grow food there because of PFAS contamination in his well water. Credit: Nadav Soroker/Searchlight New Mexico

Villegas knew the foams were on-site — but nobody had told him that the chemicals had spread into the groundwater, or that those chemicals could put his family's drinking water at risk and contaminate his neighbors' water as well.

"They know me," Villegas said of the National Guard. "I thought they would have the courtesy to tell me that our water might have a problem. I've heard nada from them — they haven't so much as offered me a glass of clean water to drink."

News of the water contamination has rocked La Cieneguilla, a small village sandwiched between the Santa Fe Airport and the neighborhood of La Cienega.

But it is only the most recent community to find itself at **the frontlines** of a national crisis: Across the country, thousands of private wells near **military sites**, **factories** and **airports** have become contaminated with PFAS at levels higher than what federal regulators and medical experts consider safe for drinking.

While there have been major efforts to address the problem, any real action to clean up PFAS contamination can take years, or even decades.

The situation can be particularly dire for private well owners, who are largely responsible for their own water quality. In New Mexico alone, an estimated **270,000 people** rely on water from a private well. They have little recourse if PFAS or other contaminants are discovered in their water. Lawsuits can be filed and the responsible party might eventually agree to a cleanup. But action is rarely swift.

A

Santa Fe County map

of the wells it tested for PFAS, one of many documents that Villegas has been collecting. Credit: Nadav Soroker/Searchlight New Mexico

“Something that tends to get lost is just how long these processes take and how many people continue to be exposed in the meantime,” said Jared Hayes, senior policy analyst at the Environmental Working Group, a nonprofit that tracks PFAS issues. “There are still going to be people drinking contaminated water for years to come.”

Another blow for a historic community

For La Cieneguilla, the contamination is like salt on old wounds. “The fact is, this is an old traditional community, right next to tribal land, and many of the residents have historic roots,” said Camilla Bustamante, the Santa Fe County Commissioner for the district. “There has been a lot of encroachment and lack of consideration on the development and impacts to that village. It’s an issue of environmental justice.”

The construction of the airport and National Guard facility on La Cieneguilla’s northern flank, as well as the installation of the Santa Fe wastewater treatment plant and other upstream projects, have all been completed without input from the community, she said, even though each has the potential to impact residents’ health.

The discovery of the PFAS contamination — and a perceived lack of communication by the National Guard and other authorities — has added to the gut punch, residents say.

Vioma Trujillo, at her home in La Cieneguilla, offers a prayer to a deceased friend who was an environmentalist. Trujillo, also an advocate for the environment and water rights, believes the PFAS problem is one more sign of government neglect. Credit: Nadav Soroker/Searchlight New Mexico

"It's an environmental catastrophe," said Vioma Trujillo, who has lived in La Cieneguilla since 1979. She's hoping the county will test her well for PFAS, saving her the hundreds of dollars it would cost out of pocket. In the meantime, she's drinking bottled water. "The government has never respected this land grant," she said, referring to the land rights granted by Spain and Mexico and **acknowledged by the U.S. government** in the 1848 Treaty of Guadalupe Hidalgo.

"We have our water rights. We respect the water, and now this. It's so painful."

Levels eight times too high

After testing Villegas's water, Santa Fe County tested an additional five private wells in the vicinity; in addition, several neighbors forked up the money for private testing. In all, concerning levels of PFAS appeared in at least 10 wells. In one instance, tests revealed the chemicals at 32 ppt — eight times the EPA's recommended drinking water limit of 4 ppt. (PFAS chemicals have also been detected at two wells in the nearby La Cienega neighborhood, but at much lower levels.)

Pablo C de Vaca points to the new well his daughter built at her home in La Cieneguilla. PFAS was discovered in the water shortly afterward. Credit: Nadav Soroker/Searchlight New Mexico

"There are kids who are drinking this water, and elderly people," said Pablo C de Vaca. His daughter, he said, recently bought a house in La Cieneguilla and paid $20,000 to install a new well, only to hear the news that the water was contaminated. "She doesn't think she could sell the house now if she wanted to," he said.

"There's been no communication" about the contamination from authorities — "we don't know what's going on," C de Vaca added.

C de Vaca's daughter hired a company to install a well-water filter system, which costs upwards of $2,000. Other neighbors have done the same, sometimes using their social security checks to cover the costs. Many residents are drinking bottled water, another expense. Some, like Jose Villegas and his wife, have stopped using their taps entirely, fearful of even bathing in the contaminated water. Villegas called one military remediation contractor to ask what it would cost to completely clean up his property. The answer: $700,000.

‘Forever chemicals’ everywhere

Since their invention in the late 1930’s, PFAS has become ubiquitous in the environment. Often called “forever chemicals” because they don’t break down in water, soil, animals or the human body, PFAS (per- and polyfluorinated alkyl substances) are present in myriad products, from nonstick cookware and stain-resistant carpeting to furniture, food packaging, outdoor gear, and **dental floss**. Most notably, the chemicals have been used at military installations in the form of Aqueous Film Forming Foams, or AFFFs, a highly effective firefighting product.

The foams were used for decades to extinguish jet fuel fires or for training exercises and were stored at military bases throughout the country — including at the National Guard facility near La Cieneguilla.

PFAS-laden foams have also seeped into the groundwater at more than **700 other military sites** around the country, according to the Environmental Working Group. That includes Cannon Air Force Base in Clovis, where dairy farmer Art Schaap had to **euthanize his entire herd** of more than 3,000 cows because they drank the water. Farmers in the area have been forced to spend hundreds of thousands of dollars on water filtration systems. Kirtland Air Force Base in Albuquerque has also detected the chemicals, as has Holloman Air Force Base near Alamogordo, where a nearby lake was found to have PFAS measuring more than **84,000 times higher** than health advisory levels.

Art Schaap looking over some of his Holstein cows at the Highland Dairy in Clovis. “This has poisoned everything I’ve worked for and everything I care about,” he said. Credit: Don J. Usner/Searchlight New Mexico

As early as **the 1960s**, studies showed that the substances could potentially be harmful to humans. Over the last 40 years, a mountain of research has revealed that PFAS is linked to numerous environmental and human health problems, including **increased risks** of cancers, liver damage, thyroid problems, kidney disease, reproductive harm and other issues.

Nevertheless, it took the EPA until 2023 to announce the first proposed legally enforceable federal standard for certain PFAS chemicals in drinking water, setting the limit — which has not yet been finalized — at 4 ppt. Crucially, the new rule would force industries to meet the limit or risk enforcement action. The EPA’s previous health guideline for drinking water set a suggested limit of 70 ppt, a level that has long been considered far too high.

A winning petition from New Mexico

There has been additional progress in the battle against PFAS exposure, especially at the state level. In December 2018, New Mexico added three types of PFAS to its list of toxic pollutants, a move that allows state regulators to require cleanups from polluters who contaminate the groundwater.

Another key regulatory move was a step the U.S. Environmental Protection Agency took this month to classify certain types of PFAS as hazardous waste — an action taken in response to a **petition** Gov. Michelle Lujan Grisham sent to the agency in 2021. This regulation will help states prevent and compel cleanups of future PFAS pollution.

But as it stands today, the process of initiating a cleanup can be excruciatingly slow. That's due in no small part to the ubiquity of PFAS in the environment: The first step in any cleanup is to identify the responsible party, but when it comes to PFAS there can be many contributors.

An entrance to the Army Aviation Support Facility in Santa Fe, where PFAS was discovered. Credit: Nadav Soroker/Searchlight New Mexico

The National Guard highlighted this in its 2023 study of PFAS found on its facility near La Cieneguilla. The report showed that groundwater under the site was flowing toward homes in La Cieneguilla and La Cienega. But the National Guard claimed that the Santa Fe Airport and neighboring municipal wastewater treatment plant potentially contributed to the contamination.

The National Guard said it plans to undertake a "remedial investigation" to define the nature and extent of the contamination and evaluate risks to human health and the environment. That process can take "several years to complete," New Mexico National Guard spokesman Hank Minitrez **stated in an email**.

In the past, in cases that didn't involve PFAS, the New Mexico Environment Department has used its legal authority to go after groundwater polluters without waiting for them to complete their own study. But in this case, the agency is holding off until the National Guard provides more information.

"At the appropriate time, we will take the appropriate action," said John Rhoderick, director of NMED's Water Protection Division. Rhoderick said the state is hoping the responsible parties will clean up the contamination voluntarily — otherwise, the process could get tied up in court, which could drag things out even further.

"I know people don't want to spend the money to pay for a filter on their home and the ongoing costs for something they didn't do," Rhoderick said. "But the reality is this: Even if we had a clear-cut responsible party and we began to move forward on everything, it would be a significant period of time before anything began to happen on those private wells, *if* anything."

The pace has infuriated residents of La Cieneguilla.

There might not be a legal obligation to inform neighbors under current law, Jared Hayes of the Environmental Working Group said of the situation. But there is "an ethical one."

"They really ought to be getting help for those surrounding communities," he said.

Pingback:
A Campaign For Water - IndieNewsNow

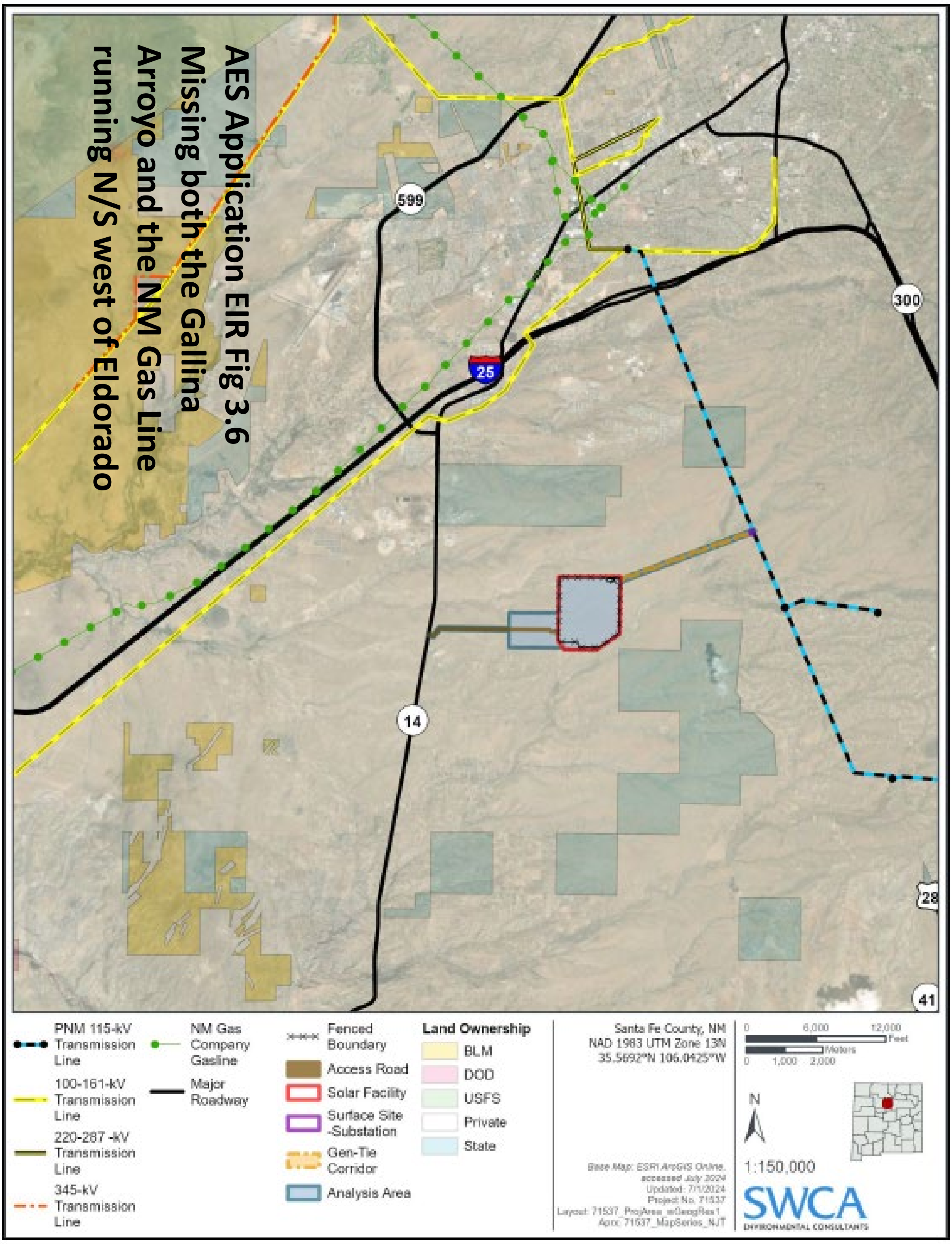
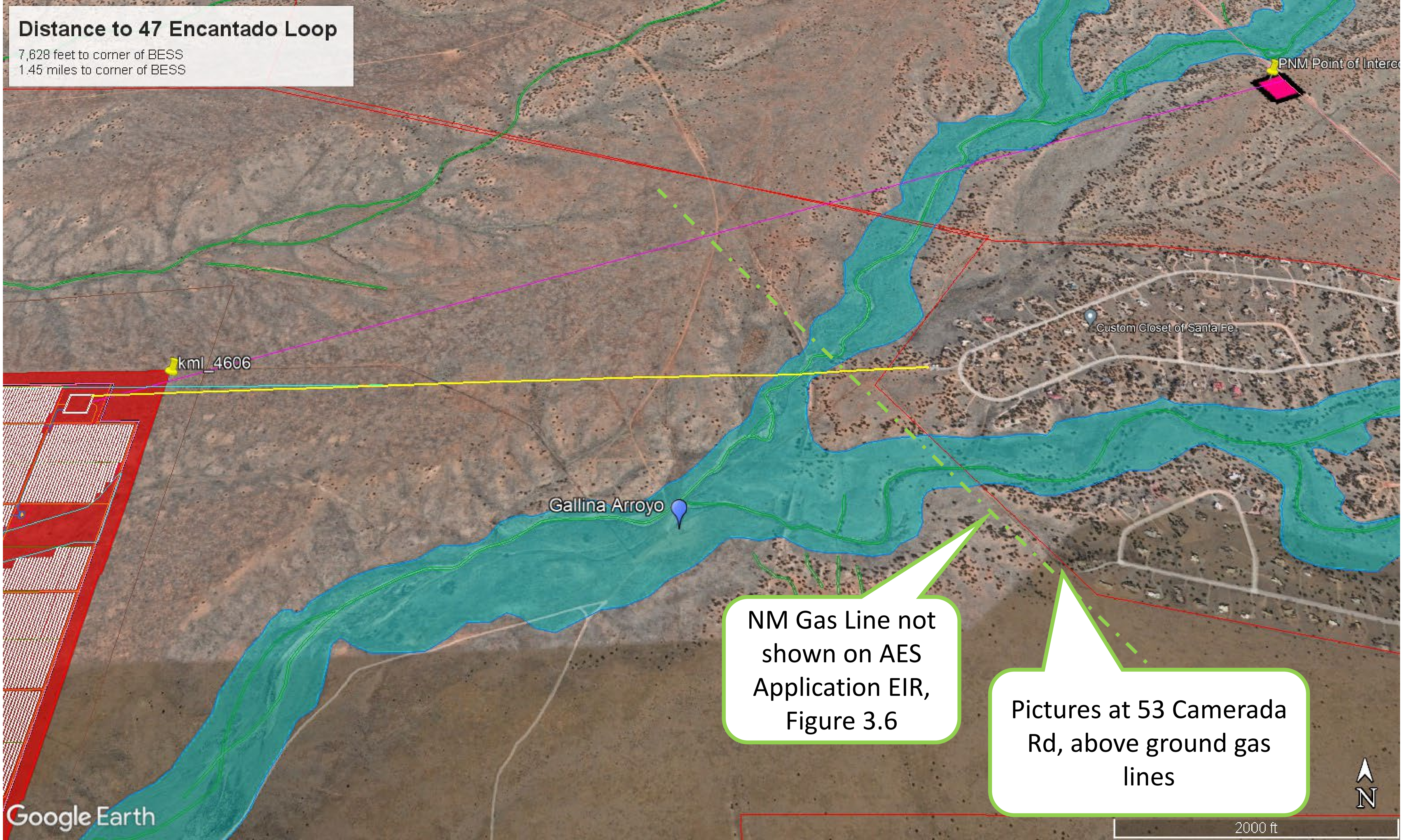
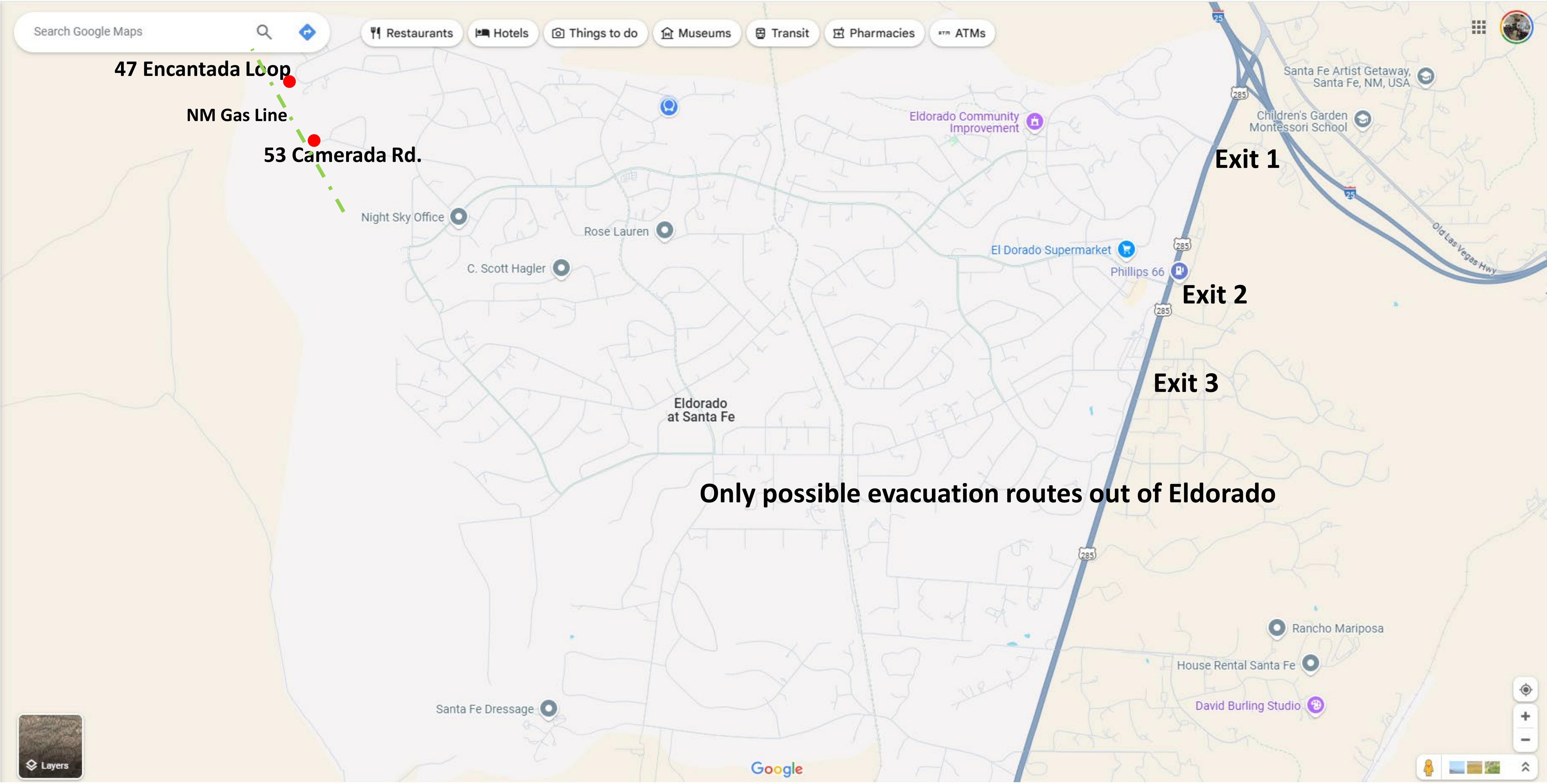


