Appendix E Natural Resources Assessment

Fleetwood Environmental Solutions, LLC
84 Russell Street
Hadley, MA 01035
413.325.7372
www.fleetwoodenv.com

MEMORANDUM

Date: **May 11, 2023**

To: **Sam Kitfield, BlueWave Solar**

Copy: **Aaron Simms, BlueWave Solar**

From: **David Cameron, PWS, Fleetwood Environmental Solutions, LLC**

Subject: **Natural Resources Assessment for 105 Old Post Road, Worthington, MA**

1.0 INTRODUCTION AND BACKGROUND

Per your request, Fleetwood Environmental Solutions, LLC ("Fleetwood") conducted an independent natural resources-based evaluation for a property at 105 Old Post Road, Worthington, identified by MassGIS as Map/Parcel ID 407 0 96.1. BlueWave Solar ("BlueWave") is pursuing a "dual-use" commercial solar development for this property, which is currently in agricultural use by a single owner.

2.0 REVIEW METHODS

2.1 *Desktop Analysis*

Fleetwood initially conducted a desktop investigation for the subject parcel. The following project file was provided by BlueWave for Fleetwood's review:

- September 9, 2022 Preliminary Site Plan, prepared by BlueWave Solar.

Fleetwood additionally consulted historic and contemporary aerial imagery, and resource maps depicting topography, elevation, land use, wetlands, floodplain, hydrologic connections, soils, Estimated Habitats of Rare Wildlife ("EH"), Priority Habitats of Rare Species ("PH"), Certified Vernal Pools ("CVPs"), Potential Vernal Pools ("PVP"), Areas of Critical Environmental Concern ("ACECs"), Outstanding Resource Waters ("ORWs"), Coldwater Fisheries Resources ("CFRs"), and the U.S. Geological Survey's StreamStats Program as part of the desktop exercise.

2.2 Field-Based Analysis

Field assessments were conducted on May 3rd and 4th, 2023 by Fleetwood. These evaluations entailed a reconnaissance-level assessment of the property, including a meander survey through active agricultural areas, focused observations of apparent and potential wetland features, and a site perimeter walk to get a sense of reference (i.e., relatively undisturbed) conditions beyond the limits of the developed portion of the parcel. In

addition, notes were collected regarding which portions of the property appear to be in some active state of agricultural use, which has implications for subsequent development, including for dual use solar concepts. Approximately 26 acres were visually inspected during the field survey, including the complete footprint of the solar project depicted on the Preliminary Site plan, plus perimeter streams within 200 feet of the footprint and perimeter wetlands within 100 feet of the footprint. Resource Areas were delineated in accordance with both state and federal guidelines, and flagged using pink, sequentially-labelled 'WETLAND DELINEATION" survey pin and tape flags for Bordering Vegetated Wetlands ("BVWs"). Given no work is proposed to occur within the streams, the associated Banks were not delineated.

3.0 FINDINGS

3.1 General

According to MassGIS data the properties are collectively comprised of 73.6 acres and are owned by Thomas Brisson.

3.2 Historic and Contemporary Aerial Imagery, Topography, Elevation, and Land Use

Elevation at the project site ranges from roughly 1,370 feet to roughly 1,470 feet, with most of the elevation gain occurring from south to north. The entire project footprint is in agricultural use, and currently composed of livestock pasture (northern field) and apparent hay (southern field). According to historic images the area has been farmed since at least 1958, and said images depict no wetlands or streams within the project area, with the exception of a potential ditch between the two fields draining what appears to be a man-made pond just off-site to the north. Historic topographic maps appear to depict the entire area as in agricultural use since at least 1946.

3.3 Wetlands and Hydrologic Connections

According to MassGIS the property contains a number of wetlands and watercourses:

- Ward Stream, west of the project footprint by approximately 600 feet;
- An unnamed stream at the southwestern corner of the property east of the project footprint by approximately 180 feet;
- A man-made pond (dating back to at least 1964 per historic mapping) east of the central portion of the project footprint by approximately 120 feet; this pond is almost entirely off-property, and is classified as "Deep marsh" by MassMapper; and
- Impounded wetlands north of Ward stream, including those classified as "Deep Marsh", "Shallow Marsh Meadow or Fen", and "Wooded Swamp, Deciduous." These are all well west (≥ 750 feet) of the project footprint.

MassGIS does not indicate any polygons of "Wetlands Change" that have been detected on the parcel, meaning no illicit alterations of wetlands have been detected via remote sensing.

Based on Fleetwood's on-site investigations, the following additional information was obtained:

- Wet meadow Bordering Vegetated Wetlands ("BVWs") were discovered on the subject property adjacent to the man-made pond depicted on MassGIS. The BVWs were flagged accordingly where they were clearly on the subject property:

    - Flags W1-100 to 109 near the southwestern portion of the pond ("Wetland 1"); and
    - Flags W2-100 to 115 near the southeastern portion of the pond ("Wetland 2").

Several of the W2-series flags extend slightly into the southern field. It is also important to note that man-made drainage ditches occur west of these delineated BVWs. Normally, these ditches would be considered jurisdictional streams. However, it is my professional opinion that these ditches were potentially over-constructed when the pond was created, and do not actually hold surface water or convey surface flows west of where Fleetwood placed the BVW flags. The delineations were conducted during rainy days, within an approximately seven-day period of rains--often intense---and following prior weeks of spring rains. These ditches not only did not hold standing or flowing water, they did not even exhibit water-stained leaves. Moreover, these ditches just peter out, and do not discharge to the wetlands immediately west. Rather, surface flows leaving the pond appear to gradually infiltrate into the soils and then re-emerge as groundwater breakout in the wetland to the west ("Wetland 4").

- A forested BVW (Flags W3-100 to 107; "Wetland 3") at the southeastern corner of the property, potentially casting a 100-foot Buffer Zone into the project footprint;

- A forested BVW (Flags W4-100 to 111; "Wetland 4") just west of the northwest corner of the southern field, potentially casting a 100-foot Buffer Zone into the project footprint; and

- A forested BVW (Flags W5-100 to 116; "Wetland 5") just west of the central portion of the southern field, potentially casting a 100-foot Buffer Zone into the project footprint.

Forested wetlands were also noted just south of the property line, which may cast 100-foot Buffer Zone into the project footprint. Given these BVWs were not on the subject property, they were not flagged by Fleetwood.

3.4 Floodplain

MassGIS does not depict any portion of the project footprint as encompassed by a 100-year floodplain. According to MassGIS and the corresponding Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), Panel 250124-0010B (Appendix A)---dated June 19, 1989---the entirety of the project footprint is depicted as occurring well beyond the 100-year floodplain of Ward Stream, which is depicted but has an undetermined base flood elevation.

3.5 Soils

A number of soils are mapped on the portion of the site which encompasses the solar project footprint depicted on the Preliminary Site Plan, per the Natural Resources Conservation Service/Hampshire County Soil Survey and MassGIS, as summarized in Table 3-1, below.

Table 3-1. Soil Types Mapped within the Vicinity of the Proposed Solar Project Footprint

Map Symbol and Unit Name	Portion of Site	Slopes	Hydric?	Prime Farmland?	Drainage Class
360A/ Peru fine sandy loam	very eastern edge	0-3%	No	Yes	Moderately well drained
905C/Peru-Marlow Association	very western edge	3-15%	No	No	Moderately well drained
122C/Turnbridge-Lyman Complex	bulk of footprint	8-15%	No	No	Well drained

There are no hydric soils mapped within the project footprint.

3.6 Estimated Habitats of Rare Wildlife

According to MassGIS there is no EH on the parcel.

3.7 Priority Habitats of Rare Species

According to MassGIS there is no PH on the parcel.

3.8 Certified Vernal Pools

According to MassGIS there are no CVPs on the parcel.

3.9 Potential Vernal Pools

According to MassGIS there is one PVP on the parcel (i.e., PVP #29469). This is the man-made pond that is mostly off-site, but which extends slightly into the central portion of the property. While PVPs are not actively regulated by the Massachusetts Division of Fisheries & Wildlife's ("MADFW") Natural Heritage & Endangered Species Program ("NHESP") under the Massachusetts Endangered Species Act, municipal conservation commissions do have broad authority and discretion to regulate the Buffer Zones of jurisdictional wetlands and ponds that concurrently constitute PVP habitat and which are Resource Areas under the Massachusetts Wetlands Protection Act.

3.10 Areas of Critical Environmental Concern

According to MassGIS the parcel is not within or encompassed by any ACECs.

3.11 Outstanding Resource Waters

According to MassGIS there are no ORWs on the parcel.

3.12 Coldwater Fisheries Resources (CFRs)

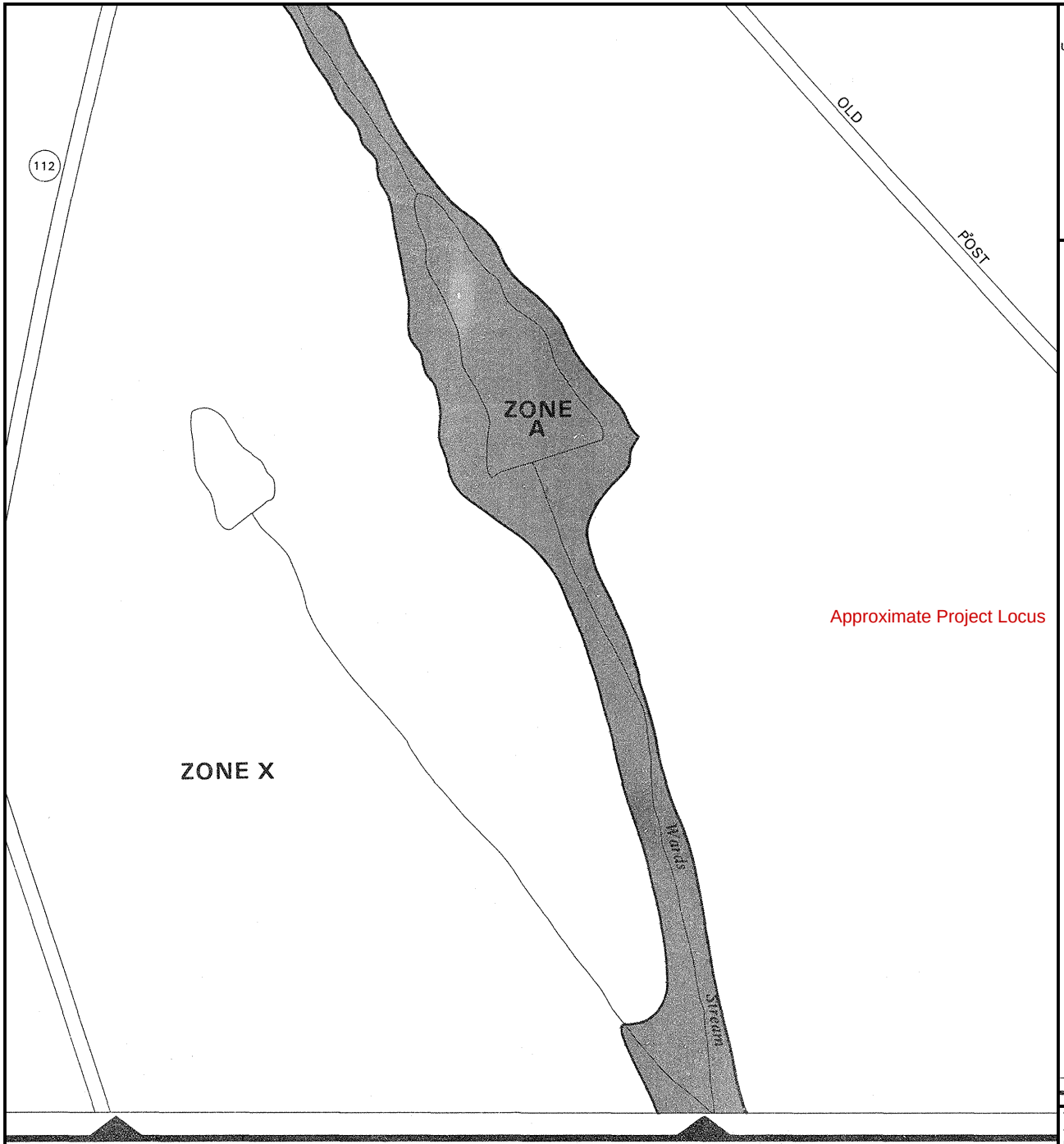
According to MassGIS, there is one designated CFRs on the parcel---Ward Stream (CFR SARIS ID #3211175). Please refer to Section 4.0 for additional discussion on this matter.

3.13 U.S. Geological Survey's StreamStats Program

StreamStats was consulted to assess whether the unnamed stream at the southeastern corner of the property has a contributing drainage area large enough for it to constitute a "River" per 310 CMR 10.04. This stream is not depicted on the most current USGS topographic map, and according to this StreamStats, the contributing drainage area to the reach of the stream adjacent to the property is only 0.23 miles, confirming it does not meet the regulatory definition of a "River" and thus, has no associated 200-Foot Riverfront Area. The StreamStats report is provided as Appendix B.

Representative site photographs are provided at Appendix C and a wetland delineation sketch is provided at Appendix D.

Thank you for your attention to this memorandum. Please contact me should you wish to discuss this investigation and its findings in detail.



determine if flood insurance is available in this community, contact your urance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

TOWN OF
WORTHINGTON,
MASSACHUSETTS
HAMPSHIRE COUNTY

PANEL 9 OF 25
(SEE MAP INDEX FOR PANELS NOT PRINTED)

PANEL LOCATION

COMMUNITY-PANEL NUMBER
250175 0009 B

EFFECTIVE DATE:
JUNE 19, 1989

Federal Emergency Management Agency

This is an official FIRMette showing a portion of the above-referenced flood map created from the MSC FIRMette Web tool. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For additional information about how to make sure the map is current, please see the Flood Hazard Mapping Updates Overview Fact Sheet available on the FEMA Flood Map Service Center home page at https://msc.fema.gov.

StreamStats Report

Region ID: MA
Workspace ID: MA20230503185114121000
Clicked Point (Latitude, Longitude): 42.40096, -72.92662
Time: 2023-05-03 14:51:49 -0400



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
ACRSDFT	Area underlain by stratified drift	0	square miles
DRNAREA	Area that drains to a point on a stream	0.23	square miles

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

USGS Software Disclaimer: This software has been approved for release by the U.S. Geological Survey (USGS). Although the software has been subjected to rigorous review, the USGS reserves the right to update the software as needed pursuant to further analysis and review. No warranty, expressed or implied, is made by the USGS or the U.S. Government as to the functionality of the software and related material nor shall the fact of release constitute any such warranty. Furthermore, the software is released on condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from its authorized or unauthorized use.

USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.14.0
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

APPENDIX C

Site Photographs from May 4, 2023

105 Old Post Road, Worthington, MA



Man-made pond; view north



Wetted portion of ditch encompassed by Wetland 1; view south



Wetland 1; view northwest



Wetland 2 where it extends slightly into southern field; view southwest



Wetland 4 with indications of livestock use; view southwest



Wetland 5; view west



Intermittent stream in southeastern corner of property; view east

Delineated Wetlands at 105 Old Post Road, Worthington



DEP Wetlands Detailed

- Barrier Beach System
- Barrier Beach-Deep Marsh
- Barrier Beach-Wooded Swamp Mixed Trees
- Barrier Beach-Coastal Beach
- Barrier Beach-Coastal Dune
- Barrier Beach-Marsh
- Barrier Beach-Salt Marsh
- Barrier Beach-Shrub Swamp
- Barrier Beach-Wooded Swamp Coniferous
- Barrier Beach-Wooded Swamp Deciduous
- Bog
- Coastal Bank Bluff or Sea Cliff
- Coastal Beach
- Coastal Dune
- Cranberry Bog
- Deep Marsh
- Barrier Beach-Open Water
- Open Water
- Rocky Intertidal Shore
- Salt Marsh
- Shallow Marsh Meadow or Fen
- Shrub Swamp
- Tidal Flat
- Wooded Swamp Coniferous
- Wooded Swamp Deciduous
- Wooded Swamp Mixed Trees

DEP Wetlands Linear Features

- SHORELINE
- HYDROLOGIC CONNECTION
- MEAN WATER LINE
- APPARENT WETLAND LIMIT
- CLOSURE LINE
- EDGE OF INTERPRETED AREA

2021 Aerial Imagery

Appendix F MHC PNF and Proof of Delivery

APPENDIX A
MASSACHUSETTS HISTORICAL COMMISSION
220 MORRISSEY BOULEVARD
BOSTON, MASS. 02125
617-727-8470, FAX: 617-727-5128

PROJECT NOTIFICATION FORM

Project Name: BlueWave Origination, LLC

Location / Address: 105 Old Post Rd

City / Town: Worthington Rd

Project Proponent

Name: BlueWave Origination, LLC

Address: 116 Huntington Avenue, Suite 601

City/Town/Zip/Telephone: Boston, MA 02116, 617-209-3122

Agency license or funding for the project (list all licenses, permits, approvals, grants, or other entitlements being sought from state and federal agencies).

Agency Name	Type of License or funding (specify)
USEPA	Constructions General Permit (CGP) eNOI
MADEP	Notice of Intent (NOI)
MADOER	Statement of Qualification (SoQ)
MADOER	Agicultural Solar Tariff Generation Unit (ASTGU)

Project Description (narrative):
Creation of a solar photovoltaic (PV) array, with a capacity of approximately 3.62 MW (DC). The site currently consists of farmland. The solar array will be a Single axis tracker ground-mounted tracker system with driven piles or ground screws. Electrical equipment will also be installed on-site on a concrete pad. (See attached project narrative)

Does the project include demolition? If so, specify nature of demolition and describe the building(s) which are proposed for demolition.

No

Does the project include rehabilitation of any existing buildings? If so, specify nature of rehabilitation and describe the building(s) which are proposed for rehabilitation.
No

Does the project include new construction? If so, describe (attach plans and elevations if necessary). Yes, the project includes the construction of a ground-mounted solar facility. Please see attached plan for more information.

APPENDIX A (continued)

To the best of your knowledge, are any historic or archaeological properties known to exist within the project's area of potential impact? If so, specify.

To the best of our knowledge, no historic or archaeological properties exist within the project area. The nearest historic properties/locations consist of the Rice, Brig. Gen. James K. Rice Monument Boulder (0.1miles) and the Rice Col. William House (0.1miles), there are a few more neighboring sites we have included (See attached MACRIS Map).

What is the total acreage of the project area?

Woodland	acres	Productive Resources:	
Wetland	acres	Agriculture	20 acres
Floodplain	acres	Forestry	acres
Open space	acres	Mining/Extraction	acres
Developed	acres	Total Project Acreage	20 acres

What is the acreage of the proposed new construction? 20 acres

What is the present land use of the project area?
Farmland used for grazing.

Please attach a copy of the section of the USGS quadrangle map which clearly marks the project location.

Please see attached map.

This Project Notification Form has been submitted to the MHC in compliance with 950 CMR 71.00.

Signature of Person submitting this form: Michael Zhe May 22, 2024 12:25 EDT Date: 24/05/22

Name: Michael Zhe

Address: 116 Huntington Avenue, Suite 601

City/Town/Zip: Boston, MA 02116

Telephone: 617-431-8758

REGULATORY AUTHORITY

950 CMR 71.00: M.G.L. c. 9, §§ 26-27C as amended by St. 1988, c. 254.

BLUEWAVE

BlueWave Origination, LLC

Project Description

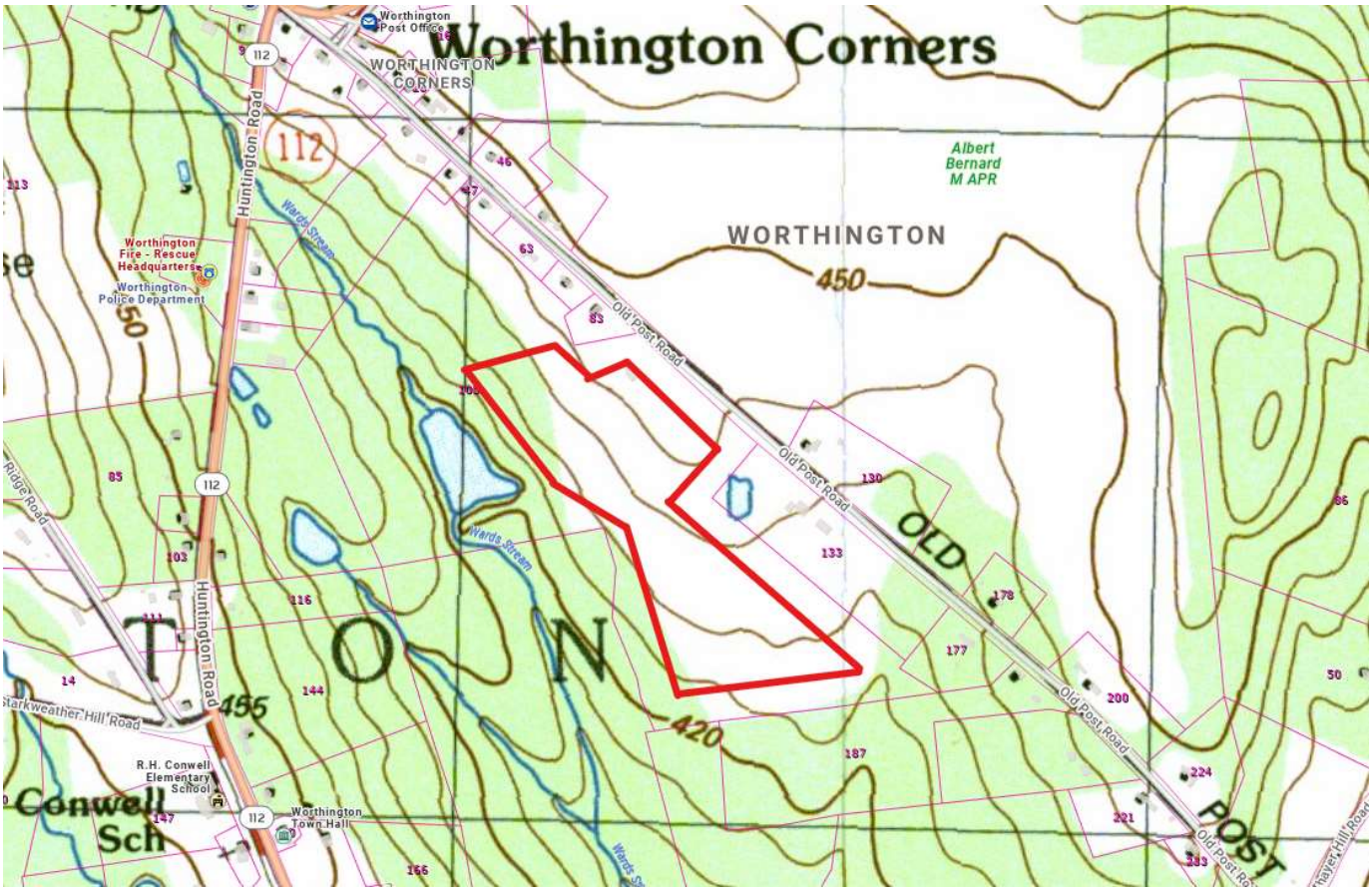
The proposed project is a 3.62 MW DC solar photovoltaic energy generating facility ("facility"). The proposed project is to be situated on parcels located 105 Old Post Rd Worthington, State of Massachusetts and identified on the Worthington Assessor's Database as Tax Parcel 407 0 96.1, and being further described in Book 10675 at Page 239 in the Hampshire County Registry of Deeds. Total acreage of the project parcel is approximately 73.56 acres; however, 20 acres of the parcel can be considered the "project area". The solar facility is shown in detail on the attached plans.

This project has not yet been permitted. BlueWave anticipates being granted a special permit from the Worthington Planning Board and submit a Notice of Intent (NOI).

The project area is currently farmland. A focus will be put on maintaining healthy soils and ecology as native, pollinator-friendly vegetation will be used within the project area.

Soils disturbances will be limited to only the construction phase of the project. Panels will be installed on racks that will consist of post or screw driven into the ground at a depth of 10' per pile to allow for the structural stability above grade to support the panels. In addition to the posts, some trenching will be required to run wire and conduit from the panels to the inverter and transformer pad.

The project will be interconnected to the electrical grid through Eversource utility poles located on Old Post Rd. Once the project is constructed, the system will require very little maintenance. When the project's operational period comes to an end, it can be extended, or the equipment will be removed, and the site will be restored to its pre-existing field conditions.



Key:

Pink: Parcel Outlines

Red: Approximate Project Location

Reference:

MassGIS

USGS Topo Map

BlueWave Origination, LLC Site Photos





Above: View of Abutter Looking North

Below: South End of Array Tree line Looking West

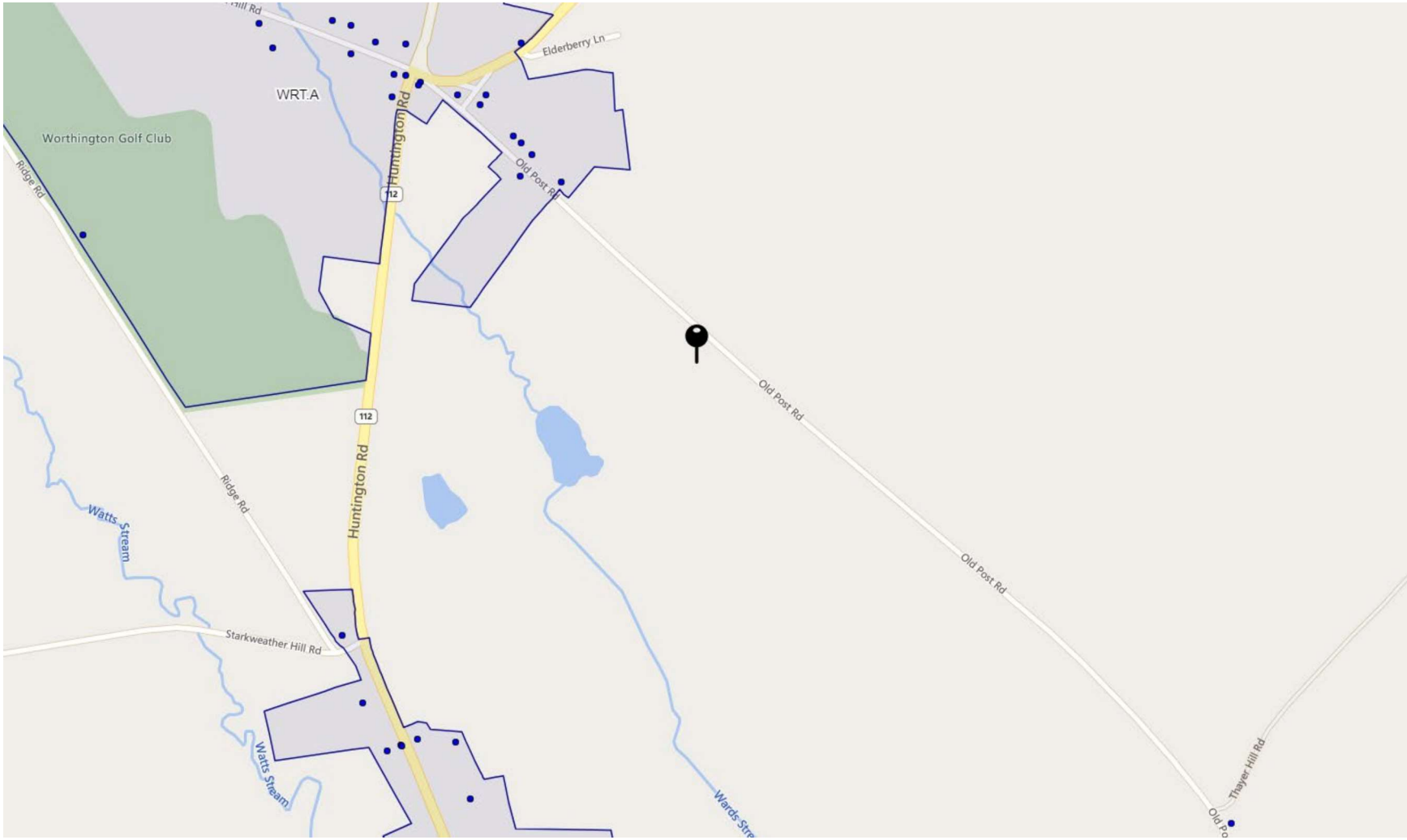
Above: Few Trees in Middle of Field to Bush Hug

Below: Northeast Corner of Array Area Looking at POI in Distance





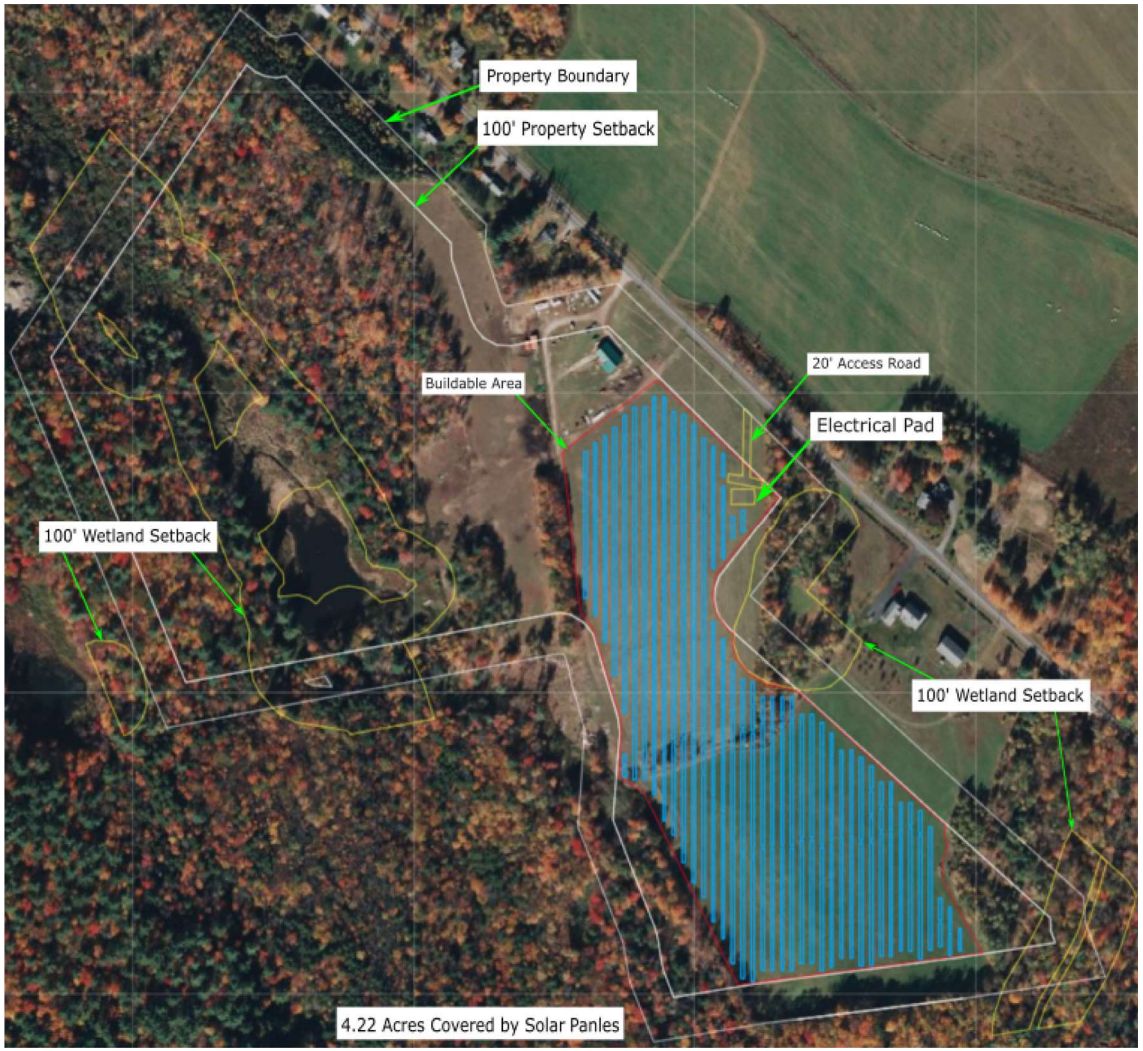
BlueWave Origination, LLC MACRIS Map



Inv. No.	Property Name	Street	Town	Year	Designations
WRT.900	Rice, Brig. Gen. James K. Rice Monument Boulder	Old Post Rd	Worthington	1923	
WRT.26	Rice, Col. William House	1 Old Post Rd	Worthington	1806	
WRT.28	Cole, Horace Merchant's House	16 Old Post Rd	Worthington	1859	
WRT.61	Cole, Horace Shoe Factory Worker Housing	24 Old Post Rd	Worthington	C 1850	
WRT.62	Cole, Horace Shoe Factory Worker Housing	28 Old Post Rd	Worthington	C 1850	
WRT.63	Worthington Inn Summer Staff House	31 Old Post Rd	Worthington	C 1910	
WRT.27	Cole, Horace Homestead	32 Old Post Rd	Worthington	C 1840	
WRT.64	Capen, Arthur House	40 Old Post Rd	Worthington	C 1905	
WRT.10	Benjamin, James House	272 Old Post Rd	Worthington	1778	
WRT.9		295 Old Post Rd	Worthington		
WRT.8		432 Old Post Rd	Worthington		

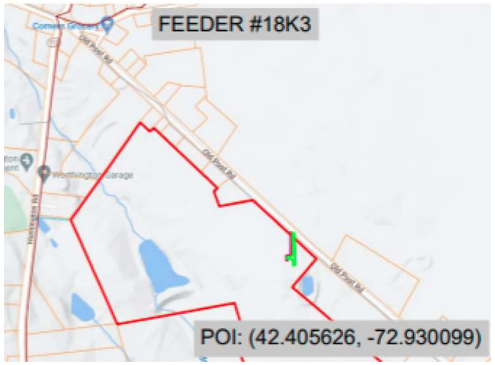
BLUEWAVE PHOTOVOLTAIC SYSTEM

MA WORTHINGTON OLD POST RD



1 PROPOSED GROUNDMOUNT PV ARRAY 3.62 MWDC: 2.66 MWAC

N



4 SITE LOCATION: OLD POST RD

N



3 SINGLE-AXIS TRACKER PV ARRAY

MODULES	580 W
ROW SPACING	18'
TRUE AZIMUTH	180°
SYSTEM SIZE DC	3.62
SYSTEM SIZE AC	2.66
ANNUAL ENERGY OUTPUT	6,455,220 kWh

2 TECHNICAL ANALYSIS

BLUEWAVE
BLUEWAVE
116 Huntington Ave
Suite 601
Boston, MA 02116
(617) 209-3122
bluewave.energy

COMMENTS

REV	DRN	DATE

© BlueWave Capital, LLC. All rights reserved. Specifications included in this drawing are subject to change without notice

PROJECT: MA WORTHINGTON OLD POST RD
150 OLD POST RD
WORTHINGTON, MA, 01098

SHEET TITLE: PRELIMINARY SITE PLAN

DRAWN BY: MG

PRINT DATE: 01/29/24

SHEET NAME: PV_P1

24-0129 Worthington 105 Old Post Rd Project Notification Form (PNF) Combined

Final Audit Report 2024-05-22

Created:	2024-05-22
By:	Melanie Guzman (mguzman@bluewavesolar.com)
Status:	Signed
Transaction ID:	CBJCHBCAABAAVG7G1EfwKWJ396_xldss5g0iO_xcldFO

"24-0129 Worthington 105 Old Post Rd Project Notification Form (PNF) Combined" History

Document created by Melanie Guzman (mguzman@bluewavesolar.com)
2024-05-22 - 3:46:57 PM GMT

Document emailed to Michael Zhe (mzhe@bluewave.energy) for signature
2024-05-22 - 3:47:03 PM GMT

Email viewed by Michael Zhe (mzhe@bluewave.energy)
2024-05-22 - 4:23:44 PM GMT

Document e-signed by Michael Zhe (mzhe@bluewave.energy)
Signature Date: 2024-05-22 - 4:25:00 PM GMT - Time Source: server

Agreement completed.
2024-05-22 - 4:25:00 PM GMT

Adobe Acrobat Sign

May 23, 2024

Dear Customer,

The following is the proof-of-delivery for tracking number: 776507748392

Delivery Information:

Status:	Delivered	**Delivered To:**	Receptionist/Front Desk
Signed for by:	S.BROWN	**Delivery Location:**	220 WILLIAM T MORRISSEY B
Service type:	FedEx Express Saver		
Special Handling:	Deliver Weekday		BOSTON, MA, 02125
		Delivery date:	May 23, 2024 09:41

Shipping Information:

Tracking number:	776507748392	**Ship Date:**	May 22, 2024
		Weight:	0.5 LB/0.23 KG

Recipient:
MASSACHUSETTS HISTORICAL COMMISSION,
220 MORRISSEY BOULEVARD
BOSTON, MA, US, 02125

Shipper:
Bluewave, BlueWave
116 Huntington Avenue
Suite 601
Boston, MA, US, 02116



Thank you for choosing FedEx

Appendix G IPaC Results

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

NOT FOR CONSULTATION

Location

Hampshire County, Massachusetts



Local office

New England Ecological Services Field Office

(603) 223-2541
(603) 223-0104

70 Commercial Street, Suite 300

Concord, NH 3301-5094

NOT FOR CONSULTATION

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

NOT FOR CONSULTATION

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Tricolored Bat Perimyotis subflavus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

Insects

NAME	STATUS
Monarch Butterfly Danaus plexippus Wherever found There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/9743	Proposed Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

You are still required to determine if your project(s) may have effects on all above listed species.

NOT FOR CONSULTATION

Bald & Golden Eagles

Bald and Golden Eagles are protected under the Bald and Golden Eagle Protection Act [2] and the Migratory Bird Treaty Act (MBTA) [1]. Any person or organization who plans or conducts activities that may result in impacts to Bald or Golden Eagles, or their habitats, should follow appropriate regulations and consider implementing appropriate avoidance and minimization measures, as described in the various links on this page.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

There are Bald Eagles and/or Golden Eagles in your project area.

Measures for Proactively Minimizing Eagle Impacts
For information on how to best avoid and minimize disturbance to nesting bald eagles, please review the National Bald Eagle Management Guidelines. You may employ the timing and activity-specific distance recommendations in this document when designing your project/activity to avoid and minimize eagle impacts. For bald eagle information specific to Alaska, please refer to Bald Eagle Nesting and Sensitivity to Human Activity.

The FWS does not currently have guidelines for avoiding and minimizing disturbance to nesting Golden Eagles. For site-specific recommendations regarding nesting Golden Eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

If disturbance or take of eagles cannot be avoided, an incidental take permit may be available to authorize any take that results from, but is not the purpose of, an otherwise lawful activity. For assistance making this determination for Bald Eagles, visit the Do I Need A Permit Tool. For assistance making this determination for golden eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

Ensure Your Eagle List is Accurate and Complete
If your project area is in a poorly surveyed area in IPaC, your list may not be complete and you may need to rely on other resources to determine what species may be present (e.g. your local FWS field office, state surveys, your own surveys). Please review the Supplemental Information on Migratory Birds and Eagles, to help you properly interpret the report for your specified location, including determining if there is sufficient data to ensure your list is accurate.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to bald or golden eagles on your list, see the "Probability of Presence Summary" below to see when these bald or golden eagles are most likely to be present and breeding in your project area.

