DOCKETED	
Docket Number:	23-OPT-02
Project Title:	Darden Clean Energy Project
TN #:	258490
Document Title:	CEC Data Request Response Set 5
Description:	Provides the Applicant's fifth response set to data requests received from the CEC. Responses address data requests related to Biological Resources, Hazardous Materials Handling, Project Description, Water Resources, and Worker Safety. The document includes the following appendices to support responses: Appendix A REV 1 DR HAZ-1 Supplemental Soil and Water Sample Results, Appendix B REV 1 DR WS-1 Updated Fire Alarm Site Plan, Appendix C REV 1 DR WS-2 Fire Protection Engineering and UL 9540A Interpretation Report, Appendix D REV 1 DR WS-2 Tesla Megapack 2/XL Hazard Mitigation Analysis, and Appendix E REV 1 DR WS-3 Lithium-ion Battery Electrolyte Safety Data Sheets.
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Darden Clean Energy Project (23-OPT-02)

CEC Data Request Response Set #5

prepared by

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1 Introduction

On June 10, 2024, IP Darden I, LLC and Affiliates (Applicant) received a Determination of Incomplete Application and Request for Information from the California Energy Commission (CEC) for the Darden Clean Energy Project (23-OPT-02) in response to the Applicant's first set of data responses, which were finalized on May 10, 2024. The following document provides the Applicant's fifth set of responses to the Data Requests received from the CEC. Table 1 lists all Data Requests for which a response is provided in Response Set #5.

Table 1 Data Responses Included in Response Set #5

Data Request Resources Area	Data Request Number
Biological Resources	REV 1 DR BIO-3
Hazardous Materials Handling	REV 1 DR HAZ-1
Project Description	REV 1 DR PD-2 and REV 1 DR PD-3
Traffic and Transportation	–
Transmission System Design	–
Water Resources	REV 1 DR WATER-1
Worker Safety	REV 1 DR WS-1 through REV 1 DR WS-3

The responses are grouped by individual discipline or topic area and are presented in the same order and with the same numbering provided by the CEC. New or revised graphics, tables, or attachments are provided throughout and as appendices to this document. The responses included in this document are considered complete responses to the corresponding Data Requests.

Table 2 provides a list of all remaining Data Requests received from the CEC that have not been addressed in Response Set #5.

Table 2 Outstanding Data Responses

Data Request Resources Area	Data Request Number
Biological Resources	REV 1 DR BIO-1 and REV 1 DR BIO-2
Hazardous Materials Handling	REV 1 DR HAZ-2
Project Description	REV 1 DR PD-1
Traffic and Transportation	REV 1 DR TRANS-1 through REV 1 DR TRANS-2
Transmission System Design	REV 1 DR TSD-1
Water Resources	–
Worker Safety	–

Supplemental Data Request Response Sets will be provided to the CEC in response to the Data Requests not addressed in this document.

2 Biological Resources

2.1 Data Request REV 1 DR BIO-3

2.1.1 Data Request REV 1 DR BIO-3

REV 1 DR BIO-3: In *CEC Data Request Response Set 4*, in response to staff's DR BIO-20, the applicant provided the maps in Appendix F. However, the maps are not in the correct units. Data was provided in g/m2, and the annual values were averaged across 5 years. Please provide revised map(s) for the total annual nitrogen deposition in kilograms of nitrogen per hectare per year (kg N/ha/yr). In adherence with Appendix B (g)(13)(B)(ii), Appendix B (g)(13)(C)(ii) and Appendix B (g)(15)(B)(ii), the maps should display the amount of total annual nitrogen deposition in kg N/ha/yr and should not be averaged across 5 years. Please refer to Great Oaks South Backup Generating Facility (20-SPPE-01) Draft Environmental Impact Report (TN 237875, pages 4.4-13 and 4.4-14), for an example of the expected mapped output, including mapped sensitive habitat, background values, and project features.

Response: Revised maps depicting the total annual nitrogen deposition in kilograms of nitrogen per hectare per year are provided in Figure 1 through Figure 4 below. The figures were revised to display the maximum annual nitrogen deposition values, rather than the 5-year average previously presented, which corresponded to a slight increase in annual nitrogen deposition values. The maps include project features, the non-agricultural areas of interest discussed in Appendix F of CEC Data Request Response Set 4, and background values.

As discussed in the response to DR BIO-20 in CEC Data Request Response Set 4, operation of the Project's emergency backup generators and fire pump engines would not lead to nitrogen deposition levels that exceed critical thresholds associated with significant impacts to non-native grassland, dune or riparian vegetation communities in the vicinity of the Project site or special status species that may occur within the vegetation communities. "Critical loads" are nitrogen deposition accumulation thresholds below which there are no discernible effects on plant diversity or soil nutrient levels. The critical load for freshwater wetlands ranges from 2.7-13 kg/ha/yr, and the critical load for California grasslands ranges from 5-10 kg/ha/yr. A threshold at which harmful effects from nitrogen deposition on dune, stream or riparian plant communities has not been firmly established; however, a value of 5 kg/ha/yr is often used for comparing nitrogen deposition among plant communities.

The updated nitrogen deposition values presented in Figure 1 through Figure 4 show a maximum annual nitrogen deposition of 0.722 kg/ha/yr compared to the 5-year average of 0.684 kg/ha/yr previously discussed in Appendix F of CEC Data Request Response Set 4. The previous response also compared the modeled nitrogen deposition to average background nitrogen deposition values expected in this region of California (7-9 kg/ha/yr); however, the figures have since been updated with background 2019 CMAQ data (with a maximum of 6.256 kg/ha/yr). The results of the nitrogen deposition model also indicate the average nitrogen deposition rates using the source group "All" conservative approach would be on the order of 1.0×10^{-5} kg/ha/yr in the non-native grassland, dune and freshwater emergent wetland habitats and 1.0×10^{-4} kg/ha/yr along the Cantua Creek aquatic habitat and riparian corridor.

Therefore, the updated figures do not change the conclusions presented in the response to DR BIO-20 or Appendix F in CEC Data Request Response Set 4. The modeled annual nitrogen deposition remains well below the critical loads at sensitive habitats, as discussed in Appendix F of Data Request Response Set 4.

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Figure 1 Nitrogen Deposition ALL Project Options

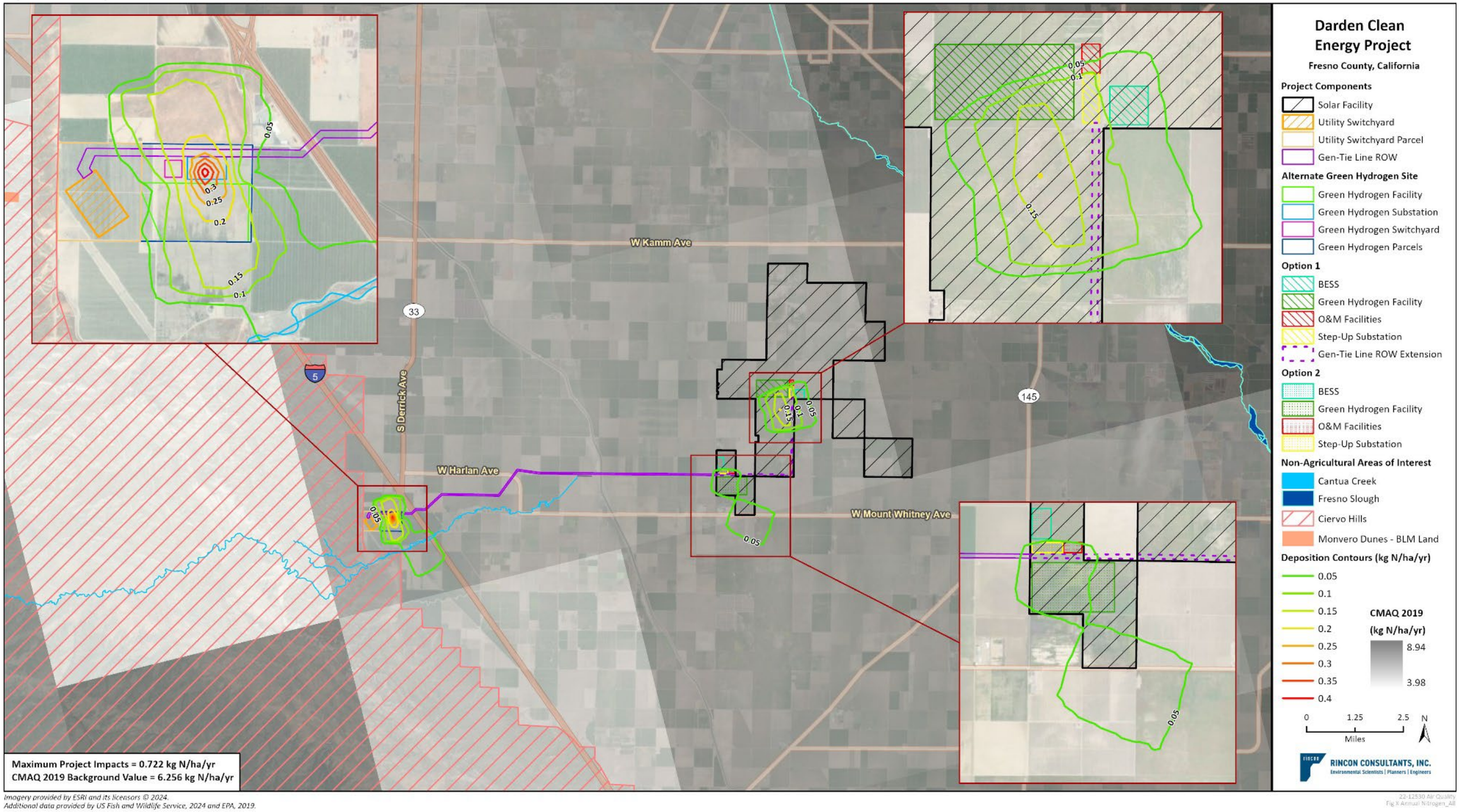


Figure 2 Nitrogen Deposition Project Option 1

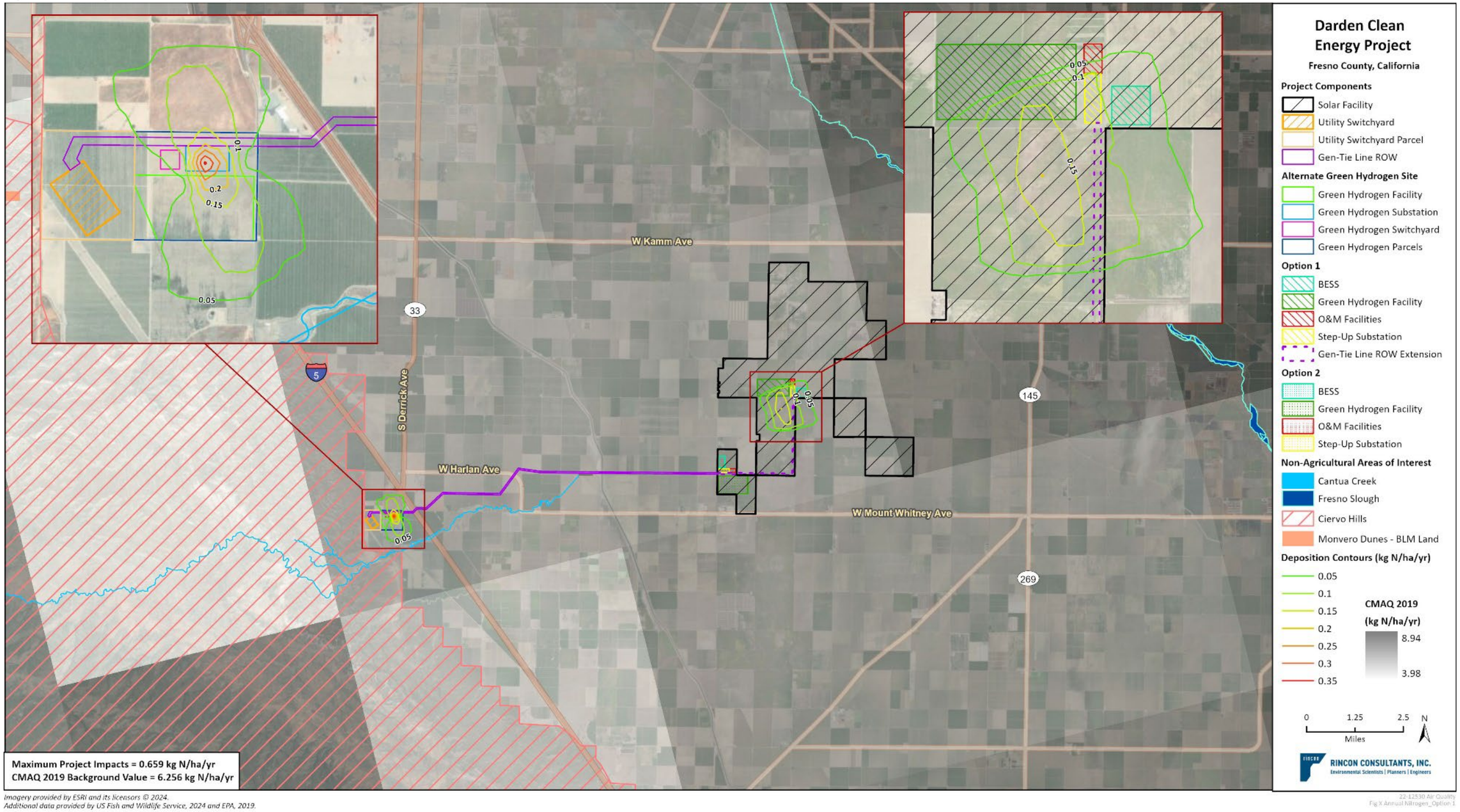


Figure 3 Nitrogen Deposition Project Option 2

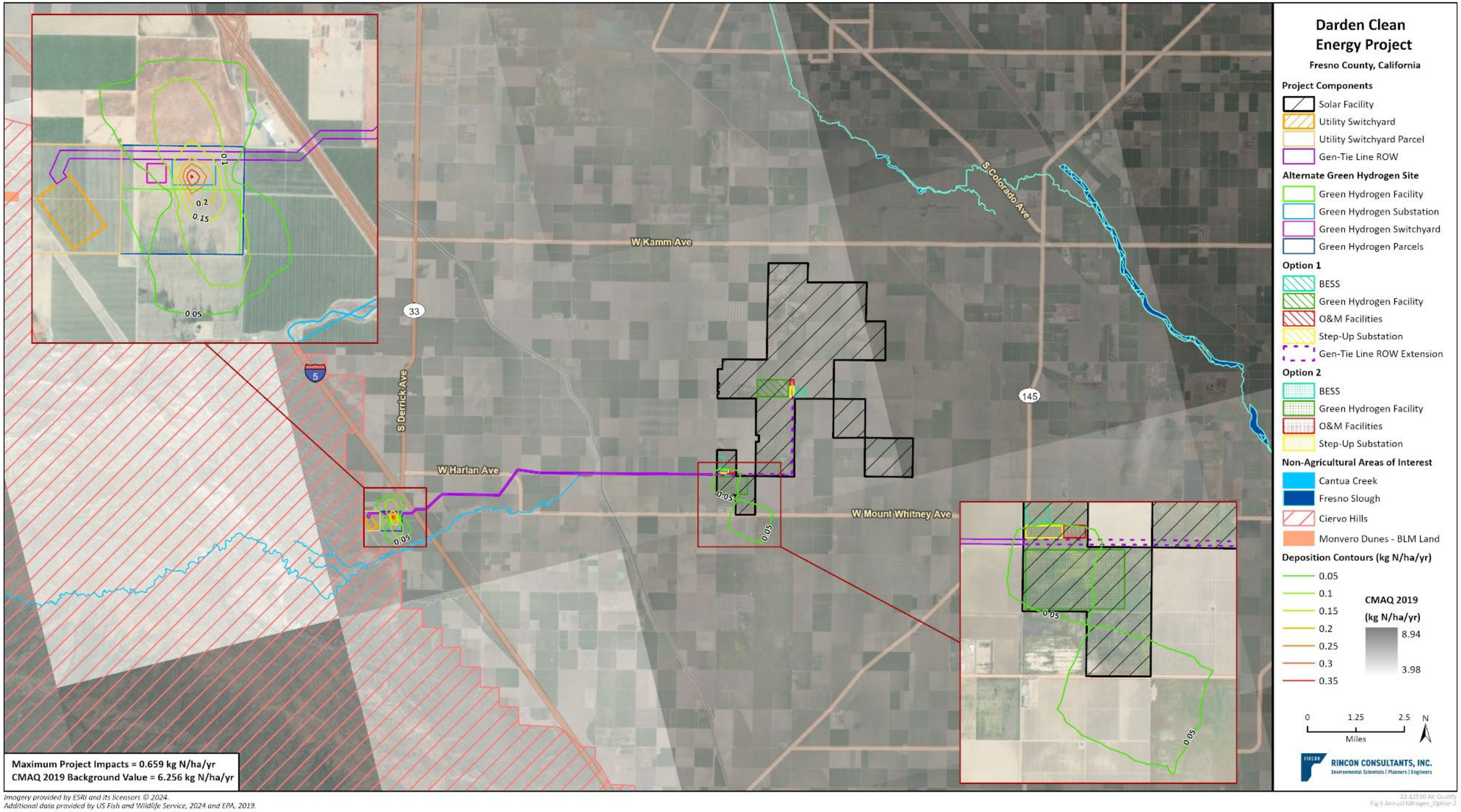
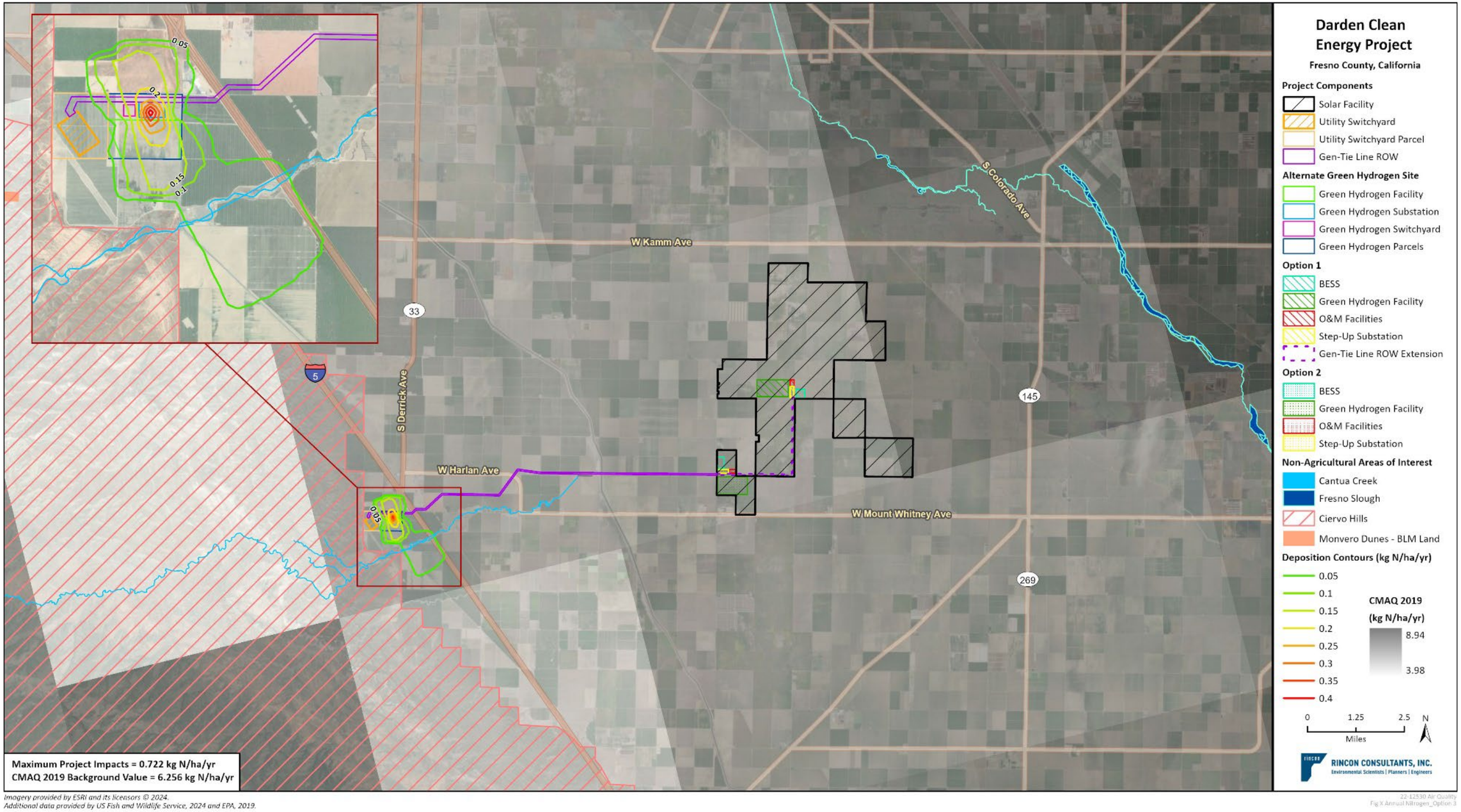


Figure 4 Nitrogen Deposition Project Option 3



3 Hazardous Materials Handling

3.1 Data Request REV 1 DR HAZ-1

3.1.1 Data Request REV 1 DR HAZ-1

REV 1 DR HAZ-1: Staff reviewed the Phase I and Phase II Environmental Site Assessments (ESAs) presented in Appendix F from applicant's CEC Data Response Set 3 in response to staff's DR HAZ-1. Staff notes that these ESAs describe obtaining soil samples at various dates in 2022 and 2023. The soil samples were analyzed for OCP (organochlorine pesticides), lead, and arsenic at 41 locations across the subject property and 10 of those 41 were analyzed for selenium. Although these reports recommended consideration of well-water for dust suppression at the site, well-water or groundwater sampling and analysis data could not be found in any of these reports.

Based on the response to staff's DR HAZ-1, staff needs additional information to assess the potential health hazards posed to workers involved in soil disturbances, trenching, and excavation activities, in addition to evaluating the use of well-water or groundwater for dust suppression. Please prepare and implement a supplemental Sampling and Analysis Plan (SAP) to sample and analyze a representative number of soil samples and well-water samples within the site and the linears (including the proposed hydrogen gas pipeline route) for the herbicide DCPA (Dacthal) and CAM-17 metals per the California Administrative Manual. This SAP should also include analysis of the organochlorine pesticides in the well-water samples and along linears that were not previously sampled.

Response: The Applicant collected additional soil samples and well-water samples in July 2024, which were analyzed for the herbicide DCPA (Dacthal) and CAM-17 metals per the California Administrative Manual, as well as organochlorine pesticides. The locations of the soil and groundwater well samples are depicted on Figure 5 below. Using input from the CEC, the Applicant sited the soil sample locations across the Project area to provide representative results across the PV facility, the utility switchyard parcel, the gen-tie corridor, and a hydrogen stub pipeline alternative. Soil samples were collected between zero and six inches below surface and five sub-samples were collected at each sampling location, then sent to the lab for analysis. For consistency, the water samples were collected from the same groundwater wells previously sampled, with one well located in the gen-tie corridor and the other 1.4 miles north of the gen-tie corridor. Irrigation pumps ran for one hour prior to sampling to ensure the collection of an accurate and representative sample of the water table quality. Although these wells have not been identified as the source for construction and operations water, the water samples provide representative data of water quality within the area surrounding the Project.

The results of the soil and water samples are provided as Appendix A to this document. The analytical results and screening thresholds for the soil samples are provided in Table 3 and the analytical results and screening threshold for the water samples are provided in Table 4. Concentrations of target soil analytes were compared to Environmental Protection Agency (EPA) Regional Screening Levels (RSL) for industrial soils, Department of Toxic Substance Control (DTSC) Screening Levels (SL) for commercial/industrial soils, and the San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESL) for commercial/industrial soils. Concentrations of target water analytes were compared to maximum contaminant levels (MCL).

Based on comparison to the thresholds described above, only arsenic was detected in soil at concentrations that exceeded screening thresholds. However, arsenic is known to occur naturally in soils in California and arsenic concentrations in the State generally range from 0.6 mg/kg to 11 mg/kg (Kearney Foundation of Soil Science Division of Agriculture and Natural Resources)[1]. The concentrations of soil samples collected at the Project site are within the background range cited by the Kearney Foundation. Dacthal was not detected above laboratory reporting limits in either soil or water samples collected.

[1] Kearney Foundation of Soil Science Division of Agriculture and Natural Resources. 1996. *Background Concentrations of Trace and Major Elements in California Soils.* March.

Figure 5 Soil and Groundwater Well Sample Locations

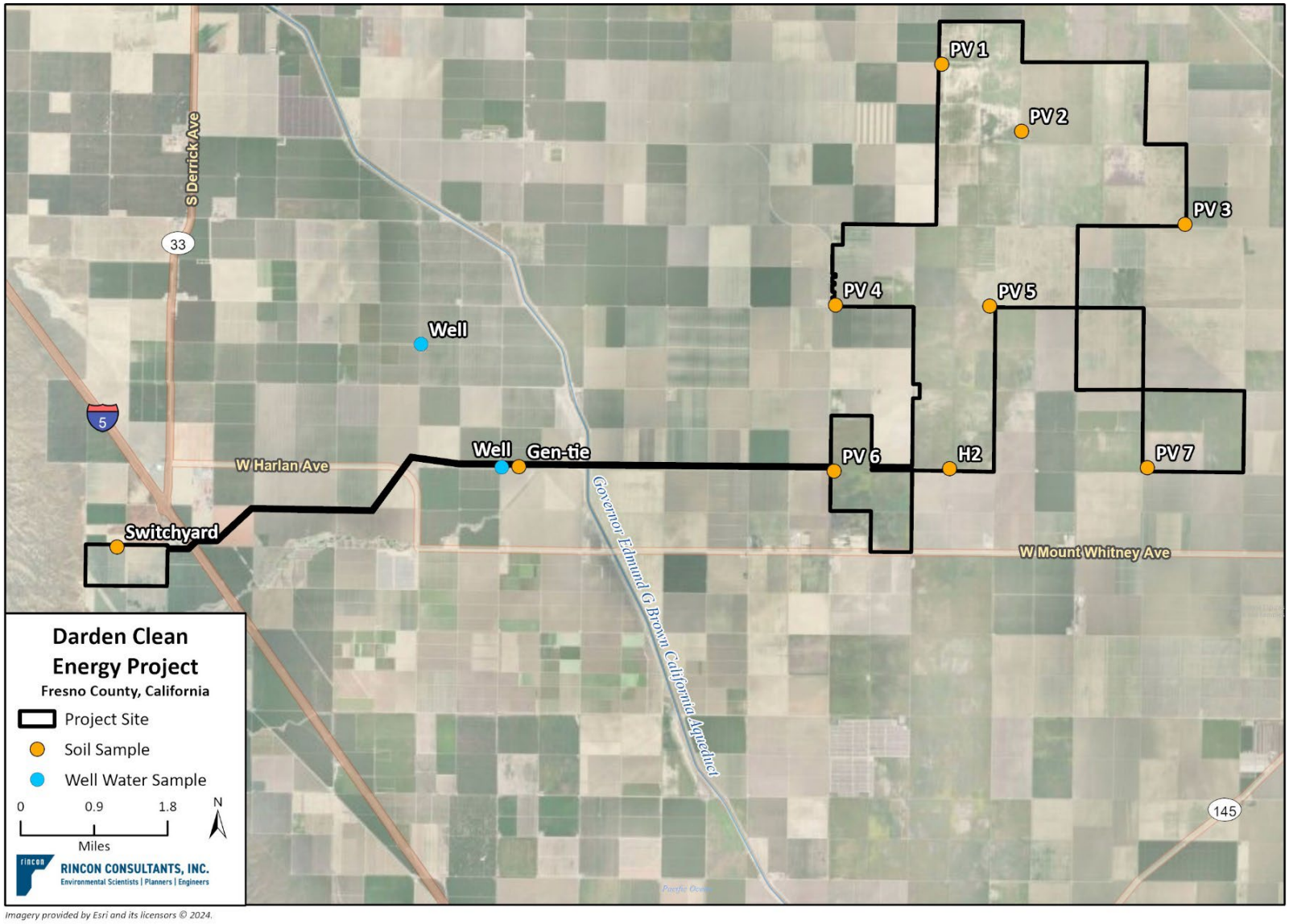


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Table 3 Soil Sample Analytic Results and Screening Thresholds

			Metals																Organochlorine Pesticides		
Sample ID	Sample Date	Sample Depth (ft bgs)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	DDE	DDT	Oxyfluorfen
			EPA Method 6020 - Concentration (mg/kg)																	OC Screen - Concentration (ppm)		
PV 1 0-6"	7/15/2024	0.5	<10	8.1	310	<1.3	<1.3	98	14	22	9.3	<0.5	<13	150	<2.5	<13	<2.0	36	75	<0.02	<0.02	<0.04
PV 2 0-6"	7/15/2024	0.5	<10	7.3	240	<1.3	<1.3	85	<13	24	9.8	<0.5	<13	120	<2.5	<13	<2.0	50	81	0.11	<0.02	<0.04
PV 3 0-6"	7/15/2024	0.5	<10	11	270	<1.3	<1.3	89	20	46	13	<0.5	<13	130	<2.5	<13	<2.0	67	120	<0.02	<0.02	<0.04
PV 4 0-6"	7/15/2024	0.5	<10	8	290	<1.3	<1.3	59	<13	27	13	<0.5	<13	93	<2.5	<13	<2.0	38	95	0.12	0.05	<0.04
PV 5 0-6"	7/15/2024	0.5	<10	8.3	320	<1.3	<1.3	120	16	26	10	<0.5	<13	170	<2.5	<13	<2.0	41	84	<0.02	<0.20	<0.04
PV 6 0-6"	7/15/2024	0.5	<10	8.4	300	<1.3	<1.3	59	<13	29	12	<0.5	<13	90	<2.5	<13	<2.0	44	94	0.03	<0.02	<0.04
PV 7 0-6"	7/15/2024	0.5	<10	8.2	190	<1.3	<1.3	69	15	34	9.5	<0.5	<13	97	<2.5	<13	<2.0	54	87	0.03	<0.02	<0.04
Gen-Tie 0-6"	7/25/2024	0.5	<10	9.1	300	<1.3	<1.3	61	14	31	13	<0.5	<13	95	<2.5	<13	<2.0	45	120	0.04	<0.02	0.05
H2 0-6"	7/15/2024	0.5	<10	8.7	320	<1.3	<1.3	82	15	31	12	<0.5	<13	120	<2.5	<13	<2.0	48	93	<0.02	<0.02	<0.04
Switchyard 0-6"	7/15/2024	0.5	<10	3.6	190	<1.3	<1.3	60	<13	19	<6.3	<0.5	<13	80	<2.5	<13	<2.0	26	96	<0.02	<0.02	<0.04
Commercial/ Industrial ESLs			160	0.31	220000	230	1100	NE	350	47000	320	190	5800	11000	5800	5800	12	5800	350000	8.3	8.5	NE
DTSC Commercial/Industrial SLs			NE	0.36	NE	230	NE	NE	NE	NE	500	4.4	NE	11000	NE	NE	NE	NE	NE	9.3	7.1	20
EPA Industrial RSLs (THQ = 1)			470	3	220000	2300	100	NE	350	47000	800	46	5800	17000	5800	5800	12	5800	350000	9.3	8.5	31

Table 4 Water Sample Analytic Results and Screening Thresholds

		Metals																Organochlorine Pesticides
Sample ID	Sample Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	lambda Cyhalothrin
		EPA Method 200.8 - Concentration (ug/L)																OC Screen - Concentration (ppm)
Well #4	7/16/2024	<2.0	2.9	19	<1.0	<1.0	35	<10	<5.0	<1.0	0.22	<10	<10	14	<10	<1.0	4.7	<50	0.13
Well #5	7/16/2024	<2.0	3.6	25	<1.0	<1.0	<10	<10	<5.0	<1.0	<0.2	14	<10	2.5	<10	<1.0	5.7	<50	<0.1
Direct Exposure Human Health Risk Levels: MCL Priority		6	10	1000	4	NE	50	6	1000	15	2	100	100	50	100	2	NE	5000	NE

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4 Project Description

4.1 Data Request REV 1 DR PD-2 and REV 1 DR PD-3

4.1.1 Data Request REV 1 DR PD-2

REV 1 DR PD-2: In CEC Data Response Set 2 to DR PD-14, Table 3 lists residential addresses within one mile of the project. However, staff specifically needs to know the direct mailing addresses for owners and occupants of all properties contiguous to the power plant, related facilities, transmission lines, or other linear facilities. If there are no contiguous properties where the site address of the property is different from the owner's mailing address (i.e., property not owner occupied), please make a statement to that effect. Otherwise, provide the site address and property owner address. This information is necessary to ensure that notification for Appendix B for the project is made consistent with the requirements of the California Environmental Quality Act (Cal. Code Regs., tit. 14, § 15087(a)(3)).

Response: Table 3 *DR PD-14 Residential Addresses within 1-Mile of the Project* provided in CEC Data Response Set 2 provides direct mailing addresses for all residences located on parcels contiguous to the Project boundary. Appendix A *Property Owner Information* of the Opt-In Application provides the parcel landowner names and mailing addresses for all parcels within 1,000 feet of Project facilities and 500 feet of the Project's generation intertie line. An updated table is provided below that includes all properties within 1,000 feet of Project facilities and 500 feet of the Project's generation intertie line, as required by Appendix B (a)(1)(e), as well as mailing addresses for all residences (Site Address) on parcels contiguous to the Project boundary. For parcels where the Site (Occupant) Address and Building Latitude and Longitude are not available, there are no known habitable structures. Table 5 provides the information necessary to ensure that notification for the Project is consistent with the California Environmental Quality Act requirement (Cal. Code Regs., tit. 14, § 15087(a)(3)), which requires public noticing through "direct mailing to the owners and occupants of property contiguous to the parcel or parcels on which the project is located. Owners of such property shall be identified as shown on the latest equalized assessment roll."

Table 5 REV 1 DR PD-2 Mailing Addresses for Parcels Adjacent to the Project Boundary

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
045-070-47S	28947 W Mt Whitney Ave Cantua Creek, CA 93608	36.42982949	-120.3197722	Rita K Mouren Trust 35244 Oil City Road Coalinga, CA 93210
045-080-28S	20009 S Derrick Ave Cantua Creek, CA 93608	36.42990256	-120.3913907	HNS Properties LLC PO Box 673 Salinas, CA 93902
045-080-37S	31485 W Harlan Ave Cantua Creek, CA 93608	36.44277598	-120.36619	City National Bank NA (Trustee) 555 S Flower Street Los Angeles, CA 90071
050-070-63S	19056 S Napa Ave Cantua Creek, CA 93608	36.45698202	-120.229554	Eric A. Grouleff 627 Meadow Lane Kerman, CA 93630
050-070-63S	19056 S Napa Ave Cantua Creek, CA 93608	36.45730821	-120.2295583	Eric A. Grouleff 627 Meadow Lane Kerman, CA 93630
050-060-20S	25457 W Cerini Ave Cantua Creek, CA 93608	36.45737888	-120.2385486	Schmiederer Family Farms LLC 2578 S Lyon Avenue Mendota, CA 93640
050-060-20S	25457 W Cerini Ave Cantua Creek, CA 93608	36.45743547	-120.238331	Schmiederer Family Farms LLC 2578 S Lyon Avenue Mendota, CA 93640
050-060-20S	25457 W Cerini Ave Cantua Creek, CA 93608	36.457532	-120.2382395	Schmiederer Family Farms LLC 2578 S Lyon Avenue Mendota, CA 93640
050-070-63S	23936 W Cerini Ave Cantua Creek, CA 93608	36.4578035	-120.229315	Eric A. Grouleff 627 Meadow Lane Kerman, CA 93630
050-060-20S	25457 W Cerini Ave Cantua Creek, CA 93608	36.45781501	-120.2386185	Schmiederer Family Farms LLC 2578 S Lyon Avenue Mendota, CA 93640
050-070-63S	23936 W Cerini Ave Cantua Creek, CA 93608	36.45802403	-120.228788	Eric A. Grouleff 627 Meadow Lane Kerman, CA 93630

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
050-030-50S	23936 W Cerini Ave Cantua Creek, CA 93608	36.45846222	-120.2294757	Eric A. Grouleff 627 Meadow Lane Kerman, CA 93630
050-020-37S	18019 S Sonoma Ave Cantua Creek, CA 93608	36.46533047	-120.2524233	George Stanley Nunn Jr. and Meredith Fitzgerald Nunn 741 Sunset Road Brentwood, CA 94513
050-020-37S	18019 S Sonoma Ave Cantua Creek, CA 93608	36.4653357	-120.2535559	George Stanley Nunn Jr. and Meredith Fitzgerald Nunn 741 Sunset Road Brentwood, CA 94513
050-020-37S	18019 S Sonoma Ave Cantua Creek, CA 93608	36.46534093	-120.2531812	George Stanley Nunn Jr. and Meredith Fitzgerald Nunn 741 Sunset Road Brentwood, CA 94513
050-020-37S	18019 S Sonoma Ave Cantua Creek, CA 93608	36.465344	-120.2527593	George Stanley Nunn Jr. and Meredith Fitzgerald Nunn 741 Sunset Road Brentwood, CA 94513
050-020-37S	18019 S Sonoma Ave Cantua Creek, CA 93608	36.46563051	-120.253062	George Stanley Nunn Jr. and Meredith Fitzgerald Nunn 741 Sunset Road Brentwood, CA 94513
050-020-37S	18019 S Sonoma Ave Cantua Creek, CA 93608	36.47223801	-120.2503572	George Stanley Nunn Jr. and Meredith Fitzgerald Nunn 741 Sunset Road Brentwood, CA 94513
050-020-37S	18019 S Sonoma Ave Cantua Creek, CA 93608	36.47227199	-120.249154	George Stanley Nunn Jr. and Meredith Fitzgerald Nunn 741 Sunset Road Brentwood, CA 94513
050-020-37S	18019 S Sonoma Ave Cantua Creek, CA 93608	36.47228093	-120.2489964	George Stanley Nunn Jr. and Meredith Fitzgerald Nunn 741 Sunset Road Brentwood, CA 94513
050-020-37S	18019 S Sonoma Ave Cantua Creek, CA 93608	36.47228155	-120.2498917	George Stanley Nunn Jr. and Meredith Fitzgerald Nunn 741 Sunset Road Brentwood, CA 94513
050-020-23S	17635 S Sonoma Ave Cantua Creek, CA 93608	36.47301148	-120.248744	Fortune Farms No. 6 PO Box 370 Cantua Creek, CA 93608

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
050-020-23S	17635 S Sonoma Ave Cantua Creek, CA 93608	36.47361757	-120.2491532	Fortune Farms No. 6 PO Box 370 Cantua Creek, CA 93608
050-020-47ST	17910 S Sonoma Ave Cantua Creek, CA 93608	36.47438552	-120.2476215	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-020-46S	17830 S Sonoma Ave Cantua Creek, CA 93608	36.47467548	-120.2476195	Clark Bros Farming 4955 E Anderson Avenue Fresno, CA 93727
050-020-46S	17830 S Sonoma Ave Cantua Creek, CA 93608	36.47498626	-120.2476535	Clark Bros Farming 4955 E Anderson Avenue Fresno, CA 93727
050-020-23S	17635 S Sonoma Ave Cantua Creek, CA 93608	36.47669399	-120.2484325	Fortune Farms No. 6 PO Box 370 Cantua Creek, CA 93608
050-020-23S	17635 S Sonoma Ave Cantua Creek, CA 93608	36.47708001	-120.248446	Fortune Farms No. 6 PO Box 370 Cantua Creek, CA 93608
050-020-23S	17635 S Sonoma Ave Cantua Creek, CA 93608	36.47807886	-120.2484278	Fortune Farms No. 6 PO Box 370 Cantua Creek, CA 93608
050-020-44S	17812 S Sonoma Ave Cantua Creek, CA 93608	36.47808	-120.247393	Clark Bros Farming 4955 E Anderson Avenue Fresno, CA 93727
050-020-23S	17635 S Sonoma Ave Cantua Creek, CA 93608	36.47850754	-120.2484267	Fortune Farms No. 6 PO Box 370 Cantua Creek, CA 93608
050-020-39S	17056 S Sonoma Ave Cantua Creek, CA 93608	36.48413057	-120.2461996	Clark Bros Farming 4955 E Anderson Avenue Fresno, CA 93727
040-100-29S	24841 W Clarkson Ave Cantua Creek, CA 93608	36.501424	-120.243147	Gary A. Hughes (Trustee) 11218 N Knotting Hill Drive Fresno, CA 93730

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
040-120-14S	N/A	N/A	N/A	James G Avila & Isabel Ann (Trustees) PO Box 609 Lemore, CA 93245
040-120-25S	N/A	N/A	N/A	James G Avila & Isabel Ann (Trustees) PO Box 609 Lemore, CA 93245
040-110-33S	N/A	N/A	N/A	B & D Walker Farms 470 E Herndon Avenue Fresno, CA 93720
050-070-17S	N/A	N/A	N/A	G & M Farms LLC 19388 Excelsior Avenue Riverdale CA, 93656
045-090-18S	N/A	N/A	N/A	Bhullar Estates Inc. 2916 Allenwood Court San Jose, CA 95148
045-160-18S	N/A	N/A	N/A	David & Marilyn Britz (Trustees) and Martin Britz (Trustee) PO Box 9050 Fresno, CA 93790
045-160-21S	N/A	N/A	N/A	David & Marilyn Britz (Trustees) and Martin Britz (Trustee) PO Box 9050 Fresno, CA 93790
045-160-22S	N/A	N/A	N/A	David & Marilyn Britz (Trustees) and Martin Britz (Trustee) PO Box 9050 Fresno, CA 93790
045-160-23S	N/A	N/A	N/A	David & Marilyn Britz (Trustees) and Martin Britz (Trustee) PO Box 9050 Fresno, CA 93790
045-160-24S	N/A	N/A	N/A	David & Marilyn Britz (Trustees) and Martin Britz (Trustee) PO Box 9050 Fresno, CA 93790
045-160-26S	N/A	N/A	N/A	David & Marilyn Britz (Trustees) and Martin Britz (Trustee) PO Box 9050 Fresno, CA 93790

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
050-080-12S	N/A	N/A	N/A	David & Marilyn Britz (Trustees) and Martin Britz (Trustee) PO Box 9050 Fresno, CA 93790
050-080-30S	N/A	N/A	N/A	David & Marilyn Britz (Trustees) and Martin Britz (Trustee) PO Box 9050 Fresno, CA 93790
050-060-44S	N/A	N/A	N/A	Britz Gin Partnership II 3265 W Figarden Drive Fresno, CA 93711
050-030-22S	N/A	N/A	N/A	C & A Farms LLC 1306 W Herndon Avenue Fresno, CA 93711
050-030-43S	N/A	N/A	N/A	C & A Farms LLC 1306 W Herndon Avenue Fresno, CA 93711
050-060-29S	N/A	N/A	N/A	C & A Farms LLC 1306 W Herndon Avenue Fresno, CA 93711
050-060-30S	N/A	N/A	N/A	C & A Farms LLC 1306 W Herndon Avenue Fresno, CA 93711
050-060-43S	N/A	N/A	N/A	C & A Farms LLC 1306 W Herndon Avenue Fresno, CA 93711
050-070-24S	N/A	N/A	N/A	C & A Farms LLC 1306 W Herndon Avenue Fresno, CA 93711
050-070-35S	N/A	N/A	N/A	C & A Farms LLC 1306 W Herndon Avenue Fresno, CA 93711
050-070-36S	N/A	N/A	N/A	C & A Farms LLC 1306 W Herndon Avenue Fresno, CA 93711

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
050-070-37S	N/A	N/A	N/A	C & A Farms LLC 1306 W Herndon Avenue Fresno, CA 93711
050-020-38S	N/A	N/A	N/A	Clark Bros Farming 4955 E Andersen Avenue Fresno, CA 93727
045-090-50S	N/A	N/A	N/A	Charles Peter Cobb and Nancy B Blattel 6083 N Figarden Drive Fresno, CA 93722
045-090-51S	N/A	N/A	N/A	Charles Peter Cobb and Nancy B Blattel 6083 N Figarden Drive Fresno, CA 93722
045-080-47S	N/A	N/A	N/A	Double J Farms PO Box 398 Corcoran, CA 93212
040-100-28S	N/A	N/A	N/A	Fortune Farms No. 2 PO Box 370 Cantua Creek, CA 93608
045-260-14S	N/A	N/A	N/A	Gonye Family Farms LLC 10735 N Frayne Drive Vero Beach, FL 32963
050-020-41S	N/A	N/A	N/A	Eric A Grouleff 627 Meadow Lane Kerman, CA 93630
050-020-42S	N/A	N/A	N/A	Eric A Grouleff 627 Meadow Lane Kerman, CA 93630
050-020-43S	N/A	N/A	N/A	Eric A Grouleff 627 Meadow Lane Kerman, CA 93630
045-070-49S	N/A	N/A	N/A	The James B and Betsy A Hansen Living Trust and James B Hansen PO Box 398 Corcoran, CA 93212

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
045-070-51S	N/A	N/A	N/A	The James B and Betsy A Hansen Living Trust and James B Hansen PO Box 398 Corcoran, CA 93212
045-080-09S	N/A	N/A	N/A	The James B and Betsy A Hansen Living Trust and James B Hansen PO Box 398 Corcoran, CA 93212
045-080-17S	N/A	N/A	N/A	The James B and Betsy A Hansen Living Trust and James B Hansen PO Box 398 Corcoran, CA 93212
045-080-49S	N/A	N/A	N/A	Nis P & Jess Hansen Trust and James B Hansen (Trustee) PO Box 398 Corcoran, CA 93212
045-070-45S	N/A	N/A	N/A	Double J Farms PO Box 398 Corcoran, CA 93212
045-080-38S	N/A	N/A	N/A	Kendall E Gardner and Nis P Hansen (Trustee) PO Box 398 Corcoran, CA 93212
040-070-29S	N/A	N/A	N/A	Holland Farms LP PO Box 80 Kerman, CA 93630
040-070-30S	N/A	N/A	N/A	Holland Farms LP PO Box 80 Kerman, CA 93630
050-020-49S	N/A	N/A	N/A	Hoppe Farming LLC 680 W Shaw Avenue Fresno, CA 93704
050-100-32S	N/A	N/A	N/A	Hoss Pistachios LLC 1324 W Craig Road North Las Vegas, NV 89032
050-100-47S	N/A	N/A	N/A	Hoss Pistachios LLC 1324 W Craig Road North Las Vegas, NV 89032

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
050-060-27S	N/A	N/A	N/A	Laura K Nunn and Lindsey Nunn Houd 10500 Brentwood Boulevard Brentwood, CA 94513
050-060-40S	N/A	N/A	N/A	Robert E Nunn and Lindsey Nunn Houd 10500 Brentwood Boulevard Brentwood, CA 94513
040-100-30S	N/A	N/A	N/A	Gary A Hughes (Trustee) 11218 N Knotting Hill Drive Fresno, CA 93730
040-100-31S	N/A	N/A	N/A	Gary A Hughes (Trustee) 11218 N Knotting Hill Drive Fresno, CA 93730
045-300-19S	N/A	N/A	N/A	Kevin Klein (Trustee) 2363 S Cedar Avenue Fresno, CA 93725
045-300-20S	N/A	N/A	N/A	Kevin Klein (Trustee) 2363 S Cedar Avenue Fresno, CA 93725
050-030-45S	N/A	N/A	N/A	Maricopa Orchards LLC 1306 W Herndon Avenue Fresno, CA 93711
050-030-46S	N/A	N/A	N/A	Maricopa Orchards LLC 1306 W Herndon Avenue Fresno, CA 93711
050-030-47S	N/A	N/A	N/A	Maricopa Orchards LLC 1306 W Herndon Avenue Fresno, CA 93711
050-030-48S	N/A	N/A	N/A	Maricopa Orchards LLC 1306 W Herndon Avenue Fresno, CA 93711
050-070-15S	N/A	N/A	N/A	Maricopa Orchards LLC 1306 W Herndon Avenue Fresno, CA 93711

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
050-070-18S	N/A	N/A	N/A	Maricopa Orchards LLC 1306 W Herndon Avenue Fresno, CA 93711
045-160-02S	N/A	N/A	N/A	Phillip A T Martin 17300 Iona Avenue Lemoore, CA 93245
045-160-03S	N/A	N/A	N/A	Phillip A T Martin 17300 Iona Avenue Lemoore, CA 93245
045-070-10S	N/A	N/A	N/A	Rita K Mouren Trust 35244 Oil City Road Coalinga, CA 93210
045-070-14S	N/A	N/A	N/A	Rita K Mouren Trust 35244 Oil City Road Coalinga, CA 93210
045-070-16S	N/A	N/A	N/A	Rita K Mouren Trust 35244 Oil City Road Coalinga, CA 93210
45-070-04	N/A	N/A	N/A	Navreen Kaur Thandi, Hirday P Singh, Kashmir K Singh <Null>
045-070-35S	N/A	N/A	N/A	Nunn Family No. 2 Limited Partnership 741 Sunset Road Brentwood, CA 94513
045-070-37S	N/A	N/A	N/A	Nunn Family No. 2 Limited Partnership 741 Sunset Road Brentwood, CA 94513
050-060-38S	N/A	N/A	N/A	Laura K Nunn Trust 10500 Brentwood Boulevard Brentwood, CA 94513
050-060-18S	N/A	N/A	N/A	James David Renton and Sarah Joy Renton 16400 E Peltier Road Acampo, CA 95220

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
050-060-34S	N/A	N/A	N/A	James David Renton and Sarah Joy Renton 420 N Almansor Street Alhambra, CA 91801
050-060-23S	N/A	N/A	N/A	Ronald Nunn Family Limited Partnership 10500 Brentwood Boulevard Brentwood, CA 94513
050-060-24S	N/A	N/A	N/A	Ronald Nunn Family Limited Partnership 10500 Brentwood Boulevard Brentwood, CA 94513
045-260-12S	N/A	N/A	N/A	Rusty Rose LLC 9422 N Sunnyside Avenue Clovis, CA 93619
050-060-49S	N/A	N/A	N/A	Binder Sandhu and Sukhdev K Sandhu 5323 W Huffman Avenue Fresno, CA 93722
040-060-10S	N/A	N/A	N/A	George J Seasholtz J 4965 N Crystal Avenue Fresno, CA 93705
045-080-46S	N/A	N/A	N/A	Superior Almond Hulling L P PO Box 399 Cantua Creek, CA 93608
050-040-20S	N/A	N/A	N/A	Ernest A Taylor & Alene L PO Box 540 Hanford, CA 93232
050-070-52S	N/A	N/A	N/A	Ernest A Taylor & Alene L PO Box 540 Hanford, CA 93232
050-070-54S	N/A	N/A	N/A	Ernest A Taylor & Alene L PO Box 540 Hanford, CA 93232
045-070-44S	N/A	N/A	N/A	Navreen Kaur Thandi Trust and Singh Hirday P Trust 10795 Road 26 Madera, CA 93637

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
045-070-26ST	N/A	N/A	N/A	United States of America Unavailable
045-260-05ST	N/A	N/A	N/A	United States of America Unavailable
040-160-15S	N/A	N/A	N/A	Brandon J Walker (Trustee) 470 E Herndon Avenue Fresno, CA 93720
050-080-25S	N/A	N/A	N/A	Walker Five Points LLC 470 E Herndon Avenue Fresno, CA 93720
040-070-25ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-070-26ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-070-31ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-070-32ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-110-15ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-110-16ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-110-20ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 9370
040-110-21ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
040-110-23ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-110-25ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-110-27ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-110-28ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-110-29ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-110-30ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-110-31ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-110-32ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-110-34ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-160-06ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-160-07ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
040-160-13ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-160-14T	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-160-16ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-160-20ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-160-21ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
045-070-46ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-04ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-05ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-07ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-08ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-10ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
050-030-21ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-24ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-25ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-26ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-27ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-29ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-30ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-31ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-32ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-33ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-030-49ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
050-040-01T	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-040-19ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-060-45ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-060-46ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-060-47ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-060-48ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-070-02T	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-070-06ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-070-30ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-070-41ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-070-42ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
050-070-43ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-070-53ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-070-55ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-070-64ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-080-01ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-080-29ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-110-01ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-290-01T	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-290-11T	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
050-080-01T	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
040-160-10ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
045-070-32ST	N/A	N/A	N/A	United States of America Unavailable
045-070-38ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
045-070-40ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
045-070-42ST	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
45-090-08	N/A	N/A	N/A	Antoinette and Lenoard D Wood Jr. Trust 30043 Creek Run Buena Vista, CO 81211
045-090-17S	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
45-090-55	N/A	N/A	N/A	Martin Phillip Joseph and Linda Gay 17300 Iona Avenue Lemoore, CA 93245
45-171-01	N/A	N/A	N/A	Robert N Stephens Trustee 2625 Trout Gulch Road Aptos, CA 95003
045-260-08ST	N/A	N/A	N/A	United States of America Unavailable
050-020-45S	N/A	N/A	N/A	Clark Bros Farming 4955 E Anderson Avenue Fresno, CA 93727
050-060-35S	N/A	N/A	N/A	James David Renton and Sarah Joy Renton 16400 E Peltier Road Acampo, CA 95220
050-290-02T	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703

Assessor's Parcel Number	Site (Occupant) Address	Building Latitude	Building Longitude	Landowner's Address
050-290-03T	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703
50-290-04	N/A	N/A	N/A	Sue Parnagian 3899 W Alluvial Avenue Fresno, CA 93711
50-290-05	N/A	N/A	N/A	Frances A Jay 518 E 19th Street Oakland, CA 94606
050-290-07T	N/A	N/A	N/A	Westlands Water District 3130 N Fresno Street Fresno, CA 93703

4.1.2 Data Request REV 1 DR PD-3

REV 1 DR PD-3: In response to DR PD-16, Figure 5 in *CEC Data Request Response Set 2* appears to show photo simulations of the various project components, except for the photovoltaic (PV) panels. Please update this figure to include a photo simulation of the PV panels. Please also provide a clearer photo simulation of the other project components.