Figure 3.6. Analysis area and surrounding land uses.


Distance to 47 Encantado Loop
7,628 feet to corner of BESS
1.45 miles to corner of BESS
PNM Point of Interc
Custom Closet of Santa Fe
kml_4606
Gallina Arroyo
NM Gas Line not shown on AES Application EIR, Figure 3.6
Pictures at 53 Camerada Rd, above ground gas lines
Google Earth
N
2000 ft

NM Gas Line not shown on AES Application EIR, Figure 3.6


View from 53 Camerada Rd. showing general wildfire fuel potential. Grass and shrubs, a mix of short and tall grasses depending on seasonal conditions.
KOP 1: View from Camerada Road looking west - Simulated Condition


Search Google Maps
Restaurants
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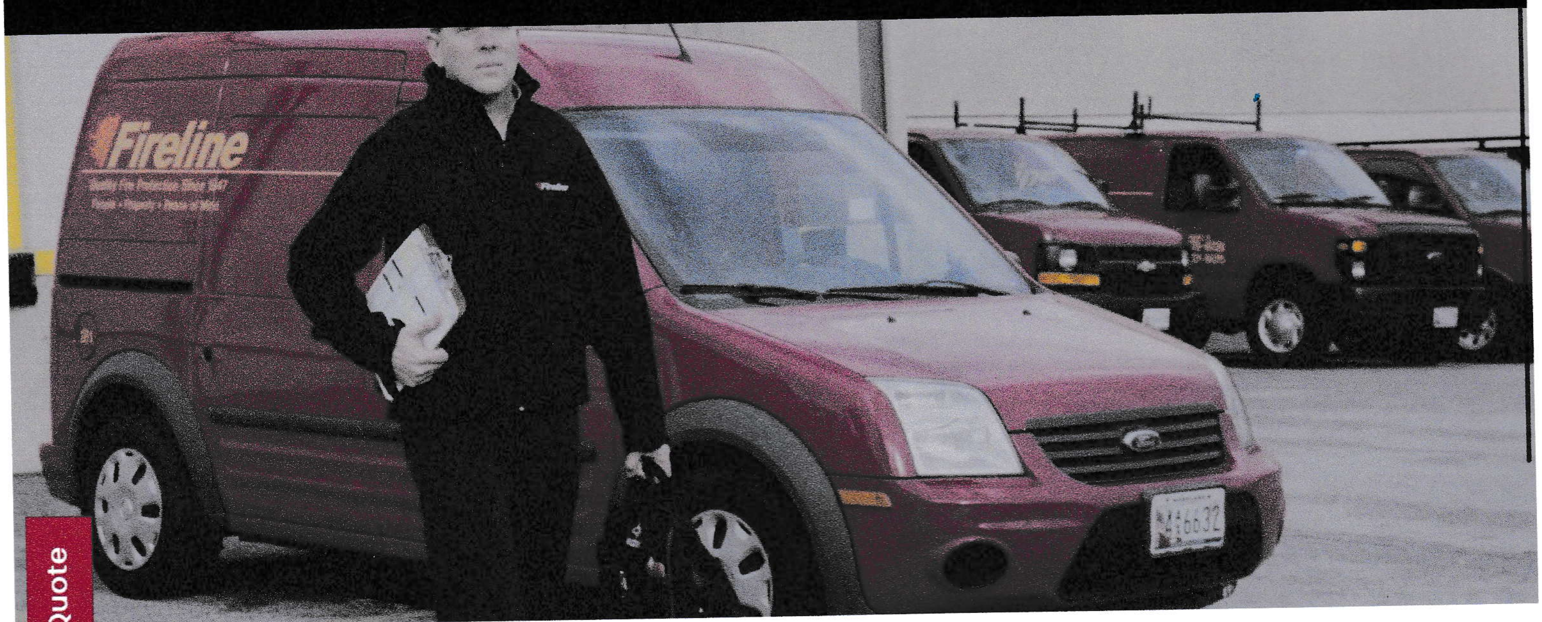
Things to do
Museums
Transit
Pharmacies
ATMs
47 Encantada Loop
NM Gas Line
53 Camerada Rd.
Night Sky Office
Rose Lauren
C. Scott Hagler
Eldorado Community Improvement
El Dorado Supermarket
Phillips 66
Santa Fe Artist Getaway, Santa Fe, NM, USA
Children's Garden Montessori School
Old Las Vegas Hwy
Exit 1
Exit 2
Exit 3
Eldorado at Santa Fe
Only possible evacuation routes out of Eldorado
Rancho Mariposa
House Rental Santa Fe
David Burling Studio
Santa Fe Dressage
Layers
Google



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low PFAS is Affecting the Fire Suppression Industry

February 9, 2023

The discontinuation of 3M Novec 1230 as a special hazard fire suppression agent due to PFAS brings more struggles to the special hazard fire suppression industry.

The hot topic in the fire suppression industry, as well as several others, is the shift away from PFAS chemicals. In particular, the use of PFAS chemicals in special hazards fire suppression systems will no longer be an option. 3M, a major multinational chemical manufacturer, announced that it would stop producing Novec 1230 by the end of 2025. Novec 1230 is a popular "clean agent" fire suppression chemical, often used in mission-critical facilities where water damage by water sprinkler systems would create catastrophic problems. With an extreme amount of litigation (3,287 lawsuits between January 2020 and December. 2021, according to Bloomberg Law), 3M announced the discontinuation of all products that include these chemicals. However, this move has the industry wondering – what comes next?

What is PFAS?

the discontinuation of all products that include these chemicals. However, this move has the industry wondering – what comes next?

more struggles to the special hazard fire suppression industry.

What is PFAS?

PFAS stands for Perfluoroalkyl and Polyfluoroalkyl Substances. As explained by the National Institute of Environmental Health Sciences (NIEHS), PFAS molecules have a chain of linked carbon and fluorine atoms. These create very strong carbon-fluorine bonds that take a long time to degrade. Due to this, they're commonly referred to as "forever chemicals." PFAS chemicals have been associated with a wide variety of serious health issues, including cancer.

The fact that these chemicals fail to degrade for an unknown amount of time, agencies such as NIEHS are concerned about the potential for damage to human health due to issues such as bioaccumulation and long-term exposure to PFAS. These concerns have led to widespread restrictions and bans on PFAS chemicals.

How is This Affecting the Fire Suppression Industry?

Special hazard fire suppression systems have been affected by new legislation aimed at restricting and banning the use of PFAS. In fact, many very effective special hazard fire suppression "clean agents" have met their end due to environmental and health concerns. The manufacture of Halon 1301, one of the earliest d most effective clean agents, was banned in 1994 because it was classified as an ozone-depleting emical. The manufacturing of FM200, the most popular Halon replacement, began a phase-out in 2022 being identified as a global warming agent. And in 2025 the production of Novec 1230 will be scontinued by 3M. Finally, AFFF firefighting foams have been severely restricted or outright banned in ost areas. This has created a challenge to the fire protection industry as they

imately, the special hazard fire suppression industry is facing another major setback as they continue to arch for a clean agent that is effective and easy to use. The agent also needs to be safe for use around humans without having a significant negative impact on the environment.

Only time will tell what is next for special hazard suppression agents as the fire suppression industry continues its research and development into appropriate alternatives.

Fire Protection Services from Fireline

Whether you need smoke detectors, fire extinguishers, or an automatic sprinkler system installed at your commercial property, Fireline has you covered. We have been protecting

people and property from fire damage since 1947—and our experience shows in our excellent work! We are known for our superb customer service, our expertise, and our reliability. For more information on how we can help your residential or commercial property, visit us online or give us a call at (800) 553-3405. We are in Baltimore, MD, with a second office in Leesburg, VA. For more fire safety tips, be sure to follow us on Facebook, Twitter, and LinkedIn.

Categories: Fire Suppression Systems | **Tags:** fire suppression, fire suppression industry, fire suppression systems, PFAS, and special hazard fire suppression

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Energy Storage: Safety FAQs

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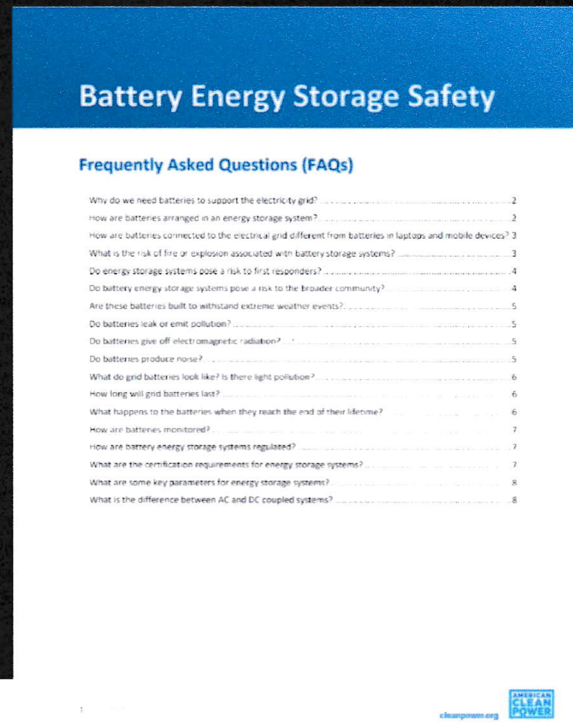


Battery Energy Storage Safety

Frequently Asked Questions (FAQs)

Energy storage is a resilience enabling and reliability enhancing technology. Across the country, states are choosing energy storage as the best and most cost-effective way to improve grid resilience and reliability.