Review the FAQs
The FAQs below provide important additional information and resources.

NAME	BREEDING SEASON

NOT FOR CONSULTATION

Bald Eagle Haliaeetus leucocephalus — Breeds Dec 1 to Aug 31

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1626

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)

Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)

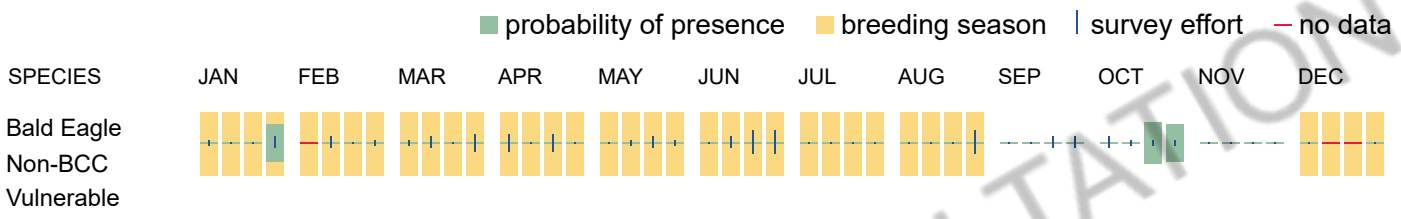
NOT FOR CONSULTATION

Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



NOT FOR CONSULTATION

Bald & Golden Eagles FAQs

What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are an eagle (Bald and Golden Eagle Protection Act requirements may apply).

Proper interpretation and use of your eagle report
On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort line or no data line (red horizontal) means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide you in knowing when to implement avoidance and minimization measures to eliminate or reduce potential impacts from your project activities or get the appropriate permits should presence be confirmed.

How do I know if eagles are breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If an eagle on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in

your “IPaC PROBABILITY OF PRESENCE SUMMARY” at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

Interpreting the Probability of Presence Graphs

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:
The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data ()
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

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Migratory birds

The Migratory Bird Treaty Act (MBTA) [1] prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior U.S. Fish and Wildlife Service (Service).

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

Measures for Proactively Minimizing Migratory Bird Impacts

Your IPaC Migratory Bird list showcases birds of concern, including Birds of Conservation Concern (BCC), in your project location. This is not a comprehensive list of all birds found in your project area. However, you can help proactively minimize significant impacts to all birds at your project location by implementing the measures in the Nationwide avoidance and minimization measures for birds document, and any other project-specific avoidance and minimization measures suggested at the link Measures for avoiding and minimizing impacts to birds for the birds of concern on your list below.

Ensure Your Migratory Bird List is Accurate and Complete

If your project area is in a poorly surveyed area, your list may not be complete and you may need to rely on other resources to determine what species may be present (e.g. your local FWS field office, state surveys, your own surveys). Please review the Supplemental Information on Migratory Birds and Eagles document, to help you properly interpret the report for your specified location, including determining if there is sufficient data to ensure your list is accurate.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the "Probability of Presence Summary" below to see when these birds are most likely to be present and breeding in your project area.

Review the FAQs

The FAQs below provide important additional information and resources.

NAME	BREEDING SEASON
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Dec 1 to Aug 31
Black-billed Cuckoo Coccyzus erythropthalmus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9399	Breeds May 15 to Oct 10

NOT FOR CONSULTATION

Bobolink Dolichonyx oryzivorus — Breeds May 20 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Canada Warbler Cardellina canadensis — Breeds May 20 to Aug 10
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Cape May Warbler Setophaga tigrina — Breeds Jun 1 to Jul 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Chimney Swift Chaetura pelagica — Breeds Mar 15 to Aug 25
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Evening Grosbeak Coccothraustes vespertinus — Breeds May 15 to Aug 10
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Olive-sided Flycatcher Contopus cooperi — Breeds May 20 to Aug 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3914

Prairie Warbler Setophaga discolor — Breeds May 1 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Rose-breasted Grosbeak Pheucticus ludovicianus — Breeds May 15 to Jul 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Veery Catharus fuscescens fuscescens — Breeds May 15 to Jul 15
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Wood Thrush Hylocichla mustelina — Breeds May 10 to Aug 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

NOT FOR CONSULTATION

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (▪)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

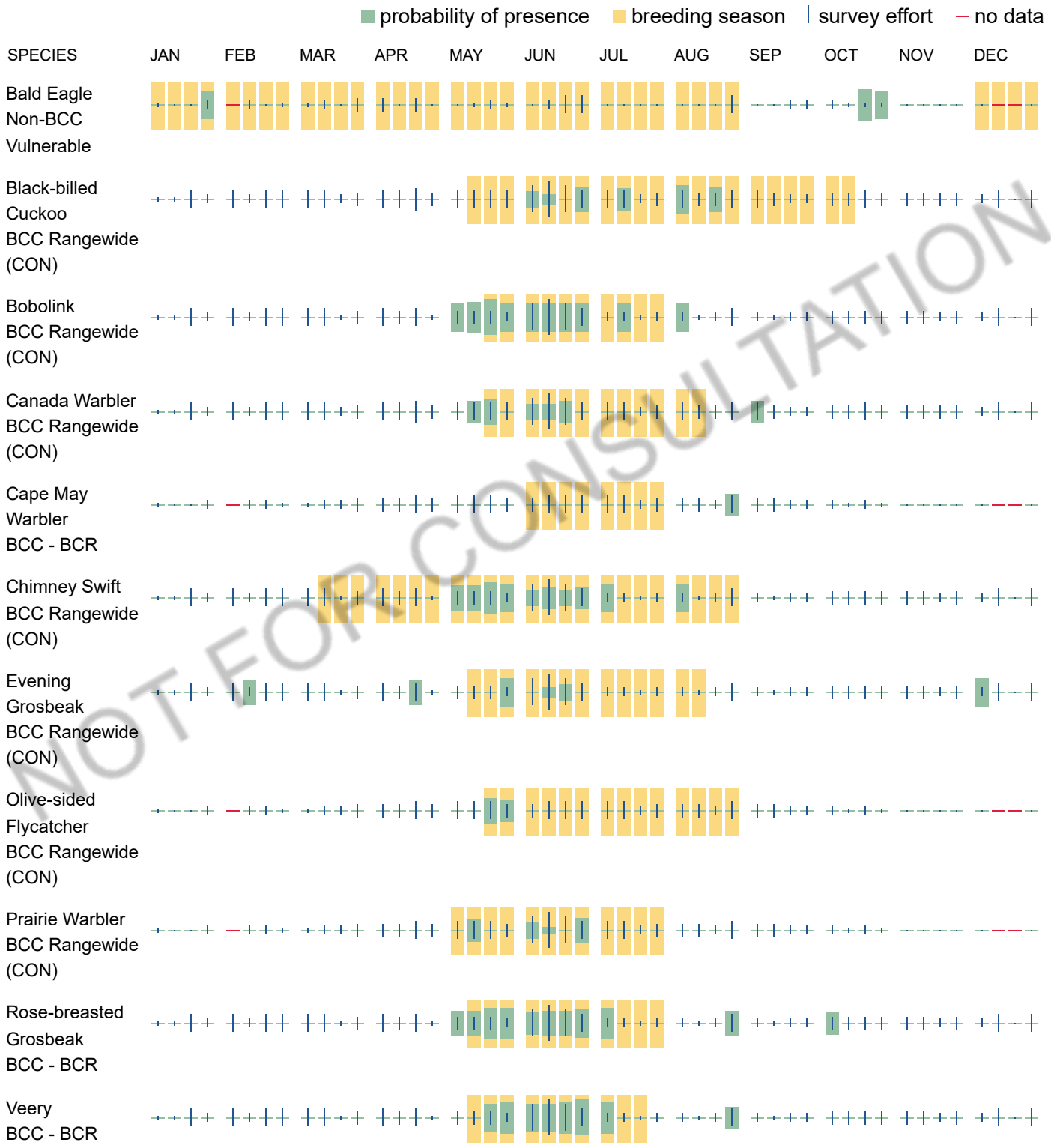
No Data (–)

NOT FOR CONSULTATION

A week is marked as having no data if there were no survey events for that week.

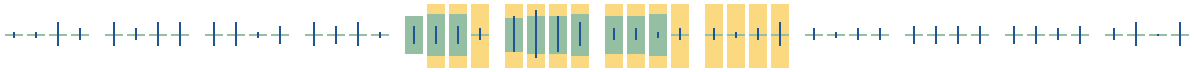
Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



NOT FOR CONSULTATION

Wood Thrush
BCC Rangewide
(CON)



Migratory Bird FAQs

Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Avoidance & Minimization Measures for Birds describes measures that can help avoid and minimize impacts to all birds at any location year-round. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is one of the most effective ways to minimize impacts. To see when birds are most likely to occur and breed in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location, such as those listed under the Endangered Species Act or the Bald and Golden Eagle Protection Act and those species marked as “Vulnerable”. See the FAQ “What are the levels of concern for migratory birds?” for more information on the levels of concern covered in the IPaC migratory bird species list.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) with which your project intersects. These species have been identified as warranting special attention because they are BCC species in that area, an eagle (Bald and Golden Eagle Protection Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, and to verify survey effort when no results present, please visit the Rapid Avian Information Locator (RAIL) Tool.

Why are subspecies showing up on my list?

Subspecies profiles are included on the list of species present in your project area because observations in the AKN for **the species** are being detected. If the species are present, that means that the subspecies may also be present. If a subspecies shows up on your list, you may need to rely on other resources to determine if that subspecies may be present (e.g. your local FWS field office, state surveys, your own surveys).

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

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Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go to the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your “IPaC PROBABILITY OF PRESENCE SUMMARY” at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Bald and Golden Eagle Protection Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially BCC species. For more information on avoidance and minimization measures you can implement to help avoid and minimize migratory bird impacts, please see the FAQ “Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds”.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Proper interpretation and use of your migratory bird report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then

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the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list does not represent all birds present in your project area. It is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide implementation of avoidance and minimization measures to eliminate or reduce potential impacts from your project activities, should presence be confirmed. To learn more about avoidance and minimization measures, visit the FAQ "Tell me about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds".

Interpreting the Probability of Presence Graphs
Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:
The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data ()
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

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Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND

- PEM1F
- PEM1C

FRESHWATER FORESTED/SHRUB WETLAND

- PFO1C
- PSS1/EM1C
- PSS1E

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FRESHWATER POND

PABH

RIVERINE

R5UBH

A full description for each wetland code can be found at the National Wetlands Inventory website

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

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Appendix H ASTGU Qualification Pre-Determination Applications

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF
ENERGY AND ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENERGY RESOURCES
100 CAMBRIDGE ST., 9TH FLOOR
BOSTON, MA 02114
Telephone: 617-626-7300
Facsimile: 617-727-0030

Maura T. Healey
Governor

Kimberley Driscoll
Lt. Governor

Rebecca L. Tepper
Secretary

Elizabeth Mahony
Commissioner

February 25, 2026

Via Electronic Mail

Sam Kitfield
BlueWave Energy
116 Huntington Ave, Suite 601
Boston, MA 02116
Email: skitfield@bluewave.energy

Dear Sam Kitfield,

This letter is in response to BlueWave Energy's Pre-Determination Form, submitted February 6, 2026, concerning the potential qualification of a proposed 2.82 MW AC solar photovoltaic installation located at 105 Old Post Road in Worthington, MA (Project) as a Dual-use Agricultural Solar Tariff Generation Unit (ASTGU) under 225 CMR 28.00. The Department of Energy Resources (Department), acting in consultation with the Massachusetts Department of Agricultural Resources (MDAR), has reviewed the request.

Special provisions for ASTGUs are detailed in both 225 CMR 28.07(5)(b)3. and the *Guideline Regarding the Definition of Dual-use Agricultural Solar Tariff Generation Units*.

Acting in accordance with 225 CMR 28.00 and applicable guidelines, the Department, in consultation with MDAR, hereby determines that the Project, as proposed, has demonstrated that it likely satisfies all criteria set forth in 225 CMR 28.00 to be considered an ASTGU.

Please be advised that this pre-determination of ASTGU eligibility is not a final Department decision, is not binding on the Department or MDAR, and does not give rise to any appeal right under M.G.L. c. 30A, or any other law. The Department, in consultation with MDAR, will make a final determination on the eligibility of the Project's status as an ASTGU at the time it issues a Statement of Qualification under 225 CMR 28.06. Such final determination may be different from the pre-determination contained in this letter if information provided by you in connection with your Pre-Determination Form is materially inaccurate or incomplete. For any material

changes to the project design, you will need to submit additional information on the design changes to the Department and MDAR for review. Please contact the Department if you have questions about what constitutes a material change.

If you have any questions regarding this pre-determination of eligibility, please contact Grace Fletcher at grace.fletcher@mass.gov.

Sincerely,



Samantha Meserve
Director, Renewable and Alternative Energy Division

Commonwealth of Massachusetts

Executive Office of Energy and Environmental Affairs
DEPARTMENT OF ENERGY RESOURCES
DEPARTMENT OF AGRICULTURAL RESOURCES

PRE-DETERMINATION FORM

DESIGN ELIGIBILITY AND FARM PLAN FOR A DUAL-USE AGRICULTURAL SOLAR TARIFF GENERATION UNIT UNDER THE SOLAR MASSACHUSETTS RENEWABLE TARGET (SMART) PROGRAM

Purpose

This pre-determination form is required for all solar PV units in advance of submitting a Statement of Qualification Application to the MA Department of Energy Resources ("Department") for qualification of a Dual-use Agricultural Solar Tariff Generation Unit ("ASTGU") under the SMART program. The form is provided to demonstrate conformance with the provisions required for ASTGUs in 225 CMR 28.07(5)(b)3 and in the *Guideline Regarding the Definition of Dual-use Agricultural Solar Tariff Generation Units*.

The UMass Amherst Clean Energy Extension advises farmers and project developers to assist in the completion of this form and to provide the required collaboration with UMass Center for Agricultural, Food and the Environment, in advising the farm plan. In preparing your ASTGU pre-determination form, it is recommended that you review the information and fact sheets available on the UMass Clean Energy Extension (CEE) website (https://ag.umass.edu/clean-energy/current-initiatives/solar-pv-agriculture) and contact CEE with any questions regarding this information. Before submitting your final pre-determination form to the Department, submit a draft version of the form to CEE, at energyextension@umass.edu. CEE will review the document with Agricultural Extension staff, and provide a letter to the applicant with any recommendations or comments regarding the proposed project plans.
Following CEE review, applicants seeking to be eligible as an ASTGU must submit the ASTGU pre-determination form, including the letter from CEE, to doer.smart@mass.gov.

This form is used by the Department and the MA Department of Agricultural Resources ("MDAR") to determine 1) that the farm site is eligible to host an ASTGU, 2) that the solar array and racking design conform with the requirements of an ASTGU, 3) that the farm plan is appropriately integrated with the shading profile determined by the required Shading Tool analysis, and demonstrates that an applicable range of productive agriculture can be maintained throughout the land covered by the array; and 4) that the farmer agrees to file annual reports on agricultural production and changes in the farm plan throughout the period of receiving the SMART tariff.

Pre-Determination Request Type

X Project meets the design criteria set forth for Agricultural Solar Tariff Generation Units in 225 CMR 28.07(5)(b)3 and the *Guideline Regarding the Definition of Agricultural Solar Tariff Generation Units*, and the attached design materials demonstrate compliance.

☐ Project seeks a waiver to the design criteria set forth for Agricultural Solar Tariff Generation Units in 225 CMR 28.07(5)(b)3 and the *Guideline Regarding the Definition of Agricultural Solar Tariff Generation Units*.

A. BASIC FARM INFORMATION

Farm Contact Person Name: Thomas Brisson ☒ Farm Owner ☒ Farm Operator
Farm Name: Stoney Acre Farm
Legal Structure: ☒ Sole Proprietor ☐ LLC ☐ Corporation
☐ Partnership ☐ Other
Mailing Address: 105 Old Post Road, Worthington, MA 01098
Street Address (if different): _____
Contact Phone: (413) 231-2514 Contact E-mail: machine.parts@hotmail.com
Check all that apply: ☐Solar facility owner ☒ Landowner ☒ Applicant

Current Type of Operation (Check all that apply):
☒ Vegetables ☒ Fruit ☒ Livestock ☐ Poultry
☐ Nursery ☒ Other: Hay

Total Acreage in Production: 150

Estimated Annual Sales: ☐ Less than $5,000 ☐ $5,000-$24,999 ☒ $25,000-$249,999
☐ $250,000-$499,999 ☐ $500,000 or more

Are any major modifications to the farm business expected in the next 5 years? ☒ Yes ☐ No
(Check all that apply.)
☐ Business Legal Structure ☐ Operation Type ☒ Expansion ☒ Diversification
☐ Retirement ☐ Sale ☐ Subdivision ☐ Other _____

SOLAR FACILITY OWNER CONTACT INFORMATION
(IF DIFFERENT FROM ABOVE)
Name: Ward Stream, LLC Business (if applicable): BlueWave
Mailing Address: 116 Huntington Ave, Suite 601, Boston, MA 02116
Street Address (if different): _____
Contact Phone: (508) 494-2698 Contact E-mail: mzimmer@bluewave.energy
Check all that apply: ☐Landowner ☐ Applicant

LANDOWNER CONTACT INFORMATION
(IF DIFFERENT FROM ABOVE)
Name: See above Business (if applicable): _____
Mailing Address: _____
Street Address (if different): _____
Contact Phone : _____ Contact E-mail: _____
Check all that apply: ☐Applicant

APPLICANT CONTACT INFORMATION
(IF DIFFERENT FROM ABOVE)
Name: N/A Business (if applicable): _____
Mailing Address: _____
Street Address (if different): _____

Contact Phone :_____ Contact E-mail:_____

B. SITE INFORMATION

Street Address: 105 Old Post Rd, Worthington

Approximate Latitude/Longitude: 42.404489, -72.930353

Assessors Map/Plat Number: N/A

Parcel/Lot Number: 407_0_96.1

Total Acreage: Parcel Acreage: 73.56; Fenced Acreage: 29.2
Land Status: For qualifying under 61A, please provide proof of either current or previous enrollment; attach the proof to this application per below.

- ☒ currently enrolled in Chapter 61A
- ☒ enrolled in Chapter 61A in previous 5 years
- ☒ Important Agricultural Farmland: *Please attach MassGIS MassMapper map showing important farmland soils*
- ☐ Fallow Farmland
- ☐ Newly Created Farmland

Will the project be implemented on APR-restricted land? ☐ Yes ☒ No
If yes, please list: Name on APR restriction:_____ Year APR recorded: _____

Will the project be implemented on land restricted by an Agricultural Covenant under the Farm Viability Enhancement Program? ☐ Yes ☒ No

Note: Please label and provide the following REQUIRED ATTACHMENTS as part of APPENDIX A: REQUIRED ATTACHMENTS, defined and found at the end of this application.

REQUIRED ATTACHMENTS for this section –

- Property map
- Soils map, if applicable
- Map of APR-restricted area, if applicable
- 61A current or previous enrollment documentation, if applicable
- CEE Letter for DOER.SMART submission

C. EXCEPTION REQUEST

Please check off the design criteria requirement(s) the Applicant is seeking an exception from:

☐ Panel Height Requirements
☐ Sunlight Requirements
☐ Growing Season Hours Considerations
☐ Other
☒ N/A

The Department recognizes the variety and, in some cases, the uniqueness of farming operations where some of the ASTGU project specification requirements may not be required to achieve the objectives of the ASTGU. To address these specific cases, an applicant may request that the Department, in consultation with MDAR, issue an exception from any of the project specification requirements. All exception requests should be submitted to DOER.SMART@mass.gov. In no case will an exception be approved by the Department if it is contrary to the intent of the regulations.

An exception request shall include the following:

i. An Alternative Plan that:

1. details how the applicant will integrate the ASTGU into their farming operation;
2. demonstrates that the Alternative Plan does not result in a diminishment in the agricultural production capacity of the land; and
3. demonstrates that the primary use of the land is for agricultural or horticultural production, as defined by M.G. L. c. 61A.

ii. Justification and Substantiation: An applicant must provide justification as to why an alternative ASTGU design is necessary for the proposed agricultural operations on the relevant parcel of land with supporting documentation.

iii. Additional Documentation: An applicant must provide documentation for each specific aspect of the project specification requirements set forth below for which the ASTGU is requesting an exception:

1. Panel Height Requirements: Explain below and provide documentation demonstrating how the proposed design will allow for the variety and flexibility of a range of potential farming operations at the farm throughout the entire SMART tariff term.

2. Sunlight Requirements

a. Explain below and provide documentation demonstrating how the proposed dual-use design will provide equal or greater total agricultural yields than if both the agricultural crop and solar array were grown and installed separately, utilizing the same amount of total land area for the comparison;

b. Explain below and provide documentation demonstrating how each square foot of land will be used for agriculture production, including at least 51% of the area directly beneath the solar modules; and

c. Explain below and provide documentation demonstrating how the design will be able to accommodate a variety of potential agricultural products throughout the SMART tariff term.

3. Growing Season Hours Considerations: Explain below and provide documentation on how the time of season and time of day data in the project specification requirements are not relevant to the farming practice and operation, currently, and for the term of the SMART Tariff.

4. Maximum Direct Current (DC) Rating: Explain below and provide documentation on the reasoning for the maximum DC rating being exceeded, if the design will result in a larger Project Footprint, and how the design will meet the intent of the ASTGU requirements in the SMART Regulation and Guideline.

5. Other: For all other requirements for which an exception is being sought, please describe the exception(s) requested, why the proposed alternatives require an exception, and how these alternatives will meet the intent of the ASTGU requirements in the SMART Regulation and Guideline.

D. SOLAR ARRAY DESIGN

Please provide the following information regarding the solar array design:

Nameplate capacity AC (in MW): 2.82 *(Note: 1 MW=1000 kW)*
Expected annual generation (in MWh): 4,862 *(Note: 1 MWh=1000 kWh)*
Acreage of farmland over which array is to be installed: +/- 16
Nameplate capacity DC (in MW): 2.94

System type: ☐ Fixed ☒ Tracking ☐ Other_____
Height of lowest panel edge (in feet):6.5' at maximum rotation, 10' in horizontal position

Height of lowest elevated horizontal mounting (in feet): 10'

Type of mounting structure and proposed materials (mono poles, I-Beams, racking, etc.):

Pile-driven or pre-drilled steel I-beams.

Description of materials and process to be used for ground penetration:

Standard solar construction equipment, materials and processes will be used to install galvanized-steel posts into the ground. The most probable, industry-standard equipment would be a rubber-tracked machine with ground pressures below those of standard agricultural tractor tires (35 psi) or duals or flotation tires at 21 psi. As with good agricultural management practice, soil decompaction will be performed if necessary following racking and panel installation.

Number of panels: 5,064 modules
Capacity per panel: 580-watt modules
Panel dimensions: 8' x 3.75' x 1.40"
Panel spacing: 0.5" between panels
Number of rows: 12, 16, 27 for 3 array sections.
55 rows total.
Distance between row mounting columns: Rows 26' center-to-center
For fixed systems horizontal tip-to-tip distance between top of panel in row in front and bottom of panel in the row behind N/A
For tracking systems distance between panels tip-to-tip in the horizontal position: 18'

If you wish to provide additional descriptive information regarding the solar array design, you may include this information below, or in a typed attachment labeled "Solar Array Design."

Note: Please label and provide the following REQUIRED ATTACHMENTS as part of APPENDIX A: REQUIRED ATTACHMENTS, defined and found at the end of this application.

REQUIRED ATTACHMENTS for this section.

The following system drawings:

- A site plan (as viewed from above) of the impacted farmland with clear depiction of the layout of all array modules, including dimensions of the overall array, each module, and all applicable spacing.
- A design drawing (from the side) of a representative module with dimensions showing panel tilt and elevations from ground.
- A design drawing of the mounting structure with details showing dimensions and all materials of the ground penetrations.
- Panel Specification sheet

E. SHADING ANALYSIS

An ASTGU must demonstrate it is in compliance with the 50% maximum shading allowance through the use of a shading analysis tool approved by the Department. This shading analysis should be completed prior to the completion of this pre-determination form.

Provide all solar array design and layout information and input data used by the shading analysis tool to conduct the shading analysis for the project.

Provide all output in the form of a screenshot from the shading analysis tool, including a site map to clearly demonstrate the simulated percent of shading over the simulated growing season of all farmland impacted by the array. The map should be discernable down to at least a per square foot scale.

Note: Please label and provide the following REQUIRED ATTACHMENTS as part of APPENDIX A: REQUIRED ATTACHMENTS, defined and found at the end of this application.

REQUIRED ATTACHMENTS for this section

- Shading Tool Screenshot
- Shading Tool Export Spreadsheet

F. AGRICULTURAL PLAN FOR DUAL-USE AREA

Planned agricultural use, Year 1. Check all that apply.

☐ Vegetable, fruit, grains, for human consumption
☒ Hay
☒ Livestock production
☐ Poultry production
☐ Horticulture
☐ Floriculture
☐ Aquaculture
☐ Other, please describe:_____

Please fill out one Crop Narrative for each crop, detailing anticipated crop management (planting, irrigation, soil amendments, harvesting) and equipment to be used. Please also fill out the Crop Table for horticulture, flowers, vegetable, fruit, grain, and hay crops. Complete one line for each crop to be grown under the solar array, including the area to be planted within the array, and expected productivity using specific units (e.g., lbs./acre, quarts per row).

Please fill out the Grazing Narrative, detailing anticipated pasture and animal management and equipment to be used. Please also fill out the Grazing Table for livestock and poultry production. Complete one line for each type of livestock or poultry to be raised under the solar array, including the area to be grazed within the array, and expected productivity using specific units (e.g. lbs of milk per year).

For all agricultural uses, please fill out the Farm Equipment Table. Complete one line for each farm vehicle to be used within the solar array.

Additional comments regarding agricultural plan for Year 1:

In Year 0, the year that construction on the solar array finishes, hay may or may not be harvested and animals may or may not be grazed, depending on the time of year in which construction finishes and the appearance of the field. Health of the soil and the permanent forage crop will be prioritized.

In Year 1, the year following construction, the array area will be used to produce hay and graze livestock.

Do you expect to grow the same crops on the land in years 2 and 3? Briefly describe your crop rotation plan and what you expect to be growing on the land for the next 5 years. Will the same equipment be used? If not, is current array design compatible with future crop management needs and equipment?

In Years 2 and 3, Stoney Acre Farm anticipates continuing to hay and graze the array area. The equipment used in Year 1 will continue to be used in years 2, 3, and beyond. Stoney Acre Farm currently sells livestock (cattle and sheep) for meat as well as round bales to area farmers, produced on a combination of land that they own and rent. It is likely that in some years, when the amount of rented land is sufficient to supply hay to all of Stoney Acre's customers, the array area will not be hayed, only grazed. Annual Reports will reflect whether the land was hayed and grazed, or exclusively grazed.

Stoney Acre Farm currently uses some of their acreage to produce fruits and vegetables for value-added products. At some point in the future, they may transition the location of this production into the array area. The array design is compatible with diverse types of farming and Stoney Acre Farm will be able to adapt their plan for farming within the array to their diversifying business.

SPECIFIC FARM INFORMATION RELATIVE TO THE ASTGU LOCATION

Please List Specific Crops Grown for the past five years with approximate acreage for the area beneath the newly proposed ASTGU array:

☐ Vegetables: _____

☐ Fruits: _____

☒ Livestock: Cattle, 16 acres

☐ Poultry: _____

☐ Nursery: _____

☒ Other: Hay, 16 acres

SPECIFIC FARM INFORMATION RELATIVE TO FARMLAND COMPLIANCES

For eligible existing farmland/newly created farmland, please confirm meeting the following items per 225 CMR 28.07(5)(b)3.c. and Section 3 of the *Guideline Regarding the Definition of Dual-use Agricultural Solar Tariff Generation Units.*

Eligible Farmland. A Dual-use Agricultural STGU must be sited on Land in Agricultural Use, land classified as Important Agricultural Farmland, Fallow Farmland, or on Newly Created Farmland.

Please indicate which of the eligible farmland definitions the project site meets:

☒ Land in Agricultural Use

☒ Important Agricultural Farmland – *a portion of the array is classified as prime farmland and farmland of statewide importance*

☐ Fallow Farmland

☐ Newly Created Farmland

Newly Created Farmland. To be deemed Newly Created Farmland, the Applicant must demonstrate the viability of agricultural production at the time a Pre-Determination Application is submitted to the Department and MDAR. Applicants may demonstrate the viability of agricultural production through soil tests, water availability, site history, farm business plans, and/or other relevant evidence.

a. Please describe how the Newly Created Farmland was developed. Please submit the supporting documentation as described above to demonstrate the viability of agricultural production.

Clearcutting Prohibition. No Newly Created Farmland Project Footprint shall be a result of the clearing or conversion of forest land that does not qualify as permissible tree clearing. Permissible tree clearing may include routine maintenance of existing field boundaries or roads, removing isolated trees in an existing cleared space, or other instances of routine agricultural activity as determined by the Department, in consultation with MDAR.

a. Please document with an existing site map that no Newly Created Farmland was the result of forest clearing or conversion.

Soil Test Requirement. For Newly Created Farmland, Applicants must provide soil tests from the UMass Amherst Soils Testing Laboratory or equivalent, demonstrating pH and macronutrients are within optimum ranges for the crops proposed to be grown.

a. Please provide soils tests as an attachment in APPENDIX A as noted at the end of this section.

Fallow Farmland. Open arable land that has not been cultivated or used in agriculture for a period of one to five years preceding the Pre-Determination Application for a Dual-use Agricultural STGU.

a. Please document with an existing site map where any of the proposed ASTGU project utilizes fallow farmland and approximate acreage.

Transitioning Greater than 10 Acres of Farmland. If, as part of its agricultural plan, the Dual-use ASTGU is proposing to transition greater than 10 acres of farmland to grazing or hay production that has not been used for those agricultural purposes during the five crop years prior to the Pre-Determination Application, the agricultural plan must demonstrate that there will be concurrent growing of Comparable Crops to the existing operation for at least the first five years of the STGU operation, consistent with the following practices:

(1) For grazing projects, a rotational plan should be included with at least 33% of the ASTGU footprint devoted to Comparable Crops.

a. Please provide a mapping plan as noted at the end of this section, and please note the Comparable Crops proposed.

(2) For hay projects, at least 50% of the ASTGU footprint must be devoted to Comparable Crops.

a. Please provide a mapping plan as noted at the end of this section, and please note the Comparable Crops proposed.

New Commodities. For the purposes of meeting the requirements above, the agricultural plan may include new commodities in the place of Comparable Crops. The agricultural plan should include the farmer's previous experience with or a working knowledge of the new commodity, an estimate or other information detailing the market viability of the new commodity, or a comparison of the economic value of the new commodity relative to current production.

a. If transitioning to new commodities, please provide the supporting documentation as described above as attachments to this application.

Note: Please label and provide the following REQUIRED ATTACHMENTS as part of APPENDIX A: REQUIRED ATTACHMENTS, defined and found at the end of this application.

REQUIRED ATTACHMENTS for this section

- Please attach a *Crop or grazing diagram overlay on the shading analysis map.*
- Please attach a copy of *Soils Tests.* (if applicable)
- Please attach a mapping plan. (if applicable)

FARM EQUIPMENT TABLE

Equipment Type	**Equipment Make & Model**	**Clearance (ft)**	**Width (ft)**	**Turning radius (ft)**	**Purpose(s) for Use within Solar Array**
Tractor	John Deere 6410	9 ft	7 ft	28 ft	Used in combination with attachments to cut, rake, dry, bale or pick up hay. Final combinations of tractors and implements to be determined.
Tractor	John Deere 6105E	8 ft 9 in	6 ft 8 in	25 ft	See above.
Tractor	John Deere 5085E	8 ft 4 in	5 ft 10 in	15 ft	See above.
Tractor	John Deere 5060E	7 ft 10 in	4 ft 10 in	15 ft	See above.
Baler	John Deere 450M	10 ft 8 in	7 ft 6 in	30 ft	Baling hay. Due to height, baler will only be driven in the interrow space.
Mower	Case IH DC102	Working height: 3 ft Transport height: 5 ft 8 in	17 ft 7 in	20 ft	Cutting hay. Stoney Acre Farm is interested in trading the Case IH DC102 for a Deere C300 mo-co with center pivot, swivel-hitch and steel rolls.
Rotary Rake	Kuhn GA4231T	Working height: 3 ft 7 in Transport: 8 ft 2 in	13 ft 10 in	30 ft	Raking hay.
Tedder	Kuhn GF5202THA	Working height: 2 ft Transport height: 9 ft	Working width: 16 ft 7 in Transport width: 9 ft 4 in	30 ft	Drying hay.

G. CROP NARRATIVE

*Please detail anticipated crop management, including approximate **dates** and **equipment** to be used. We recognize management is subject to weather, disease pressure, worker availability, etc. The purpose of this form is to demonstrate the solar array design is compatible with anticipated equipment usage and crop management needs. If you need additional space, please include a typed attachment labeled "Crop Narrative."*

Crop: *Hay*

Planting Plan: *The array area is already planted with a permanent hay mixture. Any areas damaged by construction will be re-seeded with a seed mix that matches the existing forage mix of timothy, orchardgrass and clover.*

Soil Amendment Plan: *Stoney Acre Farm typically fertilizes their pastures in the spring with a nitrogen-phosphorous-potassium mixture. They hire Helena Agri-Enterprises to spread the fertilizer and lime as needed. The exact NPK mixture, inclusion of micronutrients and application rate depends on soil tests and availability of nutrients; roughly 300 pounds per acre is typical. Based on recent soil tests which indicated either optimum or high levels of phosphorous in these fields, in 2024 the mixture did not include phosphorous.*

Cultivation Plan: *As this field is seeded with perennial hay, following post-construction seeding, no further cultivation is planned at this time.*

Irrigation Plan: *This field is not irrigated; no irrigation is planned. Worthington receives on average 52 inches of rain each year, which is sufficient for forage growth.*

Pesticide/Herbicide Plan: *Stoney Acre Farm does not currently use pesticides and does not anticipate using them broadly within the array area.*

Harvest Plan: *Stoney Acre Farm typically gets one or two cuttings of hay each year from this field. The hay will be mown when there is a dry spell expected and the grass is at an appropriate growth stage. The tedder will be used next to speed the drying process. When the hay has reached 15-18% moisture content, it will be raked and baled. The decision on when to bale is based on the practicalities of weather following mowing and the desired consumer. Stoney Acre Farm sells round bales to dairy, cow, sheep and horse producers, with horse farms requesting hay baled at lower moisture percentages. Stoney Acre Farm has many years of experience making hay and will use their best judgment to produce the most high-quality hay they can.*

CROP TABLE

Crop	**Area to be planted** ***(Row length and width or acreage, as appropriate)***	**Planting date(s)** ***(approximate)***	**Harvest date(s)** ***(approximate)***	**Expected productivity, in absence of shading**	**Expected productivity, with shading**
Hay (timothy, orchardgrass and clover)	Array acreage that needs re-seeding	Following construction, TBD based on construction impact, weather, time of year.	Late may to early July, depending on weather and labor availability.	2.58 tons/acre;	Expected 40% reduction in harvested weight due to the combination of shading, array poles, and likely harvesting only a single cut: 1.55tons/acre

H. GRAZING NARRATIVE

Please detail anticipated animal and pasture management, including ***dates*** *and* ***equipment*** *to be used. We recognize management is subject to weather, disease pressure, worker availability, etc. The purpose of this form is to demonstrate the solar array design is compatible with anticipated equipment usage and production needs. If you need additional space, please include a typed attachment labeled "Grazing Narrative."*

Type(s) of Animals to Be Grazed: *Cattle, sheep*

Pasture Management Plan: List any anticipated seeding, soil amendment, irrigation, pesticide, mowing, etc., including approximate dates and equipment to be used.

The anticipated seeding, soil amendment, irrigation, and pesticide usage on the array area are described in the Crop Narrative. After mechanically harvesting a first-cutting of hay between the array rows sometime in late May or June, Stoney Acre Farm will allow their cattle and possibly their sheep to graze the remaining forage in line with the posts. All animals have access to other pasture so the decision on whether to graze only cattle or cattle and sheep will be made based on the health of the pasture and the overall farm grazing plan. After cleaning up the remaining forage near the posts, the animals will then be moved to other pasture. When the grass recovers from the first pass of haying and grazing, after approximately 3 weeks, the cattle and sheep will be let back into the array area to graze a few acres at a time, with temporary electric fencing used to create small paddocks. If Stoney Acre Farm finds that any portion of the array is not being successfully managed using grazing, they will mow that area. Stoney Acre Farm plans to use multi-species grazing in the array, with the cattle and sheep grazing simultaneously.

Animal Management Plan:
For each type of animal to be grazed, describe anticipated management regarding housing/shelter, water source, fencing, movement, disease treatment, harvest, etc. that is expected to be carried out within the solar array area. Describe equipment to be used in these activities, and list equipment in the Farm Equipment Table.

The panels of this agrivoltaics array will provide sufficient shade and shelter for the cattle and sheep grazing the site. The sheep additionally have access to a carport on the property and all livestock have access to the woods. Livestock will have access to a water trough at all times. After haying, temporary electric fencing, in combination with the perimeter fence, will be used to divide the array area into paddocks for rotational grazing, with the size of paddocks and timing of rotation dependent on the quality of the forage at that time in the season. The animals are used to multi-species grazing and no personality conflicts are expected.

Stoney Acre Farm will use their best judgment when rotating animals through the array. In general, the pasture will be given rest periods that align with the recommendations from UMass below.

Date	***Rest Period (days)***
Mid-April to mid-May	*12-15*
June 1	*24*

July 1	*24*
August 1	*30*
September 1	*30-36*

Stoney Acre Farm has the necessary handling and veterinary equipment, skills, and knowledge to maintain the health of its livestock. Veterinary involvement will be utilized as necessary.

Describe any modifications to the solar array design made in order to reduce the risk of animal damage to the solar array, or risk of electrocution to animals.

The ASTGU has been designed with panels raised 10' at the torque tube, electrical cables buried, and perimeter feet set back a minimum of 40' from obstructions to allow for safe turning of farm equipment.

GRAZING TABLE

Type(s) of animal to be grazed	**Area to be grazed** *(acreage)*	**Grazing pressure** *(# animals per acre)*	**Purpose (e.g. meat, dairy, eggs)**	**Grazing period(s)**	**Harvest date(s)** *(if applicable)*	**Expected productivity (without solar array)**	**Expected productivity (with solar array)**
Cattle	16	2 – At any given time, Stoney Acre Farm has 25 to 40 cattle. They will adjust their target number as they adapt to farming within the array. The stocking density above refers to the estimated average density within the array area. The animals have access to additional pasture and are also fed hay from the ~150 acres that Stoney Acre Farm hays. Cattle and sheep are expected to graze in the array simultaneously, in a mixed herd.	Meat, sold as stock	July to December	When cattle reach one to two years , old.	Stoney Acre Farm expects to sell roughly 15 head per year.	No productivity is expected to be lost due to the solar array.
Sheep	16	2 – At any given time, Stoney Acre Farm has 20 – 40 sheep including lambs. The stocking density above refers to the estimated average density within the array area. The animals have access to additional pasture and are also fed hay from the ~150 acres that Stoney Acre Farm hays. Sheep and cattle are expected to graze in the array simultaneously, in a mixed herd.	Meat, fiber, sold as stock	July to December	When lambs reach six to eight months old.	Stoney Acre Farm expects to sell between 15 and 40 lambs per year.	No productivity is expected to be lost due to the solar array.