Response: An updated aerial photo simulation showing the solar PV panels and other project components for each Project alternative is provided in Figure 6 below. This image file (.jpeg) is also being provided as a standalone file with this submittal to ensure a high-quality version is available for review.

Figure 6 Aerial Simulation of Post-Construction Project Components

5 Water Resources

5.1 Data Request REV 1 DR WATER-1

5.1.1 Data Request REV 1 DR WATER-1

REV 1 DR WATER 1: The response to staff's DR WATER-1 in *CEC Data Request Response Set 4* indicates the applicant has opted to pursue zero liquid discharge (ZLD) for brine treatment. The water quality treatment process describes wastewater being sent to an evaporator where most of the remaining liquid is removed through boiling and evaporation.

Table 4 from the response to staff's DR WATER-3 in *CEC Data Responses Set 4* shows a daily wastewater generation rate of 236,579 gallons, which is reported to result in the generation of 40,600 pounds per day of solids. Title 20, Appendix B requires an applicant to provide a description of the water to be used and discharged by the project including average and maximum daily and annual water demand and wastewater discharge for both the construction and operation phases of the project.

Please provide the maximum daily and annual estimated flow rates for both water demand and wastewater generated including information as it relates specifically to wastewater (reverse osmosis reject) handling and disposal as this information was not provided in the applicant's responses to staff's DR WATER-1, as previously requested.

Response: The Applicant confirmed with the CEC that this data request is focused on the water requirements and the wastewater produced during operations of the hydrogen facility. Wastewater amounts for potable water, equipment and panel washing water, and water treatment sludge are included in the response to DR WASTE-1, Tables 5.11-1 and 5.11-2 in Data Response Set 2.

Table 4 from the response to DR WATER-3 in Data Response Set 4 has been updated with estimates for average and maximum daily and annual water requirements and wastewater amounts, provided in Table 6 and Table 7 below.

The water treatment plant is sized for peak water demand when the solar facility is operating at 100 percent capacity factor and feeding the electrolyzer to produce maximum hydrogen flow. The numbers presented in Table 6 represent this peak performance scenario. There will be times when the solar plant is not operating at 100 percent capacity factor (i.e., cloudy day, or early/late in the day) and water demands for hydrogen production will be lower. The average water demand is expected to be approximately 85 percent of the peak flow, 758,835 gallons per day (GPD) of inflow and 476,869 GPD of outflow, as the system efficiency will not change. Table 7 represents this average performance scenario.

Table 6 REV 1 DR WATER-1 Electrolyzer WTP Processes and Balance Maximums

	Daily		Annual		
Process Step	Feedstock Water Inflow	Waste Generation Rate	Feedstock Water Inflow	Waste Generation Rate	Process Efficiency
Total Inflow (Raw Water)	892,747 GPD (2.74 AF/day)	N/A	325,852,655 GPY (1,000 AFY)	N/A	N/A
Membrane Microfiltration	892,747 GPD (2.74 AF/day)	17,855 GPD (0.05 AF/day)	325,852,655 GPY (1,000 AFY)	6,517,075 GPY (20 AFY)	98% (2% loss)
First Pass Reverse Osmosis	874,892 GPD (2.68 AF/day)	218,724 GPD (0.67 AF/day)	319,335,580 GPY (978 AFY)	79,834,260 GPY (245 AFY)	75% (25% loss)
Second Pass Reverse Osmosis	656,168 GPD (2.01 AF/day)	65,617 GPD (0.20 AF/day)	239,501,320 GPY (734 AFY)	23,950,205 GPY (74 AFY)	90% (10% loss)
Other Project Operational Uses	95,145 GPD (0.29 AF/day)	N/A	34,727,925 GPY (106 AFY)	N/A	N/A
Electrodeionization	590,551 GPD (1.81 AF/day)	29,528 GPD (0.09 AF/day)	215,551,115 GPY (661 AFY)	10,777,720 GPY (33 AFY)	95% (5% loss)
Total Outflow (Ultrapure Water)	561,023 GPD (1.72 AF/day)	236,579 GPD (0.73 AF/day)*	204,773,395 GPY (628 AFY)	86,351,335 GPY (265 AFY)	63 % (27% loss)

GPD = gallons per day; AF = acre-feet; GPY = gallons per year; AFY = acre-feet per year

* This wastewater will become the inflow to the zero liquid discharge system

Table 7 REV 1 DR WATER-1 Electrolyzer WTP Processes and Balance Averages

	Daily		Annual		
Process Step	Feedstock Water Inflow	Waste Generation Rate	Feedstock Water Inflow	Waste Generation Rate	Process Efficiency
Total Inflow (Raw Water)	758,835 GPD (2.33 AF/day)	N/A	276,974,757 GPY (850 AFY)	N/A	N/A
Membrane Microfiltration	758,835 GPD (2.33 AF/day)	15,177 GPD (0.05 AF/day)	276,974,757 GPY (850 AFY)	5,539,514 GPY (17 AFY)	98% (2% loss)
First Pass Reverse Osmosis	743,658 GPD (2.28 AF/day)	185,915 GPD (0.57 AF/day)	271,435,243 GPY (831 AFY)	67,859,121 GPY (208 AFY)	75% (25% loss)
Second Pass Reverse Osmosis	557,743 GPD (1.71 AF/day)	55,774 GPD (0.17 AF/day)	203,576,122 GPY (624 AFY)	20,357,674 GPY (62 AFY)	90% (10% loss)
Other Project Operational Uses	80,873 GPD (0.25 AF/day)	N/A	29,518,736 GPY (90 AFY)	N/A	N/A
Electrodeionization	501,968 GPD (1.54 AF/day)	25,099 GPD (0.08 AF/day)	183,218,448 GPY (562 AFY)	9,161,062 GPY (29 AFY)	95% (5% loss)
Total Outflow (Ultrapure Water)	476,870 GPD (1.46 AF/day)	201,092 GPD (0.62 AF/day)*	174,057,386 GPY (534 AFY)	73,398,635 GPY (226 AFY)	63% (27% loss)

GPD = gallons per day; AF = acre-feet; GPY = gallons per year; AFY = acre-feet per year

* This wastewater will become the inflow to the zero liquid discharge system

The water listed as Other Project Operational Uses will be used for equipment and solar panel washing, building sanitary facilities and cleaning, irrigation, and other operational purposes. The waste stream from these uses is discussed in section 5.11 Waste Management of the Opt-in Application and the response to DR WASTE-1 in Data Response Set 2.

The wastewater amounts listed in the Total Outflow amounts in Table 6 and Table 7 would then be fed into the ZLD system. The ZLD process is described in the response to DR WATER-3 in Data Response Set 4. The primary ZLD processes (see flow diagram in Figure 3 in the response to DR WATER-3 in Data Response Set 4) entail a reverse osmosis concentrator and evaporation/concentration that will result in a semifluid waste product that will be disposed of at a Class I/II landfill. The maximum amount of sludge is estimated to be 40,600 pounds per day maximum and 34,510 pounds per day on average. Additional drying steps may be incorporated into the ZLD system resulting in a thicker waste product and less waste to dispose of overall, but the 40,600 pounds per day of sludge waste is the maximum expected for the system.

6 Worker Safety

6.1 Data Request REV 1 DR WS-1 through WS-3

6.1.1 Data Request REV 1 DR WS-1

REV 1 DR WS-1: Figure 1 showing a typical BESS fire protection layout was submitted in response to staff's DR WS-3 on page 29 of *CEC Staff Data Request Response Set 1*; however, the figure was not clear enough for readability. Please submit a revised Figure 1 that is legible and easier to see how the BESS would be designed and sited. Please ensure that all components of the proposed BESS fire detection and suppression system are clearly marked on the figure including alarms, detectors, any water tanks, water mains and pipes, hydrants, fire water monitors (cannons), sprinkler or deluge systems, post-indicator valves, etc.

Response: An updated, full size Fire Alarm Site Plan figure was submitted through the CEC's Kiteworks platform on June 17, 2024 and is also attached to this data request submittal as Appendix B.

6.1.2 Data Request REV 1 DR WS-2

DR WS-2: The applicant's response to staff's DR WS-3 in *CEC Staff Data Request Response Set 1* stated that "The BESS equipment to be used will be tested to demonstrate that they do not require built-in smoke, gas, or fire detection or suppression devices." Please provide justification for these statements with relevant studies, test results, and/or research articles.

Response: Justification for the statement that the BESS equipment will be tested to demonstrate that they do not require built-in smoke, gas, or fire detection or suppression devices can be found in the *Tesla Megapack 2 XL Fire Protection Engineering and UL 9540A Interpretation Report*, which is provided as Appendix C to this document, as well as the *Tesla Megapack 2/XL Hazard Mitigation Analysis*, which is provided as Appendix D to this document.

As described in Appendix C, the Tesla Megapack 2 XL (MP2XL) BESS does not have an internal fire detection system or one that is integral to its design/construction. During the UL 9540A unit level fire test, two multi-spectrum infrared (IR) flame detectors and two thermal imagers from differing manufacturers were installed pointing directly at the front and top of the initiating BESS cabinet. None of the detectors were activated during the fire test. According to Tesla, this result is expected, as no flames were observed during the test. The MP2XL also does not have an internal fire suppression system or one that is integral to its design/construction. The UL 9540A unit level test results demonstrate that a suppression system is not required to stop the spread of fire from cell to cell, module to module, or BESS cabinet to cabinet when a near -simultaneous failure of up to six cells occurs within the same battery module. In addition, as described in Appendix D, a fire suppression system is not required per the National Fire Protection Association as the MP2XL is not considered a walk-in container, occupied building, or structure.

Although the BESS does not have built-in smoke, gas, or fire detection or suppression devices, the MP2XL consists of a thermal management system, a battery management system, and an explosion control system. The thermal management system provides a suitable operating temperature for the battery and contains a closed-loop system that circulates an ethylene glycol/water mixture throughout the battery modules and power electronics to maintain optimum battery temperature

and allows cool air to enter while venting out hot air via fans through the thermal roof. The battery management system monitors battery operation and provides control of corrective and protective actions to abnormal conditions; it is engineered to react to over-temperature, loss of communication, over-voltage and isolation. The explosion control system includes pressure-sensitive vents and sparkers throughout the battery module. The sparkers are designed to ignite flammable gases before they accumulate within the enclosure and allow for release of flammable gas. Over-pressure vents open into the thermal roof when activated to allow for release of the vents, which permits gases, products of combustion, and flames to exhaust through the thermal roof.

6.1.3 Data Request REV 1 DR WS-3

REV 1 DR WS-3: The responses in *CEC Data Request Response Set 2* to staff's DR HAZ-3, DR HAZ-5, DR HAZ-7, and Appendix A (DR HAZ-7) all address the BESS choices. Page 17 of Appendix A describes proposed firefighting measures. Please provide any correspondence from the Fresno County Fire Protection District indicating that the department has reviewed the proposed firefighting measures for the project and finds that those measures are adequate. Also, please provide specific safety data sheets for each lithium-ion battery electrolyte associated with the various types of batteries that could be used, as found on page 5 of Appendix A.

Response: The Applicant has not yet corresponded with the Fresno County Fire Protection District regarding the proposed firefighting measures outlined in the Tesla Industrial Lithium-Ion Battery Emergency Response Guide (provided as Appendix A to Data Response Set 2). The battery enclosure and site installation design, and the final number and location of water tanks for emergency use will be determined in accordance with the California Fire Code and will be reviewed and approved by the local or State Fire Marshal. The Applicant intends to coordinate with the local or State Fire Marshal on the proposed firefighting measures as the Project design advances.

Safety data sheets for each lithium-ion battery electrolyte associated with the various types of batteries that could be used, as found on page 5 of the Tesla Industrial Lithium-Ion Battery Emergency Response Guide (provided as Appendix A to Data Response Set 2) are provided in Appendix E to this document.

Appendix A

REV 1 DR HAZ-1 Supplemental Soil and Water Sample Results

DELLAVALLE™
LABORATORY INC

West Yost Associates
2020 Research Park Drive Ste 100
Davis, CA 95618

Account# 00-0017201
Account Manager: Scott Sakamoto
Submitted By:
Ranch: Intersect Power

Received: 07/15/2024 15:34
Reported: 08/01/2024 13:11

Samples in this Report

Lab ID	Sample	Matrix	Sampled By	Crop	Date Sampled
24G1043-01	PV 1 0-6"	Soil	Christian Duran		7/15/2024 0:00
24G1043-02	PV 2 0-6"	Soil	Christian Duran		7/15/2024 0:00
24G1043-03	PV 3 0-6"	Soil	Christian Duran		7/15/2024 0:00
24G1043-04	PV 4 0-6"	Soil	Christian Duran		7/15/2024 0:00
24G1043-05	PV 5 0-6"	Soil	Christian Duran		7/15/2024 0:00
24G1043-06	PV 6 0-6"	Soil	Christian Duran		7/15/2024 0:00
24G1043-07	PV 7 0-6"	Soil	Christian Duran		7/15/2024 0:00

Laboratory Director/Technical Manager

ELAP Certification #1595
A2LA Certification #6440.02

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2717-01
Sampled By: Christian Duran
Sample Description: 24G1043-01 // PV 1 0-6"

Sample Date - Time: 07/15/2024 - 00:01
Matrix: Solid
Sample Type: Grab

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 6020	ND	10	mg/kg	1	AHG1245	07/24/24	07/25/24	
Arsenic	EPA 6020	**8.1**	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Barium	EPA 6020	**310**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Beryllium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cadmium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Chromium	EPA 6020	**98**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cobalt	EPA 6020	**14**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Copper	EPA 6020	**22**	5.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Lead	EPA 6020	**9.3**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Mercury	EPA 6020B	ND	0.50	mg/kg	1	AHG1245	07/24/24	07/25/24	
Molybdenum	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Nickel	EPA 6020	**150**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Selenium	EPA 6020	ND	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Silver	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Thallium	EPA 6020	ND	2.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Vanadium	EPA 6020	**36**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Zinc	EPA 6020	**75**	63	mg/kg	1	AHG1245	07/24/24	07/25/24	

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2717-02
Sampled By: Christian Duran
Sample Description: 24G1043-02 // PV 2 0-6"

Sample Date - Time: 07/15/2024 - 00:01
Matrix: Solid
Sample Type: Grab

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 6020	ND	10	mg/kg	1	AHG1245	07/24/24	07/25/24	
Arsenic	EPA 6020	**7.3**	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Barium	EPA 6020	**240**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Beryllium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cadmium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Chromium	EPA 6020	**85**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cobalt	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Copper	EPA 6020	**24**	5.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Lead	EPA 6020	**9.8**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Mercury	EPA 6020B	ND	0.50	mg/kg	1	AHG1245	07/24/24	07/25/24	
Molybdenum	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Nickel	EPA 6020	**120**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Selenium	EPA 6020	ND	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Silver	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Thallium	EPA 6020	ND	2.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Vanadium	EPA 6020	**50**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Zinc	EPA 6020	**81**	63	mg/kg	1	AHG1245	07/24/24	07/25/24	

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2717-03
Sampled By: Christian Duran
Sample Description: 24G1043-03 // PV 3 0-6"

Sample Date - Time: 07/15/2024 - 00:01
Matrix: Solid
Sample Type: Grab

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 6020	ND	10	mg/kg	1	AHG1245	07/24/24	07/25/24	
Arsenic	EPA 6020	**11**	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Barium	EPA 6020	**270**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Beryllium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cadmium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Chromium	EPA 6020	**89**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cobalt	EPA 6020	**20**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Copper	EPA 6020	**46**	5.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Lead	EPA 6020	**13**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Mercury	EPA 6020B	ND	0.50	mg/kg	1	AHG1245	07/24/24	07/25/24	
Molybdenum	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Nickel	EPA 6020	**130**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Selenium	EPA 6020	ND	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Silver	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Thallium	EPA 6020	ND	2.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Vanadium	EPA 6020	**67**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Zinc	EPA 6020	**120**	63	mg/kg	1	AHG1245	07/24/24	07/25/24	

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2717-04
Sampled By: Christian Duran
Sample Description: 24G1043-04 // PV 4 0-6"

Sample Date - Time: 07/15/2024 - 00:01
Matrix: Solid
Sample Type: Grab

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 6020	ND	10	mg/kg	1	AHG1245	07/24/24	07/25/24	
Arsenic	EPA 6020	**8.0**	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Barium	EPA 6020	**290**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Beryllium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cadmium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Chromium	EPA 6020	**59**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cobalt	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Copper	EPA 6020	**27**	5.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Lead	EPA 6020	**13**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Mercury	EPA 6020B	ND	0.50	mg/kg	1	AHG1245	07/24/24	07/25/24	
Molybdenum	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Nickel	EPA 6020	**93**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Selenium	EPA 6020	ND	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Silver	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Thallium	EPA 6020	ND	2.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Vanadium	EPA 6020	**38**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Zinc	EPA 6020	**95**	63	mg/kg	1	AHG1245	07/24/24	07/25/24	

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2717-05
Sampled By: Christian Duran
Sample Description: 24G1043-05 // PV 5 0-6"

Sample Date - Time: 07/15/2024 - 00:01
Matrix: Solid
Sample Type: Grab

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 6020	ND	10	mg/kg	1	AHG1245	07/24/24	07/25/24	
Arsenic	EPA 6020	**8.3**	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Barium	EPA 6020	**320**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Beryllium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cadmium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Chromium	EPA 6020	**120**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cobalt	EPA 6020	**16**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Copper	EPA 6020	**26**	5.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Lead	EPA 6020	**10**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Mercury	EPA 6020B	ND	0.50	mg/kg	1	AHG1245	07/24/24	07/25/24	
Molybdenum	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Nickel	EPA 6020	**170**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Selenium	EPA 6020	ND	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Silver	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Thallium	EPA 6020	ND	2.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Vanadium	EPA 6020	**41**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Zinc	EPA 6020	**84**	63	mg/kg	1	AHG1245	07/24/24	07/25/24	

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2717-06
Sampled By: Christian Duran
Sample Description: 24G1043-06 // PV 6 0-6"

Sample Date - Time: 07/15/2024 - 00:01
Matrix: Solid
Sample Type: Grab

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 6020	ND	10	mg/kg	1	AHG1245	07/24/24	07/25/24	
Arsenic	EPA 6020	**8.4**	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Barium	EPA 6020	**300**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Beryllium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cadmium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Chromium	EPA 6020	**59**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cobalt	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Copper	EPA 6020	**29**	5.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Lead	EPA 6020	**12**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Mercury	EPA 6020B	ND	0.50	mg/kg	1	AHG1245	07/24/24	07/25/24	
Molybdenum	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Nickel	EPA 6020	**90**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Selenium	EPA 6020	ND	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Silver	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Thallium	EPA 6020	ND	2.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Vanadium	EPA 6020	**44**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Zinc	EPA 6020	**94**	63	mg/kg	1	AHG1245	07/24/24	07/25/24	

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2717-07
Sampled By: Christian Duran
Sample Description: 24G1043-07 // PV 7 0-6"

Sample Date - Time: 07/15/2024 - 00:01
Matrix: Solid
Sample Type: Grab

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 6020	ND	10	mg/kg	1	AHG1245	07/24/24	07/25/24	
Arsenic	EPA 6020	**8.2**	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Barium	EPA 6020	**190**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Beryllium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cadmium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Chromium	EPA 6020	**69**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cobalt	EPA 6020	**15**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Copper	EPA 6020	**34**	5.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Lead	EPA 6020	**9.5**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Mercury	EPA 6020B	ND	0.50	mg/kg	1	AHG1245	07/24/24	07/25/24	
Molybdenum	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Nickel	EPA 6020	**97**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Selenium	EPA 6020	ND	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Silver	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Thallium	EPA 6020	ND	2.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Vanadium	EPA 6020	**54**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Zinc	EPA 6020	**87**	63	mg/kg	1	AHG1245	07/24/24	07/25/24	

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno, CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:
PO No: 61109
Client Sample ID: 24G1043-01 PV 1 0-6"

EMA Sample No: 24071808-01
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Comments:

Analyte	Amount ppm	RL ppm	Tolerance ppm
a, b, d-BHC	ND	0.010	
Alachlor	ND	0.020	
Aldrin	ND	0.010	
Benfluralin	ND	0.020	
Bifenox	ND	0.050	
Boscalid	ND	0.020	
Bromacil	ND	0.040	
Captafol	ND	0.040	
Captan	ND	0.020	
Chlordane (sum of Isomers)	ND	0.020	
Chlorfenapyr	ND	0.040	
Chlorobenzilate	ND	0.040	
Chloroneb	ND	0.040	
Chlorothalonil	ND	0.010	
Cyanazine	ND	0.100	
Dacthal	ND	0.020	
DDD	ND	0.020	
DDE	ND	0.020	
DDT	ND	0.020	
Dichlobenil	ND	0.030	
Dicloran	ND	0.020	
Dicofol	ND	0.050	
Dieldrin	ND	0.010	
Endosulfan alpha	ND	0.010	
Endosulfan beta	ND	0.010	
Endosulfan sulfate	ND	0.010	
Endosulfans (Total)	ND	0.010	
Endrin	ND	0.010	
Ethafluralin	ND	0.030	
Fenhexamid	ND	0.030	
Folpet	ND	0.050	
Heptachlor	ND	0.010	
Heptachlor epoxide	ND	0.020	
Hexachlorobenzene	ND	0.010	
Indoxacarb	ND	0.030	
Iprodione	ND	0.050	
Lindane (gamma-BHC)	ND	0.010	
Linuron	ND	0.150	
Methoxychlor	ND	0.050	
Metribuzin	ND	0.020	
Mirex	ND	0.020	
Myclobutanil	ND	0.050	
Oxadiazon	ND	0.050	
Oxyfluorfen	ND	0.040	
Pendimethalin	ND	0.050	
Pentachloronitrobenzene (PCNB)	ND	0.020	
Pentachloroanaline (PCA)	ND	0.010	
Perthane	ND	0.100	
Polychlorinated Biphenyls (as congeners)	ND	0.020	
Procymidone	ND	0.020	
Profluralin	ND	0.020	
Pronamide	ND	0.050	
Propanil	ND	0.050	
Tetradifon	ND	0.020	
Toxaphene	ND	0.250	
Triadimefon	ND	0.020	
Trifloxystrobin	ND	0.030	
Triflumazole	ND	0.050	
Trifluralin	ND	0.020	
Vegadex (Diethyldithiocarbamic Acid)	ND	0.050	
Vinclozolin	ND	0.020	

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
ND = None Detected at the Reporting Limit (RL)
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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno, CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Analyte	Amount ppm	RL ppm	Tolerance ppm
Bifenthrin	ND	0.020	
Cyfluthrin	ND	0.040	
Cypermethrin	ND	0.040	
Deltamethrin	ND	0.020	
Esfenvalerate	ND	0.030	
Fenpropathrin	ND	0.010	
Fluvalinate	ND	0.040	
lambda Cyhalothrin	ND	0.020	
Permethrin	ND	0.100	
Tralomethrin	ND	0.020	
Pyrethrins (Total)	ND	0.050	

Project No:
PO No: 61109
Client Sample ID: 24G1043-01 PV 1 0-6”

EMA Sample No: 24071808-01
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Comments:

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
ND = None Detected at the Reporting Limit (RL)
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Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:
PO No: 61109
Client Sample ID: 24G1043-02 PV 2 0-6"

EMA Sample No: 24071808-02
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Comments:

Analyte	Amount ppm	RL ppm	Tolerance ppm
a, b, d-BHC	ND	0.010	
Alachlor	ND	0.020	
Aldrin	ND	0.010	
Benfluralin	ND	0.020	
Bifenox	ND	0.050	
Boscalid	ND	0.020	
Bromacil	ND	0.040	
Captafol	ND	0.040	
Captan	ND	0.020	
Chlordane (sum of Isomers)	ND	0.020	
Chlorfenapyr	ND	0.040	
Chlorobenzilate	ND	0.040	
Chloroneb	ND	0.040	
Chlorothalonil	ND	0.010	
Cyanazine	ND	0.100	
Dacthal	ND	0.020	
DDD	ND	0.020	
DDE	0.11	0.020	
DDT	ND	0.020	
Dichlobenil	ND	0.030	
Dicloran	ND	0.020	
Dicofol	ND	0.050	
Dieldrin	ND	0.010	
Endosulfan alpha	ND	0.010	
Endosulfan beta	ND	0.010	
Endosulfan sulfate	ND	0.010	
Endosulfans (Total)	ND	0.010	
Endrin	ND	0.010	
Ethafluralin	ND	0.030	
Fenhexamid	ND	0.030	
Folpet	ND	0.050	
Heptachlor	ND	0.010	
Heptachlor epoxide	ND	0.020	
Hexachlorobenzene	ND	0.010	
Indoxacarb	ND	0.030	
Iprodione	ND	0.050	
Lindane (gamma-BHC)	ND	0.010	
Linuron	ND	0.150	
Methoxychlor	ND	0.050	
Metribuzin	ND	0.020	
Mirex	ND	0.020	
Myclobutanil	ND	0.050	
Oxadiazon	ND	0.050	
Oxyfluorfen	ND	0.040	
Pendimethalin	ND	0.050	
Pentachloronitrobenzene (PCNB)	ND	0.020	
Pentachloroanaline (PCA)	ND	0.010	
Perthane	ND	0.100	
Polychlorinated Biphenyls (as congeners)	ND	0.020	
Procymidone	ND	0.020	
Profluralin	ND	0.020	
Pronamide	ND	0.050	
Propanil	ND	0.050	
Tetradifon	ND	0.020	
Toxaphene	ND	0.250	
Triadimefon	ND	0.020	
Trifloxystrobin	ND	0.030	
Triflumazole	ND	0.050	
Trifluralin	ND	0.020	
Vegadex (Diethyldithiocarbamic Acid)	ND	0.050	
Vinclozolin	ND	0.020	

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
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1910 W. McKinley, Suite #110
Fresno, CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Analyte	Amount ppm	RL ppm	Tolerance ppm
Bifenthrin	ND	0.020	
Cyfluthrin	ND	0.040	
Cypermethrin	ND	0.040	
Deltamethrin	ND	0.020	
Esfenvalerate	ND	0.030	
Fenpropathrin	ND	0.010	
Fluvalinate	ND	0.040	
lambda Cyhalothrin	ND	0.020	
Permethrin	ND	0.100	
Tralomethrin	ND	0.020	
Pyrethrins (Total)	ND	0.050	

Project No:
PO No: 61109
Client Sample ID: **24G1043-02 PV 2 0-6”**

EMA Sample No: **24071808-02**
Date Received: **7/18/2024**
Sample Matrix: **Soil**

Analytical Method: **Pyrethroid Screen**
Extraction Method: **CDFA**
Date Extracted: **7/22/2024**
Date Completed: **7/26/2024**

Comments:

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
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Date: 07/31/24 Reviewed by: _____ Robert Hughes, Lab Manager

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E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno, CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:
PO No: 61109
Client Sample ID: 24G1043-03 PV 3 0-6"

EMA Sample No: 24071808-03
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Comments:

Analyte	Amount ppm	RL ppm	Tolerance ppm
a, b, d-BHC	ND	0.010	
Alachlor	ND	0.020	
Aldrin	ND	0.010	
Benfluralin	ND	0.020	
Bifenox	ND	0.050	
Boscalid	ND	0.020	
Bromacil	ND	0.040	
Captafol	ND	0.040	
Captan	ND	0.020	
Chlordane (sum of Isomers)	ND	0.020	
Chlorfenapyr	ND	0.040	
Chlorobenzilate	ND	0.040	
Chloroneb	ND	0.040	
Chlorothalonil	ND	0.010	
Cyanazine	ND	0.100	
Dacthal	ND	0.020	
DDD	ND	0.020	
DDE	ND	0.020	
DDT	ND	0.020	
Dichlobenil	ND	0.030	
Dicloran	ND	0.020	
Dicofol	ND	0.050	
Dieldrin	ND	0.010	
Endosulfan alpha	ND	0.010	
Endosulfan beta	ND	0.010	
Endosulfan sulfate	ND	0.010	
Endosulfans (Total)	ND	0.010	
Endrin	ND	0.010	
Ethafluralin	ND	0.030	
Fenhexamid	ND	0.030	
Folpet	ND	0.050	
Heptachlor	ND	0.010	
Heptachlor epoxide	ND	0.020	
Hexachlorobenzene	ND	0.010	
Indoxacarb	ND	0.030	
Iprodione	ND	0.050	
Lindane (gamma-BHC)	ND	0.010	
Linuron	ND	0.150	
Methoxychlor	ND	0.050	
Metribuzin	ND	0.020	
Mirex	ND	0.020	
Myclobutanil	ND	0.050	
Oxadiazon	ND	0.050	
Oxyfluorfen	ND	0.040	
Pendimethalin	ND	0.050	
Pentachloronitrobenzene (PCNB)	ND	0.020	
Pentachloroanaline (PCA)	ND	0.010	
Perthane	ND	0.100	
Polychlorinated Biphenyls (as congeners)	ND	0.020	
Procymidone	ND	0.020	
Profluralin	ND	0.020	
Pronamide	ND	0.050	
Propanil	ND	0.050	
Tetradifon	ND	0.020	
Toxaphene	ND	0.250	
Triadimefon	ND	0.020	
Trifloxystrobin	ND	0.030	
Triflumazole	ND	0.050	
Trifluralin	ND	0.020	
Vegadex (Diethyldithiocarbamic Acid)	ND	0.050	
Vinclozolin	ND	0.020	

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

460 N. East Street, Woodland, CA 95776 (530) 666-6890 emalab@emalab.com www.emalab.com

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno, CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:
PO No: 61109
Client Sample ID: 24G1043-03 PV 3 0-6"

EMA Sample No: 24071808-03
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Analyte	Amount ppm	RL ppm	Tolerance ppm
Bifenthrin	ND	0.020	
Cyfluthrin	ND	0.040	
Cypermethrin	ND	0.040	
Deltamethrin	ND	0.020	
Esfenvalerate	ND	0.030	
Fenpropathrin	ND	0.010	
Fluvalinate	ND	0.040	
lambda Cyhalothrin	ND	0.020	
Permethrin	ND	0.100	
Tralomethrin	ND	0.020	
Pyrethrins (Total)	ND	0.050	

Comments:

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
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E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno, CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:
PO No: 61109
Client Sample ID: 24G1043-04 PV 4 0-6"

EMA Sample No: 24071808-04
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Comments:

Analyte	Amount ppm	RL ppm	Tolerance ppm
a, b, d-BHC	ND	0.010	
Alachlor	ND	0.020	
Aldrin	ND	0.010	
Benfluralin	ND	0.020	
Bifenox	ND	0.050	
Boscalid	ND	0.020	
Bromacil	ND	0.040	
Captafol	ND	0.040	
Captan	ND	0.020	
Chlordane (sum of Isomers)	ND	0.020	
Chlorfenapyr	ND	0.040	
Chlorobenzilate	ND	0.040	
Chloroneb	ND	0.040	
Chlorothalonil	ND	0.010	
Cyanazine	ND	0.100	
Dacthal	ND	0.020	
DDD	ND	0.020	
DDE	0.12	0.020	
DDT	0.05	0.020	
Dichlobenil	ND	0.030	
Dicloran	ND	0.020	
Dicofol	ND	0.050	
Dieldrin	ND	0.010	
Endosulfan alpha	ND	0.010	
Endosulfan beta	ND	0.010	
Endosulfan sulfate	ND	0.010	
Endosulfans (Total)	ND	0.010	
Endrin	ND	0.010	
Ethafluralin	ND	0.030	
Fenhexamid	ND	0.030	
Folpet	ND	0.050	
Heptachlor	ND	0.010	
Heptachlor epoxide	ND	0.020	
Hexachlorobenzene	ND	0.010	
Indoxacarb	ND	0.030	
Iprodione	ND	0.050	
Lindane (gamma-BHC)	ND	0.010	
Linuron	ND	0.150	
Methoxychlor	ND	0.050	
Metribuzin	ND	0.020	
Mirex	ND	0.020	
Myclobutanil	ND	0.050	
Oxadiazon	ND	0.050	
Oxyfluorfen	ND	0.040	
Pendimethalin	ND	0.050	
Pentachloronitrobenzene (PCNB)	ND	0.020	
Pentachloroanaline (PCA)	ND	0.010	
Perthane	ND	0.100	
Polychlorinated Biphenyls (as congeners)	ND	0.020	
Procymidone	ND	0.020	
Profluralin	ND	0.020	
Pronamide	ND	0.050	
Propanil	ND	0.050	
Tetradifon	ND	0.020	
Toxaphene	ND	0.250	
Triadimefon	ND	0.020	
Trifloxystrobin	ND	0.030	
Triflumazole	ND	0.050	
Trifluralin	ND	0.020	
Vegadex (Diethyldithiocarbamic Acid)	ND	0.050	
Vinclozolin	ND	0.020	

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
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E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

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1910 W. McKinley, Suite #110
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Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:
PO No: 61109
Client Sample ID: 24G1043-04 PV 4 0-6"

EMA Sample No: 24071808-04
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Analyte	Amount ppm	RL ppm	Tolerance ppm
Bifenthrin	ND	0.020	
Cyfluthrin	ND	0.040	
Cypermethrin	ND	0.040	
Deltamethrin	ND	0.020	
Esfenvalerate	ND	0.030	
Fenpropathrin	ND	0.010	
Fluvalinate	ND	0.040	
lambda Cyhalothrin	ND	0.020	
Permethrin	ND	0.100	
Tralomethrin	ND	0.020	
Pyrethrins (Total)	ND	0.050	

Comments:

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
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Email: dataentry@dellavallelab.com

Project No:
PO No: 61109
Client Sample ID: 24G1043-05 PV 5 0-6"

EMA Sample No: 24071808-05
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Comments:

Analyte	Amount ppm	RL ppm	Tolerance ppm
a, b, d-BHC	ND	0.010	
Alachlor	ND	0.020	
Aldrin	ND	0.010	
Benfluralin	ND	0.020	
Bifenox	ND	0.050	
Boscalid	ND	0.020	
Bromacil	ND	0.040	
Captafol	ND	0.040	
Captan	ND	0.020	
Chlordane (sum of Isomers)	ND	0.020	
Chlorfenapyr	ND	0.040	
Chlorobenzilate	ND	0.040	
Chloroneb	ND	0.040	
Chlorothalonil	ND	0.010	
Cyanazine	ND	0.100	
Dacthal	ND	0.020	
DDD	ND	0.020	
DDE	ND	0.020	
DDT	ND	0.020	
Dichlobenil	ND	0.030	
Dicloran	ND	0.020	
Dicofol	ND	0.050	
Dieldrin	ND	0.010	
Endosulfan alpha	ND	0.010	
Endosulfan beta	ND	0.010	
Endosulfan sulfate	ND	0.010	
Endosulfans (Total)	ND	0.010	
Endrin	ND	0.010	
Ethafluralin	ND	0.030	
Fenhexamid	ND	0.030	
Folpet	ND	0.050	
Heptachlor	ND	0.010	
Heptachlor epoxide	ND	0.020	
Hexachlorobenzene	ND	0.010	
Indoxacarb	ND	0.030	
Iprodione	ND	0.050	
Lindane (gamma-BHC)	ND	0.010	
Linuron	ND	0.150	
Methoxychlor	ND	0.050	
Metribuzin	ND	0.020	
Mirex	ND	0.020	
Myclobutanil	ND	0.050	
Oxadiazon	ND	0.050	
Oxyfluorfen	ND	0.040	
Pendimethalin	ND	0.050	
Pentachloronitrobenzene (PCNB)	ND	0.020	
Pentachloroanaline (PCA)	ND	0.010	
Perthane	ND	0.100	
Polychlorinated Biphenyls (as congeners)	ND	0.020	
Procymidone	ND	0.020	
Profluralin	ND	0.020	
Pronamide	ND	0.050	
Propanil	ND	0.050	
Tetradifon	ND	0.020	
Toxaphene	ND	0.250	
Triadimefon	ND	0.020	
Trifloxystrobin	ND	0.030	
Triflumazole	ND	0.050	
Trifluralin	ND	0.020	
Vegadex (Diethyldithiocarbamic Acid)	ND	0.050	
Vinclozolin	ND	0.020	

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
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To see the scope of our ISO 17025 accreditation go to http://emalab.com/ISO17025.pdf

Date: 07/31/24 Reviewed by: _____ Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno, CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Analyte	Amount ppm	RL ppm	Tolerance ppm
Bifenthrin	ND	0.020	
Cyfluthrin	ND	0.040	
Cypermethrin	ND	0.040	
Deltamethrin	ND	0.020	
Esfenvalerate	ND	0.030	
Fenpropathrin	ND	0.010	
Fluvalinate	ND	0.040	
lambda Cyhalothrin	ND	0.020	
Permethrin	ND	0.100	
Tralomethrin	ND	0.020	
Pyrethrins (Total)	ND	0.050	

Project No:
PO No: 61109
Client Sample ID: 24G1043-05 PV 5 0-6”

EMA Sample No: 24071808-05
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Comments:

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180 and/or MRLdatabase.com. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
Excess sample and extracts are stored for a minimum of 30 days from the date of analytical report. Special storage arrangements possible.
Results relate only to items tested.
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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

460 N. East Street, Woodland, CA 95776 (530) 666-6890 emalab@emalab.com www.emalab.com

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno, CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:
PO No: 61109
Client Sample ID: 24G1043-06 PV 6 0-6"

EMA Sample No: 24071808-06
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Comments:

Analyte	Amount ppm	RL ppm	Tolerance ppm
a, b, d-BHC	ND	0.010	
Alachlor	ND	0.020	
Aldrin	ND	0.010	
Benfluralin	ND	0.020	
Bifenox	ND	0.050	
Boscalid	ND	0.020	
Bromacil	ND	0.040	
Captafol	ND	0.040	
Captan	ND	0.020	
Chlordane (sum of Isomers)	ND	0.020	
Chlorfenapyr	ND	0.040	
Chlorobenzilate	ND	0.040	
Chloroneb	ND	0.040	
Chlorothalonil	ND	0.010	
Cyanazine	ND	0.100	
Dacthal	ND	0.020	
DDD	ND	0.020	
DDE	0.03	0.020	
DDT	ND	0.020	
Dichlobenil	ND	0.030	
Dicloran	ND	0.020	
Dicofol	ND	0.050	
Dieldrin	ND	0.010	
Endosulfan alpha	ND	0.010	
Endosulfan beta	ND	0.010	
Endosulfan sulfate	ND	0.010	
Endosulfans (Total)	ND	0.010	
Endrin	ND	0.010	
Ethafluralin	ND	0.030	
Fenhexamid	ND	0.030	
Folpet	ND	0.050	
Heptachlor	ND	0.010	
Heptachlor epoxide	ND	0.020	
Hexachlorobenzene	ND	0.010	
Indoxacarb	ND	0.030	
Iprodione	ND	0.050	
Lindane (gamma-BHC)	ND	0.010	
Linuron	ND	0.150	
Methoxychlor	ND	0.050	
Metribuzin	ND	0.020	
Mirex	ND	0.020	
Myclobutanil	ND	0.050	
Oxadiazon	ND	0.050	
Oxyfluorfen	ND	0.040	
Pendimethalin	ND	0.050	
Pentachloronitrobenzene (PCNB)	ND	0.020	
Pentachloroanaline (PCA)	ND	0.010	
Perthane	ND	0.100	
Polychlorinated Biphenyls (as congeners)	ND	0.020	
Procymidone	ND	0.020	
Profluralin	ND	0.020	
Pronamide	ND	0.050	
Propanil	ND	0.050	
Tetradifon	ND	0.020	
Toxaphene	ND	0.250	
Triadimefon	ND	0.020	
Trifloxystrobin	ND	0.030	
Triflumazole	ND	0.050	
Trifluralin	ND	0.020	
Vegadex (Diethyldithiocarbamic Acid)	ND	0.050	
Vinclozolin	ND	0.020	

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno, CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Analyte	Amount ppm	RL ppm	Tolerance ppm
Bifenthrin	ND	0.020	
Cyfluthrin	ND	0.040	
Cypermethrin	ND	0.040	
Deltamethrin	ND	0.020	
Esfenvalerate	ND	0.030	
Fenpropathrin	ND	0.010	
Fluvalinate	ND	0.040	
lambda Cyhalothrin	ND	0.020	
Permethrin	ND	0.100	
Tralomethrin	ND	0.020	
Pyrethrins (Total)	ND	0.050	

Project No:
PO No: 61109
Client Sample ID: 24G1043-06 PV 6 0-6”

EMA Sample No: 24071808-06
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Comments:

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180 and/or MRLdatabase.com. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

460 N. East Street, Woodland, CA 95776 (530) 666-6890 emalab@emalab.com www.emalab.com

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno, CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:
PO No: 61109
Client Sample ID: 24G1043-07 PV 7 0-6"

EMA Sample No: 24071808-07
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Comments:

Analyte	Amount ppm	RL ppm	Tolerance ppm
a, b, d-BHC	ND	0.010	
Alachlor	ND	0.020	
Aldrin	ND	0.010	
Benfluralin	ND	0.020	
Bifenox	ND	0.050	
Boscalid	ND	0.020	
Bromacil	ND	0.040	
Captafol	ND	0.040	
Captan	ND	0.020	
Chlordane (sum of Isomers)	ND	0.020	
Chlorfenapyr	ND	0.040	
Chlorobenzilate	ND	0.040	
Chloroneb	ND	0.040	
Chlorothalonil	ND	0.010	
Cyanazine	ND	0.100	
Dacthal	ND	0.020	
DDD	ND	0.020	
DDE	0.03	0.020	
DDT	ND	0.020	
Dichlobenil	ND	0.030	
Dicloran	ND	0.020	
Dicofol	ND	0.050	
Dieldrin	ND	0.010	
Endosulfan alpha	ND	0.010	
Endosulfan beta	ND	0.010	
Endosulfan sulfate	ND	0.010	
Endosulfans (Total)	ND	0.010	
Endrin	ND	0.010	
Ethafluralin	ND	0.030	
Fenhexamid	ND	0.030	
Folpet	ND	0.050	
Heptachlor	ND	0.010	
Heptachlor epoxide	ND	0.020	
Hexachlorobenzene	ND	0.010	
Indoxacarb	ND	0.030	
Iprodione	ND	0.050	
Lindane (gamma-BHC)	ND	0.010	
Linuron	ND	0.150	
Methoxychlor	ND	0.050	
Metribuzin	ND	0.020	
Mirex	ND	0.020	
Myclobutanil	ND	0.050	
Oxadiazon	ND	0.050	
Oxyfluorfen	ND	0.040	
Pendimethalin	ND	0.050	
Pentachloronitrobenzene (PCNB)	ND	0.020	
Pentachloroanaline (PCA)	ND	0.010	
Perthane	ND	0.100	
Polychlorinated Biphenyls (as congeners)	ND	0.020	
Procymidone	ND	0.020	
Profluralin	ND	0.020	
Pronamide	ND	0.050	
Propanil	ND	0.050	
Tetradifon	ND	0.020	
Toxaphene	ND	0.250	
Triadimefon	ND	0.020	
Trifloxystrobin	ND	0.030	
Triflumazole	ND	0.050	
Trifluralin	ND	0.020	
Vegadex (Diethyldithiocarbamic Acid)	ND	0.050	
Vinclozolin	ND	0.020	

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

460 N. East Street, Woodland, CA 95776 (530) 666-6890 emalab@emalab.com www.emalab.com

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno, CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Analyte	Amount ppm	RL ppm	Tolerance ppm
Bifenthrin	ND	0.020	
Cyfluthrin	ND	0.040	
Cypermethrin	ND	0.040	
Deltamethrin	ND	0.020	
Esfenvalerate	ND	0.030	
Fenpropathrin	ND	0.010	
Fluvalinate	ND	0.040	
lambda Cyhalothrin	ND	0.020	
Permethrin	ND	0.100	
Tralomethrin	ND	0.020	
Pyrethrins (Total)	ND	0.050	

Project No:
PO No: 61109
Client Sample ID: 24G1043-07 PV 7 0-6”

EMA Sample No: 24071808-07
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/26/2024

Comments:

If the amount column displays: OC - See OC Screen, Pyr - See Pyrethroid Screen, ON - See ON Screen, OP - See OP Screen, CB - See CB screen, GC/MS - See GC/MS/MS Screen, LC/MS - See LC/MS/MS Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180 and/or MRLdatabase.com. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

460 N. East Street, Woodland, CA 95776 (530) 666-6890 emalab@emalab.com www.emalab.com

07/15/24 15:34 24G1043

DELLAVALLE LABORATORY, INC.