ACP has compiled a comprehensive list of Battery Energy Storage Safety FAQs for your convenience.

Read ACP's FAQ document to learn more in detail.

Fact sheets (PDF download)

Share:

Groundwater contamination from fire water runoff

The basics of battery energy storage safety

+ Why do we need batteries to support the electricity grid?

+ How are batteries arranged in an energy storage system?

+ How are batteries connected to the electrical grid different from batteries in laptops and mobile devices?

+ What is the risk of fire or explosion associated with battery storage systems?

+ Do energy storage systems pose a risk to first responders?

+ Do battery energy storage systems pose a risk to the broader community?

+ Are these batteries built to withstand extreme weather events?

- Do batteries leak or emit pollution?

In normal operation, energy storage facilities do not release pollutants to the air or waterways. Like all energy technologies, batteries can present chemistry-specific hazards under fault conditions. Batteries with free-flowing electrolytes could leak or spill chemicals, so these systems are normally equipped with spill containment. Batteries with aqueous electrolytes may emit small quantities of hydrogen gas in normal operation and larger amounts under fault conditions, but these emissions are handled by ventilation systems and are not considered polluting. As discussed previously, all batteries release toxic substances in a fire, and if water is used for firefighting, it can create contaminated runoff – another reason for manufacturers' recommendations to allow fires to burn themselves out.

Contaminated runoff

+ Do batteries give off electromagnetic radiation?

+ Do batteries produce noise?

+ What do grid batteries look like? Is there light pollution?

+ How long will grid batteries last?

+ What happens to the batteries when they reach the end of their lifetime?

+ How are batteries monitored?

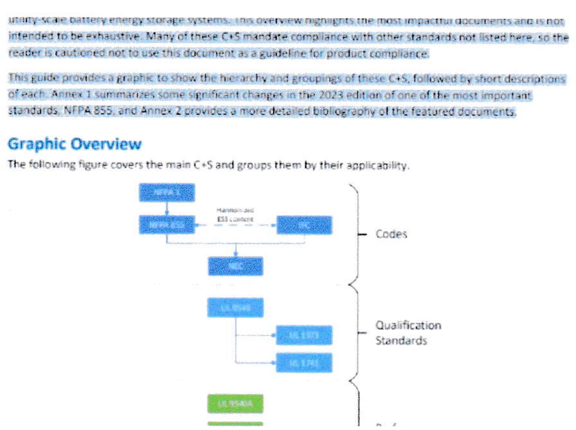
+ How are battery energy storage systems regulated?

+ What are the certification requirements for energy storage systems?

+ What are some key parameters for energy storage systems?

+ What is the difference between AC and DC coupled systems?

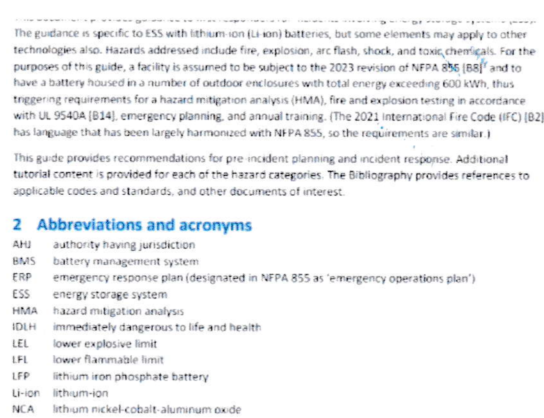
You may also be interested in:


intended to be exhaustive. Many of these C+S mandate compliance with other standards not listed here, so the reader is cautioned not to use this document as a guideline for product compliance.

This guide provides a graphic to show the hierarchy and groupings of these C+S, followed by short descriptions of each. Annex 1 summarizes some significant changes in the 2023 edition of one of the most important standards, NFPA 855, and Annex 2 provides a more detailed bibliography of the featured documents.

Graphic Overview

The following figure covers the main C+S and groups them by their applicability.


The guidance is specific to ESS with lithium-ion (Li-ion) batteries, but some elements may apply to other technologies also. Hazards addressed include fire, explosion, arc flash, shock, and toxic chemicals. For the purposes of this guide, a facility is assumed to be subject to the 2023 revision of NFPA 855 [B8] and to have a battery housed in a number of outdoor enclosures with total energy exceeding 600 kWh, thus triggering requirements for a hazard mitigation analysis (HMA), fire and explosion testing in accordance with UL 9540A [B14], emergency planning, and annual training. (The 2021 International Fire Code (IFC) [B2] has language that has been largely harmonized with NFPA 855, so the requirements are similar.)

This guide provides recommendations for pre-incident planning and incident response. Additional tutorial content is provided for each of the hazard categories. The Bibliography provides references to applicable codes and standards, and other documents of interest.

2 Abbreviations and acronyms

AHJ authority having jurisdiction
BMS battery management system
ERP emergency response plan (designated in NFPA 855 as 'emergency operations plan')
ESS energy storage system
HMA hazard mitigation analysis
IDLH immediately dangerous to life and health
LEL lower explosive limit
LFL lower flammable limit
LFP lithium iron phosphate battery
Li-ion lithium-ion
NCA lithium nickel-cobalt-aluminum oxide

Groundwater Contamination

Lithium-Ion Batteries – What are the Risks?

By Andrew Kyle | December 16, 2024

Email This (mailto:?subject=Lithium-Ion%20Batteries%20%E2%80%93%20What%20are%20the
Ion%20Batteries%20%E2%80%93%20What%20are%20the%20Risks%3F%0Ahttps%3A%2F%2 %2F2024%

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Battery power is set to gradually replace diesel-fueled generators on many U.K. train routes as the rail industry seeks to cut greenhouse gas emissions and reduce toxic pollutants. Some locomotive manufacturers are reportedly trialing lithium-ion batteries, but there are concerns that this technology could pose unique fire safety challenges. The potential environmental impact of such an event is also a significant consideration that should be factored into the equation.

Over the last 20 years, the environmental insurance industry has seen a change in the severity of contamination incidents, as well as a transition over causation and the options for waste disposal. While the U.K.'s legally binding target is to achieve net zero emissions by 2050, it is essential to also take into account the risks associated with the new technologies that will help reach this goal and how any failures might impact the environment.

Environmental Remediation

The commercial U.K. environmental remediation industry is well established, with standard guidelines for investigating and assessing contaminated land and water. During the 1990s, advances in remediation technologies drove more sustainable 'in-situ' techniques. This saw a transition from a traditional "dig and dump" approach in removing contaminated soil to using new solutions, such as chemical or biological treatments, soil stabilization to encapsulate contamination, or soil removal and cleansing prior to reuse on-site.

Within the insurance sector, the majority of contamination incidents involve loss of fuel, primarily heating oil, to the ground. The claims resolution process is well understood. It involves collecting samples to assess the extent of contamination, delivering the remediation works and then collecting additional samples for validation to ensure concentration levels are below those that would cause a risk to any receptors – whether that be humans, buildings or the wider environment.

The applicability of in-situ remediation techniques is often limited by other driving factors, such as timescale, when the customer wants to return to the property as soon as possible, for example. Cost, including the provision of alternative accommodation or premises, will also impact the remediation option that's applied.

Despite the development of new technologies aimed at providing greener solutions, there are emerging environmental risks associated with them. When failures occur, they can challenge existing environmental remediation practices and often prove costly and time-consuming to put right.

Thermal Runaway

Lithium-ion batteries have become widely used globally, and the U.K. is no exception. They are used in everything from e-scooters and mobile phones to power tools and electric vehicles (EVs). Within the domestic environment, many different devices have the same type of charging sockets, and the wrong charger, which isn't correctly rated for that particular item, can sometimes be used. Using an incorrect charger and poor battery management may lead to the device charging too quickly, which can cause overheating issues and potential thermal runaway.

On a larger scale, high numbers of EVs are often stored in one place, on transport ships, in car parks and bus depots, for example. Failure and thermal runaway of an EV battery can be explosive, and jets of flames might be emitted several meters from each side of the car. In modern car parks, with tight parking spaces, this can easily lead to the propagation of the fire to adjacent vehicles.

Battery recycling centers are another example of areas where multiple batteries stored in close proximity to each other present a similar risk. In February this year, a French warehouse storing 900 tonnes of old lithium-ion batteries caught fire following an explosion. Thick black smoke billowed around the local town of Viviez in Aveyron, and local authorities ordered residents to stay indoors and keep windows shut. Over 70 firefighters worked to put out the blaze, which had spread to nearby storage units.

According to Sedgwick's claims data, lithium-ion battery fires have increased by 81% this year compared to 2023, and the total cost of settled claims is up 140%. This trend is leading to a change in the type of environmental claims we manage in the insurance sector.

It's worth mentioning at this point that lithium-ion batteries also pose an issue for traditional fire suppression procedures. When a lithium-ion battery enters thermal runaway, it causes a rapidly accelerating chemical reaction, releasing large amounts of flammable gases. Trying to extinguish the fire with water is unlikely to be successful, although it could help stop the spread to other buildings.

Flammable Gases Released

Metal Contamination

In these types of fire incidents, high concentrations of lithium-ion and other base metals (including iron and manganese) are released and spread. Where many batteries are stored in one location, the concentrations of resulting heavy metal contamination can be very high. If surface water or groundwater becomes contaminated, a specialist resin is required to remove the metals from the water, which, in a large-scale incident, will often have to be imported from Europe. This treatment is costly and can take months, in some cases years, to resolve.

In terms of soil contamination, concentrations can also be very high, often at levels only generally seen at industrial sites. This limits the options for soil treatment, and if the concentration levels are greater than U.K. landfills can accept, it dramatically reduces the possibilities for soil disposal. Given these constraints, we must consider less sustainable approaches, such as exporting the polluted material overseas.

Metal Contamination is released and spread.

Understanding the Risk

Of course, battery technologies continue to evolve, and it's reported that their potential has yet to be reached. A recent Statista report (1) projects that between 2022 and 2030, the global demand for lithium-ion batteries (https://www.statista.com/statistics/1419502/global-lithium-ion-battery-demand-forecast/) will increase seven-fold, but their safety regularly comes under question.

While a recently published study (https://www.statista.com/topics/2049/lithium-ion-battery-industry/) found that EVs suffer 25 fires per 100,000 sold, compared to 1,530 fires in petrol or diesel vehicles, concerns remain around the storage of multiple batteries in one place. By 2035, it's estimated that 150,000 tonnes of lithium-ion batteries (https://iuk-business-connect.org.uk/wp-content/uploads/2023/05/UK-Battery-Recycling-Vision-to-2035-Report-Official.pdf) will reach their end of life annually, so it's crucial to appreciate the potential risk of operating any large-scale recycling facilities.

However, our understanding of the risk and the required level of insurance cover for such activities is improving, and new EV fire suppression systems can help prevent fires, reduce damage and minimise the risk of propagation. Particular care and appropriate precautionary measures should be taken if that facility is also located in an environmentally sensitive area—close to a river system or on an aquifer used for public groundwater abstraction and supply. Fast responses to these types of incidents will limit the spread of highly contaminated water, helping avoid significant environmental damage and reducing the potential third-party exposure and costs involved.

Precautionary measures should be taken if close to an aquifer

Correspondence with EPRI who did study but will not release to public, only to the funders. (study details attached)

From: Dupin, Brian bdupin@epri.com
Subject: Battery Firewater project
Date: Jan 7, 2025 at 12:20:29 PM
To: Kaye@coopmead.com

Hi Kaye,

I got a response from our project manager, Stephanie Shaw, and she said that only project funders received deliverables. That project wrapped up a couple years ago and I haven't seen any further work on the topic. Sorry I don't have more info…

Regards,
Brian

Brian Dupin
Technical Advisor – Distribution & ICCS
EPRI – Palo Alto, CA
Mobile: 650.906.2936 I bdupin@epri.com

This is an EPRI study they confirmed was done a couple years ago and when contacted would not release the results to the public — only to the funders.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Battery Firewater Composition and Risk Assessment

Project Highlights:

- Water contamination risk assessment for battery fire suppression
- Entrainment potential for lithium, cobalt, electrolytes, or chemical suppressants
- Evaluation of chemical release and subsequent environmental transport
- Estimated risk level for soil, surface water, and groundwater impacts

Background, Objectives, and New Learning

Use of a substantial volume of water is currently recommended in many situations to extinguish fires resulting from incidents involving lithium ion batteries. The National Fire Protection Association Standard for the Installation of Stationary Energy Storage Systems (NFPA 855)[1] requires minimum water flow densities for sprinkler systems of 0.3 gallons per minute per cubic foot. Fire management investigations have also recommended large water densities on the order of 500 hundred gallons per minute for a 1MWh system[2]. Currently, little is known about the composition of the resulting firewater (i.e., water used in firefighting) or appropriate handling methods. Anecdotal information suggests certain facility types or jurisdictions may use firewater containment processes to trap, collect and remove the large quantities of water remaining after extinguishment for safe disposal. Temporary berms, such as straw bales, are sometimes used. Sometimes the water runoff is tested with acid strips, and sometimes not. Currently there are no clear water management protocols or requirements in widespread use.

Questions exist as to whether firewater could become contaminated with hazardous materials (such as lithium, cobalt, organic electrolytes, or solubilized organics released to the gas phase) that leach or are entrained from the battery systems during suppression and subsequently released to soil, surface water, and groundwaters. If this transfer of material occurs, there is risk of exposure to personnel and environment. Thus, battery storage system developers, owners and operators, as well as first responders, must have robust information with which to propose mitigation practices and assess their value.

Importantly, data (such as the release rate of chemicals from the battery) with which to determine environmental risk, the necessity for firewater management protocols, and potential impacts on risk by implementing these protocols, are very limited or not available. In a recent survey of EPRI members interested in fire prevention and mitigation, 75% of respondents who have permitted and installed a lithium ion battery system have included a water-based fire suppression system. Similarly, 80% of those designing or considering installation of a lithium ion battery are considering using a water-based suppression system. Of those utilities, 64% are considering secondary containment of firefighting water. As a result, EPRI has received increasing inquiries for guidance on the topic of firewater management.

Thus, a need exists for the determination of a general risk level for potential soil, surface water and groundwater impacts of firefighting water from battery fires. This project would evaluate the potential for chemical release into firewater and subsequent environmental transport, and subsequently perform a first calculation to determine the general risk level.

---

[1] https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=855

[2] https://www.dnvgl.com/cases/considerations-for-battery-storage-safety-in-new-york-89392?_ga=2.88735067.1571302056.1529694727-67757860.1528844973

Benefits

This project will have widespread relevance to electric utilities, first responders and battery storage system manufacturers and developers. Benefits will include:

- Improved understanding of potential for contamination of firewater used to suppress electrochemical battery fires
- Determination of general risk levels for potential soil and groundwater impacts of firefighting water
- The option to include expanded fate and transport screening modeling, depending on early results
- Data to inform battery facility and catchment design
- Ability to inform emergency management protocols and priorities, and public health risk assessments

This project will provide data-based estimates for use by utilities, first responders or jurisdictions to inform firewater runoff management practices and designs for secondary containment.