I. Compliance with Requirements of 225 CMR 28.00.

Please respond to each of the following relevant Regulatory requirements to demonstrate compliance with all eligibility requirements for ASTGUs. You may refer to other sections within this document if you feel you have previously appropriately addressed a specific line item.

225 CMR 28.07(5)(b)3. contains the following special provisions pertaining specifically to the eligibility of ASTGUs:

a. Project Design Requirements.

i. the STGU will not impede the continued use of the land beneath the solar photovoltaic modules for agricultural purposes;

Farming will be allowed to continue unimpeded due to the following design features: (i) the canopy height of 10', (ii) inter-row spacing of +/- 18', (iii) a minimum 40-foot setback from the perimeter fence to array components to allow free movement of equipment, (iv) multiple gates within the perimeter fence.

ii. the STGU is designed to optimize a balance between the generation of electricity and the agricultural productive capacity of the soils beneath;

The proposed STGU optimizes a balance between the generation of electricity and the agricultural productive capacity of the soils beneath and is in compliance with the 50% shade rule.

iii. the STGU allows for continuous agricultural activities underneath the solar photovoltaic modules, with height enough for labor or machinery as it relates to tilling, cultivating, soil amendments, harvesting, and grazing animals;

The proposed design has modules raised 10' off the ground in the horizontal position. The lowest panel edge of 6.5' at full-tilt is adequate height for labor. Tractors will be used in the middle of the inter-row spacing where height is not an issue, with implements fitting easily underneath the panels while tilted. In the event tractors must be used directly underneath panels, the farmer will stow the panels in the horizontal position or tilted away from the working row, depending on final racking design.

b. Project Specification Requirements.

i. Panel Height Requirements. The panels of Dual-use Agricultural STGUs shall meet the following height requirements.

(i) Fixed Tilt STGUs. For fixed tilt STGUs, the minimum height of the lowest panel point shall be eight feet above ground.

(ii) Tracking STGUs. For tracking STGUs, the minimum height of the panel at its horizontal position shall be ten feet above ground. This minimum height may be reduced to eight feet if the maximum sunlight reduction requirement under 225 CMR 28.07(5)(b)3.b.ii. is still met in all tilt positions and the farm operator has functional control of the tracker control system to accommodate agricultural activities.

The minimum height of the panel at its horizontal position in this tracking STGU is 10'.

ii. Sunlight Requirements. A Dual-use Agricultural STGU shall propose a sunlight reduction plan for the STGU based upon the compatibility of the STGU with the proposed agricultural crops and productivity. The plan shall utilize the best available information as indicators, including, but not limited to, photosynthetic active radiation and light saturation data and qualitative information. The maximum sunlight reduction from a Dual-use Agricultural STGU's panels on every square foot of land directly beneath, behind, and in areas adjacent to and within the STGU's design shall not be more than 50% of baseline field conditions during the Growing Season Hours, unless the Applicant can demonstrate that an exception should be granted pursuant to 225 CMR 28.07(5)(b)3.b.iv.

Per the shading tool analysis at an interrow spacing of 18', the maximum sunlight reduction on every square of land directly beneath, behind and in the areas adjacent to and within the ASTGU's area will not exceed 50%. Maximum shade is 49% and average shade underneath and between the rows is 42%.

The reduced sunlight intensity is expected to have minimal impact on the production of orchardgrass, timothy and clover hay. At 50% shade, orchard grass has been shown to yield between 71% and 99% of "open-field" yields, depending on variety and season (see Attachment C2 referencing C.H. Lin, et al, "Shade effects on forage crops with potential in temperate agroforestry practices," Agroforestry Systems, 1999.) The maximum yield decrease observed in that study is for white clover, at a 52% decrease in 50% shade in spring-early summer. Given the availability of indirect light in the array, we expect actual yield reduction to be lower than what is shown in the "Forage Shading Table".

iii. Maximum Direct Current (DC) Rating. The maximum DC capacity rating of a Dual-use Agricultural STGU shall be no more than twice the AC capacity rating of the STGU and shall not exceed 7,500 kW DC.

The maximum DC capacity of the STGU is 4.00 MW and the maximum AC capacity is 3.00 MW. This 1.33:1 DC/AC ratio complies with the guidelines.

Note: Please label and provide the following REQUIRED ATTACHMENTS as part of APPENDIX A: REQUIRED ATTACHMENTS, defined and found at the end of this application.

- Design drawing including mounting system type (fixed, tracking), panel tilt, panel row spacing, individual panel spacing, for pole towers tower spacing and mounting height, *etc.*

J. SIGNATURES AND ATTESTATIONS

Prior to submitting the Pre-Determination Form, please read and sign as directed below.

Landowner

I hereby certify that I have personally examined and am familiar with the information submitted herein, and, based upon my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete.

Thomas Wesson Jr (Feb 4, 2026 19:12:15 EST)
Signature of Landowner

Date 04/02/2026

Farm Operator and Landowner

I/we hereby certify that the information submitted regarding the current farm conditions and practice and the Agricultural Plan for the Dual-Use Area is accurate and complete to the best of my/our knowledge and intentions, and that I/we have engaged with the University of Massachusetts Amherst Clean Energy Extension and thereby its agricultural extension service to review the Agricultural Plan and its compatibility with the solar array structures and shading. Further, I/we agree, conditional on being provided eligibility to the SMART program as an ASTGU, to submit a report, through a template provided by the University of Massachusetts Clean Energy Extension, annually throughout the duration of the SMART incentive with ASTGU adder, on the operations and productiveness of the solar array and agriculture along with any changes to the Agricultural Plan for the following year. I/we understand that failure to maintain productive agricultural activities and annual reporting may result in the disqualification of the facility as an ASTGU in the SMART program.

Thomas Wesson Jr (Feb 4, 2026 19:12:15 EST)
Signature of Farm Operator

04/02/2026
Date

Thomas Wesson Jr (Feb 4, 2026 19:12:15 EST)
Signature of Landowner

04/02/2026
Date

Solar Facility Owner

I hereby certify that the information submitted regarding the Solar Array Description and inputs and outputs of the Shading Analysis is accurate and complete to the best of my/our knowledge and intentions.

Michael Zimmer
Signature of Solar Facility Owner

04/02/2026
Date

APPENDIX A - REQUIRED ATTACHMENTS:

Please provide all required attachments referenced in this application under this section, labelled as follows:

A. SITE INFORMATION:

A1 - Property map

A2 - Soils map, if applicable

A3 - Map of APR/FVEP-restricted area, if applicable

A4 - 61A current or previous enrollment documentation

A5 – CEE Letter for DOER.SMART submission

B. SOLAR ARRAY DESIGN

The following system drawings:

B1 - A site plan (as viewed from above) of the impacted farmland with clear depiction of the layout of all array modules, including dimensions of the overall array, each module, and all applicable spacing.

B2 - A design drawing (from the side) of a representative module with dimensions showing panel tilt and elevations from ground.

B3 - A design drawing of the mounting structure with details showing dimensions and all materials of the ground penetrations.

B4 - Panel specification sheet

C. SHADING ANALYSIS

C1 - Shading Tool Screenshot

D. AGRICULUTRAL PLAN FOR DUAL-USE AREA

D1 - Please attach a *Crop or grazing diagram overlay on the shading analysis map.*

D2 - Soils Tests (if applicable)

D3 - Please attach a mapping plan (if applicable)

E. Compliance with Requirements of 225 CMR 28.00.

E1 - design drawing including mounting system type (fixed, tracking), panel tilt, panel row spacing, individual panel spacing, for pole towers tower spacing and mounting height, *etc.*

Microsoft Word - ASTGU Pre-Determination Form.docx

Final Audit Report 2026-02-05

Created:	2026-02-04
By:	Sam Kitfield (skitfield@bluewavesolar.com)
Status:	Signed
Transaction ID:	CBJCHBCAABAA2Ack0kPphMh2N2b3XiCiJBDEWaV3mJPl

"Microsoft Word - ASTGU Pre-Determination Form.docx" History

Document created by Sam Kitfield (skitfield@bluewavesolar.com)
2026-02-04 - 1:39:44 AM GMT

Document emailed to Thomas Brisson (machine.parts@hotmail.com) for signature
2026-02-04 - 1:39:50 AM GMT

Email viewed by Thomas Brisson (machine.parts@hotmail.com)
2026-02-04 - 1:42:34 AM GMT

Signer Thomas Brisson (machine.parts@hotmail.com) entered name at signing as Thomas Brisson Jr
2026-02-05 - 0:12:13 AM GMT

Document e-signed by Thomas Brisson Jr (machine.parts@hotmail.com)
Signature Date: 2026-02-05 - 0:12:15 AM GMT - Time Source: server

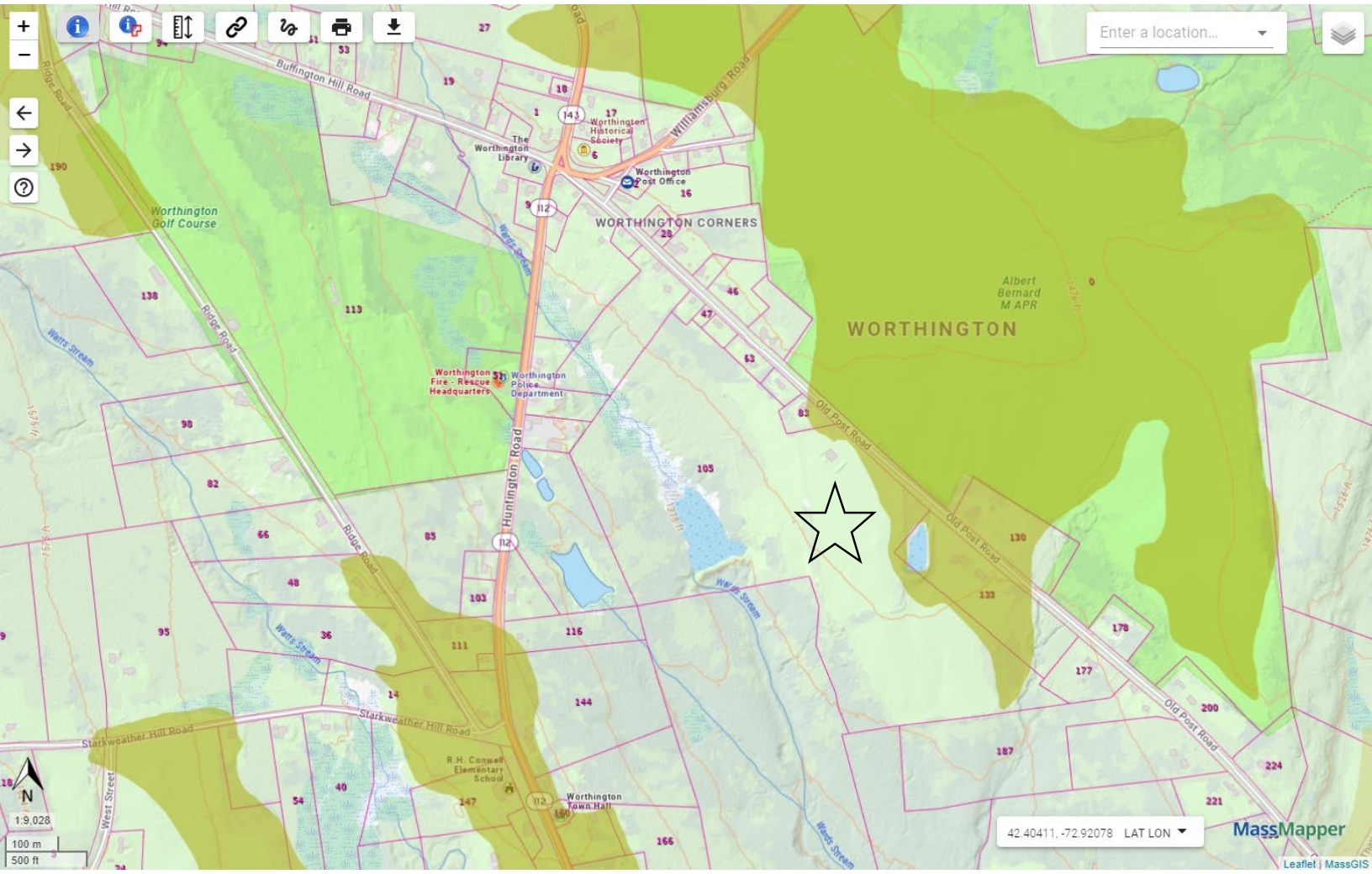
Document emailed to Michael Zimmer (mzimmer@bluewavesolar.com) for signature
2026-02-05 - 0:12:17 AM GMT

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2026-02-05 - 0:40:39 AM GMT

Document e-signed by Michael Zimmer (mzimmer@bluewavesolar.com)
Signature Date: 2026-02-05 - 0:41:12 AM GMT - Time Source: server

Agreement completed.
2026-02-05 - 0:41:12 AM GMT

Attachment A1



Attachment A2



Attachment A2

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
122C	Tunbridge-Lyman complex, 8 to 15 percent slopes, rocky	15.8	51.5%
360A	Peru fine sandy loam, 0 to 3 percent slopes	1.7	5.5%
905C	Peru-Marlow association, 3 to 15 percent slopes, extremely stony	13.1	42.7%
922B	Pillsbury-Peacham-Wonsqueak association, 0 to 8 percent slopes, extremely stony	0.1	0.2%
Totals for Area of Interest		**30.7**	**100.0%**

122C—Tunbridge-Lyman complex, 8 to 15 percent slopes, rocky

Map Unit Setting

National map unit symbol: 2trpn
Elevation: 430 to 1,870 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 52 degrees F
Frost-free period: 60 to 160 days
Farmland classification: Not prime farmland

360A—Peru fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2ty5w
Elevation: 920 to 1,710 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: All areas are prime farmland

905C—Peru-Marlow association, 3 to 15 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2ty7p
Elevation: 790 to 2,100 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: Not prime farmland

Attachment A4

2013 00031580
Bk: 11559Pg: 190 Page: 1 of 1
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THE COMMONWEALTH OF MASSACHUSETTS

WORTHINGTON

OFFICE OF THE BOARD OF ASSESSORS

CLASSIFIED FOREST-AGRICULTURAL OR HORTICULTURAL-RECREATIONAL TAX LIEN

The Board of Assessors of the Town of Worthington hereby states that it has accepted and approved the application of Thomas L. Brisson, Jr.
owner(s) of the real property described below, for the valuation, assessment and taxation of that property as classified forest agricultural or horticultural **X** recreational land under the provisions of the General Laws Chapter 61 61A **X** 61B . This classification is effective as of January 1, 2013 for the fiscal year beginning July 1, 2013.

DESCRIPTION OF PROPERTY

Assessors Map 407, Lots 96.1 & 96.6 comprised of 30.645 acres of farmland of the 73.564 acres of land located at 105 Old Post Road, as recorded in a deed in Book 10675, Page 239.

This statement made on the thirtieth day of December, 2013 constitutes a lien upon the property as provided in General laws Chapter 61 S2 61A S9 **X** 61B S6 .

Beverly J. Bowman
Jean Boudreau
BOARD OF ASSESSORS

THE COMMONWEALTH OF MASSACHUSETTS

Hampshire ss. 30 December 2013.

Then personally appeared the above named Jean Boudreau, a member of the Board of Assessors in the Town of Worthington, known to me through personal knowledge, and acknowledged the foregoing to be their free act and deed before me.

Kirsten A. Henshaw
Notary Public Kirsten A. Henshaw
My commission expires: April 11, 2014

FORM 890 A

THIS FORM APPROVED BY THE DEPARTMENT OF REVENUE

ATTEST: HAMPSHIRE, Mary Olberding, REGISTER
MARY OLBERDING

Attachment A4 (cont.)

Unofficial Property Record Card - Worthington, MA

General Property Data

Parcel ID	407 0 96.1	Account Number	
Prior Parcel ID	--		
Property Owner	BRISSON THOMAS L JR	Property Location	105 OLD POST RD
		Property Use	017
Mailing Address	105 OLD POST ROAD	Most Recent Sale Date	10/4/2011
		Legal Reference	10675-239
City	WORTHINGTON	Grantor	CHASE ENTERPRISES CORP,
Mailing State	MA Zip 01098	Sale Price	212,000
ParcelZoning		Land Area	73.560 acres

Current Property Assessment

Card 1 Value	Building Value	Xtra Features Value	Land Value	Total Value
	369,700	8,100	74,446	452,246

Building Description

Building Style RANCH	Foundation Type CONCRETE	Flooring Type HARDWOOD
# of Living Units 1	Frame Type WOOD	Basement Floor CONCRETE
Year Built 2012	Roof Structure GABLE	Heating Type FORCED H/W
Building Grade AVERAGE	Roof Cover METAL	Heating Fuel GAS
Building Condition Good	Siding LOGS	Air Conditioning 0%
Finished Area (SF) 1680	Interior Walls DRYWALL	# of Bsmt Garages 1
Number Rooms 5	# of Bedrooms 2	# of Full Baths 2
# of 3/4 Baths 0	# of 1/2 Baths 0	# of Other Fixtures 1

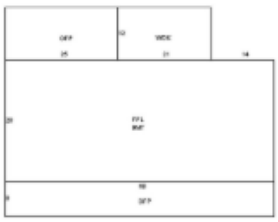
Legal Description

CH 61A plan expires 12-31-23 = 37.864 A; See PB 225 Pg 23 in 2011 for both 96.1 & 96.6; 2023- 28 ground mount solar panels = 11.06 kw

Narrative Description of Property

This property contains 73.560 acres of land mainly classified as 017 with a(n) RANCH style building, built about 2012 , having LOGS exterior and METAL roof cover, with 1 unit(s), 5 room(s), 2 bedroom(s), 2 bath(s), 0 half bath(s).

Property Images





Disclaimer: This information is believed to be correct but is subject to change and is not warranteed.

Previous Assessments

Year	Code	Building	Yard Items	Land Value	Square Feet	Special Land	Total
2025	101 - ONE FAM	369,700	8,100	62,100	2.00	0.00	439,900
2025	713 - HAY/GRN/TILL	0	0	9,166	33.70	58,167.00	9,166
2025	717 - PRDWOOD	0	0	3,180	37.86	62,129.00	3,180
2024	101 - ONE FAM	342,900	7,500	54,000	2.00	0.00	404,400
2024	713 - HAY/GRN/TILL	0	0	8,425	33.70	50,125.00	8,425
2024	717 - PRDWOOD	0	0	3,786	37.86	53,004.00	3,786
2023	101 - ONE FAM	298,100	6,600	54,000	2.00	0.00	358,700
2023	713 - HAY/GRN/TILL	0	0	7,751	33.70	50,799.00	7,751
2023	717 - PRDWOOD	0	0	4,089	37.86	52,701.00	4,089
2022	101 - ONE FAM	254,900	5,500	54,000	2.00	0.00	314,400
2022	713 - HAY/GRN/TILL	0	0	7,246	33.70	51,304.00	7,246
2022	717 - PRDWOOD	0	0	4,392	37.86	52,398.00	4,392
2021	101 - ONE FAM	219,300	5,400	54,000	2.00	0.00	278,700
2021	713 - HAY/GRN/TILL	0	0	6,605	33.70	51,945.00	6,605
2021	717 - PRDWOOD	0	0	4,581	37.86	52,209.00	4,581
2020	101 - ONE FAM	209,300	5,400	54,000	2.00	0.00	268,700
2020	713 - HAY/GRN/TILL	0	0	6,605	33.70	51,945.00	6,605
2020	717 - PRDWOOD	0	0	4,581	37.86	52,209.00	4,581

Current and previous assessments from Patriot Properties, showing the breakdown of the 73.5 acres by crop and use code denoting 61A hay land and productive woodland. Note that “square feet” refers to acres.
https://worthington.patriotproperties.com/RecordCard.asp

Attachment A5

The applicant submitted a Pre-Determination Application for the proposed array to DOER on October 24, 2024 and received a pre-determination of eligibility on December 18, 2024. Included in that application were comments received from UMass CEE on July 15, 2024. This application has not been re-reviewed by UMass CEE. The original comments are included in this attachment, with updated answers added where necessary.

UMassAmherst

Clean Energy Extension

ag.umass.edu/clean-energy

The Clean Energy Extension is an Affiliate of the UMass Amherst Center for Agriculture, Food and the Environment

209 Agricultural Engineering Building • University of Massachusetts • 250 Natural Resources Way • Amherst, MA 01003 • p: 413.545.8510

June 21, 2024

Reference: Comments on ASTGU Pre-determination Application
105 Old Post Rd, Worthington, MA

Dear Gabrielle Hayes, Thomas Brisson, Mark Sylvia, and Michael Zhe,

The attached document contains comments and suggestions regarding your draft Pre-Determination Form for an Agricultural STGU to be developed at the above referenced property. Under the Solar Massachusetts Renewable Target (SMART) program, all applicants for Agricultural STGU projects are required to collaborate with the UMass Center for Agriculture, Food, and the Environment in development of an agricultural plan for farming activities to take place under and around the proposed solar PV array. In this capacity, UMass clean energy and agricultural extension staff are reviewing draft Agricultural STGU Pre-Determination Forms to provide farmers and developers with recommendations to improve their applications. We share these comments with the Massachusetts Department of Agricultural Resources and Department of Energy Resources, but UMass Extension provides this feedback as part of its outreach and education services, and serves no decision-making role in the success or failure of a pre-determination request.

If you have additional questions, or would like to schedule a site visit to consult with agricultural and energy extension staff regarding your agricultural plan and project-specific operational considerations, please contact Mary Kraus at mlkraus@umass.edu or 413-545-8514. You can also find additional information about the SMART program, and dual-use Agricultural STGU projects in particular, on the Clean Energy Extension website: http://ag.umass.edu/clean-energy/solarag.

You are not required to revise your Pre-Determination Form before submitting the final version to the Massachusetts Department of Energy Resources (MA DOER). However, if you would like us to review an updated draft Pre-Determination Form prior to submission to MA DOER, please include a document that specifically identifies which comments have been addressed, and indicate where changes have been made in the revised Form.

Thank you,

Dwayne Breger
Director, Clean Energy Extension

UMASS AMHERST

The Center for Agriculture, Food and the Environment and its units are equal opportunity providers and employers, United States Department of Agriculture cooperating. Contact your local Extension office for information on disability accommodations. Contact the State Center Director's Office if you have concerns related to discrimination, 413-545-4800 or see ag.umass.edu/civil-rights-information/civil-rights-information-resources.

Comments regarding Pre-Determination Application for an ASTGU at 105 Old Post Rd, Worthington, MA

B. Site Information

Attachment A4 – 61A enrollment documentation: The application notes that the land is currently enrolled in Chapter 61A. The attachments appear to document 2013 status, and reference an application for 61A status that was submitted for FY 2025. Please provide documentation that shows the current land status.

We have added the property card from Patriot Properties and a screenshot of "Previous Assessment" data that shows the various land use codes for the parcel, including 33.7 acres coded 713 – HAY/GRN/TILL. You can verify this information by going to https://worthington.patriotproperties.com/Summary.asp?AccountNumber=398 and looking at the "Previous Assessment" tab. Per the Massachusetts Property Type Classification Codes prepared by the Bureau of Local Assessment and revised in April 2019, use codes beginning with 7 refer to Agricultural/Horticultural land enrolled in Chapter 61A.

D. Solar Array Design

Number of Panels: This is called out as 4950 here, but a note on Attachment B-1 states 5250 modules; please correct to be consistent.

2024 Response: This has been corrected. The current estimated number of panels is 5304.

2026 Response: Re-corrected based on updated engineering designs. The current number of modules in the design is 5,064.

Attachment B1 – Site Plan: This application requires a clear depiction of the layout of all array modules, including dimensions of the overall array, each module, and all applicable spacing. From your application, we are not able to identify the following items: distance between edge of array and fence, and length of rows; please add these to the site plan.

2024 Response: Distance between edge of array and fence (40 ft) has been added to the plan. We are unable to provide an estimate of the length of individual rows this early in the design process.

F. Agricultural Plan for Dual-Use Area

Attachment D2 – Soils tests: As noted on the application form, the soil testing is to be done at the UMass Soil Testing Lab or equivalent. The UMass Soil Testing Lab uses a methodology different from that of many other labs. The attached soil test report lacks the crucial Al and Pb levels, as well as base saturation, which is also important for determining soil fertility.

2024 Response: Results from UMass Soil Testing Lab have been included in the current application. Both portions of the field have very low levels of lead (0.4 ppm). The northern portion of the pasture has a high level of aluminum, but given the pH of 6.0, we are not concerned about this.

2026 Response: No soil tests have been included in the current application as the ASTGU does not involve the creation of new farmland.

G. Crop Narrative

Soil Amendment Plan: The attached 2023 soil test indicates the land has a very high phosphorus level. However, the note about the NPK mixture implies that phosphorus is still being applied. Please clarify whether this is the case, and if so, please explain the rationale.

In 2023, the fertilizer mixture recommended by Helena Agri-Enterprises included only a small amount of phosphorous – the NPK mixture was 25-5-20. In 2024, based on soil tests, the mixture included no phosphorous and a small amount of sulfur. The mixture recommended by Helena Agri-Enterprises is designed to be spread on all the fields that Stoney Acre Farm annually fertilizes. Thus, there is a possibility that in a given year, the mixture won't be perfectly ideal for a given field. However, Stoney Acre Farm overall is satisfied with the service being provided by Helena; they have seen significant yield improvements in fields they have managed for several years and have confidence in their fertilizing scheme going forward.

Grazing Table

Area to be Grazed: This is noted as 16 acres for both cattle and sheep. Please explain whether each type of animal is using 16 acres in total. If so, please clarify which animal grazes first and which animal comes in after the first group finishes grazing.

Stoney Acre Farm will decide on the grazing plan based on their herd sizes, the productivity of the pasture in the array area, and the grazing plan for all of the land they manage. Cattle will graze the array area, with sheep grazing as a possibility. If sheep are included, they will graze the paddocks alongside the cows, in a mixed herd. Stoney Acre Farm has had success with multi-species grazing in the past.

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF
ENERGY AND ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENERGY RESOURCES
100 CAMBRIDGE ST., 9TH FLOOR
BOSTON, MA 02114
Telephone: 617-626-7300
Facsimile: 617-727-0030

Maura T. Healey
Governor

Kimberley Driscoll
Lt. Governor

Rebecca L. Tepper
Secretary

Elizabeth Mahony
Commissioner

September 17, 2024

Via Electronic Mail

Gabrielle Hayes
BlueWave Energy
d/b/a BlueWave Origination, LLC
116 Huntington Ave, Suite 601
Boston, MA 02116
Email: ghayes@bluewave.energy

Dear Gabrielle Hayes,

This letter is in response to BlueWave Energy's (Applicant) Pre-Determination Form (Request), submitted August 1, 2024, concerning the potential qualification of a proposed 2.82 MW AC solar photovoltaic installation located at 105 Old Post Road in Worthington, MA (Project) as an Agricultural Solar Tariff Generation Unit (ASTGU) under 225 CMR 20.00. The Department of Energy Resources (Department), acting in consultation with the Massachusetts Department of Agricultural Resources (MDAR), has reviewed the Request.

Special provisions for ASTGUs are detailed in both 225 CMR 20.06(1)(d) and the *Guideline Regarding the Definition of Agricultural Solar Tariff Generation Units* (Guideline).

Special provisions for ASTGUs are detailed in 225 CMR 20.06(1)(d) as follows:

> In order to qualify as an Agricultural Solar Tariff Generation Unit, a Solar Tariff Generation Unit must submit documentation itemized in 225 CMR 20.06(1)(d). All final determinations regarding the eligibility of such facilities will be made by the Department, in consultation with MDAR. An Agricultural Solar Tariff Generation Unit must also submit satisfactory documentation to the Department as detailed in the Department's *Guideline Regarding the Definition of Agricultural Solar Tariff Generation Units*.
>
> 1. the Solar Tariff Generation Unit will not interfere with the continued use of the land beneath the canopy for agricultural purposes;

2. the Solar Tariff Generation Unit is designed to optimize a balance between the generation of electricity and the agricultural productive capacity of the soils beneath;
3. the Solar Tariff Generation Unit is a raised structure allowing for continuous growth of crops underneath the solar photovoltaic modules, with height enough for labor and/or machinery as it relates to tilling, cultivating, soil amendments, harvesting, etc. and grazing animals;
4. crop(s) to be grown to be provided by the farmer or farm agronomist in conjunction with UMass Amherst agricultural extension services, including compatibility with the design of the agricultural solar system for such factors as crop selection, sunlight percentage, etc.;
5. annual reporting to the Department and MDAR of the productivity of the crop(s) and herd, including pounds harvested and/or grazed, herd size growth, success of the crop, potential changes, etc., shall be provided after project implementation and throughout the SMART incentive period; and
6. other system design information, which shall include, but not be limited to:
    a. dual-use type, e.g., ground mount racking, pole towers, tracking, etc.;
    b. total gross acres of open farmland to be integrated with the project;
    c. type of crop(s) to be grown, including grazing crops;
    d. pounds of crop(s) projected to be grown and harvested, or grazed;
    e. animals to be grazed with herd size(s); and
    f. design drawing including mounting system type (fixed, tracking), panel tilt, panel row spacing, individual panel spacing, for pole tower spacing and mounting height, etc.

Additionally, the Guideline sets forth the following System Design Parameters for eligible projects:

i. Panel Height Requirements:
    1. For fixed tilt ASTGUs, the minimum height of the lowest panel point shall be eight (8) feet above ground.
    2. For tracking ASTGUs, the minimum height of the panel at its horizontal position shall be 10 feet above ground.
ii. Maximum Direct Sunlight Reduction Requirements:
    All ASTGUs must demonstrate that the maximum sunlight reduction from the panel shading on every square foot of land directly beneath, behind and in the areas adjacent to and within the ASTGU's design shall not be more than 50% of baseline field conditions as calculated by the SMART Tool.
iii. Compatible Sunlight Needs:
    Per SMART Regulations 225 CMR 20.06(1)(d)(4), applicant shall provide documentation that the project's proposed solar design's sunlight amount and sunlight reduction is based upon the compatibility with the proposed agricultural crops and productivity, utilizing best available information as indicators, such as photosynthetic active radiation (PAR) and light saturation data; and qualitative information, e.g., sun-loving, partial sunlight, shade tolerant.
iv. Growing Season/Time of Day Considerations:

The typical growing season shall be March through October, with sunlight hour conditions with maximum 50% sunlight reduction to be between 10AM and 5PM for March and October, and from 9AM to 6PM from April through September.

v. Maximum ASTGU Rated Capacity:

The maximum AC rated capacity of an ASTGU shall be five (5) MW. The maximum DC rating shall be 2:1 DC to AC ratio and shall not exceed 7.5 MW DC.

Acting in accordance with 225 CMR 20.00 and applicable guidelines, the Department, in consultation with MDAR, hereby determines that the Project, as proposed, has demonstrated that it likely satisfies all criteria set forth in 225 CMR 20.00 to be considered an ASTGU.

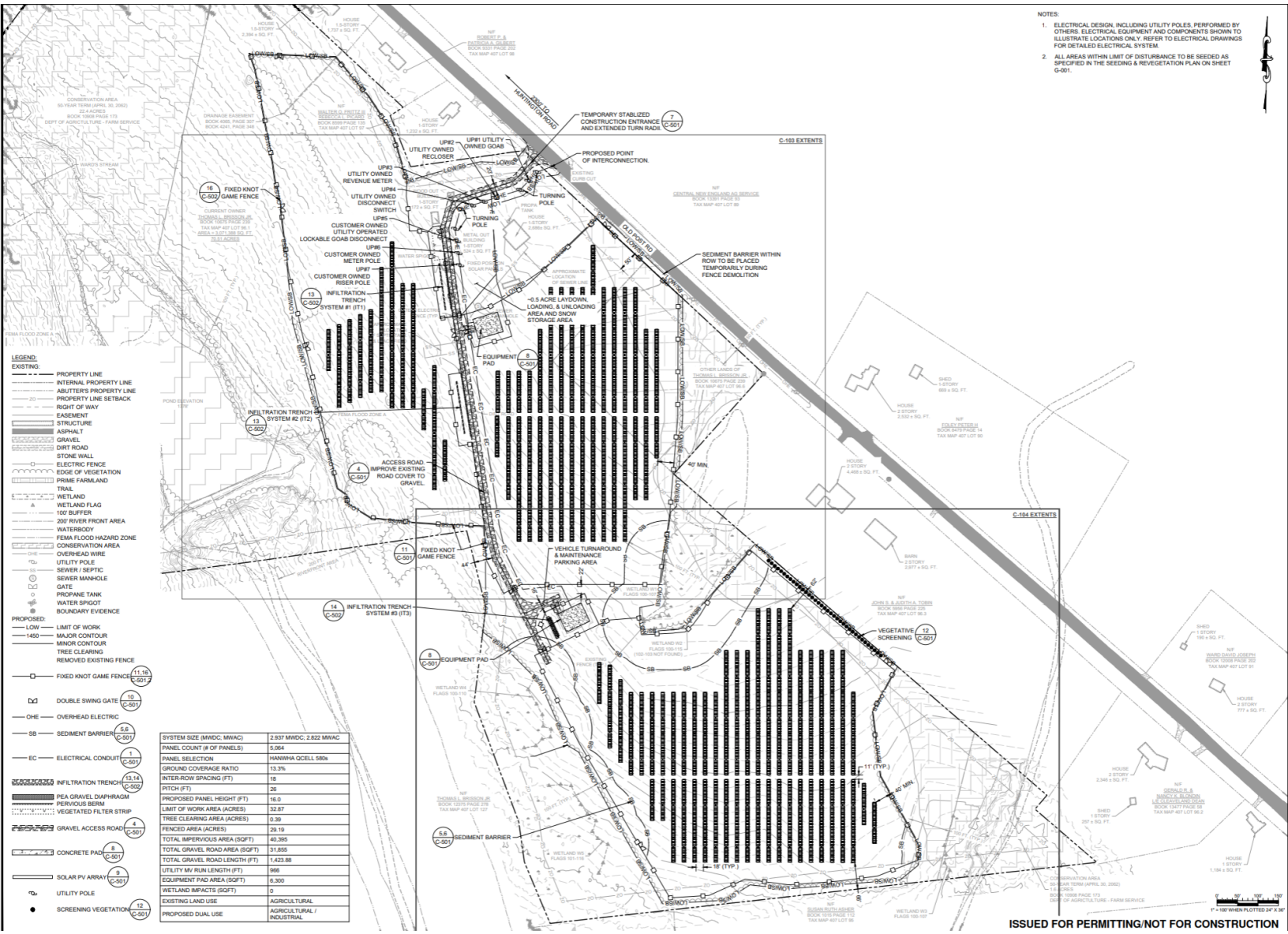
Please be advised that this pre-determination of ASTGU eligibility is not a final Department decision, is not binding on the Department or MDAR, and does not give rise to any appeal right under M.G.L. c. 30A, or any other law. The Department, in consultation with MDAR, will make a final determination on the eligibility of the Project's status as an ASTGU at the time it issues a Statement of Qualification under 225 CMR 20.06. Such final determination may be different from the pre-determination contained in this letter if information provided by you in connection with your Pre-Determination Form is materially inaccurate or incomplete. For any material changes to the project design, you will need to submit additional information on the design changes to the Department and MDAR for review. Please contact the Department if you have questions about what constitutes a material change.

If you have any questions regarding this pre-determination of eligibility, please contact Grace Fletcher at grace.fletcher@mass.gov.