1910 W. McKinley Avenue, Suite 110 • Fresno, CA 93728
www.dellavallelab.com 559 233-6129 · 800 228-9896 · Fax 559 268-8174

No. Samples: 7 Material: Soil

Purchase Order No | Bill To: | 17201 Acct # | 13 Cons #

Name: West Yost Associates
Address:
City: **State:** **Zip:**
Telephone: 661-747-5983 **Fax:**
Cell/Email hstarkey@westyost.com
COPY TO:
REQUESTED BY: Harry Starkey
RANCH: Intersect Power
ID CROP:
Present Stage of Growth
Intended Previous
Date Sampled: CO-DLL Fresno **Sampled By:** 7/15/24

Analysis Required:

Leaf:	[ ] TN	[ ] L1	[ ] L2	[ ] L3
Petiole:	[ ] NO3-N	[ ] P1	[ ] P2	[ ] P3
Grape Petiole:	[ ] NO3-N	[ ] G1	[ ] G2	[ ] G3
			[ ] G2+TN	
Soil:	[ ] NO3-N	[ ] S&S	[ ] FA1	[ ] FA2
	[ ] FA3	[ ] FA3+OM	[ ] FA4	
Crop Removal Analysis:		[ ] CRA1	[ ] CRA3	
Manure/Compost:		[ ] OSA1	[ ] OSA3	
Other:	CAM-17 Metals & DCPA			

DESCRIPTION OF SAMPLE

1	PV 1	0-6"
2	PV 2	0-6"
3	PV 3	0-6"
4	PV 4	0-6"
5	PV 5	0-6"
6	PV 6	0-6"
7	PV 7	0-6"
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		

SENDOUT

[ ] QA/QC Document [ ] Copy of Chain [ ] Comments/Recommendations

CHAIN OF CUSTODY

Carrier	Signature	Company	Received (Date/Time)	Relinquished (Date/Time)
First				
Second				
Third				
Fourth		DLL	7/15/24 15:34	

I guarantee that as the client, or on behalf of client named, I have the authority to contract the above requested services. Should it be found that I do not have such authority, I agree to be personally liable for all costs and, if there should be action against me for this breach, reasonable attorneys' fees. It is understood that payment is expected to be cash with samples unless terms have been previously arranged.
Terms are net 30 days; overdue accounts will be charged a liquidated damage fee of 2% per month (annually 24%) or $5.00 per month whichever is greater.
If payment is not made when due and a legitimate dispute exists concerning the product or services of Dellavalle Laboratory, Inc., it will be submitted to mediation under the Rules and Procedures of Creative Alternative to Litigation, Inc. (*cal*). If the dispute is not resolved in mediation, then the dispute will be submitted to binding arbitration through ***cal*** under its Rules and Procedures. The parties will equally bear the costs of mediation/arbitration. If, however, the mediator declares that no legitimate dispute exists, then debtor will pay all mediation and arbitration costs, and in the event of arbitration, reasonable attorneys' fees of Dellavalle Laboratory.

Invoicing Information: ***Shipping***
Sampling hrs $ In
Miles $ Out
Consulting

Amt Paid	Rec By	Check #	Date

Signature
Sample received in cooler with ice (coolant)
[ ] Yes [ ] No

SUBCONTRACT

DELLAVALLE™
LABORATORY INC

07/15/24 15:34 24G1043

Sending Laboratory:

Dellavalle Laboratory Inc.
1910 McKinley, Ste. 110
Fresno, CA 93728-1298
Phone: (559) 233-6129
Fax: (559) 268-8174

Attn: Kaitlynn Shaw
dataentry@dellavallelab.com

After Hours Contact:

Susan Villagran
559-530-1346
Martin James
559-940-2024

PO# 60108

Subcontracted Laboratory:

BSK & Associates - Stanislaus
687 N. Laverne
Fresno, CA 93727
Phone: (559) 497-2888
Fax: 559 485-6935

Turnaround: Standard 10 Rush __
State Forms: Yes __ No X Sys#_____

Work Order: 24G1043

Project: Intersect Power

Analysis

Sample ID: 24G1043-01 ***Soil*** ***Sampled: 7/15/2024 12:00AM***
Client Sample Name: PV 1 0-6" **Sampled By: Christian Duran**

Comments

CAM-17 Metals:SO

Containers Supplied:

Sample ID: 24G1043-02 ***Soil*** ***Sampled: 7/15/2024 12:00AM***
Client Sample Name: PV 2 0-6" **Sampled By: Christian Duran**

Comments

CAM-17 Metals:SO

Containers Supplied:

Sample ID: 24G1043-03 ***Soil*** ***Sampled: 7/15/2024 12:00AM***
Client Sample Name: PV 3 0-6" **Sampled By: Christian Duran**

Comments

CAM-17 Metals:SO

Containers Supplied:

Sample ID: 24G1043-04 ***Soil*** ***Sampled: 7/15/2024 12:00AM***
Client Sample Name: PV 4 0-6" **Sampled By: Christian Duran**

Comments

CAM-17 Metals:SO

Containers Supplied:

Released By	Date	Received By	Date
KS			
Released By	Date	Received By	Date

DELLAVALLE™
LABORATORY INC

SUBCONTRACT ORDER

07/15/24 15:34 24G1043

Work Order: 24G1043 (Continued) **Project: Intersect Power**

Analysis

Sample ID: 24G1043-05 ***Soil*** ***Sampled: 7/15/2024 12:00AM***

Client Sample Name: PV 5 0-6" **Sampled By: Christian Duran**

Comments

CAM-17 Metals:SO

Containers Supplied:

Sample ID: 24G1043-06 ***Soil*** ***Sampled: 7/15/2024 12:00AM***

Client Sample Name: PV 6 0-6" **Sampled By: Christian Duran**

Comments

CAM-17 Metals:SO

Containers Supplied:

Sample ID: 24G1043-07 ***Soil*** ***Sampled: 7/15/2024 12:00AM***

Client Sample Name: PV 7 0-6" **Sampled By: Christian Duran**

Comments

CAM-17 Metals:SO

Containers Supplied:

KS

Released By	Date	Received By	Date
Released By	Date	Received By	Date

SUBCONTRACT

DELLAVALLE™ LABORATORY INC

07/15/24 15:34 24G1043

Sending Laboratory:

Dellavalle Laboratory Inc.
1910 McKinley, Ste. 110
Fresno, CA 93728-1298
Phone: (559) 233-6129
Fax: (559) 268-8174

Attn: Kaitlynn Shaw
dataentry@dellavallelab.com

After Hours Contact:

Susan Villagran
559-530-1346
Martin James
559-940-2024

PO# 60109

Subcontracted Laboratory:

EMA
460 N. East St.
Woodland, CA 95776
Phone: (530) 666-6890
Fax:

Turnaround: Standard X Rush __
State Forms: Yes __ No X Sys#_____

Work Order: 24G1043

Project: Intersect Power

Analysis

Sample ID: 24G1043-01 ***Soil***
Sampled: 7/15/2024 12:00AM
Client Sample Name: PV 1 0-6"
Sampled By: Christian Duran

Comments

OC/Pyr Screen:SO

Containers Supplied:

Sample ID: 24G1043-02 ***Soil***
Sampled: 7/15/2024 12:00AM
Client Sample Name: PV 2 0-6"
Sampled By: Christian Duran

Comments

OC/Pyr Screen:SO

Containers Supplied:

Sample ID: 24G1043-03 ***Soil***
Sampled: 7/15/2024 12:00AM
Client Sample Name: PV 3 0-6"
Sampled By: Christian Duran

Comments

OC/Pyr Screen:SO

Containers Supplied:

Sample ID: 24G1043-04 ***Soil***
Sampled: 7/15/2024 12:00AM
Client Sample Name: PV 4 0-6"
Sampled By: Christian Duran

Comments

OC/Pyr Screen:SO

Containers Supplied:

Released By	Date	Received By	Date
KS			
Released By	Date	Received By	Date

DELLAVALLE™
LABORATORY INC

SUBCONTRACT

07/15/24 15:34 24G1043

Work Order: 24G1043 (Continued) **Project: Intersect Power**

Analysis

Sample ID: 24G1043-05 ***Soil*** ***Sampled: 7/15/2024 12:00AM***

Client Sample Name: PV 5 0-6" **Sampled By: Christian Duran**

Comments

OC/Pyr Screen:SO

Containers Supplied:

Sample ID: 24G1043-06 ***Soil*** ***Sampled: 7/15/2024 12:00AM***

Client Sample Name: PV 6 0-6" **Sampled By: Christian Duran**

Comments

OC/Pyr Screen:SO

Containers Supplied:

Sample ID: 24G1043-07 ***Soil*** ***Sampled: 7/15/2024 12:00AM***

Client Sample Name: PV 7 0-6" **Sampled By: Christian Duran**

Comments

OC/Pyr Screen:SO

Containers Supplied:

Released By	Date	Received By	Date
Released By	Date	Received By	Date

DELLAVALLE™
LABORATORY INC

West Yost Associates
2020 Research Park Drive Ste 100
Davis, CA 95618

Account# 00-0017201
Account Manager: Scott Sakamoto
Submitted By: Harry Starkey
Ranch: Intersect Power

Received: 07/15/2024 15:31
Reported: 08/01/2024 13:12

Samples in this Report

Lab ID	Sample	Matrix	Sampled By	Crop	Date Sampled
24G1047-01	Gen-Tie 0-6''	Soil	Christian Duran		7/15/2024 0:00
24G1047-02	H2 0-6''	Soil	Christian Duran		7/15/2024 0:00
24G1047-03	Switchyard 0-6''	Soil	Christian Duran		7/15/2024 0:00

Laboratory Director/Technical Manager

ELAP Certification #1595
A2LA Certification #6440.02

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2718-01
Sampled By: Christian Duran **Sample**
Description: 24G1047-01 // Gen-Tie 0-6"

Sample Date - Time: 07/15/2024 - 00:01
Matrix: Solid
Sample Type: Grab

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 6020	ND	10	mg/kg	1	AHG1245	07/24/24	07/25/24	
Arsenic	EPA 6020	**9.1**	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Barium	EPA 6020	**300**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Beryllium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cadmium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Chromium	EPA 6020	**61**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cobalt	EPA 6020	**14**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Copper	EPA 6020	**31**	5.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Lead	EPA 6020	**13**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Mercury	EPA 6020B	ND	0.50	mg/kg	1	AHG1245	07/24/24	07/25/24	
Molybdenum	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Nickel	EPA 6020	**95**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Selenium	EPA 6020	ND	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Silver	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Thallium	EPA 6020	ND	2.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Vanadium	EPA 6020	**45**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Zinc	EPA 6020	**120**	63	mg/kg	1	AHG1245	07/24/24	07/25/24	

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2718-02
Sampled By: Christian Duran
Sample Description: 24G1047-02 // H2 0-6"

Sample Date - Time: 07/15/2024 - 00:01
Matrix: Solid
Sample Type: Grab

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 6020	ND	10	mg/kg	1	AHG1245	07/24/24	07/25/24	
Arsenic	EPA 6020	**8.7**	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Barium	EPA 6020	**320**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Beryllium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cadmium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Chromium	EPA 6020	**82**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cobalt	EPA 6020	**15**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Copper	EPA 6020	**31**	5.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Lead	EPA 6020	**12**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Mercury	EPA 6020B	ND	0.50	mg/kg	1	AHG1245	07/24/24	07/25/24	
Molybdenum	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Nickel	EPA 6020	**120**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Selenium	EPA 6020	ND	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Silver	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Thallium	EPA 6020	ND	2.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Vanadium	EPA 6020	**48**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Zinc	EPA 6020	**93**	63	mg/kg	1	AHG1245	07/24/24	07/25/24	

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2718-03
Sampled By: Christian Duran
Sample Description: 24G1047-03 // Switchyard 0-6"

Sample Date - Time: 07/15/2024 - 00:01
Matrix: Solid
Sample Type: Grab

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 6020	ND	10	mg/kg	1	AHG1245	07/24/24	07/25/24	
Arsenic	EPA 6020	**3.6**	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Barium	EPA 6020	**190**	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Beryllium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cadmium	EPA 6020	ND	1.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Chromium	EPA 6020	**60**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Cobalt	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Copper	EPA 6020	**19**	5.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Lead	EPA 6020	ND	6.3	mg/kg	1	AHG1245	07/24/24	07/25/24	
Mercury	EPA 6020B	ND	0.50	mg/kg	1	AHG1245	07/24/24	07/25/24	
Molybdenum	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Nickel	EPA 6020	**80**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Selenium	EPA 6020	ND	2.5	mg/kg	1	AHG1245	07/24/24	07/25/24	
Silver	EPA 6020	ND	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Thallium	EPA 6020	ND	2.0	mg/kg	1	AHG1245	07/24/24	07/25/24	
Vanadium	EPA 6020	**26**	13	mg/kg	1	AHG1245	07/24/24	07/25/24	
Zinc	EPA 6020	**96**	63	mg/kg	1	AHG1245	07/24/24	07/25/24	

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61111

Client Sample ID: 24G1047-01 Gen-Tie 0-6"

Sample Date: 7/15/2024
EMA Sample No: 24071807-01
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/30/2024

Surrogate:
Surrogate Level:
Recovery:

Comments:

Analyte	Amount ppm	RL ppm
a, b, d-BHC	ND	0.010
Alachlor	ND	0.020
Aldrin	ND	0.010
Benfluralin	ND	0.020
Bifenox	ND	0.050
Boscalid	ND	0.020
Bromacil	ND	0.040
Captafol	ND	0.040
Captan	ND	0.020
Chlordane (sum of Isomers)	ND	0.020
Chlorfenapyr	ND	0.040
Chlorobenzilate	ND	0.040
Chloroneb	ND	0.040
Chlorothalonil	ND	0.010
Cyanazine	ND	0.100
Dacthal	ND	0.020
DDD	ND	0.020
DDE	0.04	0.020
DDT	ND	0.020
Dichlobenil	ND	0.030
Dicloran	ND	0.020
Dicofol	ND	0.050
Dieldrin	ND	0.010
Endosulfan alpha	ND	0.010
Endosulfan beta	ND	0.010
Endosulfan sulfate	ND	0.010
Endosulfans (Total)	ND	0.010
Endrin	ND	0.010
Ethafluralin	ND	0.030
Fenhexamid	ND	0.030
Folpet	ND	0.050
Heptachlor	ND	0.010
Heptachlor epoxide	ND	0.020
Hexachlorobenzene	ND	0.010
Indoxacarb	ND	0.030
Iprodione	ND	0.050
Lindane (gamma-BHC)	ND	0.010
Linuron	ND	0.150
Methoxychlor	ND	0.050
Metribuzin	ND	0.020
Mirex	ND	0.020
Myclobutanil	ND	0.050
Oxadiazon	ND	0.050
Oxyfluorfen	0.05	0.040
Pendimethalin	ND	0.050
Pentachloronitrobenzene (PCNB)	ND	0.020
Pentachloroanaline (PCA)	ND	0.010
Perthane	ND	0.100
Polychlorinated Biphenyls (as congeners)	ND	0.020
Procymidone	ND	0.020
Profluralin	ND	0.020
Pronamide	ND	0.050
Propanil	ND	0.050
Tetradifon	ND	0.020
Toxaphene	ND	0.250
Triadimefon	ND	0.020
Trifloxystrobin	ND	0.030
Triflumazole	ND	0.050
Trifluralin	ND	0.020
Vegadex (Diethyldithiocarbamic Acid)	ND	0.050
Vinclozolin	ND	0.020

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
Excess sample and extracts are stored for a minimum of 30 days from the date of analytical report. Special storage arrangements possible.
Results relate only to items tested.
Samples are analyzed as received.

To see the scope of our ISO 17025 accreditation go to http://emalab.com/ISO17025.pdf

Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61111

Client Sample ID: 24G1047-01 Gen-Tie 0-6"

Sample Date: 7/15/2024
EMA Sample No: 24071807-01
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/30/2024
Surrogate:
Surrogate Level:
Recovery:

Comments:

Analyte	Amount ppm	RL ppm
Bifenthrin	ND	0.020
Cyfluthrin	ND	0.040
Cypermethrin	ND	0.040
Deltamethrin	ND	0.020
Esfenvalerate	ND	0.030
Fenpropathrin	ND	0.010
Fluvalinate	ND	0.040
lambda Cyhalothrin	ND	0.020
Permethrin	ND	0.100
Tralomethrin	ND	0.020
Pyrethrins (Total)	ND	0.050

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61111

Client Sample ID: 24G1047-02 H2 0-6"

Sample Date: 7/15/2024
EMA Sample No: 24071807-02
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/30/2024

Surrogate:
Surrogate Level:
Recovery:

Comments:

Analyte	Amount ppm	RL ppm
a, b, d-BHC	ND	0.010
Alachlor	ND	0.020
Aldrin	ND	0.010
Benfluralin	ND	0.020
Bifenox	ND	0.050
Boscalid	ND	0.020
Bromacil	ND	0.040
Captafol	ND	0.040
Captan	ND	0.020
Chlordane (sum of Isomers)	ND	0.020
Chlorfenapyr	ND	0.040
Chlorobenzilate	ND	0.040
Chloroneb	ND	0.040
Chlorothalonil	ND	0.010
Cyanazine	ND	0.100
Dacthal	ND	0.020
DDD	ND	0.020
DDE	ND	0.020
DDT	ND	0.020
Dichlobenil	ND	0.030
Dicloran	ND	0.020
Dicofol	ND	0.050
Dieldrin	ND	0.010
Endosulfan alpha	ND	0.010
Endosulfan beta	ND	0.010
Endosulfan sulfate	ND	0.010
Endosulfans (Total)	ND	0.010
Endrin	ND	0.010
Ethafluralin	ND	0.030
Fenhexamid	ND	0.030
Folpet	ND	0.050
Heptachlor	ND	0.010
Heptachlor epoxide	ND	0.020
Hexachlorobenzene	ND	0.010
Indoxacarb	ND	0.030
Iprodione	ND	0.050
Lindane (gamma-BHC)	ND	0.010
Linuron	ND	0.150
Methoxychlor	ND	0.050
Metribuzin	ND	0.020
Mirex	ND	0.020
Myclobutanil	ND	0.050
Oxadiazon	ND	0.050
Oxyfluorfen	ND	0.040
Pendimethalin	ND	0.050
Pentachloronitrobenzene (PCNB)	ND	0.020
Pentachloroanaline (PCA)	ND	0.010
Perthane	ND	0.100
Polychlorinated Biphenyls (as congeners)	ND	0.020
Procymidone	ND	0.020
Profluralin	ND	0.020
Pronamide	ND	0.050
Propanil	ND	0.050
Tetradifon	ND	0.020
Toxaphene	ND	0.250
Triadimefon	ND	0.020
Trifloxystrobin	ND	0.030
Triflumazole	ND	0.050
Trifluralin	ND	0.020
Vegadex (Diethyldithiocarbamic Acid)	ND	0.050
Vinclozolin	ND	0.020

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61111

Client Sample ID: 24G1047-02 H2 0-6"

Sample Date: 7/15/2024
EMA Sample No: 24071807-02
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/30/2024
Surrogate:
Surrogate Level:
Recovery:

Comments:

Analyte	Amount ppm	RL ppm
Bifenthrin	ND	0.020
Cyfluthrin	ND	0.040
Cypermethrin	ND	0.040
Deltamethrin	ND	0.020
Esfenvalerate	ND	0.030
Fenpropathrin	ND	0.010
Fluvalinate	ND	0.040
lambda Cyhalothrin	ND	0.020
Permethrin	ND	0.100
Tralomethrin	ND	0.020
Pyrethrins (Total)	ND	0.050

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61111

Client Sample ID: 24G1047-03 Switchyard 0 -6"

Sample Date: 7/15/2024
EMA Sample No: 24071807-03
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/30/2024

Surrogate:
Surrogate Level:
Recovery:

Comments:

Analyte	Amount ppm	RL ppm
a, b, d-BHC	ND	0.010
Alachlor	ND	0.020
Aldrin	ND	0.010
Benfluralin	ND	0.020
Bifenox	ND	0.050
Boscalid	ND	0.020
Bromacil	ND	0.040
Captafol	ND	0.040
Captan	ND	0.020
Chlordane (sum of Isomers)	ND	0.020
Chlorfenapyr	ND	0.040
Chlorobenzilate	ND	0.040
Chloroneb	ND	0.040
Chlorothalonil	ND	0.010
Cyanazine	ND	0.100
Dacthal	ND	0.020
DDD	ND	0.020
DDE	ND	0.020
DDT	ND	0.020
Dichlobenil	ND	0.030
Dicloran	ND	0.020
Dicofol	ND	0.050
Dieldrin	ND	0.010
Endosulfan alpha	ND	0.010
Endosulfan beta	ND	0.010
Endosulfan sulfate	ND	0.010
Endosulfans (Total)	ND	0.010
Endrin	ND	0.010
Ethafluralin	ND	0.030
Fenhexamid	ND	0.030
Folpet	ND	0.050
Heptachlor	ND	0.010
Heptachlor epoxide	ND	0.020
Hexachlorobenzene	ND	0.010
Indoxacarb	ND	0.030
Iprodione	ND	0.050
Lindane (gamma-BHC)	ND	0.010
Linuron	ND	0.150
Methoxychlor	ND	0.050
Metribuzin	ND	0.020
Mirex	ND	0.020
Myclobutanil	ND	0.050
Oxadiazon	ND	0.050
Oxyfluorfen	ND	0.040
Pendimethalin	ND	0.050
Pentachloronitrobenzene (PCNB)	ND	0.020
Pentachloroanaline (PCA)	ND	0.010
Perthane	ND	0.100
Polychlorinated Biphenyls (as congeners)	ND	0.020
Procymidone	ND	0.020
Profluralin	ND	0.020
Pronamide	ND	0.050
Propanil	ND	0.050
Tetradifon	ND	0.020
Toxaphene	ND	0.250
Triadimefon	ND	0.020
Trifloxystrobin	ND	0.030
Triflumazole	ND	0.050
Trifluralin	ND	0.020
Vegadex (Diethyldithiocarbamic Acid)	ND	0.050
Vinclozolin	ND	0.020

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
Excess sample and extracts are stored for a minimum of 30 days from the date of analytical report. Special storage arrangements possible.
Results relate only to items tested.
Samples are analyzed as received.

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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

July 31, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61111

Client Sample ID: 24G1047-03 Switchyard 0 -6"

Sample Date: 7/15/2024
EMA Sample No: 24071807-03
Date Received: 7/18/2024
Sample Matrix: Soil

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/22/2024
Date Completed: 7/30/2024
Surrogate:
Surrogate Level:
Recovery:

Comments:

Analyte	Amount ppm	RL ppm
Bifenthrin	ND	0.020
Cyfluthrin	ND	0.040
Cypermethrin	ND	0.040
Deltamethrin	ND	0.020
Esfenvalerate	ND	0.030
Fenpropathrin	ND	0.010
Fluvalinate	ND	0.040
lambda Cyhalothrin	ND	0.020
Permethrin	ND	0.100
Tralomethrin	ND	0.020
Pyrethrins (Total)	ND	0.050

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
Excess sample and extracts are stored for a minimum of 30 days from the date of analytical report. Special storage arrangements possible.
Results relate only to items tested.
Samples are analyzed as received.

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Date: 07/31/24 Reviewed by: Robert Hughes, Lab Manager

460 N. East Street, Woodland, CA 95776 (530) 666-6890 emalab@emalab.com www.emalab.com

07/15/24 15:31 24G1047

DELLAVALLE LABORATORY, INC.

1910 W. McKinley Avenue, Suite 110 • Fresno, CA 93728
www.dellavallelab.com 559 233-6129 · 800 228-9896 · Fax 559 268-8174

No. Samples: Material: Soil

Purchase Order No | Bill To: 17201 Acct # | 13 Cons #

Name: West Yost Associates
Address:
City: **State:** **Zip:**
Telephone: 661-747-5983 **Fax:**
Cell/Email hstarkey@westyost.com
COPY TO:
REQUESTED BY: Harry Starkey
RANCH: Intersect Power
ID CROP:
Present Stage of Growth
Intended Previous
Date Sampled: LD-DLI Fresno **Sampled By:** 7/15/24

Analysis Required:

Leaf:	[ ] TN	[ ] L1	[ ] L2	[ ] L3
Petiole:	[ ] NO3-N	[ ] P1	[ ] P2	[ ] P3
Grape Petiole:	[ ] NO3-N	[ ] G1	[ ] G2	[ ] G3
			[ ] G2+TN	
Soil:	[ ] NO3-N	[ ] S&S	[ ] FA1	[ ] FA2
	[ ] FA3	[ ] FA3+OM	[ ] FA4	
Crop Removal Analysis:		[ ] CRA1	[ ] CRA3	
Manure/Compost:		[ ] OSA1	[ ] OSA3	

Other: OCP'S, CAM-17 Metals, & DCPA

[ ] QA/QC Document [ ] Copy of Chain [ ] Comments/Recommendations

DESCRIPTION OF SAMPLE

1	Gen-Tie	0-6"
2	H2	0-6"
3	Switchyard	0-6"
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		

SENDOUT

CHAIN OF CUSTODY

Carrier	Signature	Company	Received (Date/Time)	Relinquished (Date/Time)
First				
Second				
Third				
Fourth		DLI	7/15/24 15:31	

I guarantee that as the client, or on behalf of client named, I have the authority to contract the above requested services. Should it be found that I do not have such authority, I agree to be personally liable for all costs and, if there should be action against me for this breach, reasonable attorneys' fees. It is understood that payment is expected to be cash with samples unless terms have been previously arranged. Terms are net 30 days; overdue accounts will be charged a liquidated damage fee of 2% per month (annually 24%) or $5.00 per month whichever is greater.

If payment is not made when due and a legitimate dispute exists concerning the product or services of Dellavalle Laboratory, Inc., it will be submitted to mediation under the Rules and Procedures of Creative Alternative to Litigation, Inc. (*cal*). If the dispute is not resolved in mediation, then the dispute will be submitted to binding arbitration through ***cal*** under its Rules and Procedures. The parties will equally bear the costs of mediation/arbitration. If, however, the mediator declares that no legitimate dispute exists, then debtor will pay all mediation and arbitration costs, and in the event of arbitration, reasonable attorneys' fees of Dellavalle Laboratory.

Invoicing Information:
Sampling hrs
Miles
Consulting

Shipping
$ In
$ Out

Amt Paid	Rec By	Check #	Date

Signature
Sample received in cooler with ice (coolant)
[ ] Yes [ ] No

SUBCONTRACT

DELLAVALLE™
LABORATORY INC

07/15/24 15:31 24G1047

Sending Laboratory:

Dellavalle Laboratory Inc.
1910 McKinley, Ste. 110
Fresno, CA 93728-1298
Phone: (559) 233-6129
Fax: (559) 268-8174

Attn: Kaitlynn Shaw
dataentry@dellavallelab.com

After Hours Contact:

Susan Villagran
559-530-1346
Martin James
559-940-2024

PO# 61110

Subcontracted Laboratory:

BSK & Associates - Stanislaus
687 N. Laverne
Fresno, CA 93727
Phone: (559) 497-2888
Fax: 559 485-6935

Turnaround: Standard X Rush __
State Forms: Yes __ No X Sys#_____

Work Order: 24G1047

Project: Intersect Power

Analysis

Sample ID: 24G1047-01 ***Soil***
Sampled: 7/15/2024 12:00AM
Client Sample Name: Glen-Tie 0-6"
Sampled By: Christian Duran

Comments

CAM-17 Metals:SO

Containers Supplied:

Sample ID: 24G1047-02 ***Soil***
Sampled: 7/15/2024 12:00AM
Client Sample Name: H2 0-6"
Sampled By: Christian Duran

Comments

CAM-17 Metals:SO

Containers Supplied:

Sample ID: 24G1047-03 ***Soil***
Sampled: 7/15/2024 12:00AM
Client Sample Name: Switchyard 0-6"
Sampled By: Christian Duran

Comments

CAM-17 Metals:SO

Containers Supplied:

Released By	Date	Received By	Date
KS			
Released By	Date	Received By	Date

DELLAVALLE™
LABORATORY INC

SUBCONTRACT

07/15/24 15:31 24G1047

Sending Laboratory:

Dellavalle Laboratory Inc.
1910 McKinley, Ste. 110
Fresno, CA 93728-1298
Phone: (559) 233-6129
Fax: (559) 268-8174

Attn: Kaitlynn Shaw
dataentry@dellavallelab.com

After Hours Contact:

Susan Villagran
559-530-1346
Martin James
559-940-2024

PO# 60111

Subcontracted Laboratory:

EMA
460 N. East St.
Woodland, CA 95776
Phone: (530) 666-6890
Fax:

Turnaround: Standard ✓ Rush __
State Forms: Yes __ No ✓ Sys#_____

Work Order: 24G1047

Project: Intersect Power

Analysis

Sample ID: 24G1047-01 ***Soil***
Sampled: 7/15/2024 12:00AM
Client Sample Name: Glen-Tie 0-6"
Sampled By: Christian Duran

Comments

OC/Pyr Screen:SO

Containers Supplied:

Sample ID: 24G1047-02 ***Soil***
Sampled: 7/15/2024 12:00AM
Client Sample Name: H2 0-6"
Sampled By: Christian Duran

Comments

OC/Pyr Screen:SO

Containers Supplied:

Sample ID: 24G1047-03 ***Soil***
Sampled: 7/15/2024 12:00AM
Client Sample Name: Switchyard 0-6"
Sampled By: Christian Duran

Comments

OC/Pyr Screen:SO

Containers Supplied:

KS

Released By	Date	Received By	Date
Released By	Date	Received By	Date

DELLAVALLE™
LABORATORY INC

West Yost Associates
2020 Research Park Drive Ste 100
Davis, CA 95618

Account# 00-0017201
Account Manager: Scott Sakamoto
Submitted By: Harry Starkey
Ranch: Intersect Power

Received: 07/16/2024 13:05
Reported: 08/02/2024 15:55

Samples in this Report

Lab ID	Sample	Matrix	Sampled By	Crop	Date Sampled
24G1194-01	Well #4	Ag Water			7/16/2024 11:01
24G1194-02	Well #5	Ag Water			7/16/2024 10:21

Default Cooler
Temperature on Receipt °C: 5.7
Containers Intact
COC/Labels Agree
Received On Ice

Laboratory Director/Technical Manager

ELAP Certification #1595
A2LA Certification #6440.02

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2372-01
Sampled By: Client
Sample Description: 24G1194-01 // Well #4

Sample Date - Time: 07/16/2024 - 11:01
Matrix: Water
Sample Type: Routine

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 200.8	ND	2.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Arsenic	EPA 200.8	**2.9**	2.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Barium	EPA 200.8	**19**	5.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Cadmium	EPA 200.8	ND	1.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Chromium	EPA 200.8	**35**	10	ug/L	1	AHG1044	07/17/24	07/18/24	
Cobalt	EPA 200.8	ND	10	ug/L	1	AHG1044	07/17/24	07/18/24	
Copper	EPA 200.8	ND	5.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Lead	EPA 200.8	ND	1.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Mercury	EPA 245.7	**0.22**	0.20	ug/L	1	AHG1002	07/17/24	07/18/24	
Molybdenum	EPA 200.8	ND	10	ug/L	1	AHG1044	07/17/24	07/18/24	
Nickel	EPA 200.8	ND	10	ug/L	1	AHG1044	07/17/24	07/18/24	
Selenium	EPA 200.8	**14**	2.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Silver	EPA 200.8	ND	10	ug/L	1	AHG1044	07/17/24	07/18/24	
Thallium	EPA 200.8	ND	1.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Vanadium	EPA 200.8	**4.7**	3.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Zinc	EPA 200.8	ND	50	ug/L	1	AHG1044	07/17/24	07/18/24	

Certificate of Analysis

West Yost Associates #17201/13
Project: Intersect Power

Sample ID: AHG2372-02
Sampled By: Client
Sample Description: 24G1194-02 // Well #5

Sample Date - Time: 07/16/2024 - 10:21
Matrix: Water
Sample Type: Routine

BSK Associates Laboratory Fresno

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Antimony	EPA 200.8	ND	2.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Arsenic	EPA 200.8	**3.6**	2.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Barium	EPA 200.8	**25**	5.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Cadmium	EPA 200.8	ND	1.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Chromium	EPA 200.8	ND	10	ug/L	1	AHG1044	07/17/24	07/18/24	
Cobalt	EPA 200.8	ND	10	ug/L	1	AHG1044	07/17/24	07/18/24	
Copper	EPA 200.8	ND	5.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Lead	EPA 200.8	ND	1.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Mercury	EPA 245.7	ND	0.20	ug/L	1	AHG1002	07/17/24	07/18/24	
Molybdenum	EPA 200.8	**14**	10	ug/L	1	AHG1044	07/17/24	07/18/24	
Nickel	EPA 200.8	ND	10	ug/L	1	AHG1044	07/17/24	07/18/24	
Selenium	EPA 200.8	**2.5**	2.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Silver	EPA 200.8	ND	10	ug/L	1	AHG1044	07/17/24	07/18/24	
Thallium	EPA 200.8	ND	1.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Vanadium	EPA 200.8	**5.7**	3.0	ug/L	1	AHG1044	07/17/24	07/18/24	
Zinc	EPA 200.8	ND	50	ug/L	1	AHG1044	07/17/24	07/18/24	

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

August 1, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61091

Client Sample ID: 24G1194-01 Ag Water Well #4

Sample Date: 7/16/2024
EMA Sample No: 24071809-01
Date Received: 7/18/2024
Sample Matrix: Water

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/23/2024
Date Completed: 7/26/2024

Surrogate:
Surrogate Level:
% Recovery:

Comments:

Analyte	Amount µg/L	RL µg/L
a, b, d-BHC	ND	0.01
Alachlor	ND	0.02
Aldrin	ND	0.01
Benfluralin	ND	0.02
Bifenox	ND	0.05
Boscalid	ND	0.02
Bromacil	ND	0.04
Captafol	ND	0.04
Captan	ND	0.02
Chlordane (sum of Isomers)	ND	0.02
Chlorfenapyr	ND	0.04
Chlorobenzilate	ND	0.04
Chloroneb	ND	0.04
Chlorothalonil	ND	0.01
Cyanazine	ND	0.1
Dacthal	ND	0.02
DDD	ND	0.02
DDE	ND	0.02
DDT	ND	0.02
Dichlobenil	ND	0.03
Dicloran	ND	0.02
Dicofol	ND	0.05
Dieldrin	ND	0.01
Endosulfan alpha	ND	0.01
Endosulfan beta	ND	0.01
Endosulfan sulfate	ND	0.01
Endosulfans (Total)	ND	0.01
Endrin	ND	0.01
Ethafluralin	ND	0.03
Fenhexamid	ND	0.03
Folpet	ND	0.05
Heptachlor	ND	0.01
Heptachlor epoxide	ND	0.02
Hexachlorobenzene	ND	0.01
Indoxacarb	ND	0.03
Iprodione	ND	0.05
Lindane (gamma-BHC)	ND	0.01
Linuron	ND	0.15
Methoxychlor	ND	0.05
Metribuzin	ND	0.02
Mirex	ND	0.02
Myclobutanil	ND	0.05
Oxadiazon	ND	0.05
Oxyfluorfen	ND	0.04
Pendimethalin	ND	0.05
Pentachloronitrobenzene (PCNB)	ND	0.02
Pentachloroanaline (PCA)	ND	0.01
Perthane	ND	0.1
Polychlorinated Biphenyls (as congeners)	ND	0.02
Procymidone	ND	0.02
Profluralin	ND	0.02
Pronamide	ND	0.05
Propanil	ND	0.05
Tetradifon	ND	0.02
Toxaphene	ND	0.25
Triadimefon	ND	0.02
Trifloxystrobin	ND	0.03
Triflumazole	ND	0.05
Trifluralin	ND	0.02
Vegadex (Diethyldithiocarbamic Acid)	ND	0.05
Vinclozolin	ND	0.02

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
Excess sample and extracts are stored for a minimum of 30 days from the date of analytical report. Special storage arrangements possible.
Results relate only to items tested.
Samples are analyzed as received.

To see the scope of our ISO 17025 accreditation go to http://emalab.com/ISO17025.pdf

Date: 08/01/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

August 1, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61091

Client Sample ID: 24G1194-01 Ag Water
Well #4

Sample Date: 7/16/2024
EMA Sample No: 24071809-01
Date Received: 7/18/2024
Sample Matrix: Water

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/23/2024
Date Completed: 7/26/2024

Surrogate:
Surrogate Level:
% Recovery:

Analyte	Amount µg/L	RL µg/L
Bifenthrin	ND	0.02
Cyfluthrin	ND	0.04
Cypermethrin	ND	0.04
Deltamethrin	ND	0.02
Esfenvalerate	ND	0.03
Fenpropathrin	ND	0.01
Fluvalinate	ND	0.04
lambda Cyhalothrin	ND	0.02
Permethrin	ND	0.1
Tralomethrin	ND	0.02
Pyrethrins (Total)	ND	0.05

Comments:

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
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Date: 08/01/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

August 1, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61091

Client Sample ID: 24G1194-02 Ag Water Well #5

Sample Date: 7/16/2024
EMA Sample No: 24071809-02
Date Received: 7/18/2024
Sample Matrix: Water

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/23/2024
Date Completed: 7/26/2024

Surrogate:
Surrogate Level:
% Recovery:

Comments:

Analyte	Amount µg/L	RL µg/L
a, b, d-BHC	ND	0.05
Alachlor	ND	0.1
Aldrin	ND	0.05
Benfluralin	ND	0.1
Bifenox	ND	0.25
Boscalid	ND	0.1
Bromacil	ND	0.2
Captafol	ND	0.2
Captan	ND	0.1
Chlordane (sum of Isomers)	ND	0.1
Chlorfenapyr	ND	0.2
Chlorobenzilate	ND	0.2
Chloroneb	ND	0.2
Chlorothalonil	ND	0.05
Cyanazine	ND	0.5
Dacthal	ND	0.1
DDD	ND	0.1
DDE	ND	0.1
DDT	ND	0.1
Dichlobenil	ND	0.15
Dicloran	ND	0.1
Dicofol	ND	0.25
Dieldrin	ND	0.05
Endosulfan alpha	ND	0.05
Endosulfan beta	ND	0.05
Endosulfan sulfate	ND	0.05
Endosulfans (Total)	ND	0.05
Endrin	ND	0.05
Ethafluralin	ND	0.15
Fenhexamid	ND	0.15
Folpet	ND	0.25
Heptachlor	ND	0.05
Heptachlor epoxide	ND	0.1
Hexachlorobenzene	ND	0.05
Indoxacarb	ND	0.15
Iprodione	ND	0.25
Lindane (gamma-BHC)	ND	0.05
Linuron	ND	0.75
Methoxychlor	ND	0.25
Metribuzin	ND	0.1
Mirex	ND	0.1
Myclobutanil	ND	0.25
Oxadiazon	ND	0.25
Oxyfluorfen	ND	0.2
Pendimethalin	ND	0.25
Pentachloronitrobenzene (PCNB)	ND	0.1
Pentachloroanaline (PCA)	ND	0.05
Perthane	ND	0.5
Polychlorinated Biphenyls (as congeners)	ND	0.1
Procymidone	ND	0.1
Profluralin	ND	0.1
Pronamide	ND	0.25
Propanil	ND	0.25
Tetradifon	ND	0.1
Toxaphene	ND	1.25
Triadimefon	ND	0.1
Trifloxystrobin	ND	0.15
Triflumazole	ND	0.25
Trifluralin	ND	0.1
Vegadex (Diethyldithiocarbamic Acid)	ND	0.25
Vinclozolin	ND	0.1

R = Reported on another Screen
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Date: 08/01/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

August 1, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61091

Client Sample ID: 24G1194-02 Ag Water Well #5

Sample Date: 7/16/2024
EMA Sample No: 24071809-02
Date Received: 7/18/2024
Sample Matrix: Water

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/23/2024
Date Completed: 7/26/2024

Surrogate:
Surrogate Level:
% Recovery:

Analyte	Amount µg/L	RL µg/L
Bifenthrin	ND	0.1
Cyfluthrin	ND	0.2
Cypermethrin	ND	0.2
Deltamethrin	ND	0.1
Esfenvalerate	ND	0.15
Fenpropathrin	ND	0.05
Fluvalinate	ND	0.2
lambda Cyhalothrin	0.13	0.1
Permethrin	ND	0.5
Tralomethrin	ND	0.1
Pyrethrins (Total)	ND	0.25

Comments:

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
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Date: 08/01/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

August 1, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61091

Client Sample ID: Blank

Sample Date:
EMA Sample No: 24071809-00
Date Received: 7/18/2024
Sample Matrix: Water

Analytical Method: OC Screen
Extraction Method: CDFA
Date Extracted: 7/23/2024
Date Completed: 7/26/2024

Surrogate:
Surrogate Level:
% Recovery:

Comments:

Analyte	Amount µg/L	RL µg/L
a, b, d-BHC	ND	0.05
Alachlor	ND	0.1
Aldrin	ND	0.05
Benfluralin	ND	0.1
Bifenox	ND	0.25
Boscalid	ND	0.1
Bromacil	ND	0.2
Captafol	ND	0.2
Captan	ND	0.1
Chlordane (sum of Isomers)	ND	0.1
Chlorfenapyr	ND	0.2
Chlorobenzilate	ND	0.2
Chloroneb	ND	0.2
Chlorothalonil	ND	0.05
Cyanazine	ND	0.5
Dacthal	ND	0.1
DDD	ND	0.1
DDE	ND	0.1
DDT	ND	0.1
Dichlobenil	ND	0.15
Dicloran	ND	0.1
Dicofol	ND	0.25
Dieldrin	ND	0.05
Endosulfan alpha	ND	0.05
Endosulfan beta	ND	0.05
Endosulfan sulfate	ND	0.05
Endosulfans (Total)	ND	0.05
Endrin	ND	0.05
Ethafluralin	ND	0.15
Fenhexamid	ND	0.15
Folpet	ND	0.25
Heptachlor	ND	0.05
Heptachlor epoxide	ND	0.1
Hexachlorobenzene	ND	0.05
Indoxacarb	ND	0.15
Iprodione	ND	0.25
Lindane (gamma-BHC)	ND	0.05
Linuron	ND	0.75
Methoxychlor	ND	0.25
Metribuzin	ND	0.1
Mirex	ND	0.1
Myclobutanil	ND	0.25
Oxadiazon	ND	0.25
Oxyfluorfen	ND	0.2
Pendimethalin	ND	0.25
Pentachloronitrobenzene (PCNB)	ND	0.1
Pentachloroanaline (PCA)	ND	0.05
Perthane	ND	0.5
Polychlorinated Biphenyls (as congeners)	ND	0.1
Procymidone	ND	0.1
Profluralin	ND	0.1
Pronamide	ND	0.25
Propanil	ND	0.25
Tetradifon	ND	0.1
Toxaphene	ND	1.25
Triadimefon	ND	0.1
Trifloxystrobin	ND	0.15
Triflumazole	ND	0.25
Trifluralin	ND	0.1
Vegadex (Diethyldithiocarbamic Acid)	ND	0.25
Vinclozolin	ND	0.1

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
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Date: 08/01/24 Reviewed by: Robert Hughes, Lab Manager

E.M.A Labs
Environmental Micro Analysis

ANALYTICAL REPORT

August 1, 2024

Client:
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite #110
Fresno , CA 93728
Phone: (559) 233-6129
Fax: (559) 268-8174
Email: dataentry@dellavallelab.com

Project No:

PO No: 61091

Client Sample ID: Blank

Sample Date:
EMA Sample No: 24071809-00
Date Received: 7/18/2024
Sample Matrix: Water

Analytical Method: Pyrethroid Screen
Extraction Method: CDFA
Date Extracted: 7/23/2024
Date Completed: 7/26/2024

Surrogate:
Surrogate Level:
% Recovery:

Comments:

Analyte	Amount µg/L	RL µg/L
Bifenthrin	ND	0.1
Cyfluthrin	ND	0.2
Cypermethrin	ND	0.2
Deltamethrin	ND	0.1
Esfenvalerate	ND	0.15
Fenpropathrin	ND	0.05
Fluvalinate	ND	0.2
lambda Cyhalothrin	ND	0.1
Permethrin	ND	0.5
Tralomethrin	ND	0.1
Pyrethrins (Total)	ND	0.25

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180. Environmental Micro Analysis makes no claims as to the accuracy of tolerance numbers.
Excess sample and extracts are stored for a minimum of 30 days from the date of analytical report. Special storage arrangements possible.
Results relate only to items tested.
Samples are analyzed as received.

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Date: 08/01/24 Reviewed by: Robert Hughes, Lab Manager

07/16/24 13:05 24G1194

DELLAVALLE LABORATORY, INC.

