Project Description

Coppell Battery Energy Storage System (BESS) Project

APRIL 2023

Prepared for:

PROLOGIS Energy

2021 McKinney Ave, Suite # 1050
Dallas, Texas, 75201

Prepared by:

DUDEK

Table of Contents

INTENTIONALLY LEFT BLANK

Acronyms and Abbreviations

Acronym/Abbreviation	Definition
Applicant	Prologis Energy
BESS	Battery Energy Storage System
CMU	concrete masonry units
ERCOT	Electric Reliability Council of Texas
HVAC	heating, ventilation and air conditioning systems
MW	megawatts
MV	medium voltage
NFPA	National Fire Protection Association
Project	Coppell Battery Energy Storage System
PCS	Power Conversion System
PUCT	Public Utility Commission of Texas
RPS	Renewable Portfolio Standard
UL	Underwriters Laboratories

INTENTIONALLY LEFT BLANK

1 Introduction

Prologis Energy (Applicant) proposes to construct and operate the Coppell Battery Energy Storage System (Project) on approximately 0.33 acres of a 26-acre site to store 10 megawatts (MW) of energy. The Project site is located at 360 Freeport Parkway, Coppell, Texas 75019 (See Figure 1). The site is located entirely within the jurisdiction of the City of Coppell and zoned Light Industrial (LI) per the City's Zoning Ordinance.

The following project description has been prepared to provide an overview of the proposed facilities to better help inform the City and interested parties on the project components features and measures being put in place by the Applicant to ensure the Project is safe and reliable.

Battery storage devices do not generate any air emissions or harmful radiation and involve little to no fire risk when properly designed, installed, tested and operated. The battery storage systems contain protection and control features, including a battery management system that shuts down when operational environments are anything less than optimal.

The Project includes battery energy storage system (BESS) with associated power conversion systems, perimeter wall, metering equipment, landscaping improvements and supervisory control and data acquisition system. The Project includes a dedicated feeder to ensure that the installation does not take up existing capacity on distribution lines. This also helps ensure reliability, i.e. a dedicated feeder is less likely to be impacted by problems in other parts of the system.

The Project Site is located in an industrial and commercial park area adjacent to paved parking lots (see Appendix A, Visual Renderings). The Project Site itself consists of ornamental landscaping including trees and grass that are regularly maintained by a landscaping company. Land uses to the north consists of a commercial center, land uses to the south consist of industrial uses for trucking distribution, land uses to the east and west consist of paved parking lots. The site is immediately adjacent to a paved road that is used for hauling trucks and employees to gain access to the industrial facilities.

INTENTIONALLY LEFT BLANK.

2 Project Objectives

In 1999, the Public Utility Commission of Texas (PUCT) adopted a rule that set the state's Renewable Portfolio Standard (RPS) based on a bill enacted by the Legislature as part of restructuring in Texas. The RPS mandated that 5,000 MW of new renewable energy be installed in Texas by 2015 and set a target of 10,000 MW of renewable energy capacity by 2025. Texas surpassed its 2025 target in 2009 and had 26,045 MW of additional renewable energy capacity in 2017 relative to 1999.

The American Clean Power Association 2021 report shows Texas as the leading state in the nation in clean energy capacity that is under construction or in advanced development (including battery storage). With approximately 10,000 MW of deployed renewables and over 18,000 MW underway, the state has an increasing demand for energy storage. At the federal level, the Federal Energy Regulatory Commission Order No. 792 provides clarity through its direction to transmission providers to define electric storage devices as generating facilities, enabling these resources to take advantage of generator interconnection procedures.

Battery storage is a rapidly growing technology that has experienced significant growth in the last decade. The initial driver for this technology has been electric vehicles. However, larger stationary battery storage facilities are becoming more common. The need to store energy for use at peak times, improve reliability, and enhance the dispatching of electricity contribute to the need for more battery storage. Currently, there are several large (>10 MW) battery storage facilities located throughout Texas, with many more slated for construction. In ERCOT's 2021 State of the Market Report, approximately 24 storage projects came online in 2021 and increased ERCOT's storage capacity to approximately 1 GW. According to the latest Generator Interconnection Status report (Feb. 2023) of planned generation resources in the ERCOT Region, there over 300 planned stand-alone BESS facilities (>50,000 MW). ERCOT and electric utility providers in Texas have elected to prioritize and fast track <10MW BESS. They see the value of peak shifting, and fast frequency response that batteries can provide better than traditional resources.

Energy storage facilities are critical for meeting Texas RPS standards as they increase the different resource mix along with other renewable energy sources. Collectively, these improvements will significantly improve generation and load resources, reduce overall production costs, and improve shortage pricing. In addition to helping the nation, state, and utilities meet their renewable energy goals, the Project would also provide substantial economic benefits. Specifically, the Project would create substantial economic activity from the construction and operation of the Project, including a significant number of construction jobs, increased tax base, and increase in local business activity.

INTENTIONALLY LEFT BLANK

3 Project Characteristics

The Project will be composed of lithium-ion batteries installed in purpose-built enclosures designed for aesthetic compatibility with the surrounding area. The enclosures will have battery storage racks, with relay and communications systems for automated monitoring and managing of the batteries to ensure design performance. A Battery Management System (BMS) will be provided to control the charging/discharging of the batteries along with temperature monitoring and control of the individual battery cell temperature with an integrated cooling system. Batteries operate with direct current (DC) electricity that must be converted to alternating current (AC) for compatibility with the existing electric grid. Power inverters to convert between AC and DC, along with Power Conversion Systems to step up the voltage, will be included.

The proposed facility will provide a service to the regional electric grid by receiving energy (charging) from the Oncor electric transmission system, storing energy on site, and then later delivering energy (discharging) back to the regional grid. Following construction, the proposed use will not create emissions to air, will not require sanitary facilities, and will not require water.

3.1 Battery Energy Storage System

The BESS would include multiple self-contained, prefabricated container units in a parallel configuration. The enclosure units are anticipated to include a nameplate capacity of 344 KW. There would be no internal open space available for entry or occupation, and all battery cabinets would be fully accessible from the exterior of the enclosure via external doors.

Each enclosure unit would have a fire rating in conformance local fire authority fire permit and City of Coppell standards. Each unit would also be equipped with HVAC systems for thermal management of the batteries. Power to the HVAC and lighting would be provided through a connection to local grid. The BESS would be unmanned, and operational control would be performed off-site. Operational staff would also perform periodic inspections and maintenance as necessary.

This system would be powered from a remote uninterruptable power supply as well as a redundant battery backup local to each cabinet. Only batteries that are Underwriters Laboratories ("UL") certified and that include built-in fail safes designed specifically to prevent thermal runaway and the spread of fire would be used. The batteries proposed were required to go through UL9540A testing per NFPA 855 (Standard for the Installation of Energy Storage Systems) at the cell, module, and unit level. Therefore, not only are the batteries tested at an individual level (i.e., cell level), they are additionally tested at the unit level with all its components as they will be installed in a real-world installation. The Applicant will meet with the local building and fire officials to verify that the proposed vendor, model, and fire protection system to be installed are in compliance with local code.

The project includes two pad areas (Pad #1 and Pad #2). Pad #1 includes containers for the initial project set-up and Pad #2 includes areas for the future augmentation as BESS cabinets need to be replaced pending performance.

3.2 Power Conversion Systems, Auxiliary Power, and System Control

Power Conversion Systems (PCS) will be located adjacent to the BESS enclosures. These PCSs will convert the electricity from AC/DC (and vice-versa) and step the electricity delivered up on its way to the Project's interconnection and main on-site transformer. The proposed PCS would have integrated battery charge and discharge management, as well as a temperature controlled liquid-cooling system. The PCS is anticipated to be approximately 10 feet in height. The area adjacent to the PCS will also include required metering equipment for ONCOR and ERCOT. The PCS equipment will be utilized to support a distribution feeder that is required to ensure that the installation does not take up existing capacity on distribution lines. This also helps ensure reliability, i.e. a dedicated feeder is less likely to be impacted by problems in other parts of the system.

From the PCS equipment, cabling will be run to the BESS enclosures. All outside electrical equipment will be housed in the appropriate National Electrical Manufacturers Association (NEMA) rated enclosures and screened from view, to the extent possible, on all sides. All on-site outside electrical cabling will be run underground.

The Applicant uses only industry-standard, nationally (and internationally) recognized equipment. These PCS are unattended, stand-alone units that operate in all conditions. They operate in both a charge mode and a discharge mode. They are UL listed for bi-directional use and are monitored and controlled remotely. There will be on-site disconnects in the case of an emergency or unscheduled maintenance. They are robust in their design and are designed to last more than 30 years with proper preventive maintenance, scheduled maintenance, and occasional major overhauls.

Telecommunication Facilities

The project will also require telecommunication facilities to meet the communication requirements for interconnecting and communicating with the Oncor/ERCOT facilities and to support remote project operations monitoring. The project will use local exchange carrier services for telecommunication to support remote monitoring requirements. The project will connect to telecommunication fiber-optic lines owned and managed by local telecommunication providers.

The SCADA system is critical to ERCOT and Oncor utility interconnection and for the proper operation and maintenance of the project. The SCADA system uses proprietary software; a fiber-optic transmission system; a telephone, radio, and/or microwave communication network; and other means of communication such as radio links and phase loop communication systems. The SCADA system functions as a remote start, stop, reset, and tag out for the facility, thus minimizing the labor and site diagnostic information generated from the panels. The SCADA system will also allow for fully centralized operation of the project to meet all ERCOT and utility interconnection requirements.