Sincerely,

Samantha Meserve
Director, Renewable and Alternative Energy Division

Attachment B-1

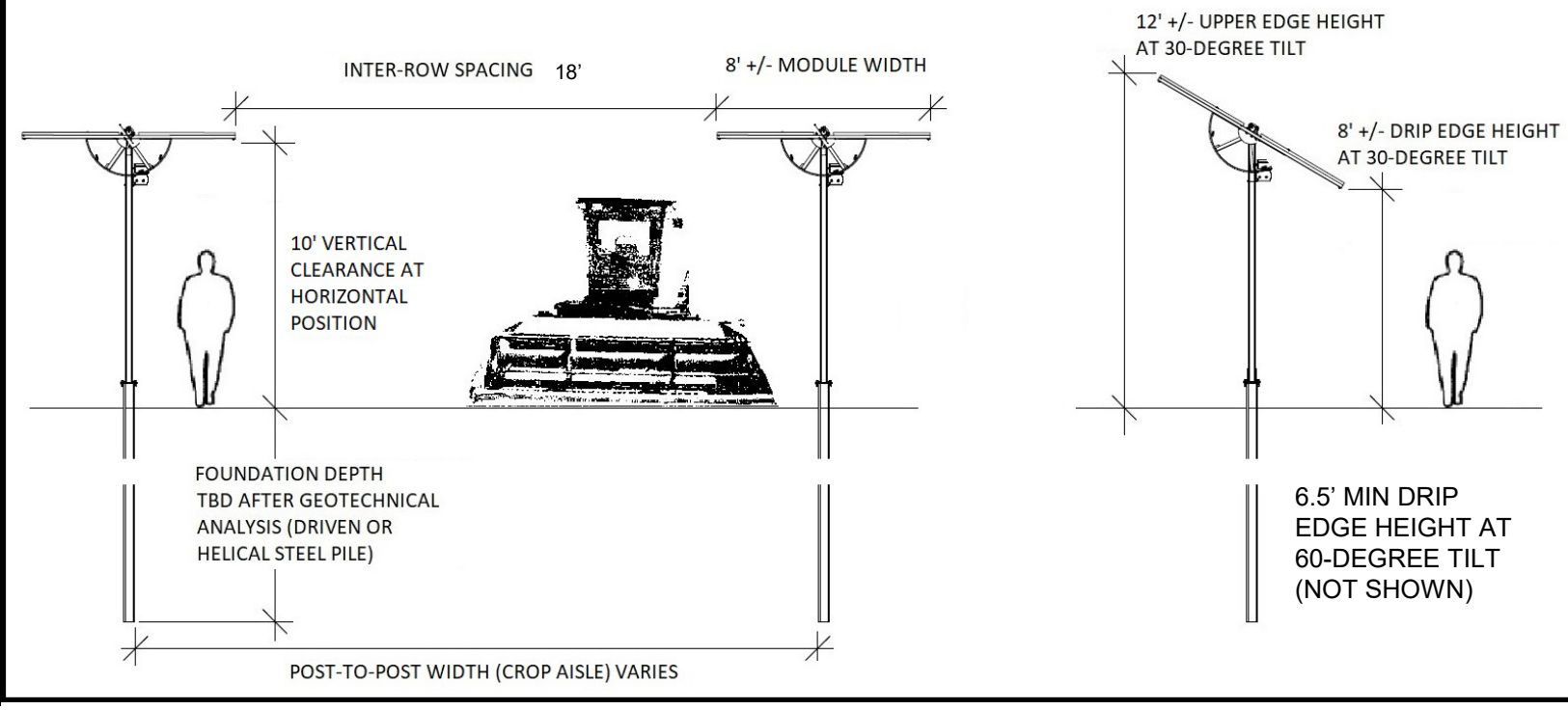


SYSTEM SIZE (MWDC; MWAC)	2.937 MWDC; 2.822 MWAC
PANEL COUNT (# OF PANELS)	5,064
PANEL SELECTION	HANWHA QCELL 580s
GROUND COVERAGE RATIO	13.3%
INTER-ROW SPACING (FT)	18
PITCH (FT)	26
PROPOSED PANEL HEIGHT (FT)	16.0
LIMIT OF WORK AREA (ACRES)	32.87
TREE CLEARING AREA (ACRES)	0.39
FENCED AREA (ACRES)	29.19
TOTAL IMPERVIOUS AREA (SQFT)	40,395
TOTAL GRAVEL ROAD AREA (SQFT)	31,855
TOTAL GRAVEL ROAD LENGTH (FT)	1,423.88
UTILITY MV RUN LENGTH (FT)	966
EQUIPMENT PAD AREA (SQFT)	6,300
WETLAND IMPACTS (SQFT)	0
EXISTING LAND USE	AGRICULTURAL
PROPOSED DUAL USE	AGRICULTURAL / INDUSTRIAL

Attachment B2

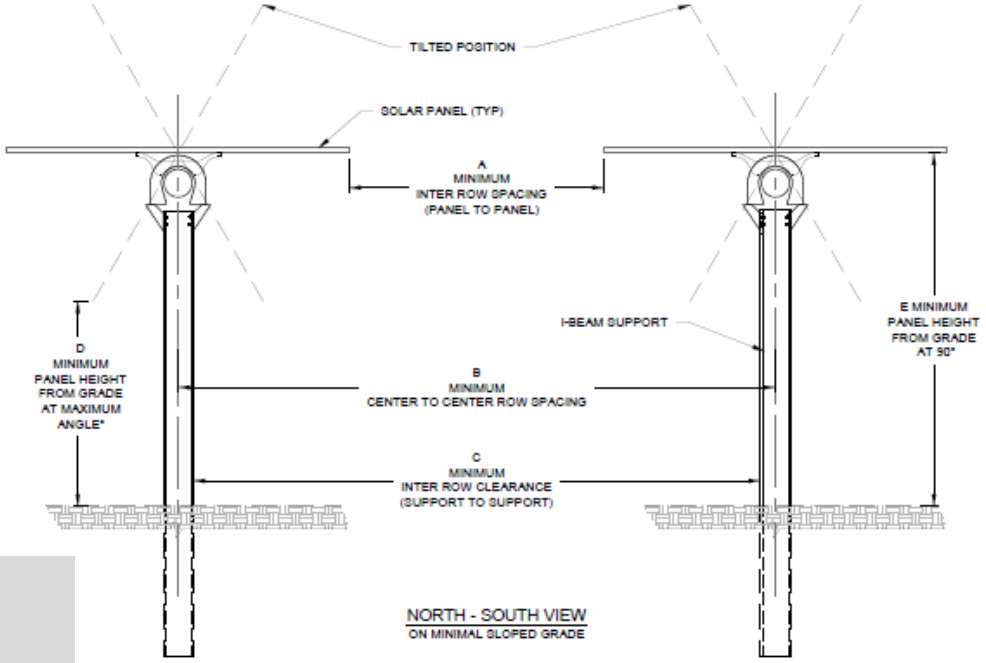
SINGLE-AXIS TRACKER AGRIVOLTAIC SYSTEM

TILT RANGE AND ROW SPACING MAY VARY TO ACCOMODATE AGRICULTURAL REQUIREMENTS



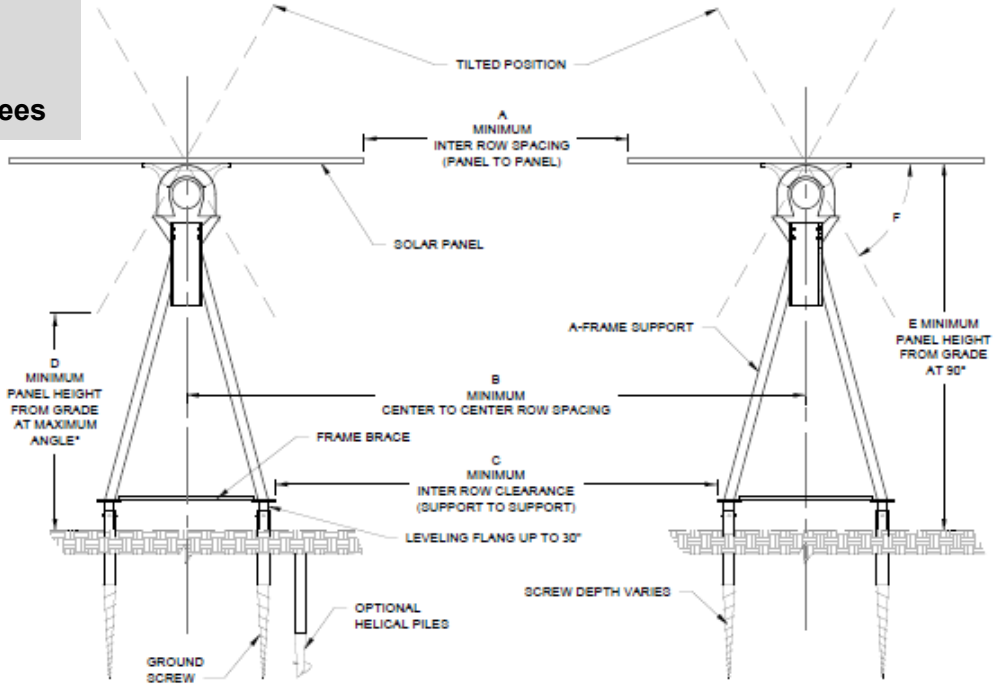
Attachment B-3

Foundation type will be finalized following completion of geotechnical studies. It will align with one of the two drawings below.



NORTH - SOUTH VIEW
ON MINIMAL SLOPED GRADE

SPACING
A: 18’
B: 26’
C (I-Beam): 25’
C (A-Frame): 20'
D: 6.5’
E: 10’
Maximum tilt angle: 60 degrees



NORTH - SOUTH VIEW
ON MINIMAL SLOPED GRADE

powered by Q.ANTUM DUO Z

Attachment B-4



Q.PEAK DUO XL-G11.3 / BFG
570-585

BIFACIAL DOUBLE GLASS MODULE
WITH EXCELLENT RELIABILITY
AND ADDITIONAL YIELD

EUPD RESEARCH TOP BRAND PV MODULES EUROPE 2021

Q CELLS Yield Security



BIFACIAL ENERGY YIELD GAIN OF UP TO 20 %
Bifacial Q.ANTUM solar cells make efficient use of light shining on the module rear-side for radically improved LCOE.

LOW ELECTRICITY GENERATION COSTS
Q.ANTUM DUO Z combines cutting edge cell separation and innovative wiring with Q.ANTUM Technology for higher yield per surface area, lower BOS costs, higher power classes, and an efficiency rate of up to 21.5 %.

INNOVATIVE ALL-WEATHER TECHNOLOGY
Optimal yields, whatever the weather with excellent low-light and temperature behavior.

ENDURING HIGH PERFORMANCE
Long-term yield security with Anti LID and Anti PID Technology[1], Hot-Spot Protect and Traceable Quality Tra.Q™.

FRAME FOR VERSATILE MOUNTING OPTIONS
High-tech aluminum alloy frame protects from damage, enables use of a wide range of mounting structures and is certified regarding IEC for high snow (5400 Pa) and wind loads (2400 Pa).

A RELIABLE INVESTMENT
Double glass module design enables extended lifetime with 12-year product warranty and improved 30-year performance warranty[2].

[1] APT test conditions according to IEC / TS 62804-1:2015 method B (–1500 V, 168 h) including post treatment according to IEC 61215-1-1 Ed. 2.0 (CD)
[2] See data sheet on rear for further information.

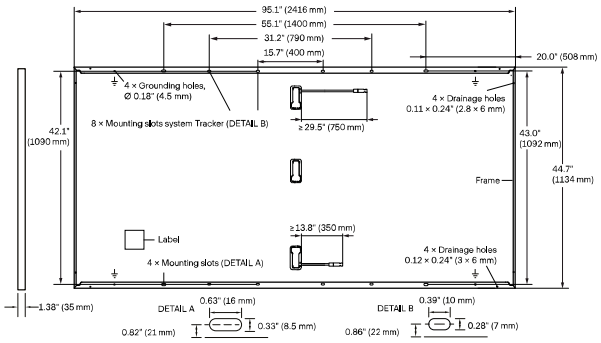
THE IDEAL SOLUTION FOR:
Ground-mounted solar power plants

Engineered in Germany

Q CELLS

MECHANICAL SPECIFICATION

Format	95.1 in × 44.7 in × 1.38 in (including frame) (2416 mm × 1134 mm × 35 mm)
Weight	75.8 lbs (34.4 kg)
Front Cover	0.08 in (2.0 mm) thermally pre-stressed glass with anti-reflection technology
Back Cover	0.08 in (2.0 mm) semi-tempered glass
Frame	Anodized aluminum
Cell	6 × 26 monocrystalline Q.ANTUM solar half cells
Junction Box	2.09-3.98 in × 1.26-2.36 in × 0.59-0.71 in (53-101 mm × 32-60 mm × 15-18 mm), IP67, with bypass diodes
Cable	4 mm² Solar cable; (+) ≥ 29.5 in (750 mm), (–) ≥ 13.8 in (350 mm)
Connector	Stäubli MC4-Evo2, Hanwha Q CELLS HQC4, IP68



ELECTRICAL CHARACTERISTICS

POWER CLASS				570		575		580		585	
MINIMUM PERFORMANCE AT STANDARD TEST CONDITIONS, STC[1] AND BSTC[1] (POWER TOLERANCE +5 W / –0 W)					BSTC*		BSTC*		BSTC*		BSTC*
Minimum	Power at MPP[1]	P_{MPP}	[W]	570	623.5	575	629.0	580	634.4	585	639.9
	Short Circuit Current[1]	I_{SC}	[A]	13.50	14.77	13.52	14.80	13.55	14.83	13.57	14.86
	Open Circuit Voltage[1]	V_{OC}	[V]	53.50	53.69	53.53	53.72	53.56	53.75	53.59	53.78
	Current at MPP	I_{MPP}	[A]	12.83	14.03	12.87	14.09	12.92	14.14	12.97	14.19
	Voltage at MPP	V_{MPP}	[V]	44.44	44.43	44.66	44.65	44.88	44.87	45.10	45.09
	Efficiency[1]	η	[%]	≥ 20.8	≥ 22.8	≥ 21.0	≥ 23.0	≥ 21.2	≥ 23.2	≥ 21.4	≥ 23.4

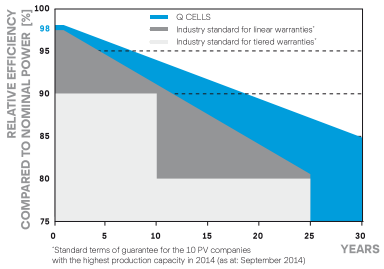
Bifaciality of P_{MPP} and I_{SC} 70 % ±5 % • Bifaciality given for rear side irradiation on top of STC (front side) • According to IEC 60904-1-2

[1] Measurement tolerances P_{MPP} ±3 %; I_{SC}, V_{OC} ±5 % at STC: 1000 W/m²; *at BSTC: 1000 W/m² + φ × 135 W/m², φ = 70 % ±5 %, 25 ± 2 °C, AM 1.5 according to IEC 60904-3

MINIMUM PERFORMANCE AT NORMAL OPERATING CONDITIONS, NMOT[2]							
Minimum	Power at MPP	P_{MPP}	[W]	429.1	432.9	436.6	440.4
	Short Circuit Current	I_{SC}	[A]	10.87	10.89	10.91	10.93
	Open Circuit Voltage	V_{OC}	[V]	50.60	50.63	50.66	50.68
	Current at MPP	I_{MPP}	[A]	10.09	10.14	10.18	10.22
	Voltage at MPP	V_{MPP}	[V]	42.51	42.71	42.89	43.08

[2] 800 W/m², NMOT, spectrum AM 1.5

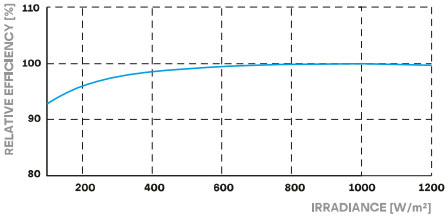
Q CELLS PERFORMANCE WARRANTY



At least 98 % of nominal power during first year. Thereafter max. 0.45 % degradation per year. At least 94 % of nominal power up to 10 years. At least 85 % of nominal power up to 30 years.

All data within measurement tolerances. Full warranties in accordance with the warranty terms of the Q CELLS sales organisation of your respective country.

PERFORMANCE AT LOW IRRADIANCE



Typical module performance under low irradiance conditions in comparison to STC conditions (25 °C, 1000 W/m²)

TEMPERATURE COEFFICIENTS							
Temperature Coefficient of I_{SC}	α	[%/K]	+0.04	Temperature Coefficient of V_{OC}	β	[%/K]	–0.27
Temperature Coefficient of P_{MPP}	γ	[%/K]	–0.34	Nominal Module Operating Temperature	NMOT	[°F]	108 ± 5.4 (42 ± 3 °C)

PROPERTIES FOR SYSTEM DESIGN

Maximum System Voltage V_{SYS}	[V]	1500	PV module classification	Class II
Maximum Series Fuse Rating	[A DC]	25	Fire Rating based on ANSI / UL 61730	TYPE 29[4]
Max. Design Load, Push / Pull[3]	[lbs/ft²]	75 (3600 Pa) / 33 (1600 Pa)	Permitted Module Temperature on Continuous Duty	–40 °F up to +185 °F (–40 °C up to +85 °C)
Max. Test Load, Push / Pull[3]	[lbs/ft²]	113 (5400 Pa) / 50 (2400 Pa)		

[3] See Installation Manual

[4] New Type is similar to Type 3 but with metallic frame

QUALIFICATIONS AND CERTIFICATES

UL 61730, CE-compliant,
IEC 61215:2016,
IEC 61730:2016,
U.S. Patent No. 9,893,215
(solar cells)

C Certified US
UL 61730

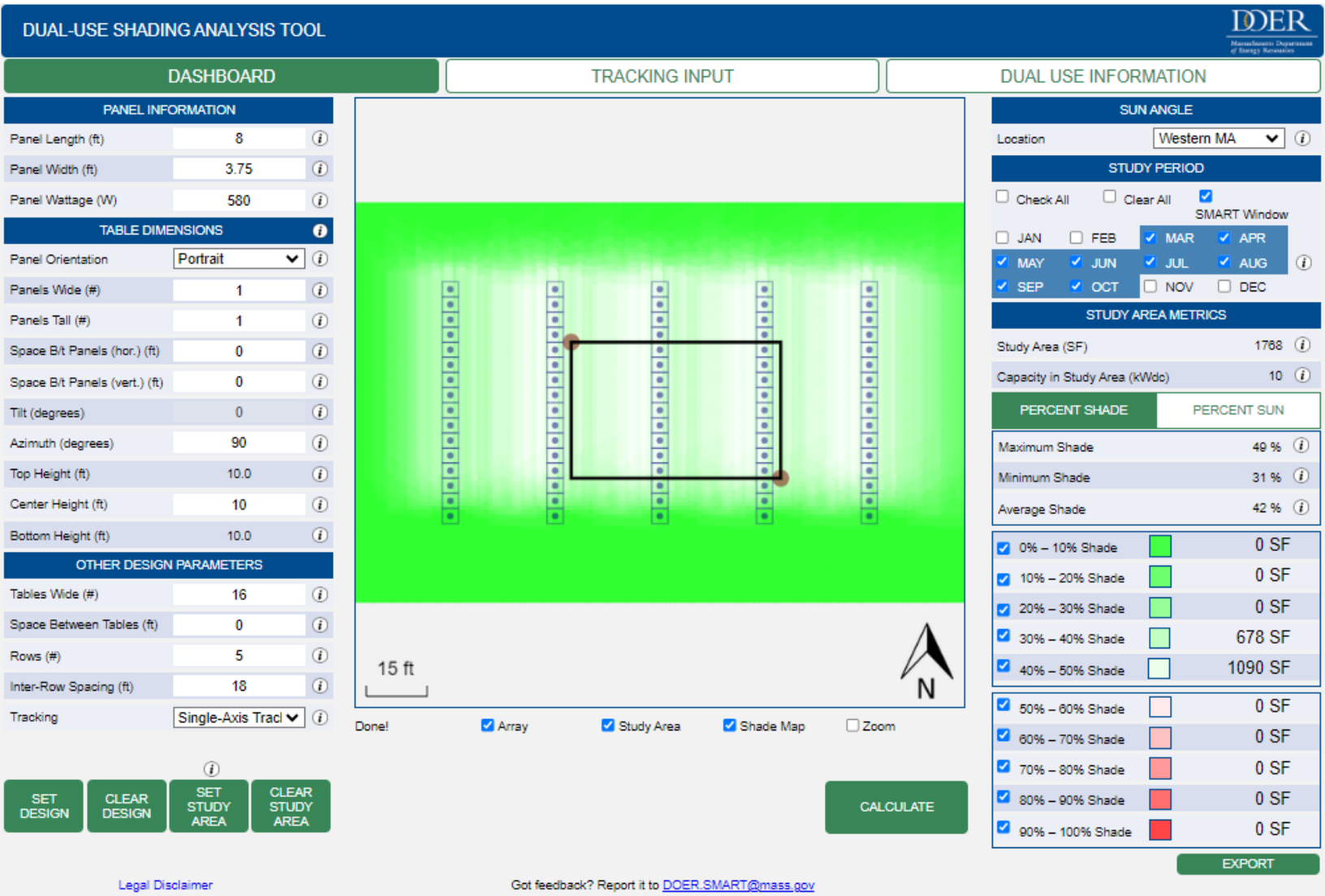
TÜVRheinland CERTIFIED
www.tuv.com
ID 1111220277

Note: Installation instructions must be followed. See the installation and operating manual or contact our technical service department for further information on approved installation and use of this product.

Hanwha Q CELLS America Inc.
400 Spectrum Center Drive, Suite 1400, Irvine, CA 92618, USA | **TEL** +1 949 748 59 96 | **EMAIL** inquiry@us.q-cells.com | **WEB** www.q-cells.us

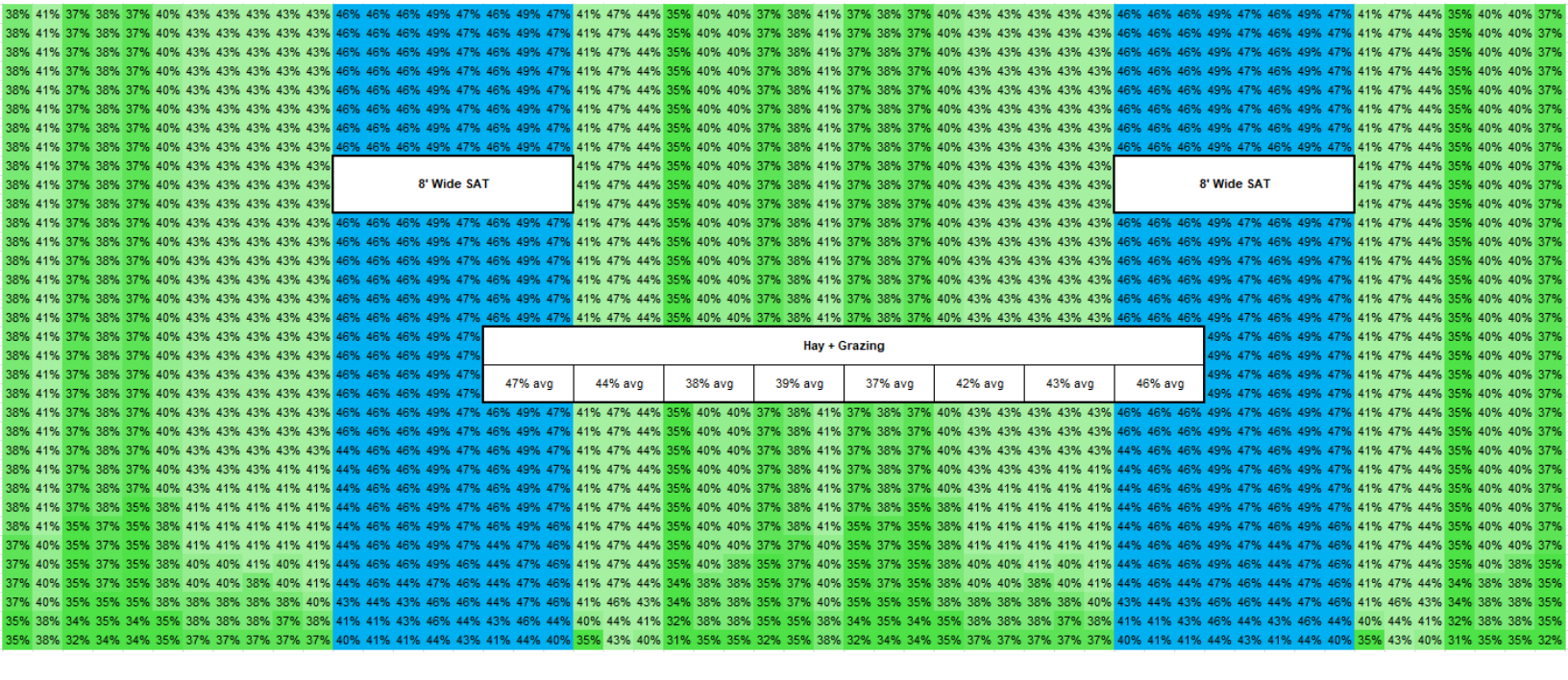
Specifications subject to technical changes © **Q CELLS** Q.PEAK DUO XL-G11.3/BFG_570-585_2021-05_Rev01_NA

Attachment C-1



| | | |

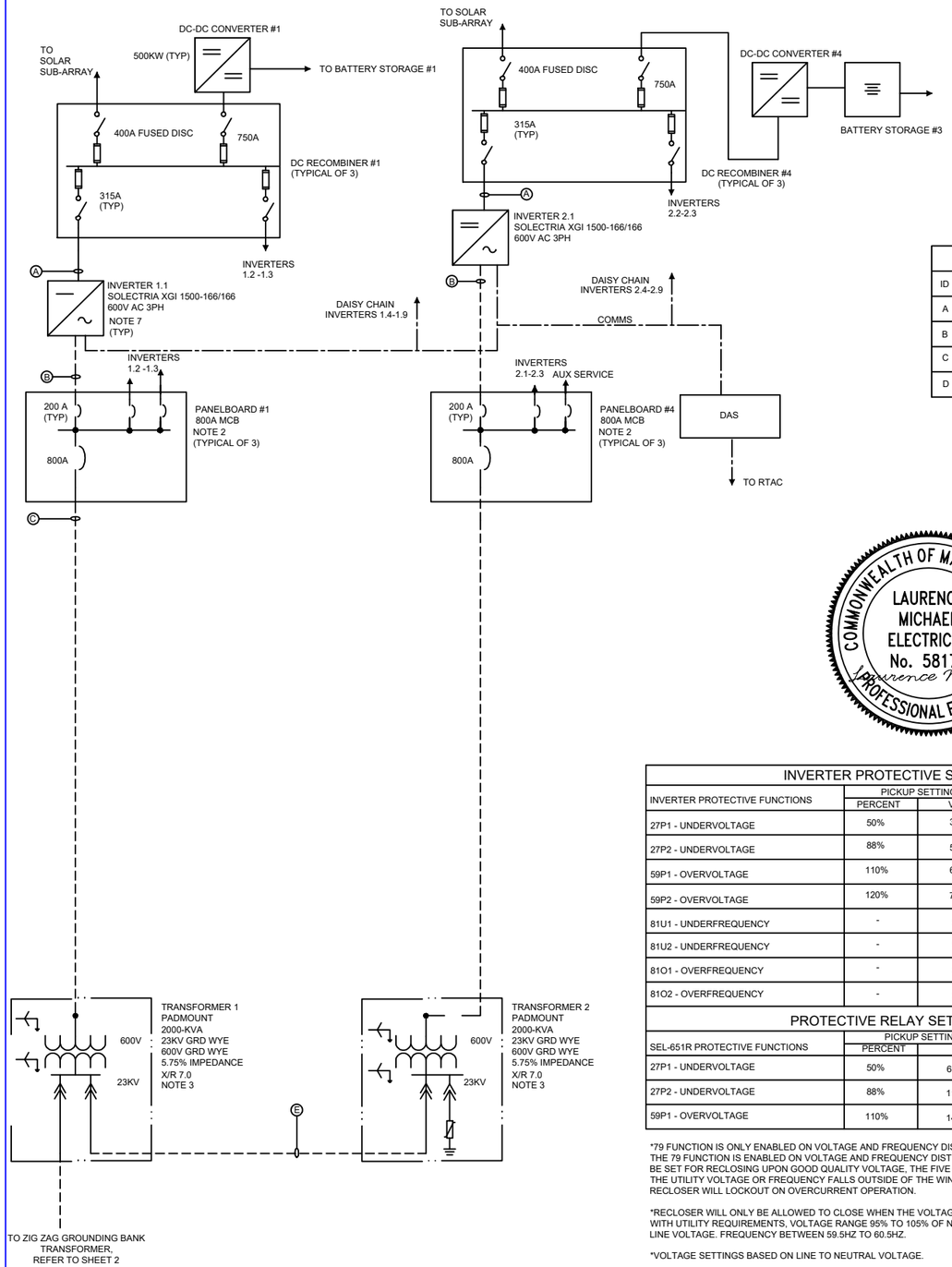
Attachment D-1



Attachment E-1

Attachments B-2 and B-3 include design drawings showing the mounting system type (single-axis tracking), panel tilt (assumed to be $\leq 60°$) and panel row spacing (18’ inter-row, 26’ center to center). Individual panels in this array will be separated by ≤ 0.5”, thus individual panel spacing is not shown.

Appendix I Electrical Diagram



AGGREGATE PROJECT RATING		
DETAIL	QTY	
INVERTER 166 KW/KVA	9	1,494 KW
INVERTER 166 KW/KVA	9	1,494 KW
TOTAL CAPACITY KW/KVA	18	2,988 KW
SYSTEM VOLTAGE KV		23KV
BATTERY (KWDC/KWH)		2539KW DC/ 10155 KWH 4-HR

WIRE AND CONDUIT SCHEDULE				
ID	VOLTAGE	SETS	WIRE	CONDUIT
A	600V	1	(4) #500 KCMIL AL	(4) 4"
B	600V	1	(4) 250 KCMIL AL	(1) 2"
C	600V	4	(4) 500 KCMIL AL	(4) 4"
D	600V	4	(4) 500 KCMIL AL	(4) 4"

MV AC WIRE AND CABLE SCHEDULE								OVERHEAD - OHMS/MILE UNDERGROUND - OHMS/1000 FT				PER UNIT VALUE (100 MVA BASE)			
FROM	TO	CABLE ID	TYPE	MATERIAL	CONDUCTOR	VOLTAGE (KV)	FEET	R1	X1	R0	X0	R1	X1	R0	X0
TRANSFORMER 1	GRNDING XMFR	E	UNDERGROUND	AL	250 KCMIL	25	20	.1842	.0623	.3684	.1247	.01315	.00445	.02631	.00891
GRNDING XMFR	RISER	F	UNDERGROUND	AL	250 KCMIL	25	225	1.0834	.7980	1.3689	3.2859	.00086	.00063	.00109	.00261
RISER	RECLOSER	G	OVERHEAD	ACSR	#4/0 AWG	25	50	1.0834	.7980	1.3689	3.2859	.00086	.00063	.00109	.00261
RECLOSER	GOAB	H	OVERHEAD	ACSR	#4/0 AWG	25	50	1.0834	.7980	1.3689	3.2859	.00086	.00063	.00109	.00261
GOAB	PCC	I	OVERHEAD	ACSR	#4/0 AWG	25	50	1.0834	.7980	1.3689	3.2859	.00086	.00063	.00109	.00261

INVERTER VOLTAGE RIDE-THROUGH CAPABILITY			
VOLTAGE RANGE	OPERATING MODE/RESPONSE	MINIMUM RIDE-THROUGH TIME (SEC)	MAXIMUM RESPONSE TIME (SEC)
V>1.20	CEASE TO ENERGIZE	N/A	.16
1.10<V≤1.20	MOMENTARY CESATION	2.0	N/A
0.88≤V≤1.10	CONTINUOUS OPERATION	INFINITE	N/A
0.50≤V<0.88	MANDATORY OPERATION	3.0	N/A
V<0.50	MOMENTARY CESATION	1.10	N/A

*IN PERMISSIVE OPERATION REGION >0.5 P.U., INVERTERS SHALL RIDE-THROUGH IN MANDATORY OPERATION MODE.
*IN PERMISSIVE OPERATION REGION <0.5 P.U., INVERTERS SHALL RIDE-THROUGH IN MOMENTARY CESSATION MODE WITH A MAXIMUM RESPONSE TIME OF 0.083 SECONDS.
*SETTINGS ARE BASED ON IEEE 1547 AND ISO NE SOURCE REQUIREMENT DOCUMENT (12/13/2022).

INVERTER FREQUENCY RIDE-THROUGH CAPABILITY		
FREQUENCY RANGE (HZ)	OPERATING MODE	MINIMUM RIDE-THROUGH TIME (SEC)
61.2<F≤61.8	MANDATORY OPERATION	300
58.8≤F≤61.2	CONTINUOUS OPERATION	INFINITE
57.0≤F<58.8	MANDATORY OPERATION	300

INVERTER PROTECTIVE SETTINGS			
INVERTER PROTECTIVE FUNCTIONS	PICKUP SETTING PERCENT	PICKUP SETTING VALUE	TOTAL CLEARING TIME CYC. (SEC)
27P1 - UNDERVOLTAGE	50%	300V	1.10
27P2 - UNDERVOLTAGE	88%	528V	3.00
59P1 - OVERVOLTAGE	110%	660V	2.00
59P2 - OVERVOLTAGE	120%	720V	0.16
81U1 - UNDERFREQUENCY	-	56.5 HZ	0.16
81U2 - UNDERFREQUENCY	-	58.5 HZ	300
81O1 - OVERFREQUENCY	-	61.2 HZ	300
81O2 - OVERFREQUENCY	-	62.0 HZ	0.16

PROTECTIVE RELAY SETTINGS 52-1			
SEL-651R PROTECTIVE FUNCTIONS	PICKUP SETTING PERCENT	PICKUP SETTING VALUE	OPERATING TIME (SECONDS)
27P1 - UNDERVOLTAGE	50%	6,639.7V	TOTAL: 1.10 RELAY: 1.05
27P2 - UNDERVOLTAGE	88%	11,685.9V	TOTAL: 3.00 RELAY: 1.95
59P1 - OVERVOLTAGE	110%	14,607.4V	TOTAL: 2.00 RELAY: 1.95
59P2 - OVERVOLTAGE	120%	15,935.3V	TOTAL: .16 RELAY: .11
81UP1 - UNDERFREQUENCY	-	56.5 Hz	TOTAL: .16 RELAY: .11
81UP2 - UNDERFREQUENCY	-	58.5 Hz	TOTAL: 300.00 RELAY: 299.95
81OP1 - OVERFREQUENCY	-	61.2 Hz	TOTAL: 300.00 RELAY: 299.95
81OP2 - OVERFREQUENCY	-	62.0 Hz	TOTAL: .16 RELAY: .11
32 - REVERSE POWER RLY (EXPORT)	2,988-KW		TOTAL: .16 RELAY: .11
32 - REVERSE POWER RLY (IMPORT)	150-KW		TOTAL: .16 RELAY: .11
59N - NEUTRAL OVERVOLTAGE	(.76V) 6,640V		TOTAL: 1.00 RELAY: 0.95
51 - PHASE TIME OVERCURRENT	1.09A (109A PRI.)		CURVE: U4 T.D.: 2
51G - GROUND TIME OVERCURRENT	.22A (22A PRI.)		CURVE: U3 T.D.: 1
79 - AUTO RESTORE VOLT. RANGE	1.43 (12,540) <-V<-1.58 (13,860)		300
79 - AUTO RESTORE FREQ. RANGE	59.5 <-f<-60.5		300
ALARM - HARDWARE AND LOSS OF POWER (AC AND DC)	-	-	<2

*79 FUNCTION IS ONLY ENABLED ON VOLTAGE AND FREQUENCY DISTURBANCES. A 5 MINUTE DELAY FOR THE 79 FUNCTION IS ENABLED ON VOLTAGE AND FREQUENCY DISTURBANCES ONLY. A 5 MINUTE DELAY WILL BE SET FOR RECLOSING UPON GOOD QUALITY VOLTAGE, THE FIVE MINUTE TIME INTERVAL WILL RESTART IF THE UTILITY VOLTAGE OR FREQUENCY FALLS OUTSIDE OF THE WINDOW IDENTIFIED IN THE ABOVE CHART. RECLOSER WILL LOCKOUT ON OVERCURRENT OPERATION.

*RECLOSER WILL ONLY BE ALLOWED TO CLOSE WHEN THE VOLTAGE AND FREQUENCY ARE IN COMPLIANCE WITH UTILITY REQUIREMENTS, VOLTAGE RANGE 95% TO 105% OF NOMINAL. VOLTAGE IS BASED ON LINE TO LINE VOLTAGE. FREQUENCY BETWEEN 59.5HZ TO 60.5HZ.

*VOLTAGE SETTINGS BASED ON LINE TO NEUTRAL VOLTAGE.

*INVERTER AND PROTECTIVE RELAY (52-1) SETTINGS ARE BASED ON IEEE 1547 REQUIREMENTS.

*RELAY WILL AUTOMATICALLY TRIP AND BLOCK CLOSE IF THERE IS A HARDWARE FAILURE OR POWER SUPPLY FAILURE AND ON ANY OVERCURRENT OPERATION (51 & 51G). THIS WILL BE DONE VIA LOGIC IN THE SEL-651R RELAY.

*TOTAL CLEARING TIME INCLUDES RELAY OPERATING TIME AND RECLOSER OPERATING TIME. RECLOSER OPERATING TIME IS 3.0 CYCLES.

NOTES:

1. DC DESIGN (ARRAY, CONVERTERS, ETC.) BY OTHERS.
2. PANELS AND BREAKERS TO BE RATED FOR 100% DUTY, FOR BACK FEED, AND FOR THE APPROPRIATE FAULT DUTY AND LOCATION. BUS SIZING AND DISTRIBUTION SWITCHGEAR SHALL ADHERE TO NEC 705.12.
3. PROVIDE TRANSFORMER WITH BAY-O-NET FUSES, ELBOW TYPE S.A. AND FULLY RATED NEUTRAL.
4. GROUNDING TRANSFORMER SPECS TO BE CONFIRMED BY UTILITY. GROUNDING TRANSFORMER CONNECTED IN PARALLEL OFF THE PRIMARY WINDINGS OF TRANSFORMER 1.
5. EQUIPMENT HAS BEEN SIZED FOR PRELIMINARY DESIGN PURPOSES. ALL EQUIPMENT, INCLUDING, SWITCHES, RECLOSERS, SWITCHGEAR, CABLES AND CONDUITS TO BE SIZED AND LISTED ON FINAL DESIGN DRAWINGS.
6. RELAY SETTINGS ARE PRELIMINARY. TO BE CONFIRMED VIA IMPACT STUDY AND ENGINEER OF RECORD.
15,935.3V
7. INVERTERS TO BE FACTORY LIMITED AS SHOWN WITH NAMEPLATE MODIFIED TO REFLECT CHANGE.
8. AFTER AN AREA EPS DISTURBANCE, SYSTEM SHALL NOT RECONNECT UNTIL 5 MINUTES AFTER THE AREA EPS VOLTAGE IS WITHIN 95% TO 105% OF NOMINAL AND FREQUENCY IS WITHIN RANGE OF 59.5 HZ TO 60.5 HZ.
9. WIRELESS SERVICE TO BE PROVIDED TO UTILITY REVENUE METERING
10. TARVRIDA RECLOSER SHALL BE EQUIPPED WITH THE SAFE TRIP FUNCTION. THIS FUNCTION WILL BE USED TO TRIP THE RECLOSER ON LOSS OF DC. THE OUTPUT CONTACT (OUT201) IS WIRED TO AN INTEGRATED AUXILIARY RELAY MOUNTED UP AT THE RECLOSER. UPON LOSS OF ALL POWER TO THE RELAY THE AUXILIARY RELAY WILL DROP OUT AND THE RECLOSER WILL TRIP.
11. TAVRIDA VOLTAGE SENSING DEVICES PROVIDED LINE TO NEUTRAL VOLTAGE INPUTS ("WYE GROUNDED") TO THE SEL-651R. THE VY VOLTAGES ARE ON THE UTILITY SIDE OF THE RECLOSER.
12. RTAC REQUIREMENTS: CUSTOMER RTAC TO BE FAILSAFE. IF RTAC IS OFFLINE FOR 300 SECS, IT WILL SEND A TRIP SIGNAL TO THE RELAY. IF THE CUSTOMER RTAC RECIEVES A HARD-WIRED TRIP OR SOFTWARE TRIP ALARM, A PULSE WILL STAY ON THE RISING EDGE FOR SECONDS AND AGAIN SEND A TRIP SIGNAL TO THE RELAY. CUSTOMER RTAC WILL ISSUE A DELAYED TRIP IF ES RTAC TO DSCADA COMMUNICATION HAS FAILED (AFTER 5 MINUTES).
13. CUSTOMER RTAC WILL ISSUE A DELAYED TRIP IF ES RTAC TO DSCADA COMMUNICATION HAS FAILED (AFTER 5 MINUTES). CUSTOMER RTAC WILL ISSUE A DELAYED TRIP IF ES RTAC TO DSCADA COMMUNICATION HAS FAILED (AFTER 10 MINUTES)ENTIRE LOGIC SHALL BE IMPLEMENTED INSIDE THE RTAC. RELAY SETTINGS SHALL INCORPORATE REMOTE COMMAND FROM RTAC INTO TRIP AND BLOCK CLOSE EQUATIONS. RELAY WILL TRIP THE BREAKER IF IT LOSES COMMUNICATION WITH THE RTAC. SEL RELAY WILL TRIP THE BREAKER IF IT LOSES COMMUNICATION WITH THE RTAC (AFTER 1 MINUTE). CONNECTION MEDIUM FROM RELAY TO RTAC SHALL BE SERIAL OR ETHERNET. RTAC-RTAC AND RELAY-RTAC COMMUNICATION TO BE DNP3.
14. ALL INTERCONNECTION REQUIREMENTS SUCH AS MAXIMUM AND MINIMUM IMPORT/EXPORT LIMITS SHALL BE PROGRAMMED INSIDE THE CUSTOMER RTAC.
15. SOLECTRIA'S XGI 1500 INVERTERS OPERATE UNI-DIRECTIONALLY, EXPORTING POWER TO THE GRID, WHEN USED IN THE SOLECTRIA PVS-500 DC-COUPLED STORAGE SYSTEM. POWER CANNOT BE IMPORTED FROM THE GRID. CHARGING CONNECTED BATTERIES WITH POWER FROM THE GRID IS NOT POSSIBLE IN THE SOLECTRIA PVS-500 DCCOUPLED STORAGE SYSTEM.

