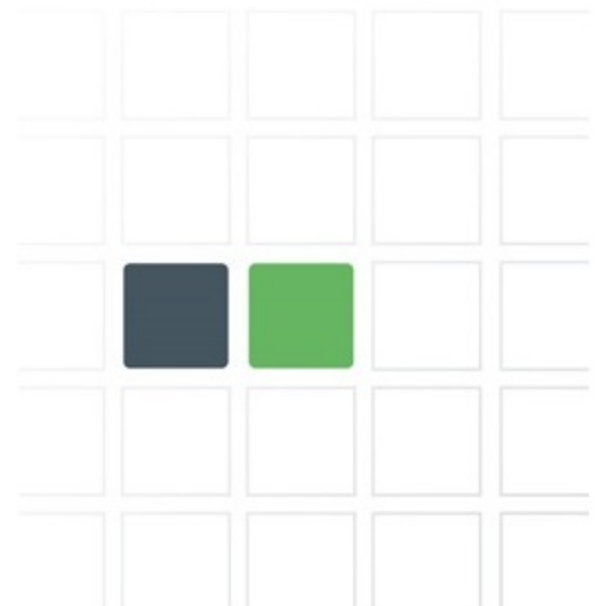


## Hazardous Materials Business Plan Binder

**DO NOT REMOVE, DO NOT DISCARD**

Keep this information on site to comply with environmental regulations.

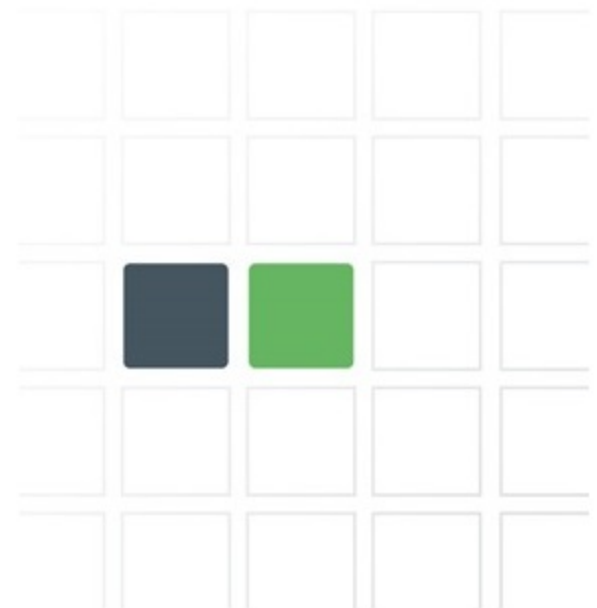
Please call Bloom Energy with questions at 408-543-1673



## Table of Contents

1. Bloom Energy Contacts	p3
2. Safety Data Sheet	p5
3. Canister Design	p13
4. Canister Replacement Process	p17
5. Containment & Cleanup	p22
6. Employee Training	p25

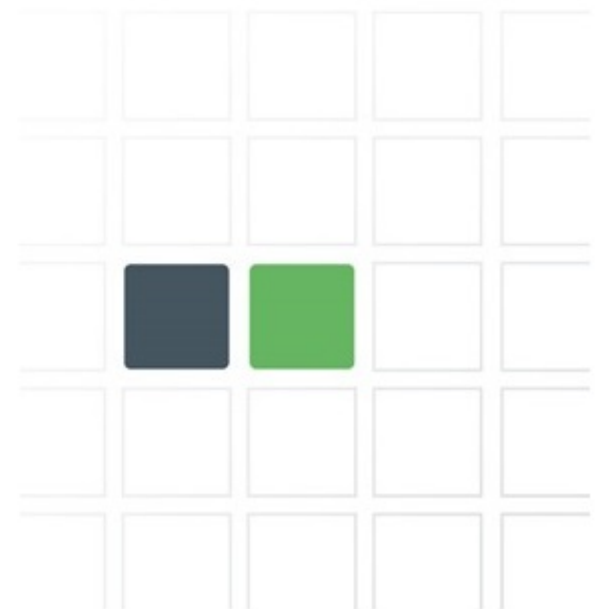
## Section 1: Bloom Energy Contact Information