1910 W. McKinley Avenue, Suite 110 • Fresno, CA 93728
www.dellavallelab.com 559 233-6129 · 800 228-9896 · Fax 559 268-8174

Purchase Order No | Bill To: 17201 Acct # 13 Cons #

Results Need By

No. Samples: 2 No of Bottles: 6

Water Type: [ ] Drinking Water [ ] Wastewater [X] Ag Water [ ] Groundwater [ ] Monitoring Well

Name: West Yost Associates

Other:

Address:

Analysis and Bottles Required: (*Please indicate Analysis*)

City: **State:** CA **Zip:**

Organochloride Pesticides (OCP'S)

Phone: 661-747-5983 **Fax:**

CAM-17 Metals

Cell/Email: hstarkey@westyost.com

DCPA (DACTHAL)

COPY TO:

SENDOUT

REQUESTED BY: Harry Starkey

PROJECT: Intersect Power

CROP:

[ ] Co. Health Dept

[ ] RWQCB [ ] Copy of Chain

[ ] State Forms [ ] QA/QC Documents

Sampled By:

	Description of Samples	Date Sampled	Time Sampled	Rec'd Temp °C	Field EC
1	~~GPS~~: Well #4	7/16	11:01	5.7	
2	~~GPS~~: Well #5	7/16	10:21	5.4	
3					
4					
5					
6					
7					
8					
9					
10					

IR Thermometer SN: 200560723
Correction Factor: 0°C
Calibration Due: 09/04/2024
Location: Laboratory

CHAIN OF CUSTODY

Carrier	Signature	Company	Received (Date/Time)	Relinquished (Date/Time)
First		DLI		7/16/24 12:56
Second				
Third				
Fourth		DLI	7/16/24 1305	

I guarantee that as the client, or on behalf of client named, I have the authority to contract the above requested services. Should it be found that I do not have such authority, I agree to be personally liable for all costs and, if there should be action against me for this breach, reasonable attorneys' fees. It is understood that payment is expected to be cash with samples unless terms have been previously arranged. Terms are net 30 days; overdue accounts will be charged a liquidated damage fee of 2% per month (annually 24%) or $5.00 per month whichever is greater.

If payment is not made when due and a legitimate dispute exists concerning the product or services of Dellavalle Laboratory, Inc., it will be submitted to mediation under the Rules and Procedures of Creative Alternative to Litigation, Inc. (*cal*). If the dispute is not resolved in mediation, then the dispute will be submitted to binding arbitration through ***cal*** under its Rules and Procedures. The parties will equally bear the costs of mediation/arbitration. If, however, the mediator declares that no legitimate dispute exists, then debtor will pay all mediation and arbitration costs, and in the event of arbitration, reasonable attorneys' fees of Dellavalle Laboratory.

Invoicing Information:

Sampling hrs

Miles

Consulting

Shipping

$ In

$ Out

Amt Paid	Rec By	Check #	Date

Signature

Sample received in cooler with ice (coolant)

[ ] Yes [ ] No

Shipping Information: Fed Ex □ UPS □ Walk In □ GSO □ Ontrac □ PMS □ DLI Sampler ☒ Other □ _____

Shipping Container: Ice Chest ☒ None □ Box □

Refrigerant: Wet Ice: ☒ Blue Ice: □ None: □

All Samples Received? Yes No **All sample containers intact?** Yes No **Description match the COC?** Yes No

Sample Matrix (Circle One): DW WW Ag MW Other:_____

Container(s) Received	1	2	3	4	5	6	7	8	9	10
Plastics:										
100 mL sterile plastic $Na_2S_2O_3$ (Green)										
250 mL unpreserved (White)										
250 mL HNO_3 (Red)	2	2								
250 mL H_2SO_4 (Yellow)										
1 L unpreserved (White)										
1 L unpreserved (BOD) (Purple)										
1 L HNO_3 (Red)										
1 L H_2SO_4 (Yellow)										
VOA Vials in sets of 3:										
40 mL VOA, HCl (Blue)										
40 mL VOA, $Na_2S_2O_3$ (Green)										
40 mL VOA, unpreserved (White)										
Glass:										
250 mL AG unpreserved (White)										
250 mL AG H_2SO_4 (Yellow)										
250 mL AG $Na_2S_2O_3$ (Green)										
250 mL AG $Na_2S_2O_3$ + MCAA										
500 mL glass unpreserved (White)										
500 mL AG HCl (Blue)										
1 L AG unpreserved (White)	1	1								
1 L AG H_2SO_4 (Yellow)										
1 L AG $Na_2S_2O_3$ (Green)										
1 L AG HCl (Blue)										
Special:										
Cr^{6+} w/Borate/HCO3/CO3										
Cyanide - 500 mL NaOH										
Asbestos - 2 - 1L P wrapped in foil										
500 mL or 1 L **AP** $Na_2S_2O_3$ (Green)										
1 L **AG** or **P** NaOH + ZnAc (Sulfide)										
Chlorite/Bromate 250 mL AG with EDA										

07/16/24 13:05 24G1194

SUBCONTRACT

DELLAVALLE™ LABORATORY INC

07/16/24 13:05 24G1194

Sending Laboratory:

Dellavalle Laboratory Inc.
1910 McKinley, Ste. 110
Fresno, CA 93728-1298
Phone: (559) 233-6129
Fax: (559) 268-8174

Attn: Kaitlynn Shaw
dataentry@dellavallelab.com

After Hours Contact:
Susan Villagran
559-530-1346
Martin James
559-940-2024

PO# 61090

Subcontracted Laboratory:

BSK & Associates - Stanislaus
687 N. Laverne
Fresno, CA 93727
Phone: (559) 497-2888
Fax: 559 485-6935

Turnaround: Standard Y Rush __
State Forms: Yes __ No X Sys#_____

Work Order: 24G1194 **Project: Intersect Power**

Analysis

Sample ID: 24G1194-01 ***Ag Water*** ***Sampled: 7/16/2024 11:01AM***

Client Sample Name: Well #4

Comments

CAM-17 Metals:SO

Containers Supplied:

Sample ID: 24G1194-02 ***Ag Water*** ***Sampled: 7/16/2024 10:21AM***

Client Sample Name: Well #5

Comments

CAM-17 Metals:SO

Containers Supplied:

KS	7-16-24		
Released By	Date	Received By	Date
Released By	Date	Received By	Date

SUBCONTRACT

DELLAVALLE™
LABORATORY INC

07/16/24 13:05 24G1194

Sending Laboratory:

Dellavalle Laboratory Inc.
1910 McKinley, Ste. 110
Fresno, CA 93728-1298
Phone: (559) 233-6129
Fax: (559) 268-8174

Attn: Kaitlynn Shaw
dataentry@dellavallelab.com

After Hours Contact:

Susan Villagran
559-530-1346
Martin James
559-940-2024

PO# 61091

Subcontracted Laboratory:

EMA
460 N. East St.
Woodland, CA 95776
Phone: (530) 666-6890
Fax:

Turnaround: Standard ✓ Rush __
State Forms: Yes __ No ✓ Sys#_____

Work Order: 24G1194

Project: Intersect Power

Analysis

Sample ID: 24G1194-01 ***Ag Water*** ***Sampled: 7/16/2024 11:01AM***

Client Sample Name: Well #4

Comments

OC/Pyr Screen:SO

Containers Supplied:

Sample ID: 24G1194-02 ***Ag Water*** ***Sampled: 7/16/2024 10:21AM***

Client Sample Name: Well #5

Comments

OC/Pyr Screen:SO

Containers Supplied:

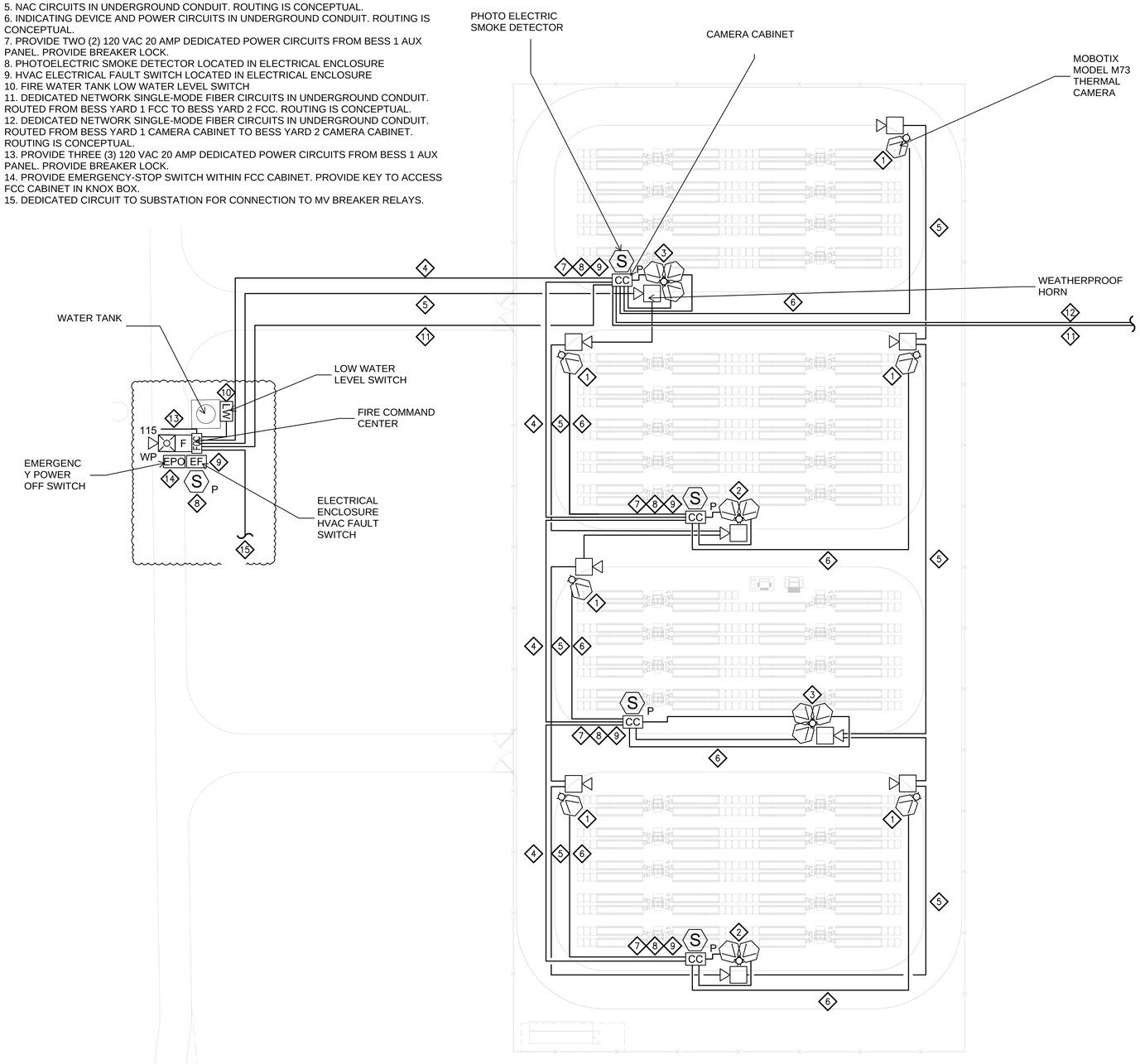
KS

Released By	Date	Received By	Date
Released By	Date	Received By	Date

Appendix B

REV 1 DR WS-1 Updated Fire Alarm Site Plan

KEY NOTES:
1. (1) POLE-MOUNTED THERMAL CAMERA AND (1) HORN (TYPICAL).
2. (2) POLE-MOUNTED THERMAL CAMERA AND (1) HORN (TYPICAL).
3. (3) POLE-MOUNTED THERMAL CAMERA AND (1) HORN (TYPICAL).
4. SIGNALING LINE CIRCUITS AND ETHERNET CIRCUITS IN UNDERGROUND CONDUIT. ROUTING IS CONCEPTUAL.
5. NAC CIRCUITS IN UNDERGROUND CONDUIT. ROUTING IS CONCEPTUAL.
6. INDICATING DEVICE AND POWER CIRCUITS IN UNDERGROUND CONDUIT. ROUTING IS CONCEPTUAL.
7. PROVIDE TWO (2) 120 VAC 20 AMP DEDICATED POWER CIRCUITS FROM BESS 1 AUX PANEL. PROVIDE BREAKER LOCK.
8. PHOTOELECTRIC SMOKE DETECTOR LOCATED IN ELECTRICAL ENCLOSURE
9. HVAC ELECTRICAL FAULT SWITCH LOCATED IN ELECTRICAL ENCLOSURE
10. FIRE WATER TANK LOW WATER LEVEL SWITCH
11. DEDICATED NETWORK SINGLE-MODE FIBER CIRCUITS IN UNDERGROUND CONDUIT. ROUTED FROM BESS YARD 1 FCC TO BESS YARD 2 FCC. ROUTING IS CONCEPTUAL.
12. DEDICATED NETWORK SINGLE-MODE FIBER CIRCUITS IN UNDERGROUND CONDUIT. ROUTED FROM BESS YARD 1 CAMERA CABINET TO BESS YARD 2 CAMERA CABINET. ROUTING IS CONCEPTUAL.
13. PROVIDE THREE (3) 120 VAC 20 AMP DEDICATED POWER CIRCUITS FROM BESS 1 AUX PANEL. PROVIDE BREAKER LOCK.
14. PROVIDE EMERGENCY-STOP SWITCH WITHIN FCC CABINET. PROVIDE KEY TO ACCESS FCC CABINET IN KNOX BOX.
15. DEDICATED CIRCUIT TO SUBSTATION FOR CONNECTION TO MV BREAKER RELAYS.



SYMBOL LEGEND:

- WEATHERPROOF HORN
- MOBOTIX MODEL M73 THERMAL CAMERA
- WEATHERPROOF HORN/STROBE
- F — WEATHER PROOF MANUAL FIRE ALARM PULL STATION
- CC — WEATHERPROOF CAMERA CABINET
- EF — ELECTRICAL ENCLOSURE HVAC FAULT SWITCH
- LW — LOW WATER LEVEL SWITCH
- EPO — EMERGENCY POWER OFF SWITCH
- S P — PHOTOELECTRIC SMOKE DETECTOR
- POLE
- FCC — FIRE COMMAND CENTER (FCC)
- FIRE WATER TANK

PRELIMINARY

SHEET TITLE:
FIRE ALARM SITE PLAN

FIRE ALARM SYSTEM SITE PLAN

1/32"=1'-0" 0 8 16 24 32 48 64 96

N

PRELIMINARY

FA-01

Appendix C

REV 1 DR WS-2 Fire Protection Engineering and UL 9540A Interpretation Report

Tesla Megapack 2 XL

Fire Protection Engineering and
UL 9540A Interpretation Report

FIRE & RISK ALLIANCE

EXECUTIVE SUMMARY

Fire & Risk Alliance (FRA), performed a fire protection engineering (FPE) analysis of Tesla's Megapack 2 XL (MP2XL) battery energy storage system (BESS). The MP2XL (MP2XL) is a lithium-ion BESS with a storage capacity up to four megawatt hours (MWh). The MP2XL is a fully integrated BESS consisting of battery modules, power electronics, control systems, a battery management system, a thermal management system, and an explosion control system all pre-assembled within a single, non-occupiable cabinet. They are meant for outdoor installations, mounted to the ground, for commercial, industrial, and utility applications. This FPE analysis includes a review of the MP2XL, its construction, design, fire safety features, and an analysis of the UL 9540A cell, module, and unit level test data. Based on this review, FRA offers the following summary of our findings:

1. UL 9540A cell and module level testing demonstrated that flammable gases vent from the MP2XL cells during thermal runaway; however, the cells do not release toxic gases sometimes associated with the failure of lithium-ion batteries, such as HCN, HCL and HF.

2. UL 9540A unit level testing forced six cells into thermal runaway, which resulted in propagation to a seventh cell; however, thermal runaway did not propagate beyond the seventh cell.

3. During UL 9540A unit level testing, the MP2XL met all the performance criteria of UL 9540A, Table 9.1. Therefore, UL 9540A installation level testing is not required for a MP2XL installation.

4. The MP2XL can meet or exceed all the installation level codes and standards, such as the IFC and NFPA 855, required for outdoor, ground mounted BESS installations when it is installed in accordance with the MP2XL Design and Installation Manual.

This executive summary is an abbreviated list of findings. Refer to the main report for details of the analysis.

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1. INTRODUCTION

Fire & Risk Alliance (FRA), performed a fire protection engineering (FPE) analysis of Tesla's Megapack 2 XL (MP2XL) battery energy storage system (BESS). The MP2XL is a lithium-ion BESS with a storage capacity of up to four megawatt hours (MWh). The MP2XL is a fully integrated BESS consisting of battery modules, power electronics, control systems, a battery management system, a thermal management system, and an explosion control system all pre-assembled within a single, non-occupiable cabinet. They are meant for outdoor installations, mounted to the ground, for commercial, industrial, and utility applications. This FPE analysis includes a review of the MP2XL, its construction, design, and fire safety features, and an analysis of the UL 9540A cell, module, and unit-level test data. This narrative has been prepared by FRA and summarizes our analysis. It is intended to be used as a tool for a project designer, installer, fire code official (FCO), or an authority having jurisdiction (AHJ) to assist in their design, installation, or review of a MP2XL installation.

1.1 Codes, Standards, and Test Methods

The following codes, standards, and test methods have been applied to this analysis:

- 2024 International Building Code® (IBC).
- 2024 International Fire Code® (IFC).
- 2024 NFPA 1, Fire Code (NFPA 1).
- 2023 NFPA 855, Standard for the Installation of Stationary Energy Storage Systems (NFPA 855).
- 2023 NFPA 68, Standard on Explosion Protection by Deflagration Venting (NFPA 68).
- 2024 NFPA 69, Standard on Explosion Prevention Systems (NFPA 69).
- IEC 60529, Degrees of Protection Provided by Enclosures, 2.2 Edition, January 2019 (IP Code).
- IEC 62619, Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications, Edition 1.0, 2017 (IEC 62619).
- IEC 62933-5-2, Electrical energy storage (EES) systems - Part 5-2: Safety requirements for grid-integrated EES systems - Electrochemical-based systems, April 15, 2020 (IEC 62933-5-2).
- UL 1642, Lithium Batteries, Edition 6, September 29, 2020 (UL 1642).
- UL 1973, Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications, Edition 2, February 7, 2018 (UL 1973).
- UL 9540, Standard for Safety of Energy Storage Systems and Equipment, Edition 2, February 27, 2020 (UL 9540).
- UL 9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems, Edition 4, November 12, 2019 (UL 9540A).

1.2 Reference Materials

In addition to the fire codes, standards, and test methods listed above, the following reference materials were reviewed as part of this analysis:

- MP2XL Design and Installation Manual – Rev. 2.2, dated January 30, 2024 (MP2XL DIM).
- MP2XL Operation and Maintenance Manual - Rev. 1.2, dated January 30, 2024 (MP2XL O&MM).
- Industrial Lithium-Ion Battery Emergency Response Guide – Rev. 2.7, dated February 16, 2024 (ERG).
- MP2/2XL UL 9540A Cell Level Fire Test Report, dated February 25, 2022.
- MP2/2XL UL 9540A Module Level Fire Test Report, dated July 15, 2022.
- MP2/2XL UL 9540A Unit Level Fire Test Report, dated August 5, 2022.
- Megapack 2XL Compliance Packet – Rev. 2.8, dated February 14, 2024.

1.3 Acronyms and Abbreviations

Authority Having Jurisdiction	AHJ	Light Electric Rail	LER
Battery Energy Storage System	BESS	Lithium Iron Phosphate	LFP
Battery Management System	BMS	Lower Flammability Limit	LFL
Centimeter	cm	Megapack 2	MP2
Contemporary Amperex Technology Co., LTD	CATL	Megapack 2XL	MP2XL
Controller Area Network	CAN	Megapack 2 & 2 XL	MP2/2XL
Customer Input/Output Terminals	I/O	Megawatt hour	MWh
Customer Interface Bay	CIB	Meter	m
Electrical Energy Storage	EES	Millimeter	mm
Emergency Response Plan	ERP	National Fire Protection Association	NFPA
Energy Storage System	ESS	Nationally Recognized Testing Laboratory	NRTL
Fire Code Official	FCO	Non-walk-in	NWI
Failure Modes and Effects Analysis	FMEA	Parts Per Million	ppm
Feet	ft	Pound Per Square Inch Gauge	psig
Fire Protection Engineering	FPE	Safety Data Sheet	SDS
Fire & Risk Alliance, LLC	FRA	Second	s
Gram	g	State of Charge	SOC
International Electrotechnical Commission	IEC	Supervisory Control and Data Acquisition	SCADA
International Fire Code	IFC	Tesla Site Controller	TSC
Inch	in	Thermal Management System	TMS
Kilogram	kg	TÜV SÜD	TÜV
Kilowatt hour	kWh	UL, LLC	UL

2. MP2XL DESIGN & FIRE SAFETY FEATURES

The MP2XL is a fully integrated BESS consisting of battery modules, power electronics, control systems, a battery management system, a thermal management system, and an explosion control system all pre-assembled within a single, non-occupiable cabinet. The MP2XL has a standardized, modular design that is not customizable or adjustable. MP2XL arrives at the site fully assembled needing just the alternate current (AC) connection and communications cables to be connected on the site. Meaning, every installation has the same MP2XL cabinets that are pre-assembled at the factory. It is approximately 28.9 ft in length, 5.4 ft deep, 9.2 ft in height, and can weigh up to 84,000 pounds (8.800 m by 1.650 m by 2.785 m and 38,100 kg). Below is a brief description of the MP2XL, its components, design listing, and fire safety features. For a more detailed discussion on the MP2XL components, their location, functionality, and purpose, refer to the MP2XL DIM.

2.1 Cabinet Layout

The MP2XL is intended for outdoor installations, ground-mounted to a foundation or base strong enough to support the weight of the equipment and anchor loads (including concrete pads, grade beams, etc.). The thermal roof (part of the thermal management system) is enclosed within an IP20 enclosure that sits above the battery module bays, as shown in Figure 1.

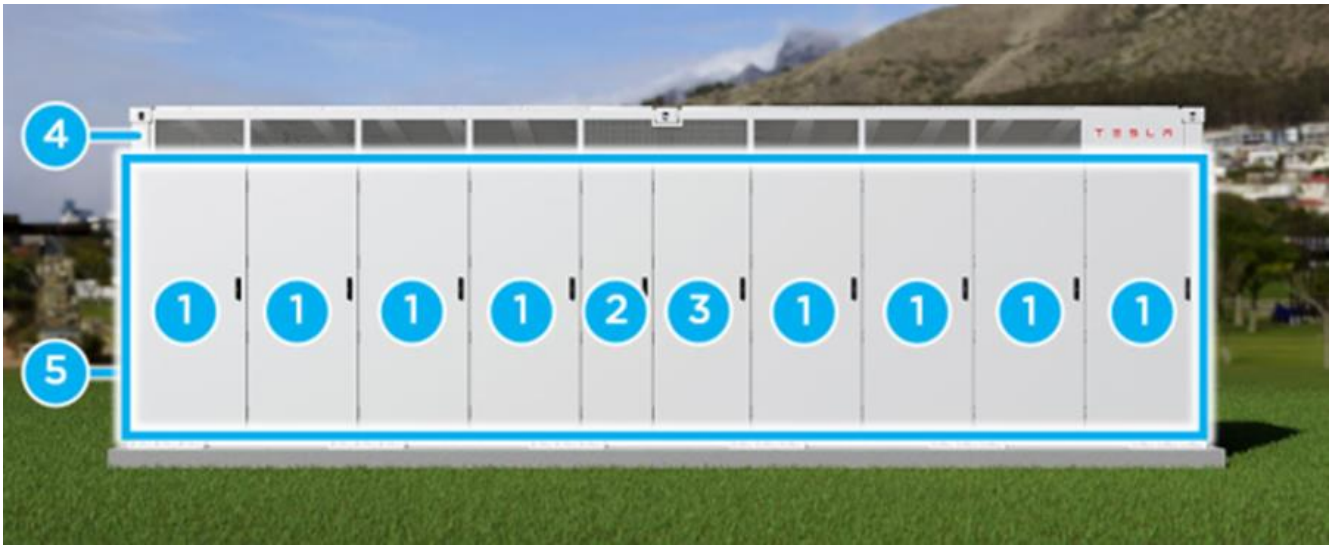


Figure 1 MP2XL internal components: (1) Battery Module Bays, (2) Thermal Cabinet, (3) Customer Interface Bay, (4) IP20 Thermal Roof Enclosure, (5) IP66 Enclosure.

The lithium-ion batteries are housed inside an IP66 steel enclosure (battery module bay) that provides protection against particle and water ingress coming into contact with the battery modules and power electronics. The IP66 enclosure is one continuous unit, meaning each of the ten bays are open to one another. However, when the MP2XL cabinet is populated with battery modules, it cannot be entered. This modular, cabinet style approach allows for the system to be easily maintained and serviced from outside the cabinets

(i.e., the battery modules, thermal management system, and power electronics are serviced through doors located on the front of the cabinets or from the top through the thermal roof), thus eliminating the need for personnel to enter an enclosure, structure, building or container to perform those activities. Since the BESS cabinets do not permit walk-in access, it is a non-walk-in style (NWI) BESS, they are not defined as occupied buildings or structures per the IBC, IFC, NFPA 1, or NFPA 855.

2.2 Cells and Battery Modules

The MP2XL can be populated with up to twenty-four battery modules with a maximum storage capacity of 3,854.4 kWh for the 2-hour duration system, 3,847.2 kWh for the 3-hour duration system, and 3,916.8 kWh for the 4-hour duration system. Each battery module contains three battery trays, as shown in Figure 2, which are arrays of prismatic, lithium phosphate (LFP) cells. The LFP cells (the cells) utilized in the MP2XL are 157.2 amp hour (Ah) with a nominal voltage of 3.22 volts (V) and are individually hermetically sealed. They are approximately 50.75 millimeters (mm) by 166.0 mm by 169.3 mm and weigh 2,991 grams (g). Each battery tray contains 112 cells; therefore, each battery module has 336 cells, and a fully populated MP2XL (twenty-four battery modules) has 8,064 cells. Note the MP2XL utilizes the same cells and battery modules found in the Megapack 2 (MP2).

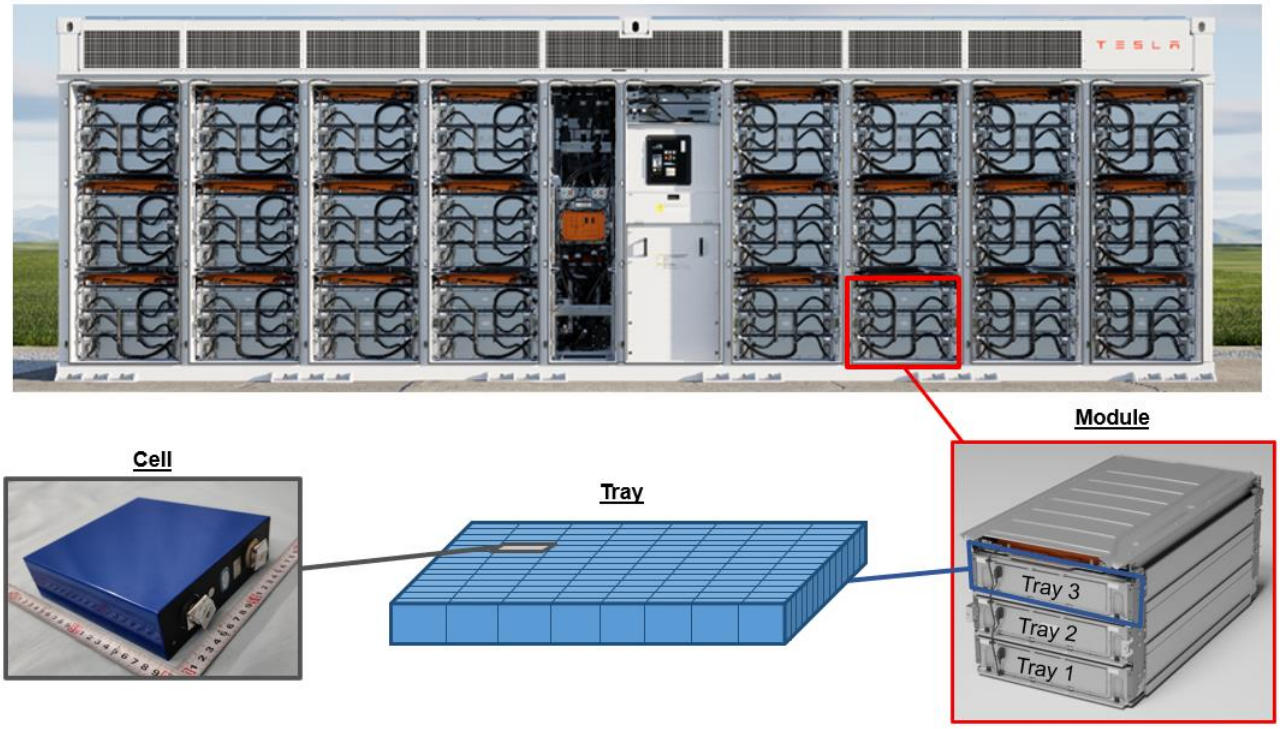


Figure 2 MP2XL, module, generalized tray, and an individual cell layout.

2.3 Customer Interface Bay

The Customer Interface Bay (CIB) is a single bay that includes all the external connections needed for initial MP2XL installation. When the fully assembled MP2XL arrives at the site, the only work necessary inside the cabinet is performed inside the CIB. Once installed, the CIB is a user-accessible area designed for operation and servicing. The CIB includes the main AC breaker, a status panel and controller area network (CAN) interface for service personnel, customer input/output (I/O) terminals, and the keylock switch (a “Lock Out/Tag Out” switch), which shuts down the AC bus to permit MP2XL maintenance by service personnel.

2.4 Thermal Management System

The thermal management system (TMS) provides a suitable operating temperature for MP2XL. The thermal bay and thermal roof house the components of the TMS. The TMS contains a closed-loop liquid cooling system that circulates a 50/50 mixture of ethylene glycol and water throughout the battery modules and power electronics to maintain an optimum battery operating temperature. The TMS works autonomously and does not require user feedback or controls to turn the system on when needed or to adjust temperature settings. The thermal cabinet includes pumps that circulate the liquid coolant through the MP2XL, an in-line heater that can warm the coolant and a compressor that maintains thermal control for the cabinet. The thermal roof, located above the battery bays within its own IP20 enclosure, provides a ventilation airspace for the MP2XL. It contains fans and radiators that cool the ethylene glycol-water solution. Cool air enters the thermal roof through the grates on the front of the MP2XL. The cool air then passes over the radiators, absorbing heat, and then is exhausted out of the top of the thermal roof via fans, as shown in Figure 3. The liquid cooling system utilizes approximately 400 liters (106 gallons) of the ethylene glycol-water solution, and the compressor utilizes 1.5 kilograms (3.3 pounds) of R-134a refrigerant for the 4-hour duration MP2XL and 3.0 kilograms (6.6 pounds) for the 2-hour duration MP2XL.

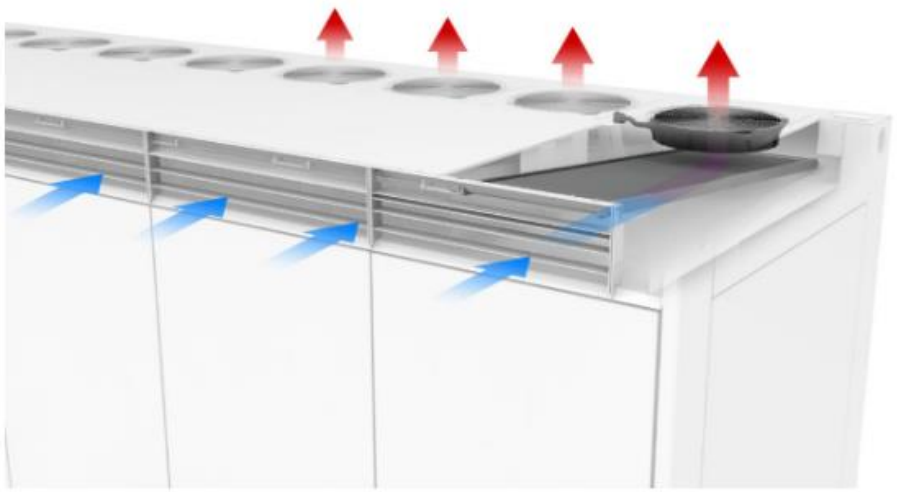


Figure 3 Airflow through the thermal roof.

2.5 Battery Management System

The MP2XL has an integrated battery management system (BMS) that tracks the performance, voltage, current, and state of charge of the cells (among many other datapoints). The BMS is a layered system, where each battery module has its own BMS and the MP2XL itself has a bus controller supervising the output of all the battery modules at the AC bus level. The BMS is engineered to react to fault conditions in an autonomous manner, with safeguards built into the firmware. These fault conditions include, but are not limited to, over-temperature, loss of communication, over-voltage, and isolation. For instance, to prevent a cell over-temperature the TMS is enabled by the BMS to cool the cells/module. This action by the BMS (which is just one example of many ways the BMS can respond to a fault condition) can either prevent thermal runaway from occurring in the cell or prohibit the propagation of thermal runaway to adjacent cells. Depending on the severity of the fault condition, the BMS can automatically isolate the affected battery module temporarily (less severe fault) or it can permanently disconnect the module.

2.6 Site Controller and Monitoring

Beyond the built-in safeguards of the BMS described above, the MP2XL is supported by a Tesla Local Operations Center (LOC), which is designed to support the global fleet of energy storage products. The MP2XL has 24/7 remote monitoring, diagnostics, and troubleshooting capabilities, without needing a Tesla technician on site. Customers and first responders also benefit from immediate hotline support from trained technicians via these LOCs. Additionally, the local energy provider or the facility can monitor the MP2XL through a local Supervisory Control and Data Acquisition (SCADA) system. All faults are transmitted to a Tesla LOC, alerting them to off-normal conditions that may require corrective action, either through remote means or an in-person field service visit. This communication link is accomplished via the Tesla Site Controller (TSC). The TSC provides the single point of interface for the utility, network operator, and/or the customer's SCADA systems to control and monitor the entire energy storage site. It dictates the charge and discharge functions of the MP2XL cabinets, aggregating real-time information and using the information to optimize the commands sent to each individual MP2XL cabinet. As such, every MP2XL has a wired Ethernet connection to the TSC, which communicates with a Tesla LOC via a built-in cellular modem. If the cellular network in the installation area is not sufficient, a hardwired internet connection can be provided. Additionally, if the BESS owner or operator wants a network connection for a control interface, the TSC becomes that point of connection to the MP2XL cabinet at the site

2.7 Electrical Fault Protection Devices

The MP2XL has several passive and active safety control mechanisms installed within the battery module circuit and distribution circuit that would be available to interrupt a fault current. At a high level, these electrical fault protection features include:

- Battery module overcurrent protection: The battery modules contain DC single-use fusible links mounted directly on the battery modules. These fuses are one-time only use safety devices that can interrupt the flow of an overcurrent in the battery module during an off-normal electrical event.

- Inverter DC protection: The inverter modules, which are installed at each of the battery modules, are equipped with a high-speed pyrotechnic fuse that can isolate the battery module passively or actively during an off-normal event.
- Inverter AC protection: In addition, each inverter module is equipped with its own AC contactor and AC fuses should an off-normal electrical event occur at the inverter module on the AC side of the circuit.
- Ground fault protection: Finally, the MP2XL is also provided with a DC ground fault detection system. It measures insulation resistance prior to operation and looks for excessive leakage current during operation. Additionally, the MP2XL also contains an AC circuit breaker, with ground-fault trip settings, which is installed within the CIB to provide distribution system protection.

2.8 Explosion Control System

The MP2XL includes an explosion control system to mitigate the risk of an uncontrolled deflagration. The system includes pressure-sensitive vents (overpressure vents) and sparkers installed throughout the battery module bay. The sparkers are designed to ignite flammable gases very early in a thermal runaway event before they accumulate within the enclosure and become an explosion hazard. They are installed at a variety of locations and heights throughout the battery module bays to ensure the flammable gases released during thermal runaway quickly meet an ignition source. Note, this explosion control system is the same approach that Tesla has utilized in previous versions of the Megapack (Megapack 1 and Megapack 2) and is not a new concept. It has been extensively validated through installation level testing for these previous Megapack versions as well as the MP2XL and its performance has been demonstrated in the field during thermal events involving Megapacks.

The overpressure vents are installed in the roof of the sealed battery bay's IP66 enclosure, as shown in Figure 4. When activated, the overpressure vents open up into the enclosed thermal roof, ensuring that the release of the overpressure vents does not create a projectile hazard. In addition, since they are installed in between the battery module bays and the thermal roof, the overpressure vents are not exposed to the environment, which means they are protected from the elements, such as falling tree limbs or snow, which could impact their functionality.

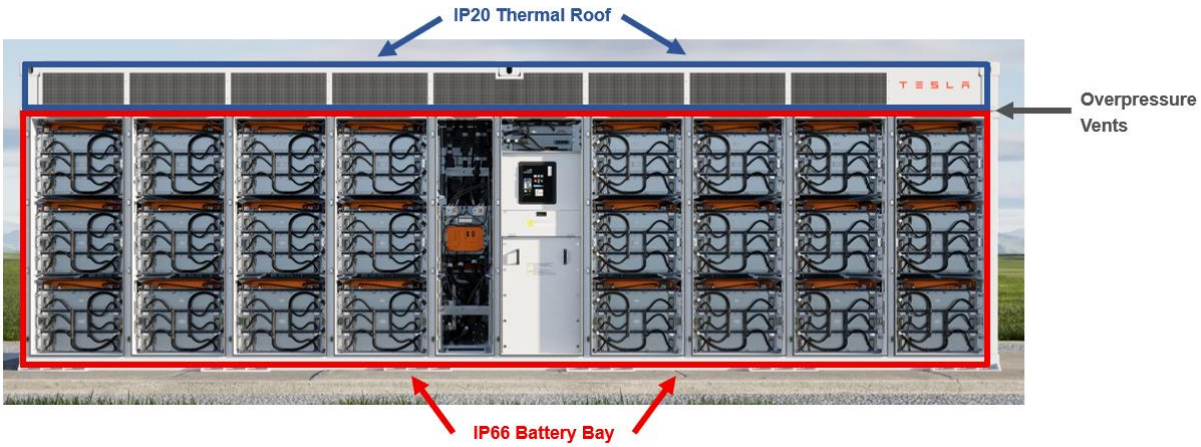


Figure 4 Location of overpressure vents in between the IP66 battery bay and the IP20 thermal roof

Once opened, the overpressure vents permit gases, products of combustion, and flames to safely exhaust through the roof of the MP2XL during a thermal event. By designing this natural ventilation flow path, flammable gases are not permitted to accumulate within the MP2XL cabinet, reducing the risk of a deflagration or explosion that could compromise the cabinet's integrity, push open the front doors, or expel projectiles from the cabinet. In addition, the ventilation path creates a controlled fire condition, should one occur, out the top of the MP2XL cabinet. By maintaining the MP2XL cabinet's integrity, keeping all the doors shut during a fire event, reducing the risk of projectiles, and creating a controlled path for flames to exit the top of the MP2XL cabinet, the likelihood of a thermal event having an impact on life safety, site personnel or first responders, is reduced. In addition, by maintaining these features, the likelihood of a fire propagating to adjacent MP2XL cabinets, electrical equipment, or other exposures is also reduced.

The overpressure vents themselves are passive and are not actuated or controlled by another device. They are designed to release during an overpressure event, such as the rapid ignition of flammable gases by a sparker. The number and total area of overpressure vents were sized following the guidance of NFPA 68 with a safety factor of two times the enclosure's strength, including the front doors. Tesla developed the overpressure vents and sparker system because the direct application of NFPA 68 or NFPA 69 is not suitable for the MP2XL cabinet, which does not have large volumes of open-air space. This engineered approach is permitted by NFPA 855 §9.6.5.6.4 provided it is validated by installation-level fire and explosion testing and an engineering evaluation, which Tesla has performed.

2.9 Fire Detection

The MP2XL does not have an internal fire detection system or one that is integral to its design/construction. If fire detection is required at the BESS site, multi-spectrum IR flame detectors can be installed external to the MP2XL to detect flames exiting the cabinets. Testing performed by Tesla has demonstrated that multi-spectrum IR flame detectors are capable of detecting a fire once flames have exited the cabinet.

2.10 Clearances

The MP2XL can be installed back-to-back and side-to-side with a clearance distance of 6 inches and can be installed 8 feet in front of adjacent MP2XL cabinets. These clearance distances are based on large-scale fire tests and fire modeling results that demonstrate a fire will not propagate from one MP2XL to adjacent MP2XL cabinets.

2.11 Emergency Response

Tesla developed a lithium-ion battery emergency response guide (ERG) to provide guidance to anyone responding to an emergency involving a MP2XL. This guide can be utilized by site owners to develop their own site-specific emergency response plans.

3. MP2XL PRODUCT LISTINGS

The MP2XL and its subcomponents are certified or listed to multiple national and international product design standards. These certifications and listings apply to the cells, battery modules, inverters, power electronics, control systems, integration between the BESS and the grid, as well as the BESS as a whole. The standards highlighted below pertain to the lithium-ion cells, the battery modules, and the MP2XL BESS at the unit level. For a full listing of all certifications and listings for all the MP2XL components, please refer to the MP2XL Compliance Packet.

3.1 Cell and Module Level

The lithium-ion batteries utilized in MP2XL are certified and listed to national and international product safety standards from entities such as UL, LLC (UL) and the International Electrotechnical Commission (IEC). These certifications include, but are not limited to:

UL 1642: This certification standard is applicable to secondary (rechargeable) lithium-ion cells and batteries used as a power source (such as BESS). The standard's requirements are intended to reduce the risk of fire or explosion when the battery is used in a product. For example, the standard subjects lithium-ion batteries to severe abuse conditions and evaluates if they can safely withstand them.

UL 1973: This certification standard is applicable to batteries and battery systems utilized for energy storage. The standard evaluates the battery system's ability to safely withstand simulated abuse conditions. For example, the standard subjects module-level stationary batteries to an internal fire exposure test to force a thermal runaway in one cell to ensure it does not explode, propagate fire to neighboring cells, or propagate to the rest of the modular battery system. UL 1973 applies to stationary BESS applications, such as photovoltaic installations and wind turbine energy storage systems, as well as other specialized energy storage systems, such as light electric rail (LER) operations.

IEC 62619: This safety standard specifies requirements and tests to ensure the safe operation of secondary (rechargeable) lithium-ion cells and batteries used in ESS and in other industrial applications. Electrical safety is covered under Clause 8 of the standard, which requires the completion of a risk analysis to determine specific electrical safety issues associated with the intended use of a given battery system or device.

3.2 Unit Level

The MP2XL, as entire cabinets, are also certified, tested, and listed to national and international product safety standards and test methods, including, but not limited to:

IEC 62933-5-2: This safety standard addresses various aspects of BESS, including the requirements for grid-integrated BESS.

UL 9540: This standard covers energy storage systems (including lithium-ion BESS) for stationary indoor and outdoor installations and establishes the system-level certification for energy storage systems and their associated equipment.

UL 9540A: The test methodology evaluates the fire characteristics and thermal runaway fire propagation of a BESS (including lithium-ion BESS). The test method provides a means to evaluate thermal runaway and fire propagation at the cell level, module level, and unit level. The data generated from the test method can be used to determine the fire and explosion protection required for a BESS installation based on fire test data. This test is specifically referenced by the IFC, NFPA 1, and NFPA 855 to demonstrate the functionality of the BESS fire protection features during large-scale fire testing.

3.3 Installation Level

The MP2XL can meet the installation level requirements in the 2024 Edition of the International Fire Code, the 2023 Edition of NFPA 855, and the 2022 California Fire Code for outdoor, ground-mounted BESS installations when they are installed in accordance with its listing and the MP2XL DIM.

4. UL 9540A TESTING

The UL 9540A test method provides a method to evaluate thermal runaway and fire propagation of a lithium-ion BESS at the cell level, module level, unit level, and installation level. The data generated from the test method can be used to determine the fire and explosion protection systems/features required for a BESS installation. This includes, but is not limited to, thermal runaway characteristics of the cell; cell thermal runaway gas composition; the fire propagation potential from cell to cell, module to module, and unit to unit; products of combustion; heat release rate; smoke release rate; and performance of fire protection systems. A summary of the cell, module, and unit-level test results for the MP2XL is provided below.

4.1 UL 9540A Cell Level Testing

Cell-level testing was conducted at UL in December 2021. UL is an OSHA-approved Nationally Recognized Testing Laboratory (NRTL) and offers the UL mark for products. Testing was performed on five model CB5T0, 3.22 V, 157.2 Ah, LFP cells manufactured by Contemporary Amperex Technology Co., Ltd. (CATL) for use in the Megapack 2 and Megapack 2 XL (MP2/2XL).[1] Each cell was charged to 100% state of charge (SOC) prior to testing. Thermal runaway was initiated via film strip heaters installed on both of the wide side surfaces of each cell, as shown in Figure 5. Meaning two heaters were installed on each cell. The heaters were programmed to increase the temperature of the cell's surface by approximately 4.5°C per minute until the cell vented and went into thermal runaway. The cell was placed within an enclosed enclosure and the products released during testing were collected and analyzed.

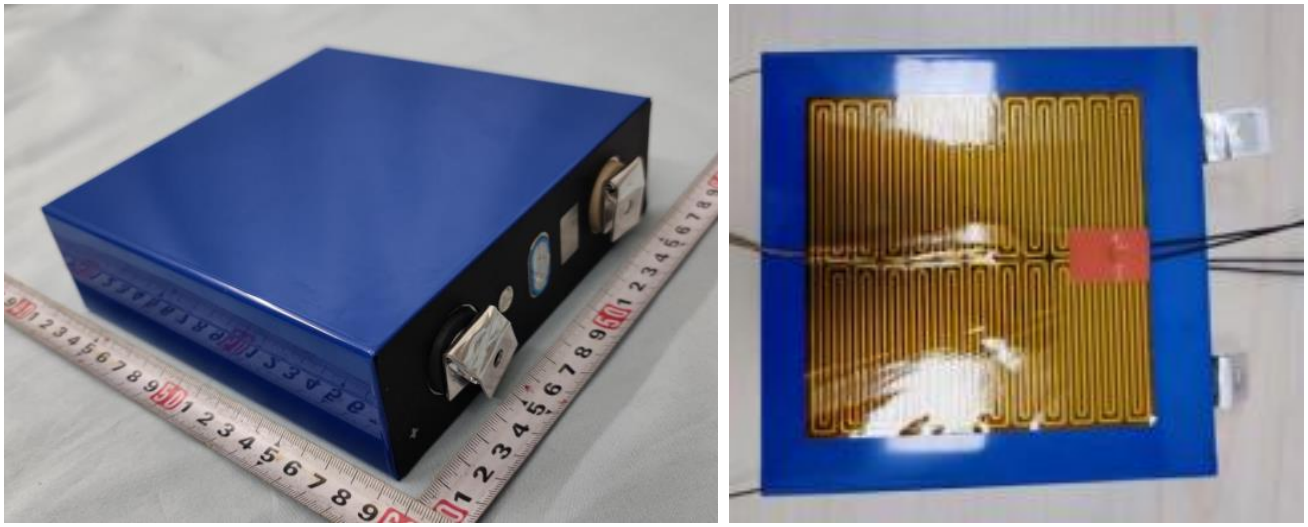


Figure 5 Individual cell tested to UL 9540A (left) and installed film strip heater (right).

[1] Note, as described in Section 2.2, the MP2 and MP2XL utilize the same cells and battery modules.

4.1.1 Test Results

The key flammability and gas composition properties from the UL 9540A cell level tests are summarized below in Table 1 and Table 2.