COMMONWEALTH OF MASSACHUSETTS
LAURENCE MICHAEL ELECTRICAL No. 58176
PROFESSIONAL ENGINEER

PROGRESS SET NOT FOR CONSTRUCTION

BLUEWAVE
116 HUNTINGTON AVE,
SUITE 601
BOSTON, MA 02116
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www.bluewave.energy

REV	DRN	DATE	COMMENTS

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PROJECT: MA WORTHINGTON 105 OLD POST RD
SINGLE LINE DIAGRAM
GPS:(42.405626, -72.930099) POI
105 OLD POST RD, WORTHINGTON, MA 01098

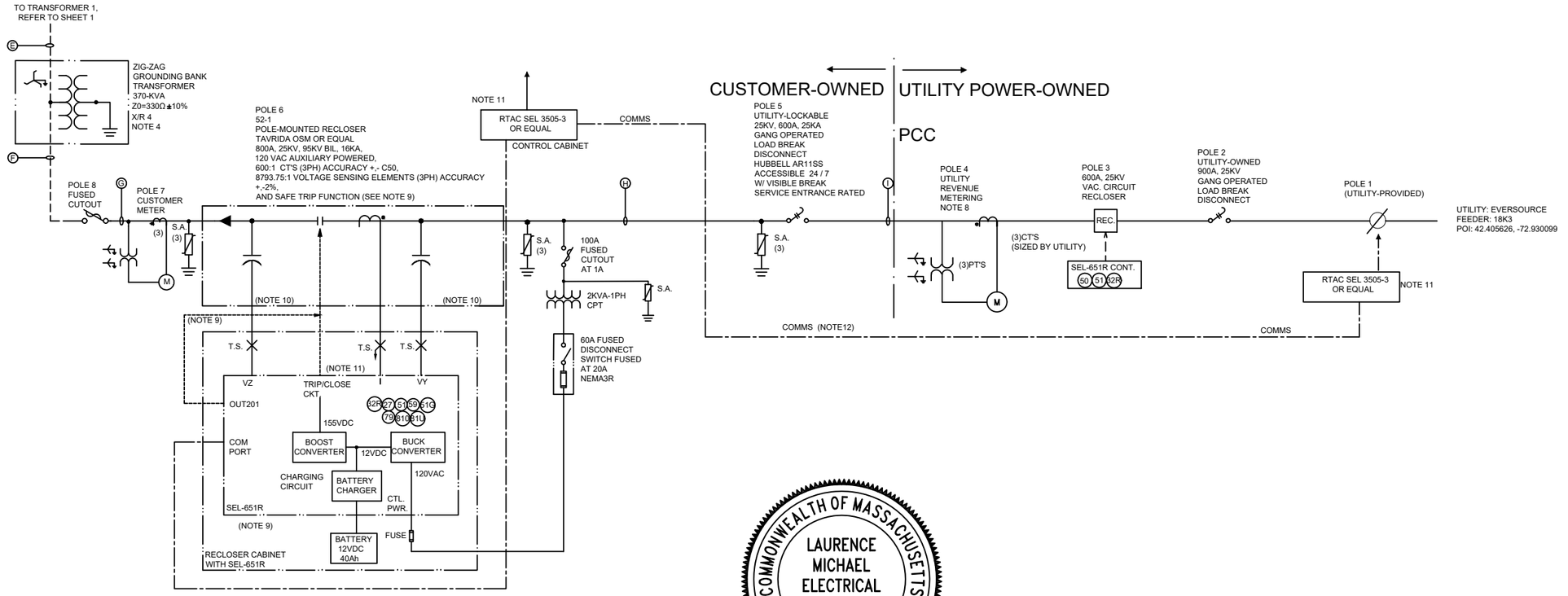
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PRINT DATE: APRIL 2024

SCALE:

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SINGLE LINE DIAGRAM
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105 OLD POST RD, WORTHINGTON, MA 01098

SHEET TITLE: SINGLE LINE DIAGRAM

DRAWN BY:

PRINT DATE: APRIL 2024

SCALE:

SHEET NO.:

Appendix J Battery Energy Storage Systems: Frequently Asked Questions Draft Hazard Mitigation Plan Draft Emergency Response Plan

Battery Energy Storage Systems:

Frequently Asked Questions on Fire Safety and Public Health

BACKGROUND

Battery energy storage systems (BESS) are lowering costs and improving energy reliability across the country. These projects yield significant economic benefits by optimizing electric grid operations, reducing the cost of meeting peak demand, avoiding the need for additional transmission and distribution investments, and balancing the electric grid during times when supply and demand are not aligned. BESS are critical to meeting growing electricity demand cleanly and efficiently and reducing greenhouse gas emissions. BESS absorb and store electricity generated by sources like wind and solar, and then discharge that electricity later to meet customer demand. BESS also improve the resilience of the electric grid by continuing to supply power during emergency situations in many circumstances. All of these attributes help ratepayers and the economy at large by reducing electricity costs and improving reliability.

Due to their many benefits, BESS are becoming increasingly common in Massachusetts and around the country. According to the federal U.S. Energy Information Administration, U.S. battery capacity increased 66% in 2024, and is poised to set new records in 2025. Over 80% of new electric generation capacity is expected to come from battery storage and solar, led by states like Texas. This growth creates opportunities for new job growth, investment in manufacturing, and can be a source of increased local property tax revenues in communities where it is deployed.

Most BESS utilize lithium-ion batteries to store energy. Lithium-ion batteries have high energy density, meaning that they pack a lot of power in comparison to their overall volume. This is why they are used for so many consumer devices, such as laptops, phones, electric bikes, and electric vehicles. When used, charged, and stored properly, lithium-ion batteries are safe. In the rare case of a fire or other incident at a BESS, fires can be very difficult to extinguish and can reignite after suppression. Because of this, the Commonwealth has adopted numerous codes, standards and best practices to mitigate the risk of fire-related incidents at BESS installations.

<u>References</u>

U.S. Energy Information Administration. “U.S. battery capacity increased 66% in 2024.” 2025

Massachusetts Energy Storage Initiative (ESI) Goals & Storage Target. 2024 ES Target Reports

NFPA, Energy Storage Systems (ESS) and Solar Safety, https://www.nfpa.org/education-and-research/electrical/energy-storage-systems

US EPA, Battery Energy Storage Systems: Main Considerations for Safe Installation and Incident Response, https://www.epa.gov/electronics-batteries-management/battery-energy-storage-systems-main-considerations-safe

TYPES OF BATTERY ENERGY STORAGE SYSTEMS

Many types of grid energy storage are commercially available today, each of which have different methods of storing and dispatching energy. Some of these use electrochemical compositions (e.g., lithium-ion, lead-acid, sodium-ion, iron oxide, etc.), while others use thermal (e.g., sensible heat storage, latent heat storage, or thermochemical) or mechanical energy (e.g., pumped hydroelectric, compressed air, gravity-based storage, etc.). Nearly 97% of the energy storage being constructed in Massachusetts today are electrochemical BESS that use lithium-ion batteries. Lithium-ion batteries are a class of energy storage technologies that were first sold starting in the 1990s and have since become ubiquitous in consumer electronics such as mobile phones and laptop computers, electric vehicles, and BESS. Due to the heavy proliferation of lithium-ion batteries, all references to BESS in this document refer to lithium-ion BESS.

References

2024 Energy Storage Target Reports

Nishi, Yoshio. "The Dawn of Lithium-Ion Batteries." The Electrochemical Society Interface, Vol. 25, Iss. 71 (2016).

PURPOSE OF FAQ

This FAQ is intended to help local decision-makers and community members answer common questions about BESS. Specifically, this FAQ addresses some commonly asked questions about grid connected lithium-ion BESS, with a particular focus on questions pertaining to fire safety, environmental impacts, and public health.

1. **How will my community benefit from a BESS?**

   Communities across the state host energy infrastructure like BESS, making up our highly reliable electric grid. BESS, in particular, reduce the cost of meeting peak demand, avoiding the need for additional transmission and distribution investments, reducing wholesale energy supply costs, and improving reliability. BESS are critical to meeting and managing growing electricity demand. Unlike other forms of energy infrastructure, BESS do not emit significant pollution, and will ultimately help replace highly polluting peaker plants across the state. Communities may also benefit from added investment from developers through community benefits plans, tax revenue, and jobs to communities.

2. **What can cause a BESS to catch fire?**

   During normal operation, a battery's lithium-ion cells charge from and discharge electricity to the grid, which generates a small amount of heat that usually safely dissipates. However, if a battery is overcharged, short circuits, is defective or sustains mechanical damage, the heat may not dissipate and can cause the temperature inside the lithium-ion cells to rise uncontrollably beyond operational limits. This causes what's known as a thermal runaway fire. There may also still be energy within the BESS after being involved in a fire and this so-called "stranded energy" may cause reignition of the fire hours, days, or weeks later.

Resources:

Electric Power Research Institute, Insights from EPRI's Battery Energy Storage Systems (BESS) Failure Incident Database: Analysis of Failure Root Cause, May 2024.

Energy Storage Systems Safety Fact Sheet, National Fire Protection Association, Published February 2024.

UL Research Institutes: What Is Thermal Runaway? Published August 24, 2021

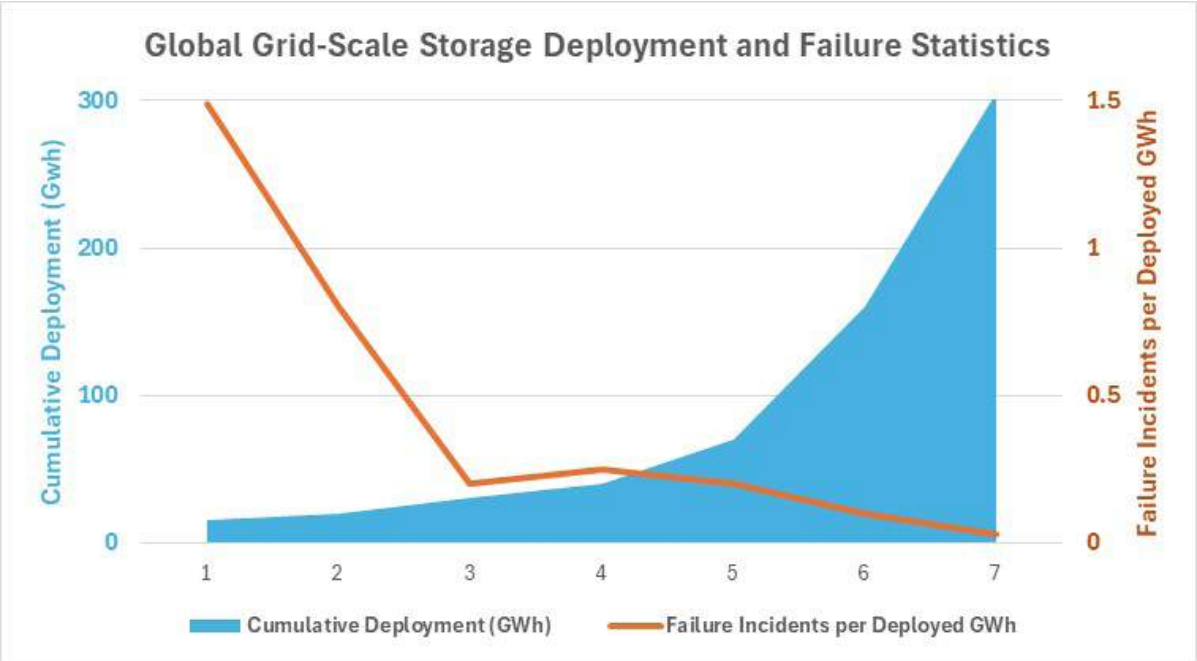
UL Research Institutes: What Causes Thermal Runaway? Published August 20, 2021

3. What is the likelihood that a BESS catches fire?

Many types of infrastructure, including BESS, come with some degree of risk that a fire incident could occur. BESS related fires are rare if designed with sufficient safety protections and are installed, operated, and maintained in a manner that maintains the system safely — as demonstrated by the many systems currently operating safely. In the Commonwealth today, there are over 6,000 grid connected BESS installations, ranging from residential to large-scale installations, with some BESS having first been installed nearly 10 years ago.

Additionally, data shows the safety record of BESS has improved significantly in recent years as the technology has matured, industry practices have improved and regulatory standards and codes incorporate learnings gained from experience. A comprehensive worldwide analysis by the Electric Power Research Institute found that the failure rate of utility-scale BESS decreased by 98% between 2018 and 2024 while the deployment of BESS greatly increased.

Figure 1: Global Grid-Scale BESS Deployment and Failure Statistics



Lessons learned from earlier incidents when the technology was nascent have led to robust requirements and improved industry practices, which today inform the safe siting of BESS and emergency response procedures in the Commonwealth. For example, the Moss Landing facility in California, at which a large indoor BESS fire occurred on January 16, 2025, was designed to be located inside a 1950s era building that previously housed an old power generation facility. The facility was also unique in how it arrayed its battery racks and utilized a less common nickel-manganese cobalt chemistry as opposed to lithium-ion phosphate, which is more common and safer. Such a facility would not be permitted under revised codes and standards that exist today for installations within the Commonwealth.

Resources:

Electric Power Research Institute, BESS Failure Incident Database. Accessed October 20, 2025.

Fire & Risk Alliance, LLC and the American Clean Power Association, Assessment of Potential Impacts of Fires at BESS Facilities, 2025.

4. **Are there any codes or standards in Massachusetts to mitigate the risk of fires at BESS installations?**

Yes. There are robust standards and codes in place today to which all BESS constructed in Massachusetts must adhere. BESS that are installed, operated, and maintained in accordance with these standards should typically be operated without incident.

In Massachusetts, BESS must comply with 527 CMR 1.00: The Massachusetts Comprehensive Fire Safety Code, which is adopted by the Massachusetts Board of Fire Prevention Regulations (BFPR). This code is consistent with the national model fire code developed by the National Fire Protection Association (NFPA) NFPA 1, but contains some additional Commonwealth-specific standards.

The Massachusetts Comprehensive Fire Safety Code is updated every three years to reflect updates to NFPA 1 and NFPA 855. These updates to the fire code incorporate the latest lessons learned and evidence-based practices for new developments in energy systems such as BESS. It sets comprehensive fire protection criteria for BESS and other energy storage installations based on the technology used, the setting where the system is being installed, the size and separation of the containers or installations, and the fire suppression and control systems in place. NFPA 855 also reflects the current best practice for mitigating the risk of explosions and safely containing fires and applies to all lithium-ion BESS with a capacity larger than 20 kilowatt-hours.

In addition, all BESS constructed in Massachusetts must be listed with a Nationally Recognized Testing Laboratory to UL 9450 (Standard for Energy Storage Systems and Equipment) or an approved equivalent.

NFPA 1, Fire Code

NFPA 855, Standard for the Installation of Stationary Energy Storage Systems (2026)

527 CMR 1.00: The Massachusetts Comprehensive Fire Safety Code

5. **Do BESS that catch fire emit toxic chemicals into the air?**

While fire related BESS incidents are rare, the byproducts released during BESS fires have been found to be largely similar to those released during conventional fires (e.g., house and structure fires) with no contaminant concentrations beyond the immediate fire scene that posed a risk to public health.

Between 85-92% of the gas volume produced in BESS fires has been found to consist of hydrogen (H2), carbon dioxide (CO2), and carbon monoxide (CO). BESS may also emit volatile organic compounds (VOCs),or other trace gases depending on the battery chemistry and overall materials used in the construction of the BESS unit. The state of charge (i.e., how charged a battery is) at the time of a fire is a contributing factor in the proportion of different gases emitted, with a lower state of charge leading to higher CO2 and lower CO emissions, and a higher state of charge leading to the reverse. With these factors in mind, it is important to note that in some situations, unignited gases may create potentially hazardous conditions within and around the BESS room or container.

Air sampling from past BESS incidents across the United States found that no incident had contaminant concentrations beyond the immediate fire scene that posed a public health risk. Studies indicate that emissions are mostly confined to the immediate vicinity of the fire because the ignited gases resulting from a BESS fire become rapidly dispersed and diluted in the air to safe levels. However, the smoke emitted from fire incidents always presents a public health risk for the immediate fire scene and the appropriate emergency response measures should always be followed. In the event of a fire at a BESS facility, nearby residents and businesses should follow all instructions from fire officials, which may involve the evacuation of residents depending upon the scale of the fire, similar to emergency responses for other structural or industrial fires.

C. Essl et al., "Comprehensive Hazard Analysis of Failing Automotive Lithium-Ion Batteries in Overtemperature Experiments," Batteries, vol. 6, no. 2, p. 30, May 2020, DOI Foundation: https://doi.org/10.3390/batteries6020030.

Fire & Risk Alliance, LLC and the American Clean Power Association, Assessment of Potential Impacts of Fires at BESS Facilities, 2025.

Energy Storage Systems Safety Fact Sheet, National Fire Protection Association, Published February 2024.

6. **What emergency response steps are in place if there's a BESS fire?**

In the rare case of a fire or other incident at a BESS, there are multiple layers of local, state, and federal emergency response procedures in place to reduce risks to public health, safety, and environment. In the event of a fire or spill at a BESS facility, the local fire department should be called immediately. Depending on the nature of the incident and the capabilities of the local fire department, additional firefighting resources may be required from neighboring communities. The fire response could ultimately require firefighters and apparatus from across the region through the Statewide Fire Mobilization Plan.

After the local fire department has been notified, MassDEP Emergency Response must be notified via the Emergency Response Hot Line (888-304-1133) within 2 hours of a release or spill of hazardous materials that meet MassDEP's 2-hour reporting thresholds requirements. MassDEP

Emergency Response personnel are available 24/7 to respond and help contain and assess spills/releases of oil or hazardous chemicals.

Following a battery fire or other release to the environment, the owner of the BESS is required to hire a Licensed Site Professional/response contractor to implement immediate response actions. As the circumstances require, response actions could include immediate containment or spill cleanup, as well as sampling of nearby soils, surface waters and groundwater for residual contamination.

If contamination is found above regulatory limits, then further cleanup is required. If the owner/potentially responsible party is unwilling or unable to hire a contractor, MassDEP has the ability to activate one, and pursue cost recovery from the potentially responsible party. MassDEP also maintains on its website a list of licensed hazardous waste transporters who can provide transport and disposal services. The regulations governing these environmental response measures are known as the Massachusetts Contingency Plan.

Resources:

Massachusetts Contingency Plan, 310 CMR 40.0000.

MassDEP, Environmental Emergency Response Program.

Massachusetts Statewide Fire Mobilization Plan, https://www.mass.gov/info-details/fire-mobilization.

MassDEP, Licensed Hazardous Waste Transporters.

7. **Can BESS that catch fire lead to chemicals leaching into the ground or groundwater, including aquifers and drinking water sources?**

In past BESS fire incidents where environmental sampling was conducted, water and soil samples did not reveal hazardous contamination levels requiring remediation. Massachusetts regulations will require BESS to be built on pads that allow for the containment of materials preventing them from leaching into the soil below.

Due to the potential of water runoff from firefighting activities in these incidents, the consensus best practice today for response to a BESS fire is to surround the fire with cooling water to prevent the spread of the fire and protect surrounding areas and structures, including trees, brush, and any nearby buildings. In doing so, water is less likely to pick up potential contaminants in any runoff.

Additionally, studies show that the chemical byproducts produced in BESS fires have low water solubility, limiting the potential for groundwater contamination. Across 35 documented large-scale BESS fire incidents in the United States that occurred between 2012 and 2024, there has been no evidence of any air, soil, or water contamination at levels that would pose a public health concern or require further remediation.

Resources:

Fire & Risk Alliance, LLC and the American Clean Power Association, Assessment of Potential Impacts of Fires at BESS Facilities, 2025.

Eurofins Calscience, "Water Quality Report: SDG&E Battery Fire," Sep. 2024. https://www.escondido.gov/DocumentCenter/View/6717/SDGE-Water-Run-Off-ReportPDF?bidId=

New York State Interagency Fire Safety Working Group, "Air, Soil, and Water Data Findings," NYSERDA, Dec. 2023.

Electric Power Research Institute (EPRI), The Evolution of Battery Energy Storage Safety Codes and Standards, EPRI White Paper, November 2023.

8. **What rules and standards exist to ensure that a BESS fire does not lead to environmental contamination or endanger public health?**

All BESS constructed in Massachusetts must adhere to robust standards and codes. Facilities are required to be listed by a Nationally Recognized Testing Laboratory to UL 9450 (Standard for Energy Storage Systems and Equipment) or an approved equivalent. BESS must also meet NFPA standards and the latest edition of the Massachusetts State Fire Code, which includes emergency operations plans, emergency training, smoke detection systems, fire control and suppression systems, explosion control, spill response measures, enclosure of electrical circuitry within weatherproof enclosures, setback requirements, and recommendations on the use of water as the primary fire suppression agent for BESS fires, among other requirements.

Additionally, BESS must already comply with certain state and local requirements that aim to prevent fire related runoff from affecting the public health and the environment. For example, the Massachusetts Department of Environmental Protection's (MassDEP) Stormwater Management Standards require measures to control surface water runoff that may contribute to downstream flooding, and that prevent stormwater discharges from causing or contributing to the pollution of surface water and groundwater. For projects proposed on land held by public water systems for drinking water purposes, BESS must be located in a self-containment area so that in the event of a fire, fire extinguishing chemicals will be contained.

Under new draft rules that have been proposed by the Energy Facilities Siting Board (EFSB) and Department of Energy Resources (DOER), all BESS are proposed to be required to provide emergency response plans that must be provided to permitting authorities prior to filing a permit application. In the case of small BESS facilities subject to DOER's rules, the emergency response plan is proposed to be created in consultation with local fire, police, and emergency management departments.

Resources:

UL 9540, Energy Storage Systems and Equipment

UL 9540A, Test Method for Battery Energy Storage Systems (BESS)

NFPA 1, Fire Code

NFPA 855, Standard for the Installation of Stationary Energy Storage Systems (2026)

527 CMR 1.00: The Massachusetts Comprehensive Fire Safety Code

MassDEP Drinking Water Program Guideline, *Information to be Submitted to MassDEP for Proposed Solar and Wind Energy Projects on Lands Owned or Controlled by Public Water Systems for Drinking Water Purposes*, updated April 18, 2018.

Massachusetts General Law Chapter 131, Section 40 (the Wetlands Protection Act).

980 CMR 1.00 through 17.00 (DRAFT). More information available at: https://www.mass.gov/info-details/efsb-25-10-proposed-rulemaking.

225 CMR 29.00 (DRAFT). More information and materials are available at: https://www.mass.gov/info-details/clean-energy-siting-permitting-regulations.

9. Given the growth of BESS, what more can be done to mitigate the risks of fire, and protect public health and the environment?

The state is adding additional methods of avoiding, minimizing, and mitigating risks associated with fire from BESS, including by updating siting and permitting procedures. Pursuant to Chapter 239 of the Acts of 2024, Massachusetts is currently overhauling its siting and permitting procedures related to clean energy infrastructure, which includes clean energy generation (e.g., solar, wind, and anaerobic digesters), transmission and distribution infrastructure, and BESS. These new rules are currently being established by the Executive Office of Energy and Environmental Affairs (EEA), EFSB, and DOER and must be in place by March 1, 2026. The agencies involved are responsible for developing the following:

- Developing a Site Suitability Methodology and guidance that evaluates the suitability of locations for hosting different types of clean energy infrastructure facilities.

- Establishing regulation that creates procedures for local governments to adhere to when issuing consolidated local permits to Small Clean Energy Infrastructure Facilities, including standard permit conditions for small BESS facilities (i.e., less than 100 MWh).

- Establishing regulations that govern the process of issuing consolidated permits to Large Clean Energy Infrastructure Facilities and some types of Small Clean Energy Infrastructure Facilities, including standard permit conditions for large BESS (i.e., equal to or greater than 100 MWh) facilities.

These new rules will establish additional standards and procedures that help ensure BESS are sited and designed to avoid, minimize, and mitigate any potential public health, environmental, and safety risks. They will also establish standard permit conditions that apply to BESS, which shall be designed to be protective of public health, safety, and the environment.

DOER is also developing a Model Energy Storage Bylaw for municipalities, which will be made publicly available later in 2025.

Through proper project design, siting, and fire management practices, many of which are already largely in place today, the risks to public health and the environment from a BESS fire can be effectively minimized and managed.

Resources:

Fire & Risk Alliance, LLC and the American Clean Power Association, Assessment of Potential Impacts of Fires at BESS Facilities, 2025.

980 CMR 1.00 through 17.00 (DRAFT). More information available at: https://www.mass.gov/info-details/efsb-25-10-proposed-rulemaking.

225 CMR 29.00 (DRAFT). More information and materials are available at: https://www.mass.gov/info-details/clean-energy-siting-permitting-regulations.

EEA Site Suitability Guidance (DRAFT). More information is available at: www.mass.gov/energypermitting.

BLUEWAVE

Illustrative Draft Hazard Mitigation Analysis

***Site specific plan to be finalized prior to building permit filing**

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Worthington BESS

Hazard Mitigation Analysis

Outdoor Ground Mounted Battery Energy Storage System

Canadian Solar Solbank 3.0

190 Ridge Road, Worthington, MA (BWC Wades Stream, LLC)



Revision Draft RevB

April 16, 2026

The distribution of this document to third parties is prohibited without written approval from Fire & Risk Alliance, LLC

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EXECUTIVE SUMMARY

Fire and Risk Alliance, LLC, (FRA) performed a hazard mitigation analysis (HMA) for the battery energy storage system (BESS) proposed for installation at the Worthington BESS site located at 190 Ridge Road, Worthington, MA (Worthington BESS). The HMA was performed in accordance with the 2020 Edition of NFPA 855 which is referenced by 527 CMR (Massachusetts Comprehensive Fire Safety Code) pursuant the 2021 Edition of NFPA 1. The Worthington BESS is anticipated to include two SolBank 3.0 (SB3) cabinets manufactured by e-STORAGE of Canadian Solar and will have an approximate capacity of 2.4 megawatts (MW)/9.6 megawatt hours (MWh). This HMA report is intended to be used as a tool for a fire code official (FCO) or an authority having jurisdiction (AHJ) to assist in their review of the Worthington BESS.

Based on a review of the SB3 and the IFP drawing package dated 12/23/2025 (the drawing set), the SB3 installation at the Worthington BESS site design can meet the NFPA 855 installation level requirements for an outdoor, NWI style BESS when it is installed in accordance with the manufacturer's instructions, its listing, the approved drawings, and NFPA 855. However, as the final site design is developed, several items were identified in this analysis that still need modification/confirmation to ensure compliance. These include:

- Approved signage must be provided at the site per NFPA 855 §4.3.5.
- Increase minimum unobstructed fire apparatus access roadway width from 16 ft to 20 ft.
- Obtain FCO approval for having no fire protection water supply at the site per NFPA 855 §4.13.

The HMA demonstrates the Worthington BESS meets all the HMA performance criteria for approval outlined in NFPA 855 §4.1.4.3, as follows:

- Fires will be contained to a single SB3 as demonstrated through UL 9540A unit level testing and should a fully developed fire event occur, site level emergency response procedures (such as exposure protection) could be utilized during a fire event, based on real time fire conditions and observations (i.e., wind direction/speed, fire intensity, proximity of flames to adjacent cabinets), to minimize the potential for fire to spread to adjacent cabinets.
- Suitable deflagration protection is provided for the SB3 cabinet via the NFPA 69 CCR explosion control system.
- Fires will be detected in time to allow personnel to safely evacuate via the fire alarm system and internal sensors of the SB3.
- Toxic and highly toxic gases will not be released during normal charging, discharging, and operation of the SB3 given the listed lithium-ion cells utilized in the SB3 are hermetically sealed and do not vent during charging, discharging or normal operation.
- Toxic and highly toxic gases released during fires and other fault conditions will not reach concentrations in excess of IDLH levels within a building or an adjacent means of egress given the nearest building is approximately 500 ft away.
- Flammable gases will not be released during charging, discharging and normal operation of the SB3 given the listed lithium-ion cells utilized in the SB3 are hermetically sealed and do not vent during charging, discharging or normal operation.

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In summary, based on the UL 9540A testing and a review of the drawing set, the Worthington BESS meets the Hazard Mitigation Analysis approval criteria presented in NFPA 855. In addition, as the site design is still under development, it is assumed that all the code required items, as listed above, will be addressed prior to commercial operational of the facility.

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 and Risk Alliance, LLC, (FRA) performed a hazard mitigation analysis (HMA) for the battery energy storage system (BESS) proposed for installation at the Worthington BESS site located at 190 Ridge Road, Worthington, MA (Worthington BESS). The HMA was performed in accordance with the 2020 Edition of NFPA 855 which is referenced by 527 CMR (Massachusetts Comprehensive Fire Safety Code) pursuant the 2021 Edition of NFPA 1. The Worthington BESS is anticipated to include two SolBank 3.0 (SB3) cabinets manufactured by e-STORAGE of Canadian Solar and will have an approximate capacity of 2.4 megawatts (MW)/9.6 megawatt hours (MWh). This HMA report has been prepared by FRA and summarizes our analysis. It is intended to be used as a tool for a fire code official (FCO) or an authority having jurisdiction (AHJ) to assist in their review of the Worthington BESS.

1.1 Purpose and Scope

NFPA 855 §4.1.4.2 requires an HMA to evaluate the consequences associated with the following failure modes, and others deemed necessary by the FCO. Note, only single failure modes must be considered in this analysis:

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.

After analyzing these single failure modes and analyzing their potential consequences per NFPA 855 §4.1.4.3, the AHJ is authorized to approve the HMA provided that it demonstrates all of 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 permissible exposure limit (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 lower flammability limit (LFL).

To perform this evaluation for the Worthington BESS, the framework of FRA's HMA is as follows:

- **Review the SB3 and UL 9540A Test Data**: FRA reviewed the SB3, its construction, design, fire safety features, listings, and UL 9540A fire test data (see Sections 2.0 and 3.0).
- **Review Site Specifications:** FRA reviewed the proposed Worthington BESS site layout including the areas surrounding the BESS yard (see Section 4.0).

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- **Prescriptive Code Compliance Review:** The proposed site layout and BESS plans were reviewed for compliance with NFPA 855 requirements. Where gaps were identified in the BESS site design, recommendations are provided (see Sections 5.0 and 6.0).
- **Hazard Mitigation Analysis:** The HMA evaluates the BESS failure modes as required by NFPA 855. The consequence-based analysis considers product level and site level barriers to prevent failure or reduce the consequences of a failure scenario. Based on the provided barriers, the consequences of a failure event are analyzed. NFPA 855 outlines acceptance criteria for which the FCO or AHJ is authorized to approve the HMA provided the consequences of the analysis meet or exceed the criteria (see Section 7.0).
- **Recommendations:** Recommendations are provided throughout the report where gaps exist between the site design and code requirements and where the consequences of failure modes exceed the approval criteria (see Section 8.0).

1.2 Codes, Standards, and Test Methods

The following code and standards are applicable to this analysis:

- Massachusetts Comprehensive Fire Safety Code, based on the 2021 Edition of NFPA 1, *Fire Code* (527 CMR).
- NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems* – 2020 Edition (NFPA 855).

The following standards and test methods are also relevant to this analysis:

- NFPA 68, Standard on Explosion Protection by Deflagration Venting – 2018 Edition (NFPA 68).
- NFPA 69, Standard for Explosion Control Systems - 2019 Edition (NFPA 69).
- UL 1973, Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications – 2018 Edition (UL 1973).
- UL 9540, Standard for Safety of Energy Storage Systems and Equipment - 2016 Edition (UL 9540).
- UL 9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems - 2018 (UL 9540A).

1.3 Reference Materials

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

- IFP drawing package dated 12/23/2025 (the drawing set).
- UL 1973 Certificate #CU7230247601, Hithium Model LFP71173207, dated 01/11/2023.
- UL 1973 Certificate #CU724059830001, CSI Models SolBank-R-418-2h-H and SolBank-R-418-4h-H, dated 07/18/2024.
- UL 9540 Certificate #CU724062740001, CSI Model SolBank-S-5016-2h-NA, dated 07/18/2024.
- UL9540A Cell Test Report #CN23F118001, Hithium Model LFP71173207, TÜV Rheinland (Shenzhen), dated 12/06/2023.

- UL9540A Module Test Report #CN248UKE001, CSI Models SolBank-P-104.5-2h-H and SolBank-P-104.5-4h-H, TÜV Rheinland (Shanghai), dated 06/28/2024.
- UL9540A Unit Test Report #CN24M32L001, CSI Models SolBank-R-418-2h-H and SolBank-R-418-4h-H, TÜV Rheinland (Shanghai), dated 06/28/2024.
- NFPA 69 System Evaluation Report #CN24SBF7001, CSI Models SolBank-S-5016-2h-NA and SolBank-S-5016-4h-NA, TÜV Rheinland (Shanghai), dated 08/09/2024.
- SolBank 3.0 BESS HMA, ESRG, V2, dated 12/19/2021
- SolBank 3.0 Datasheet, CSI Models SolBank-S-5016-2h-NA and SolBank-S-5016-4h-NA
- SolBank 3.0 Installation Manual, V1.3, e-STORAGE of Canadian Solar, 2024.
- SolBank 3.0 Commissioning Manual, V1.0, e-STORAGE of Canadian Solar, 2024.
- SolBank 3.0 User Manual, V1.5, e-STORAGE of Canadian Solar, 2024.
- SolBank 3.0 Safety Manual, V1.1, e-STORAGE of Canadian Solar, 2024.
- SolBank 3.0 Maintenance Manual, V1.3, e-STORAGE of Canadian Solar, 2024.
- SolBank 3.0 Decommissioning Manual, V1.0, e-STORAGE of Canadian Solar, 2024.
- SolBank 3.0 Fire Safety System and BMS Overview, e-STORAGE of Canadian Solar, September 2023.

DRAFT

2. SB3 DESCRIPTION

The SB3 is a fully integrated BESS consisting of battery modules, power electronics, control systems, battery management system (BMS), thermal management system (TMS), fire detection and notification system, and explosion prevention system all pre-assembled within a single, non-occupiable cabinet. It is meant for outdoor installations, mounted to the ground. Below is a brief description of the SB3, its components, design listing, and fire safety features. For a more detailed discussion of the SB3 components, their location, functionality, and purpose, refer to the SB3 installation manual.

2.1 Cell

The cell is the smallest anatomy of the battery assembly. The SB3 utilizes a lithium iron phosphate (LFP) prismatic cell, as shown in Figure 1. The cells are Model LFP71173207 manufactured by Xiamen Hithium Energy Storage Technology Co. Ltd. (Hithium) and are UL 1973 compliant. Each cell has a nominal capacity of 314 amp-hour (Ah), a nominal voltage of 3.2 volts (V), and is prismatic in geometry. The cell has overall dimensions of 6.9 in (175 mm) × 8.2 in (207 mm) × 2.8 in (72 mm). This cell is manufactured for use in the SB3 and is intended to be part of the module assembly. Passive safety features include material reliability and manufacturing process. Known hazards of the cell during normal operation consist of either electrical, thermal, or mechanical failures which could result in gas release, flaming electrical fluid, electrical shorting, thermal heating, and/or thermal runaway.

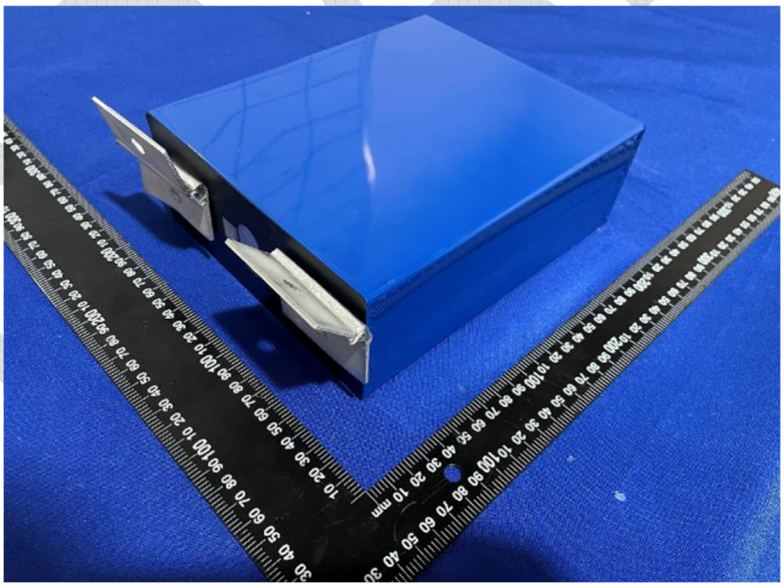


Figure 1: SB3 Cell

2.2 Module (Pack)

The battery module, also known as the pack, is the second smallest level of the BESS anatomy. The SB3 module is Model SolBank-P-104.5-4h-H manufactured by CSI Energy Storage Co., Ltd. (CSI), which is liquid-cooled with a metal enclosure. The module has a 1P104S cell configuration which comprises 104 LFP71173207 cells in series, as shown in Figure 2. The module has a nominal capacity of 314 Ah, a nominal voltage of 332.8 V, and a nominal energy capacity of 104.5 kWh. Each module has overall dimensions of 7.2 ft (2,180 mm) × 2.6 ft (790 mm) × 0.8 ft (248 mm).

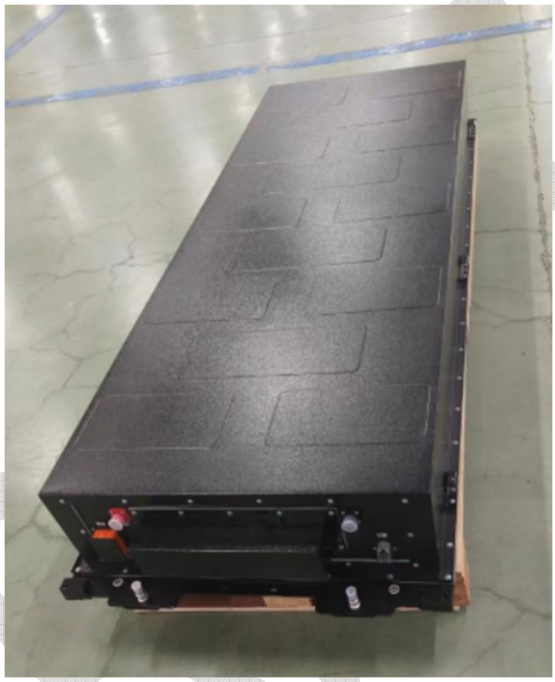


Figure 2: SB3 Module

This module is manufactured for use in the SB3 and is intended to be part of the unit-level assembly. The module assembly supports safe operation through its material insulation and internal cooling. Aerogel spacers are installed between each cell to insulate each cell from one another. Passive safety features include material reliability and manufactured assembly process. The module itself does not have any active emergency functions for disconnection from the charging source or discharging stored potential energy.