# Contact Information

	<b>Environmental</b>	<b>Emergency</b>
<b>Primary</b>	Bloom EHS Director (408) 543-1056 (408) 543-1584	<b>Remote Monitoring Control Center 24hrs</b> <b>408-543-1678 or 408-543-1679</b>
<b>Secondary</b>	Bloom EHS Department (408) 543-1084	

## Section 2: SDS of the Composite Copper Catalyst



# SAFETY DATA SHEET

## Section 1. Identification

**Product Name:** Composite Copper Catalyst  
**Recommended Use:** Industrial Chemicals  
**Manufacturer:** Bloom Energy Corporation  
**Address:** 1299 Orleans Drive  
Sunnyvale, CA 94089  
**Phone number:** 408-543-1500  
**Emergency Number:** 408-543-1678

## Section 2. Hazards Identification

**OSHA/HCS status** This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

**Classification of the substance of mixture** Acute toxicity (oral, dermal, inhalation) (Category 4).  
Eye damage irritation (Category 2B).  
Skin corrosion/irritation (Category 2).  
Specific target organ toxicity with repeated exposure (Category 2).

**GHS label elements**  
**Pictogram**



**Signal Word** Warning

**Hazard Statement** H302 Harmful if swallowed.  
H312 Harmful in contact with skin.  
H332 Harmful if inhaled.  
H320 Causes eye irritation.  
H315 Causes skin irritation.  
H373 May cause damage to organs (lungs) through prolonged or repeated exposure.

**Precautionary statements** P260 Do not breathe dust/fume/gas/mist/vapors/spray.  
P264 Wash skin thoroughly after handling.  
P270 Do not eat, drink or smoke when using this product.  
P271 Use only outdoors or in a well-ventilated area.  
P280 Wear protective gloves/protective clothing/eye protection/face protection.  
P284 Wear respiratory protection.

P301 + P312 + P330 IF SWALLOWED: Call a POISON CENTER/doctor/physician if you feel unwell. Rinse mouth.  
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.  
P314 Get medical advice/attention if you feel unwell.  
P337+P313 If eye irritation persists: Get medical advice/attention.  
P340 Remove victim to fresh air and keep at rest in a position comfortable for breathing.  
P352 Wash with plenty of soap and water.  
P501 Dispose of contents/container to an approved waste disposal plant.

**Other Hazards:** Particulates of this material may cause mechanical irritation to the skin, eye and/or respiratory tract.  
This product may contain trace quantities of benzene and/or other substances that may cause cancer.

### Section 3. Composition/information on ingredients

**Substance/mixture:** Chemical Mixture  
**CAS number:** Not available

Ingredient name	CAS number	Wt % Dry
Copper Oxide	1317-38-0	5-30
Copper Carbonate	1184-64-1	0-20
Manganese Dioxide	1313-13-9	7-25
Aluminum Oxide	1344-28-1	5-16
Activated Carbon	7440-44-0	2-8
Zeolites	1318-02-1	35-65

In addition to the dry components, the mixture contains <30% water (H<sub>2</sub>O) by weight.

### Section 4. First aid measures

**Eye contact:** Immediately flush with water for 15 minutes. Seek medical attention if irritation develops.

**Inhalation:** Do not breathe dust. Remove victim to fresh air. If symptoms persist, contact a physician.

**Skin contact:** Brush dry material from skin. Immediately flush skin with large quantities of soap and water while removing contaminated clothing. Wash clothing before reuse. If symptoms persist, contact a physician.

**Ingestion:** IF SWALLOWED: Call a POISON CENTER/doctor/physician if you feel unwell. Rinse mouth.

**Note to Physician:** Provide general supportive measures and treat symptomatically.

## Section 5. Fire-fighting measures

<b>Suitable extinguishing media:</b>	Use extinguisher measures that are appropriate to local circumstances and the surrounding environment.
<b>Unsuitable extinguishing media:</b>	No information available.
<b>Specific hazards during firefighting</b>	None known. Product does not normally present a fire or explosion hazard.
<b>Further information:</b>	Wear positive pressure self-contained breathing apparatus and protective clothing.
<b>Special protective equipment for firefighters:</b>	No special precautions required.