Site Access and Security

The project site can be accessed from various roadways. Highway 121 is the largest highway in the immediate area and provides regional access to the project site from the north and the south. Access to the project site will be provided via Freeport Parkway. No new roads will be required to provide access to the project site. The site is located along an existing truck route.

Permanent motion-sensitive, directional security lights will be installed to provide adequate illumination around the substation areas and points of ingress/egress. All lighting will be shielded and directed downward to minimize the potential for glare or spillover onto adjacent properties. Security cameras will be placed on site and monitored 7 days a week and 24 hours per day.

3.3 Perimeter Wall, Landscaping and Lighting

Perimeter Wall and Landscaping

The perimeter of the Project would be enclosed by an 8-foot-tall concrete masonry units (CMU) wall with decorative columns placed approximately every 25 feet. Access would be controlled through drive-through gates. The purpose of the wall would be to prevent unauthorized access to the site and provide visual aesthetic enhancements.

The project also includes landscaping along the northern, southern and western perimeter. An existing live oak within the project footprint will be translocated to the eastern edge of the of the site. The landscaping plan includes the following plant list; (8) Bald Cypress, (28) Eastern Red Cedar, (25) Like Oak, (21) Red Oak "Shumard" and (37) Nellie R Stevens Holly.

Lighting

Low-elevation (<14-foot), controlled security lighting would be installed at primary access gates and the entrance to energy storage structures. The lighting would only switch on when personnel enter the area (through either motion-sensor or manual activation [switch]). All safety and emergency services signs would be lit when the lights are on. The lighting would be shielded so the light is directed downwards. Electrical power to supply the access gate and lighting would be obtained from Oncor. Lighting would be only in areas where it is required for safety, security, or operations. All lighting would be directed on site and would include shielding as necessary to minimize illumination of the night sky or potential impacts to surrounding viewers.

3.4 Construction

Construction would be primarily composed of the following activities:

- **Site Preparation:** The site would be prepared for construction. For example, rough grading may be performed where required to accommodate the support structures and access roads.
- **Electrical Work and BESS Container Installation:** Following site preparation, electrical work will be completed to connect the BESS enclosures to the PCS structures. The enclosure modules would be off-loaded and installed using cranes, boom trucks, forklifts, rubber-tired loaders, and other small- to medium-sized construction equipment, as needed.

Site preparation and construction will occur in accordance with all federal, state, and City zoning codes and requirements. All applicable federal, state, and local requirements and best management practices (BMPs) will be incorporated into the construction activities for the project site. Beginning work on the project site will involve preparing the land for installation of the BESS-related infrastructure, access driveways, and temporary construction staging areas.

The construction contractor will be required to incorporate BMPs consistent with the City zoning to reduce potential impacts related to construction of the proposed project. Prior to initial construction mobilization, pre-construction surveys will be performed and sediment and erosion controls will be installed in accordance with state and City guidelines. Stabilized construction entrances and exits will be installed at driveways to reduce tracking of sediment onto adjacent public roadways.

Dust-minimizing techniques will be employed, such as application of water, and application of dust suppressants. Earthworks, excavators, water trucks, haul vehicles, and graders may all be used to perform grading. Land-leveling equipment, such as a trench roller and tamping ram, will be used to even the surface of the ground and to compact the upper layer of soil to a value recommended by a geotechnical engineer for structural support. Soil movement from grading will be balanced on the site.

Trenching will be required for placement of underground electrical and communication lines, and may include the use of trenchers, backhoes, excavators, haul vehicles, compaction equipment, and water trucks. After preparation of the site, the pads for structures will be prepared per geotechnical engineer recommendations.

During this work, multiple crews will be working on the site with various equipment and vehicles, including vehicles for transporting the batteries and other equipment. As the BESS enclosures are constructed, the electrical collection and communication systems will be installed. The wiring will connect to the appropriate electrical and communication terminations and the circuits will be checked and commissioned prior to operation.

Schedule

The Project is anticipated to be built over an approximately 3-month timeframe, commencing June 2023 and ending in August 2023. Estimated durations of construction activities is presented below in Table 1. It is anticipated that the work would be completed in 8- or 10-hour shifts, with a total of five shifts per week (Monday–Friday). Overtime and weekend work would be used only as necessary to meet scheduled milestones or accelerate schedule and would comply with applicable Texas labor laws.

Table 1. Estimated Construction Activity Durations

Construction Activity	Duration
1) Site Preparation	2 Weeks
2) Battery/Container Installation	4 Weeks
3) Power Conversion Systems, Auxiliary Power, and System Control	4 Weeks
4) Perimeter Wall, Landscaping and Lighting	4 Weeks

Traffic

Delivery of material and supplies would reach the Project through on-road truck delivery through Highway 121 to Freeport Parkway. The majority of the truck deliveries would be for the battery enclosures, inverters, and transformer material, as well as any concrete or aggregate material that may be required for foundations.

Water Use

During construction of the proposed project, water will be required for common construction-related purposes, including but not limited to dust suppression, soil compaction, and grading. Dust-control water may be used during ingress and egress of on-site construction vehicle equipment traffic and during the construction of the energy storage equipment. A sanitary water supply will not be required during construction, because restroom facilities will be provided by portable units to be serviced by licensed providers. During the 3-month construction period, the water used is anticipated to be supplied by purchasing water from the local water purveyor.

Solid and Nonhazardous Waste

The project site will produce a small amount of solid waste from construction activities. This may include paper, wood, glass, plastics from packing material, waste lumber, insulation, scrap metal and concrete, empty nonhazardous containers, and vegetation waste. These wastes will be segregated, where practical, for recycling. Non-recyclable wastes will be placed in covered dumpsters and removed on a regular basis by a certified waste-handling contractor for disposal at a Class III (nonhazardous waste) landfill.

Hazardous Materials

The hazardous materials used for construction will be typical of most construction projects of this type. Materials will include small quantities of gasoline, diesel fuel, oils, lubricants, solvents, detergents, degreasers, paints, ethylene glycol, dust palliatives, herbicides, and welding materials/supplies. A hazardous materials business plan will be prepared to manage materials during construction. The hazardous materials business plan will include a complete list of all materials used on site and information regarding how the materials will be transported and in what form they will be used. This information will be recorded to maintain safety and prevent possible environmental contamination or worker exposure. During project construction, material safety data sheets for all applicable materials present at the site will be made readily available to on-site personnel.

Hazardous Waste

Small quantities of hazardous wastes will most likely be generated over the course of construction. These wastes may include waste paint, spent construction solvents, waste cleaners, waste oil, oily rags, waste batteries, and spent welding materials. Workers will be trained to properly identify and handle all hazardous materials. Hazardous waste will be either recycled or disposed of at a permitted and licensed treatment and/or disposal facility. All hazardous waste shipped off site for recycling or disposal will be transported by a licensed and permitted hazardous waste hauler.

3.5 Operations and Maintenance Activities

Typical operations and maintenance activities that will occur on the project site during operation include, but are not limited to, liaison and remote monitoring administration and reporting; semi-annual and annual services; remote operations of batteries, PCS's, and site security and management; additional communication protocols; and repair and maintenance of the BESS, and other project facilities. The electrical equipment; heating, ventilation, and air conditioning; fire protection systems; and security will be automated and monitored remotely. In-person inspections will be included as needed, as part of a security contract. The site will be unoccupied but will be visited periodically through the year for equipment inspections, monitoring and testing, and maintenance as needed.

Batteries and various components will be replaced or renewed as necessary to ensure optimal performance. The operations and maintenance activities will be completed by one to two employees, who will visit the site approximately every 2 to 4 weeks.

Solid and Nonhazardous Waste

The project will produce a small amount of waste associated with maintenance activities, which could include broken and rusted metal, defective or malfunctioning electrical materials, empty containers, and other miscellaneous solid waste, including the typical refuse generated by workers. Most of these materials will be collected and delivered back to the manufacturer or to recyclers. Non-recyclable waste will be placed in covered dumpsters and removed on a regular basis by a certified waste-handling contractor for disposal at a Class III landfill.

Hazardous Materials

Limited amounts of hazardous materials will be used on the site during operations, including diesel fuel, gasoline, and motor oil for vehicles; mineral oil to be sealed within the transformers; and lead-acid-based batteries for emergency backup. Appropriate spill containment and cleanup kits will be maintained during operation of the project. A spill prevention control and countermeasures plan will be developed for site operations.

Hazardous Waste

Fuels and lubricants used in operations will be subject to the spill prevention control and countermeasures plan to be prepared for the proposed project. Solid waste, if generated during operations, will be subject to the material disposal and solid waste management plan to be prepared for the proposed project.

Security and Lighting

The proposed project will be fenced to help prevent access by the public. Gates will be installed at the roads entering the project site at the western and eastern limits of the site. Limiting access to the project site will be necessary both to ensure the safety of the public and to protect the equipment from potential theft and vandalism.

The project's lighting system will provide operations and maintenance personnel with illumination for both normal and emergency conditions. Lighting will be designed to provide the minimum illumination needed to achieve safety and security objectives. Additionally, lighting will be directed downward and shielded to focus illumination on the desired areas only and to minimize light trespass.