2.3 Unit (Rack)

The battery unit, also known as the rack, is the third level of BESS anatomy. Each unit holds 4 modules and a BMS box, as shown in Figure 3. The unit is Model SolBank-R-418-4h-H manufactured by CSI with a nominal capacity of 314 Ah, a nominal voltage of 1,331.2 V, and a nominal energy capacity of 418 kWh. The unit is manufactured for use in the SB3 and is intended to be part of the cabinet-level assembly.



Figure 3: SB3 Unit

2.4 Cabinet

The cabinet is the final and largest level of the BESS. The SB3 cabinet is a rigid metal (steel) enclosure designed to house the batteries, associated controllers, and appurtenances. The cabinet supports the safe operation of the BESS through its exterior rigid housing structure that helps to protect the batteries from mechanical damage and weather conditions. It is 2438 mm (8.0 ft) wide, 2896 mm (9.5 ft) tall, and 6058 mm (19.9 ft) long and is intended for ground-mounted, outdoor installations, with an IP-55 rating. The SB3 is equipped with 12 battery racks, as shown in Figure 4.

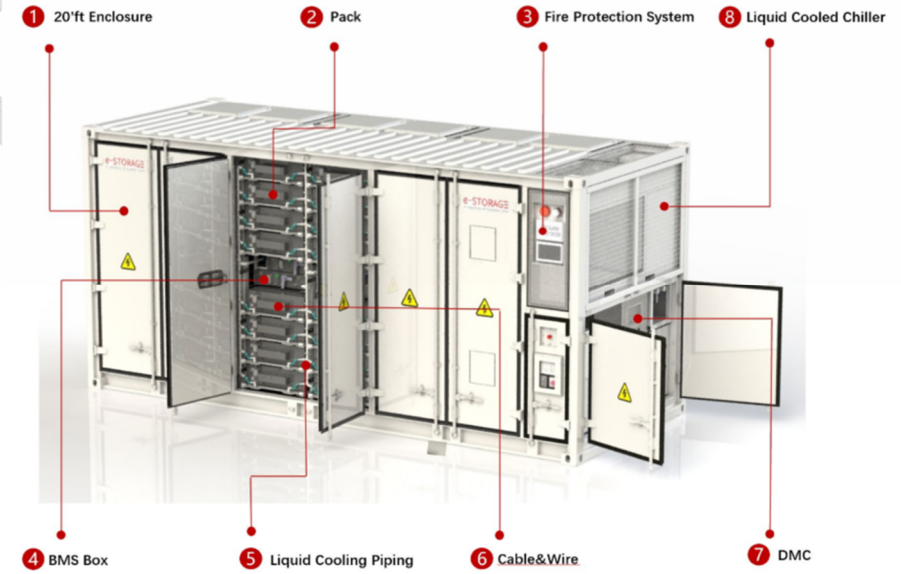


Figure 4: SB3 Cabinet

As described above, each unit contains 4 modules, and each module contains 104 LFP cells. In total, the SB3 has 4,992 cells with an energy capacity of 4,800 kWh and weighs approximately 43,000 kg (94,799 lbs.). Additional features of the SB3 cabinet include 12 rack-mounted BMS, a liquid cooling and heating system, and the integration of all power electronics, controls, and safety features required to support the DC side of the BESS.

2.5 Thermal Management System

Each SB3 is equipped with a TMS which utilizes a liquid cooling and heating system to maintain optimum cell temperature, between 20°C and 35°C. A temperature-regulated ethylene glycol solution is distributed throughout the cabinet using a piping system that connects the battery modules to the chiller in the HVAC cabinet of the BESS, as seen in Figure 5.

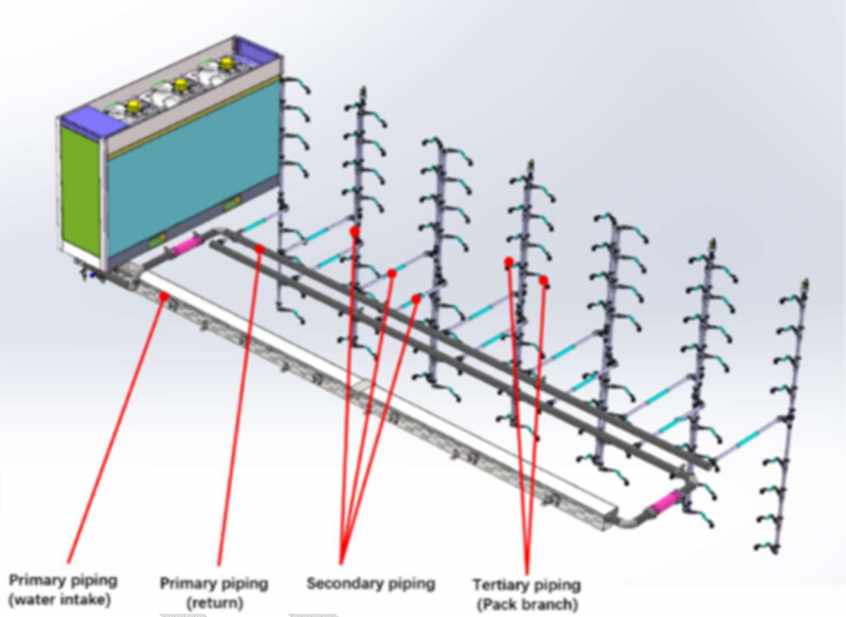


Figure 5: SB3 TMS

After passing through each device and absorbing or releasing heat, the refrigerant flows back into the HVAC cabinet where it is cooled, if necessary. The cabinet is continuously monitored for temperature and liquid chiller operation and will send alerts if either critical levels are reached or if loss of communication from the system occurs.

2.6 Battery Management System

Each SB3 is equipped with a dedicated BMS for each battery unit, with a total of 12 rack-mounted BMS per cabinet. The BMS is an electronic system that can identify possible risks to the battery system by monitoring battery cell performance, temperature, voltage, and current, and state-of-charge (SOC) in real-time. It is used to monitor and maintain the health and capacity of a battery to ensure optimal battery functionality and safety.

The BMS ensures early detection of pre-fault conditions and immediate direction of fault events. If a parameter exceeds pre-determined permissible values, the BMS will open the integrated DC contactors to automatically disconnect the affected string and send an alarm to the site's energy management system (EMS).

The BMS also interfaces with the fire alarm control panel (FACP) and can control the disconnection of the module(s) from the system in the event of abnormal conditions. When the FACP receives an alarm, such as combustible gas, heat, or smoke, this notification is routed to the EMS, which autonomously isolates the trouble battery cabinet.

The BMS function is intended to prevent the risk of thermal runaway by preventing the risks of overcharge, over-discharge, over-temperature, and overcurrent. It provides thermal runaway risk protection by safely disconnecting the batteries in case of fault conditions.

2.7 Electrical Fault Protection

In addition to BMS protections, electrical fault protection devices are provided for the SB3 and the power conversion system (PCS). The cabinet's DC junction box contains all primary DC busbars, fuses, surge protection devices, and power monitoring required to safely exchange power between the SB3 and the PCS. All SB3 electrical circuits are protected by overcurrent protection devices. Site-level electrical fault protection devices are provided by the UL 1741 listed inverter, including insulation monitoring devices for ground fault protection, medium voltage (MV) switchgear, DC switch disconnectors, and Type 2 protection for AC and DC overvoltage protection. The BESS MV switchgear typically includes protection and switching equipment to sufficiently protect both the BESS facility as well as the grid from faults: relays, meters, breakers (motorized or non-motorized), fuses, and other distribution gear.

2.8 Fire and Gas Detection System

The SB3 cabinet is provided with a fire and gas detection system that includes three photoelectric smoke detectors (two in the battery compartment and one in the electrical compartment), three heat detectors (two in the battery compartment and one in the electrical compartment), and two hydrogen gas detectors in the battery compartment, as shown in Figure 6. The fire and gas detection system is connected to a FACP. Any alarm or supervisory condition from the FACP is relayed to the site EMS.

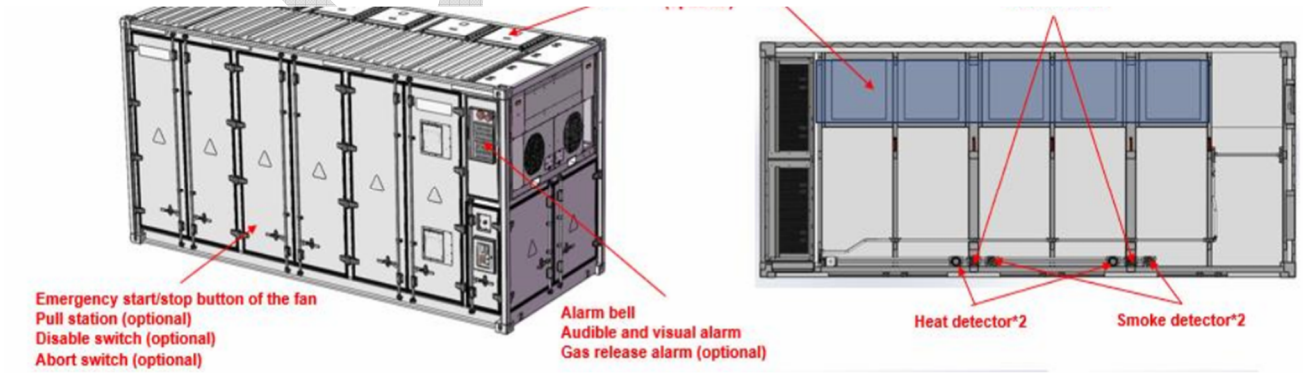


Figure 6: SB3 Fire and Gas Detection System

For local notification, an alarm bell and an audible/visible appliance are installed on the exterior of the SB3 cabinet. An emergency start/stop (E-stop) button is provided within each end of the cabinet, which will shut down the SB3 cabinet when pressed. Additional safety features are available optionally, including a pull station, disable switch, abort switch, and gas release alarm.

2.9 Fire Suppression System

The SB3 can come equipped with an optional aerosol suppression system or an optional dry sprinkler system. The SB3 cabinets at the Worthington BESS will not be equipped with the optional fire suppression system.

2.10 Explosion Control System

The SB3 cabinet is equipped with a combustible gas concentration reduction (CCR) system that consists of gas detection, an explosion-proof exhaust fan, and two air intake louvers that provide make-up air for the cabinet, as shown in Figure 7. This system utilizes two flammable gas detectors calibrated to hydrogen. Upon detection of 10% of the LFL, the explosion control system activates, ventilating the SB3 to maintain the gas concentration of the cabinet below 25% LFL. In addition, the BMS receives an alarm, the horn/strobe on the exterior of the cabinet activates, the BMS shuts down the battery system, and the HVAC system shuts down.

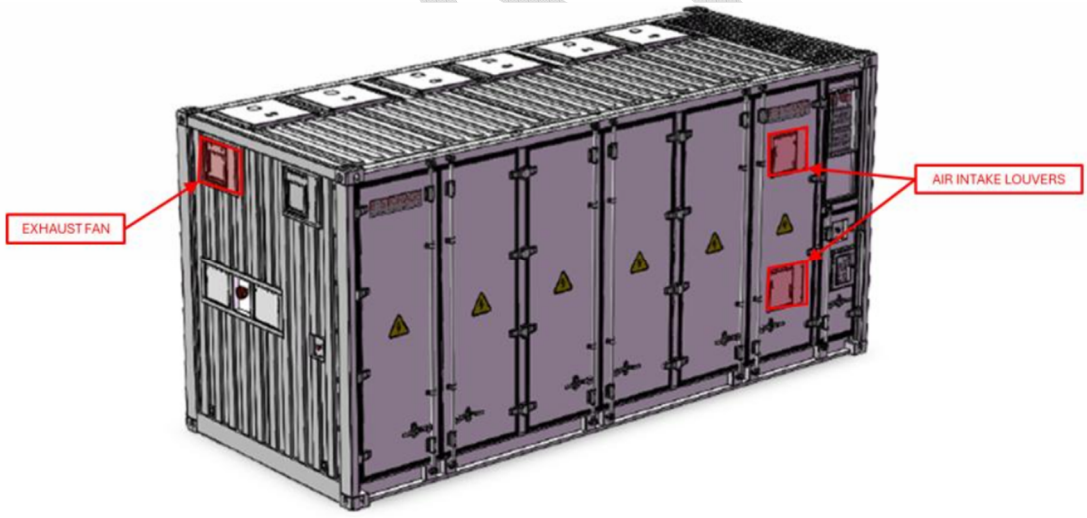


Figure 7: SB3 Explosion Control System

2.11 Site Controller and Monitoring

The SB3 is monitored and controlled by a site EMS or local plant controller (LPC) during normal operations. The EMS or LPC will communicate with an offsite fleet controller, SCADA operations center, or other third-party dispatch and monitoring entity to allow remote control and operations of the system. System status and alarms are communicated to the EMS and remote operations personnel. In the event of emergency conditions, the SB3 can be remotely shut down.

3. UL 9540A SUMMARY & ANALYSIS

UL 9540A 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.

Initially, cells are tested to determine if further testing is required. Module level testing is required if the following observations are recorded during cell level testing:

- Thermal runaway is induced in the cell; and,
- The cell vent gas is flammable in air when tested in accordance with ASTM E918.

Module level testing examines the module design, heat release rate, gas generation, external debris, and flying debris hazards. Unit level testing is required if the following observations are recorded during module level testing:

- Module design is unable to contain thermal runaway; and,
- Cell vent gas is flammable.

Unit level testing assesses the BESS design of the unit, heat release rate, gas generation and composition, deflagration and flying debris hazards, BESS and wall surface temperatures, heat flux at the target walls, and reignition. Installation level testing is required if the following observations are recorded during unit level testing:

- Flaming is observed outside the initiating BESS unit;
- Surface temperature of the modules in the adjacent BESS unit exceeds the temperature at which cell level gas venting occurred;
- Surface temperatures of wall surfaces increase more than 175ºF (97ºC) from ambient; and,
- Explosion hazards are observed.

Installation level testing assesses the effectiveness of fire protection systems installed as mitigation methods for the BESS in its intended installation configuration.

A summary of the cell, module, unit, and installation level test results for the SB3 are provided below.

3.1 UL 9540A Cell Level Testing

Cell-level testing was completed at TÜV Rheinland (Shenzhen) Co., Ltd. (TÜV) September through November 2023. TÜV is an OSHA-approved Nationally Recognized Testing Laboratory (NRTL) and offers the cTÜVus mark, which is equivalent to other NRTL marks such as UL, ETL or CSA. Testing was performed on five Model LFP71173207, 3.2 V, 314 Ah, LFP cells manufactured by Hithium and used in the SB3. Each cell was charged to 100% state of charge (SOC) prior to testing. Thermal runaway was initiated via an external film heater installed

on each cell, as shown in Figure 8. The cell sample and heater were clamped by two steel plates together during the test to simulate the constraint in the BESS module to prevent excessive swelling during the test. The heater was programmed to increase the temperature of the cell's surface at a rate from 4°C-7°C per minute until the cell vented and went into thermal runaway. The cell was placed within a sealed enclosure and the products released during testing were collected and analyzed.



Figure 8: Cell Test Setup

3.1.1 Key Results & Takeaways

Key takeaways from the tests include:

- The average cell vent and thermal runaway temperature was determined to be 203.7°C (399°F) and 295.7°C (564°F), respectively, as listed Table 1.
- 130 liters of cell vent gases were released.
- The cell vent gas mixture is flammable and has an LFL of 8.1% at ambient temperature.
- The cell vent gases were predominantly (approximately 95%) Carbon Monoxide (CO), Carbon Dioxide (CO2), Hydrogen (H2), and Methane (CH4), as listed in Table 2.

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

Flammability Property	Value
Average cell surface temperature at gas venting	203.7°C
Average cell surface temperature at thermal runaway	295.7°C
Cell vent gas volume released	130 L
LFL, % volume in air at the ambient temperature	8.1%
LFL, % volume in air at the venting temperature	6.5%
Burning velocity (S_u)	0.779 m/s
Maximum pressure (P_{max})	0.78 MPa

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	16.202	10.9
Carbon Dioxide	CO_2	26.861	N/A
Hydrogen	H_2	49.875	4.0
Methane	CH_4	3.671	4.4
Ethylene	C_2H_4	1.389	2.4
Ethane	C_2H_6	0.548	2.4
Propene	C_3H_6	0.745	1.8
Propane	C_3H_8	0.18	1.7
-	n-C_4H_{10}	0.068	-
-	n-C_4H_8	0.22	-
-	n-C_5H_{12}	0.076	-
-	iso-C_5H_{12}	0.112	-
-	n-C_5H_{10}	0.053	-
Total	-	100	-

3.1.2 Performance Criteria

UL 9450A Section 7.7 outlines the performance criteria for the cell level test. If all these conditions are met, further tests (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; and
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 that the cell went into thermal runaway and vented flammable gases, UL 9540A module level testing was required.

3.2 UL 9540A Module Level Testing

Module level testing was completed at TÜV Rheinland (Shanghai) Co., Ltd. April through May 2024. Testing was performed on a 332.8 V, 314 Ah, Model SolBank-R-418-2h-H module manufactured by Hithium and used in the SB3, as shown in Figure 9. The module consisted of 104 Model LFP71173207, 3.2 V, 314 Ah, LFP cells manufactured by Hithium which were charged to 100% SOC prior to testing. During the test, the module was not connected to the BMS or TMS, i.e., 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 cell #40 within the module. This resulted in the simultaneous heating of three cells forcing multiple cells into thermal runaway at approximately the same time. The heaters were programmed to increase the cell surface temperature until the cells vented and went into thermal runaway. The module was placed under an instrumented hood and the products released during combustion were collected for analysis.

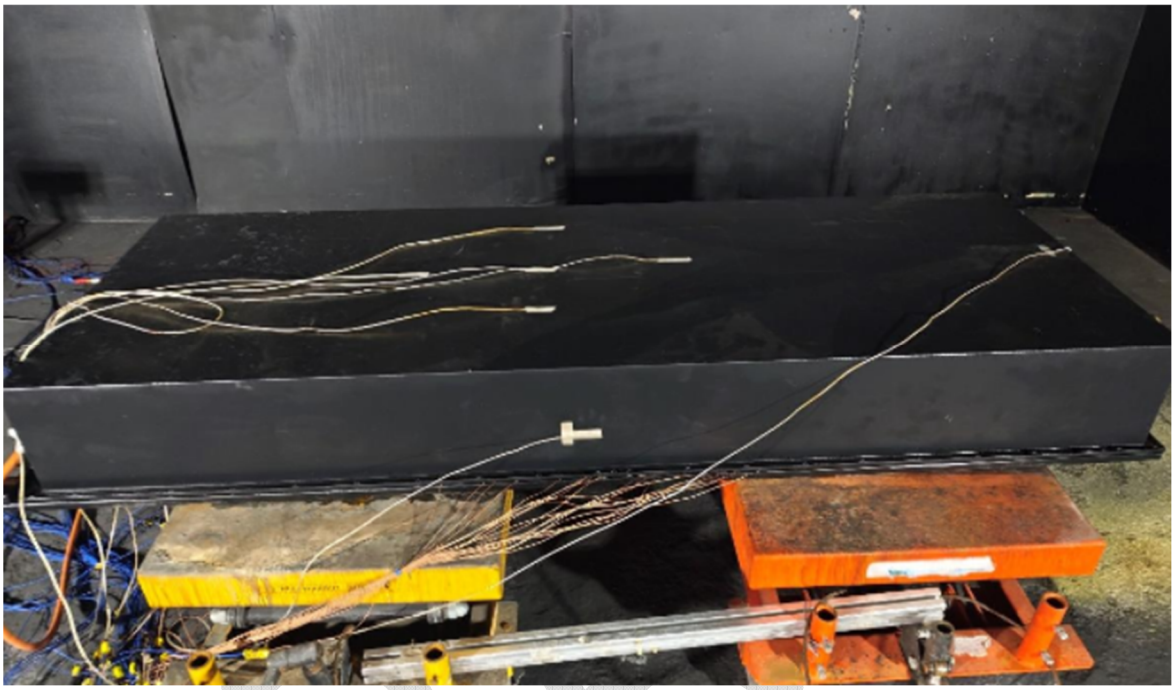


Figure 9: Module Test Setup

3.2.1 Key Results & Takeaways

This simultaneous heating of three cells forced multiple cells to go into thermal runaway that propagated from the initiating cells to two additional cells in the module. Key takeaways from the UL 9540A module level test include:

- Thermal runaway propagated from the three initiating cells to two additional cells in the module.
- No sparks, flying debris, or flaming was observed during the test.
- Products of combustion were collected, as listed in Table 3.
- Toxic gases sometimes associated with lithium-ion batteries, such as HF, HCl, and HCN, were not detected during the combustion of the module.

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

Gas Name	Chemical Structure	Total Volume (L)	Detection Method
Carbon Monoxide	CO	157.10	FTIR
Carbon Dioxide	CO_2	388.98	FTIR
Methane	CH_4	85.54	FTIR

Gas Name	Chemical Structure	Total Volume (L)	Detection Method
Acetylene	C_2H_2	3.05	FTIR
Ethene	C_2H_4	56.26	FTIR
Ethane	C_2H_6	12.22	FTIR
Propylene	C_3H_6	29.24	FTIR
Propane	C_3H_8	20.11	FTIR
Hydrogen	H_2	262.16	Hydrogen Sensor
Total Hydrocarbons	(Propane Equivalent)	285.55	FID

3.2.2 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) is not required. The acceptable performance criteria during the UL 9450A module level test are as follows:

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

Given the cell vent gases are flammable (as summarized previously), UL 9540A unit level testing was required.

3.3 UL 9540A Unit Level Testing

The unit level fire test was completed at TÜV Rheinland (Shanghai) Co., Ltd. in May 2024. 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 and systems during the test. This discussion is a summary of the test setup, test data and results. For a full description of the test, please refer to TÜV's UL 9540A unit level test report.

3.3.1 Test Setup and Initiation

The SB3 test unit consisted of 4 battery modules, with a capacity of 418 kWh, tested at 100% SOC. During the test, the BMS and TMS were disabled, i.e., they were 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 scenario fire scenario, where the unit tested was at the highest energy density possible (100% SOC), and the BMS and TMS were disabled and, therefore, unable to actively respond to the thermal runaway condition.

The initiating battery module was chosen to be the second battery module from the bottom in the initiating unit (Unit 1), as shown in Figure 10. This location was deemed to be the worst case, given there are battery modules directly above it and below it. In addition, by initiating in the battery module second from the bottom, there are two battery modules installed directly above the initiation location. Within the battery module itself, three interior cells were simultaneously heated via two film heaters. 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.

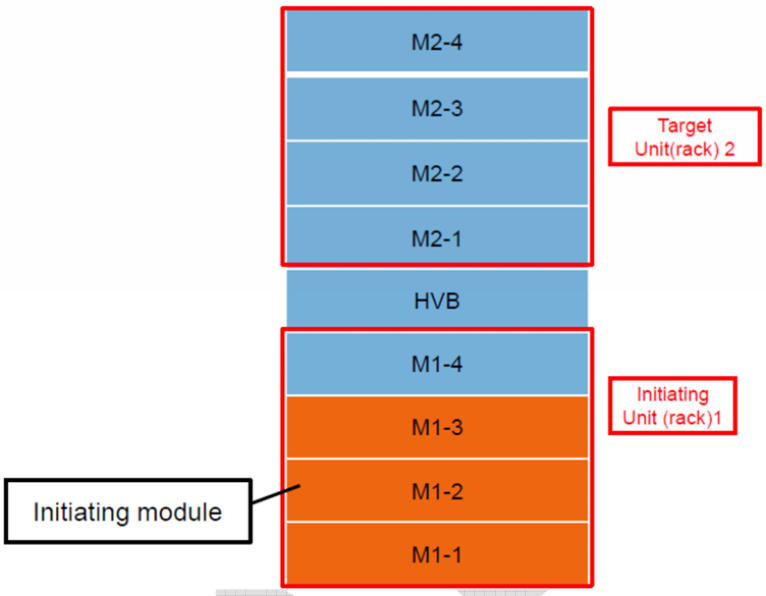


Figure 10: Initiating Module Location

Two additional target SB3 units were installed approximately 4.4 in (112 mm) to the side of the initiating unit, as shown in Figure 11. The two target SB3 units to the side simulate a multiple SB3 installation to determine if thermal runaway and/or fire will propagate from one SB3 cabinet to adjacent cabinets at separation distances of 4.4 in (112 mm). Additionally, the units were enclosed by three walls installed as close as 1.5 in (40 mm) from the initiating unit to demonstrate if fire could spread to a combustible surface during the test.

Note: this testing was performed as an indoor BESS. Therefore, not tested as specifically prescribed by NFPA 855. However, the testing arrangement can be considered conservative for an outdoor ground mounted BESS.

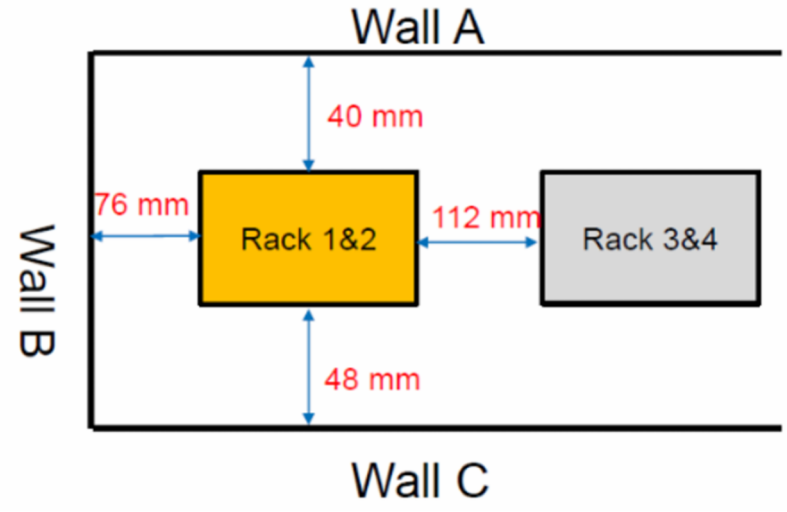


Figure 11: Instrumentation and Target SB3 Unit Setup (Top View)

3.3.2 Key Results & Takeaways

Table 4 provides a summary of key events from the UL 9540A unit level fire test of the SB3.

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

Locations (Cell #)	Event	Time
-	Test Start	15:45
40	Vent	16:40
40	Thermal Runaway	16:55
39	Thermal Runaway	17:04
41	Thermal Runaway	17:06
38	Thermal Runaway	17:09
42	Thermal Runaway	17:14

After the test, analysis of the data and a visual inspection of the initiating SB3 yielded the following observations:

- Over the duration of the test, five cells went into thermal runaway: the three that were forcibly heated and two additional cells. This demonstrated that cell to cell propagation had occurred during the test, as is required by UL 9540A.
- No other signs of distress were observed in the initiating battery module. Thermal runaway did not propagate beyond the three cells within the initiating module, nor did it spread to the module above or below it within the battery rack.
- Visible clues of fire damage were not observed to components (plastics, electronics, etc.) adjacent to the five failed cells. Based on this observation, it is likely that a sustained fire did not occur around the initiating battery module, even with the failure of five cells occurring.
- The battery modules within the target unit installed above and below were unaffected.
- Heat flux measurements were recorded throughout the UL 9540A unit level fire test on each wall and the target units to the side of the initiating unit. Since flames did not occur outside the initiating unit, predictably, these measurements were 0.0 kW/m^2 throughout the entire test.
- Explosion hazards, including but not limited to, observations of a deflagration, projectiles, flying debris, detonation, or other explosive discharge of gases were not observed during the test when a near simultaneous failure of up to five cells occurs within the same battery module.

These test results meet all five of UL 9540A's performance criteria for outdoor ground mounted BESS units. The unit level test demonstrated that the near simultaneous failure of five cells within the same battery unit did not lead to flaming combustion nor to a propagating thermal runaway event throughout the SB3 cabinet.

3.4 Large-Scale Fire Testing

This fire test information will be included once provided.

4. WORTHINGTON BESS SITE

The Worthington BESS is being proposed for installation in Worthington, MA. It is bounded by Ridge Road to the east, Buffington Hill Road to the north, and undeveloped land to the south/west as shown in Figure 12. As such, the Worthington BESS will be located in a rural area primarily surrounded by residential neighborhoods and undeveloped land with limited nearby commercial properties.

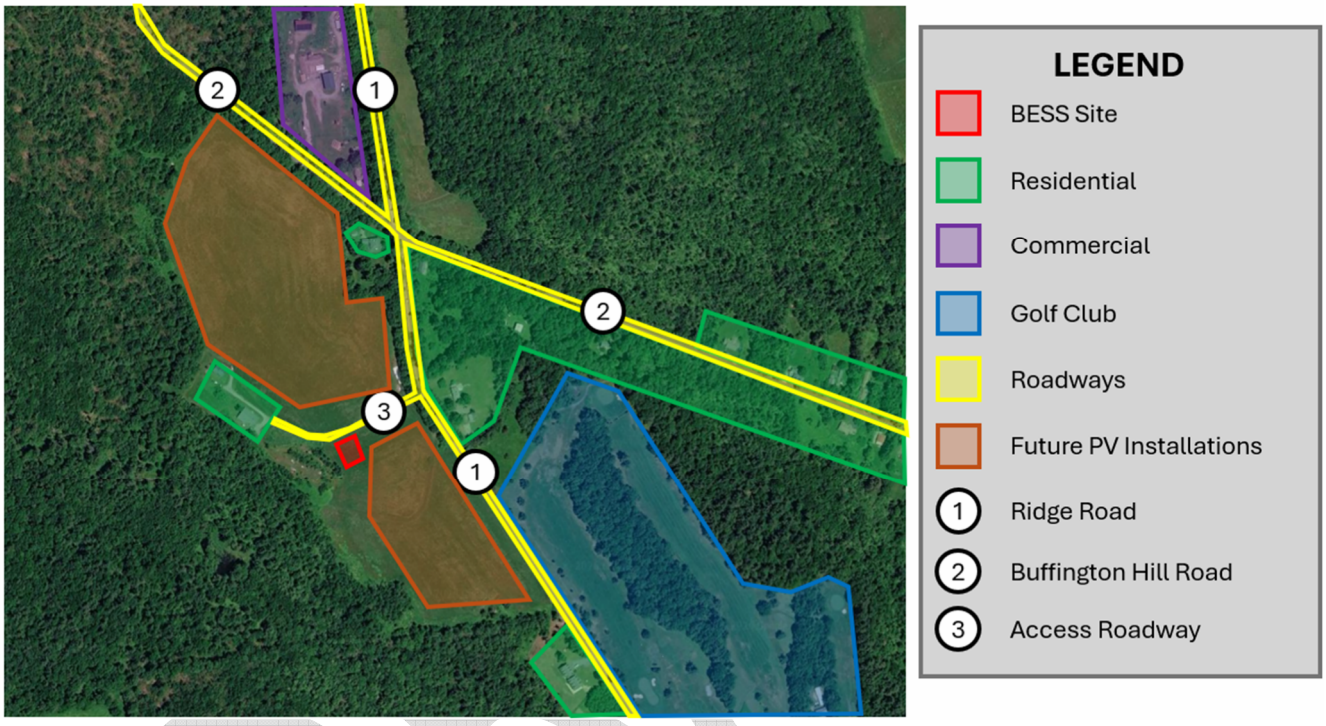


Figure 12: Aerial Map (Near View)

4.1 Site Level Fire Safety Features

Based on a review of the IFP drawing package dated 12/23/2025 (the drawing set) and discussion with BlueWave Energy, the Worthington BESS is anticipated to include two SB3 cabinets with an approximate capacity of 9.6 MWh, as shown in Figure 13. A fire apparatus access roadway will be constructed to connect the BESS yard to Ridge Road. This roadway also provides access to one on-site residence.

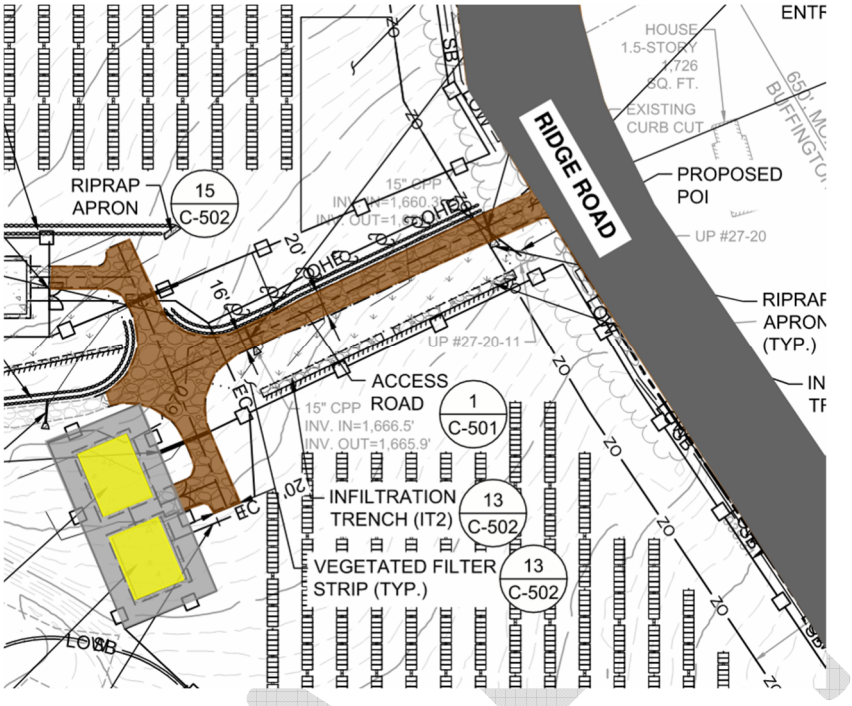


Figure 13: Site Plan (BESS Pads Highlighted)

As shown in the drawing set and the SB3 product documentation, the Worthington BESS will have a number of site-level fire safety systems and features as described in the following sections.

4.1.1 BESS Monitoring and Emergency Notification

It is anticipated that the Worthington BESS will be remotely monitored. If an abnormal signal is received, the O&M management organization and the responsible service personnel (O&M service personnel) would be notified in such a case. However, additional details of the BESS monitoring and emergency notification are forthcoming as the design progresses.

4.1.2 Periodic Maintenance

It is anticipated that the Worthington BESS will be periodically inspected and serviced by trained O&M service personnel.

4.1.3 BESS Security

An 8-ft tall fixed knot farm fence will be installed around the perimeter of the BESS yard at the Worthington BESS to prohibit access to the SB3 cabinets. Also, the secured area around the BESS yard will include one 20-ft wide double swing access gate on the yard's east side.

4.1.4 Fire Department Access

The Worthington District Fire Department is the closest fire department to the Worthington BESS and is approximately 1 mile away from the BESS installation. The closest access road to the Worthington BESS is Ridge

Road which connects to the fire apparatus access roadway as shown in Figure 13 above. The fire apparatus access roadway has the following design features:

- Extends to within 150 ft of each SB3 cabinet contained in the BESS yard.
- Minimum unobstructed width of 16 ft with suitable turning radius/angles of approach/departure and an unobstructed vertical clearance.
- Constructed of 6-in. depth gravel to provide all-weather driving capabilities.
- No dead ends exceeding 150 ft. in length.
- It is anticipated that the grade of the fire apparatus access roadway will not exceed 10%.

4.1.5 Emergency Water

No on-site water will be provided for firefighting purposes.

Note, based on the UL 9540A unit level fire testing, manual fire suppression (hose lines) is not required to suppress a SB3 fire.

4.1.6 Fire Alarm and Notification System

The SB3 cabinet is provided with fire and gas detection. The fire and gas detection system includes three photoelectric smoke detectors (two in the battery compartment and one in the electrical compartment), three heat detectors (two in the battery compartment and one in the electrical compartment), and two hydrogen gas detectors in the battery compartment. The fire and gas detection system is connected to a FACP. For local notification, an alarm bell and an audible/visible appliance are installed on the exterior of the SB3 cabinet. Additional safety features are available optionally, including a pull station, disable switch, abort switch, and gas release alarm.

As the site design is still under development, fire alarm design drawings have not been provided. It is anticipated that the fire alarm system will be monitored locally by a FACP. It is anticipated that the FACP will be monitored 24/7 by a remote monitoring station. Should a fire or other thermal event occur at the Worthington BESS that triggers an alarm at the FACP, the remote monitoring station would receive that alarm signal and could then notify the site contact and the fire department.

4.1.7 Fire Suppression System

No external nor internal fire suppression system will be provided on or in the SB3 cabinets.

4.1.8 Emergency Stop

An emergency start/stop (E-stop) button is provided at each end of the SB3 cabinet, which will shut down the SB3 cabinet when pressed. This E-Stop can be used for maintenance purposes or during an emergency to isolate the SB3 cabinets from connected energy sources. Note, a site-wide E-Stop should never be initiated without first coordinating with the site and the Utility.

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4.2 Permanent BESS or Electrical Grid Exposures

The Worthington BESS and its associated equipment are intended to operate year-round, 24 hours a day, 365 days a year. It is anticipated that each SB3 cabinet will be installed on a concrete pad surrounded by gravel. As the design for the BESS yard is progressed, the clearance distances to permanent electrical exposures associated with the Worthington BESS and/or electrical grid will be confirmed.

4.3 Permanent Public Exposure Hazards

All permanently installed public exposures (lot lines, public ways, buildings, stored combustible materials, hazardous materials, high-piled stock, and exposure hazards not associated with electrical grid infrastructure) are greater than 10 ft from the closest SB3 cabinet. As described in the drawing set and aerial map, clearance distances to public exposures are summarized in Figure 14 and Table 5.