Project Approach and Summary

This project will gather information on firewater containment requirements and runoff composition testing from prior research activities and real-world incidents. New laboratory-scale burn testing will also be performed, and the composition and amount of materials leached or entrained into suppression water will be measured directly. Different chemistries and capacities will be tested as funding allows. EPRI will also pursue opportunities to collect water samples from collaborators' burn testing for analysis in this project. This information will be used to estimate the mass fraction of material from a full-scale battery energy storage facility event that could be transferred to surface water and to the soil and pore water through infiltration and equilibrium partitioning. Estimated surface water concentrations will be compared to ecotoxicological data from U.S. EPA ambient water quality criteria and species-specific information (which is often less conservative). The resulting potential concentrations in groundwater as the runoff mixes with porewater and rainfall will be estimated using attenuation factors (e.g. sorption and dilution). Sensitivity to various driving factors, such as fraction of water discharged to soil vs catchment ponds, can also be investigated. The resulting concentrations will be compared to background groundwater geochemistry, and metrics such as stormwater runoff permit limits, soil, and groundwater risk-based screening levels and maximum contaminant levels (MCLs) used to evaluate drinking water quality. Discussion of the fate of fire suppressants can also be included based on funder priorities. Assumptions will be noted, and input data cited, so that future calculations can be updated.

Deliverables

The deliverables from the project will include:

1. Report describing water sampling and testing methodologies, results of chemical testing, assessment of potential impact on soil and groundwater, and comparisons to risk-screening and regulatory threshold concentration levels
2. Implications for runoff water management at battery energy storage facilities
3. Periodic webcast updates to funders
4. Discussions with relevant stakeholders in the battery, firefighting and environmental management communities

The non-proprietary results of this work will be incorporated into EPRI's Environmental Aspects of Fueled Distributed Generation and Energy Storage R&D program, and made available to the public, for purchase, or otherwise.

Price of Project

The price to participate is $40,000. This project is eligible for Tailored Collaboration, Self-Directed Funds, or co-funding.

Project Status and Schedule

The project is expected to take one year and can begin when two funders join. Fully funding the planned effort requires four funders. Additional funders would allow for expanding the range of battery scenarios tested for chemical release.

Who Should Join

This project would be of interest to all utilities who own, operate or procure services from electrochemical battery energy storage facilities. Other stakeholders with interest in understanding the environmental impact from firefighting methods used for electrochemical battery facilities.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

Technical Contact

Stephanie Shaw at 650.855.2353 (sshaw@epri.com)

Member Support Contacts

Brian Dupin at 650.906.2936 (bdupin@epri.com)
Barry Batson at 704.905.2787 (bbatson@epri.com)

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800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com

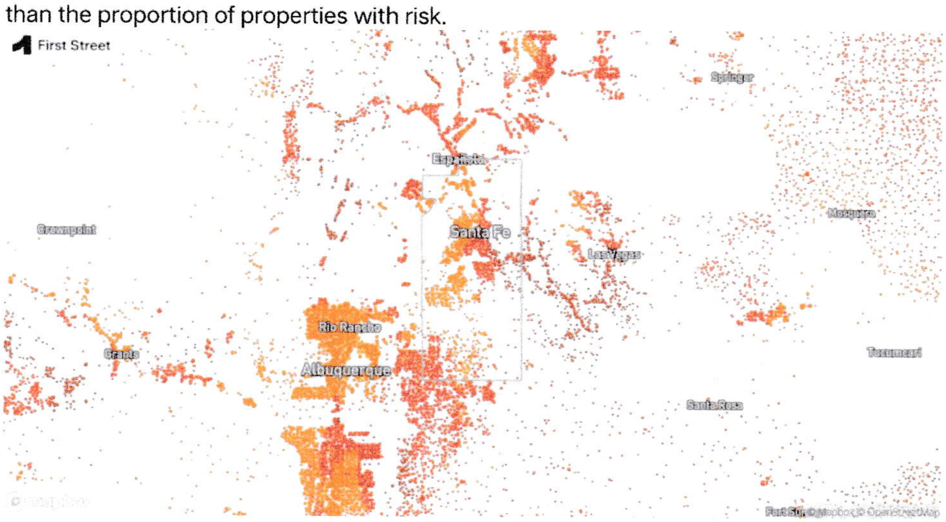
SF County Major Wildfire Risk

Does Santa Fe County have Wildfire Risk?

Major
FIRE FACTOR

There are **79,111 properties** properties in **Santa Fe County** that have some risk of being affected by wildfire over the next 30 years. This represents **100%** of all properties in Santa Fe County.

In addition to damaging properties, wildfire can also cut off access to utilities, emergency services, impact evacuation routes, and may impact the overall economic well-being of an area. Overall, **Santa Fe County** has a **major risk of wildfire** over the next 30 years. This is based on the level of risk the properties face rather than the proportion of properties with risk.



Properties at risk from fire

Minimal | Minor | Moderate | Major | Severe | Extreme

Residential: Major Risk ⓘ
78,914 out of 78,916 homes at risk

Infrastructure: Moderate Risk
298 out of 298 facilities at risk

Commercial: Major Risk ⓘ
5,992 out of 5,992 properties at risk

Social: Major Risk
517 out of 530 facilities at risk

Find the Wildfire Risk for Any Property

Discover it's current and future risk from wildfire, wildfire history, damage estimates and understand steps you can take to reduce risk.

Search an address

Wildfire Protection Measures for Santa Fe County

Although wildfire risk can never be completely eliminated, communities that adapt to higher standards can limit damage and lower rebuilding costs. Learn more about solutions.

Residential: Major Risk

78,914 out of 78,916

homes at risk

Infrastructure: Moderate Risk

298 out of 298

facilities at risk

Commercial: Major Risk

5,992 out of 5,992

properties at risk

Social: Major Risk

517 out of 530

facilities at risk

Wildfire Protection Measures for Santa Fe County

Although wildfire risk can never be completely eliminated, communities that adapt to higher standards can limit damage and lower rebuilding costs. Learn more about solutions.

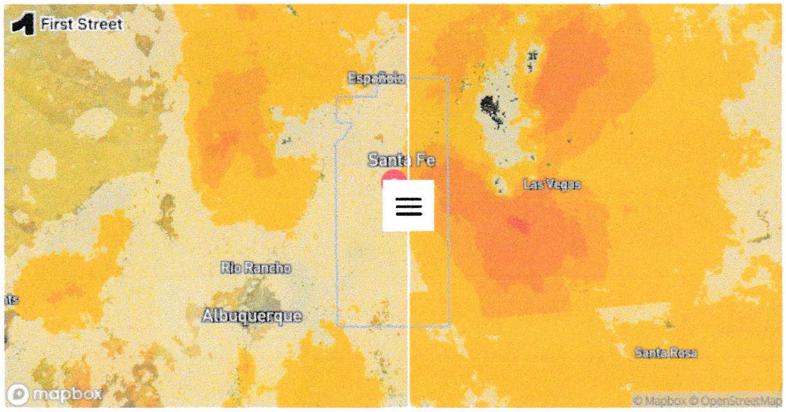
Known controlled burns

0	0
Known controllled burns	Properties near controlled burns

Understanding Vulnerability

% likelihood of wildfire

This year ⟷ In 30 years



<0.1% 0.5% 1% 2% 5%+

Properties at risk

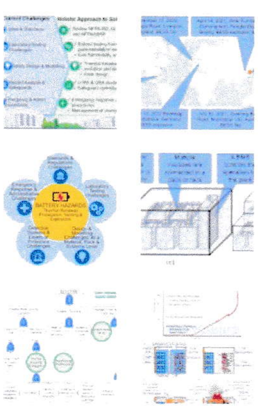
79,079	79,111
Today	In 30 years

Historical Wildfire Events in Santa Fe County

There have been **5** wildfires recorded near **Santa Fe County** between 1984 and 2021.
In **August, 2020**, **1** buildings in **Santa Fe County** were impacted by **a wildfire**. This fire covered **17 square miles**.

Spotlight: MEDIO, August 2020

Figures (14)



Tables (4)

ELSEVIER
Journal of Energy Chemistry
Volume 92, May 2024, Pages 422-439

Review

A holistic approach to improving safety for battery energy storage systems

James Close [a] [b], Jonathan E. Barnard [a], Y.M. John Chew [a], Semali Perera [a]

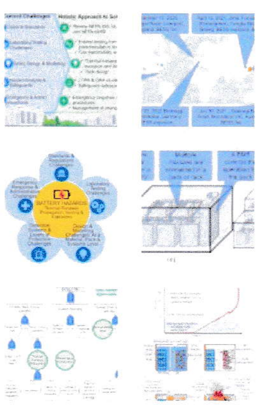
https://doi.org/10.1016/j.jechem.2024.01.012 Get rights and content

Abstract

The integration of battery energy storage systems (BESS) throughout our energy chain poses concerns regarding safety, especially since batteries have high energy density and numerous BESS failure events have occurred. Wider spread adoption will only increase the prevalence of these failure events unless there is a step change in the management and design of BESS. To understand the causes of failure, the main challenges of BESS safety are summarised. BESS consequences and failure events are discussed, including specific focus on the chain of events causing thermal runaway, and a case study of a BESS explosion in Surprise Arizona is analysed. Based on the technology and past events, a paradigm shift is required to improve BESS safety. In this review, a holistic approach is proposed. This combines currently adopted approaches including battery cell testing, lumped cell mathematical modelling, and calorimetry, alongside additional measures taken to ensure BESS safety including the requirement for computational fluid dynamics and kinetic modelling, assessment of installation level testing of the full BESS system and not simply a single cell battery test, hazard and layers of protection analysis, gas chromatography, and composition testing. The holistic approach proposed in this study ai[redacted]form the

Outline

Figures (14)



Tables (4)

2. BESS consequences and failures

The consequences and failure causes will be assessed in this section to highlight the challenges associated with BESS safety and how these failure modes will aid in forming a holistic approach. BESS consequences can fall into two main categories.

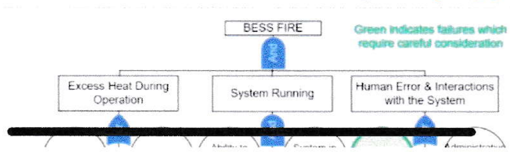
Operational impacts: Batteries that fail during operation can result in the system to be out of service. Operational failures can result in loss of a BESS to provide electricity for example.

Environmental and safety impacts: Pertains to potential property damage, safety, and environmental consequences, including severe consequences such as thermal runaway, which can lead to fires, explosions, and the release of toxic gases [7], [22], [23], [24], [25].

A major consequence is a BESS fire or explosion, fires resulting from BESS failures can pose serious safety risks to nearby personnel, communities, and emergency responders. The release of toxic fumes and hazardous materials during a battery fire can further exacerbate health and safety concerns. Fires and the release of toxic pollutants can have adverse effects on the environment, including soil, air, and water contamination.

SOIL, AIR, and WATER CONTAMINATION

BESS can fail in numerous ways; a brief overview of potential failures that can lead to BESS fires is provided in the fault tree analysis (FTA) diagram in Fig. 4 [26]. Some BESS failures presented in Fig. 4 should be more carefully considered during a hazard analysis than others (highlighted in Fig. 4). Incorrect installation practices highlighted in Fig. 4 should be carefully considered; one of the key findings of the month long investigation into the BESS fires by Korea's Ministry of Trade, Industry and Energy found that poor installation was a contributing factor to the fire incidents occurring in South Korea within the years 2017 to 2019 due to potential spark and short circuit generations creating a source of heat or ignition [12], [26], [27], [28]. Incorrect practices can result in mechanical damage to components and cells, faulty wiring and improper ventilation, leading to overheating of the system and abuse of the cells within the system [26], [28].



4. A holistic approach to improving safety for BESS

There have been many thermal runaway incidents in energy storage systems. Although safety systems, equipment and procedures were put into place based on recent codes and standards, fires and explosions still occur. Heavy reliance on codes and cell testing can create installation safety gaps.

Despite new codes, fires & explosions still occur

Similar to process safety in the chemical industry, a holistic approach to battery safety summarised in Fig. 10 should be considered to provide a combination of modelling, risk-based assessments, consequence modelling, design and testing solutions that are necessary to improve the understanding of credible hazard scenarios and the adequate safeguards that can be implemented to prevent failures and minimise consequences that can occur from low probability high-impact events.

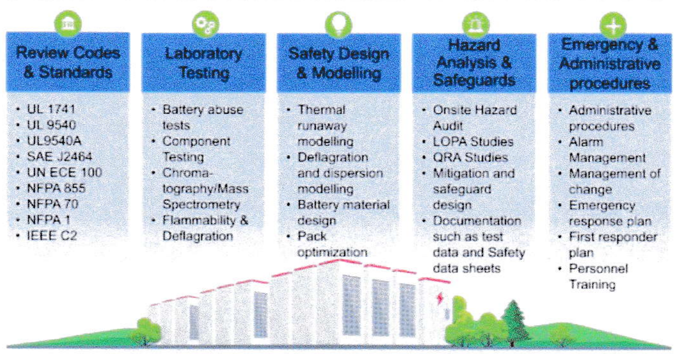


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Fig. 10. The overview of the holistic approach to battery safety.

4.1. Standards and regulation challenges

Despite rapid battery evolution, codes and standards development has lagged, though they are crucial for safety, reliability, and interoperability. However, they mainly focus on generating data and pass/fail criteria, making reliance on testing alone unadvisable. UL 9540A and other standards offer different tests but lack guidance on understanding energy storage system risks, designs, and mitigation.

Some regulations and standards struggle to keep up with evolving technologies and have overlooked critical inherent hazards like gases produced during thermal runaway and thermal propagation. Hence, standardising pass/fail criteria, best practices, and test setup is a challenge. A battery passport scheme is being attempted to trace, standardise

Chemicals from Moss Landing battery plant fire raises health concerns

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KSBW ACTION NEWS 8 Updated: 5:52 PM PST Jan 17, 2025

Infinite Scroll Enabled

Erin Clark
News Anchor

MOSS LANDING, Calif. — A chemical fire involving lithium-ion batteries has raised health concerns in the local community due to the release of dangerous

MOSS LANDING, Calif. — A chemical fire involving lithium-ion batteries has raised health concerns in the local community due to the release of dangerous chemicals into the air.

The biggest concern with this fire is the dangerous chemicals released into the air through the smoke and its potential impact on people and animals.

This fire involves lithium-ion batteries, which release toxic chemicals when they burn. The most dangerous of these chemicals is hydrogen fluoride, a gas that poses extreme health hazards when inhaled at high levels.