Fire Safety

With growing concerns of the potential hazards associated with lithium-ion battery storage, the proposed BESS system would be built with safety features at the forefront of the design process. Each battery cabinet has its own aerosol fire suppression system integral to its construction. This system is powered from a remote uninterruptable power supply as well as a redundant battery backup local to each cabinet. They are also equipped with a port on the top side to enable the fire department to fill any container needed with water without having to open the door. The batteries are required to go through UL9540A testing per NFPA 855 at the cell, module, and unit level. This means that the batteries are tested at an individual level (i.e., cell level), as well as at the unit level with all its components as they will be installed in a real-world installation. The risk of fire is extremely low with the system having the ability to automatically identify and isolate any issues prior to a fire starting. The energy storage devices and hardware will be acquired from reputable suppliers. The installation will be reviewed by a fire protection engineer and with input from the local Fire Marshall. The project will also comply with all NFPA 855 standards.

In addition to these safety features the Applicant has contracted with Fisher Engineering, Inc. for Fire Protection Engineering (FPE) consultation. The primary contact for this FPE is Mr. Andrew Blum. Mr. Blum has a Bachelor of Science and a Master of Science degree in Fire Protection Engineering from the University of Maryland. He is also a principal member on the technical committee on NFPA 855, Standard for the Installation of Stationary Energy Storage Systems and is an active member of the NFPA, ICC, ASTM and Society of Fire Protection Engineers. He has specific expertise in fire-testing lithium- ion batteries used in consumer electronics/products, battery energy storage systems, electric drive vehicles, and in-storage configurations. In addition, Mr. Blum has special expertise in evaluating and performing third-party reviews of BESS products for manufacturers and evaluating proposed BESS installations for energy companies.

3.6 Decommissioning

At the end of the Project's life, the BESS would be recycled as described in the following section. Most parts of the proposed system are recyclable. Batteries include lithium-ion, which degrades but can be recycled or repurposed. Battery enclosures include steel or aluminum, with concrete foundations which can also be recycled. Local recyclers are available, and metal and scrap equipment and parts that do not have free-flowing oil may be sent for salvage.

Fuel, hydraulic fluids, and oils would be transferred directly to a tanker truck from the respective tanks and vessels. Storage tanks and vessels would be rinsed and transferred to tanker trucks. Other items that are not feasible to remove at the point of generation, such as lubricants, paints, and solvents, would be kept in a locked utility structure with integral secondary containment that meets applicable requirements for hazardous waste storage until removal for proper disposal and recycling. It is anticipated that all oils and batteries would be recycled at an appropriate facility. Site personnel involved in handling these materials would be trained to properly handle them. Enclosures used to store hazardous materials would be inspected regularly for any signs of failure or leakage. Transportation of the removed hazardous materials would comply with applicable regulations for transporting hazardous materials, including those set by the U.S. Department of Transportation, U.S. Environmental Protection Agency, Texas Public Health Region 11 Toxic Substance Control Division, Texas Highway Patrol, and Texas State Fire Marshal.

INTENTIONALLY LEFT BLANK

4 Regulatory Setting

The proposed facility would be required to comply with all applicable regulatory provisions, including but not limited to the following:

- Coppell Adopted Code, including:
  - International Building Code
  - International Mechanical Code
  - National Electrical Code
  - International Energy Conservation Code
- International Fire Code, as adopted by section 15-5-1 of the City of Coppell Municipal Code
- City of Coppell Municipal Code and Zoning Ordinance

4.1 Hazardous Materials Management

The facility will be required to prepare a Hazardous Materials Business Plan (HMBP) for its construction and operations in compliance with applicable regulations. The hazardous materials that are anticipated to be used at the project site are safe under normal handling and operating conditions. Each individual BESS enclosure will be monitored and controlled to ensure safe and efficient operations, and every BESS enclosure will be equipped with an integrated fire suppression system, ventilation, as well as gas, heat, and smoke detection and alarms. The system will be designed, constructed, and operated pursuant to the most recently adopted Fire Code.

The following hazardous materials are anticipated to be present at the Project site during construction, operation, and decommissioning of the Project site:

- Petroleum such as Diesel No. 2 or gasoline may be stored onsite during construction to fuel construction equipment, though it is not anticipated to be stored onsite during the operation of the site.
- Lithium-ion batteries commonly contain the heavy metals cobalt, copper, and nickel as well as other trace heavy metals depending on the location of the source of the mined components. The exact components will be provided when the batteries are sourced closer to construction. These materials are fully encased and contained in the battery modules, and will be fully removed from the site when the project is decommissioned.

4.2 Land Use and Zoning

The City of Coppell 2030 Comprehensive Plan presents a vision for the City's future land use, development, preservation, and resource conservation decisions. The General Plan includes goals, policies, and programs that address a broad range of topics required by State law and that address unique local concerns (City of Coppell 2016). The Project site is designated as Industrial Special District per the Land Use Element of the 2030 Comprehensive Plan. The following Land Use (LU) Policy for this district would apply to the Project:

- LU-2: Encourage the redevelopment and reuse of lands used in the past or already used for linear "strip commercial" development to uses compatible with the adjoining neighborhoods and focus more compact "nodal: pattern of higher intensity development to mixed-used activity centers. Include densities in these areas that support transit use.

Additionally, the Project is also in line with the City's "ecoCoppell" sustainability initiative to provide public infrastructure and facilities that are retrofit for energy efficiency. Once installed, the Project would occupy less than 0.3 acers of green space on a previously developed lot. By enabling peak shifting, BESS facilities, such as the one proposed by this Project, allow for more effective use of pre-existing power available on the grid, thus providing electrical resiliency and lower cost energy to the community.

The Project site is zoned Light Industrial (LI) per the City's Zoning Ordinance. Per Article 30 Section 12-30-12, electrical substation, transmission line, and other public use utility project may be permitted via a special use permit within the LI zone.

The location of the Project was selected because of the existing industrial and commercial facilities in the area and that no new lands would need to be disturbed beyond those currently being used for industrial purposes. The Project would utilize the existing direct feeder being added to enable the batteries to provide fast frequency response. No new disturbance would be required which results in an excellent opportunity to provide energy grid resiliency in the area.

The project site is located within Light Industrial zoned lands where electric substation, telephone exchange, transmission line or other public use utilities are a permitted use, provided that such manufacturing or industrial operation shall not disseminate dust, fumes, gas, noxious odor, smoke, glare, or other atmospheric influence beyond the boundaries of the property on which such use is located and which produces no noise exceeding in intensity at the boundary of the property the average intensity of noise of street traffic at that point and provided that such use does not create fire hazards on surrounding property.

The purpose of the light industrial zone is to provide for manufacturing and other uses that are generally passive because the light industrial zone can be established adjacent to residential and commercial areas. Battery storage is a passive utility use that has no emissions, noise, night lighting or onsite employees, and is similar to other permissible uses in the light industrial zone (warehouses and distribution, fuel dispensing for private industry and others).

As demonstrated by the materials provided to the City, the Project would not generate any hazards and nuisance conditions beyond the property line that would potentially impact other land uses in the vicinity. See Appendix A for a visual rendering that demonstrates compatibility with surrounding land uses.

4.3 Noise

The Project site is in a developed area surrounded by industrial uses. Per noise modeling completed for similar facilities, sound emission from a 1-hour-long period of all operating battery energy storage enclosures stays below 63 dBA Leq within 10 feet of the operating components. Consequently, noise sources affecting noise levels on the Project site and in the vicinity include industrial land use noise sources, primarily of vehicular traffic and existing energy generation production. The proposed Project facilities are not anticipated to generate significant noise and the Project would be designed to meet the requirements of City municipal code.

4.4 Air Quality

The Project would not increase long-term operational criteria air pollutant emissions. The Project would collect and store energy but would not itself be a source of air pollutant emissions. The Project would not increase operational mobile source emissions as minimal vehicle trips would be added by the Project. Emissions of criteria pollutants during construction would be minimal for all construction phases for all pollutants and construction activities would be required to implement standard measures as required by City grading permit to minimize air emissions during construction.

A Hazardous Consequences Analysis has been prepared for the Project (see Appendix B), to evaluate the project's potential to cause adverse health effects on nearby sensitive receptors in the highly unlikely scenario of a thermal runaway event. As presented in Appendix B, emissions calculations indicated that for all of the modeled scenarios, the public health impacts from toxic pollutants associated with the worst-case battery cell malfunction scenario would be less than significant.

4.5 Fire Protection

The Applicant will use battery storage systems that are NFPA 855 Code compliant and UL Certified and that include built-in failsafe and cooling systems designed to prevent thermal runaway and the spread of fire. A fire protection system will be installed to automatically shut down the affected battery storage components and prevent the spread of the fire to the other battery storage modules.

The City will have review and approval rights for the facility fire protection and suppression plans. The review/approval by the authority having jurisdiction will cover all applicable design, construction, and testing requirements of the NFPA 855 Code.

INTENTIONALLY LEFT BLANK

5 Representative Project Photos

Photo 1: Overview of a typical Battery Energy Storage System (BESS) containers.