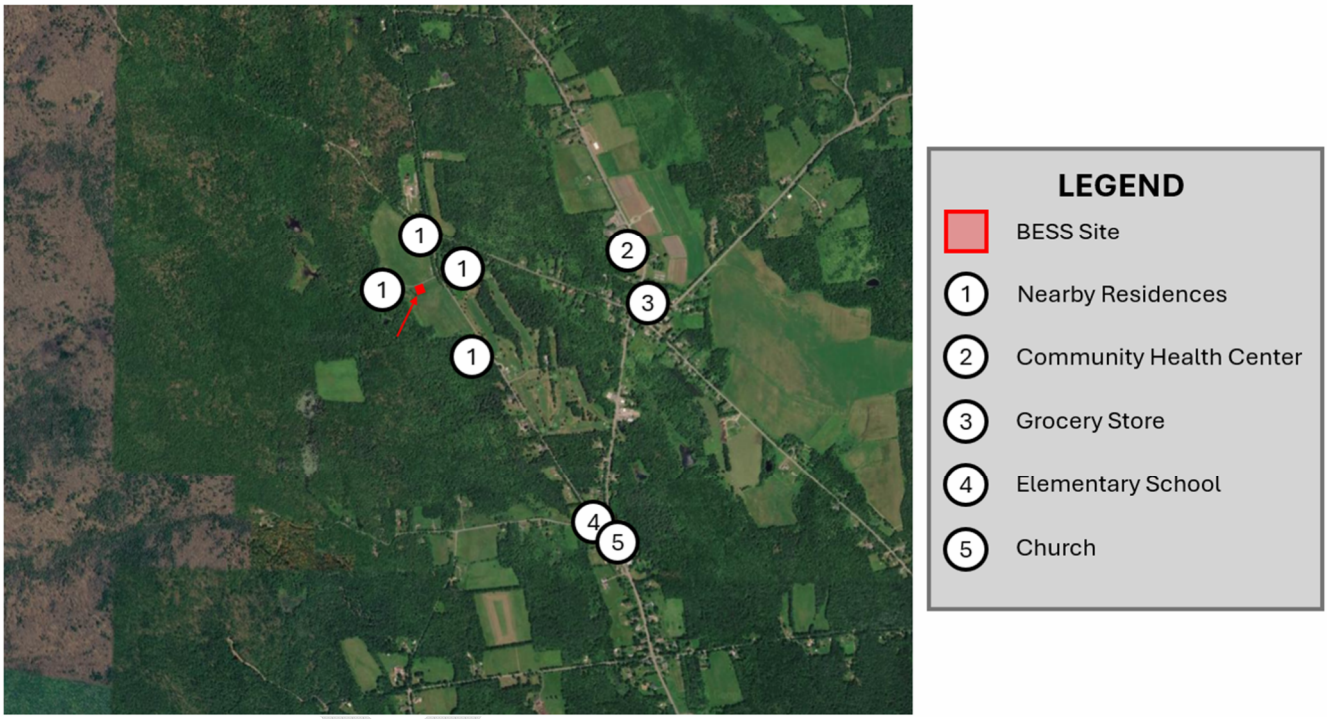


Figure 14: Aerial Map (Far View)

Table 5: Distance to Permanent Public Exposures

Exposure	Approximate Distance
Nearest Property Line Boundary	400 ft.
Nearest Roadway (Ridge Road)	400 ft.
Closest Residence	500 ft.

Exposure	Approximate Distance
Other Nearby Residences	800 ft.
Hilltown Community Health Center	3,300 ft.
Corners Grocery	3,600 ft.
RH Conwell Elementary School	1 mile
First Congregational Church Worthington	1 mile

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5. SITE DESIGN CODE ANALYSIS

527 CMR (Massachusetts Comprehensive Fire Safety Code) adopts/amends the 2021 Edition of NFPA 1. As amended by 527 CMR, NFPA 1 Chapter 52 (Energy Storage Systems) references the 2020 Edition of NFPA 855. Accordingly, the code analysis herein is conducted in accordance with NFPA 855 (2020).

Compliance with NFPA 855 is required when a lithium-ion BESS installation has an energy capacity greater than 20 kWh (NFPA 855 Table 1.3). Since the Worthington BESS is anticipated to have an energy capacity of approximately 9.6 MWh, NFPA 855 requirements apply. Below is a review of the Worthington BESS site design for compliance with NFPA 855. Note, this code analysis applies only to site design elements of the Worthington BESS pertaining to fire and life safety. Other aspects of the site design, including the electrical or structural design, are outside the scope of this review. As this is a site design review, elements related to the installation itself are also outside the scope of this analysis. It is assumed that the BESS and its associated equipment, including all fire protection systems, will be installed, commissioned, inspected, tested, and maintained as required by the manufacturer(s), NFPA 855, and/or other applicable codes and standards.

5.1 Outdoor BESS Classifications

The Worthington BESS is anticipated to include two SB3 cabinets (subject to change as the design progresses). The SB3 is a NWI style BESS that is unoccupiable, with all internal components accessible via exterior doors. NFPA 855 defines this type of BESS as an Energy Storage System Cabinet, which is an enclosure containing components of the ESS where personnel cannot enter the enclosure other than reaching in to access components for maintenance purposes. For outdoor BESS installations, NFPA 855 provides code requirements based on the proximity and location of the BESS equipment from adjacent exposures (NFPA 855 §4.4.3.1). The two relevant outdoor installation classifications are as follows:

- **Remote locations** – BESS located more than 100 ft from buildings, lot lines that can be built upon, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with electrical grid infrastructure.
- **Locations near exposures** – BESS locations that do not comply with remote outdoor location requirements.

Based on the drawing set, there is greater than a 100 ft separation distance between the SB3 cabinets and the nearest exposures not associated with the electrical grid infrastructure. As such, the Worthington BESS is classified as a remote, outdoor BESS for this analysis. Table 6 summarizes code requirements pertaining to a remote, outdoor lithium-ion BESS installation, which are discussed in detail within the following sections. Other NFPA 855 requirements that apply to all facilities, BESS or otherwise, include fire apparatus access roads (NFPA 855 §4.4.3.8).

Table 6: NFPA 855 Outdoor BESS Installation Requirements

Requirement	Remote Exposures	NFPA 855 Reference
All ESS Installations	Yes	§4.1-4.3
Maximum Size	Yes	§4.4.3.2
Clearance to Exposures	N/A	§4.4.3.3
Means of Egress Separation	N/A	§4.4.3.4
Vegetation Control	Yes	§4.4.3.6
Size and Separation	No	§4.6
Maximum Stored Energy	No	§4.8
Smoke and Fire Detection	Yes	§4.10
Fire Control and Suppression	Yes	§4.11
Fire Protection Water Supply	Yes	§4.13
Technology Specific Protection – Lithium-Ion Batteries		
Thermal Runaway	Yes	§9.3
Explosion Control	Yes	§4.12
Other NFPA 855 Requirements – All Facilities		
Fire Department Access Roads	Yes	§4.4.3.8

5.2 All ESS Installations

NFPA 855 §4.1 through §4.3 apply to all ESS installations: indoor, outdoor, stationary, and mobile. Only the fire and life safety general installation requirements applicable to the site design of a remote, outdoor, NWI style BESS installation are summarized in the following sections. Requirements unrelated to fire and life safety (such as electrical or structural) or pertaining to other types of BESS installations (such as indoor) are not discussed. These include electrical installations (NFPA 855 §4.3.1), seismic and structural design (NFPA 855 §4.3.3), design loads (NFPA 855 §4.3.4), egress (NFPA 855 §4.3.10), open rack installations (NFPA 855 §4.3.11), fire-resistance rated separations/barriers (NFPA 855 §4.3.6), and occupied work centers (NFPA 855 §4.7).

5.2.1 Combustible Storage

NFPA 855 §4.1.6 does not permit combustible materials to be stored in ESS rooms, cabinets, enclosures, areas, or walk-in units. In addition, combustible materials cannot be stored within 3 ft of the ESS. The SB3 is a NWI style BESS that is unoccupiable with all internal components accessible via exterior doors. It does not have free open space within the cabinet to store additional combustible materials. Based on a review of the drawing set, no combustible materials will be stored within 3 ft of the SB3 cabinets. As such, the Worthington BESS site design complies with NFPA 855 combustible storage requirements.

5.2.2 Equipment

NFPA 855 §4.2.1 requires ESS to be listed in accordance with UL 9540. The SB3 is listed to UL 9540. As such, the Worthington BESS site design complies with NFPA 855 equipment listing requirements.

5.2.3 Environment

NFPA 855 §4.2.6 requires the temperature, humidity, and other environment conditions in which the ESS is located to be maintained in accordance with the listing and the manufacturer's specifications. The SB3 is provided with a TMS that maintains suitable environmental conditions for the ESS, as described in Section 2.5. As such, the Worthington BESS site design complies with NFPA 855 environment requirements.

5.2.4 Energy Storage Management System (ESMS)

NFPA 855 §4.2.9 requires ESS to be provided with an ESMS or a BMS. The SB3 is provided with a BMS that monitors battery cell temperatures, voltages, currents, and dry contact switching in real-time, as described in Section 2.6. As such, the Worthington BESS complies with NFPA 855 ESMS requirements.

5.2.5 Toxic and Highly Toxic Gases

NFPA 855 §4.1.1 does not permit ESS to release toxic and highly toxic gas during normal charging, discharging, and use. The SB3 uses listed lithium-ion cells that do not vent toxic or highly toxic gases, or any gases, during charging, discharging, or normal use conditions. As such, the Worthington BESS site design complies with NFPA 855 toxic and highly toxic gas requirements.

5.2.6 Enclosures

NFPA 855 §4.4.3.7 requires enclosures to be noncombustible and weatherproof. The SB3 is a noncombustible cabinet with an IP66 rating. As such, the Worthington BESS site design complies with NFPA 855 enclosures requirements.

5.2.7 Signage

NFPA 855 §4.3.5 requires approved signage to be provided in the following locations:

1. On the front of doors to rooms or areas containing ESS or in approved locations near entrances to ESS rooms.
2. On the front of doors to outdoor occupiable ESS.
3. In approved locations on outdoor ESS that are not enclosed in occupiable containers or otherwise enclosed.

The signage required must be in compliance with ANSI Z535 and include the following information:

1. "Energy Storage Systems" with symbol of lightning bolt in a triangle.
2. Type of technology associated with the ESS.
3. Special hazards associated as identified in Chapters 9 through 15.
4. Type of suppression system installed in the area of the ESS.

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5. Emergency contact information.

A permanent plaque denoting the location of all electric power source disconnecting means on or in the premises shall be installed at each service equipment location and at the location(s) of the system disconnect(s) for all energy sources capable of being interconnected. The Worthington BESS is capable of being installed in accordance with these requirements; however, signage will be evaluated once additional site design details are provided to confirm compliance.

5.2.8 Impact Protection

NFPA 855 §4.3.7 requires ESS to be located or protected to prevent physical damage, including impact by a motor vehicle. Based on a review of the drawing set, vehicle impact protection is not being provided at the Worthington BESS. However, the Worthington BESS is a secure, remote installation that does not have personnel on site each day. In addition, there is no motor vehicle traffic moving through the site other than the occasional maintenance vehicle (i.e., there are no public roads/ways on the site) and access to one on-site residence. Therefore, vehicle impact protection is not necessary for the Worthington BESS. As such, the Worthington BESS site design complies with NFPA 855 impact protection requirements.

5.2.9 Security of Installation

NFPA 855 §4.3.8 requires rooms, areas, and walk-in units in which electrochemical ESS are located to be secured against unauthorized entry and safeguarded in an approved manner. Security barriers, fences, landscaping, and other enclosures shall not inhibit the required air flow to or exhaust from the electrochemical ESS and its components. As described in Section 4.1.3, a gated, 8-ft tall fixed knot farm fence will be installed around the perimeter of the BESS yard to prohibit access to the SB3 cabinets. This fencing shall not, however, prohibit the required air flow to the cabinets. As such, the Worthington BESS site design complies with NFPA 855 security of installation requirements.

5.2.10 Access Roads

NFPA 855 §4.4.3.8 requires fire department access roads to be provided to outdoor ESS installations in accordance with the local fire code. NFPA 1 Chapter 18 requires fire apparatus roads to be provided in accordance with §18.2.3 for every facility, building, or portion of a building hereafter constructed or relocated. At a minimum, the fire apparatus access roads must meet the following:

- Extend to within 150 ft of all portions of the facility and all portions of the exterior walls of the first story of the building as measured by an approved route around the exterior of the building or facility (§18.2.3.2.2).
- Have an unobstructed width of not less than 20 ft and an unobstructed vertical clearance of not less than 13 ft 6 inches (§18.2.3.5.1.1 and §18.2.3.5.1.2).
- Be designed and maintained to support the imposed loads of fire apparatus and shall be surfaced so as to provide all-weather driving capabilities (§18.2.3.5.2).
- Have a turning radius, angles of approach and departure that are approved by the FCO (§18.2.3.5.3).
- Minimum inside turning radius of 25 ft. (§18.2.3.5.3.1 as amended by 527 CMR).
- Dead-end fire apparatus access roads in excess of 150 ft in length shall be provided with an approved area for turning around fire apparatus (§18.2.3.5.4).

- The grade of the fire apparatus access road shall not exceed 10% unless approved by the FCO (§18.2.3.5.6.1 as amended by 527 CMR).

Based on the review of the drawing set, the 6-in. depth crushed stone access roadway at the Worthington BESS is within 150 ft of all areas of the BESS facility, there are no dead ends exceeding 150 ft, and the access roads within the BESS facility are anticipated to be less than 10% in grade. However, the minimum unobstructed roadway width must be increased from 16 ft to 20 ft or obtain AHJ approval.

5.3 Outdoor ESS Installations

5.3.1 Size and Separation

NFPA 855 §4.6 requires near exposures, outdoor BESS to be segregated into groups not exceeding 50 kWh with each group to be separated by minimum 3 ft from other groups. However, these requirements do not pertain to the Worthington BESS as it is classified as a remote, outdoor BESS.

5.3.2 Maximum Stored Energy

NFPA 855 §4.8 requires near exposures, outdoor BESS to meet the maximum allowable quantities threshold of 600 kWh. However, this requirement does not pertain to the Worthington BESS as it is classified as a remote, outdoor BESS.

5.3.3 Maximum Size

NFPA 855 §4.4.3.2 does not permit outdoor ESS cabinets to exceed 53 ft × 8.5 ft × 9.5 ft, not including HVAC and other equipment. The SB3 is a NWI style cabinet with dimensions 19.9 ft × 8.0 ft × 9.5 ft, which is smaller than the maximum permitted size for outdoor cabinets per NFPA 855. As such, the Worthington BESS site design complies with the NFPA 855 maximum size requirements.

5.3.4 Clearance to Exposures

NFPA 855 §4.4.3.3 requires ESS located outdoors to be separated by a minimum of 10 ft (3048 mm) from the following exposures: lot lines, public ways, buildings, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards. Note, the *other exposure hazards* applies to other exposure hazards not associated with the electrical grid infrastructure. Based on a review of the drawing set, no exposure is within 10 ft of the nearest SB3. As such, the Worthington BESS site design complies with the clearance to exposures requirements.

5.3.5 Means of Egress Separation

NFPA 855 §4.4.3.4 requires ESS located outdoors to be separated from any accessible means of egress as required by the FCO to ensure safe egress under fire conditions, but not less than 10 ft. The FCO is authorized to approve a reduced separation distance to 3 ft where large-scale fire testing complying with NFPA 855 §4.1.5 is conducted and demonstrates that a fire involving the ESS will not adversely impact occupant egress. Based

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on a review of the drawing set, the Worthington BESS site design complies with the means of egress separation requirement.

5.3.6 Vegetation Control

NFPA 855 §4.4.3.6 requires areas within 10 ft on each side of outdoor ESS to be cleared of combustible vegetation and other growth. It is anticipated that each SB3 cabinet will be installed on a concrete pad surrounded by gravel. This design would provide at least 10 ft on each side of all SB3 cabinets free of combustible vegetation. As such, the Worthington BESS site design complies with the vegetation control requirements.

5.3.7 Smoke and Automatic Fire Detection

NFPA 855 §4.10 requires areas containing ESS located within buildings or structures to be provided with a smoke detection or radiant energy sensing system in accordance with NFPA 72. The SB3 is a NWI style BESS that is unoccupiable, with all internal components accessible via exterior doors. It is not being installed inside a room, indoor areas, or walk-in units. Therefore, the SB3 installation at the Worthington BESS does not require smoke and automatic fire detection. As such, the Worthington BESS site design complies with the smoke and automatic fire detection requirements.

However, the SB3 is equipped with a smoke and heat detection system. In addition, the SB3 is equipped with an audible/visual notification appliance located on the exterior of the cabinet. It is anticipated that any alarm state communicated from a SB3 BMS would be seen at the full site network's EMS as described in Section 2.6. Although this system is not required by NFPA 855, FRA recommends that any fire alarm system be designed, commissioned, and installed in accordance with NFPA 72.

5.3.8 Fire Suppression System

NFPA 855 §4.11 requires an automatic fire suppression system to be installed in rooms and areas within buildings and walk-in units containing ESS. The SB3 is a NWI style BESS that is unoccupiable with all internal components accessible via exterior doors. It is not being installed inside a room or within a building. Therefore, the SB3 installation at the Worthington BESS does not require fire suppression systems. As such, the Worthington BESS site design complies with fire suppression system requirements.

5.3.9 Water Supply

NFPA 855 §4.13 requires sites where non-mechanical ESS are installed to be provided with a permanent source of water for fire protection. Where no permanent and reliable water supply exists for firefighting purposes, the requirements of NFPA 1142, *Standard on Water Supplies for Suburban and Rural Firefighting*, apply. As discussed in Section 4.1 above, no on-site water will be provided for firefighting purposes which will require FCO approval. However, when agreeable with the ESS owner and approved by the AHJ, a permanent water supply for firefighting purposes can be omitted [NFPA 855 Table 4.4.3 Footnote D]. The Worthington BESS is capable of being installed in accordance with these requirements; however, the AHJ must approved the omission of a permanent firefighting water supply.

Note, typical BESS firefighting response procedures do not require or recommend offensive firefighting tactics to manually suppress a BESS fire. In addition, UL 9540A unit level fire testing (see Section 3.3) demonstrated that a fire will not spread from module to module within the SB3 cabinet or to adjacent SB3 cabinets. This result was without a fire suppression system installed inside the SB3 cabinet and without manual fire suppression via hose lines.

5.4 Technology Specific Protection – Lithium-Ion Batteries

NFPA 855 requires electrochemical ESS to comply with the thermal runaway requirements of NFPA 855 §9.3 and the explosion control requirements of NFPA 855 §4.12. Note, lithium-ion batteries do not need to meet the exhaust ventilation requirements of NFPA 855 §4.9, the spill control and neutralization requirements NFPA 855 §4.14 and §4.15, or the safety cap requirements NFPA 855 §9.4.

5.4.1 Explosion Control

NFPA 855 Table 9.2 requires lithium-ion ESS installed within a room, building, ESS cabinet, ESS walk-in unit, or otherwise unoccupiable enclosure to be provided with one of the following per §4.12:

(1) Explosion prevention systems designed, installed, operated, maintained, and tested in accordance with NFPA 69; or

(2) Deflagration venting installed and maintained in accordance with NFPA 68.

The SB3 is equipped with a CCR system that is designed per NFPA 69 to maintain the flammable gas concentration inside the SB3 cabinet below 25% of the LFL, thereby minimizing the deflagration potential. To detect flammable gases, two combustible gas detectors are installed at the top interior of each cabinet and are activated when the concentration of hydrogen at the detector location reaches 10% of the LFL. Once activated, the FACP receives an alarm signal, which activates the alarm bell, exhaust fan, and intake air louvers.

TÜV performed a review of the explosion control system and associated fluid dynamics (CFD) simulations for the SB3 and determined the system complies with NFPA 69. This NFPA 69 evaluation report is not endorsed by a registered design professional. A detailed compliance review of these systems was not part of this scope of work. Based on the TÜV CFD modeling, the SB3 installation at the Worthington BESS can meet the NFPA 855 explosion control requirements. FRA recommends that the NFPA 69 compliance evaluation be signed and sealed by a registered design professional.

5.4.2 Thermal Runaway Protection

NFPA 855 §9.3 requires thermal runaway protection for lithium-ion BESS. This protection can be provided with a listed device or other approved method to prevent, detect, and minimize the impact of thermal runaway. The thermal runaway protection is permitted to be part of the BMS that has been evaluated with the battery as part of the evaluation to UL 1973 or UL 9540. The SB3 is equipped with a BMS that was tested and verified to UL 9540. As such, the Worthington BESS site design complies with NFPA 855 thermal runaway requirements.

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5.5 Product Design Code Analysis Summary

Based on a review of the SB3 and the IFP drawing package dated 12/23/2025 (the drawing set), the SB3 installation at the Worthington BESS site design can meet the NFPA 855 installation level requirements for an outdoor, NWI style BESS when it is installed in accordance with the manufacturer's instructions, its listing, the approved drawings, and the NFPA 855. However, as the final site design is developed, several items were identified in this analysis that still need modification/confirmation to ensure compliance. These include:

- Approved signage must be provided at the site per NFPA 855 §4.3.5.
- Increase minimum unobstructed fire apparatus access roadway width from 16 ft to 20 ft or obtain AHJ approval per NFPA 855 §4.4.3.8.
- Obtain FCO approval for having no fire protection water supply at the site per NFPA 855 §4.13.

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6. BESS PLANS & TRAINING

NFPA 855 requires several plans to be developed for a BESS site. Often times, these documents are developed during construction or after substantial completion of the facility, such that they include site specific details that would not be available prior (such as during the design phase of the project).

6.1 Commissioning, Operation, Decommissioning, and ITM

NFPA 855 requires commissioning, decommissioning, and inspection, testing, and maintenance (ITM) requirements for all BESS installations. It states that the operation, inspection, testing, and maintenance must follow the manufacturer's instructions.

A commissioning plan must be developed for the integration of the new BESS equipment into the electrical utility grid. The commissioning documentation is to capture the commissioning roles and responsibilities, list of equipment, conditions, BESS operation compliance, fire protection feature compliance, and operability (NFPA 855 Chapter 6). An operation and maintenance manual must be developed and provided to both the owner, or their authorized agent, and the BESS operator before the BESS is put into operation (NFPA 855 Chapter 7). A decommissioning plan must be developed to provide the organization, documentation requirements, contingencies, and methods and tools necessary to indicate how the safety systems, ESS, and components will be decommissioned and removed from the site (NFPA 855 Chapter 8). In addition, all fire protection systems must be designed, installed, commissioned, inspected, tested, and maintained as required by each respective NFPA standard.

6.2 Emergency Operations Plan

NFPA 855 §4.1.3.2.1 requires an emergency operations plan (EOP) to be readily available at a BESS site for use by facility operations and maintenance personnel. The EOP is a living document that should be updated when conditions change that affect the response considerations and procedures. At a minimum, the EOP shall include the following: procedures for safe operational shutdown, inspection testing and maintenance, BESS response procedures, fire response procedures, safety data sheets, emergency contact information, procedures for dealing with damaged equipment, and procedures for conducting drills [NFPA 855 §4.1.3.2.1.4].

6.3 Emergency Response Plan

An ERP is typically developed to be readily available at the Worthington BESS for use by facility operations and maintenance personnel. The ERP is a living document that should be updated when conditions change that would affect the response considerations and procedure changes. It should be written using terminology that the fire department and first responders are familiar with and should consider them as the primary reader. The BESS ERP, at a minimum, should include: contact information, a site overview, BESS details, site fire protection system details, site hazards, response tactics and recovery/post incident operations.

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6.4 Emergency Response Training

NFPA 855 §4.1.3.1 requires the owner of the BESS or their authorized representative to engage in emergency planning and training of ESS facility operations and maintenance personnel and emergency responders so that they can effectively address foreseeable hazards associated with the on-site systems. Additionally, NFPA 855 §4.1.3.2.2 requires all personnel responsible for the operation, maintenance, repair, servicing, and response of the ESS to be trained in the procedures included in the EOP. In addition, annual refresher training must be provided, and records of the training must be retained.

6.5 Plans and Training Summary

Canadian Solar has developed commissioning, installation, user, maintenance manuals, safety and decommissioning manuals for the SB3 to provide guidance to anyone designing, installing, commissioning, operating, maintaining, servicing, decommissioning, or responding to an emergency involving an SB3. These manuals can be utilized by site owners/operators to develop their own site-specific documents. As the site is still in the design phase, more details related to these plans will be included once provided. It is anticipated that a commissioning plan, operations and maintenance manual, a decommissioning plan, EOP, or an ERP will be developed for the Worthington BESS to meet the NFPA 855 requirements. FRA recommends that all of these plans be finalized and approved prior to energizing the Worthington BESS and that all site personnel and emergency response personnel, who could be responsible for responding to a Worthington BESS emergency, be trained prior to energizing the Worthington BESS. In addition, refresher training should be provided as appropriate, typically annually, as required by NFPA 855.

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7. HAZARD MITIGATION ANALYSIS

This HMA is being prepared following the guidance by NFPA 855. The HMA evaluates the fire safety features of the SB3, the findings of the UL 9540A cell, module, and unit level tests, and the site level fire safety features of the Worthington BESS.

Based on the product level and site level safety features, the fire and life safety consequences associated with typical BESS failure modes can be evaluated to determine the impact to site personnel, the general public, and adjacent exposures.

NFPA 855 §4.1.4.2 requires an HMA to evaluate the consequences associated with the following failure modes, and others deemed necessary by the FCO. Note, only single failure modes must be considered in this analysis:

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.

The consequences of each failure mode are evaluated in Sections 7.1 through 7.4 of this report.

7.1 Thermal Runaway Condition

7.1.1 Description

Thermal runaway is a condition in which a self-heating chemical reaction occurs within a battery cell. This occurs when the battery cell generates heat faster than the battery cell is able to dissipate heat. Thermal runaway can be caused by physical damage (e.g. puncture, crushing), electrical malfunctions (e.g. overcharging), exposure to elevated ambient temperatures (e.g. adjacent cells in thermal runaway with elevated temperatures), manufacturing defects, and other internal conditions which may develop inside of aging battery cells (e.g. dendrites).

Thermal runaway typically results in an overpressure event within the battery cell due to internal heat generation inside the casing causing battery gases to be ejected from the cell through the pressure relief valve. Depending on the conditions, thermal runaway may be limited to the initiating cell(s) or thermal runaway may propagate to adjacent cells. Thermal runaway propagation typically occurs through conductive and convective heating or physical damage of adjacent cells due to swelling of the initiating cell. Conductive heating is the primary mode of heat transfer to adjacent cells for a non-flaming event and convective heating is the primary mode of heat transfer to adjacent cells for a flaming event.

Based on cell level and module level testing, the SB3 cells generate toxic and flammable gases. Depending on the conditions of release, flammable gases released during a thermal runaway event may present an explosion or fire hazard. An explosion hazard exists when sufficient flammable gases are released in the absence of an ignition source and build up within the cabinet. A fire hazard exists when the flammable gases are released in

the presence of an ignition source or self-ignite. It should be noted, the fire hazard and explosion hazard are not mutually exclusive, and both may exist at different time periods throughout a propagating thermal runaway event. In addition, toxic gases present a health exposure hazard to site personnel and first responders located in the vicinity of a BESS failure.

7.1.2 Barriers

Passive and active mitigation strategies are provided to prevent batteries from entering thermal runaway and cool adjacent batteries to prevent thermal runaway propagation. The following barriers are provided in the SB3:

- The cells and modules utilized in the SB3 are certified to UL 1973.
- The SB3 is equipped with a BMS which monitors cell health and shuts down power to modules/cabinets with cells operating outside of their operating conditions, as described in Section 2.6.
- The SB3 is equipped with a TMS which automatically activates to provide cooling and prevent batteries from overheating and escalating to a thermal runaway event, as described in Section 2.5. Additionally, the TMS cools adjacent batteries in a thermal runaway scenario to prevent thermal runaway propagation.
- The SB3 modules are equipped with passive barriers to minimize the likelihood of thermal runaway of spreading from cell to cell.
- The SB3 is equipped with a series of electrical fault protection devices, as described in Section 2.7.
- The SB3 will be regularly maintained to ensure it is operating within its specific parameters and to verify the batteries are in good working condition, as described in Section 4.1.2.

7.1.3 Consequences

The consequences of thermal runaway can vary widely depending on the gas release scenario and level of confinement; however, the primary consequences of thermal runaway can be grouped into the following hazard categories: fire and radiant heat, deflagrations and explosions, and toxic gases.

7.1.3.1 Fire & Radiant Heat Exposure Hazard

UL 9540A unit level testing did not result in a fire (i.e., flaming thermal runaway). During that test, five cells went into thermal runaway: the three that were forcibly heated and two additional cells. Thermal runaway did not propagate beyond the fifth cell, and no sustained fire event occurred. However, a large-scale fire test (LSFT) and/or fire modeling has not been performed to explicitly evaluate the potential for thermal runaway to propagate from one SB3 cabinet to adjacent SB3 cabinets or to determine the minimum approach distances (MAD) should a fully involved SB3 fire occur. In the absence of this data, FRA recommends that site level emergency response procedures be utilized during a fire event to minimize the potential for fire to spread to adjacent cabinets and exposures.

Note, typical BESS firefighting response procedures do not require or recommend offensive firefighting tactics to manually suppress a BESS fire. If manual firefighting tactics are used, water is considered the preferred agent for managing lithium-ion battery fires, suppressing nearby combustibles, cooling nearby exposures, and controlling smoke. Other fire suppression methods, such as gaseous agents (CO_2, Halon), dry chemical suppressants, or foams, are unlikely to be effective. As such, FRA recommends defensive firefighting tactics to be utilized during a fire event involving a SB3 cabinet, and first responders should be trained on these tactics.

Accordingly, FRA recommends that fire responders remain at an initial MAD of 100 ft during a battery emergency. Note, these aspects provide mitigation only in the case in which multiple failures occur, including all of the battery system barriers identified in Section 7.1.2.

7.1.3.2 Deflagration & Explosions Hazard

The SB3 has been tested to UL 9540A, as described in Section 3.0. These test results demonstrated that flammable gases are released from the cells during thermal runaway which can pose a deflagration hazard within the SB3. To mitigate the impact of this hazard, the SB3 is equipped with a CCR system as described in Section 2.10. The CCR system is activated upon receiving signals from the gas detection sensors within the cabinet. Upon gas detection of 10% of the LFL, the ventilation system activates, pulling in outside air and exhausting internal air, to reduce the concentrations of flammable gases to under 25% of the LFL. In addition, the activation of the CCR system would also trigger the sounding of local fire notification appliances installed on the exterior of the SB3. These appliances can alert local site personnel and/or first responders, should any be in the area, of the hazard. Per the EOP/ERP and the training of site personnel/first responders, all personnel would be prompted to evacuate the area immediately upon activation of a fire alarm notification appliance. By immediately evacuating to a designated safe area, site personnel and first responders would provide physical separation between them and the potential deflagration and explosion hazard. This provides a second mitigation feature, physical separation of people from the SB3 cabinets, in addition to the CCR system. Note, these aspects provide mitigation only in the case in which multiple failures occur, including all of the battery system barriers identified in Section 7.1.2 and the CCR system. Accordingly, FRA recommends that first responders remain at an initial MAD of 100 ft from the distressed SB3 cabinet during a battery emergency.

7.1.3.3 Toxic Gas Hazard

The SB3 is not occupiable; therefore, toxic or highly toxic gas exposure is limited to individuals standing outside, in the open ambient air, in proximity to the SB3 cabinet during a failure/fire event. The toxic gases collected during the module level testing include typical fire byproducts, such as CO and CO2. The fire alarm notification system is one mitigation feature installed at the cabinet level to address this hazard. This system can alert local site personnel and/or first responders, should any be in the area, of the hazard. Per the EOP/ERP and the training of site personnel/first responders, all personnel would be prompted to evacuate the area immediately upon activation of a fire alarm notification appliance. By immediately evacuating to a designated safe area, site personnel and first responders would provide physical separation between them and the potential toxic gas hazard. In addition, an ERP should direct first responders to wear proper Personal Protective Equipment (PPE), including a self-contained breathing apparatus (SCBA) and turnout gear, when responding to a battery emergency should they need to approach a distressed cabinet. Given the Worthington BESS is installed outdoors, any gas release would be diluted by the entrainment of outside air. At the quantities measured during UL 9540A module level fire testing, such gases would not be expected to have an adverse effect on individuals during the time deemed necessary to evacuate from the area (i.e., approximately 30 seconds to walk 100 ft away/evacuate from a burning SB3) nor expected to have an adverse effect on emergency response personnel wearing appropriate PPE including a SCBA while responding to an SB3 fire. Note, these aspects provide mitigation only in the case in which multiple failures occur, including all of the battery system barriers identified in Section 7.1.2. Accordingly, FRA recommends that first responders remain at an initial MAD of 100 ft from the distressed SB3 cabinet during a battery emergency.

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Note, toxic gases sometimes associated with lithium-ion batteries, such as HF, HCl, and HCN, were not detected during the UL 9540A module level testing of the SB3. However, the internal components of the SB3 (plastics, printed circuit boards, wiring, coolants, refrigerants, and the lithium-ion cells) could experience thermal decay that contributes to the fuel load, heat release rate, and production of trace toxic components. These could include the release of HF gas upon thermal degradation/decomposition of the lithium-ion cells. Additionally, thermal decomposition of refrigerants included in the TMS and wire insulation can be other potential contributing sources of HF. Acid gases like HCN could also form from the incomplete combustion of nitrogen-containing materials (such as wool, silk, cotton, paper, and plastics) and HCl could be released from the pyrolysis of chlorinated plastics, particularly polyvinyl chloride (PVC), and other chlorine-containing materials/plastics. Note, these hazards are not exclusive to battery fires. As the modern built environment has expanded the use of plastic goods, materials, and electronics to a wide variety of household products, HF, HCl, HCN and other products of combustion are also found in modern day fires. As such, the gases mentioned above are similar to gases first responders would encounter in a typical Class A structure or vehicle fire and do not contain any unique, or atypical, gases beyond what you would find in the combustion of modern combustible materials, such as plastics and other electronics. Therefore, although these gases were not detected during the UL 9540A module level testing of the SB3, FRA recommends that monitoring of these gases in addition to CO and CO2 be conducted during a battery emergency.

7.2 Failure of the Energy Management System

7.2.1 Description

The SB3 is equipped with a BMS. The BMS tracks the performance, voltage, current, and SOC of the cells to ensure they are operating within manufacturer specifications. Per NFPA 855 §4.2.9.2 the BMS is required to disconnect electrical connections to the ESS if potentially hazardous conditions occur. Additionally, the BMS can initiate other controls based on the hazard detected as described in Section 2.6. Consequences due to BMS failure are evaluated in this section.

7.2.2 Barriers

The following barriers are provided to prevent BMS failure and minimize the consequences of BMS failure:

- The BMS is certified as part of the battery module to UL 1973.
- The BMS will be monitored as described in Section 2.6.
- Electrical fault protection is provided as described in Section 2.7.
- The BMS will be regularly maintained to ensure it is operating within its specific parameters, as described in Section 4.1.2.

7.2.3 Consequences

Failure of the BMS will prevent active monitoring of battery cell conditions. The BMS will be monitored such that a failure will be quickly detected and remediated reducing the duration a SB3 is operating with deficient safety features. Additionally, remote capabilities will be provided to discharge batteries from an affected SB3 cabinet or shut down modules/entire cabinets, depending on the severity of the issue and the operational capabilities

of the system at the time. Discharging the batteries reduces the consequences of a potential thermal event while the BMS is offline because the fire and explosion hazard is a direct correlation to battery SOC. It should be noted, BMS failure alone will not cause battery failure. In a worst-case scenario, a BMS failure in conjunction with a secondary failure condition (such as over voltage, excess temperature, etc.) may result in a thermal runaway event. Barriers and consequences of thermal runaway are provided in Sections 7.1.2 and 7.1.3 of this report.

7.3 Failure of Any Required Ventilation System

7.3.1 Description

A failure scenario involving any required ventilation or exhaust may expose the batteries to elevated operating temperatures. Depending on the resulting ambient temperature, ventilation failure may cause batteries to be exposed to temperatures outside of the manufacturer recommended operating conditions or temperatures at which the cell fails. The SB3 is not provided with any required ventilation or exhaust system beyond that utilized for explosion prevention. However, the SB3 is provided with a closed loop liquid cooling TMS for the battery modules, as described in Section 2.5. The cooling system performs a similar function to ventilation such that it is provided to cool battery cells and maintain battery operating temperatures within the manufacturer's recommended range. This failure scenario evaluates the consequences associated with a failure of the liquid cooling system.

7.3.2 Barriers

The SB3 is equipped with the following barriers to prevent ventilation system failure and reduce the consequences of a failure event:

- The TMS is monitored as described in Section 2.5.
- The TMS will be regularly maintained to ensure it is operating within its specific parameters, as described in Section 4.1.2.

7.3.3 Consequences

Failure of the cooling system may expose batteries to ambient temperatures. The average peak ambient temperature in Worthington, MA is 82ºF (28ºC) and occurs in July. The peak temperature is less than the cell venting temperature 399ºF (203.7°C); therefore, failure of the cooling system is not anticipated to lead to a thermal runaway event. The TMS is monitored such that a failure will be quickly detected and remediated reducing the duration a SB3 is operating with deficient safety features. Additionally, remote capabilities will be provided to discharge batteries from an affected SB3 cabinet or shut down modules/entire cabinets, depending on the severity of the issue and the operational capabilities of the system at the time. Discharging the batteries reduces the consequences of a potential thermal event while the TMS is offline because the fire and explosion hazard is a direct correlation to battery SOC. In a worst-case scenario, batteries operating at elevated temperatures for extended periods of time may degrade and have a higher likelihood of failure over time, possibly leading to thermal runaway. Barriers and consequences of thermal runaway are provided in Sections 7.1.2 and 7.1.3 of this report.

7.4 Failure of a Fire Protection System

7.4.1 Description

The SB3 is equipped with a fire and gas detection system and a CCRS, as described in Sections 2.8 and 2.10. The fire and gas detection system includes three photoelectric smoke detectors (two in the battery compartment and one in the electrical compartment), three heat detectors (two in the battery compartment and one in the electrical compartment), two hydrogen gas detectors in the battery compartment, and an addressable FACP. For local notification, an alarm bell and an audible/visible appliance are installed on the exterior of the SB3 cabinet. Failure of the fire and gas detection system may result in a delay in fire/gas detection, a delay in the activation of the CCRS, and a delay in on-site and off-site notification of the thermal event. This failure scenario evaluates the consequences associated with failure of the fire and gas detection system and the CCRS.

7.4.2 Barriers

The following barriers are provided to prevent fire and gas detection system and CCRS failure and minimize the associated consequences:

- The fire and gas detection system will be designed in accordance with NFPA 72.
- Three smoke detectors are installed throughout the cabinet providing coverage throughout.
- Three heat detectors are installed throughout the cabinet providing coverage throughout.
- Two gas detectors are installed throughout the cabinet providing coverage throughout.
- The smoke and gas detectors are continuously monitored by the FACP.
- Integral backup power supply will be provided in case of a loss of auxiliary power, as required by NFPA 72.
- Remote monitoring will be provided; if power is lost, O&M service personnel will be notified to remediate the issue.
- Regular inspection, testing, and maintenance (IT&M) performed on the fire and gas detection system through its lifespan, as required by NFPA 72.
- The CCRS is designed in accordance with NFPA 69.
- Regular inspection, testing, and maintenance should be performed on the CCRS throughout its lifespan, as required by NFPA 69.

7.4.3 Consequences

Potential fire and gas detection system failure could produce two primary consequences: (1) a delay or complete failure to operate the explosion prevention system and/or (2) a delay in detection/notification of a thermal event to on-/off-site personnel. The primary potential causes for this failure would be a fault in a listed fire alarm initiating device, an initial installation error, or degradation of a fire alarm device/wiring over time. The likelihood of these occurring with a properly designed, installed, commissioned, monitored, inspected, tested, and maintained fire alarm system is historically low based on data from the National Fire Protection Association (NFPA). Also, the fire alarm system is an addressable system where the status of each device is monitored by the FACP and BMS; therefore, failure of a system component would be reported and can be remediated. Lastly, IT&M would be periodically performed to inspect the fire alarm system for damage/degradation and to test the

devices for proper performance. Each of these fire alarm system mitigation aspects would be in place to minimize the likelihood of system failure over the life span of the SB3.