## Section 6. Accidental release measures

<b>Personal precautions, protective equipment and emergency procedures</b>	Do not breathe dust. Sweep or vacuum material to minimize dust formation. Avoid using compressed air or any method that creates airborne dust. If cleanup may create airborne dust, personnel should wear eye, skin, and respiratory protection. Dispose in accordance with local, state, and federal regulations.
<b>Environmental precautions:</b>	Collect and label all material, which may be released, into appropriate containers. Do not let product enter drains.
<b>Methods and materials for containment and cleaning up:</b>	Take up contaminated material and pass on for further processing. Take up contaminated material by mechanical means, load into clean containers, and dispose of in accordance with legal regulations.

## Section 7. Handling and storage

<b>Advice on safe handling</b>	Avoid contact with skin, eyes and clothing. Wash thoroughly after handling. Keep away from heat and sources of ignition. Do not ingest. Wear appropriate personal protective equipment (PPE) while handling product. Handle in accordance with good industrial hygiene and safety practice.
<b>Conditions for safe storage, including any incompatibilities</b>	Keep container tightly closed and dry.

## Section 8. Exposure controls/personal protection



Ingredient name	Exposure limits
Copper oxide (CAS 1317-38-0)	OSHA PEL (copper) : 0.1 mg/m <sup>3</sup> ACGIH TWA (copper): 0.1 mg/m <sup>3</sup> (fume) NIOSH REL (copper): not established
Aluminum oxide (CAS 1344-28-1)	OSHA PEL : 10 mg/m <sup>3</sup> (total dust); 5 mg mg/m <sup>3</sup> (respirable dust), 1 mg/m <sup>3</sup> (respirable fraction)  ACGIH TWA: 15 mg/m <sup>3</sup> (total dust); 5 mg/m <sup>3</sup> (respirable fraction), 0.1 mg/m <sup>3</sup> (fume) NIOSH REL: not established
Manganese dioxide (CAS 1313-13-9)	OSHA PEL (Manganese): 5 mg/m <sup>3</sup> ACGIH TWA (Manganese): 0.2 mg/m <sup>3</sup> (total) 0.1 mg/m <sup>3</sup> (inhalation), 0.1 mg/m <sup>3</sup> (respirable fraction) NIOSH REL (Manganese): 1 mg/m <sup>3</sup>

**Appropriate engineering controls:** Use adequate exhaust ventilation and/or dust collection to keep dust levels below exposure limits.

**Hygiene measures:** Wash hands before breaks and immediately after handling the product. Keep working clothes separately.

**Hand protection:** Chemical-resistant gloves.

**Skin and body protection:** Wear protective clothing, including long sleeves and gloves, to prevent skin contact. Thoroughly wash clothing before reuse.

**Eye protection:** Wear safety glasses or safety goggles. If respiratory protection is needed under dusty conditions, a full face piece respirator with organic vapor cartridges is recommended to provide both eye and respiratory protection.

**Respiratory protection:** Wear NIOSH approved particulate filtering respirator rated N, R, or P95 or 100 or equivalent in the absence of proper environmental control. Type of respirator depends on level of exposure.

## Section 9. Physical and chemical properties

<b>Appearance:</b>	Extrusions and pellets	<b>Vapor Pressure:</b>	N/A
<b>Physical State:</b>	Solid	<b>Vapor Density:</b>	N/A
<b>Odor:</b>	Strong odor	<b>Melting Point:</b>	N/A
<b>Odor Threshold:</b>	N/A	<b>Boiling Point:</b>	N/A
<b>pH:</b>	N/A	<b>Freezing Point:</b>	N/A (0°C if wet)
<b>Viscosity:</b>	N/A	<b>Evaporation Rate:</b>	N/A
<b>Solubility:</b>	Insoluble	<b>Flash point:</b>	N/A