Table 1 UL 9540A Cell Level Testing: Key Flammability Characteristics

Flammability Property	Value
Average cell surface temperature at gas venting	174°C
Average cell surface temperature at thermal runaway	239°C
Cell vent gas volume released	93.3 L
LFL, % volume in air at the ambient temperature	7.15%
LFL, % volume in air at the venting temperature	6.05%
Burning Velocity (S_u)	90.0 cm/s
Maximum pressure (P_{max})	98.46 psig

Table 2 UL 9540A Cell Level Testing: Cell Vent Gas Composition (Excluding O_2 and N_2)

Gas Name	Chemical Structure	% Measured	Component LFL
Carbon Monoxide	CO	10.881	10.9
Carbon Dioxide	CO2	27.107	N/A
Hydrogen	H2	50.148	4.0
Methane	CH4	6.428	4.4
Acetylene	C2H2	0.264	2.3
Ethylene	C2H4	3.283	2.4
Ethane	C2H6	1.100	2.4
Propene	C3H6	0.379	1.8
Propane	C3H8	0.125	1.7
-	C4 (Total)	0.190	N/A
-	C5 (Total)	0.027	N/A
-	C6 (Total)	0.005	N/A
Benzene	C6H6	0.002	1.2
Toluene	C7H8	0.002	1.0
Dimethyl Carbonate	C3H6O3	0.055	N/A
Ethyl Methyl Carbonate	C4H8O3	0.004	N/A
Total	-	100	-

4.1.2 Key Takeaways

Key takeaways from the tests include:

- The average cell vent and thermal runaway temperature was determined to be 174°C (345°F) and 239°C (462°F), respectively.
- 93.3 liters of cell vent gases were released.
- The cell vent gas mixture is flammable and has an LFL of 7.15% at ambient temperature.
- The cell vent gases were predominantly (approximately 95%) Carbon Monoxide (CO), Carbon Dioxide (CO_2), Hydrogen (H_2), and Methane (CH_4).
- Toxic gases sometimes associated with lithium-ion batteries, such as Hydrogen Fluoride (HF), Hydrogen Chloride (HCL), and Hydrogen Cyanide (HCN) were not vented from the cell.

4.1.3 Performance Criteria

UL 9540A, Section 7.7 outlines the performance criteria for the cell level test. If all these conditions are met, further testing (such as module, unit, or installation level tests) are not required. The acceptable performance criteria during the UL 9540A cell level test are as follows:

1. Thermal runaway cannot be induced in the cell.
2. The cell vent gas does not present a flammability hazard when mixed with any volume of air, at both ambient and vent temperatures.

Given the cell went into thermal runaway and vented flammable gases, UL 9540A module level testing was required.

4.2 UL 9540A Module Level Testing

Module level testing was conducted at a TÜV SÜD (TÜV) laboratory in May 2022. TÜV is an OSHA-approved NRTL and offers the cTÜVus mark, which is equivalent to other NRTL marks such as UL, ETL or CSA. Testing was performed on a 360.64 V, 157.2 Ah, MP2/2XL tray (model MP2 Module), manufactured by CATL.[2] Each tray consists of 112, CATL model CB5T0 LFP cells that were charged to 100% SOC prior to testing. During the test, the MP2XL tray is not connected to the BMS or TMS; meaning, they are not actively operating to prevent thermal runaway in a cell or to prohibit the propagation of thermal runaway from cell to cell. Thermal runaway was initiated via film strip heaters installed on both of the wide side surfaces of two cells, similar to the cell level test (see Figure 5). This resulted in the simultaneous heating of six cells forcing multiple cells into thermal runaway at approximately the same time. The heaters were programmed to increase the temperature of the cell's surface by approximately 4.17 - 4.52°C per minute until the cells vented and went into thermal runaway. The tray was placed under an instrumented hood and the products released during combustion were collected for analysis.

[2] Note, as described in Section 2.2, the MP2 and MP2XL utilize the same cells and battery modules.

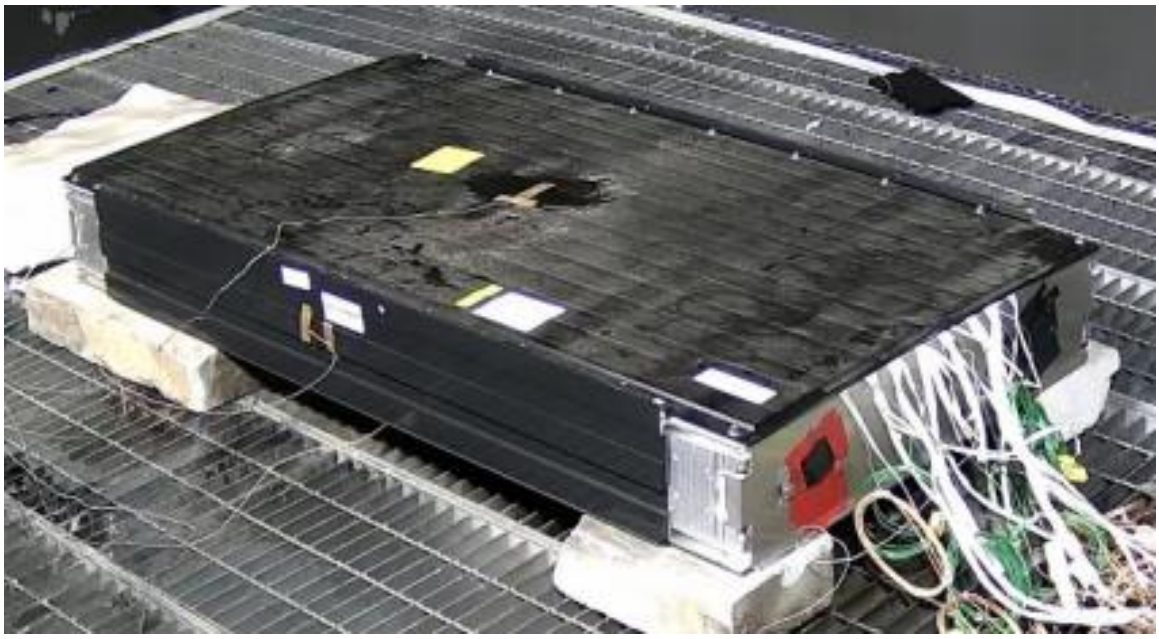


Figure 6 Tray tested to UL 9540A module level testing.

4.2.1 Test Results

This simultaneous heating of six cells forced multiple cells to go into thermal runaway that propagated from the initiating cells to all the cells in the MP2/2XL tray. Once ignited, the MP2/2XL tray fire appears to be a slow-progressing thermal event that took approximately 30-35 minutes to burn itself out. Sparks and flying debris were observed during the test; however, there were no explosive discharges of gases. Products of combustion were collected in the hood and flammable gases were identified, as listed in Table 3. However, toxic gases sometimes associated with lithium-ion batteries, such as HF, HCL, and HCN, were not detected during the combustion of the MP2/2XL tray.

4.2.2 Key Takeaways

Key takeaways from the UL 9540A module level test include:

- Thermal runaway propagated from the initiating cells to all the cells in the MP2/2XL tray.
- The MP2/2XL tray fire appears to be a slow-progressing thermal event requiring over 30 minutes to burn itself out.
- Sparks and flying debris were observed, however, there were no explosive discharges of gases.
- Products of combustion were collected and were identified as flammable.
- Toxic gases sometimes associated with lithium-ion batteries, such as HF, HCL, and HCN, were not detected during the combustion of the MP2/2XL tray.

Table 3 UL 9540A Module Level Testing: Products of Combustion

Gas Name	Chemical Structure	Measurement Peak (ppm)
Carbon Monoxide	CO	205
Carbon Dioxide	CO2	6721
Methane	CH4	68.8
Acetylene	C2H2	17.1
Ethene	C2H4	Not Detected
Ethane	C2H6	Not Detected
Propane	C3H8	Not Detected
Butane	C3H4	Not Detected
Pentane	C3H6	Not Detected
Benzene	C6H6	9.0
Hexane	C7H14	Not Detected
Hydrofluoric Acid	HF	Not Detected
Hydrogen Chloride	HCL	Not Detected
Hydrogen Cyanide	HCN	Not Detected
Hydrogen	H2	446
Total Hydrocarbons	(Propane Equivalent)	247

4.2.3 Performance Criteria

UL 9540A, Section 8.4 outlines the performance criteria for the module level test. If all these conditions are met, further testing (such as unit or installation level tests) are not required. The acceptable performance criteria during the UL 9540A module level test are as follows:

1. Thermal runaway is contained by module design.
2. Cell vent gas is nonflammable as determined by the cell level test.

Given the cell vent gases are flammable (as summarized previously) and thermal runaway was not contained by the module design, UL 9540A unit level testing was required.

4.3 UL 9540A Unit Level Testing

The unit level fire test was conducted at the Northern Nevada Research Center on March 9, 2022, and was certified by TÜV. TÜV is an OSHA-approved NRTL and offers the cTÜVus mark, which is equivalent to other NRTL marks such as UL, ETL or CSA. Note, the MP2XL design is almost identical to the MP2 other than being greater in length to accommodate the additional battery modules. It uses the exact same cells, battery modules, and power electronics (i.e., all the same internal components) that the MP2 utilizes in its design. In addition, the design of the cabinet itself, enclosure strength, and fire safety features, such as the BMS, site controller, monitoring, electrical fault protections, and explosion control system are nearly identical for the two products.

After reviewing the MP2 unit level fire test results and comparing the MP2 and MP2XL products to one another, TÜV determined the MP2 UL 9540A unit level fire test results can be applied to the MP2XL and an additional UL 9540A unit level fire test for the MP2XL was not required for its listing. As such, given all these factors, a stand-alone MP2XL unit level fire test was not performed, nor required. Therefore, the UL 9540A unit level fire test results, described below for the MP2, can be applied to the MP2XL.

4.3.1 Test Unit

The test was performed on a fully populated MP2, consisting of nineteen battery modules, with a capacity of 3,100.8 kWh, tested at 100% SOC. Of all the MP2 variations, the unit tested during UL 9540A unit level testing is the largest capacity variation Tesla manufactures. In addition, during the test, the BMS and TMS are disabled; meaning, they are not actively operating to prevent thermal runaway in a cell or to prohibit the propagation of thermal runaway from cell to cell, or module to module. As such, the UL 9540A unit level fire test can be considered a worst-case fire scenario, where: (1) the unit tested was the largest variation in terms of energy capacity; (2) the unit tested was at the highest energy density possible (100% SOC); and (3) the BMS and TMS were disabled and, therefore, unable to actively respond to the thermal runaway condition. As such, any tests performed on a smaller capacity MP2, at a lower SOC, or on an operating MP2 (one with an active BMS and TMS) would be expected to perform similarly, if not better, than this worst-case scenario. Below is a summary of the UL 9540A unit level fire test results as well as a description of the performance of key fire safety features/systems during the test.

4.3.2 Test Setup

The test setup included all the required instrumentation and data collection as required by UL 9540A as well as some additional measurements that go beyond what is required. These additional measurements were collected to provide additional information to project designers, installers, a FCO, or an AHJ to assist in their design, installation, or review of a MP2XL installation.

4.3.3 Initiation

The initiating battery module was chosen to be the bottom battery module from Bay 7, in the middle battery tray, as shown in Figure 7.

Figure 7 Initiation location: Bay 7, bottom battery module within tray 2.

This location was deemed to be the worst-case, given there are battery trays directly above it and below it. In addition, by initiating in the bottom battery module, there are two additional battery modules installed directly above the initiation location. Within the battery tray itself, six interior cells were simultaneously heated via four film heaters, as shown in Figure 8. The heaters were programmed to provide a heating rate of 5°C (9°F) per minute, as specified by UL 9540A. The number of cells and the location were selected to provide the greatest thermal exposure to adjacent cells to ensure cell-to-cell propagation during the test. The objective of this initiation method is to simulate a mass failure of multiple cells in a localized area within the same battery module.

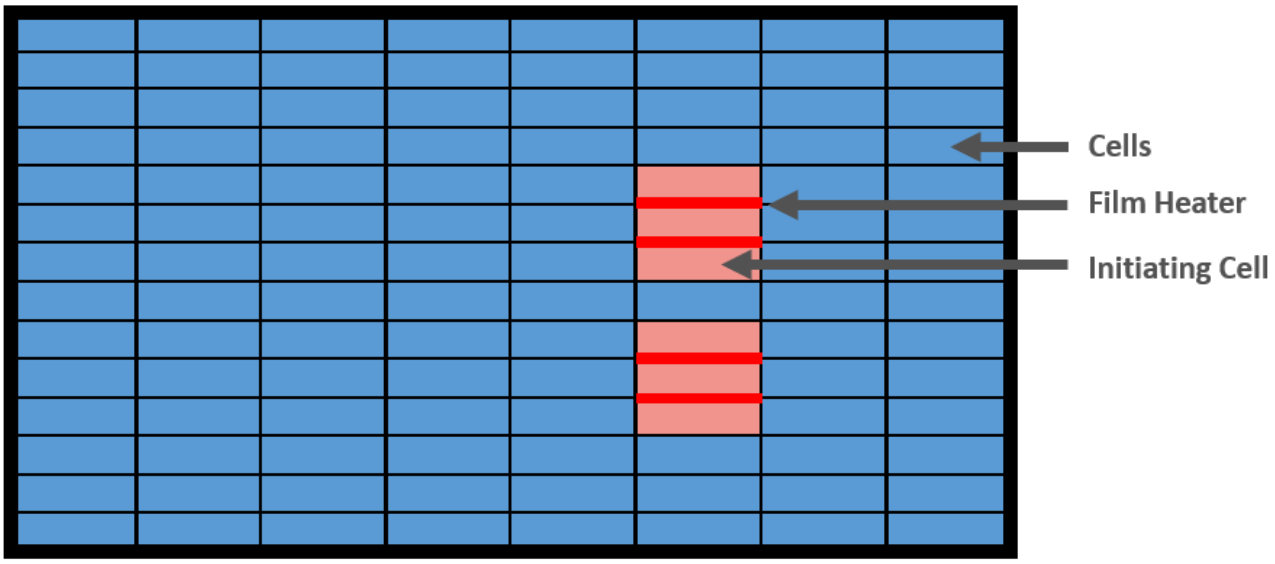


Figure 8 Film heater locations within the initiating tray (top view).

4.3.4 Instrumentation

Outside the initiating battery module and MP2 cabinet, three additional target MP2 cabinets were installed: (1) 6 inches (in) or 150 mm behind the initiating MP2; (2) 6 in (150 mm) to the side of the initiating MP2; and (3) 8 ft (2.44 m) in front the initiating MP2, as shown in Figure 9. The two target MP2 cabinets behind and to the side were populated with 100% SOC battery modules to simulate a multiple MP2 cabinet installation and to determine if thermal runaway and/or fire will propagate from one MP2 cabinet to adjacent cabinets at separation distances of 6 in (150 mm). Additionally, a combustible, instrumented wall (wood framing with plywood facing, painted black) was installed 5 ft (1.52 m) to the side of the initiating MP2 to demonstrate if fire could spread to a combustible surface (plywood wall) during the test.

Thermocouples were installed in the initiating battery module on the external surface of the initiating cells, inside the initiating MP2 cabinet, inside the target MP2 cabinets, on the instrumented wall, and on the exterior surfaces of all the MP2 target cabinets. Heat flux sensors were installed at distances of 3, 5, 8, 20, and 30 ft (0.91, 1.52, 2.44, 6.10, and 9.14 m) from the initiating MP2, as shown in Figure 9. Two external flame detectors and two thermal imagers were installed facing the initiating MP2 to demonstrate their functionality should flames exit the initiating MP2 during the test.

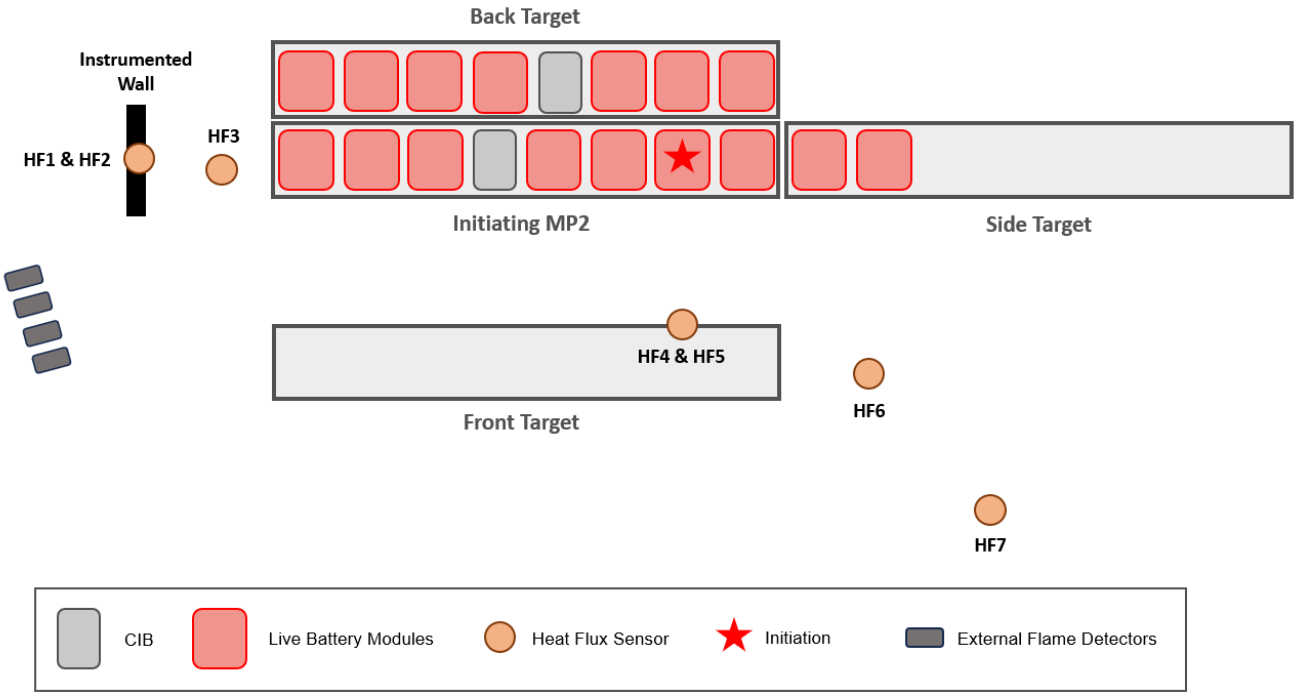


Figure 9 Instrumentation and target MP2 cabinet setup (top view).

4.3.5 Test Results

The test was performed starting around 11:30 am on March 9, 2022. The ambient temperature was between 50.5°F and 52.9°F. It was a sunny, clear day with no precipitation and a relative humidity between 14% and 19%. These outdoor environmental conditions meet the requirements of UL 9540A, Section 9.1.2. The cameras and instrumentation were turned ON at or around time 0:00:00 (hours: minutes: seconds) and the heaters within the initiating MP2 were turned ON at time 0:09:25. Six cells were heated simultaneously for over 1 hour and 18 minutes until the first initiation cell reached its thermal runaway temperature (as measured on the external surface of the cell via a thermocouple) of 239°C (462°F). Fifteen minutes later, the second group of initiating cells reached their thermal runaway temperature. Around 6 minutes later (approximately 1 hour 39 minutes into the test), light smoking/off-gassing was observed exiting the MP2 cabinet in the location where instrumentation was routed into the cabinet (i.e., where thermocouple/power wiring was in contact with the gasket that forms a tight seal for Bay 7's front door). Cell-to-cell propagation (thermal runaway spreading beyond the initial six cells being forcibly heated) was confirmed at approximately 1 hour 45 minutes when a seventh cell reached a temperature of 239°C (462°F). The heaters continued to run for an additional 5 minutes after this observation and then were turned off (at approximately 1 hour and 51 minutes into the test). Thermocouple temperatures inside the initiating MP2 subsided and no additional off-gassing, smoking, or cell thermal runaways were observed. By 2 hours and 30 minutes, the test ended. However, a period of observation and data collection continued for hours afterward to ensure the MP2 did not demonstrate any signs of distress. Table 4 provides a summary of key events from the UL 9540A unit level fire test of the MP2.

Table 4 UL 9540A Unit Level Testing: Timeline of Key Events

Elapsed Time hr:min:sec	Event
00:00:00	Start of Test. Cameras and Data acquisition system (DAQ) turned on.
0:09:25	Heaters ON.
1:18:18	First group of initiating cells reach thermal runaway temperature of 239°C (462°F).
1:33:38	Second group of initiating cells reach thermal runaway temperature of 239°C (462°F).
1:39:28	Smoke observed exiting out the bottom of the initiating MP2 cabinet's bay door where instrumentation was routed into the cabinet.
1:45:48	Confirmation of cell propagation to a 7th cell via internal thermocouple measurements.
1:51:09	Heaters turned OFF.
2:00:00	No additional smoke was observed from the initiating MP2 cabinet. Internal temperatures subside.
2:30:00	End of Test.
Post Test Overhaul	The initiating MP2 cabinet was observed for several hours afterwards and allowed to cool. No additional off-gassing, smoking, elevated temperatures, fire, thermal runaways, or signs of off-normal conditions were observed.

After 24 hours, the initiating MP2 showed no signs of abnormal conditions or distress since the test had concluded (no additional off-gassing, smoking, smells, thermal runaway, or flare-ups) and it was opened for inspection. Prior to opening the initiating MP2, handheld gas detection devices were utilized around the cabinets and did not detect the presence of flammable gases nor were flammable gases detected internally after the Bay 7 door was opened. A visual inspection of the initiating MP2 yielded the following observations:

- Seven cells had gone into thermal runaway: the six that were forcibly heated and one additional cell, as illustrated in Figure 10. This demonstrated that cell-to-cell propagation had occurred during the test, as is required by UL 9540A.

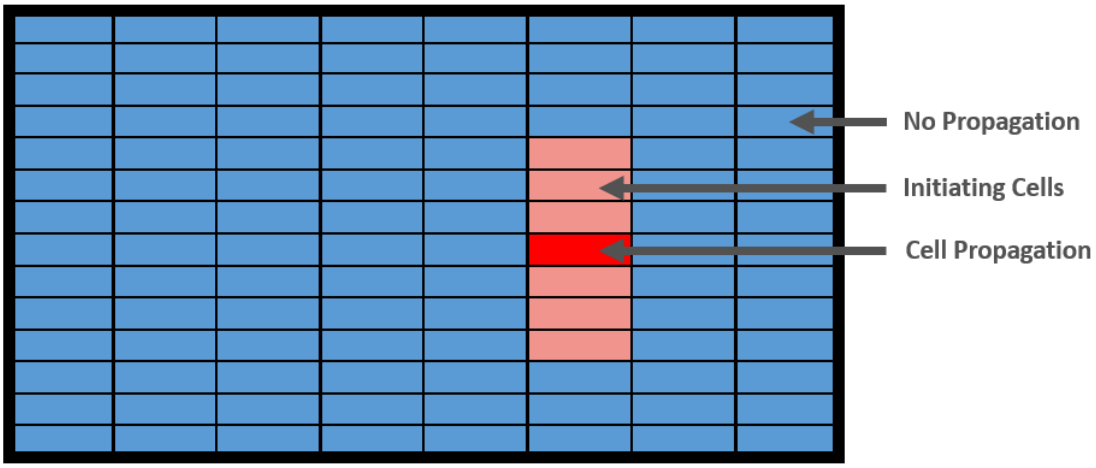


Figure 10 Cell propagation during UL 9540A unit level fire testing (top view).

- No other signs of distress were observed in the initiating battery module. Thermal runway had not propagated beyond the seven cells within Tray 2, nor had it spread to the tray above or below it within the battery module.
- Internal cell components were observed inside the initiating MP2 cabinet in the area of the initiating battery module and around Bay 7's front door; however, no free-flowing liquid or runoff was observed.
- The overpressure vents in Bay 7 had not opened, indicating that the internal pressure within Bay 7 did not see a significant rise during the failure of the seven cells.
- Visible clues of fire damage to surrounding components (plastics, electronics, etc.) were not observed. Based on this observation, it is likely that a sustained fire did not occur around the initiating battery module, even with the failure of seven cells occurring.
- The battery modules within the target MP2 cabinets installed 6 in (150 mm) behind and to the sides were also unaffected.

4.3.6 Fire Propagation

UL 9540A unit level fire testing of the MP2 demonstrated that an internal failure event causing thermal runaway of six cells nearly simultaneously will not propagate thermal runaway throughout the battery module. The nearly simultaneous failure resulted in thermal runaway propagating only to one additional cell and no further. The first group of initiating cells went into thermal runaway approximately 1-hour and 18 minutes into the test, as shown in Figure 11. This observation is based on internal thermocouple measurements installed on the surface of the cells within the initiating battery module.

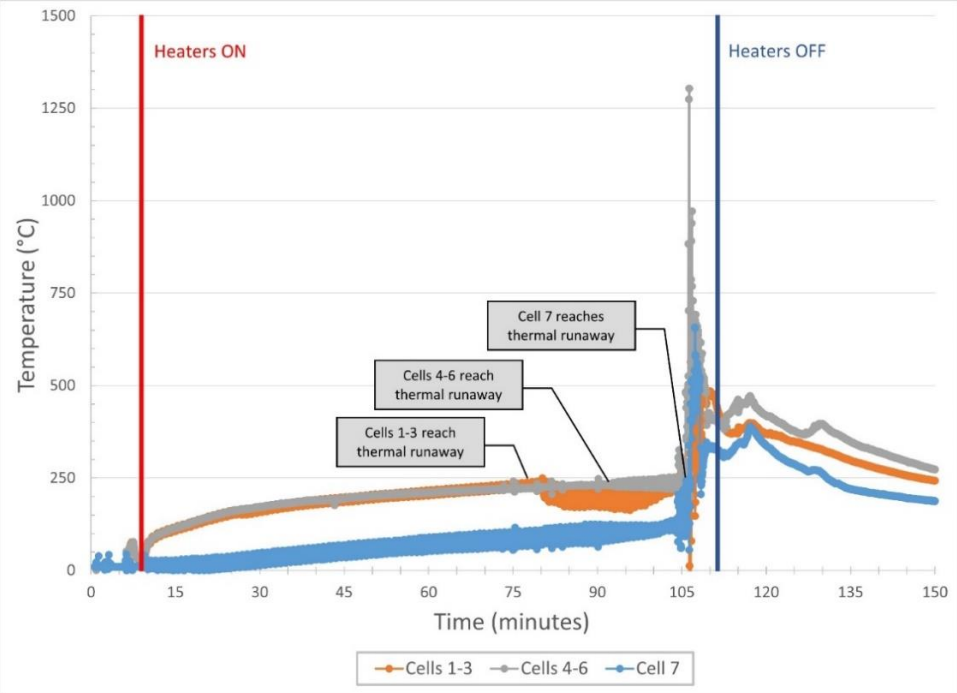


Figure 11 Cell surface temperatures recorded during UL 9540A unit level fire testing.

Fifteen minutes later the second group of initiating cells went into thermal runaway and cell-to-cell propagation was confirmed at approximately 1 hour 45 minutes when a seventh cell reached 239°C (462°F). Note, this result was with a disabled BMS and TMS (i.e., no safety protections were in place). Thermal runaway did not propagate beyond the seventh cell within Tray 2 of the initiating module, nor did it propagate to the battery modules installed above. In addition, thermal runaway did not propagate to the target MP2 cabinets installed 6 in (150 mm) behind and to the sides of the initiating MP2 cabinet. Lastly, no flaming was observed outside of the unit during the test.

4.3.7 Target Battery Module Surface Temperatures

As shown in Table 5, surface temperatures of battery modules within the target MP2 cabinets did not exceed 174°C (345°F), the temperature at which thermally initiated cell venting occurs (as determined during UL 9540A cell level testing).

Table 5 UL 9540A Unit Level Testing: Target Battery Module Surface Temperatures

Location	Maximum Battery Module Temperature Recorded	Ambient Temperature at the Start of Test	Cell Venting Temperature	Cell Thermal Runaway Temperature
Back Target Modules	13.8°C (56.4°F)	10.2°C (50.4°F)	174°C (345°F)	239°C (462°F)
Side Target Modules	13.2°C (55.8°F)	8.0°C (46.4°F)	174°C (345°F)	239°C (462°F)

These temperatures were recorded at the battery modules closest to the initiating battery module, as shown in Figure 12. As plotted in Figure 13, the internal temperature of the target battery modules gently rose throughout the 2½-hour test as the ambient, outdoor temperature also increased from 10.3°C to 11.6°C. These temperature measurements indicate the target battery modules were not affected by the thermal runaway of the seven cells within the initiating battery module.

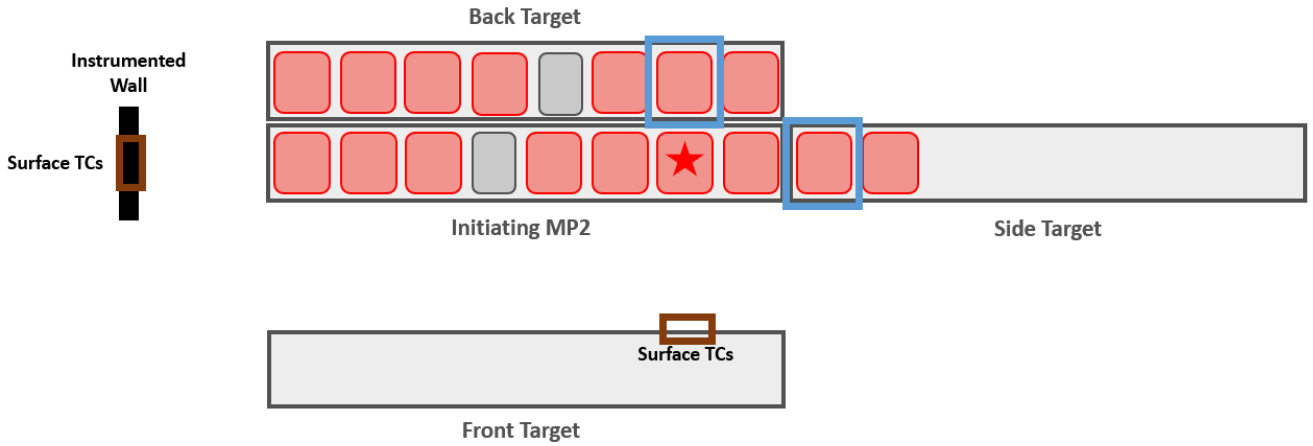


Figure 12 Temperature measurement locations: at side and back target battery modules (blue boxes) and the front target and instrumented wall surface temperatures (brown boxes).

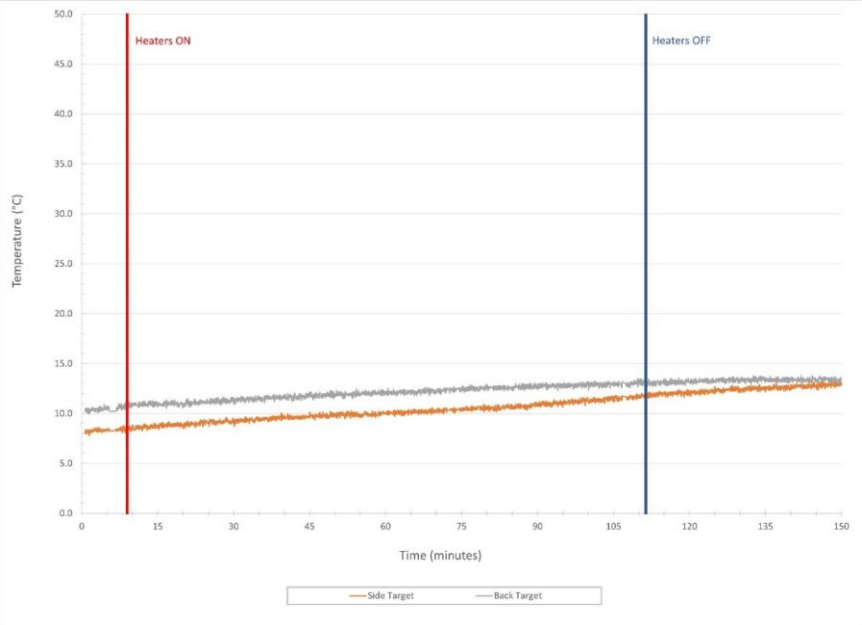


Figure 13 Side and back target battery module temperatures during UL 9540A unit level fire testing.

4.3.8 Exposure Surface Temperatures

As shown in Table 6, surface temperatures on exposures 5 ft (1.52 m) to the side (instrumented wall) and 8 ft (2.44 m) directly in front of the initiating MP2 cabinet (front target) did not exceed 97°C (175°F) above ambient.

Table 6 UL 9540A Unit Level Testing: Exposure Surface Temperatures

Location	Maximum Temperature Recorded	Ambient Temperature Recorded by the TC at the Start of Test	Temperature Rise Above Ambient
Front Target Surface	16.8°C (62.2°F)	11.3°C (52.3°F)	5.5°C (9.9°F)
Instrumented Wall Surface	25.9°C (78.6°F)	20.4°C (68.7°F)	5.5°C (9.9°F)

These temperatures were recorded directly in front of the initiating battery module and at the instrumented wall, as shown in Figure 12. The surface temperature of the front target gently rose throughout the 2½-hour test from a starting temperature of 11.3°C (52.3°F) to a maximum surface temperature of 16.8°C (62.2°F), as shown in Figure 14. Similarly, the 24 thermocouples installed on the instrumented wall also gently rose throughout the test and fluctuated slightly with the outdoor environmental conditions (i.e., wind blowing, sun exposure, increasing ambient temperatures), as shown in Figure 15. The maximum temperature measured on the instrumented wall was 25.9°C (78.6°F), which was a temperature rise of 5.5°C (9.9°F) above its ambient temperature at the start of the test. Note, the temperature rise above ambient can be attributed to the environmental conditions during the 2½-hour test and is not directly related to the thermal runaway of the seven cells within the initiating MP2. As these measurements are surface temperatures, the temperature rise within

the front target surface and the instrumented wall surface is predominantly due to the sun heating up those surfaces during the test (the test was run between 11 am and 1:30 pm on a mostly sunny day). These temperature measurements indicate an exposure surface 5 ft (1.52 m) to the side and adjacent MP2 cabinets 8 ft (2.44 m) in front, were not affected by the thermal runaway of the seven cells within the initiating battery module.

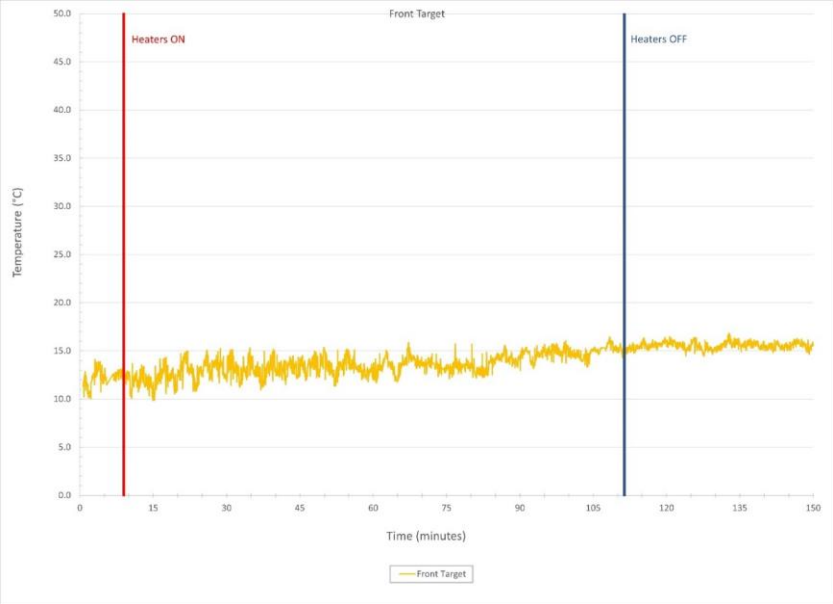


Figure 14 Front target external surface temperature 8 ft (2.44 m) directly in front of the initiating module.

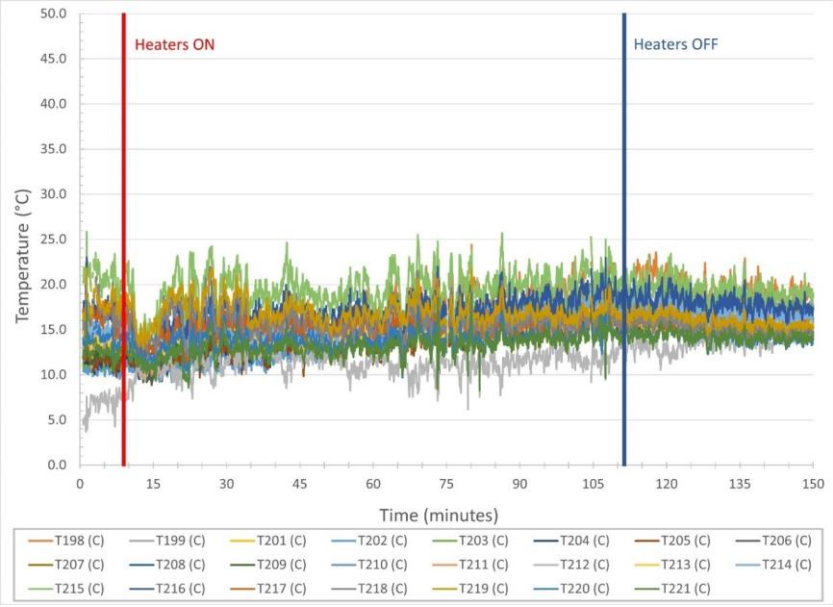


Figure 15 Instrumented wall surface temperatures during UL 9540A unit level fire testing.

Note: T200, the 24th thermocouple installed on the instrumented wall, did not work during testing, and was therefore removed from this plot as the measurements recorded were erroneous.

4.3.9 Heat Flux Measurements

Heat flux measurements were recorded throughout the UL 9540A unit level fire test at distances of 3, 5, 8, 20, and 30 ft (0.91, 1.52, 2.44, 6.10, and 9.14 m). Since flames did not occur outside the initiating MP2 cabinet, predictably, these measurements were essentially 0.00 kW/m^2 throughout the entire test, as summarized in Table 7 and plotted in Figure 16.

Table 7 UL 9540A Unit Level Testing: Maximum Recorded Heat Fluxes

Location	Maximum Heat Flux Recorded (W/m^2)
HF1	0.0000013
HF2	0.0000013
HF3	0.0000014
HF4	0.0000016
HF5	0.0000014
HF6	0.0000016
HF7	0.0000013

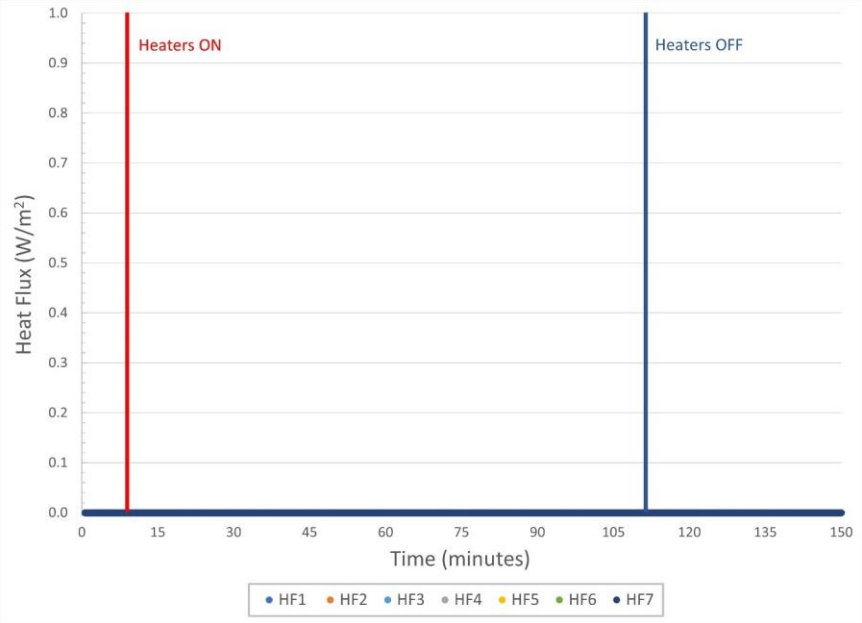


Figure 16 Heat flux measurements recorded during UL 9540A unit level fire testing.

The maximum heat flux recorded was 0.0000016 W/m^2, which was recorded at both the front target and at a distance of 20 ft from the initiating MP2. Note, these heat flux values, in W/m^2, are essentially reading no heat flux values at all, as would be expected given no flaming was observed outside the MP2 cabinet nor was the cabinet itself warmed enough to impose a heat flux on the sensors. These heat flux measurements indicate an exposure surface 3-5 ft (0.91-1.52 m) to the side, an adjacent MP2 cabinet 8 ft (2.44 m) in front, and other

exposures further away at 20-30 ft (6.10-9.14 m), were not affected by the thermal runaway of the seven cells within initiating battery module. Furthermore, the heat flux measurements in front of and to the side of the initiating MP2 cabinet did not exceed 1.3 kW/m^2 at any time during the test.

4.3.10 External Fire Detection System

The MP2 does not have an internal fire detection system or one that is integral to its design/construction. During the UL 9540A unit level fire test, two multi-spectrum IR flame detectors and two thermal imagers from differing manufacturers were installed pointing directly at the front and top of the initiating MP2 cabinet. None of the detectors were activated during the fire test. This result is expected, as no flames were observed during the test. However, previous testing by Tesla on the MP1 has demonstrated that multi-spectrum IR flame detectors can detect a fire should flames exit the cabinet through the thermal roof and can be incorporated into a site design, if required.

4.3.11 Fire Suppression System

The MP2 does not have an internal fire suppression system or one that is integral to its design/construction. The UL 9540A unit level test results demonstrate that a suppression system is not required to stop the spread of fire from cell to cell, module to module, or MP2 cabinet to cabinet when a near-simultaneous failure of up to six cells occurs within the same battery module.

The UL 9540A unit level fire test also demonstrated that manual fire suppression (hose lines) is not required to stop the spread of fire from a MP2 cabinet to adjacent MP2 cabinets installed 6 in (150 mm) behind and to the sides when a near-simultaneous failure of up to six cells occurs within the same battery module.

4.3.12 Explosion Control

UL 9540A unit level fire testing of the MP2 demonstrated that a failure event causing the near-simultaneous thermal runaway of six cells will not cause a deflagration. During the test, pressure transducers were installed within the battery module bay to monitor overpressures within the MP2 cabinet. After the test, no pressure spikes were observed in the data, indicating no sudden increases in pressure, consistent with a deflagration, occurred within the MP2 cabinet during the UL 9540A unit level test. In addition, the overpressure vents did not open, the MP2 cabinet doors were not forced open, nor did the MP2 cabinet fail to hold containment. Meaning, no visual indications of an overpressure event occurring inside the MP2 cabinet were observed. Light smoking/off-gassing (i.e., not a pressurized discharge or deflagration) did escape the initiating MP2 during the test, likely through pathways created by the required instrumentation (thermocouples, film heaters, etc.) for the test; however, explosion hazards, including but not limited to, observations of a deflagration, projectiles, flying debris, detonation, hazardous pressure waves, shrapnel, or other explosive discharge of gases, were not observed.

4.3.13 Runoff/Products of Combustion

UL 9540A unit level fire testing does not require the collection of runoff or products of combustion as part of an outdoor installation test. However, during the unit level test, and afterwards during cleanup, no liquid runoff

(such as the water-glycol solution from the TMS) was observed. Internal cell components were observed after the test on the interior of the cabinet around the Bay 7 door, as would be expected after the failure of seven cells. However, no free-flowing liquid, or runoff was observed once the MP2 doors were opened. If necessary, should a failure event occur, internal cell components/electrolytes can be disposed of in an appropriate manner as specified by Tesla's ERG and Safety Data Sheets (SDS).

4.3.14 Performance Criteria

UL 9540A, Table 9.1 outlines the performance criteria for outdoor, ground-mounted BESS. If all these conditions are met, further testing (such as installation-level testing) is not required. The performance criteria during the UL 9540A unit level fire test is as follows:

1. No flaming observed outside of the unit.
2. Surface temperatures of battery modules within the targets adjacent to the initiating unit cannot exceed the temperature at which thermally initiated cell venting occurs.
3. Surface temperatures on exposures 5 ft (1.52 m) to the side and 8 ft (2.44 m) in front of the initiating unit cannot exceed 97°C (175°F) above ambient.
4. No explosion hazards, including but not limited to, observations of a deflagration, projectiles, flying debris, detonation, or other explosive discharge of gases observed.
5. Heat flux in the center of the accessible means of egress cannot exceed 1.3 kW/m^2.

As described above, no flaming was observed outside the MP2 cabinet during the unit level test. In addition, surface temperatures of the battery modules within the targets were below the temperature at which cell venting occurs (174°C or 345°F), and external surface temperatures on exposures 5 and 8 ft (1.52 and 2.44 m) away did not exceed 97°C (175°F) above ambient. Lastly, no explosion hazards were observed, and all heat fluxes remained below 1.3 kW/m^2. Based on the above UL 9540A unit level fire test results, the MP2 meets all five of the above performance criteria. By meeting the unit level performance criteria, UL 9540A installation-level testing is not required for a MP2 installation.

5. CONCLUSIONS

Based on our review of the available materials, our background, experience and training, and the analysis performed to date described above, the following conclusions are submitted within a reasonable degree of scientific and engineering certainty:

1. The MP2XL is listed to all product design standards (such as UL and IEC) required of a BESS and has been tested to UL 9540A at the cell, module, and unit level.
2. Cell and module level UL 9540A testing demonstrated that the venting and combustion of the MP2XL cells release flammable gases that are commonly detected in a vented lithium-ion cell; however, they do not release toxic gases sometimes associated with the failure of lithium-ion batteries, such as HCN, HCL, and HF.
3. The largest variant of the MP2, a 3,100.8-kWh unit, was tested at a worst-case scenario (i.e., 100% SOC with the BMS and TMS disabled) to the UL 9540A unit level fire test method where six cells within the same battery module were forced into thermal runaway.
4. The MP2XL design is almost identical to the MP2 other than being greater in length to accommodate the additional battery modules. It uses the exact same cells, battery modules, and power electronics (i.e., all the same internal components) that the MP2 utilizes in its design. In addition, the design of the cabinet itself, enclosure strength, and fire safety features, such as the BMS, site controller, monitoring, electrical fault protections, and explosion control system are nearly identical for the two products. As such, TÜV determined the MP2 UL 9540A unit level fire test results summarized below can be applied to the MP2XL.
5. The performance criteria outlined in UL 9540A, Table 9.1 for outdoor, ground-mounted BESS were all met during the unit level test. Specifically, the performance criteria results were:
    a. No flaming was observed outside of the unit.
    b. Surface temperatures of battery modules within the target MP2 cabinets adjacent to the initiating MP2 cabinet did not exceed the temperature at which thermally initiated cell venting occurs. The maximum temperatures recorded at the battery modules of the adjacent MP2 cabinets were 13.8°C (56.4°F) and 13.2°C (55.8°F). These temperatures are significantly below the temperature at which cell venting occurs (174°C or 345°F).
    c. Surface temperatures on exposures 5 ft (1.52 m) to the side and 8 ft (2.44 m) in front of the initiating MP2 cabinet did not exceed 97°C (175°F) above ambient. The maximum external surface temperatures recorded at the instrumented wall 5 ft (1.52 m) to the side was 25.9°C (78.6°F) with a temperature rise above ambient of 5.5°C (9.9°F). The maximum external surface temperatures recorded at the front target 8 ft (2.44 m) directly in front of the initiating MP2 was 16.8°C (62.2°F) with a temperature rise above ambient of 5.5°C (9.9°F). These temperatures are significantly below the maximum permitted temperature rise above ambient of 97°C (175°F).
    d. Explosion hazards, including but not limited to, observations of a deflagration, projectiles, flying debris, detonation, or other explosive discharge of gases were not observed.
    e. Heat flux measurements did not exceed 1.3 kW/m^2. The maximum heat flux recorded was 0.0000016 W/m^2, which was the sensor installed on the front target MP2 cabinet and was the ambient heat flux the sensor was exposed to throughout the test.