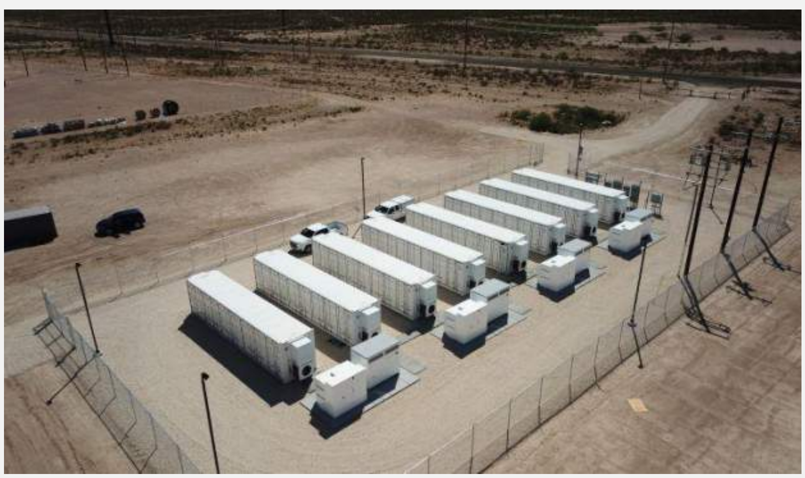
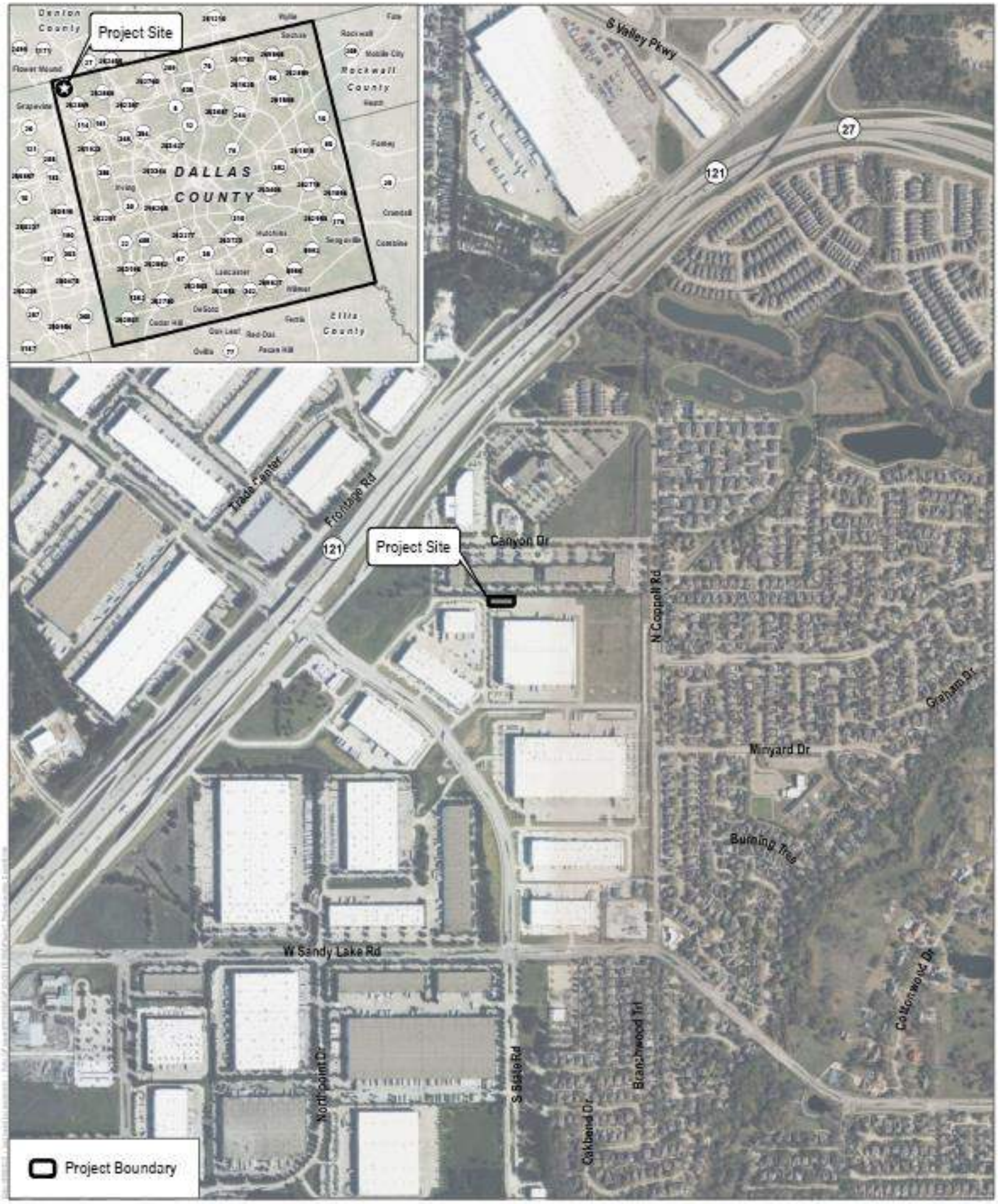


Photo 2: Aerial view of a typical BESS Project site.



SOURCE: Bing Maps 2023

DUDEK

0 500 1,000 Feet

FIGURE 1
Project Location
Coppell BESS

Appendix A
Visual Renderings

Existing view

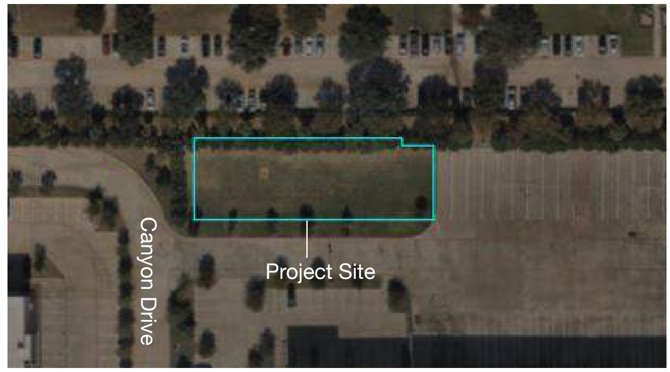


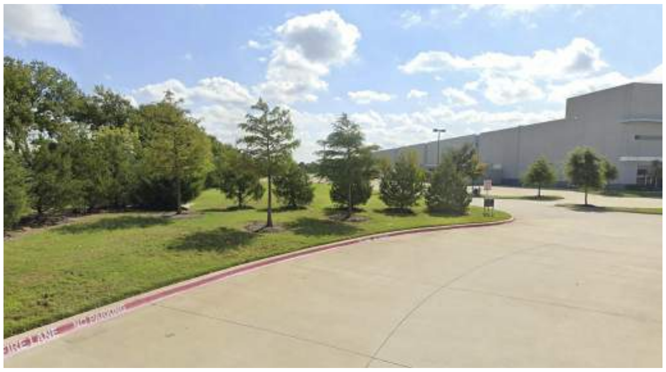
Photo location map

Visual Renderings

SOURCE: Google Earth/Dudek

DUDEK

Visual Renderings
Aerial View



Existing view

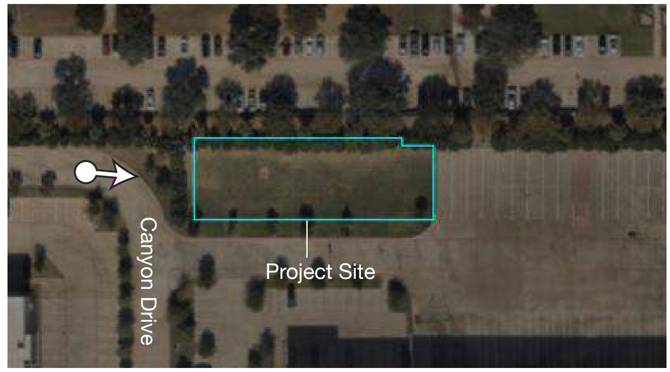


Photo location map

Visual Renderings

SOURCE: Google Earth/Dudek

DUDEK

Visual Rendering
Street View

INTENTIONALLY LEFT BLANK

Appendix B
Hazards Consequences Analysis

To:	Prologis Energy, 2021 McKinney Ave, Suite # 1050, Dallas, Texas, 75201
From:	Adam Poll, Dudek
Subject:	Hazardous Consequence Analysis for the Coppell BESS Project
Date:	April 16, 2023
cc:	David Hochart, Dudek
Attachments:	A, Emission Calculations
	B, Prior Studies on Emissions from Battery Malfunctions
	C, ALOHA Modeling Outputs

Dudek is pleased to present this hazardous consequence analysis technical memorandum (study) for the Coppell Battery Energy Storage System (BESS) Project (project) to be constructed and operated in Coppell, Texas. This study presents an executive summary of the assessment, the project description, a discussion on relevant codes and standards, applicable sensitive receptors, methodologies, conclusions of the study, and references cited.

Executive Summary

Prologis Energy proposes to install a BESS with a capacity of 10 megawatts (MW) in Coppell, Texas. This study evaluated the project's potential to cause adverse health effects on nearby sensitive receptors in the highly unlikely scenario of a thermal runaway event. As further discussed herein, emissions calculations indicated that for all of the modeled scenarios, the public health impacts from toxic pollutants associated with the worst-case battery cell malfunction scenario would be less than significant.

This study also evaluated potential for a deflagration event[1] caused by ignition of off-gasses resulting from a thermal-runaway scenario. Results from the analysis indicate that the worst-case battery cell malfunction scenario would result in acute impacts for toxic pollutant exposures below significant thresholds. Additionally, deflagration event emissions were determined to remain onsite and would not impact offsite locations or receptors. Therefore, the maximum potential public health impacts from the Facility are considered less than significant.