Failure of the CCRS may result in the accumulation of flammable gases in the cabinet and subsequent deflagration. However, the CCRS is expected to be properly designed, installed, commissioned, monitored, inspected, tested, and maintained to minimize likelihood of failure. In the case that the CCRS malfunctions, notification by the fire and gas detection system would alert local site personnel and/or first responders, should any be in the area, of the hazard. Per the EOP/ERP and the training of site personnel/first responders, all personnel would be prompted to evacuate the area immediately upon activation of a fire alarm notification appliance. By immediately evacuating to a designated safe area, site personnel and first responders would provide physical separation between them and the potential toxic gas hazard. In addition, an ERP should direct first responders to wear proper PPE, including a SCBA and turnout gear, when responding to a battery emergency should they need to approach a distressed cabinet.

7.5 HMA Analysis Approval

Based on the analysis above, the Worthington BESS meets all of the HMA approval criteria for FCO or AHJ approval per NFPA 855 §4.1.4.3, as it has demonstrated that:

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.

   The Worthington BESS meets this approval criteria. The SB3 is a non-occupiable cabinet that is installed outdoors, not within unoccupied ESS rooms. However, it should be noted that the SB3 has a number of protection schemes in place to prohibit fire from spreading from one SB3 cabinet to another. As demonstrated in UL 9540A unit level testing, thermal runaway was contained to a single module within a SB3 cabinet. As discussed in 7.1.3.1, a LSFT and/or fire modeling has not been performed to explicitly evaluate the potential for thermal runaway to propagate from one SB3 cabinet to adjacent SB3 cabinets. Therefore, site level emergency response procedures (such as exposure protection) could be utilized during a fire event, based on real time fire conditions and observations (i.e., wind direction/speed, fire intensity, proximity of flames to adjacent cabinets), to minimize the potential for fire to spread to adjacent cabinets.

2. Suitable deflagration protection is provided where required.

   The Worthington BESS meets this approval criteria. The SB3 is equipped with a CCR system which activates upon receiving signals from the gas detection sensors contained within the cabinet. Upon gas detection of 10% of the LFL, the ventilation system activates, pulling in outside air and exhausting internal air, to reduce the concentrations of flammable gases to under 25% of the LFL. In addition, the activation of the CCRS would also trigger the sounding of local fire notification appliances installed on the exterior of the SB3. These appliances can alert local site personnel and/or first responders, should any be in the area, of the hazard. Per the EOP/ERP and the training of site personnel/first responders, all personnel would be prompted to evacuate the area immediately upon activation of a fire alarm

notification appliance. By immediately evacuating to a designated safe area, site personnel and first responders would provide physical separation between them and the potential deflagration and explosion hazard. This provides a second mitigation feature, physical separation of people from the SB3 cabinets, in addition to the CCRS.

3. ESS cabinets in occupied work centers allow occupants to safely evacuate in fire conditions.

   The Worthington BESS meets this approval criteria. The SB3 is a non-occupiable cabinet that is installed outdoors, not within occupied work centers (or any other room). However, it should be noted that the SB3 has numerous internal sensors that are monitored by the BMS that can detect abnormal events and/or failures of the unit. The SB3 also includes smoke, heat, and gas detection systems with an alarm bell and audible/visible appliance installed on the exterior of the cabinet to provide local notification. These systems are also monitored remotely, providing off-site notification in the unlikely event of a fire. Although this applies to occupied work centers (and not an outdoor installation), the Worthington BESS still meets the intent of the approval criteria through the internal sensors, fire and gas detection system, the remote monitoring provided, and the local notification appliances installed in each SB3 cabinet.

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.

   The Worthington BESS meets this approval criteria. The SB3 utilizes listed lithium-ion cells that are hermetically sealed and do not vent during charging, discharging or normal operation. Unlike other battery types, no toxic gases are released during normal operation of the lithium-ion batteries. As such, no toxic gases will be released from the Worthington BESS during charging, discharging, and normal operation.

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

   The Worthington BESS meets this approval criteria. The SB3 is installed outdoors, not within a building or adjacent to any means of egress. The nearest building/structure is an individual residence, which is approximately 500 ft from a SB3 cabinet. This distance is greater than the 10-ft clearance distance required by NFPA 855 from the BESS to adjacent buildings and/or means of egress. The fire alarm notification system is one mitigation feature installed at the cabinet level to address this hazard. This system can alert local site personnel and/or first responders, should any be in the area, of the hazard. Per the EOP/ERP and the training of site personnel/first responders, all personnel would be prompted to evacuate the area immediately upon activation of a fire alarm notification appliance. By immediately evacuating to a designated safe area, site personnel and first responders would provide physical separation between them and the potential toxic gas hazard. In addition, an ERP should direct first responders to wear proper PPE, including a SCBA and turnout gear, when responding to a battery emergency should they need to approach a distressed cabinet. Given the Worthington BESS is installed outdoors, any gas release would be diluted by the entrainment of outside air. At the quantities measured during UL 9540A module level fire testing, such gases would not be expected to have an adverse effect

on individuals during the time deemed necessary to evacuate from the area (i.e., approximately 30 seconds to walk 100 ft away/evacuate from a burning SB3) nor expected to have an adverse effect on emergency response personnel wearing appropriate PPE including a SCBA while responding to an SB3 fire. Although this applies to a building or to an installation that is immediately adjacent to a means of egress route, the Worthington BESS still meets the intent of the approval criteria.

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

   The Worthington BESS meets this approval criteria. The SB3 utilizes listed lithium-ion cells that are hermetically sealed and do not vent during charging, discharging or normal operation. Unlike other battery types, no flammable gases are released during normal operation of the lithium-ion batteries. As such, no flammable gases exceeding 25% of their LFL will be released from the Worthington BESS during charging, discharging, and normal operation.

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8. RECOMMENDATIONS

Throughout the report, FRA provided several recommendations related to the Worthington BESS installation and emergency response to mitigate the hazards of a fire event. These recommendations are based on our review of the available materials, our background, experience and training, the analyses performed to date described above, common industry best practices for responding to a thermal event involving lithium-ion BESS, as well as from FRA's experience with lithium-ion battery hazards, lithium-ion battery BESS hazards, and previous BESS fires. These recommendations do not provide opinions or conclusions meant to address specific circumstances or all possible scenarios of an emergency. As with all emergency events, emergency response actions should be evaluated and performed based on real time fire conditions and observations (i.e., wind direction/speed, fire intensity, proximity of flames to adjacent electrical equipment and structures) during the actual emergency. Below is a summarized list of the recommendations provided throughout the report:

1. **Site Design Elements:** As the design of the site is finalized, FRA recommends the following:
    a. Approved signage must be provided at the site per NFPA 855 §4.3.5.
    b. Increase minimum unobstructed fire apparatus access roadway width from 16 ft to 20 ft.
    c. Obtain FCO approval for having no fire protection water supply at the site per NFPA 855 §4.13.
2. **BESS Plans:** FRA recommends that prior to energizing the Worthington BESS, develop commissioning, operations and maintenance, decommissioning and EOP/ERP plans, as required by NFPA 855.
3. **Emergency Response Training:** FRA recommends that all site personnel and emergency response personnel, who could be responsible for responding to a Worthington BESS emergency, be trained on the EOP/ERP prior to energizing the Worthington BESS. Refresher training should be provided as appropriate, typically annually, as required by NFPA 855.
4. **Fire Protection Systems:** FRA recommends that all fire protection systems be designed, installed, commissioned, and periodically inspected, tested, and maintained as required by each respective NFPA standard.
5. **Minimum Approach Distance (MAD):** When responding to a battery emergency, FRA recommends that all site personnel and first responders remain at a safe distance, upwind from a distressed SB3 cabinet, as should be designated in an ERP, to ensure they are not momentarily exposed to dangerous conditions. Initially, this MAD should be a minimum of 100 feet. In addition, site personnel and first responders should not approach the front of distressed SB3 cabinets, and all first responders should wear proper PPE when approaching a distressed SB3 cabinet during a battery emergency.

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9. 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 with a reasonable degree of scientific and engineering certainty:

- The SB3 and the Worthington BESS site design can meet NFPA 855 requirements for an outdoor BESS installation when it is installed in accordance with the SB3 instructions, its listing, the approved drawings, and NFPA 855. Several aspects were identified in this analysis that require modification/confirmation to ensure compliance as identified in Section 5.5.
- As described in detail in Section 7.5, the HMA demonstrates the Worthington BESS meets all the HMA performance criteria for approval outlined in NFPA 855 §4.1.4.3, as follows:
  - Fires will be contained to a single SB3 as demonstrated through UL 9540A unit level testing and should a fully developed fire event occur, site level emergency response procedures (such as exposure protection) could be utilized during a fire event, based on real time fire conditions and observations (i.e., wind direction/speed, fire intensity, proximity of flames to adjacent cabinets), to minimize the potential for fire to spread to adjacent cabinets.
  - Suitable deflagration protection is provided for the SB3 cabinet via the NFPA 69 CCR explosion control system.
  - Fires will be detected in time to allow personnel to safely evacuate via the fire alarm system and internal sensors of the SB3.
  - Toxic and highly toxic gases will not be released during normal charging, discharging, and operation of the SB3 given the listed lithium-ion cells utilized in the SB3 are hermetically sealed and do not vent during charging, discharging or normal operation.
  - Toxic and highly toxic gases released during fires and other fault conditions will not reach concentrations in excess of IDLH levels within a building or an adjacent means of egress given the nearest building is approximately 500 feet away.
  - Flammable gases will not be released during charging, discharging and normal operation of the SB3 given the listed lithium-ion cells utilized in the SB3 are hermetically sealed and do not vent during charging, discharging or normal operation.

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10. LIMITATIONS

At the request of BlueWave Energy, FRA performed an HMA in accordance with the requirements of NFPA 855 2020 Edition for the Worthington BESS located at 190 Ridge Road, Worthington, MA. The scope of services performed during this analysis may not adequately address the needs of other users of this report, and any re-use of this report or its conclusions presented herein are at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the analysis, which has been provided to FRA by others. No guarantee or warranty as to future performance of any reviewed condition is expressed or implied.

As the Worthington BESS site is still under development, this analysis assumed that the BESS and its associated equipment, as well as all fire protection systems, will be installed, commissioned, inspected, tested, and maintained as required by the manufacturer(s), NFPA 855, and/or other applicable codes and standards throughout the lifetime of the BESS. The accuracy and applicability of this report's findings are subject to change based on changes to the site. FRA assumes no liability for performance, errors, omissions, or failures that may arise during construction or operation, and no warranty of fitness for a particular purpose is implied.

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11. REVISIONS

Date	Revision	Reason for Issue	Developed By	Reviewed By	Approved By
04/16/2026	B	Client Comments	KL	AB	AB

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Warning, this document is a preliminary draft.

Significant changes will occur once site design and equipment decisions are finalized.

APPENDIX 1: ACRONYMS AND NOMENCLATURE

Acronyms and Abbreviations

Authority Having Jurisdiction	AHJ
Battery Energy Storage System	BESS
Battery Management System	BMS
Emergency Response Plan	ERP
Energy Storage System	ESS
Fire & Risk Alliance, LLC	FRA
Fire Code Official	FCO
Hazard Mitigation Analysis	HMA
Lithium Iron Phosphate	LFP
Lower Flammability Limit	LFL
National Fire Protection Association	NFPA
Non-Walk-In	NWI
Operations and Maintenance	O&M
Personal Protective Equipment	PPE
State of Charge	SOC
Thermal Management System	TMS
Underwriters Laboratory, LLC	UL

Nomenclature

Ampere-hour	Ah
Degree Celsius	°C
Degree Fahrenheit	°F
feet	ft
inch	in
kilopascal	kPa
kilowatt-hour	kWh
Megawatt	MW
Megawatt-hour	MWh

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Millimeter	mm
Liter	L
Pounds per square inch absolute	psia
Parts per million	ppm
Volt	V

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BLUEWAVE

Illustrative Draft BESS Emergency Response Plan

***Site specific plan to be finalized prior to building permit filing**

116 HUNTINGTON AVENUE • SUITE 601 • BOSTON, MASSACHUSETTS 02116
BLUEWAVE.ENERGY **T**: 617.209.3122

FIRE & RISK ALLIANCE

BESS ERP

Emergency Response Plan – Rev0



Prepared for: Blue Wave Energy

Date: 03-10-2026

The distribution of this document to third parties is prohibited without written approval from Fire & Risk Alliance, LLC.

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1 GENERAL INFORMATION

1.1 Scope

This document is a product-agnostic emergency response plan (ERP) intended to be used for initial documentation of a typical battery energy storage system (BESS) facility. This product-agnostic ERP provides a general overview of a typical facility and site design, along with a description of typical equipment and safety features found at most BESS facilities. Basic response recommendations are also provided for potential BESS facility failure scenarios.

Important Note
This product-agnostic ERP is not based on any specific battery product or any specific BESS facility. It is meant to be informational in nature to provide the type of content typically included in an BESS facility ERP. It should not be utilized for an operating BESS facility. Any use or reuse of this document for an operating BESS facility is not authorized. Once a BESS facility has been approved and designed, a site-specific ERP should be developed to include the product and site specific design details.

1.2 Purpose

This product-agnostic ERP is intended to provide basic information to BESS subject matter experts (SMEs) and fire department personnel about potential hazards at BESS facilities as an initial document submission for permit application purposes. This information is general in nature and does not reflect specific hazards or a finalized site design, which will be provided in a future site-specific ERP.

1.3 Site Owner

Site Owner: BlueWave Energy

Headquarters Address: 116 Huntington Ave, Suite 601, Boston, MA 02116

Headquarters Telephone: 617.209.3122

1.4 Location

Site address and coordinates should be provided in this section.

1.5 Emergency Contact

The remote operations center (ROC) can be reached at **XXX.XXX.XXXX** for any emergency that may occur at the BESS facility.

The local 911 dispatch center can be reached for non-emergencies at XXX.XXX.XXXX.

Table 1 Emergency Services Contact Information

Emergency Services Agency	Address
All Emergencies	***Call 911***
Local Fire Department	Fire Department Address
Local Police Department	Police Department Address
Local Hospital	Hospital Address

2 SITE OVERVIEW

2.1 General Site Overview

The proposed BESS facility location should be described in this section. A description of the size, location, and surrounding area of the facility will be provided to detail the surrounding area for the fire department. A site overview diagram would be provided in Figure 1.

A specific BESS product has not yet been chosen for the facility. However, the proposed equipment will be compliant with NFPA 855 as it relates to safety features and equipment listings. BESS facilities are normally unstaffed and are monitored by an ROC.

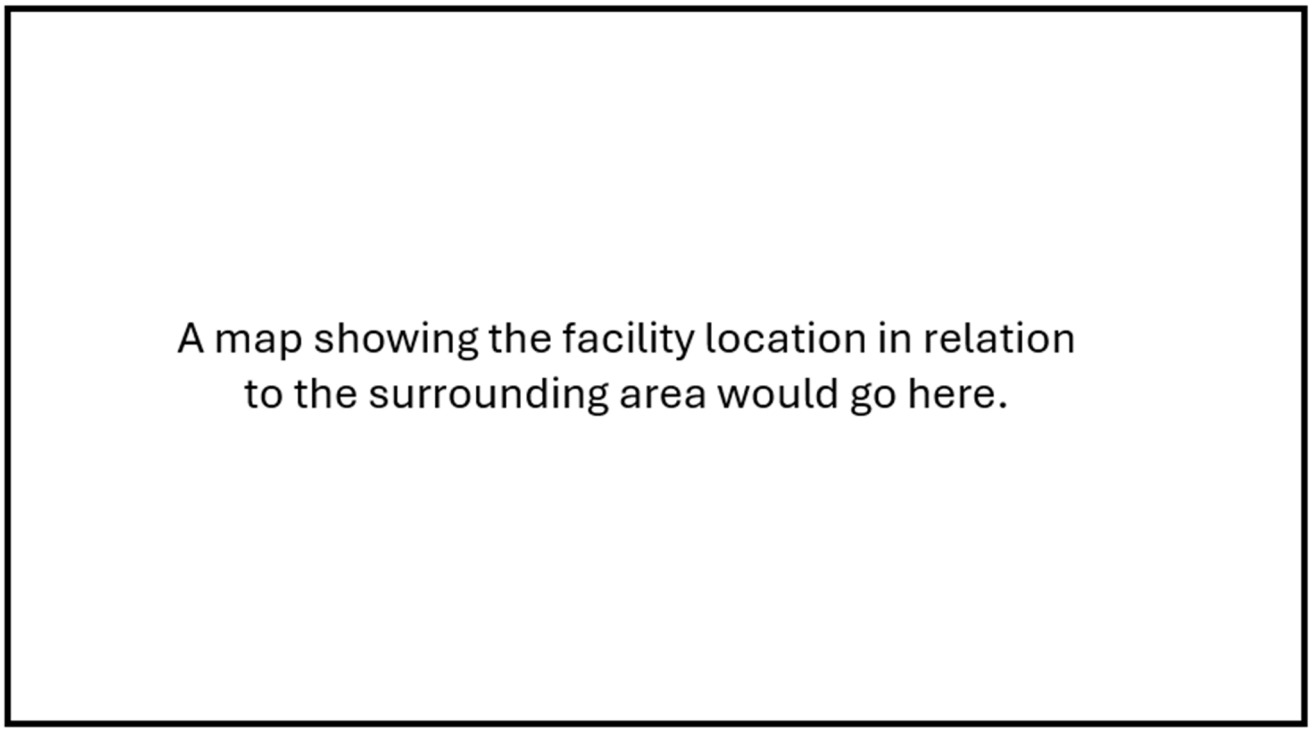


Figure 1 Example Site Overview

2.2 Energy Storage System Site Overview

The preliminary design for the facility has not yet been completed. An example equipment arrangement is shown in Figure 2. Typically, BESS cabinets are divided up into blocks. Each block is generally made up of a number of BESS cabinets and a power conversion system (PCS). Each PCS contains inverters, transformers, and disconnects. BESS cabinets produce DC voltage, which is sent to the inverters for conversion to AC voltage. The transformers step up the AC voltage for distribution to a substation or other point of interconnection (POI) with the grid, where it is distributed to end users.

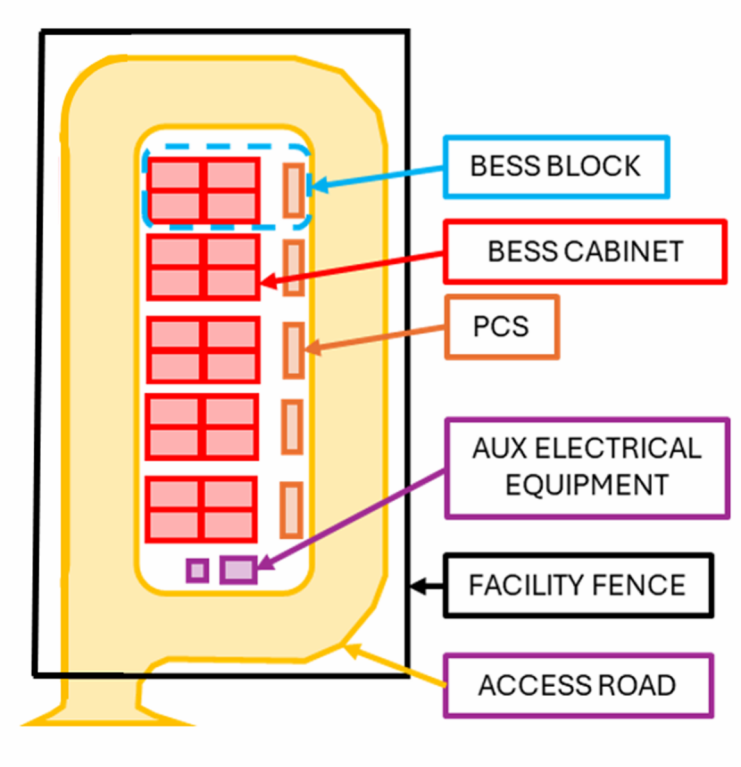


Figure 2 Example Equipment Arrangement

3 MITIGATION

3.1 Battery Cabinet Equipment Overview

The smallest component of a BESS is a cell. Lithium-ion style batteries with lithium iron phosphate (LFP) chemistry are expected to be used. Cells are combined into modules which are combined into racks. Cabinets contain multiple racks and additional protection, monitoring, and isolation features powered by on-site auxiliary power. Generally, every battery cabinet is rated to withstand outdoor environmental conditions.

3.2 Fire Protection Overview

3.2.1 Site Access

Entrance locations to the site are typically noted. Facility driving surfaces that will be provided are generally shown and labeled in Figure 2.

3.2.2 Fire Alarm and Detection System

Fire alarm and detection systems are typically required for BESS facilities. Depending on the BESS product, there will be internal smoke, heat, and/or gas detectors to detect thermal runaway conditions within each BESS cabinet, or there will be an external stand-alone infrared (IR) flame detection system. Internal detection systems can utilize Fire Alarm Control Panels (FACPs) within each BESS cabinet or a site-level FACP to aggregate alarms for the site. External IR detection systems will report to a central FACP. In either case, the central FACP will have a horn strobe for local notification of alarms, a manual pull station for manual activation of the alarm and will also report to a 24/7 remote monitoring station that will alert first responders to an incident. All site fire alarm systems will be designed for compliance with NFPA 72.

3.2.3 Fire Protection Water Supply

If a fire protection water supply for the facility is provided, it will be noted in this section. If a fire protection water supply is not provided, alternatives will be discussed, such as a fire department tanker shuttle or relay pumping operation that can be set up to provide water to the site from an established drafting source or water supply system. This water shall be used for the intermittent cooling of exposures to prevent propagation should this risk exist, not for offensive firefighting of fires involving battery cabinets.

3.3 Explosion Control and Prevention Systems

All utility-scale BESS are required to contain an explosion control or prevention system. Many contain both types of systems. Explosion prevention systems are designed to stop an explosion before it starts. They work by using a combustible gas detection system to monitor the air inside the battery enclosure. If flammable gases are detected, the system activates a powered ventilation system, which includes air intakes, exhausts, and fans, as shown in Figure 3. The goal is to rapidly purge the enclosure with fresh air, keeping the concentration of any explosive gas mixture below 25% of its lower flammability limit (LFL). This ensures the atmosphere is never rich

enough to ignite. The entire system is typically monitored by an FACP, which can be located at the cabinet or site level.

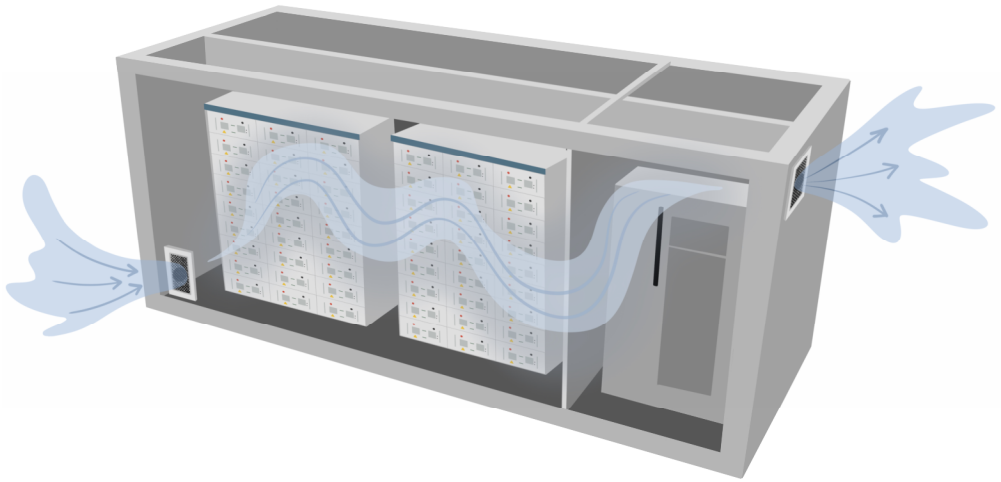


Figure 3 Explosion Prevention System

An explosion control system uses passive deflagration panels, which are essentially engineered weak points in a BESS enclosure. These panels are designed to burst open at a specific, low pressure. When a rapid pressure increase from a thermal runaway event occurs, the panels vent the pressure and flames in a controlled way, as shown in Figure 4. This action prevents the pressure from building up to a dangerous level, which could otherwise cause the entire BESS unit to fail, leading to catastrophic damage and a much greater risk to nearby personnel.

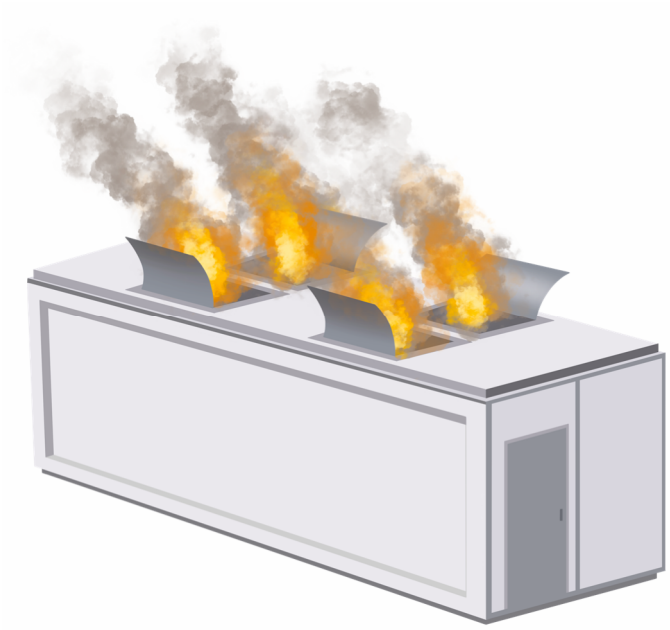


Figure 4 Explosion Control System

3.4 Battery Management System

The battery management system (BMS) monitors, protects, and manages the BESS, ensuring battery health parameters are maintained for efficient and continual operation.

Table 2 BMS Functions

Function	Description
Monitoring	The BMS continuously monitors key parameters such as voltage, current, temperature, and state of charge (SOC).
Protection	The BMS protects the battery from over-charging, over-discharging, over-current, over-temperature, and short circuits by isolating batteries that exceed predetermined operating parameters.
Balancing	The BMS helps to equalize the SOC across all cells.
Thermal Management	The BMS regulates the battery temperature by controlling heating or cooling systems, keeping the battery within the predetermined temperature range.
Power Control	The BMS regulates the power in and out of the batteries.
Communication	The BMS remotely communicates the status of monitored parameters and autonomously performed functions.

3.5 Emergency Stop

Some, but not all, BESS products and PCS are equipped with physical emergency stop (E-stop) buttons. Most BESS products are equipped with remote or virtual E-stop functionality. The operation of a BESS E-stop isolates the BESS cabinet. Though isolated, the BESS batteries still maintain their SOC. The operation of a PCS E-Stop isolates the PCS from the BESS and the grid. Operation of a site E-stop isolates the site from the grid. Never approach a trouble cabinet or PCS for manual activation of the E-Stop. Electrical switching at the site will be limited to facility personnel.

3.6 Power Conversion System

A PCS typically contains inverters, a medium voltage (MV) step-up transformer, and a system disconnect switch. The PCS inverter converts DC energy from the batteries to AC. Power is then routed through the MV step-up transformer where voltage is stepped up for interconnection with the grid.

4 PREPAREDNESS

4.1 Chemical Hazards

4.1.1 Cell Vent Gas

During a failure event, battery cells produce toxic gases that have the potential to be harmful to site personnel and first responders. If the failure spreads to other BESS components, it can produce additional toxic gases similar to those released during the combustion of ordinary manufactured products. Although outdoor BESS cabinets are not occupiable, site personnel and first responders can still be exposed to these toxic gases while operating near a BESS during a failure or fire event. In the event of a gas release, these toxic gases are expected to be diluted by the entrainment of outside air. Fire department personnel should wear the appropriate personal protective equipment (PPE), as outlined in Section 4.5.

4.1.2 Hydrogen

When the temperature of a cell reaches the venting stage, the primary hazard is the production of hydrogen gas (H2). The gas is odorless, colorless, and requires internal sensors or external meters for detection. H2 is flammable and lighter than air.

Table 3 Hydrogen Characteristics

Characteristic	Description/Value
Appearance	Colorless Gas
Odor	Odorless
LFL	4%
UFL	76%
Auto Ignition	500°C/932°F
25% LFL	1% or 10,000 ppm
Vapor Density	0.69 (Air = 1)

4.1.3 Carbon Monoxide

Carbon monoxide (CO) is an odorless, colorless gas, and requires internal sensors or external meters for detection. CO is produced during incomplete combustion and/or cell failure.

Table 4 Carbon Monoxide Characteristics

Characteristic	Description/Value
Appearance	Colorless Gas
Odor	Odorless
LFL	12.5 %

Characteristic	Description/Value
UFL	74.2%
Auto Ignition	607°C (1125°F)
25% LFL	3.125% or 31,250 ppm
Vapor Density	0.97 (Air = 1)

4.1.4 Transformer Dielectric Fluid

Dielectric fluid is used to insulate and cool site transformers such as PCS transformers and auxiliary power transformers. During a transformer failure, arcing and sustained fire can lead to heat retention in the windings and metal cabinet of the transformer, making this a persistent fire.

4.1.5 Refrigerant

Refrigerant is commonly used within the BESS thermal management system. Refrigerants are nonflammable under normal operating conditions. However, refrigerants are pressurized and can become combustible when mixed with air at elevated temperatures and pressures. Refrigerants can also release toxic by-products as a result of heating and decomposition. In high concentrations, refrigerants can also become an asphyxiation hazard.

Table 5 Refrigerant Characteristics

Characteristic	Description
Appearance	Colorless Liquid
Odor	Faintly Sweet

4.2 Electrical Hazards

Shielded electrical hazards at the BESS facility include battery cabinets, inverters and transformers. Outer covers around the equipment eliminate casual contact and locks prevent access to energized areas.

Unshielded electrical hazards at the facility include exposed bus within a substation or overhead electrical connections to the surrounding grid. OSHA regulations require a minimum standoff distance of 10 feet from equipment and power lines. The minimum clearance should be increased by 4 inches for every 10kV over 50kV.

BESS products contain batteries that are ALWAYS energized and present an electrical hazard even when disconnected from an electrical source. The operation of breakers or E-Stops will serve to isolate trouble equipment. However, the operation of these devices will not remove stranded energy. Class C electrical hazards constantly exist at BESS facilities.

NFPA 1970 structural firefighting ensemble is not rated for arc flash hazards. Maintain a 10-foot standoff distance from any open doors on BESS cabinets.

E-field detectors are commonly used to identify potential AC hazards. These devices do not have the ability to detect DC voltage from battery cabinets. Do not use E-field detectors within a BESS facility.

4.3 Thermal Runaway and Fire Hazards

Thermal runaway occurs when an electrochemical battery cell's temperature increases at an accelerating rate in an uncontrollable fashion sufficient to result in damage to the cell. The thermal runaway progresses when the cell's generation of heat is at a higher rate than the heat it can dissipate.

During thermal runaway, flammable gas and heat is produced. Failure may spread to adjacent cells or modules and the gas may ignite. Due to the high pressure at which these gases vent and the lack of a listed suppression agent, no attempt should be made to suppress this fire.

4.4 Explosion Hazard

The failure of a cell will begin with the venting stage; this is the pre-cursor to thermal runaway. Accumulation of flammable gases within a confined space, such as a BESS cabinet, can lead to an explosive atmosphere where the gas concentration falls within its upper and lower flammability limits. An explosion can occur when cell vent gases accumulate and contact a competent ignition source. While safety features are present to decrease the risk of an explosion, always assume that they are non-operational. Maintain an exclusion zone from the trouble equipment for the duration of the incident.

4.5 Recommended PPE

The recommended PPE is NFPA 1970 structural firefighting gear and the use of a self-contained breathing apparatus (SCBA) when exposed to respiratory hazards. All chemicals associated with the failure of BESS equipment and ancillary electrical components present dermal and respiratory hazards.

The PPE recommendation is for emergency response operations and life safety. PPE recommendations for the post-fire removal of damaged modules will be defined by conditions found at the time of decommissioning. In addition, structural firefighting ensembles are not designed to provide protection from arc flash hazards.

4.6 BESS Subject Matter Expert

Typically, a BESS SME is a person or group familiar with the BESS product, the site layout and equipment, installation guides and manuals, the BMS architecture, passive and active protection systems, notification sequencing, and this product-agnostic ERP.

The BESS SME, equipment owner, and site operator play a critical role in guiding fire department personnel responding to a BESS emergency by coordinating the following:

- Ensuring security of the site and limiting access to only authorized personnel.
- Ensuring accountability of non-fire department personnel inside the facility.
- Ensuring authorized personnel have PPE that is appropriate to their assigned role/task.
- Reviewing and interpreting BMS data including SOC, state of health (SOH), temperature, and status of equipment.
- Locating and isolating trouble equipment.
- Ensuring an exclusion zone has been established around the trouble equipment.

- Expanding exclusion zone in the event additional battery cabinets sustain alarms or direct fire impingement.
- Evaluating the status of the explosion control and prevention system (if applicable).
- Identifying need for exposure protection.
- Leading post-incident operations.
- Administering decommissioning plan.

5 RESPONSE

5.1 Tactics

DO NOT FORCE ENTRY

Fire department personnel should not encroach within 100 feet of the facility fence line until the trouble battery cabinet has been identified.

Upon arrival, fire department incident command should contact the ROC at **XXX.XXX.XXXX** to obtain preliminary information including the following:

- Accountability
  - ☐ Were any personnel present at the site?
  - ☐ If personnel are present, what is the status of their accountability?
- Location of Equipment in Alarm
  - ☐ What is the type and location of the trouble equipment in alarm?
- Alarm Type
  - ☐ What type of alarm has generated the initial response and have any other alarms been received that would suggest conditions are deteriorating?
- Equipment Status
  - ☐ Has trouble equipment been isolated autonomously or manually?
- Explosion Control and Prevention Systems
  - ☐ What is the status of the explosion control and prevention system?

5.1.1 Life Safety

BESS facilities are normally not staffed and are observed and controlled remotely. However, facility personnel may be on-site periodically for inspection, testing and maintenance of equipment. Accountability shall be confirmed with the ROC.

Obvious line of sight rescues is the priority for responding fire department personnel. Fire department personnel shall not enter the facility for recovery operations.

Unescorted Rescue Considerations:

- Personnel located >100 feet from the battery cabinet in alarm
  - Outside explosion risk zone
- Personnel located <100 feet from battery cabinet in alarm
  - Inside explosion risk zone
- Personnel located near battery cabinet with door open
  - Possible equipment contact – shock or electrocution risk.

5.1.2 Community Air Monitoring

Utilizing a four- or five-gas meter, establish air monitoring 100 feet downwind from the facility fence line to

evaluate gas dispersion from failed equipment. Visually observe smoke plume to ensure it is not encroaching on exposure structures. If metering equipment detects abnormal levels, consider evacuating affected areas.

5.1.3 Exclusion Zone

Once the trouble equipment is identified, establish a 100-foot exclusion zone. Expand the exclusion zone if failure conditions spread to adjacent equipment.



Figure 5 General 100' Exclusion Zone

5.1.4 Alarms Monitoring

Monitor input alarms from the FACP and the BMS for the trouble equipment. Receipt of additional alarms can indicate deteriorating conditions within the trouble equipment. A review of the BMS can indicate the possible origin location and further impacted internal equipment.

First responder dispatch will be notified in advance of any planned drills conducted on-site.

5.1.5 Isolation of Trouble Equipment

Confirm trouble equipment has been autonomously isolated. If recommended by the BESS SME, remotely isolate adjacent equipment.

Fire Department personnel should never operate equipment or controls within the site. The BESS SME will coordinate all operational requests.

Never approach a trouble cabinet for manual activation of the E-Stop.

5.1.6 Condition Monitoring

From outside the exclusion zone, visually and audibly monitor the conditions of the trouble cabinet. Look for the presence of white gas, smoke, fire, and damage to the cabinet. Even if there are no visible or audible indications of failure, hazards to responding fire department personnel may still be present.

5.1.7 Exposure Assessment

Assess the adjacent equipment to determine if exposure protection is necessary. Evaluate the following:

- Are there any heat and/or cell temperature alarms in adjacent equipment?

- Expand exclusion zone if adjacent equipment becomes involved.
- Based on thermal imaging camera readings, is there any increase in temperature on adjacent equipment?
  - If temperatures reach 50% of the average cell vent temperature as determined by UL9540A testing, see Section 5.1.8
- Is there any direct flame impingement on adjacent equipment?

5.1.8 Exposure Protection

Exposure protection should be considered if conditions warrant or if recommended by the BESS SME. While maintaining the exclusion zone, establish a continuous water supply. From outside the exclusion zone, using a rain down method, apply water in a fog pattern to cool the exposure equipment. Do not use a solid or straight stream to ensure fire department personnel safety and limit water intrusion into uninvolved equipment.

5.2 Incident Stabilization

5.2.1 Under Control

The incident may be considered under control when:

- Fire is contained to the equipment involved with no exposure concerns
- No new alarms have been generated
- The volume of fire or gas has decreased

Once the incident has been placed under control, establish continuous fire-watch for the facility through decommissioning.

5.3 Inverter Failure

Inverter failures do not typically result in a fire, rather they manifest as an arc flash. Inverter fires can be fought using agents rated for Class C hazards, as they are classified as Class C fires until power is disconnected. Once disconnected from the electrical source, an inverter fire can be treated as a Class A fire and is limited to isolated pockets of burning insulation.

5.4 Transformer Fire

Following a transformer fire, the presence of sustained arching is a sign that the fault condition has not cleared. This will present with a blue flame or electrical arc and may be a precursor to a catastrophic failure of the transformer. Transformer fires are classified as Class B and C fires until power is disconnected. Once the electrical source is removed, the transformer fire can then be reclassified as a solely Class B fire (insulating oil). CO2 is the recommended agent for transformer fires. If the fire is unresponsive to extinguishment efforts, the unit should be allowed to burn off and consume dielectric fluid until the fire self-extinguishes.

6 RECOVERY

Recovery focuses on equipment assessments for determining repair, replacement, or restoration as part of the facility owner/operator's recovery plan. Implementation of the recovery plan is the responsibility of the facility owner/operator and should be overseen by the BESS SME. Fire department involvement in the recovery plan is at the discretion of the BESS SME and the facility owner/operator.

Typical facility recovery plans can include:

- Facility fire watch
- Post-incident equipment assessment including:
  - Grid connectivity
  - BMS status
  - Fire alarm status
  - Fire suppression status
  - Explosion control status
- Lock out/Tag out
- Decommissioning
- Installation of new equipment
- Recommissioning

7 REVISION SHEET

Date	Revision	Reason for Issue	Developed By	Reviewed By	Approved By
03/10/2026	Rev0	Initial ERP	TH	KL	AFB