6. Based on a review of the MP2XL, its fire safety features, and the UL 9540A unit level fire test results, the MP2XL meets or exceeds all the performance criteria of UL 9540A, Table 9.1 and UL 9540A installation level testing is not required for a MP2XL installation.
7. None of the external fire detectors activated during the UL 9540A unit level fire test (two multi-spectrum IR flame detectors and two thermal imagers). This result is expected, as no flaming was observed outside of the cabinet during the test; however, previous testing by Tesla on the MP1 has demonstrated that multi-spectrum IR flame detectors can detect a fire should flames exit the cabinet through the thermal roof.
8. An integral fire suppression system or an external fire suppression system is not required to stop the spread of fire from cell to cell, module to module, or MP2XL cabinet to cabinet when a near-simultaneous failure of up to six cells occurs within the same battery module.
9. Manual fire suppression (hose lines) is not required to stop the spread of fire from a MP2XL cabinet to adjacent MP2XL cabinets installed 6 in (150 mm) behind and to the sides when a near-simultaneous failure of up to six cells occurs within the same battery module.
10. Based on a review of the MP2XL, its fire safety features, and the UL 9540A test results, the MP2XL can meet or exceed all the installation level codes and standards, such as the IFC and NFPA 855, required for outdoor, ground mounted BESS installations when installed in accordance with the MP2XL DIM.

6. REVISION CONTROL SHEET

Date	Revision	Reason for Issue	Developed By	Reviewed By	Approved By
04/03/2024	Rev0	Initial Report	AFB	BA	NLR

Revision	Section	Changed Noted

Appendix D

REV 1 DR WS-2 Tesla Megapack 2/XL Hazard Mitigation Analysis

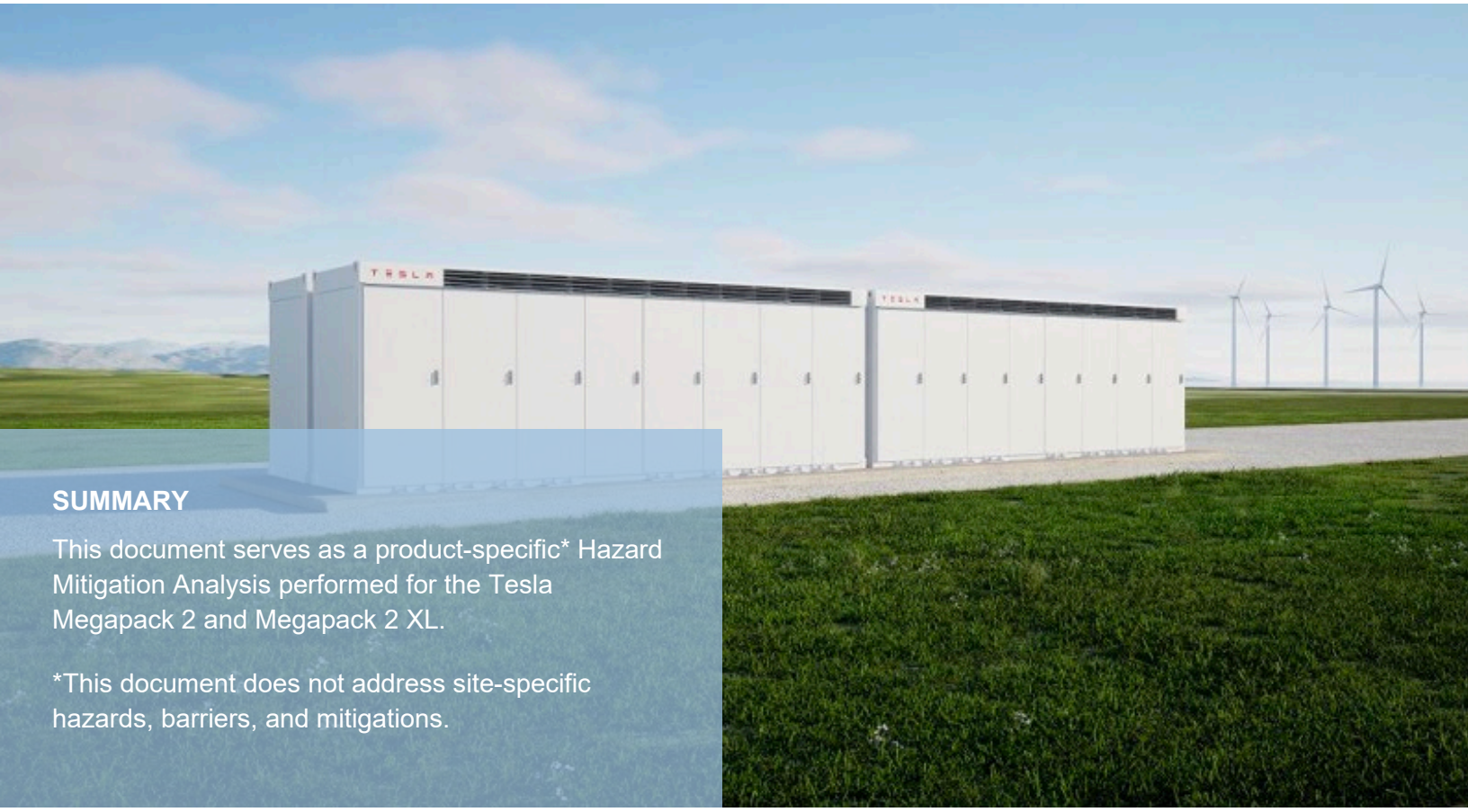
ESRG
ENERGY SAFETY
RESPONSE GROUP

TESLA

TESLA MEGAPACK 2/XL

HAZARD MITIGATION ANALYSIS

February 22nd, 2023 | Rev. 4



SUMMARY

This document serves as a product-specific* Hazard Mitigation Analysis performed for the Tesla Megapack 2 and Megapack 2 XL.

*This document does not address site-specific hazards, barriers, and mitigations.

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PROJECT DESCRIPTION

Project Name	Tesla Megapack 2/XL Hazard Mitigation Analysis
Project No.	22-20231
Prepared For	**Tesla, Inc.** 45500 Fremont Blvd Fremont, CA 94538
Revision No.	Rev. 4
Date of Issue	2/22/2023

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Revision History

Revision No.	Date of Issue	Substance of Change	Prepared By	Reviewed By
Rev. 1	10/6/2022	Draft issue	N. Petrakis	
Rev. 2	11/15/2022	Comments addressed – minor changes	N. Petrakis	
Rev. 3	12/27/2022	Comments addressed – minor changes	N. Petrakis	
Rev. 4	2/22/2022	Comments addressed – minor updates	N. Petrakis	

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1 INTRODUCTION

1.1 Background

Energy Safety Response Group (ESRG) has been retained by Tesla, Inc. to perform a product specific Hazard Mitigation Analysis (HMA) in accordance with *NFPA 855 Standard for the Installation of Stationary Energy Storage Systems §4.1.4 Hazard Mitigation Analysis* and the *2021 International Fire Code (IFC) §1207.1.4.1*. This HMA can be utilized to assess the anticipated overall effectiveness of protective barriers in place to mitigate the consequences of a battery-related failure. The analysis was performed based on the current documentation available at the time of the report.

1.2 Applicable Codes and Standards

The 2020 edition of *NFPA 855 Standard for the Installation of Energy Storage Systems §4.1.4 Hazard Mitigation Analysis* requires an evaluation on the consequences of the following failure modes:

1) *Thermal runaway condition in a single module, array, or unit*
2) *Failure of an energy storage management system*
3) *Failure of a required ventilation or exhaust system*
4) *Failure of a required smoke detection, fire detection, fire suppression, or gas detection system*

Additionally, for the completeness, this report also includes two additional failure modes required per *2021 International Fire Code (IFC) §1207.1.4.1:*

5) *Voltage surges on the primary electric supply*
6) *Short circuits on the load side of the ESS*

For the purposes of this report, only single failures modes shall be considered for each mode given above.

Per *NFPA 855 §4.1.4.2, Analysis Approval,* the AHJ shall be permitted to approve the hazardous mitigation analysis as documentation of the safety of the ESS installation provided the consequences of the analysis demonstrate the following:

1) *Fires will be contained within unoccupied ESS rooms for the minimum duration of the fire resistance rating specified in NFPA 855 §4.3.6.*
2) *Suitable deflagration protection is provided where required.*
3) *ESS cabinets in occupied work centers allow occupants to safely evacuate in fire conditions.*
4) *Toxic and highly toxic gases released during normal charging, discharging, and operation will not exceed the PEL in the area where the ESS is contained.*

5) *Toxic and highly toxic gases released during fires and other fault conditions will not reach concentrations in excess of immediately dangerous to life or health (IDLH) level in the building or adjacent means of egress routes during the time deemed necessary to evacuate from that area.*

6) *Flammable gases released during charging, discharging, and normal operation will not exceed 25 percent of the LFL.*

The following key codes, standards, and local requirements are referenced throughout the report:

- *NFPA 855 Standard for the Installation of Stationary Energy Storage Systems*, 2020 Edition
- *International Fire Code §1207 Electrical Energy Storage Systems*, 2021 Edition
- *UL 9540A Standard for Test Method for Evaluation Thermal Runaway Fire Propagation in Battery Energy Storage Systems,* 4th Edition
- *UL 9540 Standard for Energy Storage Systems and Equipment,* 2nd Edition

1.3 Summary of Findings

Based on review of documentation provided by Tesla, Inc., ESRG finds that adequate protections are provided for the fault conditions listed per *NFPA 855 §4.1.4* and *IFC §1207.1.4.1,* as well as for analysis approval requirements per *NFPA 855 §4.1.4.2*. Key findings include:

- The Tesla Megapack 2/XL is equipped with a number of protection systems (e.g., deflagration control system consisting of overpressure vents and sparker system, BMS control, electrical shutdowns and disconnects, etc.) that are anticipated to effectively manage all applicable fault conditions required per *NFPA 855 §4.1.4* and *IFC §1207.1.4.1.*

***NFPA 855 §4.1.4* and *IFC §1207.1.4.1* Hazard Mitigation Analysis Requirements**	
Thermal runaway condition in a single module, array, or unit	The system is provided with several passive and active measures to mitigate or contain a propagating thermal runaway condition. UL 9540A testing further shows that the effects of thermal runaway are contained within the module and Unit.
Failure of an Energy Storage Management System	Multiple levels of system monitoring provide redundant protection in the unlikely event of a failure of the energy storage management system.
Failure of a Required Ventilation or Exhaust System	The Megapack 2/XL is not required to have a ventilation or exhaust system. A proprietary explosion protection system is designed to mitigate the effects of flammable gasses generated during an abnormal condition.

Failure of a Required Smoke Detection, Fire Detection, Fire Suppression, or Gas Detection System	The Megapack 2/XL does not rely on dedicated smoke detection, fire suppression, or gas detection systems to mitigate the hazards associated with thermal runaway. Along with subsequent safety actions, the BMS fault notifications are transmitted to Tesla's 24/7 Operations Center, alerting key stakeholders of any abnormal conditions.
Voltage Surges on the Primary Electric Supply	Voltage surges on the primary electric supply are mitigated by BMS and inverter controls, voltage monitoring, and automatic disconnects.
Short Circuits on the Load Side of the ESS	Short circuits on the load side are mitigated by BMS controls and automatic safety actions.

- The Tesla Megapack 2/XL is compliant with all applicable Analysis Approval requirements per *NFPA 855 §4.1.4.2.*

***NFPA 855 §4.1.4.3* – Analysis Approval**	
Fires will be contained within unoccupied ESS rooms for the minimum duration of the fire resistance rating specified in NFPA 855 §4.3.6.	N/A – The Megapack 2/XL is intended for outdoor installations.
Suitable deflagration protection is provided where required.	The Megapack 2/XL is provided with a proprietary explosion protection system. The effectiveness of the explosion protection system was validated during internal destructive fire testing.
ESS cabinets in occupied work centers allow occupants to safely evacuate in fire conditions.	N/A – The Megapack 2/XL is not intended for installation within occupied work centers.
Toxic and highly toxic gases released during normal charging, discharging, and operation will not exceed the PEL in the area where the ESS is contained.	N/A – Lithium-ion batteries do not release toxic or highly toxic gases during normal charging or discharging operations.
Toxic and highly toxic gases released during fires and other fault conditions will not reach concentrations in excess of immediately dangerous to life or health (IDLH) level in the building or adjacent means of egress routes	Internal Unit level testing conducted on the products of combustion from the Megapack 2/XL indicated that there was no Mercury (Hg) observed, and trace levels of HF far below NIOSH Immediately Dangerous to Life or Health (IDLH) levels.

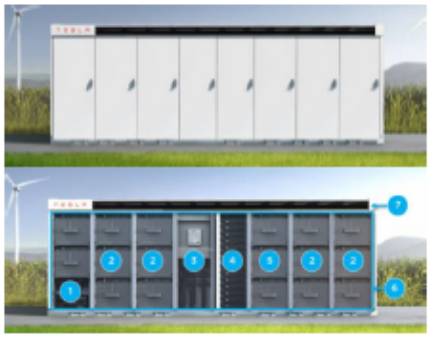
during the time deemed necessary to evacuate from that area.	
Flammable gases released during charging, discharging, and normal operation will not exceed 25 percent of the LFL.	N/A – Lithium-ion batteries do not release flammable gasses during charging, discharging, or normal operations.

- The effectiveness of the Megapack 2/XL's proprietary explosion mitigation system has been validated by UL 9540A Unit level and additional large-scale fire and destructive testing and has shown to be effective in preventing the occurrence of any hazardous pressure waves, debris, shrapnel, or ejection of enclosure pieces during a failure event.
- When subjected to a near-simultaneous failure of 6 cells within a module during UL 9540A full-scale fire testing, the Tesla Megapack 2 has proven that the system is provided with robust thermal runaway propagation prevention. As indicated in the UL 9540A Unit Level testing report by TUV, "the testing performed on MP2 is considered harsher with higher gas concentrations, and fundamental engineering analysis for MP2XL shows comparable behavior as worst case" therefore the testing results for the Megapack 2 can be utilized as comparable results for the Megapack 2 XL. The Megapack 2/XL does not rely on any internal or external fire suppression systems to prevent cascading thermal runaway propagation at the module and unit (Megapack-to-Megapack) level.
- Additional voluntary destructive testing was conducted by Tesla on a representative Megapack 2/XL. This testing utilized a more aggressive approach than typical UL 9540A testing by initiating a thermal runaway of all 48 cells within a module simultaneously and forcing a catastrophic failure of a battery module. Results of this testing showed that due to the robustness of the system design the following is noted:
    - It is difficult to initiate and maintain any cascading thermal runaway within the unit.
    - In the unlikely event of a fire, the system will consume itself slowly in a safe and controlled manner, without any explosive bursts, projectiles, or unexpected hazards.
- During the aforementioned testing, third-party analysis on products of combustion collected indicated no Hg and trace levels of HF far below NIOSH Immediately Dangerous to Life or Health (IDLH) levels.
- Voluntary fire propagation modeling was conducted by Tesla to determine the anticipated impacts on representative target Megapack 2 units from an external heat flux generated by a failing unit. Even with worst-case wind scenarios taken into account, in the unlikely event of a Megapack 2/XL fire, the model shows that thermal runaway would not propagate to the adjacent units that are installed as per Tesla's site design requirements.

2 ENERGY STORAGE SYSTEM DESCRIPTION

2.1 Megapack 2/XL Overview

The Tesla Megapack 2 and Megapack 2 XL (which may also be referred to as Megapack 2/XL or MP2/XL throughout this report), is a modular, fully integrated, AC-coupled battery energy storage system (BESS or ESS). The Megapack 2 is an updated version of the original Megapack 1 and utilizes similar deflagration control systems in the form of pressure-sensitive vents and sparker systems to manage explosion risk. The Megapack 2 XL is a design evolution of Megapack 2, which leverages the same core technology platform (cells, vents, sparker system, etc.) The Megapack 2/XL, however, utilizes lithium iron phosphate (LFP) battery cells provided by CATL, as opposed to the nickel manganese cobalt oxide (NMC) and nickel cobalt aluminum oxide (NCA) cells used in the Megapack 1.

Megapack 1	Megapack 2
	
Cells and Battery Modules:	
Cylindrical 2170 NMC	Prismatic LFP
1,000 Cells per Tray, 12 Cell Trays 12,000 Cells per Battery Module	112 Cells per Tray, 3 Cell Trays 336 Cells per Battery Module
Each Module Equipped with an Integrated BMS	
Layout/Construction:	
Modular Cabinet Design, Not Occupiable	
Thermal Bay, Customer Interface Bay, IP66 Battery Module Bay, and Thermal Roof	
23.5 x 5.4 x 8.3 ft	23.75 x 5.4 x 8.2 ft
Up to 17 Battery Modules	Up to 19 Battery Modules
Safety Features:	
Thermal Management System: Closed Loop Liquid Coolant System and R-134A Refrigerant	
Customer Interface Bay: User-accessible Area Designed for Operation and Servicing	
Electrical Fault Protection: Passive and Active Safety Control Mechanisms (Fuses, Circuit Interrupters, Pyrotechnic Fuse) Installed within the Battery Module Circuits and Distribution Circuit	
Autonomous BMS with 24/7 Remote Monitoring by Tesla Operation Facilities	
No Integral Fire Detection or Fire Suppression System	
Thermal Insulation	No Thermal Insulation[1]
Explosion Control System:	
33 Overpressure Vents, 8 Sparkers	22 Overpressure Vents, 12 Sparkers[1]

[1] Modified explosion control system and thermal insulation to account for the different cells (NMC vs. LFP) utilized in the MP2.

Megapack 1	Megapack 2
	
Listings and Certifications	
Component and BESS Design Certifications/Listings (UL9540 and IEC 62933-5-2)	
Installation Level Codes and Standards (IFC and NFPA 855)	
UL 9540A Unit Level Test Results	
Internally Heated Cells: Led to Cascading Thermal Runaway of All Cells	Internally Heated Cells: Led to Thermal Runaway of One Additional Cell
Fire Propagation: Consumed the Entire Cabinet	No Fire Propagation: No Evidence of Sustained Flaming
Flames Observed Outside the Cabinet Exiting via the Thermal Roof	No Flames Observed Outside the Cabinet
Heat Fluxes Recorded at Distances of up to 20-30 ft From the Cabinet	No Heat Fluxes Recorded at Distances of up to 20-30 ft From the Cabinet
Explosion hazards, including but not limited to, observations of a deflagration, projectiles, flying debris, detonation, or other explosive discharge of gases were not observed.	
No Fire Propagation to Adjacent Cabinets at 6-inch (150 mm) Spacing to the Sides and Behind	
No Fire Propagation to Adjacent Cabinets at 8 ft (2.44 m) Spacing Directly in Front	
Integral Fire Suppression Not Required to Stop Cabinet to Cabinet Fire Spread	
Manual Fire Suppression (Hose Lines) Not Required to Stop Cabinet to Cabinet Fire Spread	
No Free-Flowing Liquid Runoff Observed After the Test	

Megapack 2	Megapack 2XL
	
Cells and Battery Modules:	
Same Cells, Battery Modules and Integrated BMS	
Layout/Construction:	
Same Modular Cabinet Design, Not Occupiable with the Same or Substantially Similar Thermal Bay, Customer Interface Bay, IP66 Battery Module Bay, and Thermal Roof	
23.75 x 5.40 x 8.20 ft	28.83 x 5.42 x 9.17 ft
Up to 19 Battery Modules (3,100.8 kWh)	Up to 24 Battery Modules (3,854.0 kWh)
Safety Features:	
Same or Substantially Similar Thermal Management System, Customer Interface, Electrical Fault Protections and Autonomous BMS with 24/7 Remote Monitoring by Tesla Operation Facilities	
No Integral Fire Detection or Fire Suppression System	
Explosion Control System:	
22 Overpressure Vents, 12 Sparkers	26 Overpressure Vents, 12 Sparkers
Listings and Certifications	
Has the Same Component and BESS Design Certifications/Listings (UL 9540 and IEC 62933-5-2)	
Meets the Same Installation Level Codes and Standards (IFC and NFPA 855)	
UL 9540A Unit Level Test Results	
Same UL 9540A Fire Test Results: No Fire Propagation or Evidence of Sustained Flaming, No Flames Observed Outside the Cabinet, No Fire Propagation to Adjacent Cabinets, Integral Fire Suppression or Manual Fire Suppression (Hose Lines) Not Required to Stop Cabinet to Cabinet Fire Spread, No Observations of Explosion Hazards, No Free-Flowing Liquid Runoff Observed After the Test	

Each Megapack 2 unit contains up to 19 modules with inverters, a thermal bay and associated thermal roof components, an AC circuit breaker, and a set of customer interface terminals and internal controls circuit boards. The Megapack 2 XL uses identical components to the Megapack 2, including batteries, converters, and explosion protection systems. The main difference (other than the footprint) to the Megapack 2 is that that the Megapack 2 XL contains 24 AC battery modules rather than 19. Depending on the system configuration (2-hour or 4-hour), each Megapack can be configured with different quantities of battery modules which, together with the site's grid voltage, determine Megapack's nominal power rating. All components are housed in a cabinet-style enclosure, with access for maintenance provided via enclosure doors. The Megapack 2/XL, therefore, cannot be physically entered by any person and is thus not considered a walk-in container, occupied building, or structure as defined by *NFPA 855* and *IFC*. Thermal management is provided to the internal Megapack 2/XL components via active liquid cooling and heating system utilizing 50/50 ethylene glycol and water and R-134a refrigerant.

The Megapack 2/XL and constituent components are tested and certified to UL 9540, UL 1642, UL 1973, IEC 62619, and IEC 62933-5-2. UL 9540A (4th Edition) large-scale fire testing was performed at the Cell, Module, and Unit level (Installation level testing was not required, as all Unit level performance criteria were met). From the UL 9540A Unit level report by TUV, "Based on the limited module propagation observed during MP2 testing (7 cells in runaway) the behavior would be the same with MP2XL. With the increase in volume and sparker count, the deflagration risk is minimized. The testing performed on MP2 is considered harsher with higher gas concentrations, and fundamental engineering analysis for MP2XL shows comparable behavior as worst case".

Figure 2-1 - Tesla Megapack 2

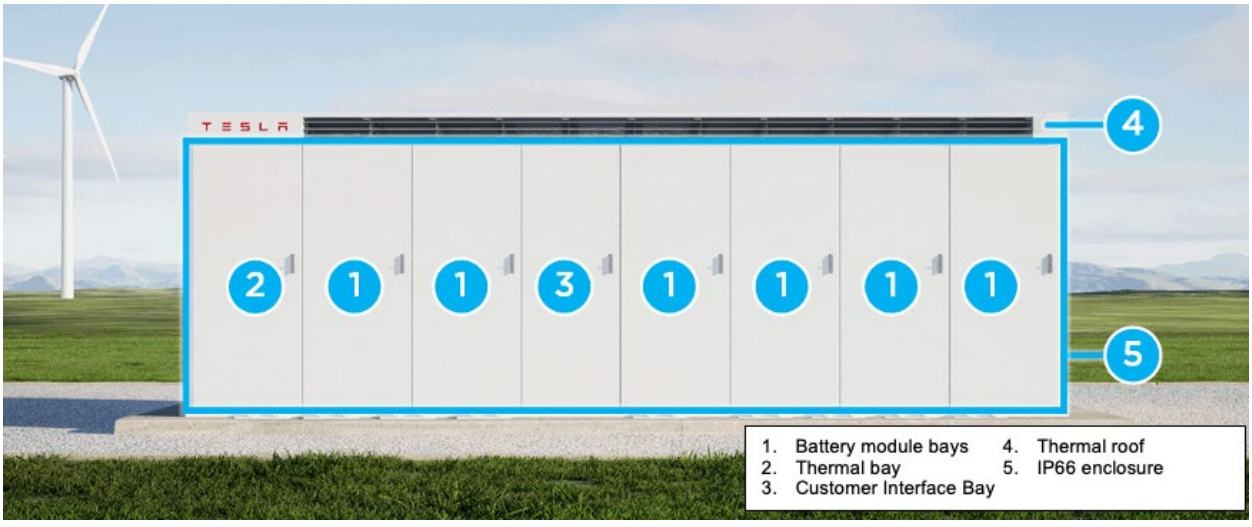


Figure 2-2 - Megapack Internal Architecture

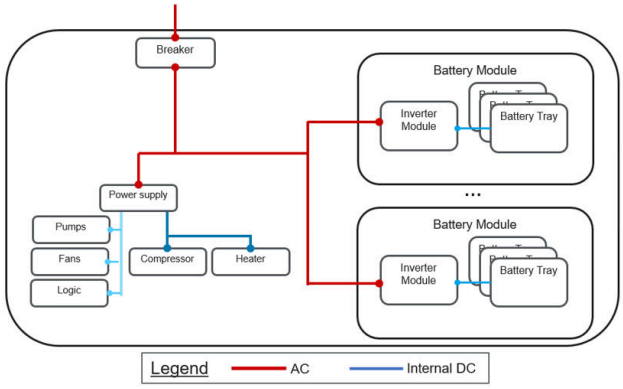


Figure 2-3 - Battery Module

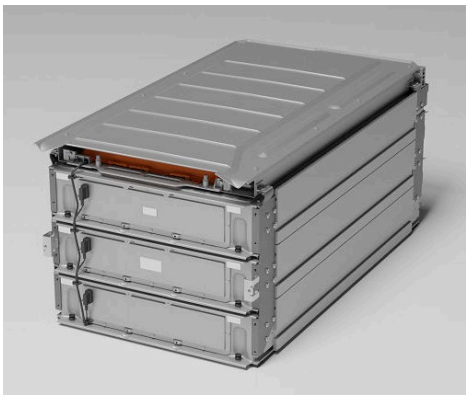
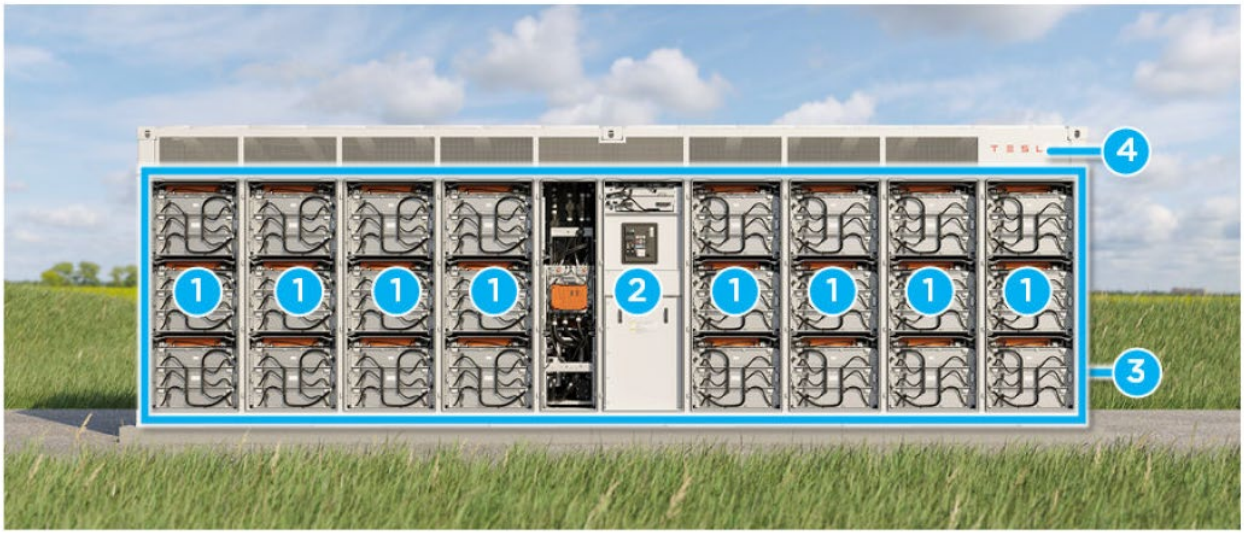


Figure 2-4 - Tesla Megapack 2 Thermal Management System

Figure 2-5 - Tesla Megapack 2 XL



1. Battery modules with active and passive fuses – externally serviceable
2. Touch-safe Customer Interface Bay
3. Non-walk-in IP66 enclosure and deflagration mitigation
4. Thermal roof with overpressure vents

For more information on the Tesla Megapack 2 and Megapack 2 XL, please refer to official product documentation provided by Tesla.

2.2 Fire Safety Features

The Tesla Megapack 2/XL is equipped with a number of fire safety features designed to mitigate the propagation of a battery failure or prevent the failure from occurring altogether. These protections are aligned with the requirements of the 2020 Edition of NFPA 855, as well as the 2021 International Fire Code §1207 Electrical Energy Storage Systems.

2.2.1 Deflagration Control System

Each Megapack 2/XL is provided with an integral and proprietary explosion mitigation system (deflagration control). This explosion mitigation system is comprised of numerous pressure-sensitive (overpressure) vents located at the top of the Megapack and a sparker system; working in conjunction to ignite any flammable gasses that could be generated within the unit during a failure event. The Megapack 2 is provided with twenty-two (22) overpressure vents and 12 sparkers, while the Megapack 2 XL is provided with twenty-six (26) overpressure vents and 12 sparkers. Any overpressures generated from the ignition of flammable gasses within the unit will be relieved via the nearest pressure-sensitive vents and routed upwards, protecting the Megapack's structural integrity and preventing any hazardous pressure build-up within. The sparkers are located throughout the Megapack at various heights and continuously operate to ensure that any flammable gas build-up is ignited early – limiting the concentration of flammable gas within the unit and activating the pressure-sensitive vents to create a natural ventilation pathway to the exterior.

2.2.2 Battery Management System (BMS)

An integrated Battery Management System (BMS) monitors key datapoints such as voltage, current, and state of charge (SOC) of battery cells, in addition to providing control of corrective and protective actions in response to any abnormal conditions. Each battery module is equipped with a dedicated BMS, with a Megapack-level bus controller supervising output of all modules at the AC bus level. Critical BMS sensing parameters include battery module over / under voltage, cell string over / under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will generally first raise an information warning, and then trigger a corresponding corrective action should certain levels be reached.

2.2.3 Fire Detection

In addition to monitoring of thermal sensors within the Megapack by the BMS – which may be transmitted to Tesla's 24/7 Operations Center, described below, and made available to a Subject Matter Expert (SME) if abnormal conditions are detected –External multi-spectrum infrared (IR) flame detectors can be provided to meet compliance with prescriptive requirements for automatic fire detection systems if they are mandated by the site-specific installation codes and standards.

While the IR detectors were not activated during UL 9540A unit level testing for the Megapack 2/XL (as no fire occurred), full-scale testing of previous Megapack systems showed that the external third-party multi-spectrum IR detectors effectively detected failure conditions that initiated within the unit.

2.2.4 Site Controller and Monitoring

The Tesla Site Controller provides a single point of interface for the utility, network operator, or customer SCADA systems to control and monitor the entire energy storage site. It hosts the control algorithm that dictates the charge and discharge functions of the battery system units, aggregating real-time information and using the information to optimize the commands sent to each individual Megapack unit.

The Megapack 2/XL is supported by Tesla's 24/7 Operations Center , which is designed to support the global fleet of energy storage products. In conjunction with local operation centers, the Megapack 2/XL has 24/7 remote monitoring, diagnostics, and troubleshooting capabilities. In the event of an emergency, this information may be made available to a Subject Matter Expert (SME) responsible for the system to inform emergency response personnel.

2.2.5 Fire Suppression Systems

NFPA 855 and the *2021 IFC Chapter 12* both require fire control and suppression systems to be provided in certain installation conditions for battery ESS. These fire suppression systems, however, are typically required for rooms, areas within buildings, and "walk-in" units when installed outdoors.

All components of the Tesla Megapack 2/XL are housed in a cabinet-style enclosure, with access for maintenance provided via enclosure doors that cannot be physically entered by any person. The installation codes and standards, thus, would not consider the Tesla Megapack 2/XL walk-in container, occupied building, or structure as defined by *NFPA 855* and *IFC*.

The Tesla Megapack 2/XL does not rely on any external or internal fire suppression systems to limit cascading thermal runaway. Additional bespoke testing and subsequent fire modeling has indicated that the Megapack's passive construction provides a robust thermal resistance from the impacts of an adjacent Megapack during a large-scale failure.

2.2.6 Electrical Fault Protection Devices

Multiple levels of passive and active electrical protections are provided for the Megapack 2/XL. At the battery module level, overcurrent protection is provided for each module in the form of single-use fusible links, providing interruption of overcurrent in the battery module in the case of an abnormal electrical event. Inverter modules, which are installed at each of the battery modules, are equipped with both DC protection via high-speed pyrotechnic fuse for passive or active isolation of battery module, as well as dedicated AC

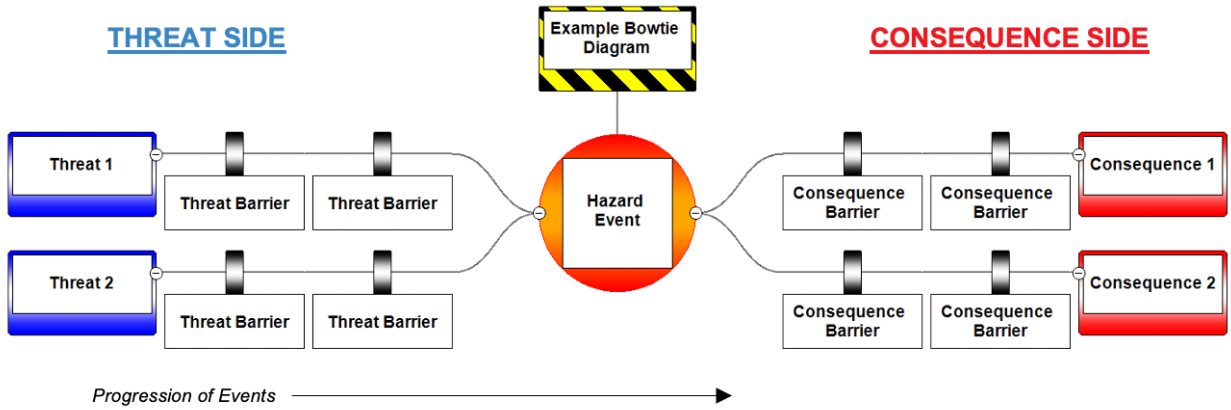
contactor and AC fuses should an abnormal electrical event occur at the inverter module on the AC side of the circuit. Additionally, the Megapack 2/XL is equipped with DC ground fault detection system and AC circuit breaker with ground fault trip settings for distribution system protection.

3 HAZARD MITIGATION ANALYSIS

3.1 HMA Methodology

ESRG utilizes the bowtie methodology for hazard and risk assessments, as is described in *ISO.IEC IEC 31010 §B.21*, as it allows for in-depth analysis on individual mitigative **barriers** and serves as a strong tool for visualizing the chronological pathway of **threats** leading to critical hazard events, and ultimately to greater potential **consequences**, as depicted in the figure below. This simple diagrammatic way of describing and analyzing the pathways of a risk from hazards to outcomes can be considered to be a combination of the logic of a fault tree analyzing the cause of an event and an event tree analyzing the consequences.

Figure 3-1 - Example Bowtie Diagram



Each fault condition per *NFPA 855* and *IFC* assessed in Sections 3.4.1 – 3.4.6 below is accompanied by a corresponding bowtie diagram indicating critical *threat* and *consequence* pathways and the mitigative barriers between them. As the most critical risk posed by lithium-ion battery cells comes from the propagation of thermal runaway from a failing cell (or multiple cells) to surrounding cells, this serves as the primary critical hazard for the subsequent failure scenarios.

In addition to main barriers for fault conditions on the *threat* side of the diagram, the *consequence* barriers on the right side of the diagram (e.g., explosion protection and emergency response plan) **also** contribute added layers of safety on top of the main threat barriers shown. It is important to note that the barriers on the left side, along a threat path, are intended to keep the threat from becoming a thermal runaway, while the barriers on the right side, along the consequence pathway, are intended to keep that single thermal runaway from evolving into one of the more severe consequences such as fire spread beyond containment, off-gassing leading to explosion,

or fire spread beyond containment. For more on the methodology and relevant terminology, see Appendix B of this report.

3.2 Relevant Supporting Information

3.2.1 UL 9540A Large-Scale Fire Testing

UL 9540A (4th Edition) testing was performed for the constituent Cell, Module, and Unit levels of the Tesla Megapack 2/XL.

Cell Level Test Report [1]

UL 9540A (4th Edition) Cell level testing was performed on the Contemporary Amperex Technology Co., Ltd. (CATL) 3.22V, 157.2Ah lithium iron phosphate (LFP) battery cell at UL LLC (Changzhou) Quality Technical Service Co., LTD. in July 2021. The test was re-run on February 25th, 2022.

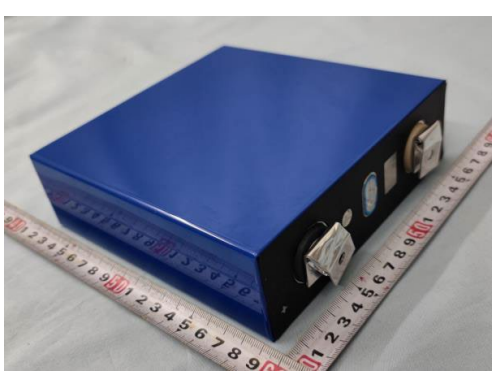
Thermal runaway was initiated via film strip heater, resulting in average cell surface temperature of 174°C and average cell surface temperature at thermal runaway of 239°C. Gas analysis of the gas generated from the well were identified as flammable. As these performance criteria per *UL 9540A Clause 7.7* and *Figure 1.1* were not met, Module level testing was required.

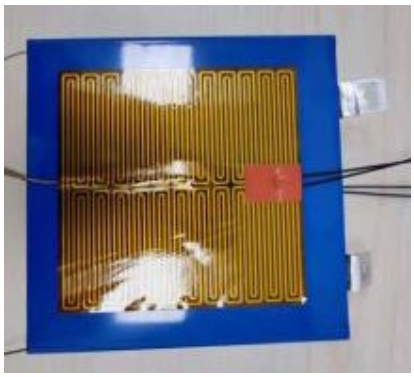
Table 3-1 – Results of Gas Analysis (Excluding O_2 and N_2)

Gas Component	Measured %	Component LFL
Carbon Monoxide (CO)	10.881	10.9
Carbon Dioxide (CO_2)	27.107	N/A
Hydrogen (H_2)	50.148	4.0
Methane (CH_4)	6.428	4.4
Acetylene (C_2H_2)	0.264	2.3
Ethylene (C_2H_4)	3.283	2.4
Ethane (C_2H_6)	1.100	2.4
Propane (C_3H_8)	0.125	1.7
C4 (Total)	0.190	N/A
C5 (Total)	0.027	N/A
C6 (Total)	0.005	N/A
Benzene (C_6H_6)	0.004	1.2
Toluene (C_7H_8)	0.002	1.0

Dimethyl Carbonate ($C_3H_6O_3$)	0.055	N/A
Ethyl Methyl Carbonate ($C_4H_8O_3$)	0.004	N/A
Total	100	-

Figure 3-2 – Cell Level Testing – Flexible Film Heater Installation





Module Level Test Report [2]

UL 9540A (4th Edition) Module level testing was performed on the Contemporary Amperex Technology Co., Ltd. (CATL) MP2 360.64Vdc, 156Ah battery module at TÜV SÜD SW Rail Transportation Technology (Jiangsu) Co., Ltd. in December of 2021 and repeated in May of 2022.

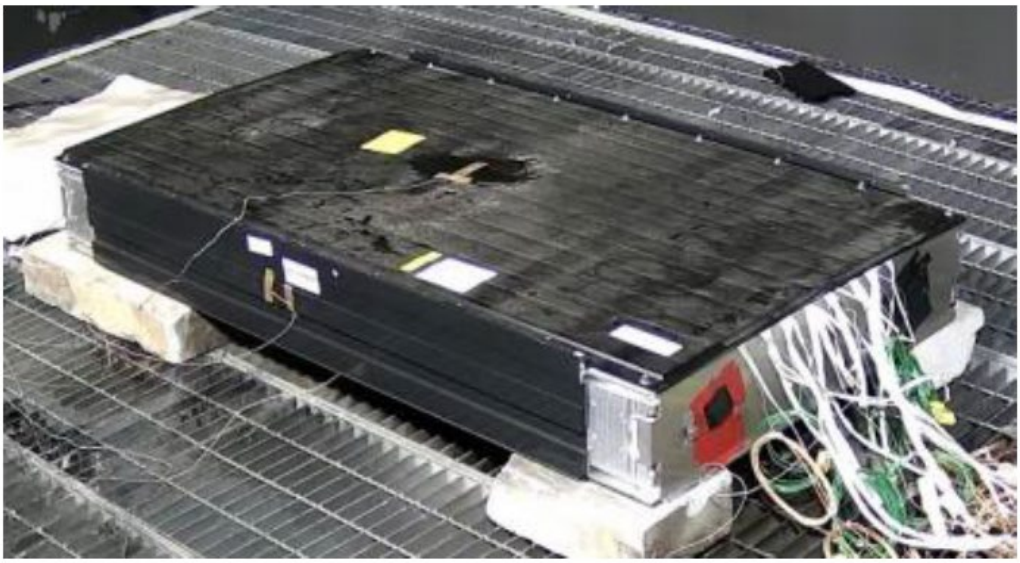
Thermal runaway was initiated via film strip heaters installed on both of the wide side surfaces of each cell, similar to the cell level test. In the module level test, however, two cells were heated simultaneously to force multiple cells into thermal runaway at the same time.

Thermal runaway propagated from the initiating cells to all cells within the MP2 tray (module). Sparks and flying debris were observed, however, there were no explosive discharges of gases. Gases generated from the cell were identified as flammable, but there was no detection of toxic gases that are sometimes associated with lithium-ion battery failure such as HF, HCL, and HCN. Unit level testing to the UL 9540A test method is required due to the fact that the gases generated are flammable.

Table 3-2 - Module Level Test Gas Analysis

Gas Name	Chemical Structure	Measurement Peak (ppm)	Detection Method
Carbon Monoxide	CO	204.84	FTIR
Carbon Dioxide	CO_2	6720.62	FTIR
Methane	CH_4	67.83	FTIR
Acetylene	C_2H_2	17.11	FTIR
Ethene	C_2H_4	Not Detected	FTIR
Ethane	C_2H_6	Not Detected	FTIR
Propane	C_3H_8	Not Detected	FTIR
Butane	C_3H_4	Not Detected	FTIR
Pentane	C_3H_6	Not Detected	FTIR
Benzene	C_6H_6	9.01	FTIR
Hexane	C_7H_{14}	Not Detected	FTIR
Hydrofluoric Acid	HF	Not Detected	FTIR
Hydrogen Chloride	HCL	Not Detected	FTIR
Hydrogen Cyanide	HCN	Not Detected	FTIR
Hydrogen	H_2	446	Hydrogen Sensor
Total Hydrocarbons	(Propane Equivalent)	246.53	FID

Figure 3-3 - Highlights of Module Testing



Unit Level Test Report [3]

UL 9540A (4th Edition) Unit level testing was performed for the Tesla Megapack 2/XL model 1748844-XX-Y at TUV Rheinland of North America, Inc. May 9, 2022.

Burn marks were observed on initiating AC battery module, though no external damage was observed. No damage to target units or adjacent walls were observed. All performance criteria for outdoor ground mounted non-residential use ESS were met, therefore Installation level testing was not required.

A full review of Unit level testing was provided by Fisher Engineering, Inc., as is briefly summarized below.

3.2.2 Tesla Megapack 2/XL: Fire Protection Engineering Analysis

A fire protection engineering analysis and UL 9540A Unit level fire test analysis report was provided by Fisher Engineering, Inc. (FEI) which includes review of the Megapack 2 construction, design, fire safety features, and large-scale fire test data [4]. A brief summary of key takeaways is provided below. For more information, please refer to **Tesla_Megapack_2_and_XL_-_FPE Report_Final.pdf**.

Key takeaways from the report include:

1. The MP2 XL design is almost identical to the MP2 other than being greater in length to accommodate the additional battery modules. Given the limited module propagation observed during UL 9540A unit level testing of the MP2 (seven cells went into runaway) the behavior is expected to be no different with the MP2 XL. As such, a stand-alone UL9540A unit level fire test for the MP2XL was not performed. The UL 9540A unit level fire test results, described above for the MP2, can be applied to the MP2XL.
    a. Similarly, after reviewing the MP2 unit level fire test results and comparing the MP2 and MP2 XL to one another, TÜV determined the MP2 UL 9540A unit level fire test results can be applied to the MP2XL and an additional UL 9540A unit level fire test for the MP2XL was not required for its listing.

2. The largest variant of the Megapack 2 was tested at a worst-case scenario (i.e., 100% SOC with BMS and TMS disabled) to the UL 9540A Unit level fire test method in which six cells within a battery module of the initiating Megapack 2 unit were forced into thermal runaway. Thermal runaway propagated to a seventh cell but did not propagate any further. No propagation to adjacent battery modules or target Megapack units occurred.
3. All Unit level performance criteria outlined in 9540A, Table 9.1 for outdoor, ground-mounted ESS were met, therefore Installation level testing was not required. Specifically, these results included:
    a. No flaming was observed outside of the unit.

b. Surface temperatures of battery modules within the target units did not exceed the temperature at which thermally initiated cell venting occurs. The maximum temperatures recorded at the battery modules of the adjacent cabinets were 13.8°C and 13.2°C, which are significantly below the temperature at which cell venting occurs (174°C).

c. Surface temperatures of exposures 5 ft (1.52 m) to the side and 8 ft (2.44 m) in front of the initiating unit did not exceed 97°C (175°F) above ambient. The maximum external surface temperatures recorded at the instrumented wall 5 ft to the side was 25.9°C (78.6°F) with a temperature rise above ambient of 5.5°C (9.9°F). The maximum external surface temperatures recorded at the front target 8 ft directly in front of the initiating unit was 16.8°C with a temperature rise above ambient of 5.5°C. These temperatures are significantly below the maximum permitted temperature rise above ambient of 97°C (175°F).

d. Explosion hazards, including, but not limited to, observations of a deflagration, projectiles, flying debris, detonation, or other explosive discharge of gases were not observed.

e. Heat flux did not exceed 1.3 kW/m2. The maximum heat flux recorded was 0.0000016 W/m2, which was the sensor installed on the front target cabinet and was the ambient heat flux the sensor was exposed to throughout the test.

4. A maximum surface temperature of 16.8°C was measured on the front target Megapack 2 unit installed 8 ft in front of the initiating Megapack 2 unit, and 13.8°C and 13.2°C at the battery modules of the adjacent unit. Based on cell venting and thermal runaway temperatures from 9540A Cell level test report (174°C and 239°C, respectively), propagation to the battery modules within a unit at clearances of 8 ft is not possible.

5. Smaller capacity MP2 cabinets, populated with less than nineteen battery modules, would be expected to perform similarly given they are designed and constructed substantially similar (with the same cells, battery modules, fire safety features, etc.) than the larger capacity 3,100 kWh MP2 cabinet tested and described in the Fisher report.

6. None of the fire detectors activated during the fire test (two multi-spectrum IR flame detectors and two thermal imagers), which is expected, as no flaming was observed outside of the cabinet during the test; however, previous testing on the Tesla Megapack 1 units demonstrated that multi-spectrum IR flame detectors can detect a fire should flames exit the cabinet through the roof.

7. An internal fire suppression system or an external fire suppression system is not required to stop propagating thermal runaway from cell to cell, module to module, or MP2 cabinet to cabinet when near simultaneous failure of up to six cells occurs within the same battery module.

8. Manual fire suppression (hose lines) is not required to stop propagating thermal runaway and the spread of fire from a MP2 cabinet to adjacent MP2 cabinets installed

6 in (150 mm) behind and to the sides when a near simultaneous failure of up to six cells occurs within the same battery module.