Project Description

The purpose of the BESS Facility is to provide new and incremental capacity to the electrical grid. The Facility would provide increased electrical reliability and stability to the local grid by storing electricity in the BESS and then releasing the power into the grid during peak periods when electricity is needed. Grid balancing from BESS reduces the need to operate fossil-fuel generators, the consumption of fossil fuels, and the creation of associated emissions.

Prologis Energy (applicant) proposes to develop, construct, and operate the project located in Coppell, Texas. The site would encompass a 0.33-acre parcel at the northeast intersection of Northwestern Drive and Freeport Parkway. The site is located entirely within the jurisdiction of the City of Coppell and zoned Light Industrial (LI) per the City's Zoning Ordinance.

1 Deflagration is defined as subsonic combustion that propagates through a gas or along a surface.

The Project would consist of a BESS facility with a capacity of 10 MW, which would include multiple battery storage containers/enclosures and associated on-site support facilities including a distribution feeder/ERCOT meter, power conversion systems, and a perimeter wall and landscaping. The proposed battery cell type would be lithium ion, which is similar to those used in common items such as cell phones, electric vehicles, and home storage (albeit with various safety features not found in consumer applications).

Battery Technology Overview

Lithium-ion batteries were introduced commercially by Sony in 1991 for use primarily in consumer products. Since then, they have become the most widely used battery technology for grid-scale energy storage. Lithium-ion batteries have the versatility to handle smaller-scale applications, such as powering electric vehicles, as well as grid-scale applications requiring megawatts of power for hours at a time.

The name lithium-ion batteries is derived from the transfer of lithium ions between the electrodes during operation. Instead of metallic lithium (a reactive substance), lithium-ion batteries use safer lithiated metal oxides as the cathode and carbon as the anode. When a lithium-ion battery cell is charging, lithium ions migrate from the cathode through a lithium-salt organic solvent catalyst that facilitates ionic movement (the electrolyte) to the anode. The process happens in reverse when discharging. Cathodes have a more positive electrode potential than anodes (versus the standard lithium reference), thus, they are considered to be the positive terminal of the battery. Similarly, anodes have a more negative electrode potential than cathodes (versus the standard lithium reference), thus, they are considered to be the negative terminal of a battery. The anode and cathode are divided by a separator, often microperforated plastic which is soaked in the electrolyte. The separator allows ions to pass through while maintaining electrical isolation between the electrodes. The entire battery is protected by a sealed metallic casing.

The US' installations of advanced energy storage — almost entirely lithium-ion battery systems — went beyond 1 GW / 3.5 GWh in 2020 according to research firm Wood Mackenzie Power & Renewables' which forecasts, then records and analyses energy storage deployments (Energy Storage News 2021). The Wood Mackenzie team foresees that the US will add around five times more storage in 2025 than it did in 2020. Additionally, according to the US Energy Information Agency, large-scale battery storage capacity is expected to grow from 1 GW in 2019 to 17 GW in 2050 (EIA 2020).

Codes and Standards

Regulatory requirements are discussed below.

Battery Testing Requirements and Regulations

BESS facilities and batteries are subject to several codes and standards. Some of the relevant ones are discussed below.

Underwriters Laboratories (UL), a globally-recognized safety certification company.

> **UL9540A:** Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems – this test methodology evaluates the fire characteristics of battery cells, modules, and

installations that are purposefully induced into thermal runaway. The data generated can be used to determine the fire and explosion protection required for an installation of a battery energy storage system

UL1973: Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications - This standard evaluates the battery system's ability to safely withstand simulated abuse conditions. This standard evaluates the system based upon the manufacturer's specified charge and discharge parameters. Requires that a BESS is not allowed to be an explosion hazard when exposed to an external fire source and that a single cell failure will not result in a cascading thermal runaway of cells.

UL1741: Inverters, Controllers, Converters, and Interconnection Equipment Standards - These requirements cover inverters, converters, charge controllers, and interconnection system equipment (ISE) intended for use in stand-alone (not grid-connected) or interactive (grid-connected) power systems. Interactive inverters, converters, and ISE are intended to be operated in parallel with an electric power system (EPS) to supply power to common loads.

UL9540A: Energy Storage Systems and Equipment – This standard requires compliance with key UL sub-standards as well as standards from other recognized parties to certify safety of an integrated energy storage system.

Institute of Electrical and Electronics Engineers (IEEE): the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

IEEE C2: This Code covers basic provisions for safeguarding of persons from hazards arising from the installation, operation, or maintenance of (1) conductors and equipment in electric supply stations, and (2) overhead and underground electric supply and communication lines. It also includes work rules for the construction, maintenance, and operation of electric supply and communication lines and equipment. The Code is applicable to the systems and equipment operated by utilities, or similar systems and equipment, of an industrial establishment or complex under the control of qualified persons.

International Fire Code (IFC): is the model up-to-date fire code addressing conditions hazardous to life and property from fire, explosion, handling or use of hazardous materials and the use and occupancy of buildings and premises.

IFC: Specifies minimum size requiring permits (Lithium, all types, 20 kilowatt-hours (kWh)), specifies maximum limits on sizing for battery systems (Lithium all type, 50 kwh each array), seismic and structural design, spacing (minimum 3 feet separation of arrays), vehicle impact protection, testing, maintenance and repairs, maximum quantities within a building (Lithium of 600 kwh), BMS monitoring, shutdown and notification requirements, automatic smoke detector requirements, automatic fire sprinkler systems, ventilation specifications.

National Fire Protection Association (NFPA): is an international nonprofit organization devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards.

NFPA 70: National Electrical Code, addresses electrical design, installation, and inspection.

NFPA 550: Guide to Fire Safety Concepts Tree for Protecting Energy Systems - addresses issues such as utilizing BMS and compatible equipment, ventilation as needed, fire resistive separation, array spacing, signage.

NFPA 855: Standard for the Installation of Stationary Energy Storage Systems - offers comprehensive criteria for the fire protection of BESS installations based on the technology used in BESS, the setting where the technology is being installed, the size and separation of BESS installations, and the fire suppression and control systems in place. Additional considerations include ventilation, detection, signage, listings, and emergency operations responding to BESS emergencies.

Sensitive Receptors

There are sensitive receptors located near the Facility. The closest sensitive receptor to the Facility is utilized in the analysis. The distance to receptors' property boundaries proximate to the site are listed in Table 1. Figure 1 shows the location of each of these receptors in relation to the nearest BESS cabinets. Because the study evaluates short-term acute impacts from a thermal runaway, all nearby receptors are considered where a person may be present for at least an hour.

Table 1. Distance to Receptors

Receptor	Receptor Distance to Closest BESS Cabinet (feet)
IAS Claim Services	133
Subaru of America	136
Shred-it	142
Triumph	263
Residential (east)	1,161
Cottonwood Creek Elementary School	2,615

SOURCE: BING

DUDEK

0 500 1,000 Feet

FIGURE 1

Sensitive Receptors

Coppell BESS

Methodology

During normal operations, there will be no toxic air emissions from the Facility. The BESS would also be equipped with i) monitoring and control systems, ii) fire detection and protection systems, and iii) gas ventilation systems, among others, to prevent, monitor, and/or control any battery cell malfunctions. However, to determine the worst-case public health impacts for this analysis, it is assumed that these multiple safety and ventilation systems fail and do not control the battery cell malfunction. It is also assumed that the battery cell malfunction continues until the reaction is sufficiently abated (e.g., via suppression or water cooling) or ceases once stored energy has been expended.

In the event of a battery cell malfunction, such as a thermal runaway[2] event, a fire could occur. While modern-day systems are designed to contain such fires within a single battery module, if a fire does occur, pollutants could be emitted to the atmosphere. Lithium-ion battery system fires are generally considered Class A (plastics fires, from materials such as the separator) and Class B (flammable liquids, from materials such as the electrolyte) but may also have characteristics of Class C (electrical fires) as well. As such, the pollutants generated are not dissimilar from other common residential and commercial fires.

To capture a worst-case scenario, it is assumed that the release of pollutants to the atmosphere would occur within a relatively short and concentrated period of time (i.e., one hour or less). The actual rate of release would be dependent on energy stored within the system and how the local fire department chooses to address the fire (e.g., a passive management approach vs. the application of water).

In the unlikely event of a battery cell malfunction, the primary emissions released would be carbon dioxide (CO_2) and carbon monoxide (CO), along with lesser amounts of other compounds. The emissions also include the chemicals released by the fire suppression system (for non-water-based systems). Table 2 provides a list of chemical constituents that could be emitted from lithium-ion batteries during a thermal runaway event.

As mentioned above, as part of UL testing compliance, battery systems must be designed to limit thermal propagation. Therefore, it is highly unlikely that multiple adjoining battery cells or modules would become involved in a single thermal runaway event. As such, as conservative scenario, it is assumed that 1.5 battery modules would be involved in a thermal runaway event.

Emissions

Battery cell malfunctions, such as thermal runway events, can result in the release of toxic emissions and/or flammable gas mixtures to the atmosphere. Several studies have examined the emissions of pollutants from battery off-gassing situations during thermal runaway events, with some studies examining only the concentration of toxic pollutants and others also examining emission rates. The relevant studies are listed in Attachment B.

For lithium-ion batteries, proprietary studies performed on lithium-ion cells (Attachment B) indicate that the primary toxic pollutants could be any of the pollutants listed in Table 2. Generally, the battery cell will start to off gas through pressure relief vents (or pouch seams) if the temperature exceeds 120°C (DNV GL 2017); however, the battery will not enter thermal runaway until in exceeds the thermal runaway onset temperature, which is usually between 170°C and 220°C, depending on the cathode chemistry.