"Hydrogen fluoride seems to be the most concerning form. It is a chemical in small amounts that can be irritating. It irritates the eyes, nose, and lungs, but the concern is at higher doses of exposure you can get swelling in the lungs, scarring in the lungs, and permanent damage. Certainly can burn and this chemical can be absorbed into the body and produce more generalized symptoms," said Dr. Steven Prager, a specialist in immunology and asthma with Salinas Valley Health,

Vistra has its own monitoring company to measure chemical levels in the air, and the EPA is also on the scene. They reported levels of hydrogen fluoride at safe levels so far, and monitoring continues.

"When we deploy our assets to do the monitoring, they are in certain locations that they are collecting the data to where it is potentially drifting to," said Vistra regional vice president Pete Ziegler.

"We've got a highly trained consultant doing that right now and sharing that with other officials and complementing what the EPA is doing for air monitoring. We want to make sure the air is clear and safe and getting people back into their homes, and it will be ongoing to find out what caused it," said Vistra director of community affairs Brad Watson.

RECOMMENDED

Neighborhood in Monterey has been without power for days

Scott Bessent faces bipartisan scrutiny in US Treasury confirmation hearing

Beyoncé postpones Jan. 14 announcement due to ongoing LA wildfires

Trump's Cabinet picks are set for Senate hearings. Here's the schedule

Recommended

Dr. Prager says as long as the winds keep the smoke aloft, higher in the atmosphere, it will likely dissipate and mitigate the risk. However, he advises caution.

"If you are in the area, the most important thing is to have a protected air space. Stay indoors, keep windows closed. If you are in an evacuation zone, get out. Don't stick around," said Dr. Prager.

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Man killed by 2 vehicles while crossing road in Monterey County identified

Fire breaks out at world's largest battery storage plant

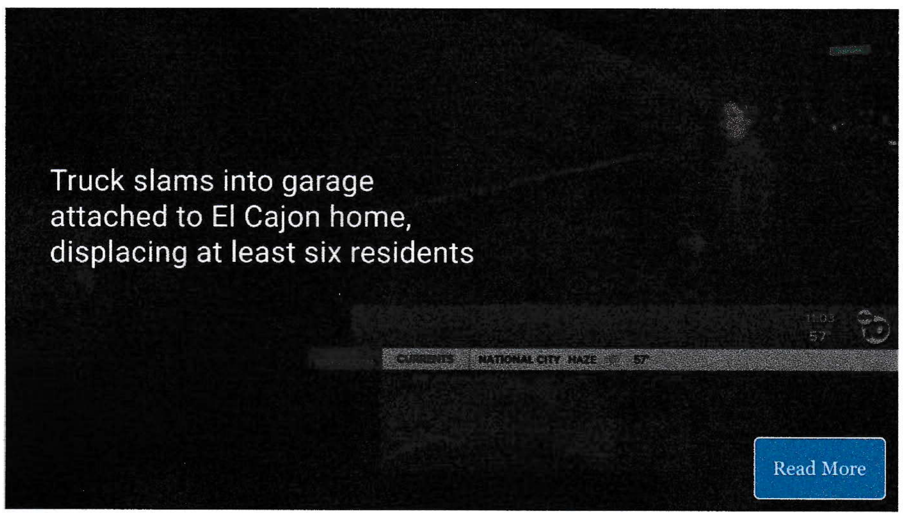
The blaze led to the evacuation of up to 1,500 people and dealt a blow to the young battery storage industry.

By: AP via Scripps News

Posted 6:04 PM, Jan 17, 2025 and last updated 8:50 AM, Jan 18, 2025

A fire at the world's largest battery storage plant in Northern California smoldered Friday after sending plumes of toxic smoke into the atmosphere, leading to the evacuation of up to 1,500 people. The blaze also shook up the young battery storage industry.

The fire at the Vistra Energy lithium battery plant in Moss Landing generated huge flames and significant amounts of smoke Thursday but had diminished significantly by Friday, Fire Chief Joel Mendoza of the North County Fire Protection District of Monterey County said. Vistra is based in Texas.



"There's very little, if any, of a plume emitting from that building," Mendoza said. Crews are not engaging with the fire and are waiting for it to burn out, he said. Letting lithium ion battery fires burn out is not unusual because they burn very hot and are hard to put out.

No injuries have been reported but residents raised concerns about hazardous gases being released into the air.

The fallout from the fire at the battery storage facility about 100 miles south of San Francisco was just beginning.

"This is more than a fire, this a wake-up call for the industry. If we're going to be moving ahead with sustainable energy, we need to have a safe battery system in place," Monterey County Supervisor Glenn Church said at a Friday morning briefing.

Battery storage is considered crucial for feeding clean electricity onto the grid when the sun is not shining or the wind is not blowing, and it has been used in significant amounts only in the last couple of years. But the batteries are nearly all lithium, which has a tendency toward "thermal runaway," meaning it can catch fire and burn very hot, releasing toxic gases.

Vistra sells energy to Pacific Gas & Electric, one of the nation's largest utilities.

The blaze did not spread beyond the facility, according to Monterey County spokesperson Nicholas Pasculli. Evacuation orders for from 1,200 to 1,500 people remained in place as of Friday and residents were advised to close their windows and turn off their air conditioning.

RELATED STORY | Star-studded 'FireAid' concert will benefit Los Angeles area wildfire victims

"There's no way to sugar coat it. This is a disaster," Monterey County Supervisor Glenn Church told KSBW-TV.

Brad Watson, Vistra's senior director of community affairs, said the Environmental Protection Agency is testing air quality at the facility and that the company has hired an air consultant to check for pollution in nearby communities. Vistra will share the results when they are available, Watson said.

Kelsey Scanlon, director of Monterey County's Department of Emergency Management, told reporters that the release of hydrogen fluoride into the atmosphere from the blaze is a cause for concern.

The Centers for Disease Control and Prevention says hydrogen fluoride

The Centers for Disease Control and Prevention says hydrogen fluoride gas can irritate the eyes, mouth, throat, lungs and nose, and that too much exposure to the gas can be deadly.

Residents expressed concerns about air quality during an emergency meeting of the Monterey County Board of Supervisors earlier Friday.

"It doesn't appear that the fire department had the appropriate fire retardants to minimize this fire and have to resort to actually letting it burn, exposing all of the residents, including Watsonville in Santa Cruz County, and this is extremely disturbing," resident Silvia Morales said.

Monterey County Sheriff Tina Nieto said air quality monitoring systems had not detected any hazardous gases in the air. She said the county was awaiting the arrival of a more advanced monitoring system Friday afternoon before lifting the evacuation order.

Watson said two "overheating events" happened at the battery plant in 2021 and 2022 because the batteries got wet. A third incident happened in 2022 in the neighboring Elkhorn battery plant that is owned by PG&E, he said.

Lithium batteries make the power grid more stable and reduce the need for energy to be generated from fossil fuels, which release planet-warming gases. California was an early adopter of battery storage and leads the nation with more than 11 gigawatts of utility-scale storage online, which can meet nearly half of the demand on the state's main grid for four hours per day.

Experts say lithium batteries are a safe technology that are essential for lowering carbon emissions and making grids more reliable. But they are a significant fire risk if they are damaged or overheat.

"We are not convinced that this incident could materially shift the national trend of growing grid scale battery deployment," said Timothy Fox, managing director of ClearView Energy Partners, a non-partisan energy research firm.

It was unclear what caused this latest fire. Vistra said in a statement that after it was detected, everyone at the site was evacuated safely. After the fire is out, an investigation will begin.

"Our top priority is the safety of the community and our personnel, and Vistra deeply appreciates the continued assistance of our local emergency responders," Jenny Lyon, a spokesperson for Vistra, said in a statement.

Jodie Lutkenhaus, professor of chemical engineering at Texas A&M University, said safer batteries must be found that can be used on the grid.

Some improvements, such as more fire prevention measures, can be made to reduce fire risks with lithium batteries, Lutkenhaus said, "but the only way to really address the problem is to use a safer technology." Water-based and redox flow batteries are being developed by scientists but have not yet scaled commercially.

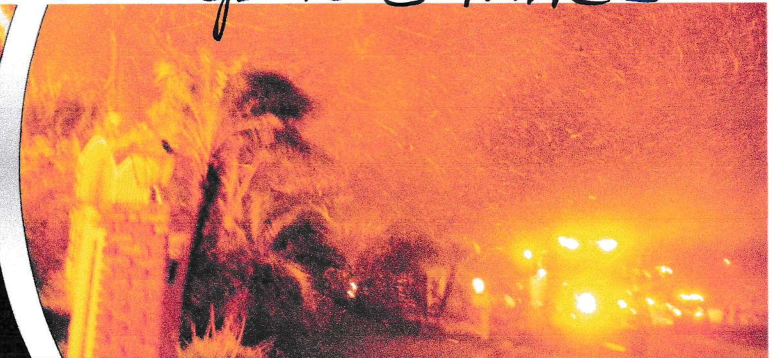
Lithium iron phosphate batteries are a possible alternative because they are highly stable, but they still carry some fire risk.

No matter what kind of lithium battery you use, "when you reach a certain size, it is inherently very dangerous and easy to catch fire," said Yiguang Ju, engineering professor at Princeton University.

Embers travel up to 5 miles

READY, SET, GO!

BE EMBER AWARE



Embers are burning pieces of vegetation or other flammable material and are the leading cause of structural damage and home loss from a wildfire.

In order to successfully protect your home, you need to understand the real threat during a wildfire.

Once they're picked up by strong winds, embers can travel as much as five miles in front of the active front of a wildfire. Before flames get anywhere near your home, embers can land in dry or flammable vegetation or small open spaces on your roof or walls, and ignite, threatening your home.

If embers fall on and ignite nearby plants, the radiant heat created by the fire can burn combustible siding, doors, or window frames. Radiant heat can also cause windows to break, creating openings that allow flames and embers to enter your home. Once the home is on fire, it will create more embers that can be picked up by winds, travel to other homes and neighborhoods, and increase fire damage for the entire community.

Embers create a huge threat during a wildfire. It's the steps you take now to make your home and landscaping more ember-resistant that will protect your family, your home, and your community during the next wildfire. Take responsibility!

FIRE ORANGE COUNTY CALIFORNIA AUTHORITY Est. 1995

Orange County Fire Authority

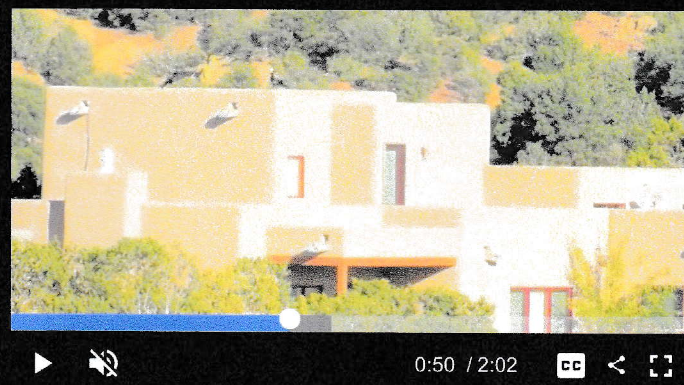
www.ocfa.org/RSG

For more information, please visit the OCFA website or call **(714) 573-6774** to schedule a Wildfire Home Assessment.

NEW MEXICO NEWS

Santa Fe ranks 12th in the west for greatest wildfire risk

by: Rachel Knapp
Posted: Sep 18, 2019 / 10:30 PM MDT
Updated: May 24, 2021 / 03:50 PM MDT



SHARE

SANTA FE, N.M. (KRQE) – A New Mexico city was recently ranked as having one of the highest risks for wildfires in the west. If there's a fire, it would be expensive.

Breathtaking views of mountains and forests, many people have a stunning view of the Capital City from their backyards. It's the natural beauty that draws people to build their homes here in Santa Fe, but all that vegetation raises concerns when it comes to fires.

"This is a real risk," said Alan Hook with the Santa Fe Water Division. "We're in the west and fire is part of the landscape."

The State Forest office created the Greater Santa Fe Fireshed Coalition, saying the Capital City is, and has been, an extreme fire risk. A new report from Core Logic backs this up, ranking Santa Fe 12th in the west for cities with the greatest fire risk.

A fire there would be extremely costly. The study said more than 23,000 homes in the Santa Fe area face an extreme wildfire risk, estimating a whopping $7.28 billion worth of reconstruction if those homes go up in flames.

"That would be a big loss," said Hook. "Insurance companies look at that and its real potential impact to the community of Santa Fe."

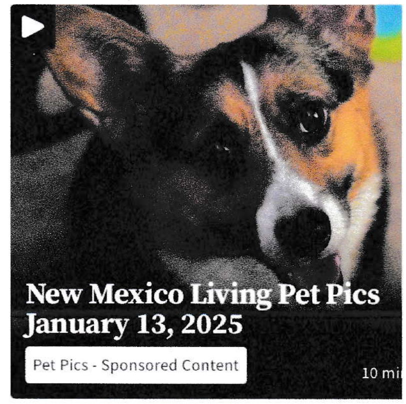
The homes at most risk are in the outskirts of the city.

"People in this field have always known this," said Greater Santa Fe Fireshed Coalition Chair Eytan Krasilovsky. "But it's good to hear this information that confirms what our information shows, but it is troubling and we have a lot of work ahead of us."

That work includes forest thinning, which the Forest Service said some homeowners have tried to stop.

"So we don't want this catastrophic wildfire to occur, but from the city's perspective, we're doing all we can do prevent that," said Hook.

NEW MEXICO LIVING ›



New Mexico Living Pet Pics January 13, 2025

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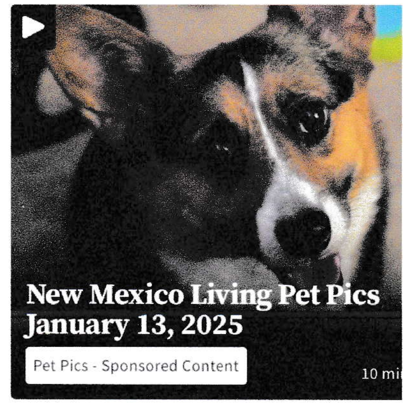
"So we don't want this catastrophic wildfire to occur, but from the city's perspective, we're doing all we can do prevent that," said Hook.

The last major fire near Santa Fe was the Pacheco Canyon wildfire in 2011. It was caused by a campfire and burned more than 10,000 acres.

NEW MEXICO LIVING ›



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TRAVELERS

Groundwater contamination and toxic fumes

Home > Prepare & Prevent > Industries > Energy > Battery Energy Storage System (BESS) Technology Growth and Risks

Resources for the Energy Industry

Battery Energy Storage System (BESS) Technology Growth and Risks

By Travelers | 4 minutes

Renewable energy sources, such as solar and wind, are projected to generate 44% of all power in the U.S. by 2050,[1] which is increasing demand for the battery energy storage systems (BESS) needed to store this energy.