3.2.3 Tesla Megapack 2/XL: Internal Fire Testing

3.2.3.1 Destructive Unit Level Testing

Voluntary destructive testing was conducted by Tesla on a representative and fully populated Megapack 2 XL. This destructive fire testing utilized a more aggressive approach than what is required by the UL 9540A test method in order to force the system into a more severe cascading thermal runaway event. This destructive test was conducted to demonstrate the Megapack 2/XL's ability to fail in a safe manner, even in the extreme event of a catastrophic failure within an entire battery module. Additionally, the destructive testing further validated the design of the Megapack 2/XL proprietary explosion mitigation system.

This testing was conducted at the Northern Nevada Research Center on May 19th, 2022. The test utilized film heaters to simultaneously heat forty-eight (48) cells within a module, creating a severe failure scenario that is well beyond what is contemplated by the UL 9540A test method. The goal of this testing was to assess the risk of a large-scale fire resulting from an initiating Megapack 2/XL during a thermal runaway event propagating to an adjacent Megapack 2/XL. The results of this testing show some key takeaways, as detailed in the Fisher Engineering FPE report:

- Thermal runaway propagated from the initiating cells to all the cells in the initiating tray.
- A thermal event occurred, likely initiated by the ignition of flammable gases by the sparker system. An overpressure vent installed above the initiating battery module opened and was visually confirmed through video. The cabinet doors immediately adjacent to the initiating battery module remained closed. No hazardous pressure waves, debris, shrapnel, or pieces of the cabinet were ejected.
- After approximately 10 minutes of smoking, a sustained fire began within the initiating battery module. The fire spread to the adjacent battery bays until reaching the CIB and stopped. The fire only burned half of the cabinet.
- Fire spread from battery bay to battery bay was a slow progressing event. In total, visible flames were observed for 6 hours and 40 minutes while the four battery bays (bays 7-10) burned, as shown in Figure 18 of the Fisher report.
- Maximum flame heights were observed to be 11.5 ft (3.5 m) from ground to the top of the flame, 2.5 ft (0.75 m) above the top of the cabinet and had a base (a width) of 3.3 ft (1 m) during peak flame intensity. This peak flame intensity occurred approximately 60-90 minutes after initial flaming was observed.
- An analysis of the pressure profile inside the cabinet during the test demonstrated the operation of the explosion control system, as shown in Figure 19 of the Fisher report. Pressure inside the cabinet increased to nearly 11 kPa (1.60 psi) until the deflagration vent opened and the pressure diminished. The overpressure vents

are designed to operate at approximately 12 kPa (1.74 psi), or 2.5 times below the cabinet's strength of 30 kPa (4.35 psi).

3.2.3.2 Fire Modeling – Propagation Model

Subsequent fire propagation modeling was conducted to assess the fire propagation risk to adjacent Megapack 2/XL units during a more severe event such as what was observed during the internal destructive testing referenced in Section 3.2.3.1. This fire propagation model showed that due to the robustness of the system design, it is unlikely that a fire from an initiating Megapack 2/XL would propagate to the adjacent Megapack 2/XL, even during worst-case scenario wind conditions. The modeling assessed two scenarios – a non-flaming event and the impact of heat transfer on a target Megapack 2/XL as well as a flaming event and the impact of radiative heat transfer on a target Megapack 2/XL installed per Tesla's recommendations.

3.2.3.3 Product of Combustion - Unit Level Testing

Tesla conducted additional internal Unit Level testing to obtain and analyze the products of combustion from a failing Megapack Unit. The products of combustion were collected at locations 20 ft upwind and 5 ft downwind from the initiating unit to assess airborne contaminants which may be present during an incident. Subsequent third-party analysis concluded that no traces of Mercury was present over the entire 2.5-hour test duration. Hydrogen Fluoride (HF) was detected at values of 0.10 and 0.12 parts per million (ppm) in the two sampling locations over the course of the test – far below accepted NIOSH Immediately Dangerous to Life or Health (IDLH) value of 30 ppm for HF.

3.2.4 Emergency Response Guide

A product-level Emergency Response Guide (ERG) was provided by Tesla and provides an overview of the product materials, handling and use precautions, hazards, emergency response procedures, and storage and transportation instructions. Tesla's Emergency Response Guide is publicly available to all First Responders and can be found at: https://www.tesla.com/firstresponders

In addition to this product-level guide, a site-specific Emergency Response Plan (ERP) will provide an additional level of safety and familiarization for first responders who may be arriving on-scene to an incident at an installation utilizing the Megapack 2/XL system.

3.3 Primary Consequences of ESS Failure and Mitigative Barriers

The dynamics of lithium-ion ESS failures are extremely complex, and the pathway of failure events may vary widely based on system design, mitigative approaches utilized, and even small changes in environmental or situational conditions. However, the primary consequences stemming from a propagating lithium-ion battery failure largely fall into a number of specific hazard scenarios, as depicted in the diagram and associated table below (though other scenarios not listed may certainly also occur). These primary consequences serve as the basis for the consequence side of the majority of the fault condition diagrams in the following sections of this report.

While not explicitly detailed in the simplified diagram below, the criticality and effectiveness of the barriers may vary based on associated threat or consequence pathway. For example, a water-based suppression system may be more critical for mitigation of cell or module combustion from spreading, ultimately leading to fire spread beyond containment, than it is for preventing off-gassing within the enclosure, potentially leading to explosion. Similarly, the same water-based suppression system may be more effective for mitigating spread of fire throughout the system than it is for reducing risk of explosion).

Figure 3-4 - Primary Consequence Diagram

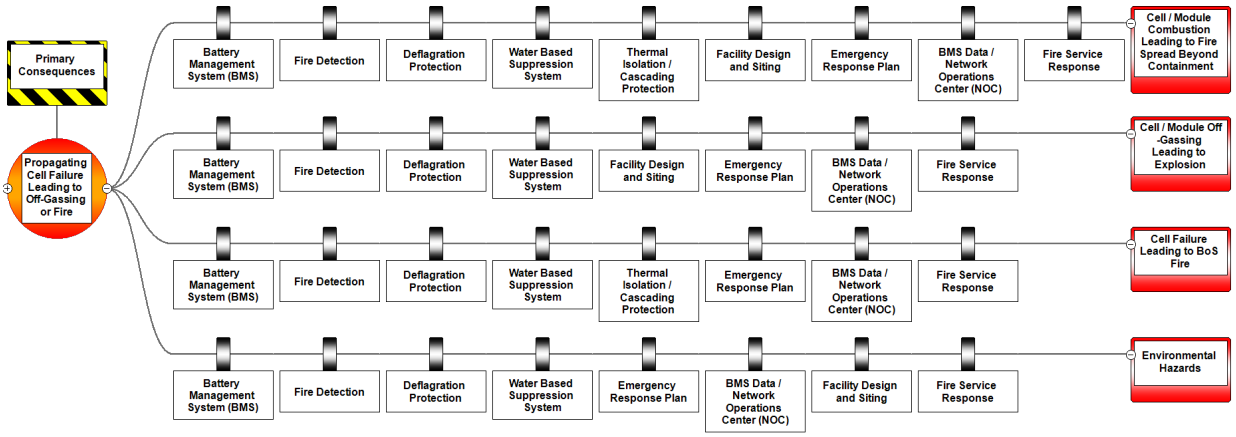


Table 3-3 - Primary Consequence Barriers

PRIMARY CONSEQUENCE BARRIERS	
Battery Management System (BMS)	Critical BMS sensing parameters for the Megapack 2/XL include battery module over / under voltage, cell string over / under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will generally first raise an information warning, and then trigger a corresponding corrective action should certain levels be reached.

Fire Detection	Multi-spectrum infrared detectors can be provided to satisfy automatic fire detection requirements of the regulations adopted for that installation.
Water-Based Suppression System*	The Megapack 2/XL does not rely on any external or internal water-based suppression system to prevent or mitigate hazards resulting from large-scale failure.
Deflagration Protection	The Megapack 2/XL is equipped with deflagration protection in the form of pressure-sensitive vents and sparker system designed to ignite any flammable gases and release in a controlled manner before they are allowed to accumulate and create an explosive atmosphere within the enclosure.
Electrical Fault Protection Devices	The Megapack 2/XL is equipped with a number of electrical fault protection in the form of battery module overcurrent protection, inverter DC and AC protection, and ground fault protection.
Facility Design and Siting*	Proper siting based on appropriate separation distances from nearby exposures, land area and use, facility type, and other design factors may increase strength of this barrier. Project developers using the Megapack 2/XL should follow Tesla recommended installation guidelines.
Emergency Response Plan / First Responders*	A product-level Emergency Response Guide (ERG) is provided for the Tesla Megapack 2/XL, outlining key product information, safety hazards, and general emergency response procedures. A site-specific Emergency Response Plan (ERP) in accordance with the requirements of the locally adopted codes/standards will provide an additional level of safety for individual installations utilizing the Megapack 2/XL. Additionally, adequate familiarization designated subject matter experts (SMEs) and corporate first responders can greatly improve the strength of this barrier.
BMS Data Availability / Operations Center	Tesla Site Controller provides point of interface for the utility, network operator or customer SCADA systems to control and monitor the energy storage site. 24/7 remote monitoring by Tesla's Operations Center can be provided if requested.
Fire Service Response*	It is unknown if an adequate water supply or source will be available at most sites for firefighting purposes. As recommended in Tesla's Emergency Response Guide (ERG); a defensive firefighting approach shall be utilized, with water sprayed on neighboring exposures and neighboring enclosures if advised by Tesla or at the discretion of the first responders. Site-specific training and installation familiarization for local responding stations may further increase the strength of this barrier, and that fire department equipment and capabilities will be strong with this familiarization.
** Barrier may vary on site-by-site basis and are therefore not fully assessed within the scope of this report.*	

3.4 Fault Condition Analysis

Per *NFPA 855 §4.1.4.2*, the analysis shall evaluate the consequences of the following failure modes and others deemed necessary by the AHJ:

1) *Thermal runaway condition in a single module, array, or unit*
2) *Failure of an energy storage management system*
3) *Failure of a required ventilation or exhaust system*
4) *Failure of a required smoke detection, fire detection, fire suppression, or gas detection system*

For completeness, additional failure modes required per *2021 IFC §1207.1.4.1* are also considered in the analysis.

5) *Voltage surges on the primary electric supply*
6) *Short circuits on the load side of the ESS*

For the purposes of this report, it shall be assumed that all construction, equipment, and systems that are required for the ESS shall be installed, tested, and maintained in accordance with local codes and the manufacturer's instructions. The assessment is based on the most recent information provided by the Tesla, Inc. at the time of this writing.

The following table provides a summary of findings from the hazard mitigation analysis performed in fulfillment of *NFPA 855 §4.1.4.2,* with each fault condition described in greater detail, accompanied by simplified bowtie diagrams for visualization of mitigative barriers. Additionally, full bowtie diagrams with barrier descriptions are provided in Appendix A.

Table 3-4 - Summary of Fault Condition Analysis

Compliance Requirement	Comments
1. Thermal runaway condition in a single module, array, or unit	A number of passive and active measures are implemented to reduce the potential of a thermal runaway event from occurring including BMS control and active cooling to internal components. Battery modules and cells have been listed to UL 1973 and UL 1642. Should a thermal runaway event occur, additional mitigative measures are provided to prevent further propagation of failure throughout the system (see Section 3.3 above for list of all consequence barriers).
2. Failure of an energy storage management system	In the event of a failure of module-level BMS, the Megapack-level BMS (which may be considered "ESMS")

	shall isolate effected modules, mitigating against further propagation of failure across the system. Should a failure of the Megapack-level BMS occur, each module is equipped with a dedicated BMS to provide corrective actions in case of detection of abnormal operation outside of set parameters. To further isolate any failure stemming from a failure of the energy storage management system, passive and active electrical fault protections are provided at multiple levels, as described in Section 2.2.6 above.
3. Failure of a required ventilation or exhaust system	The Megapack 2/XL does not utilize a system to exhaust flammable gasses, as lithium-ion batteries do not release flammable gas during normal operations. Flammable gasses generated during abnormal operations are mitigated by the Megapack 2/XL's proprietary explosion mitigation system.
4. Failure of a required smoke detection, fire detection, fire suppression, or gas detection system	The Tesla Megapack 2/XL does not rely on a dedicated smoke detection, fire detection, or gas detection system. Multi-spectrum infrared (IR) detection can be provided to satisfy the automatic fire detection requirements of the locally adopted codes/standards. Should IR detection systems fail, it is anticipated that BMS fault notifications shall be transmitted to Tesla's 24/7 Operations Center, alerting system owner to abnormal conditions. Data from the BMS may be communicated to Certificate of Fitness holder to provide guidance to the fire department in case of emergency. The Megapack 2/XL does not rely on an integrated fire suppression system (such as internal water-based or gas-phase suppression system) to mitigate the hazards associated with propagating thermal runaway. Bespoke fire testing and subsequent fire modeling has shown that the robust passive thermal protection of the Megapack 2/XL design will prevent an unlikely fire from cascading to an adjacent Megapack from the initiating system. Furthermore, UL 9540A Unit level testing indicates that no flaming occurred and that no propagation of heat from the initiating unit to adjacent units / modules reached levels capable of initiating cell venting or thermal runaway.

5. Voltage surges on the primary electric supply *(IFC §1207.1.4.1(4))*	Voltage surges on the primary electric side are anticipated to be mitigated by the provided BMS and inverter controls, voltage monitoring and automatic disconnect provided by the BMS, in addition to a number of passive circuit protections briefly noted in Section 2.2.6 of this report.
6. Short circuits on the load side of the ESS *(IFC §1207.1.4.1(5))*	Short circuits on the load side of the ESS are anticipated to be mitigated by BMS control and subsequent safety actions, in addition to a number of passive circuit protections briefly noted in Section 2.2.6 of this report.

3.4.1 Thermal Runaway Condition

Thermal runaway, as defined per *NFPA 855 §3.3.20*, is defined as the condition when an electrochemical cell increases its temperature through self-heating in an uncontrollable fashion and progresses when the cell's heat generation is at a higher rate than it can dissipate, potentially leading to off-gassing, fire, or explosion. The cause of a thermal runaway event can range from a manufacturer defect in the cell, external impact, exposure to dangerously high temperatures, or a multitude of controls and electrical failures. Furthermore, a thermal runaway event in a single cell can propagate to nearby cells, thus creating a cascading runaway event across battery modules and racks, leading to more heat generation, fire, off-gassing, and increased potential for a deflagration event.

The Tesla Megapack 2/XL is equipped with a number of passive and active mitigations such as BMS Control and active thermal management system for cooling of internal components to reduce the potential of a thermal runaway event from occurring, as is depicted on the *threat* side of the diagram below. Threat scenarios accounted for include single-cell thermal runaway, multi-cell thermal runaway, and internal defect or failure not resulting in thermal runaway, leading to the primary hazard event (propagating cell failure leading to off-gassing or fire).

Should thermal runaway occur within a battery module, a number of key barriers are provided to mitigate against propagation of failure throughout the system leading to more severe consequences, which are described in detail in Section 3.3 of this report above.

Figure 3-5 - Thermal Runaway Condition Diagram

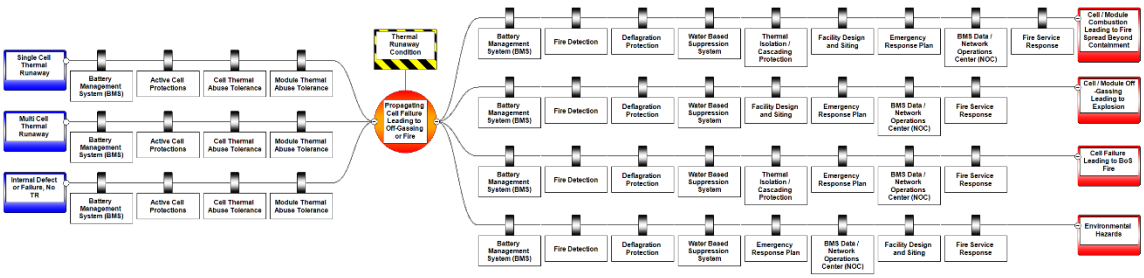


Table 3-5 - Thermal Runaway Condition Barriers

Barrier	Barrier Description
THREAT BARRIERS	
Battery Management System (BMS)	BMS provides sensing and control of critical parameters and triggers protective or corrective actions if system is operating out of normal parameters. Parameters include battery module over / under voltage, cell string over / under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will first raise an information warning and then trigger a corresponding corrective action should certain levels be reached.
Thermal Management System	Active thermal management system provides liquid cooling to internal components within the Megapack 2/XL to limit heat diffusion.
Cell Thermal Abuse Tolerance	Cell has been tested and listed to UL 1973 in which thermal abuse tolerance was tested.
Module Thermal Abuse Tolerance	Module has been tested and listed to UL 1973 in which thermal abuse tolerance was tested.
CONSEQUENCE BARRIERS	
See Section 3.3 above for list of primary consequence barriers.	

3.4.2 Failure of an Energy Storage Management System

The loss, failure, or abnormal operation of an energy storage control system (controllers, sensors, logic / software, actuators, and communications networks) may directly impact the proper function of the system. The Tesla Megapack 2/XL utilizes a tiered hierarchy of controls starting at the module level up to the site level.

In the event of a failure of module-level BMS, the Megapack-level BMS (which may be considered “ESMS”) shall isolate effected modules, mitigating against further propagation of failure across the system. Should a failure of the Megapack-level BMS occur, each module is equipped with a dedicated BMS to provide corrective actions in case of detection of abnormal operation outside of set parameters. To further isolate any failure stemming from a failure of the energy storage management system, passive and active electrical fault protections are provided at multiple levels, as described in Section 2.2.6 above.

Finally, should a propagating thermal runaway occur, a number of key barriers are provided to mitigate against propagation of failure throughout the system leading to more severe consequences, which are described in detail in Section 3.3 of this report above.

Figure 3-6 - Failure of an Energy Storage Management System Diagram

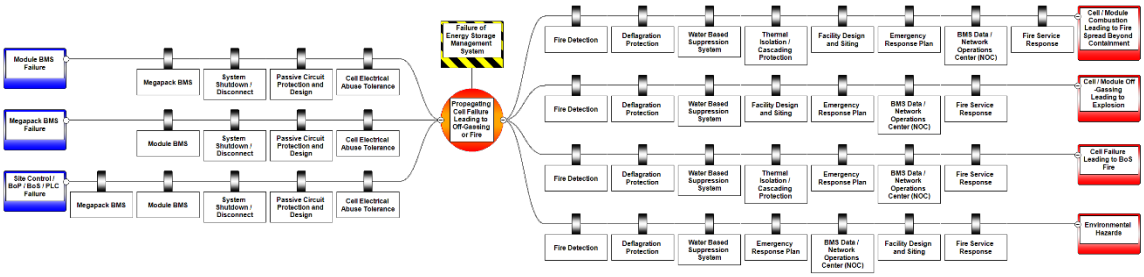


Table 3-6 - Failure of an Energy Storage Management System Barriers

Barrier	Barrier Description
THREAT BARRIERS	
Energy Storage Management System (ESMS)	Megapack-level Energy Storage Management System (ESMS) supervising output of all modules at AC bus level to provide isolation / protective actions in case of module BMS failure.
Module BMS	Module-level BMS to provide isolation / protective actions in case of ESMS failure.
System Shutdown / Disconnect	Multiple levels of passive and active electrical protections are provided for the Megapack 2/XL including module overcurrent protection via fusible links on the DC side of the modules, inverter DC and AC protections, and ground fault detection.
Passive Circuit Protection and Design	Fused disconnects and DC disconnect switches, in addition to ground fault detection / interruption and over voltage protection provided.
Cell Electrical Abuse Tolerance	Cell tested and certified to UL 1642 Standard for Lithium Batteries.
CONSEQUENCE BARRIERS	
See Section 3.3 above for list of primary consequence barriers.	

3.4.3 Failure of a Required Ventilation or Exhaust System

The Megapack 2/XL does not utilize a system to exhaust flammable gasses, as lithium-ion batteries do not release flammable gas during normal operations. Flammable gasses generated during abnormal operations are mitigated by the Megapack 2/XL's proprietary explosion mitigation system.

3.4.4 Failure of a Required Smoke Detection, Fire Detection, Fire Suppression, or Gas Detection System

The Tesla Megapack 2/XL does not rely on a dedicated smoke detection, fire detection, or gas detection system. Multi-spectrum infrared (IR) detection can be provided to satisfy the automatic fire detection requirements of the locally adopted codes/standards. Should IR detection systems fail, it is anticipated that BMS fault notifications shall be transmitted to Tesla's 24/7 Operations Center, alerting system owner to abnormal conditions. Data from the BMS may be communicated to a Subject Matter Expert to provide guidance to the fire department in case of emergency.

The Megapack 2/XL does not inherently rely on an integrated or external fire suppression system. A fire is not expected to propagate through the system or to nearby exposures based on UL 9540A Unit level testing, indicating that no flaming occurred and that no propagation of heat from the initiating unit to adjacent units / modules reached levels capable of initiating cell venting or thermal runaway. Bespoke fire testing and subsequent fire modeling has further assessed the robustness of the Megapack 2/XL system design and resistance to propagating failures. Furthermore, fire department response is expected to be strong based on training, robust firefighting capabilities and timely response.

Figure 3-7 - Failure of Smoke Detection, Fire Detection, Fire Suppression, or Gas Detection System Diagrams

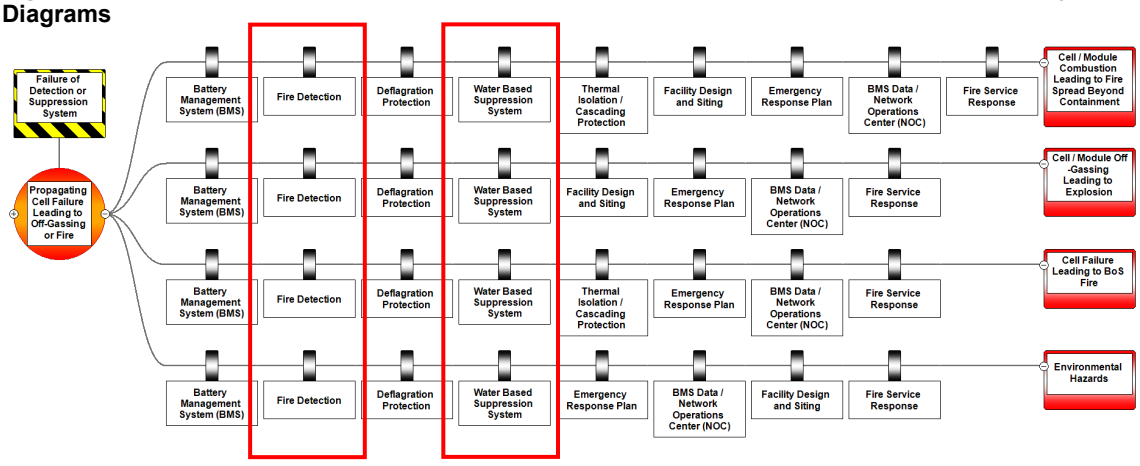


Table 3-7 - Failure of Smoke Detection, Fire Detection, Fire Suppression, or Gas Detection System Barriers

Barrier	Barrier Description
CONSEQUENCE BARRIERS	
Battery Management System (BMS)	BMS provides sensing and control of critical parameters and triggers protective or corrective actions if system is operating out of normal parameters. Parameters include battery module over / under voltage, cell string over / under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will first

	raise an information warning and then trigger a corresponding corrective action should certain levels be reached.
Deflagration Protection	The Megapack 2/XL is equipped with deflagration protection in the form of pressure-sensitive vents and sparker system designed to ignite any flammable gases and release in a controlled manner before they are allowed to accumulate and create an explosive atmosphere within the enclosure.
Thermal Isolation / Cascading Protection	Thermal isolation shown to be effective in limiting heat transfer between Megapacks in UL 9540A Unit level testing.
Facility Design and Siting*	Facility design and siting may vary based on site-by-site basis. It should be ensured that sites follow Tesla recommended guidance for siting and other installation specifications be followed.
Emergency Response Plan / First Responders*	Product-level Emergency Response Guide (ERG) provided by Tesla. Additional level of safety may be provided via site-specific Emergency Response Plans (ERP) in accordance with the locally adopted codes/standards.
BMS Data / Operations Center	Megapack data accessible remotely via Tesla's 24/7 Operations Center.
Fire Service Response	Site-specific training and installation familiarization for local responding stations will increase the strength of this barrier, and fire department equipment and capabilities will be strong with this familiarization.
** Barrier may vary on site-by-site basis and are therefore not fully assessed within the scope of this report.*	

3.4.5 Voltage Surges on the Primary Electric Supply

Voltage surges on the primary electric supply are expected to be largely mitigated by voltage monitoring and corrective actions taken by the BMS. Should corrective actions triggered by the BMS fail to prevent further propagation of failure, a number of electrical fault protections are provided for the Megapack 2/XL, as are briefly described in Section 2.2.6 of this report.

Figure 3-8 - Voltage Surges on the Primary Electric Supply Diagram

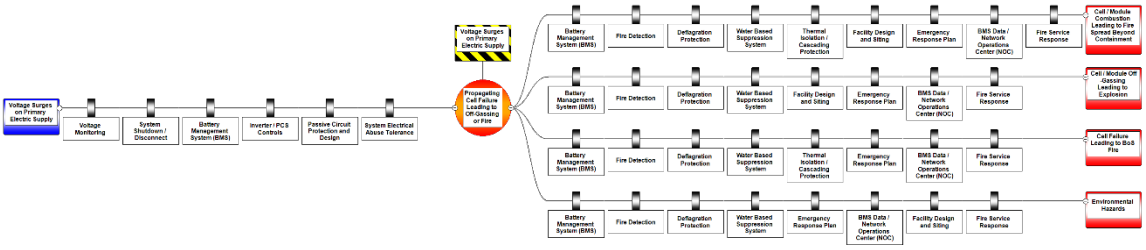


Table 3-8 - Voltage Surges on the Primary Electric Supply Barriers

Barrier	Barrier Description
THREAT BARRIERS	
Voltage Monitoring	Voltage is measured by BMS, triggering fault and alarm monitor indicators, and potential system disconnect or other corrective actions if operating out of normal parameters.
System Shutdown / Disconnect	Multiple levels of passive and active electrical protections are provided for the Megapack 2/XL including module overcurrent protection via fusible links on the DC side of the modules, inverter DC and AC protections, and ground fault detection.
Battery Management System (BMS)	BMS provides sensing and control of critical parameters and triggers protective or corrective actions if system is operating out of normal parameters. Parameters include battery module over / under voltage, cell string over / under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will first raise an information warning and then trigger a corresponding corrective action should certain levels be reached.
Inverter / PCS Controls	Inverter modules equipped with both DC protection via high-speed pyrotechnic fuse for passive or active isolation of battery module, as well as dedicated AC contactor and AC fuses should an abnormal electrical event occur at the inverter module on the AC side of the circuit.
Passive Circuit Protection / Design	Fused disconnects and DC disconnect switches, in addition to ground fault detection / interruption and over voltage protection provided.
System Electrical Abuse Tolerance	System tested and listed to UL 9540.
CONSEQUENCE BARRIERS	

See Section 3.3 above for list of primary consequence barriers.

3.4.6 Short Circuits on the Load Side of the ESS

Short circuits on the load side of the ESS are anticipated to be largely mitigated by BMS control and passive circuit protection and design (e.g., fused disconnects, ground fault detection / interruption, and overvoltage protection), as described in previous sections of this report. The Megapack 2/XL has been tested and listed to UL 9540A, demonstrating adequate system electrical abuse tolerance and compatibility of constituent components.

Finally, as is consistent across all previous fault conditions covered above, should propagating thermal runaway occur, a number of key barriers are provided to mitigate against propagation of failure throughout the system leading to more severe consequences, which are described in detail in Section 3.3 of this report above.

Figure 3-9 - Short Circuits on the Load Side of the ESS Diagram

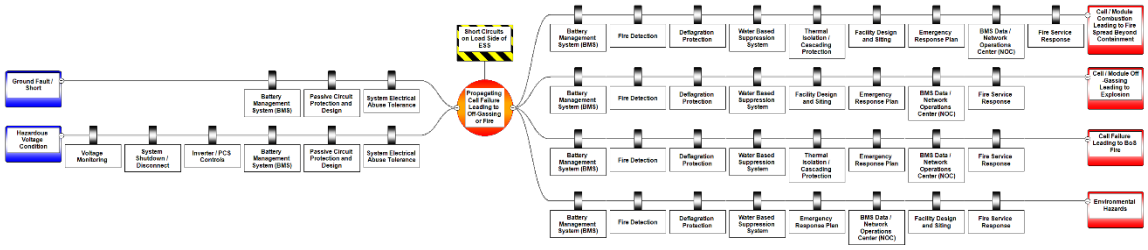


Table 3-9 - Short Circuits on the Load Side of the ESS Barriers

Barrier	Barrier Description
THREAT BARRIERS	
Battery Management System (BMS)	BMS provides sensing and control of critical parameters and triggers protective or corrective actions if system is operating out of normal parameters. Parameters include battery module over / under voltage, cell string over / under voltage, battery module over temperature, temperature signal loss, and battery module over current. In the event of any abnormal conditions, the BMS will first raise an information warning and then trigger a corresponding corrective action should certain levels be reached.
Voltage Monitoring	Voltage is measured by BMS, triggering fault and alarm monitor indicators, and potential system disconnect or other corrective actions if operating out of normal parameters.

System Shutdown / Disconnect	Multiple levels of passive and active electrical protections are provided for the Megapack 2/XL including module overcurrent protection via fusible links on the DC side of the modules, inverter DC and AC protections, and ground fault detection.
Passive Circuit Protection / Design	Fused disconnects and DC disconnect switches, in addition to ground fault detection / interruption and over voltage protection provided.
System Electrical Abuse Tolerance	System tested and listed to UL 9540.
CONSEQUENCE BARRIERS	
See Section 3.3 above for list of primary consequence barriers.	

3.5 Analysis Approval

Per *NFPA 855 §4.1.4.3*, the AHJ shall be permitted to approve the hazardous mitigation analysis as documentation of the safety of the ESS installation provided the consequences of the analysis demonstrate the following:

1) *Fires will be contained within unoccupied ESS rooms for the minimum duration of the fire resistance rating specified in NFPA 855 4.3.6.*
2) *Suitable deflagration protection is provided where required.*
3) *ESS cabinets in occupied work centers allow occupants to safely evacuate in fire conditions.*
4) *Toxic and highly toxic gases released during normal charging, discharging, and operation will not exceed the PEL in the area where the ESS is contained.*
5) *Toxic and highly toxic gases released during fires and other fault conditions will not reach concentrations in excess of immediately dangerous to life or health (IDLH) level in the building or adjacent means of egress routes during the time deemed necessary to evacuate from that area.*
6) *Flammable gases released during charging, discharging, and normal operation will not exceed 25 percent of the LFL.*

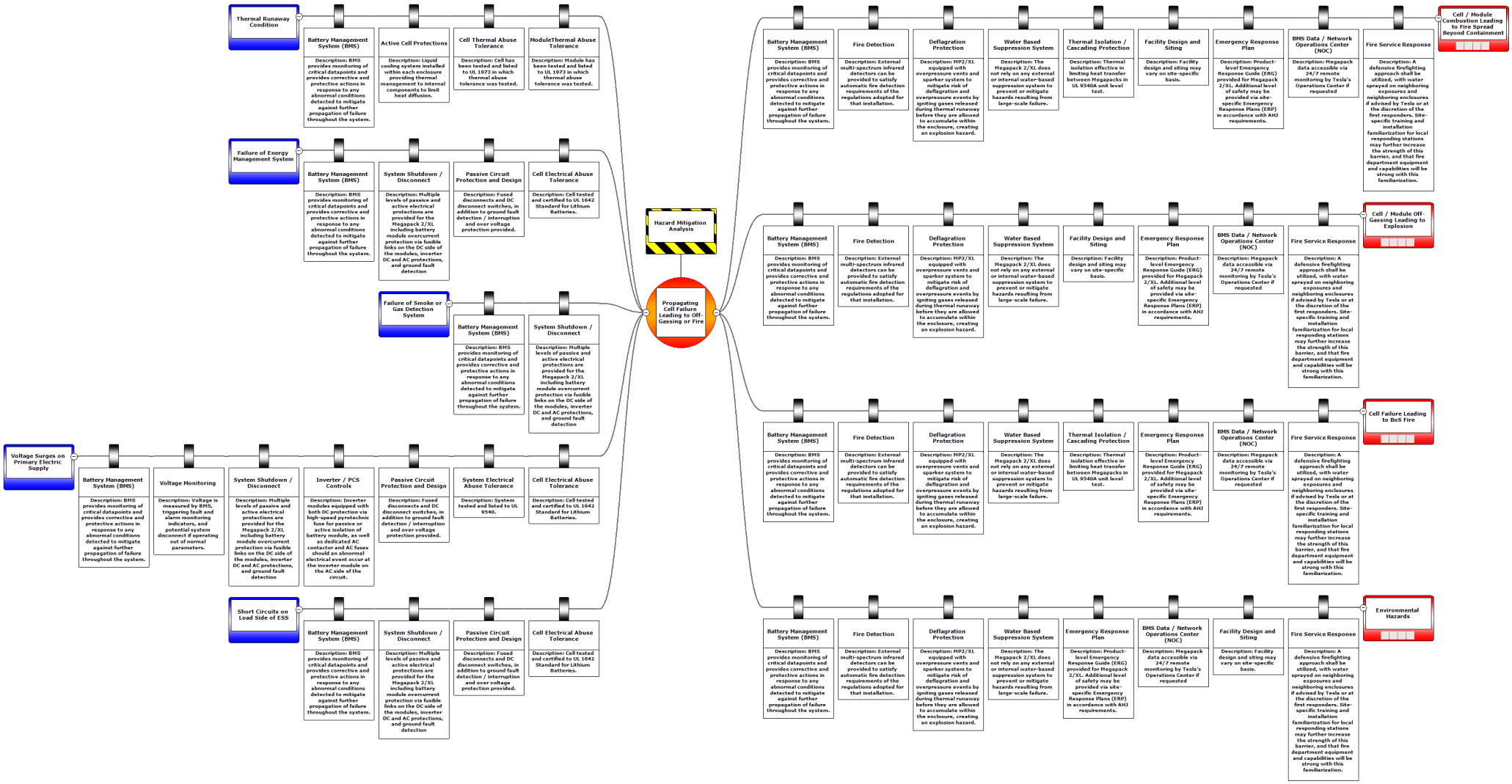
Table 3-10 - Summary of Analysis Approval

Compliance Requirement	Comments
1. Fires will be contained within unoccupied ESS rooms for the minimum duration of the fire resistance rating specified in NFPA 855 4.3.6.	**Not applicable.** The Megapack 2/XL is intended for outdoor ground-mounted installations only and shall not be installed within any ESS rooms or structures.
2. Suitable deflagration protection is provided where required.	**Compliant.** The Megapack 2/XL is equipped with deflagration protection in the form of pressure-sensitive vents and sparker system designed to ignite any flammable gases and release in a controlled manner before they are allowed to accumulate and create an explosive atmosphere within the enclosure.
3. ESS cabinets in occupied work centers allow occupants to safely evacuate in fire conditions.	**Not applicable.** The Megapack 2/XL is not intended to be installed in any occupied work centers.
4. Toxic and highly toxic gases released during normal charging, discharging,	**Not applicable.** Lithium-ion batteries do not release toxic gases during normal operation.

and operation will not exceed the PEL in the area where the ESS is contained.	
5. Toxic and highly toxic gases released during fires and other fault conditions will not reach concentrations in excess of immediately dangerous to life or health (IDLH) level in the building or adjacent means of egress routes during the time deemed necessary to evacuate from that area.	**Compliant.** Additional testing and third-party analysis performed on products of combustion from the Megapack 2/XL at locations 20 ft and 5 ft conclude no traces of Mercury or 27 different metals tested for. HF was detected at values of 0.10 and 0.12 ppm over the course of the test – far below accepted NIOSH Immediately Dangerous to Life or Health (IDLH) value of 30 ppm for HF. Environmental considerations (e.g., facility siting, nearby buildings, exposures, or public ways) should be taken into account on a site-by-site basis.
6. Flammable gases released during charging, discharging, and normal operation will not exceed 25 percent of the LFL.	**Not applicable.** Lithium-ion batteries do not release flammable gases during charging, discharging, or normal operation. In the case of flammable off-gases being released due to a thermal runaway event, the Megapack 2/XL is equipped with pressure-sensitive vents and sparker system designed to ignite any flammable gases and release in a controlled manner before they are allowed to accumulate and create an explosive atmosphere within the enclosure.

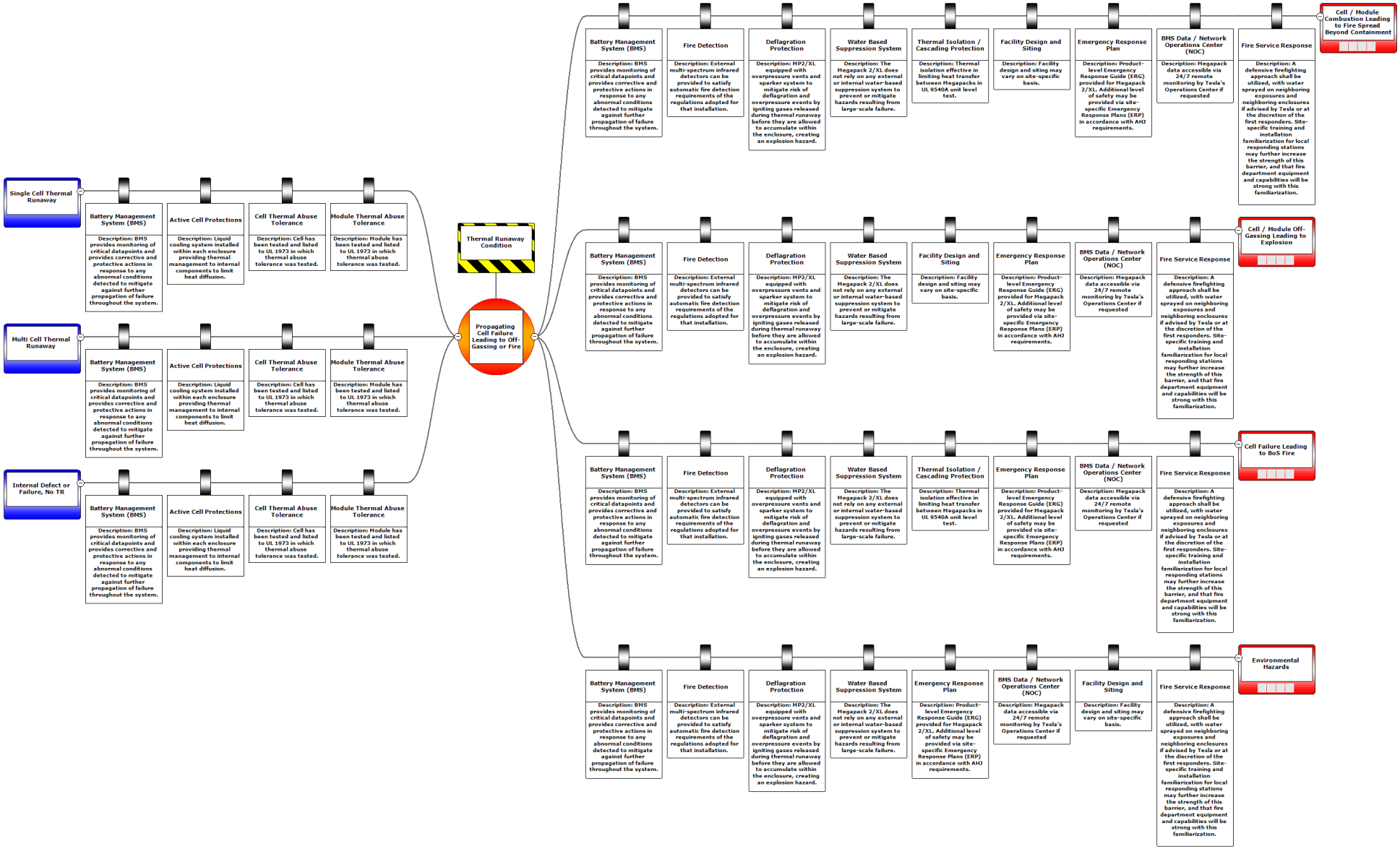
APPENDIX A – DETAILED HMA DIAGRAMS AND BARRIER DESCRIPTIONS

3.6 A.1 All Fault Conditions

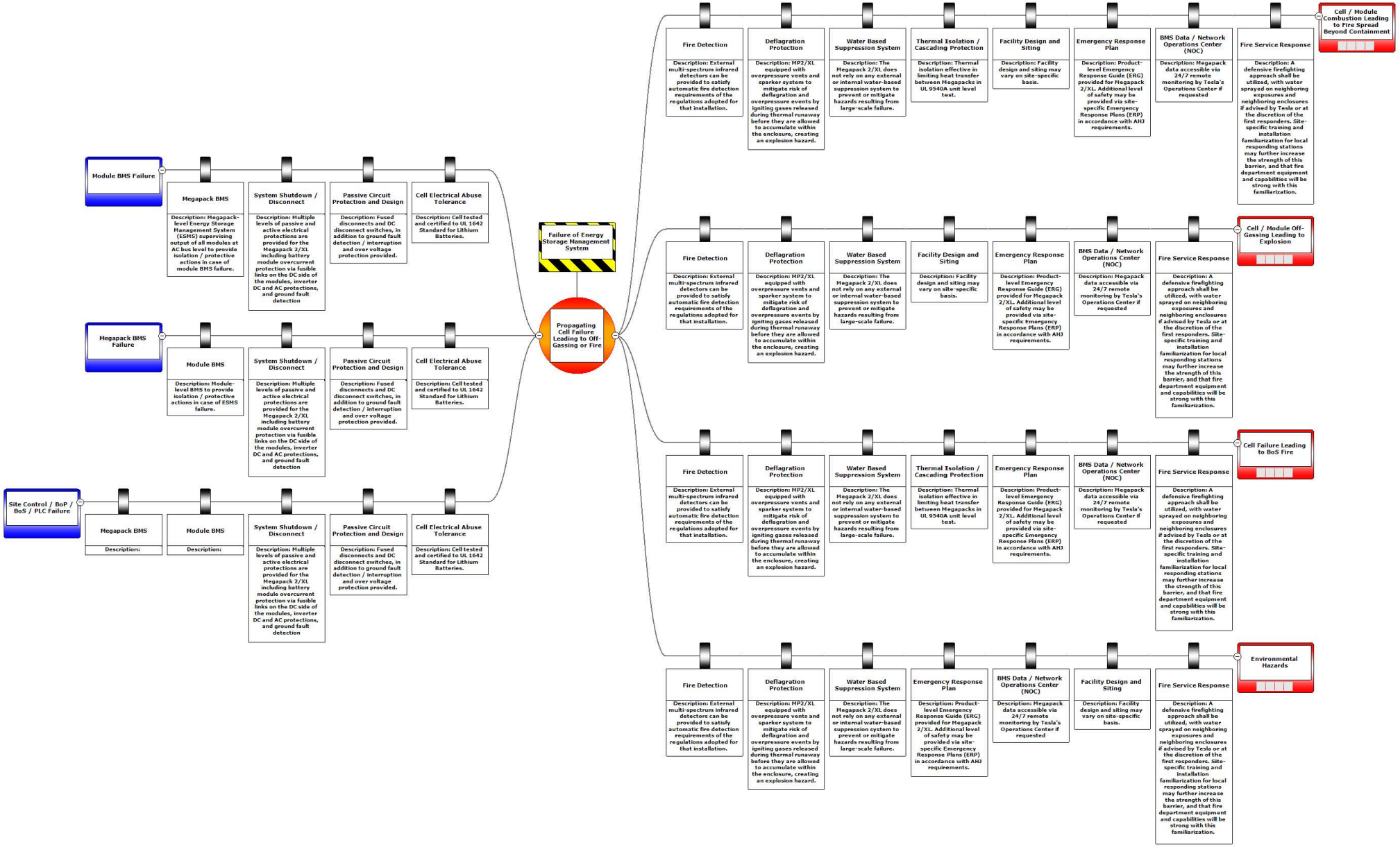


3.6.1

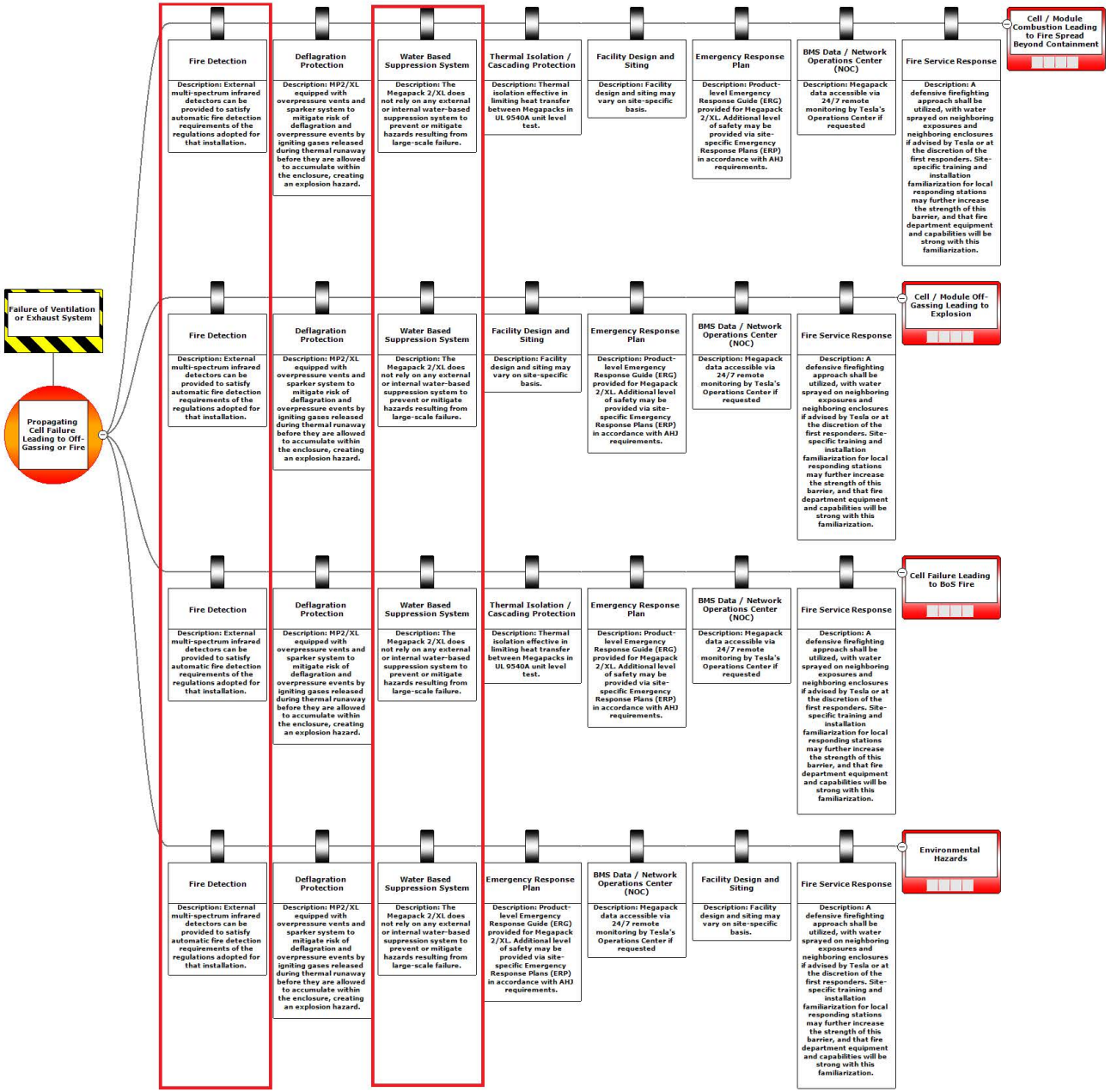
3.7 A.2 Thermal Runaway Condition



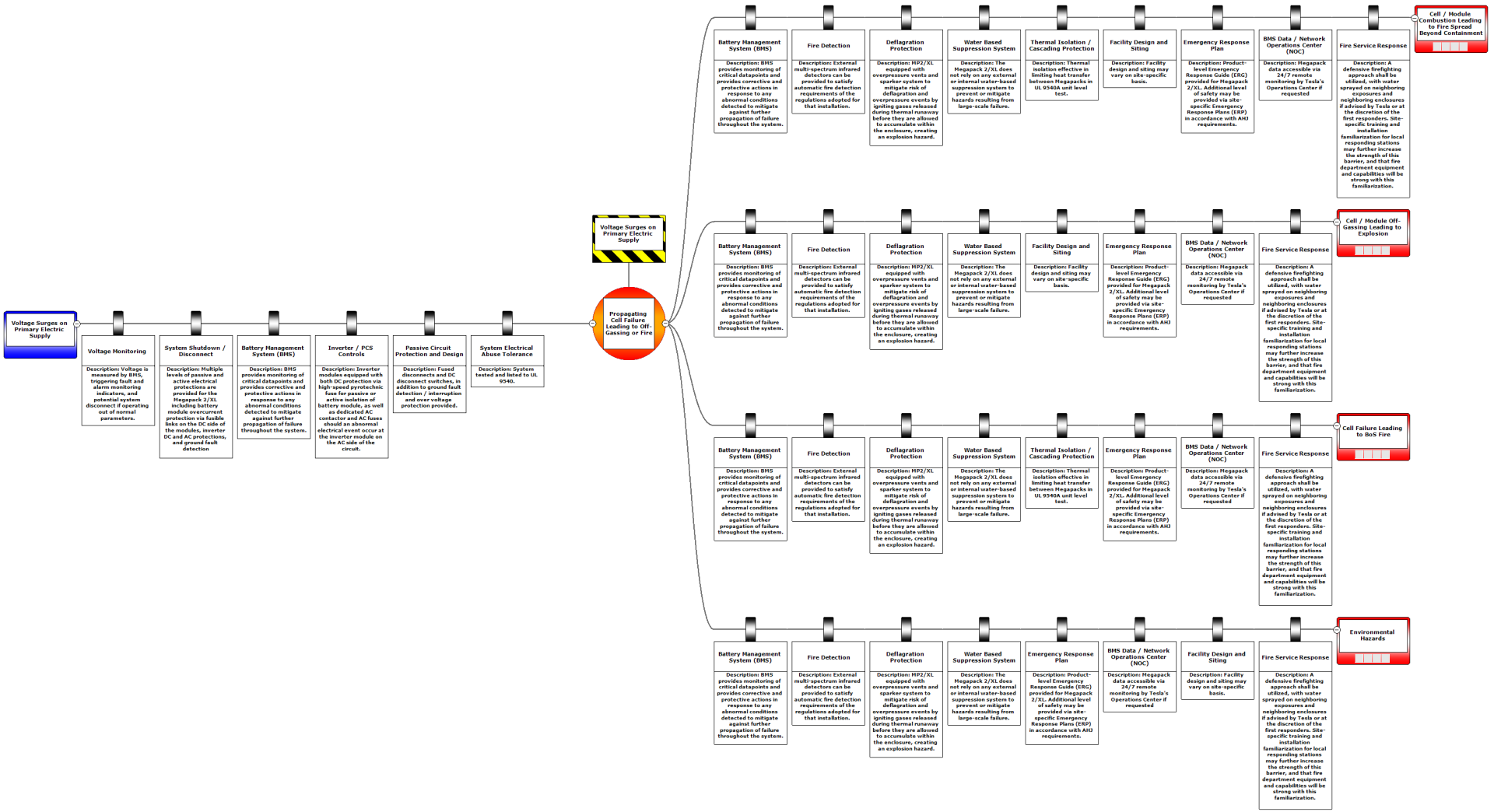
3.8 A.3 Failure of an Energy Storage Management System