2 Thermal runaway is a situation where the current flowing through the battery cell during either operation or a short circuit causes the cell temperature to rise to the point where a feedback loop can cause a thermal chain reaction.

Table 2. Chemical Constituents Emitted from Lithium-ion batteries

Chemical Formula	Chemical Name
H_2	Hydrogen
CO	Carbon monoxide
CO_2	Carbon dioxide
CH_4	Methane
C_2H_2	Acetylene
C_2H_4	Ethylene
C_2H_6	Ethane
C_3H_4	Propyne
C_3H_6	Propene
C_3H_8	Propane
C_4	Butane
C_5	Pentane
C_6	Benzotriyne
C_7H_{14}	Cycloheptane
C_6H_6	Benzene
C_7H_8	Toluene
$C_3H_6O_3$	2-Hydroxypropanoic acid
$C_4H_8O_3$	Ethoxyacetic acid

Source: Tesla 2022.

Based upon testing data in available publications (the DNV GL Report, National Fire Protection Association studies), there are hazardous substances that are potentially released during an accidental event within a BESS that may have an impact on nearby receptors. The hazardous substances include hydrogen chloride (HCl), hydrogen fluoride (HF), hydrogen cyanide (HCN), methanol, styrene, toluene, and carbon monoxide (CO). Based on the UL9540A testing, the emissions in Table 2 were seen at the cell level; however, only emissions of hydrogen, carbon monoxide, carbon dioxide, methane, acetylene, propane, and benzene were detected at the module level (Tesla 2022).

The following describes the potential air toxics, potential effects from acute inhalation exposure, Emergency Response Planning Guidelines (ERPG) values, and Acute Exposure Guideline Levels (AEGLs). The descriptions of health effects are summarized from the National Institute of Health PubChem database. ERPGs are developed by the Emergency Response Planning committee of the American Industrial Hygiene Association (AIHA). AEGLs are developed by the National Academy of Sciences. Both the ERPGs and AEGLs have three levels, categorized by severity of impact.

The ERPG values are defined as follows:

- ERPG-1 is the maximum airborne concentration below which nearly all individuals could be exposed to for up to one hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odor.

- ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed to for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

- ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed to for up to one hour without experiencing or developing life-threatening health effects.

The AEGL values are defined as:

- AEGL-1 is the airborne concentration (expressed as parts per million (ppm) or milligrams per cubic meter (mg/m^3)) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

- AEGL-2 is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

- AEGL-3 is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

The distance of toxic endpoints uses the ERPG-2 and AEGL-2 values per EPA guidance to evaluate potential risk to nearby receptors or first responders. The applicable ERPG-2 and AEGL-2 values for the pollutants in Table 2 with an acute reference exposure level are shown below in Table 3.

Table 3. Chemical Constituents ERPG and AEGL Values

Chemical Name	ERPG-2 (ppm)	AEGL-2 (ppm)
Carbon monoxide	350	150
Butane	NA	17,000
Toluene	300	760
Propane	NA	17,000
Benzene	150	1,100

Source: AIHA 2022; EPA 2018.

Flammable Components and Flammability

Flammable components are also emitted from battery off-gassing situations during a thermal runway event. Based upon the studies listed in Attachment B, the flammable components could include those listed in Table 4.

Table 4. Potential Flammable Components from Lithium-ion Battery Off-Gassing

Component	Lower Flammability Limit (LFL), Volume Percent
Acetylene (C_2H_2)	2.5
Butanes (C_4)	1.8
Carbon monoxide (CO)	12.5
Ethane (C_2H_6)	3.0
Ethylene (C_2H_4)	2.7
Hydrogen (H_2)	4.0

Table 4. Potential Flammable Components from Lithium-ion Battery Off-Gassing

Component	Lower Flammability Limit (LFL), Volume Percent
Methane (CH_4)	5.0
Pentanes (C_5)	1.4
Propane (C_3H_8)	2.1
Propene (C_3H_6)	2.0

Source: DOT 2016.

Depending on the combination of these flammable materials, the off-gasses could have varying degrees of flammability. The composition of battery off-gassing components as part of the UL9540A testing are shown in Table 5.

Table 5. Battery Off-Gassing Primary Flammable Components

Component	Volume Percent
H_2	47.4
CO	11.1
CO_2	29.3
CH_4	6.2
C_2H_2	0.2
C_2H_4	3.4
C_2H_6	1.0
C_3H_4	0.001
C_3H_6	0.5
C_3H_8	0.2
C_4	0.4
C_5	0.1
C_6	0.03
C_7H_{14}	0.002
C_6H_6	0.4
C_7H_8	0.001
$C_3H_6O_3$	0.3
$C_4H_8O_3$	0.01

Source: Tesla 2022.
Note: Based on UL9540A testing.

The Compressed Gas Association (CGA) Publication P-23 provides algorithms for estimating the level of flammability of gas mixtures. The application of this technique to the off-gassed materials as provided by the manufacturer as part of the UL9540A testing (shown in Table 5) indicates that the released vapor/gas would be flammable, with a Q value of over 10.0 and an estimated lower flammability limit of between 3.9 and 5.9 percent (CGA 2015).

Screening and Modeling

The EPA's "Risk Management Program Guidance for Offsite Consequence Analysis" recommends conducting an offsite consequence analysis to represent release scenarios that are possible (although unlikely) to occur under a variety of weather and wind conditions to determine the distance to a toxic or flammable endpoint (EPA 2009). Modeling assumptions and meteorological conditions that were used for conducting this offsite consequence analysis are specified in EPA's Risk Management guidance.

This Analysis was conducted using EPA's "Areal Location Hazardous Atmospheres" ([ALOHA]; Version 5.4.7, September 2016) hazards modeling program to determine distances to the toxic endpoints for release scenarios (EPA 2016). The distance to the toxic endpoint is the distance a toxic vapor cloud, heat from a fire, or blast waves from an explosion will travel before dissipating to the point where serious injuries from short-term exposures will no longer occur. Plume analysis and exposure impacts were conducted using USEPA's ALOHA hazards modeling program. Based on information about a chemical release, ALOHA estimates how quickly the chemical will escape from containment and form a hazardous gas cloud, and also how that release rate may change over time. ALOHA can then model how that hazardous gas cloud will travel downwind, including both neutrally buoyant and heavy gas dispersion. Additionally, if the chemical is flammable, ALOHA simulates pool fires, boiling liquid expanding vapor explosions, vapor cloud explosions, jet fires, and flammable gas clouds (where flash fires might occur). ALOHA evaluates different types of hazards (depending on the release scenario); toxicity, flammability, thermal radiation, and overpressure. ALOHA produces a threat zone estimate, which shows the area where a particular hazard (such as toxicity or thermal radiation) is predicted to exceed a specified level of concern at some time after the release begins. ALOHA is able to determine a threat zone under different weather and wind scenarios. The supporting ALOHA hazards modeling program output files for the Analysis are provided in Appendix C.

The following parameters within the ALOHA were used to evaluate potential impacts to offsite receptors:

- The thermal runaway event would occur within 1.5 battery modules over a 30-minute duration.
- The nighttime conditions includes a wind speed of 3.4 miles per hour (mph) from the south-southeast (Meteoblue 2023) and an atmospheric stability class F (very stable atmospheric conditions). Threat at point was set to closest receptor downwind.
- The daytime conditions include a wind speed of 8.7 mph from the south-southeast and atmospheric stability class D (slightly unstable atmospheric conditions). Threat at point was set to closest receptor downwind.
- Default atmospheric air temperature of 77°F was assumed for all scenarios.
- Default humidity of 50% was assumed for nighttime and daytime scenarios.
- No ambient temperature inversion was assumed.
- The height of release was assumed to be ground level.
- The surface roughness was assumed to be open country, which is conservative as the plume cloud travels farther than over urban or forest.

Exposure Assessment

Under the worst-case scenario, the burning and/or venting of the battery cells due to a battery cell malfunction would result in combustion-related emissions. Inhalation is the main pathway by which these emissions could potentially cause public health impacts.

UL9540A Testing

Tesla (as a surrogate for the battery chemistry used at the Facility) provided information on primary pollutants from a battery combustion malfunction. Battery cells produced by Tesla are used in a broad range of BESS systems, and thus, serve as a good representation of the battery cells to be installed onsite.

Detailed emissions calculations are provided in Attachment A. The compounds and the associated mass emission rates were determined by proprietary testing performed by Tesla as part of the UL9540A testing protocol.

The tests showed that in the event of a single battery cell undergoing thermal runaway, there was no propagation to surrounding cells. In addition, the tests showed that when an entire battery system module was intentionally ignited, and the fire suppression system discharged, there was no propagation to surrounding modules. Because the battery malfunction events discussed above are unlikely to occur, and if such events were to occur, it will occur only within a single battery cell. Therefore, this analysis, which assumes 1.5 modules would be affected, presents a worst-case analysis (i.e., a multi-battery cell malfunction).

Significance Criteria

The distance of toxic endpoints uses the ERPG-2 and AEGL-2 values per EPA guidance to evaluate potential risk to nearby receptors or first responders. If the ERPG-2 or AEGL-2 values shown in Table 3 are exceeded at the distance closest receptors are to the project as shown in Table 1, there would be a potentially significant impact during a thermal runaway event.