Unprecedented public investment in clean energy – afforded mainly by the Infrastructure Investment and Jobs Act, or IIJA (2021), the Inflation Reduction

One unique BESS hazard is battery fire and/or explosion caused by thermal runaway, or the rapid uncontrolled release of energy from a battery cell. Thermal runaway can be caused by an internal short circuit, which can be caused by mechanical, thermal or electrical damage to the battery before, during or after installation.

3. Environmental pollution and health hazards

Some chemicals used to make batteries may be hazardous. Even when the best safe handling practices are followed, accidents can happen – and any damage caused during the manufacturing, transportation or disposal process can expose people working or living in or near a BESS facility to harmful gases or pollute the surrounding soil and groundwater.

Thermal runaways require a significant amount of water to cool and control. Potentially hazardous chemicals released during the fire can pollute the water used to fight it, contaminating any soil or groundwater absorbing the runoff.[5] Fumes released can also be a risk to the public and first responders.

Effective BESS risk management

Managing BESS-related risk depends on planning, preparation and having a trusted, experienced partner. With a dedicated team of energy experts and Claim specialists, Travelers has been providing specialized coverage and risk control solutions to support owners and operators in the rapidly growing renewables industry for over 30 years.

To learn more, visit Travelers Insurance for the Renewable Energy Industry or contact your agent today.

Sources:

[1] *EIA projects that renewable generation will supply 44% of U.S. electricity by 2050, U.S. Energy Information Administration, March 18, 2022. - https://www.eia.gov/todayinenergy/detail.php?id=51698*

[2] *Bloomberg New Energy Finance (BNEF), 2019 Long-Term Energy Storage Outlook, Bloomberg NEF, New York, 2019 – as cited in Energy Storage Grand Challenge: Energy Storage Market Report, U.S. Department of Energy, December 2020, pg. 17. -*

Resources for the Energy Industry

Chemical release hazards

Lithium-Ion Battery Energy Storage Systems (BESS) Risks

By Travelers | 57 minutes

There is growing demand for lithium-ion battery energy storage systems (BESS), and for good reason. Consumers, businesses and public and private organizations can benefit greatly from BESS. Benefits include cost savings through time-shifting (i.e., storing energy when the cost is low for use during times when energy is expensive), improved quality of power supply and availability of emergency backup power.

According to the U.S. Department of Energy, the lithium-ion battery energy storage segment is the fastest-growing rechargeable battery segment worldwide and is projected to make up the majority of energy storage grow[th] across the stationary, transportation and consumer electronics markets by 2030.[1]

What are the hazards of lithium-ion battery energy storage?

While lithium-ion BESS offer multiple benefits, they can also present significant hazards. Understanding the risks and having a plan in place to address them is an important consideration when adding a BESS to your home or business electrical system.

Fire hazards

Understanding the unique fire risks presented by BESS is critical. Some fire suppression systems may be ineffective, and improper firefighting techniques can worsen the outcome, potentially causing additional harm to people and property.

A battery fire can generate chemical gases with potential to cause an explosion, especially if they are not properly ventilated. If a fire occurs, emergency response efforts must be tailored for the individual BESS site.

Fires in a BESS are often a result of a process called thermal runaway. This occurs when a battery cell creates heat that it cannot adequately dissipate. The resulting dynamic temperature increase in the cell and adjacent cells creates a cascading effect. This phenomenon can occur in a battery cell that has internal defects or mechanical damage, been exposed to heat from an external source or been overcharged, or it may be due to a battery management system failure and/or malfunction.

Key controls for BESS owners to prevent and/or mitigate fire losses include:

- Proper handling and installation.
- Effective operations and maintenance (O&M) performed by qualified personnel.
- Adequate protection from vehicle/equipment damage (e.g., bollards).
- Collaboration with the fire department to develop a fire response plan that accounts for:
  - BESS chemistry
  - Location
  - Protective features (such as fire suppression and explosion venting)
- Knowledge of manufacturer-specific requirements (e.g., maintenance frequency/intervals).
- Effective battery management system (BMS) monitoring.
- Other site-specific considerations.

Chemical release hazards

- Other site-specific considerations.

Chemical release hazards

Chemicals contained within a battery can be released during a fire and may create an explosion. Chemical releases can also contribute to liquid pollution when mixed with firefighting water, potentially contaminating soil or groundwater.

Key controls to help prevent losses related to chemical release include:

- Proper site design that contemplates water management (e.g., berms, dikes, drainage) and equipment location.
- Proactively developing proper containment systems. no containment system
- Thorough emergency preplanning.

Stranded energy hazards

When batteries are damaged, they can still contain energy. This "stranded" energy should be dissipated prior to interaction with or removal of impacted cells. If not handled properly, the damaged batteries could cause injury, including electrical shock.

Only qualified personnel should perform maintenance and repair work on BESS. BESS owners consider the following for preventing stranded energy-related losses:

- Proper contractor selection for installation and ongoing O&M (e.g., proper high-voltage training where applicable, effective lockout/tag-out protocols).
- Preventing unauthorized personnel from accessing BESS.

How might lithium-ion BESS hazards affect your organization?

As you weigh the benefits and costs associated with owning and operating a BESS, it's important to consider the potential exposures and how they may impact your organization's personnel and property. Consider working with an insurance carrier that has in-depth experience in the renewable energy industry.

Travelers works with customers across the United States who own and operate battery energy storage systems. Our experienced team of Risk Control professionals is well-versed in both battery risks and fire protection. Through collaboration, we provide customers with tailor-made solutions and services addressing renewable risks and exposures.

Learn more about Travelers' expertise in renewable energy. Ask your insura[nce] agent how a robust insurance program from Travelers can help protect your organization.

Wildfirerisk.org

Santa Fe County has a high risk of wildfire—higher than 85% of counties in the US.

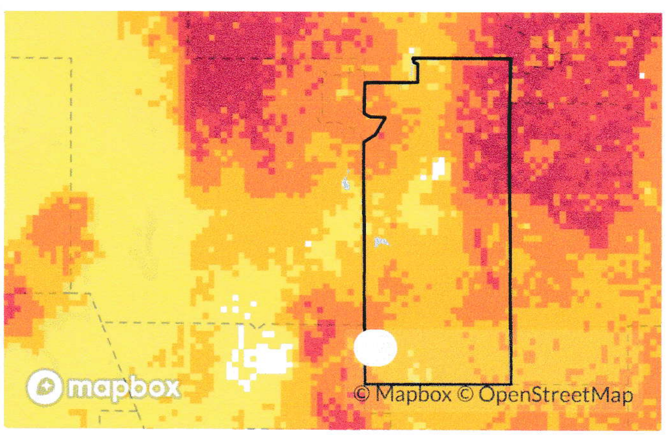
↓ Choose from the topics below to learn more

Understand your risk

Risk to Homes

Where are homes at risk of wildfire?

High



Wildfire Likelihood

How likely is a wildfire in this

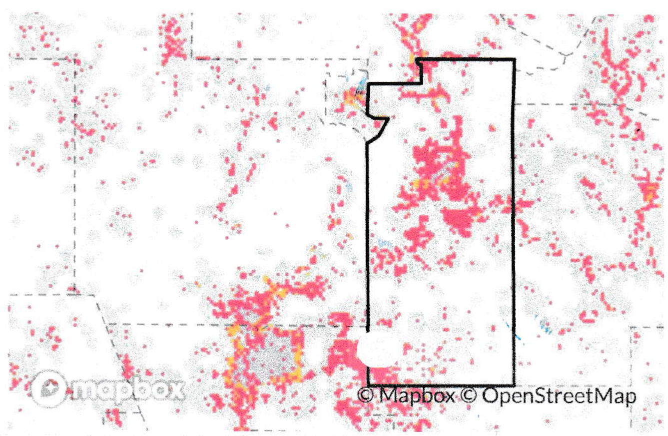
High

Reduce your risk

Risk Reduction Zones

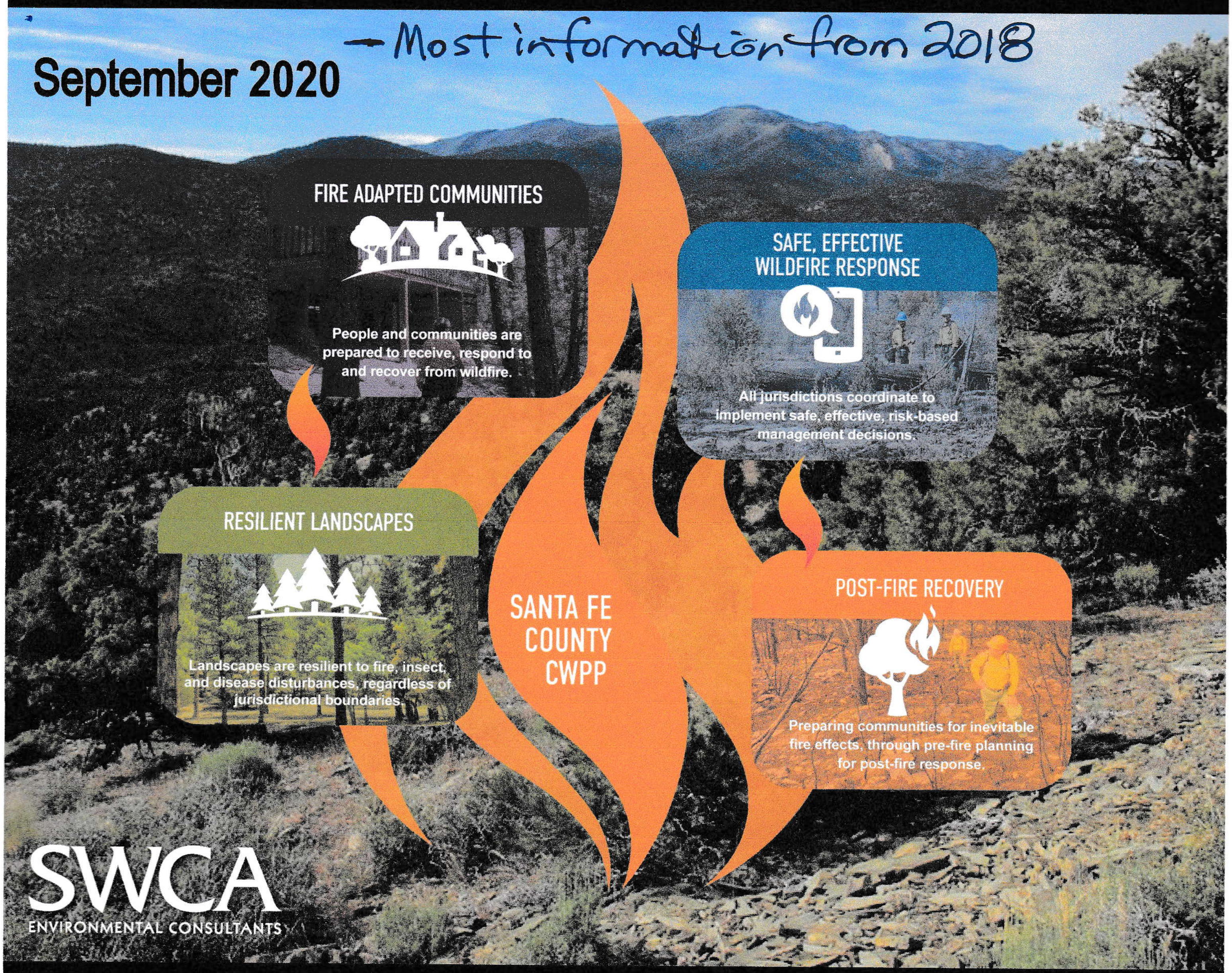
Which actions are most effective to reduce risk?

High



Vulnerable Populations

Med



Santa Fe County
Community Wildfire Protection Plan

Availability of firefighting resources

Although fire suppression is still aggressively practiced, fire management techniques are continually adapting and improving, especially in light of changing climate. Management of fire for resource objectives is an option for land managers in the County. Due to scattered human developments (homes, ranches, and farms) and values (residential and commercial structures, historic and natural values) throughout the WUI, suppression in WUI areas will always have to be a priority. However, combining prescribed fire and managing wildland fire for resource objectives with effective fuels management and restoration techniques have been proven to help re-establish natural fire regimes and reduce the potential for catastrophic wildfires on public lands associated with heightened risk due to a warming climate. The use of prescribed fire on private land is a decision to be made by the landowner, and it is acknowledged that given the prevailing drought such a management technique may not always be feasible in the County.

FIRE RESPONSE CAPABILITIES

Planning and Decision Support

As wildfires have continued to grow in size and severity over the last decade, this has led to fire managers needing to institute more robust pre-fire planning as well as adapt and improve decision-making tools in order to reduce risk to fire responders and the public and assess impacts on ecological processes.

A primary decision tool utilized by fire managers across all agencies is the Wildland Fire Decision Support System (WFDSS), a system that assists fire managers and analysts in making strategic and tactical decisions for fire incidents (WFDSS 2015).[6] WFDSS combines desktop applications for fire modeling into one web-based system. It provides a risk-informed decision process and documentation system for all wildland fires and it also introduces economic principles into the fire decision process in order to improve efficiencies which also ensuring safe and effective wildfire response.

One intent of WFDSS is to ensure that when fire response decisions are made, they fall in line with agency land and resource management plans. Agencies have recently been moving away from the traditional written fire management plans and instead are developing spatial fire management plans that can be housed within WFDSS (WFDSS 2015). The Santa Fe National Forest for example will have all management requirements and strategic objectives for fire management, contained within WFDSS, so that in the event of a fire, incident managers are considering this information when making decisions and developing strategic direction for the wildfire incident (WFDSS 2015).

Another tool employed by fire managers in pre-fire planning is the potential operational delineation (POD). PODs combine fire modeling with expertise from local fire practitioners and managers to identify potential locations where fire suppression could be effective (Caggiano et al. 2020; Harden 2020). This concept was tested in northern New Mexico during the 2019 fire season on seven New Mexico fires, including land in the Santa Fe National Forest. This pilot project demonstrated the effectiveness of PODs for decision support. It is anticipated that these processes will continue to be used in future fire planning across jurisdictions.

Fire Resources

The availability of resources is dictated by the state and federal wildland fire season. From approximately April 15 through July 15, resources are plentiful around the region. This time period is considered the Southwest fire season, so multiple crews, engines, helicopters, and air tankers are available. However, from July 15 to October 31, firefighting focus often changes to other regions such as to the Northwest and California. During this period, the time frame to obtain resources is extended, sometimes taking up to 48 hours. During the winter months, obtaining resources is difficult as many firefighters are employed seasonally from April through October. Given the changing fire regimes, wildfires now occur throughout the entire year, extending beyond the state and federal designated wildland fire season. Resources are limited for fires that occur outside of this time frame.