**Specific Gravity:** 0.8-1.0 g/ml

**Flammability:** N/A

**Decomposition Temperature:** N/A

**Auto-ignition** N/A

**Temperature:**  
**Water solubility:** insoluble

**Octanol/H<sub>2</sub>O Coeff.** N/A

## Section 10. Stability and reactivity

**Reactivity:** Stable under recommended storage conditions.

**Chemical stability:** Stable under normal condition.

**Possibility of hazard reaction:** None known.

**Conditions to avoid:** None known.

**Incompatible materials:** None Known.

**Hazardous Decomposition Products:** No decomposition if stored and applied as directed.

## Section 11. Toxicological information

### Acute toxicity

Product/ingredient name	Result	Species	Dose
Aluminum oxide	LD50 (oral)	Rat	>5000mg/kg
	LD50 (dermal)	Rat	2,778 mg/kg
	LD50 (inhalation)	Rat	>2.3 mg/L
Copper oxide	LD50 (oral)	Rat	>2000 mg/kg
	LD50 (dermal)	Rat	>2000 mg/kg
Manganese dioxide	LD50 (oral)	Rat	>3480 mg/kg
	LD50 (inhalation)	Guinea pig	>0.022 mg/L

**Skin Irritation/corrosion:** Not available

**Eye damage/irritation:** Not available.

**Carcinogenicity:** May contain chemical(s) that may cause cancer.

### Potential acute health effects

**Eye contact:** Cause eye irritation, watering, redness.

**Inhalation:** Irritating to respiratory system. Symptoms may include coughing and sneezing. May cause nausea and headache.

**Ingestion:** May be irritating to mouth, throat and stomach.

**Skin contact:** May cause skin irritation.

**Ingestion:** May be harmful if swallowed.

**Potential chronic health effect**

**General:** No known significant effects or critical hazards.

**Carcinogenicity:** May cause cancer. Risk of cancer depends on duration and level of exposure.

**Numerical measures of toxicity** Not available.

**Section 12. Ecological information**

Ecotoxicity No data available.

Persistent and degradability No data available.

Bioaccumulation No data available.

Mobility in soil No data available.

**Section 13. Disposal considerations**

**Disposal Methods:** Dispose in accordance with local, state, and federal regulations.

**Section 14. Transport information**

**DOT** Not restricted.

**IATA** Not restricted.

**IMDG** Not restricted.

**Section 15. Regulatory information**

TSCA All components are listed or exempted.

EPCRA Emergency Planning and Community Right-to-Know Act.

CERCLA Reportable Quantity (RQ) This material does not contain any components with a CERCLA RQ.

SARA Section 302 Threshold Planning (TPQ) No Chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 311/312 Immediate (acute) health hazard.  
Delayed (chronic) health hazard.

SARA Section 313 This product contains the chemical or chemicals listed below which are subject to the supplier notification requirements of Section 313 of the Superfund Amendments and Reauthorization Act of 1986 "SARA") and the requirements of 40 CFR Part 372.

Copper	7440-50-8	10%
Copper Compound	Not assigned	10%
Manganese Compound	Not assigned	15%
Manganese	7439-96-5	15%

Clean Water Act Contains the following Priority Pollutants at concentrations greater than 0.1%: Copper.

California Proposition 65 Warning: This product may contain trace quantities of a substance(s) known to the State of California to cause cancer.

Ingredient Name	Cancer	Developmental Toxicity	Reproductive	No significant risk level	Maximum acceptable dosage level
Benzene	Yes	No	No	No	No