Conclusions

Table 6 presents the results of the ALOHA modeling of the thermal runaway scenario of 1.5 modules as discussed in the methodology above. This represents emissions detected at the module level which have known ERPG-2 and AEGL-2 values.

Table 6. Battery Off-Gassing Modeling Results

Pollutant	Scenario	Threat at Point (ppm)
Carbon monoxide	Day	0.0118
	Night	0.222
Propane	Day	ND
	Night	ND
Benzene	Day	ND

Table 6. Battery Off-Gassing Modeling Results

Pollutant	Scenario	Threat at Point (ppm)
	Night	ND

Note: ND = no data.
Source: Attachment C.

As shown in Table 6, the results of the offsite consequence analysis showed that concentrations at the ERPG-2 or AEGL-2 thresholds would not exceed the applicable thresholds from the toxic release. Therefore, the project would result in a less than significant impact due to thermal runway of battery modules offsite.

References

AIHA (American Industrial Hygiene Association). 2022. Emergency Response Planning Guidelines Values. https://aiha-assets.sfo2.digitaloceanspaces.com/AIHA/resources/ERPG-Chemicals-List-REV-2022.pdf.

Anderson. 2013. Investigation of fire emissions from Li-ion batteries. http://www.diva-portal.org/smash/get/diva2:962743/FULLTEXT01.pdf.

Blum. 2016. Lithium-Ion Battery Energy Storage System Fires. March 2. https://nfpa.org/-/media/Files/News-and-Research/Resources/Research-Foundation/Symposia/2016-SUPDET/2016-Papers/SUPDET2016BlumLong.ashx.

CGA (Compressed Gas Association). 2015. P-23 Standard for Categorizing Gas Mixtures Containing Flammable and Nonflammable Components.

DNVGL. 2017. Considerations for ESS Fire Safety. February 9. https://www-nyserda-ny-gov.webpkgcache.com/doc/-/s/www.nyserda.ny.gov/-/media/Project/Nyserda/files/Publications/Research/Energy-Storage/20170118-ConEd-NYSERDA-Battery-Testing-Report.pdf.

DOT (United States Department of Transportation). Lithium Battery Thermal Runaway Vent Gas Analysis. November. https://www.fire.tc.faa.gov/pdf/TC-15-59.pdf.

EIA (U.S. Energy Information Administration). 2020. Battery Storage in the United States: An Update on Market Trends. July. Accessed May 2021. https://www.eia.gov/analysis/studies/electricity/batterystorage/pdf/battery_storage.pdf.

Energy Storage News. 2021. "In 2020 the US went beyond a gigawatt of advanced energy storage installations for first time ever." March 4. Accessed May 2021. https://www.energy-storage.news/news/in-2020-the-us-went-beyond-a-gigawatt-of-advanced-energy-storage-installati.

EPA (U.S. Environmental Protection Agency). 2009. Risk Management Program Guidance for Offsite Consequence Analysis. March. Accessed April 2023. https://www.epa.gov/sites/default/files/2013-11/documents/oca-chps.pdf.

EPA. 2016. ALOHA Software, version 5.4.7. September. Accessed December 2022. https://www.epa.gov/cameo/aloha-software.

EPA. 2018. Compiled AEGL Values. July 27. Accessed November 2022. https://www.epa.gov/sites/default/files/2018-08/documents/compiled_aegls_update_27jul2018.pdf.

IEEE (Institute of Electrical and Electronics Engineers). 2022. IEEE C2 National Electrical Safety Code(R) (NESC(R)). August 1.

IFC (International Fire Code). 2021. https://codes.iccsafe.org/content/IFC2021P1/preface#:~:text=The%20International%20Fire%20Code%C2%AE,materials%20and%20new%20system%20designs.

Larsson. 2017. Toxic Fluoride Gas Emissions from Lithium-Ion Battery Fires. https://www.nature.com/articles/s41598-017-09784-z.pdf.

Meteoblue. 2023. Wind Rose for Coppell, Texas. Accessed April 2023. https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/coppell_united-states_4683217.

NFPA (National Fire Protection Association). 2017. Technical Committee on Stationary Energy Storage Systems Minutes of Meeting. January 10. https://www.nfpa.org/assets/files/AboutTheCodes/855/855_ESS_AAA_DraftDevminutes_01_17.pdf.

NFPA. 2022. NFPA 550 Guide to the Fire Safety Concepts Tree.

NFPA. 2023. NFPA 70 National Electrical Code.

NFPA. 2023. NFPA 855 Standard for the Installation of Stationary Energy Storage Systems.

Tesla. 2022. Tesla Megapack 2/XL Hazard Mitigation Analysis. December 27.

UL (Underwriters Laboratories). 2019. UL 9540A ANSI/CAN/UL Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems. November 12.

UL. 2020. UL 9540 Standard for Energy Storage Systems and Equipment. February 27.

UL. 2021. UL 1741 Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources. September 28.

UL. 2022. UL 1973 Batteries for Use in Stationary and Motive Auxiliary Power Applications. February 25.

Attachment A

Emission Calculations

TAC Emission Calculations

Pollutant	Vol %	Volume (Liter)	MW (g/mol)	Moles	Single Cell Emissions (grams)	Single Cell Rate (g/s)	Single Cell Rate (lbs/hr)	Module Rate (ppm)	Module Rate (mg/L)	Module Rate (lbs/hr)	1.5 Module Rate (lbs/hr)
Primary Compounds											
H2	47.405	46.1	2.0	2.05576	4.1	1.14E-03	0.0091	446.00	37.00	0.004	0.01
CO	11.073	10.8	28.0	0.48019	13.4	3.73E-03	0.0296	204.84	235.00	0.006	0.01
CO2	29.285	28.5	44.0	1.26997	55.9	1.55E-02	0.1232	6720.62	12089.00	0.759	1.14
CH4	6.200	6.0	16.0	0.26887	4.3	1.19E-03	0.0095	67.83	44.00	0.001	0.001
C2H2	0.190	0.2	26.0	0.00824	0.2	5.96E-05	0.0005	17.11	18.00	0.00001	0.00001
C2H4	3.367	3.3	28.1	0.14601	4.1	1.14E-03	0.0090	ND	ND	ND	ND
C2H6	0.997	1.0	30.1	0.04323	1.3	3.61E-04	0.0029	ND	ND	ND	ND
C3H4	0.001	0.0	40.1	0.00004	0.0	4.83E-07	0.0000	ND	ND	ND	ND
C3H6	0.537	0.5	42.1	0.02329	1.0	2.72E-04	0.0022	ND	ND	ND	ND
C3H8	0.195	0.2	44.1	0.00846	0.4	1.04E-04	0.0008	246.53	444.00	0.0002	0.0003
C4	0.390	0.4	58.1	0.01691	1.0	2.73E-04	0.0022	ND	ND	ND	ND
C5	0.054	0.1	72.2	0.00234	0.2	4.70E-05	0.0004	ND	ND	ND	ND
C6	0.031	0.0	28.0	0.00134	0.0	1.05E-05	0.0001	ND	ND	ND	ND
C7H14	0.002	0.0	98.2	0.00009	0.0	2.37E-06	0.0000	ND	ND	ND	ND
C6H6	0.400	0.4	78.1	0.01735	1.4	3.76E-04	0.0030	9.01	29.00	0.00002	0.00004
C7H8	0.001	0.0	92.1	0.00004	0.0	1.11E-06	0.0000	ND	ND	ND	ND
C3H6O3	0.290	0.3	90.1	0.01258	1.1	3.15E-04	0.0025	ND	ND	ND	ND
C4H8O3	0.009	0.0	104.1	0.00039	0.0	1.13E-05	0.0001	ND	ND	ND	ND
Total	100	97.2	-		88.4	0.0	0.2	7,711.9		0.8	1.2

Assumes: Atmospheric Normal Temperature and Pressure (298.15K and 100.3 kpa)
Vol % and single cell emissions total provided by manufacturer
Standard temperature and pressure (STP) is defined as 0°C (273.15 K) and 1 atm of pressure
Time of event, minutes 30
Gas compsitions based on Tesla studies, maximum values measured for cell and module level testing.
ND = Non-detect

Attachment B

Prior Studies on Emissions from Battery Malfunctions

Several studies have examined the emissions of pollutants from battery off-gassing situations during thermal runaway events, with some studies examining only the concentration of toxic pollutants and others also examining emission rates. The relevant studies are listed in Table B-1 below.

Table B-1 Studies on Emissions from Battery Malfunctions

Study	Description	Results
Anderson 2015	Exposure of battery to heat source, off gasses tested. LFP battery, 1.2 kg, 35 Ah	HF: 30-50ppm peak POF_3: 1-2ppm peak HF Rate: 0.01 g/s
Blum 2016	Modules tested with heat exposure until thermal runaways. 100 kWh unit by Tesla.	HF: 100 ppm peak
CATL	UL 9540A testing	Composition of off gassing: primary pollutants only. Up to 153.5 L off gas per cell
Larsson 2017	External propane burner used to heat batteries, measured toxic gasses. Examined different battery types	HF: up to 145 ppm peak HF rate: 50 mg/s peak HF rate: 200mg/whr peak POF_3 rate: 22 mg/whr peak
LG Chem	Proprietary data on LFP battery tests. NMC battery type.	HF-0.2ppm PH_3-1.0ppm HF rate: 4.7e-7 g/hr PH_3 rate: 2.4e-4 g/hr Up to 244 L off gas per cell
DNVGL 2017	Measured characteristics of a wide range of battery types and failures	release rates per kg of battery weight: HF rate: 1.7e-7 kg/s-kg

Notes: ppm = parts per million; NMC = nickel manganese cobalt; LFP = lithium iron phosphate; kg = kilogram; L = liter; g/s = grams per second; kwh = kilowatt-hour; Ah = amp-hour; HF = hydrogen fluoride; PH3 = phosphine.