[6] WFTDSS: https://wfdss.usgs.gov/wfdss/WFDSS_Home.shtml

Santa Fe County Fire Department

Volunteer and career firefighters at the County and community level have similar capabilities throughout the entire year, while state and federal responders are affected by fire season. In spite of the continuous level of capabilities, ebbs and flows occur within the volunteer service. Recruiting and retaining volunteers is challenging due to people's lifestyles and the training requirements one must follow to be a volunteer firefighter. Although several volunteer firefighters are present in the County, not all are available to respond to every fire. The County Wildland Division has taken steps to have a fire crew all year round for county response.

Santa Fe National Forest

The Santa Fe National Forest provides fire response on USFS land in the County. Fire management and suppression protocols are directed by the Forest Plan.

On USFS land, the USFS has the responsibility for initial attack (initial response). The USFS maintains Mutual Aid Agreements (MAA) with the New Mexico State Forestry Division (NMSF), the County, and the NPS. Under the MAA, agency personnel may respond to incidents outside their agency boundaries.

The management of wildfire ignitions for multiple resource objectives (managing naturally burning fires in forests as a tool for helping to restore forest health and mitigating the escalating costs of fire suppression) is practiced on federal land but depends upon a thorough assessment of risk to values at risk in the WUI. Depending on the location and nature of a wildfire, USFS policies outline appropriate management responses to guide district personnel in the application of specific suppression techniques. All large wildfire response would be based upon assessment using WFDSS.

In wilderness areas, the Santa Fe National Forest supervisor must approve the use of helicopters, portable pumps, and chainsaws, as well as the construction of helispots. The Southwestern Regional Forester must approve the use of motorized vehicles and bulldozer line construction. Fire strategies call for:

- restoring fire to the ecosystem;
- using prescribed fire to reduce hazards;
- managing wildland fires so that air quality issues are compatible with local, state, and federal laws; and
- minimizing suppression impacts to wilderness as well as impacts to the surrounding area.

The USFS has the following resources available for fire suppression throughout the County:

- Santa Fe Supervisors Office
    - 3 – Type 3 Incident Command
    - 2 – Operations Section Chiefs
    - 3 – Task Force Leaders
    - Santa Fe Hotshots
- Espanola Ranger District
    - 2 – Type 3 ICs/Division Supervisors
    - 1 – Type 4 Engine
    - 1 – Type 6 Engine
- Pecos/Las Vegas Ranger District
    - 2 – Type 3 ICs/Division Supervisors
    - 1 – Type 3 Engine
    - 1 – Type 6 Engine

Vegetation in the existing setting

FUELS AND TOPOGRAPHY WITHIN THE WUI IN SANTA FE COUNTY

The southern half of the County is predominantly composed of grassland fuels, transitioning into shrubsteppe- or shrubland-dominated fuels to the north. Forested communities exist primarily in the higher elevations of the Sangre de Cristo Mountains in the northeastern portion of the County. Grassland communities are primarily characterized by shortgrass prairie, which is relatively sparse and usually occurs on flat to rolling topography at lower elevations. Grasslands may occur as pure herbaceous stands, as a shrubsteppe community, or as a juniper savanna.

Grasslands

Grassland fires have the potential to move quickly under dry, windy, and steep conditions and can easily spread at a surprisingly rapid rate, often reaching over 300 feet per minute. Many authors have suggested that the historical fire-return intervals (FRIs) for grasslands throughout the seventeenth to early nineteenth centuries are thought to have been every 5 to 10 years (Leopold 1924; Swetnam et al. 1992). Fire-suppression policies may have contributed to declining fire frequency in this cover type, but other interacting factors may have contributed as well. About the time of the Civil War, intensive livestock grazing is thought to have been responsible for a decline in grassland fires (Touchan et al. 1996; West 1984). Heavy grazing reduced the fuels available to propagate fire spread and also reduced competition with herbaceous plants, tipping the balance in favor of the woody species. Woodland encroachment, increased tree density, and altered fire behavior characterize many former grasslands of the Southwest. Once woody plants become dominant, their long lifespans and their ability to extract both shallow and deep soil moisture can maintain a woodland condition indefinitely (Burgess 1995). Frequent fire plays a significant role in grassland nutrient cycling and successional processes, and long-term exclusion may produce irreversible changes in ecosystem structure and function (McPherson 1995).

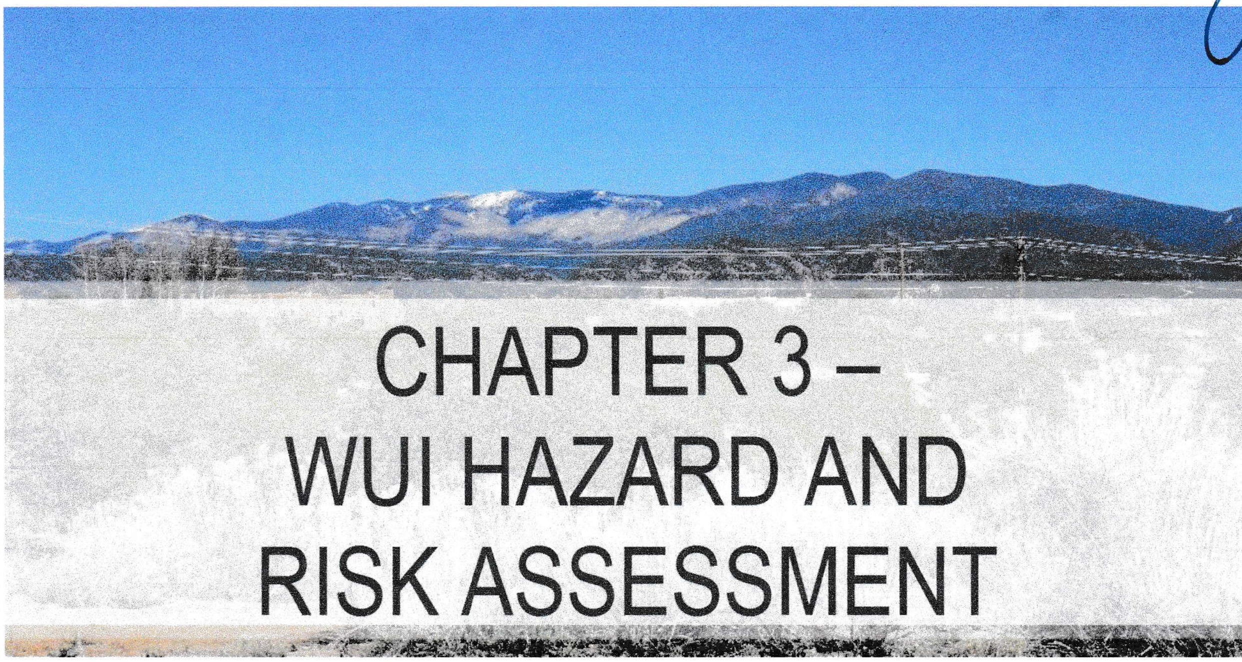
Piñon-juniper Woodlands

One of most common vegetative communities in the County is piñon-juniper woodland. These woodlands are some of the most poorly understood ecosystems in terms of fire regimes, but recent research suggests that fire may have been a less-common and less-important disturbance agent in piñon-juniper woodlands compared with adjacent ponderosa pine and grassland ecosystems. In a recent review of piñon-juniper disturbance regimes, Romme et al. (2007) has subdivided the piñon-juniper cover type into three subtypes: areas of potential woodland expansion and contraction, piñon-juniper savannas, and persistent woodlands. These categories are helpful in separating the broad piñon-juniper cover type into distinct communities, which are subject to different climatic, topographic, and disturbance conditions.

Areas of potential expansion and contraction are those zones wherein the boundaries of the piñon-juniper ecotones have shifted. As mentioned previously, many grasslands in the Southwest have been colonized by trees as a result of a complex interplay of environmental factors. The issue of woodland encroachment into grasslands goes hand in hand with the assessment of historical conditions of the woodlands. These shifting boundaries have been widely documented (e.g., Gottfried 2004) but the historical condition of the ecosystem may be relative to the time scale of evaluation. Betancourt (1987) has suggested that the changing distribution patterns seen in the last century may be part of larger trends that have occurred over millennia and not the result of land use changes. Overall, it is believed that greater landscape heterogeneity existed previously in many of these areas that are now uniformly covered with relatively young trees (Romme et al. 2007).

Piñon-juniper savannas are found on lower elevation sites with deep soils where most precipitation comes during the summer monsoon season. Juniper savanna, the most common savanna in New Mexico, consists of widely scattered trees in a grass matrix (Dick-Peddie 1993). Similar to grasslands, the range of savannas has decreased as tree density has increased, but the mechanisms for tree expansion are complex as is the subject of current research. Significant scientific debate currently exists over the natural FRI for savannas, but most experts agree that fire was more frequent in savannas than in persistent woodlands.

Wildfire highly likely hazard in Santa Fe County



CHAPTER 3 – WUI HAZARD AND RISK ASSESSMENT

PURPOSE

The purpose of developing the risk assessment model described here is to create a unique tool for evaluating the risk of wildland fires to communities within the WUI areas of Santa Fe County. Although many definitions exist for hazard and risk, for the purpose of this document these definitions follow those used by the firefighting community:

> ***Hazard*** is a fuel complex defined by kind, arrangement, volume, condition, and location that forms a special threat of ignition and resistance to control.
>
> ***Risk*** is defined as the chance of a fire starting as determined by the presence and activity of causative agents (National Wildfire Coordinating Group [NWCG] 1998).

The hazard and risk assessment is twofold and combines a geographic information system (GIS) model of hazard based on fire behavior and fuels modeling technology (Composite Risk/Hazard Assessment) and a Core Team generated assessment of on-the-ground community hazards and values at risk.

From these assessments, land use managers, fire officials, planners, and others can begin to prepare strategies and methods for reducing the threat of wildfire, as well as work with community members to educate them about methods for reducing the damaging consequences of fire. The fuels reduction treatments can be implemented on both private and public land, so community members have the opportunity to actively apply the treatments on their properties, as well as recommend treatments on public land that they use or care about.

The Santa Fe County Hazard Mitigation Plan (HMP) (Santa Fe County 2018) lists wildfire hazard as a highly likely hazard, with extensive spatial extent, with a critical magnitude/severity and high overall significance.

Chapter 3 from the Santa Fe County Wildfire Protection Plan

Air Monitoring

NEWS

After Huge Monterey County Battery Fire, Locals Describe Headaches, Nausea and a Taste of Metal

By Juan Carlos Lara Jan 24 Save Article

A view of flames at Moss Landing Power Plant located on Pacific Coast Highway in Monterey Bay, California, on Jan. 16, 2025. *(Tayfun Coskun/Anadolu via Getty Images)*

Hazy skies, a rank, perhaps acidic smell in the air, and a lingering taste of metal. Later — headaches, sore throats and nausea.

Residents in the Monterey and Santa Cruz areas have reported such health issues in the wake of last week's massive fire at a Monterey County energy storage facility, fearing they are related. Authorities have said they didn't detect toxins in the smoke, but some experts worry the test results aren't giving the full picture — and now state and local officials will be conducting further testing.

Eva Faste said she was outside her home in the Santa Cruz Mountains with her dogs when she first started getting a headache and a sore throat.

She didn't think much of it until that night when her phone buzzed with an alert about a battery storage facility that had caught fire roughly 25 miles away in Moss Landing.

“I woke up the following morning, my nose was bleeding, and since then, I’ve been feeling worse every day,” Faste said. Her sore throat, along with stomach problems and low energy, have persisted into this week, even though the fire has since died out.

The Jan. 16 fire started at what is reportedly the largest lithium battery storage facility in the world, with over 100,000 batteries used to store solar power and other forms of electricity to help supply the grid. The flames raged for hours, igniting the batteries stored within the facility and sending a dark plume of smoke high into the air until 80% of the building and its contents were consumed.

Lithium battery fires are notoriously difficult to extinguish and, as is often the case, emergency responders decided to let the fire burn itself out.

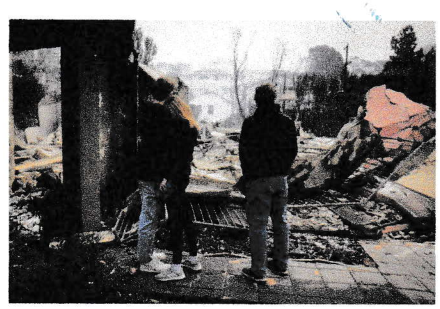
Since then, a Facebook group about possible fire-related symptoms has ballooned to more than 2,000 members. People have mentioned, along with Faste’s symptoms, a metallic taste in their mouth and a persistent smell in the air.

One person who spoke at Tuesday’s Monterey County Board of Supervisors meeting compared the sensation to what they experienced while receiving chemotherapy.

“I live in Prunedale. I have never had a metallic taste in my mouth before,” Heather Griffin said. “Yes, there are people who burn fires in their fireplaces; we do, too. But I’ve never had a metallic taste.”

The day after the fire began, the U.S. Environmental Protection Agency began monitoring the air for small particulate matter and hydrogen fluoride, a highly toxic gas emitted by lithium-ion battery fires. Officials set up nine nearby monitoring stations and did not detect harmful levels of either pollutant, the agency said, adding that the sensors for hydrogen fluoride can also detect other compounds.

“To be conservative and most protective of public health, our operations assumed anything we were detecting was hydrogen fluoride, which is the most harmful of these mineral acid gases,” the EPA said in a statement. “And, as noted before, no hydrogen fluoride exceeding health standards was detected.”



A contractor hired by Vistra simultaneously tested for most of the same compounds and received similar results.

➡ California Approves $2.5 Billion Fire Relief Plan Ahead of Trump's Pacific Palisades Visit

However, experts said sensors are unlikely to pick up hydrogen fluoride once the main smoke plume has died down.

"These chemistries dictate to us that those compounds are not going to last for a very long time in the air," said Michael Polkabla, the principal industrial hygienist with BioMax Environmental, a consulting firm specializing in hazardous materials and industrial hygiene. "So it's really irrelevant to measure hydrogen fluoride hours after the plume passes because it's going to be gone."

And although the full list of specific elements within Vistra's batteries is not publicly known, Polkabla has a few other pollutants he's concerned about.

"The metals — lithium, nickel, magnesium, cobalt are kind of the big four that would be produced and could have settled. These all have individual toxicities associated with them," Polkabla said.

A fire burns at Moss Landing Power Plant on Thursday, Jan. 16, 2025. *(Courtesy Iman-Floyd Carroll)*

Dustin Mulvaney, an environmental studies professor at San José State University, agreed, adding that a more comprehensive test would have required sending a drone into the smoke plume to test hydrogen fluoride there. He, like Polkabla, also worries about the other pollutants that the fire could have let off.

"You may think of a fire as a big chemical reactor doing an uncontrolled chemical reaction," Mulvaney said. "So it's actually the fire itself is sometimes manufacturing pollutants."

He added that the smoke plume could have carried some heat-resistant materials like metals or PFAS, also known as forever chemicals, because they take a very long time to break down.