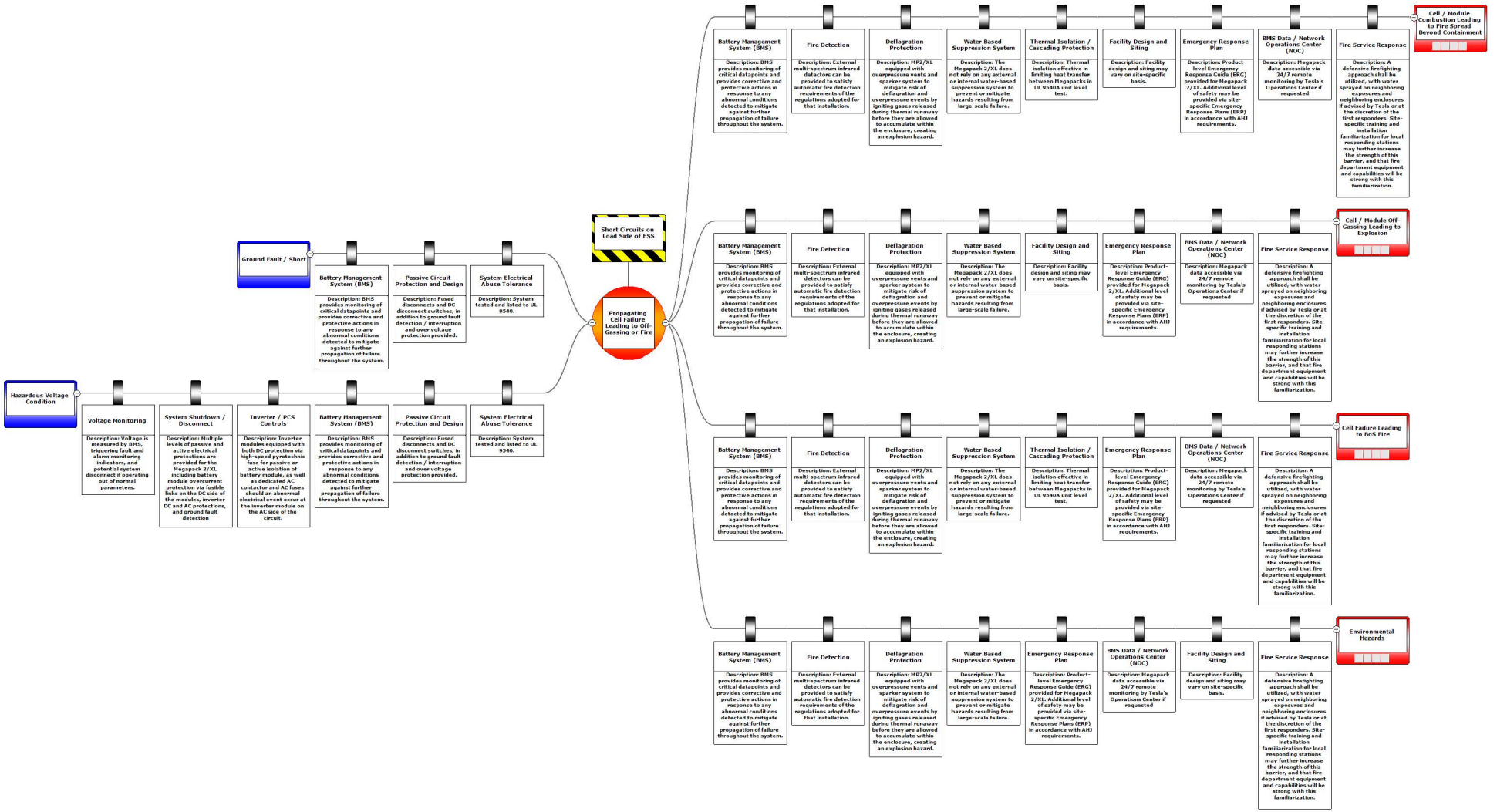
3.9 A.4 Failure of a Required Smoke Detection, Fire Detection, Fire Suppression, or Gas Detection System



3.10A.5 Voltage Surges on the Primary Electric Supply



3.11 A.6 Short Circuits on the Load Side of the ESS

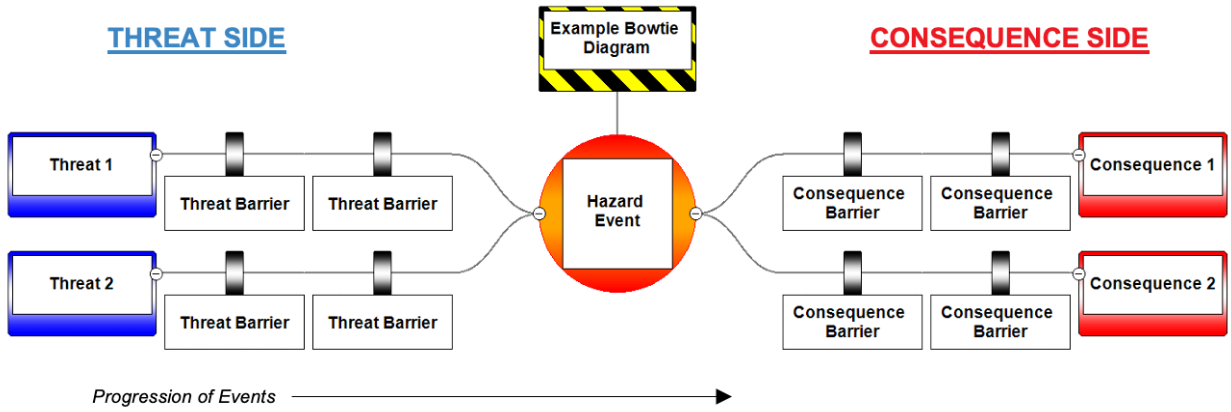


APPENDIX B – HMA METHODOLOGY

This Appendix serves as a supplemental write up for the overall Hazard Mitigation Analysis (HMA) and provides additional context on the Bowtie methodology used, as well as key definitions and concepts.

ESRG utilizes the bowtie methodology for hazard and risk assessments, as is described in *ISO.IEC IEC 31010 §B.21*, as it allows for in-depth analysis on individual mitigative **barriers** and serves as a strong tool for visualizing the chronological pathway of **threats** leading to critical hazard events, and ultimately to greater potential **consequences**, as depicted in the figure below. This simple diagrammatic way of describing and analyzing the pathways of a risk from hazards to outcomes can be considered to be a combination of the logic of a fault tree analyzing the cause of an event and an event tree analyzing the consequences.

The strength of the bowtie approach comes from its visual nature, which forgoes complex, numerical tables for threat pathways which show a single risk or consequence and all the barriers in place to stop it. On the left side are the threats, which are failures, events, or other actions which all result in a single, common hazard event in the center. For our model, many of these threats are the requirements of the fire code such as an unexpected thermal runaway.



- **Hazard Event / Top Event**

  The hazard (or “top”) event – depicted as the center point in the middle of the bowtie diagram – represents a deviation from the desired state during normal operations (in this case, a thermal runaway or cell failure event), at which point control is lost over the hazard and more severe consequences ensue. This event happens before major damage has occurred, and it is still possible to prevent further damage.

- **Threats**

  There often may be several factors that cause a “top event”. In bowtie methodology, these are called threats. Each threat itself has the ability to cause the center event. Examples of threats are hazardous temperature conditions, BMS failure, and water damage from

condensation, each leading to cell failure (the center event for many of the following bowtie diagrams for lithium-ion ESS failures).

Threats may not necessarily address a fully involved system fire or severe explosion, but rather smaller, precursor events which could lead to these catastrophic consequences. Some threats occur without any intervention, such as defect propagation or weather-related events, while others represent operational errors (either human or system-induced). Often threats may also be consequences of even earlier-stage threats, spawning a new bowtie model that includes the threat at the center point or right side of the new bowtie. The diagrams that follow include careful selection and placement of each of the elements to best capture the perspective of system owners and operators responsible for ensuring safe operation.

- **Consequences**

  Consequences are the results of a threat pathway reaching and exceeding its center event. For the models described here, the center events were selected as the event in which proactive protections give way to reactive measures mostly related to fire protection systems and direct response. As the center event then is defined as either “cell failure” or propagating cell failure, the consequences in the models described assume a condition exists in which flammable gas is being released into the system or a fire is burning within the system.

  Consequence pathways include barriers that may help to manage or prevent the consequence event. Threat pathways are often consequence pathways from a separate hazard assessment, as is the case with thermal runaway. In other words, thermal runaway may result from many different threats at the end of a separate hazard pathway (if not properly mitigated) and may also be the threat that could result in several other consequences. The task force identified a set of common consequences representing areas of key concern to utilities, energy storage system operators, and first responders.

- **Barriers**

  In order to control risks, mitigative “barriers” are placed to prevent propagation of failure events across the system. A barrier can be any measure taken that acts against an undesirable force or intention, in order to maintain a desired state, and can be included as proactive threat barriers or reactive consequence barriers.

  Each barrier in these models is more indicative of a concept that may include a single approach or may consist of a complex series of combined measures. Similarly, the analysis may not include barriers required to prevent the threats at the far left of the diagram (which would be placed even further left) to ensure the models do not extend infinitely, though the incorporation of these variables into site-specific safety evaluations may provide additional benefit. This list does not contain all possible solutions and in some designs, these barriers may not exist at all. Many of the same barriers apply to a number of threats.

Barriers may mitigate hazards or consequences in a variety of ways. For example, common barriers to thermal runaway include active electrical monitoring and controls, redundant failure detection, and even passive electrical safeties (such as over-current protection devices and inherent impedances). Should these systems fail to detect the threat, shutdown the system, or otherwise prevent thermal runaway from occurring, the hazard may persist.

APPENDIX D – REFERENCED DOCUMENTATION

[1] *Tesla_Megapack 2_-_ANSI-UL_9540A_Cell_Level_Report_Redacted.pdf*

[2] *Tesla_Megapack 2_-_ANSI-UL_9540A_Module_Level_Report.pdf*

[3] *Tesla_Megapack 2_Megapack 2XL-_ANSI-UL_9540A_Unit_Level_Report.pdf*

[4] *22035-01R (MP2 UL9540A).pdf*

[5] *Tesla Megapack 2 – FPE Report – Final.pdf*

APPENDIX E – REFERENCED CODES AND STANDARDS

- *NFPA 855 Standard for the Installation of Stationary Energy Storage Systems*, 2020 Edition
- *International Fire Code §1207 Electrical Energy Storage Systems*, 2021 Edition
- *UL 9540A Standard for Test Method for Evaluation Thermal Runaway Fire Propagation in Battery Energy Storage Systems,* 4th Edition
- *UL 9540 Standard for Energy Storage Systems and Equipment,* 2nd Edition

Appendix E

REV 1 DR WS-3 Lithium-ion Battery Electrolyte Safety Data Sheets

Safety Data Sheet

1. Product and Company Identification

Product Number: EQ-Lib-LNCA810
Substance Name: Lithium Nickel Cobalt Aluminum Oxide
CAS#: 193214-24-3
Chemical Formula: NCA
Identified uses: Laboratory chemicals, Synthesis of substances

Contact Information:
MTI Corporation
860 South 19th Street
Richmond, CA 94804, USA
Tel: 510-525-3070
Fax: 510-525-4705
Email: info@mtixtl.com
Website: www.mtixtl.com

Non-emergency assistance: 1-888-525-3070

Emergency assistance:
CHEMTEL (MTI Contract# MIS2559467 Day or Night
Tel (Within USA and Canada): 1-800-255-3924
Tel (Outside USA and Canada): 1-813-248-0585

2. Hazards Identification

Emergency Overview: GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Skin sensitization (Category 1), H317
Carcinogenicity (Category 2), H351

For the full text of the H-Statements mentioned in this Section, see Section 16.

GHS Label elements, including precautionary statements

Pictogram	
Signal	Warning
Hazard statement(s)	
H317	May cause an allergic skin reaction.
H351	Suspected of causing cancer.
Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P261	Avoid breathing dust/fume/gas/mist/vapors/spray.
P272	Contaminated work clothing should not be allowed out of the workplace.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water
P308 + P313	If exposed or concerned: Get medical advice/ attention.
P321	Specific treatment (see supplemental first aid instructions on this label).
P333 + P313	If skin irritation or rash occurs: Get medical advice/ attention.

P363	Wash contaminated clothing before reuse.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

Hazards not otherwise classified (HNOC) or not covered by GHS
None

3. Composition/Information on Ingredients

Substance Name: NCA
Formula: LiNi0.815Co0.15Al0.035O2
Molecular Weight: 96.56 g/mol

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. First Aid Measures

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.
Ingestion may cause nausea & vomiting.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11.

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. Firefighting Measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol resistant-foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance mixture
Nickel/nickel oxides, Lithium oxides, Cobalt/cobalt oxides, Aluminum oxide

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further Information
No data available.

6. Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapors, mist, or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

7. Handling and Storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.

Storage class (TRGS 510): 13: Non-combustible solids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. Exposure Control/ Personal Protection

8.1 Control parameters

Components with workplace control parameters

Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Face shield and safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body Protection

Complete suit protecting against chemicals. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multipurpose combination type N100 (US) or type A3(EN 143) respirator cartridges as a backup to engineering controls.

If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. Physical and Chemical Properties

9.1 Information on basic physical and chemical properties

a) Appearance	Form: powder Color: black
b) Odor	No data available
c) Odor Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	> 1,000 °C (> 1,832 °F) - lit.
f) Initial boiling point and boiling range	No data available
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapor pressure	No data available
l) Vapor density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

9.2 Other safety information

No data available

10. Stability and Reactivity

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

No data available

10.4 Conditions to avoid

No data available

10.5 Incompatible materials

Strong oxidizing agents

10.6 Hazardous decomposition products

Other decomposition products - No data available

Hazardous decomposition products formed under fire conditions. - Nickel/nickel oxides, Lithium oxides, Cobalt/cobalt oxides, Aluminum oxide

In the event of fire: see section 5

11. Toxicological Information

11.1 Information on toxicological effects

Acute toxicity

Inhalation: no data available

Dermal: no data available

No data available

Skin corrosion/irritation

No data available

Serious eye damage/eye irritation

no data available

Respiratory or skin sensitization

No data available

Germ cell mutagenicity

No data available

Carcinogenicity

Limited evidence of a carcinogenic effect.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity

No data available

Specific target organ toxicity - single exposure

No data available

Specific target organ toxicity - repeated exposure

No data available

Aspiration hazard

No data available

Additional Information

RTECS: not available

Large doses of lithium ion have caused dizziness and prostration, and can cause kidney damage if sodium intake is limited. Dehydration, weight loss, dermatological effects, and thyroid disturbances have been reported. Central nervous system effects that include slurred speech, blurred vision, sensory loss, ataxia, and convulsions may occur. Diarrhea, vomiting, and neuromuscular effects such as tremor, clonus, and hyperactive reflexes may occur as a result of repeated exposure to lithium ion., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

12. Ecological Information

12.1 Toxicity

no data available

12.2 Persistence and degradability

no data available

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment PBT/vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

No data available

13. Disposal Considerations

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

14. Transport Information

DOT (US)

Not dangerous goods

IMDG

Not dangerous goods

IATA

Not dangerous goods

15. Regulatory Information

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

Massachusetts Right to Know Components

No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right to Know Components	CAS-No.	Revision Date
Lithium nickel cobalt aluminum oxide	193214-24-3	2015-07-08
New Jersey Right to Know Components		
Lithium nickel cobalt aluminum oxide	193214-24-3	2015-07-08

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. Other Information

H317	May cause an allergic skin reaction.
H351	Suspected of causing cancer.

The information above is believed to be accurate and represents the best information currently available to us. However, it does not represent any guarantee of the properties of the product. We make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we shall not be held liable for any damage resulting from handling or from contact with the above product. Users should make their own investigations to determine the suitability of the information for their particular purposes.

SAFETY DATA SHEET

Version 8.10
Revision Date 03/02/2024
Print Date 06/23/2024

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Lithium nickel manganese cobalt oxide

Product Number : 761001
Brand : Aldrich
CAS-No. : 346417-97-8

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

Uses advised against : The product is being supplied under the TSCA R&D Exemption (40 CFR Section 720.36). It is the recipient's responsibility to comply with the requirements of the R&D exemption. The product may not be used for a non-exempt commercial purpose under TSCA unless appropriate consent is granted in writing by MilliporeSigma.

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 SPRUCE ST
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Skin sensitization (Category 1), H317
Carcinogenicity (Category 2), H351

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal Word Warning

Hazard Statements

H317	May cause an allergic skin reaction.
H351	Suspected of causing cancer.

Precautionary Statements

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P261	Avoid breathing dust.
P272	Contaminated work clothing must not be allowed out of the workplace.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P333 + P313	If skin irritation or rash occurs: Get medical advice/ attention.
P363	Wash contaminated clothing before reuse.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms : NMC

Formula : LiNi0.33Mn0.33Co0.33O2
CAS-No. : 346417-97-8
EC-No. : 620-032-4

Component	Classification	Concentration
Lithium nickel manganese cobalt oxide		
	Skin Sens. 1; Carc. 2; H317, H351	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
Show this material safety data sheet to the doctor in attendance.

If inhaled
After inhalation: fresh air. Call in physician.

In case of skin contact
In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower. Consult a physician.

In case of eye contact
After eye contact: rinse out with plenty of water. Call in ophthalmologist. Remove contact lenses.

If swallowed
After swallowing: immediately make victim drink water (two glasses at most). Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media
For this substance/mixture no limitations of extinguishing agents are given.

5.2 Special hazards arising from the substance or mixture
Nickel/nickel oxides
Lithium oxides
Cobalt/cobalt oxides
Manganese/manganese oxides
Not combustible.
Ambient fire may liberate hazardous vapours.

5.3 Advice for firefighters
Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information
Suppress (knock down) gases/vapors/mists with a water spray jet. Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel: Avoid inhalation of dusts. Avoid substance contact. Ensure adequate ventilation. Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions

Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up dry. Dispose of properly. Clean up affected area. Avoid generation of dusts.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling
Work under hood. Do not inhale substance/mixture.

Hygiene measures
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
Tightly closed. Dry.

Storage class
Storage class (TRGS 510): 13: Non Combustible Solids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Lithium nickel manganese cobalt oxide	346417-97-8	C	5 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.02 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Dermal Sensitization Respiratory sensitization Confirmed animal carcinogen with unknown relevance to humans		
		TWA	1 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	3 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	0.015 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen		
		PEL	0.2 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Lithium nickel manganese cobalt oxide	346417-97-8	Nickel	5 µg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift at end of workweek			
		Nickel	30 µg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			
		Cobalt	15 µg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			
		Cobalt		Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			

8.2 Exposure controls

Appropriate engineering controls
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.

Personal protective equipment

Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Safety glasses

Skin protection
Handle with impervious gloves.

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN 16523-1 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

Body Protection
protective clothing

Respiratory protection
Recommended Filter type: Filter type P3
The entrepeneur has to ensure that maintenance, cleaning and testing of respiratory protective devices are carried out according to the instructions of the producer. These measures have to be properly documented.
required when dusts are generated.
Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

Control of environmental exposure
Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: powder Color: black

b)	Odor	No data available
c)	Odor Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: > 290 °C (> 554 °F) - lit.
f)	Initial boiling point and boiling range	No data available
g)	Flash point	()Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	The product is not flammable.
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapor pressure	No data available
l)	Vapor density	No data available
m)	Density	2.11 g/cm3
	Relative density	No data available
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	Not applicable for inorganic substances
p)	Autoignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	none

9.2 Other safety information
No data available

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions
Violent reactions possible with:

Strong oxidizing agents

10.4 Conditions to avoid
no information available

10.5 Incompatible materials
No data available

10.6 Hazardous decomposition products
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
Oral: No data available
Inhalation: No data available
Dermal: No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitization
May cause allergic skin reaction.

Germ cell mutagenicity
No data available

Carcinogenicity
Suspected of causing cancer.

IARC:	1 - Group 1: Carcinogenic to humans (Lithium nickel manganese cobalt oxide)
NTP:	Known - Known to be human carcinogen (Lithium nickel manganese cobalt oxide)
OSHA:	No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

11.2 Additional Information

Large doses of lithium ion have caused dizziness and prostration, and can cause kidney damage if sodium intake is limited. Dehydration, weight loss, dermatological effects, and thyroid disturbances have been reported. Central nervous system effects that include slurred speech, blurred vision, sensory loss, ataxia, and convulsions may occur. Diarrhea, vomiting, and neuromuscular effects such as tremor, clonus, and hyperactive reflexes may occur as a result of repeated exposure to lithium ion.
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12: Ecological information

12.1 Toxicity

No data available

12.2 Persistence and degradability

The methods for determining biodegradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Endocrine disrupting properties

No data available

12.7 Other adverse effects

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself.

SECTION 14: Transport information

DOT (US)

Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

Further information
Not classified as dangerous in the meaning of transport regulations.

SECTION 15: Regulatory information

SARA 302 Components
This material does not contain any components with a section 302 EHS TPQ.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Lithium nickel manganese cobalt oxide	346417-97-8	2015-07-08

SARA 311/312 Hazards
Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Lithium nickel manganese cobalt oxide	346417-97-8	2015-07-08

California Prop. 65 Components

	CAS-No.	Revision Date
, which is/are known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov.Lithium nickel manganese cobalt oxide	346417-97-8	2007-09-28

SECTION 16: Other information

Further information

The information is believed to be correct but is not exhaustive and will be used solely as a guideline, which is based on current knowledge of the chemical substance or mixture and is applicable to appropriate safety precautions for the product. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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Version: 8.10 Revision Date: 03/02/2024 Print Date: 06/23/2024

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 6.3
Revision Date 09.06.2022
Print Date 02.08.2024
GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name	:	Lithium iron(II) phosphate Lithium iron(II) phosphate
Product Number	:	759546
Brand	:	Aldrich
REACH No.	:	A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.
CAS-No.	:	15365-14-7

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses	:	Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company	:	Sigma-Aldrich Inc. 3050 SPRUCE ST ST. LOUIS MO 63103 UNITED STATES
Telephone	:	+1 314 771-5765
Fax	:	+1 800 325-5052

1.4 Emergency telephone

Emergency Phone #	:	800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Not a hazardous substance or mixture according to Regulation (EC) No 1272/2008.

2.2 Label elements

Not a hazardous substance or mixture according to Regulation (EC) No 1272/2008.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms	:	Ferrous lithium phosphate Iron lithium phosphate Triphylite LFP
Formula	:	$LiFePO_4$
Molecular weight	:	157,76 g/mol
CAS-No.	:	15365-14-7

No components need to be disclosed according to the applicable regulations.

SECTION 4: First aid measures

4.1 Description of first-aid measures

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration.

In case of skin contact
Wash off with soap and plenty of water.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Oxides of phosphorus
Lithium oxides
Iron oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Avoid dust formation. Avoid breathing vapors, mist or gas.
For personal protection see section 8.

6.2 Environmental precautions
No special environmental precautions required.

6.3 Methods and materials for containment and cleaning up
Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on protection against fire and explosion
Provide appropriate exhaust ventilation at places where dust is formed.

Hygiene measures
General industrial hygiene practice.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

Storage class
Storage class (TRGS 510): 13: Non Combustible Solids

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

8.2 Exposure controls

Personal protective equipment

Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of Regulation (EU) 2016/425 and the standard EN 374 derived from it.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0,11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0,11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the EC approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
No special environmental precautions required.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Physical state	powder
b)	Color	No data available
c)	Odor	No data available
d)	Melting point/freezing point	Melting point/freezing point: > 300 °C
e)	Initial boiling point and boiling range	No data available
f)	Flammability (solid, gas)	No data available
g)	Upper/lower flammability or	No data available

	explosive limits	
h)	Flash point	No data available
i)	Autoignition temperature	No data available
j)	Decomposition temperature	No data available
k)	pH	No data available
l)	Viscosity	Viscosity, kinematic: No data available Viscosity, dynamic: No data available
m)	Water solubility	No data available
n)	Partition coefficient: n-octanol/water	No data available
o)	Vapor pressure	No data available
p)	Density	No data available
	Relative density	No data available
q)	Relative vapor density	No data available
r)	Particle characteristics	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information
No data available

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - female - > 2.000 mg/kg
(OECD Test Guideline 423)
LC50 Inhalation - Rat - male and female - 4 h - > 3,2 mg/l - dust/mist

(OECD Test Guideline 403)
LD50 Dermal - Rat - male and female - > 2.000 mg/kg
(OECD Test Guideline 402)

Skin corrosion/irritation
Skin - Rabbit
Result: No skin irritation - 4 h
(OECD Test Guideline 404)

Serious eye damage/eye irritation
Eyes - Rabbit
Result: No eye irritation - 72 h
(OECD Test Guideline 405)

Respiratory or skin sensitization
Local lymph node assay (LLNA) - Mouse
Result: negative
(OECD Test Guideline 429)

Germ cell mutagenicity
Test Type: Ames test
Test system: Escherichia coli/Salmonella typhimurium
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 471
Result: negative
Test Type: In vitro mammalian cell gene mutation test
Test system: mouse lymphoma cells
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 476
Result: negative
Test Type: Chromosome aberration test in vitro
Test system: Human lymphocytes
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 473
Result: negative

Test Type: Micronucleus test
Species: Mouse
Cell type: Bone marrow
Application Route: Intraperitoneal
Method: OECD Test Guideline 474
Result: negative

Carcinogenicity
No data available

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

11.2 Additional Information

Repeated dose toxicity - Rat - male and female - Gavage - 90 d - NOAEL (No observed adverse effect level) - 100 - < 250 mg/kg
Remarks: Subchronic toxicity

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	static test LC50 - Cyprinus carpio (Carp) - > 28 mg/l - 96 h (OECD Test Guideline 203)
Toxicity to daphnia and other aquatic invertebrates	static test EC50 - Daphnia magna Straus (Water flea) - > 28 mg/l - 48 h (OECD Test Guideline 202)
Toxicity to algae	static test ErC50 - Pseudokirchneriella subcapitata - > 24 mg/l - 72 h (OECD Test Guideline 201)
Toxicity to bacteria	EC50 - activated sludge - > 100 mg/l - 3 h (OECD Test Guideline 209)

12.2 Persistence and degradability
The methods for determining biodegradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Endocrine disrupting properties
No data available

12.7 Other adverse effects
No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number
ADR/RID: - IMDG: - IATA: -

14.2 UN proper shipping name
ADR/RID: Not dangerous goods
IMDG: Not dangerous goods
IATA: Not dangerous goods

14.3 Transport hazard class(es)
ADR/RID: - IMDG: - IATA: -

14.4 Packaging group
ADR/RID: - IMDG: - IATA: -

14.5 Environmental hazards
ADR/RID: no IMDG Marine pollutant: no IATA: no

14.6 Special precautions for user

Further information
Not classified as dangerous in the meaning of transport regulations.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture
This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.2 Chemical Safety Assessment
For this product a chemical safety assessment was not carried out

SECTION 16: Other information

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See

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ACCORDING TO EC-REGULATIONS 1907/2006 (REACH), 1272/2008 (CLP) & 2015/830

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1 Product identifier

Product Name	Lithium Nickel Manganese Oxide (LiNi0.5Mn1.5O4)
Synonyms	Lithium Manganese Nickel Oxide
Chemical Name	Lithium Nickel Manganese Oxide
Chemical Formula	LiNi0.5Mn1.5O4
CAS No.	12031-75-3
EC No.	Not Applicable
Index No.	Not Applicable
REACH Registration No.	Not applicable.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified Use(s)	PC21 Laboratory chemicals, Research and development use *only*

1.3 Details of the supplier of the safety data sheet

Company Identification	Ossila Limited
Address of Supplier	Solpro Business Park Windsor Street Sheffield
Postal code	S4 7WB, UK
Telephone:	+441142999180
E-mail	info@ossila.com
Office hours	08:00 - 17:00

1.4 Emergency telephone number

Emergency Phone #	+44 (0) 20 3885 0382 (CHEMTREC)

Other Regions	Emergency Phone Number (CHEMTREC)
Europe, Middle East, Africa	+44 20 3885 0382
North America	+1 703 527 3887
Central America	+52 55 8526 4930
South America	+55 11 4349 1359
Asia, India, and Oceania	+65 3163 8374

SECTION 2: HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Regulation (EC) No. 1272/2008 (CLP)	Skin Sens. 1: May cause an allergic skin reaction Acute Tox. 4: Harmful if inhaled Carc. 1B: May cause cancer STOT RE 1: Causes damage to organs through prolonged or repeated exposure Aquatic Chronic 1: Very toxic to aquatic life with long lasting effects

2.2 Label elements

	According to Regulation (EC) No. 1272/2008 (CLP)
Product Name	Lithium Nickel Manganese Oxide (LiNi0.5Mn1.5O4)
Hazard Pictogram(s)	 GHS07 GHS08 GHS09
Signal Word(s)	Danger
Hazard Statement(s)	H317: May cause an allergic skin reaction H332: Harmful if inhaled H350: May cause cancer H372: Causes damage to organs through prolonged or repeated exposure H410: Very toxic to aquatic life with long lasting effects
Precautionary Statement(s)	P273: Avoid release to the environment. P280: Wear protective gloves/protective clothing/eye protection/face protection. P302 + P352 IF ON SKIN: Wash with plenty of water. P304 + P340: IF INHALED: Remove person to fresh air and keep comfortable for breathing. P319: Get medical help if you feel unwell.

P333 + P313: If skin irritation or rash occurs: Get medical advice/attention.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

2.4 Additional Information

Not applicable.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Hazardous ingredient(s)	CAS No.	EC No.	%W/W	Hazard Statement(s)
Lithium Nickel Manganese Oxide	12031-75-3	Not Applicable	≤100	Skin Sens. 1 H317 Acute Tox. 4 H332 Carc. 1B H350 STOT RE 1 H372 Aquatic Chronic 1 H410

3.2 Mixtures

Not applicable.

SECTION 4: FIRST AID MEASURES

4.1 Description of first aid measures

General Advice	First aiders should ensure they have taken adequate steps to protect themselves from exposure (see Section 8 for recommended personal protection equipment) Show this safety data sheet to the doctor in attendance.
Inhalation	Remove person to fresh air and keep comfortable for breathing. Get medical advice/attention if you feel unwell.
Skin Contact	Rinse skin with water. If skin irritation occurs, get medical advice/attention.
Eye Contact	Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Ingestion	Rinse out mouth with water. Get medical advice/attention if you feel unwell.

4.2 Most important symptoms and effects, both acute and delayed

Most important symptoms and effects, both acute and delayed, are included on labelling (Section 2.2) and in Section 11.

4.3 Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

SECTION 5: FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable Extinguishing media	As appropriate for surrounding fire.
Unsuitable extinguishing media	As appropriate for surrounding fire.

5.2 Special hazards arising from the substance or mixture

Lithium oxides
Manganese/manganese oxides
Nickel/nickel oxides

5.3 Advice for firefighters

Fire fighters should wear complete protective clothing including self-contained breathing apparatus.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Follow safe handling advice and personal protective equipment recommendations (as per section 8). Provide adequate ventilation.

6.2 Environmental precautions

Avoid release to the environment.

6.3 Methods and material for containment and cleaning up

Sweep up spilled substance - avoid making dust. Use vacuum equipment for collecting spilt materials, where practicable. Dispose of contents in accordance with local, state or national legislation.

6.4 Reference to other sections

See Also Section 8, 13.

SECTION 7: HANDLING AND STORAGE

7.1 Precautions for safe handling

Advice on safe handling	Avoid inhalation, ingestion, and contact with skin and eyes. Use only in a well-ventilated area. Wear protective clothing as per section 8.
Hygiene measures	Keep away from food and drink. Wash hands after handling, before breaks, and at the end of workday.

7.2 Conditions for safe storage, including any incompatibilities

Store in a well-ventilated place. Keep container tightly closed. Store locked up.

Storage temperature	Ambient.
Storage life	Stable under normal conditions.
Incompatible materials	None known.

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

8.1.1 Occupational Exposure Limits

UK – EH40 Workplace Exposure Limits (WEL).

Occupational Exposure Limits						
SUBSTANCE.	CAS No.	LTEL (8 hr TWA ppm)	LTEL (8 hr TWA mg/m³)	STEL (ppm)	STEL (mg/m³)	Note
Manganese and its inorganic compounds (as Mn)	12031-75-3		0.2 (Inhalable Fraction), 0.05 (Respirable Fraction)			
Nickel and its inorganic compounds: nickel and water-insoluble nickel compounds (as Ni)	12031-75-3		0.5			

Region	Source
EU	EU Occupational Exposure Limits
United Kingdom	UK Workplace Exposure Limits EH40/2005 (Third edition, published 2018)

8.2 Exposure controls

8.2.1. Appropriate engineering controls	Ensure adequate ventilation and/or exhaust. A washing facility/water for eye and skin cleaning purposes should be present.
8.2.2. Personal protection equipment	
Eye Protection	Wear eye protection with side protection tested and approved under appropriate government standards such as EN166 (EU).
Hand protection	Handle with gloves. Gloves must be inspected prior to use and proper glove removal techniques should be used. The selected protective gloves have to satisfy the specifications of Regulation (EU) 2016/425 and the standard EN 374 derived from it.
Body protection	Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place.
Respiratory protection	Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N99 (US) or type P2 (EN 143) respirator cartridges as a backup to engineering controls.
Thermal hazards	None known.
8.2.3. Environmental Exposure Controls	Avoid release to the environment.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Physical State	Solid: Powder.
Colour	Black/Grey.
Odour	Not known.
Odour threshold	Not known.
Melting point/freezing point	> 290 °C
Initial boiling point and boiling range	Not known.
Flammability	Not known.
Lower and upper explosion limit	Not known.
Flash Point	Not known.
Auto-ignition temperature (°C)	Not known.
Decomposition temperature (°C)	Not known.
pH	Not known.
Kinematic viscosity	Not known.
Solubility(ies)	Solubility (Water): Not known. Solubility (Other): Not known.
Partition coefficient: n-octanol/water (log value)	Not known.
Vapour pressure	Not known.
Density	Not known.
Relative density	Not known.
Relative vapour density	Not known.
Particle characteristics	Not known.

9.2 Other information

None.

SECTION 10: STABILITY AND REACTIVITY

10.1 Reactivity

None anticipated.

10.2 Chemical Stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

Not known.

10.4 Conditions to avoid

Not known.

10.5 Incompatible materials

Not known.

10.6 Hazardous decomposition products

In the event of fire: see Section 5

SECTION 11: TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity - Ingestion	No data available.
Acute toxicity - Skin Contact	No data available.
Acute toxicity - Inhalation	No data available.
Skin corrosion/irritation	No data available.
Serious eye damage/irritation	No data available.
Skin sensitization data	No data available.
Respiratory sensitization data	No data available.
Germ cell mutagenicity	No data available.
Carcinogenicity	No data available.
Reproductive toxicity	No data available.
Lactation	No data available.
STOT - single exposure	No data available.
STOT - repeated exposure	No data available.
Aspiration hazard	No data available.

11.2 Information on other hazards

11.2.1 Endocrine disrupting properties

None known.

11.2.2. Information on other hazards

None known.

SECTION 12: ECOLOGICAL INFORMATION

12.1 Toxicity

No data available.

Toxicity - Aquatic invertebrates	Not known.
Toxicity - Fish	Not known.
Toxicity - Algae	Not known.
Toxicity - Sediment Compartment	Not known.
Toxicity - Terrestrial Compartment	Not known.

12.2 Persistence and Degradation

Not known.

12.3 Bioaccumulative potential

Not known.

12.4 Mobility in soil

Not known.

12.5 Results of PBT and vPvB assessment

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Endocrine disrupting properties

Not known.

12.7 Other adverse effects

Not known.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Dispose of contents in accordance with local, state or national legislation. Recycle only completely emptied packaging. Normal disposal is via incineration operated by an accredited disposal contractor. Send to a licensed recycler, reclaimer or incinerator.

13.2 Additional Information

Disposal should be in accordance with local, state or national legislation.

SECTION 14: TRANSPORT INFORMATION

14.1 UN number

UN No.	3077

14.2 UN proper shipping name

UN proper shipping name	Environmentally hazardous substance, solid, n.o.s. (Lithium Nickel Manganese Oxide)

14.3 Transport hazard class(es)

ADR/RID	9
IMDG	9
IATA	9

14.4 Packing group

Packing group	III

14.5 Environmental hazards

Environmental hazards	Not classified as a Marine Pollutant.

14.6 Special precautions for user

Special precautions for user	Not known.

14.7 Maritime transport in bulk according to IMO instruments

Not known.

SECTION 15: REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

European Regulations - Authorisations and/or Restrictions On Use

Candidate List of Substances of Very High Concern for Authorisation	Not listed
REACH: ANNEX XIV list of substances subject to authorisation	Not listed
REACH: Annex XVII Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles	Not listed
Community Rolling Action Plan (CoRAP)	Not listed
Regulation (EC) N° 850/2004 of the European Parliament and of the Council on persistent organic pollutants	Not listed
Regulation (EC) N° 1005/2009 on substances that deplete the ozone layer	Not listed
Regulation (EU) N° 649/2012 of the European Parliament and of the Council concerning the export and import of hazardous chemicals	Not listed

National regulations

Other	Not known.

15.2 Chemical Safety Assessment

A REACH chemical safety assessment has not been carried out.

SECTION 16: OTHER INFORMATION

The following sections contain revisions or new statements:

LEGEND

Acronyms	ADN : European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways ADR : European Agreement concerning the International Carriage of Dangerous Goods by Road CAS : Chemical Abstracts Service CLP : Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures DNEL : Derived No Effect Level EC : European Community EINECS : European Inventory of Existing Commercial Chemical Substances IATA : International Air Transport Association IBC : Intermediate Bulk Container ICAO : International Civil Aviation Organization IMDG : International Maritime Dangerous Goods LTEL : Long term exposure limit PBT : Persistent, Bioaccumulative and Toxic PNEC : Predicted No Effect Concentration REACH : Registration, Evaluation, Authorisation and Restriction of Chemicals RID : Regulations concerning the International Carriage of Dangerous Goods by Rail STEL : Short term exposure limit

STOT : Specific Target Organ Toxicity
UN : United Nations
vPvB : very Persistent and very Bioaccumulative

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Safety Data Sheet

1. Product and Company Identification

Product Name: Lithium cobalt (III) oxide
CAS#: 12190-9-3
Identified uses: Laboratory chemicals, Synthesis of substances
Formula: $LiCoO_2$
Molecular Weight 97.87 g/mol

Contact Information:
MTI Corporation
860 South 19th Street
Richmond, CA 94804, USA
Tel: 510-525-3070
Fax: 510-525-4705
Email: info@mtixtl.com
Website: www.mtixtl.com

Non-emergency assistance: 1-888-525-3070

Emergency assistance:
Company: CHEMTEL (MTI Contract# MIS2559467) Day or Night
Tel (Within USA and Canada): 1-800-255-3924
Tel (Outside USA and Canada): 1-813-248-0585

2. Hazards Identification

Emergency Overview: GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Skin sensitization (Category 1), H317
Carcinogenicity (Category 1B), H350

For the full text of the H-Statements mentioned in this Section, see Section 16.

HMIS Rating
Health hazard: 2
Chronic Health Hazard: *
Flammability: 0
Physical Hazard 0

NFPA Rating
Health hazard: 2
Fire Hazard: 0
Reactivity Hazard: 0

GHS Label elements, including precautionary statements

Pictogram

Signal	Danger
Hazard statement(s)	
H317	May cause an allergic skin reaction.
H350	May cause cancer.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.
P272	Contaminated work clothing should not be allowed out of the workplace.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water
P308 + P313	If exposed or concerned: Get medical advice/ attention.
P321	Specific treatment (see supplemental first aid instructions on this label).
P333 + P313	If skin irritation or rash occurs: Get medical advice/ attention.
P363	Wash contaminated clothing before reuse.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

Hazards not otherwise classified (HNOC) or not covered by GHS

none

3. Composition/Information on Ingredients

Substance Name: Lithium cobalt (III) oxide
Other Name: Lithium cobaltite
Formula: $LiCoO_2$

Hazardous Components

Lithium cobalt (III) oxide	Skin Sens. 1; Carc. 1B; H317,H350

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. First Aid Measures

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

5. Firefighting Measures

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol resistant-foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance mixture

Lithium oxides, Cobalt/cobalt oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further Information

No data available.

6. Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust. For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

7. Handling and Storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. Exposure Control/ Personal Protection

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control Parameters	Basis
Lithium cobalt(III) oxide	12190-79-3	TWA	0.020000 mg/m^3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Pulmonary function Asthma Myocardial effects		

		Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		
		TWA	0.02 mg/m^3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Pulmonary function Asthma Myocardial effects Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological Specimen	Basis
Lithium cobalt(III) oxide	12190-79-3	Cobalt	15 µg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift at end of workweek			
		Cobalt	15 µg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body Protection

Complete suit protecting against chemical. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. Physical and Chemical Properties

9.1 Information on basic physical and chemical properties

a) Appearance	Form: Powder Color: Black
b) Odor	Odorless
c) Odor Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	No data available
f) Initial boiling point and boiling range	No data available No data available
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapor pressure	No data available
l) Vapor density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

9.2 Other safety information

No data available

10. Stability and Reactivity

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

No data available

10.4 Conditions to avoid

Avoid moisture.

10.5 Incompatible materials

Strong oxidizing agents

10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Lithium oxides, Cobalt/cobalt oxides
Other decomposition products - No data available
In the event of fire: see section 5

11. Toxicological Information

11.1 Information on toxicological effects

Acute toxicity

No data available
Inhalation: No data available
Dermal: No data available
No data available

Skin corrosion/irritation

No data available

Serious eye damage/eye irritation

No data available

Respiratory or skin sensitization

No data available

Germ cell mutagenicity

No data available

Carcinogenicity

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Lithium cobalt(III) oxide)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity

No data available

Specific target organ toxicity - single exposure

No data available

Specific target organ toxicity - repeated exposure

No data available

Aspiration hazard

No data available

Additional Information

RTECS: Not available
Large doses of lithium ion have caused dizziness and prostration, and can cause kidney damage if sodium intake is limited. Dehydration, weight loss, dermatological effects, and thyroid disturbances have been reported. Central nervous system effects that include slurred speech, blurred vision, sensory loss, ataxia, and convulsions may occur. Diarrhea, vomiting, and neuromuscular effects such as tremor, clonus, and hyperactive reflexes may occur as a result of repeated exposure to lithium ion., May cause irritation of the: nose, Throat., Rash, Vomiting, Diarrhea, sensation of heat, Exposure can cause damage to the:, Kidney, Lungs, Thyroid.
Stomach – Irregularities – Based on Human Evidence
Stomach – Irregularities – Based on Human Evidence

12. Ecological Information

12.1 Toxicity

No data available

12.2 Persistence and degradability

No data available

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment PBT/vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

No data available

13. Disposal Considerations

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

14. Transport Information

DOT (US)

Not dangerous goods

IMDG

Not dangerous goods

IATA

Not dangerous goods

15. Regulatory Information

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards

Acute Health Hazard. Chronic Health Hazard

Massachusetts Right to Know Components

No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right to Know Components	CAS-No.	Revision Date
Lithium cobalt (III) oxide	12190-79-3	2007-03-01
New Jersey Right to Know Components		
Lithium cobalt (III) oxide	12190-79-3	2007-03-01

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. Other Information

Carc.	Carcinogenicity
H317	May cause an allergic skin reaction.
H350	May cause cancer.
Skin Sens.	Skin sensitization

The information above is believed to be accurate and represents the best information currently available to us. However, it does not represent any guarantee of the properties of the product. We make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we shall not be held liable for any damage resulting from handling or from contact with the above product. Users should make their own investigations to determine the suitability of the information for their particular purposes.