Attachment C

ALOHA Modeling Outputs

Table of Contents

```
SITE DATA:
  Location: COPPELL, TEXAS
  Building Air Exchanges Per Hour: 0.65 (sheltered single storied)
  Time: April 10, 2023  1200 hours CDT (user specified)

CHEMICAL DATA:
  Chemical Name: BENZENE
  CAS Number: 71-43-2                    Molecular Weight: 78.11 g/mol
  AEGL-1 (60 min): 52 ppm   AEGL-2 (60 min): 800 ppm   AEGL-3 (60 min): 4000 ppm
  IDLH: 500 ppm      LEL: 12000 ppm      UEL: 80000 ppm
  Carcinogenic risk - see CAMEO Chemicals
  Ambient Boiling Point: 175.2° F
  Vapor Pressure at Ambient Temperature: 0.12 atm
  Ambient Saturation Concentration: 126,915 ppm or 12.7%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 8.7 miles/hour from SSE at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 77° F
  Stability Class: D (user override)
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 0.00004 pounds/hr       Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 6.67e-07 pounds/min
  Total Amount Released: 2.00e-005 pounds

THREAT ZONE:
  Model Run: Gaussian
  Red   : less than 10 meters(10.9 yards) --- (150 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (1100 ppm)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.

THREAT AT POINT:
  Concentration Estimates at the point:
  Downwind: 133 feet                     Off Centerline: 0 feet
  Note: Concentration not drawn because
     there is no significant concentration at the point selected.
```

```
SITE DATA:
  Location: COPPELL, TEXAS
  Building Air Exchanges Per Hour: 0.33 (sheltered single storied)
  Time: April 10, 2023  2359 hours CDT (user specified)

CHEMICAL DATA:
  Chemical Name: BENZENE
  CAS Number: 71-43-2                    Molecular Weight: 78.11 g/mol
  AEGL-1 (60 min): 52 ppm   AEGL-2 (60 min): 800 ppm   AEGL-3 (60 min): 4000 ppm
  IDLH: 500 ppm      LEL: 12000 ppm      UEL: 80000 ppm
  Carcinogenic risk - see CAMEO Chemicals
  Ambient Boiling Point: 175.2° F
  Vapor Pressure at Ambient Temperature: 0.12 atm
  Ambient Saturation Concentration: 126,915 ppm or 12.7%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 3.4 miles/hour from SSE at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 77° F                 Stability Class: F
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: .00004 pounds/hr        Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 6.67e-07 pounds/min
  Total Amount Released: 2.00e-005 pounds

THREAT ZONE:
  Model Run: Gaussian
  Red   : less than 10 meters(10.9 yards) --- (150 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (1100 ppm)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.

THREAT AT POINT:
  Concentration Estimates at the point:
  Downwind: 133 feet                     Off Centerline: 0 feet
  Note: Concentration not drawn because
     there is no significant concentration at the point selected.
```

```
SITE DATA:
  Location: COPPELL, TEXAS
  Building Air Exchanges Per Hour: 0.65 (sheltered single storied)
  Time: April 10, 2023  1200 hours CDT (user specified)

CHEMICAL DATA:
  Chemical Name: CARBON MONOXIDE
  CAS Number: 630-8-0                    Molecular Weight: 28.01 g/mol
  AEGL-1 (60 min): N/A   AEGL-2 (60 min): 83 ppm   AEGL-3 (60 min): 330 ppm
  IDLH: 1200 ppm     LEL: 125000 ppm     UEL: 742000 ppm
  Ambient Boiling Point: -313.0° F
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 8.7 miles/hour from SSE at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 77° F
  Stability Class: D (user override)
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: .01 pounds/hr           Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 1.67e-04 pounds/min
  Total Amount Released: 0.0050 pounds
  Note: This chemical may flash boil and/or result in two phase flow.
     Use both dispersion modules to investigate its potential behavior.

THREAT ZONE:
  Model Run: Gaussian
  Red   : less than 10 meters(10.9 yards) --- (350 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (150 ppm)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.

THREAT AT POINT:
  Concentration Estimates at the point:
  Downwind: 133 feet                     Off Centerline: 0 feet
  Max Concentration:
     Outdoor: 0.0118 ppm
     Indoor:  0.00325 ppm
```

```
SITE DATA:
  Location: COPPELL, TEXAS
  Building Air Exchanges Per Hour: 0.33 (sheltered single storied)
  Time: April 10, 2023  2359 hours CDT (user specified)

CHEMICAL DATA:
  Chemical Name: CARBON MONOXIDE
  CAS Number: 630-8-0                    Molecular Weight: 28.01 g/mol
  AEGL-1 (60 min): N/A   AEGL-2 (60 min): 83 ppm   AEGL-3 (60 min): 330 ppm
  IDLH: 1200 ppm     LEL: 125000 ppm     UEL: 742000 ppm
  Ambient Boiling Point: -313.0° F
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 3.4 miles/hour from SSE at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 77° F                 Stability Class: F
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: .01 pounds/hr           Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 1.67e-04 pounds/min
  Total Amount Released: 0.0050 pounds
  Note: This chemical may flash boil and/or result in two phase flow.
     Use both dispersion modules to investigate its potential behavior.

THREAT ZONE:
  Model Run: Gaussian
  Red   : less than 10 meters(10.9 yards) --- (350 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (150 ppm)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.

THREAT AT POINT:
  Concentration Estimates at the point:
  Downwind: 133 feet                     Off Centerline: 0 feet
  Max Concentration:
     Outdoor: 0.222 ppm
     Indoor:  0.0334 ppm
```

```
 SITE DATA:
   Location: COPPELL, TEXAS
   Building Air Exchanges Per Hour: 0.65 (sheltered single storied)
   Time: April 10, 2023  1200 hours CDT (user specified)

 CHEMICAL DATA:
   Chemical Name: PROPANE
   CAS Number: 74-98-6                    Molecular Weight: 44.10 g/mol
   AEGL-1 (60 min): 5500 ppm   AEGL-2 (60 min): 17000 ppm   AEGL-3 (60 min): 
33000 ppm
   IDLH: 2100 ppm     LEL: 21000 ppm      UEL: 95000 ppm
   Ambient Boiling Point: -44.4° F
   Vapor Pressure at Ambient Temperature: greater than 1 atm
   Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

 ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
   Wind: 8.7 miles/hour from SSE at 3 meters
   Ground Roughness: open country         Cloud Cover: 5 tenths
   Air Temperature: 77° F
   Stability Class: D (user override)
   No Inversion Height                    Relative Humidity: 50%

 SOURCE STRENGTH:
   Direct Source: .0003 pounds/hr         Source Height: 0
   Release Duration: 30 minutes
   Release Rate: 5e-06 pounds/min
   Total Amount Released: 1.50e-004 pounds
   Note: This chemical may flash boil and/or result in two phase flow.

 THREAT ZONE:
   Model Run: Gaussian
   Red   : less than 10 meters(10.9 yards) --- (17000 ppm = AEGL-2 [60 min])
   Note: Threat zone was not drawn because effects of near-field patchiness
      make dispersion predictions less reliable for short distances.

 THREAT AT POINT:
   Concentration Estimates at the point:
   Downwind: 133 feet                     Off Centerline: 0 feet
   Note: Concentration not drawn because
      there is no significant concentration at the point selected.
```

```
 SITE DATA:
   Location: COPPELL, TEXAS
   Building Air Exchanges Per Hour: 0.33 (sheltered single storied)
   Time: April 10, 2023  2359 hours CDT (user specified)

 CHEMICAL DATA:
   Chemical Name: PROPANE
   CAS Number: 74-98-6                      Molecular Weight: 44.10 g/mol
   AEGL-1 (60 min): 5500 ppm   AEGL-2 (60 min): 17000 ppm   AEGL-3 (60 min):
33000 ppm
   IDLH: 2100 ppm     LEL: 21000 ppm        UEL: 95000 ppm
   Ambient Boiling Point: -44.4° F
   Vapor Pressure at Ambient Temperature: greater than 1 atm
   Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

 ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
   Wind: 3.4 miles/hour from SSE at 3 meters
   Ground Roughness: open country           Cloud Cover: 5 tenths
   Air Temperature: 77° F                   Stability Class: F
   No Inversion Height                      Relative Humidity: 50%

 SOURCE STRENGTH:
   Direct Source: .0003 pounds/hr           Source Height: 0
   Release Duration: 30 minutes
   Release Rate: 5e-06 pounds/min
   Total Amount Released: 1.50e-004 pounds
   Note: This chemical may flash boil and/or result in two phase flow.

 THREAT ZONE:
   Model Run: Gaussian
   Red   : less than 10 meters(10.9 yards) --- (17000 ppm = AEGL-2 [60 min])
   Note: Threat zone was not drawn because effects of near-field patchiness
      make dispersion predictions less reliable for short distances.

 THREAT AT POINT:
   Concentration Estimates at the point:
   Downwind: 133 feet                       Off Centerline: 0 feet
   Note: Concentration not drawn because
      there is no significant concentration at the point selected.
```