"I think the public that's experiencing these symptoms is going to want to know what they were actually exposed to," Mulvaney said. "And I don't think that those EPA sensors are telling the full story of what was in that plume."

The EPA clarified that it did initially test for other compounds, including carbon monoxide and ammonia, then transitioned to focusing on particulate matter and hydrogen fluoride because they "are the two contaminants of concern from a battery fire that would pose a potential immediate health risk through inhalation."

On Jan. 20, four days after the fire started, the EPA ended its monitoring.

With the fire now over, Mulvaney and Polkabla both said that the best way to learn about the pollutants that were dispersed is to test soil and water samples both at the facility and in neighboring regions — including environmentally significant areas like Monterey Bay and the Elkhorn Slough.

"Those particles are not necessarily going away unless they're removed," Polkabla said. "If they're a hazard, we need to identify what it is and have a protocol for how to remove that."

During a Wednesday press briefing, Vistra's Senior Director of Community Affairs, Brad Watson, said the company might test the soil "if there are indications around the site that there might be some compounds or constituents that we think need to be tested."

Monterey County officials used similarly indefinite language during the meeting, but by Thursday afternoon, Supervisor Glenn Church announced that local and state officials plan to do both water and soil testing.

"I think there's been a lot of concerns from folks and in this area of what is really out there. So we're looking into that," Church said.

The county Health Department said late Thursday that local and state partners will work together on collecting samples of water, debris and dust at the Vistra facility and in nearby areas, though they have not yet determined a timeline. Additional water and soil testing will follow, county representatives said.

➡ **When an Oakland Hills Home Caught Fire Near Closed Station, the Response Was Slow**

Health officials added that residents who may have found residue from the fires on their property are urged to use caution when cleaning up.

In the meantime, some continue to worry about what they are potentially being exposed to.

Faste and her husband are considering leaving the area for a while in the hopes that her symptoms will diminish once she's farther from the site of the fire.

"We're debating what to do, you know? We live here. I have a disability, so it's really hard for me to go places. I'm in a wheelchair most of the time, so it's complicated," Faste said.

The couple will likely book a short-term rental or stay with family for about a week and then reevaluate. Although the move won't be easy, Faste said she has a compromised immune system and worries she'll get worse if they stay.

"We kind of moved in the mountains to be in the clean air," she said. "So it's kind of sad that we will have to leave because the air is not good."

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Current Emergency Information

2025 Moss Landing Vistra Power Plant Fire

Current Situation

Webpage updated 01/24/2025 11:19 AM

Impacted Areas	**Moss Landing**
EOC Activations	**Level 3**
Disaster Declaration	**Local Proclamation**

A lithium-ion battery fire broke out at the Moss Landing Vistra Power Plant on Thursday January 16, 2025. The cause of the fire is unknown.

View Incident Map (https://montereyco.maps.arcgis.com/apps/webappviewer/index.html?id=905a9458324b4868804d96b5593eb978)

Alerts, Warnings, and Evacuations

Emergency Personnel at the Moss Landing Vistra fire continue to monitor and evaluate the fire. It remains unknown how long the fire will last as first responders continue to evaluate the impacted building(s).

El personal de emergencia en el incendio de la planta Vistra en Moss Landing continúa monitoreando y evaluando el fuego. Aún se desconoce cuánto tiempo durará el incendio, ya que los equipos de emergencia continúan evaluando los edificios afectados.

View a slide presentation about the incident and a timeline of response presented to the County of Monterey Board of Supervisors 1.21.25 (https://www.readymontereycounty.org/home/showpublisheddocument/137921/638730600662000000)

Evacuation Orders and Warnings

The Monterey County Sheriff's Office has lifted all Evacuation Orders for the Moss Landing Vistra Power Plant Fire.

La Oficina del Sheriff del Condado de Monterey ha levantado todas las órdenes de evacuación por el incendio de la planta eléctrica Moss Landing Vistra.

Road Closures

Some County of Monterey Road Closures remain in place.

Road Closures (https://www.countyofmonterey.gov/government/departments-i-z/public-works-facilities-parks/public-works/road-closures-information)

Algunos cierres de carreteras en el Condado de Monterey permanecen en vigor.

Cierres de Carreteras (https://www.countyofmonterey.gov/government/departments-i-z/public-works-facilities-parks/public-works/road-closures-information)

Air Quality Monitoring Reports/ Reportes de Calidad de Aire

The US Environmental Protection Agency (EPA), the Monterey Bay Air Resources District (MBARD), and Vistra monitored the air quality in and around the fire perimeter and across Monterey County. The County of Monterey has received raw air quality data from the US EPA, which is being analyzed with assistance from the California Office of Environmental Health Hazard Assessment (OEHHA). Air monitoring results indicate that no levels of Hydrogen Fluoride (HF) exceeded OEHHA's acute Reference Exposure Level (REL) of 300 parts per billion (ppb) in the community, at Vistra's fence line, or at the site of the fire. The acute REL is the highest concentration of a chemical that a person can safely be exposed to for one hour without an increased risk of serious, non-cancer health impacts, including for children and sensitive individuals. No PM 2.5 levels exceeded the National Ambient Air Quality Standard (NAAQS) of 35 micrograms per cubic meter.

The County is committed to transparency and will continue to post raw data and additional information as it becomes available. The raw data collected by the US EPA will be made accessible through this webpage in downloadable spreadsheet format for public review.

La Agencia de Protección Ambiental de los Estados Unidos (EPA), el Distrito de Recursos del Aire de la Bahía de Monterey (MBARD) y Vistra monitorearon la calidad del aire dentro y alrededor del perímetro del incendio y en todo el Condado de Monterey. El Condado de Monterey ha recibido datos preliminares de la calidad de aire de la EPA de EE.UU, los cuales están siendo analizados con la ayuda de la Oficina de Evaluación de Riesgos para la Salud Ambiental de California (OEHHA). Los resultados de el monitoreo de aire indican que ningún nivel de fluoruro de hidrógeno (HF) superó el Nivel de Exposición de Referencia (REL) agudo de la OEHHA de 300 partes por billón (ppb) en la comunidad, en el perímetro de Vistra o en el sitio del incendio. El REL agudo es la concentración más alta de un químico a la que una persona puede estar expuesta de manera segura durante una hora sin un mayor riesgo de efectos graves en la salud no relacionados con el cáncer, incluyendo a niños y personas sensibles. Ningún nivel de PM 2.5 superó el estándar nacional de Calidad del Aire Ambiental (NAAQS) de 35 microgramos por metro cúbico.

El Condado está comprometido con la transparencia y continuará publicando datos preliminares e información adicional a medida que esté disponible. Los datos preliminares recopilados por la EPA de EE.UU estarán disponibles en esta página web en formato de hoja de cálculo descargable para revisión pública.

EPA Air Quality Monitoring Results:

Data Summary Moss Landing 1-20-25 12pm-5pm
(https://www.readymontereycounty.org/home/showpublisheddocument/137883/638730444254670000)

Data Summary Moss Landing 1-20-25 6am-11am
(https://www.readymontereycounty.org/home/showpublisheddocument/137877/638729906742400000)

Data Summary Moss Landing 1-19-25 11pm-5am
(https://www.readymontereycounty.org/home/showpublisheddocument/137869/638729907362970000)

Data Summary Moss Landing 1-19-25 6pm-11pm
(https://www.readymontereycounty.org/home/showpublisheddocument/137873/638729907234830000)

Data Summary Moss Landing 1-19-25 12pm-5pm
(https://www.readymontereycounty.org/home/showpublisheddocument/137871/638729907307730000)

Data Summary Moss Landing 1-19-25 6am-11am
(https://www.readymontereycounty.org/home/showpublisheddocument/137875/638729907168930000)

Data Summary Moss Landing 1-19-25 12am-5am
(https://www.readymontereycounty.org/home/showpublisheddocument/137867/638729907457000000)

Data Summary Moss Landing 1-18-25 6pm-11pm
(https://www.readymontereycounty.org/home/showpublisheddocument/137865/638729907517000000)

Data Summary Moss Landing 1-18-25 12pm-5pm
(https://www.readymontereycounty.org/home/showpublisheddocument/137863/638729907574670000)

SPM Flex Data 1-17-25
(https://www.readymontereycounty.org/home/showpublisheddocument/137861/638729907674530000) ← earliest data from EPA (see attached)

Dust Trak Data 1-17-25
(https://www.readymontereycounty.org/home/showpublisheddocument/137859/638729907734130000)

The U.S. Environmental Protection Agency (EPA) has concluded supplemental air monitoring in the vicinity of the Vistra Energy battery power storage facility fire in Moss Landing and demobilized operations. Results for hydrogen flouride and particulate matter showed no risk to public health throughout the incident, and smoke from the facility has greatly diminished.

Press Release: EPA Completes Air Monitoring Near Moss Landing Vistra Battery Fire (https://www.countyofmonterey.gov/home/showdocument?id=137931)

La Agencia de Protección Ambiental de EE.UU. (EPA) ha concluido el monitoreo de aire suplementario en los alrededores del incendio de la instalación de almacenamiento de energía de baterías de Vistra Energy.

Comunicado de Prensa: La EPA finaliza el monitoreo del aire acerca del incendio de batería Vistra en Moss Landing (https://www.readymontereycounty.org/home/showpublisheddocument/137933/638730779196700000)

Vistra Moss Landing Incident Preliminary Air Monitoring Summaries:

CTEH ← report attached

- January 17, 2025 (https://www.mosslandingresponse.com/s/Preliminary-Data-Summary-2025-01-17.pdf)
- January 18, 2025 (https://www.mosslandingresponse.com/s/Preliminary-Data-Summary-2025-01-18-1630-v10.pdf)
- January 19, 2025 (https://www.mosslandingresponse.com/s/Preliminary-Data-Summary-2025-01-19-v10.pdf)
- January 20, 2025 (https://www.mosslandingresponse.com/s/Preliminary-Data-Summary-2025-01-20-v10.pdf)
- January 21, 2025 (https://www.mosslandingresponse.com/s/Preliminary-Data-Summary-2025-01-21-v10.pdf)

Vistra Energy Incident Page

https://www.mosslandingresponse.com/ (https://www.mosslandingresponse.com/)

Additional Air Monitoring Resources

Current air quality conditions can be found on MBARD's website:

MBARD Air Quality Forecast (https://www.mbard.org/current-air-quality-forecast-1ac8512)

MBARD Wildfire Smoke Information and Resources (https://www.mbard.org/wildfire-smoke-information-and-resources)

MBARD Resumen de Calidad de Aire (https://www.mbard.org/current-air-quality-forecast-1ac8512)

MBARD Recursos e informacion sobre humo de incendios forestales (https://www.mbard.org/wildfire-smoke-information-and-resources)

NEW! Moss Landing Event FAQs (https://www.countyofmonterey.gov/Home/Components/News/News/11126/1336?backlist=%2fgovernment%2fdepartments-a-h%2fhealth%2f)

NEW! Information Sheet: Hydrogen Fluoride (HF) and Particulate Matter (PM) from a Battery Fire (https://www.readymontereycounty.org/home/showpublisheddocument/137857/638731404049270000)

Health Information for High Risk Individuals Near Smoke/Informacion de salud para individuos de alto riesgo cerca del humo

Health officials in Monterey, San Benito, and Santa Cruz Counties understand that individuals may be concerned about potential impacts of smoke on their health and the health of their family and friends. Local health officials wish to remind community residents that smoke may cause eye and throat irritation, coughing, and difficulty breathing. People who may be the most sensitive to smoke from a fire include:

- Young children,
- Older adults,
- Pregnant people, and
- People with heart and lung conditions such as heart failure, asthma, and chronic obstructive pulmonary disease, also called COPD.

Station ID	Location	Type	Gas Name	Timestamp	Measurement (PPM)
→ 2	Fire East	TWA	Hydrogen Fluoride	1/17/25 7:54	0.000 ppm
2	Fire East	TWA	Hydrogen Fluoride	1/17/25 4:42	0.000 ppm
1	Fire North	TWA	Hydrogen Fluoride	1/17/25 16:00	0.000 ppm
N/A	Fire West	TWA	Hydrogen Fluoride	1/17/25 16:00	0.000 ppm

EPA's earliest data reported 7:54 am on 1/17/25 (approximately 17 hours after fire begins)

CTEH

Monitoring starts at 5:30 am on Jan. 17th approximately 14 hrs. after fire begins.

Moss Landing Incident Preliminary Air Monitoring Summary

January 17, 2025

Moss Landing, California

1.0 Introduction

On January 17, 2025, CTEH, LLC began conducting community air monitoring in the area surrounding the Moss Creek Battery Fire which began on January 16, 2025. Air monitoring was conducted to assess the potential community exposure to compounds which may be present during fires involving lithium batteries. This report summarizes data collected on January 17, 2025 from 05:30 to 17:30.* During this monitoring period, all measurements were below site-specific action levels.

2.0 Real-time Air Monitoring

Real-time air monitoring refers to the use of direct-reading instruments to provide a near-instantaneous measurement of chemical concentration in the air. CTEH personnel developed and implemented a Preliminary Air Sampling and Analysis Plan (SAP) to characterize the nature and extent of the potential release.

Air monitoring efforts focused on monitoring hydrogen fluoride (HF), hydrogen chloride (HCl), carbon monoxide (CO), hydrogen cyanide (HCN), 2.5 µm particulate matter ($PM_{2.5}$), along with percentage of the Lower Explosive Limit (%LEL). Measurements were recorded at heights representative of community breathing zones. All instrumentation was calibrated at least daily or per manufacturer's recommendations.

2.1 Handheld Real-Time Monitoring Results

During this monitoring period, no detections of site-specific action levels occurred for the compounds measured in **Table 1**, except for $PM_{2.5}$ using handheld real-time monitoring equipment. The measured concentration of $PM_{2.5}$ remained below the site-specific action level of 0.138 mg/m^3 over a period of 15-minutes. **Appendix A** contains maps of monitoring locations by analyte.

Table 1 Handheld Real-Time Air Monitoring Results

Analyte	Count of Measurements	Count of Detections	Range of Measurements
CO	110	0	< 1 ppm
HCl	124	0	< 1 ppm
HCN	126	0	< 0.5 ppm
HF	71	0	< 0.4 ppm
%LEL	29	0	< 1 %
O_2	28	28	20.9 %
$PM_{2.5}$	118	117	0.001 - 0.042 mg/m^3

**Analytes with no detections are reported as less than (<) the instrument's Limit of Detection (LOD)*

ppm=parts-per-million

* *The data provided has not yet undergone full quality assurance and quality control (QAQC) processes and therefore is considered preliminary.*

No information from Appendix A included

Appendix A: Handheld Real-Time Air Monitoring Locations

CTEH®

Handheld Real-Time Air Monitoring | Community Monitoring

Moss Landing Incident | January 15, 2025 05:34 - 17:30

Project: PROJ 050399
Client: Vistra Corp.
City: Moss Landing, CA
County: Monterey