## Section 16. Other information

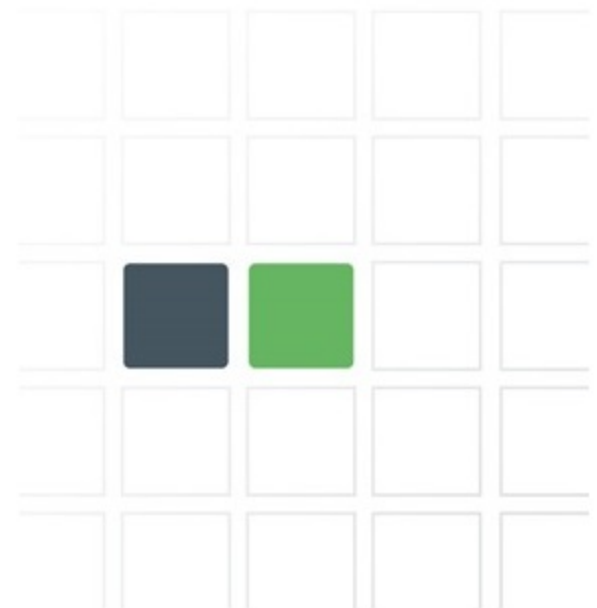
Suggested NFPA Rating:

Health	Fire	Reactivity	Other
2	0	0	E

**Revision Date: February 28, 2018**

All information, recommendations, and suggestions appearing herein concerning our product are based on tests and data believed to be reliable. However, it is the user's responsibility to determine the safety, toxicity, and suitability for use of the product described herein. Recipients are advised to confirm in advance of need, that the information is current, applicable, and suitable to their conditions. Since the actual use by others is beyond our control, no guarantee, expressed or implied, is made to the effects of such use. Bloom Energy does not assume any liability arising out of use, by others of the products referred to herein. Nor is the information herein to be construed as absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist because of applicable laws or government regulations.

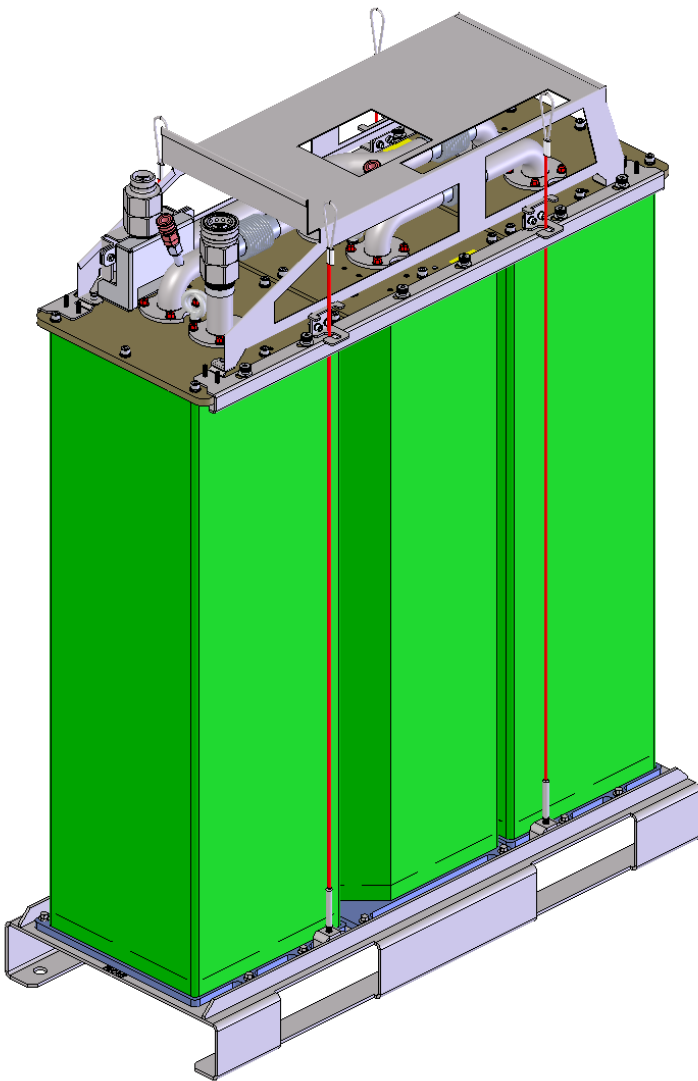
## Section 3: Composition and Design of the Desulfurization Canisters



## Design of the Desulfurization Unit

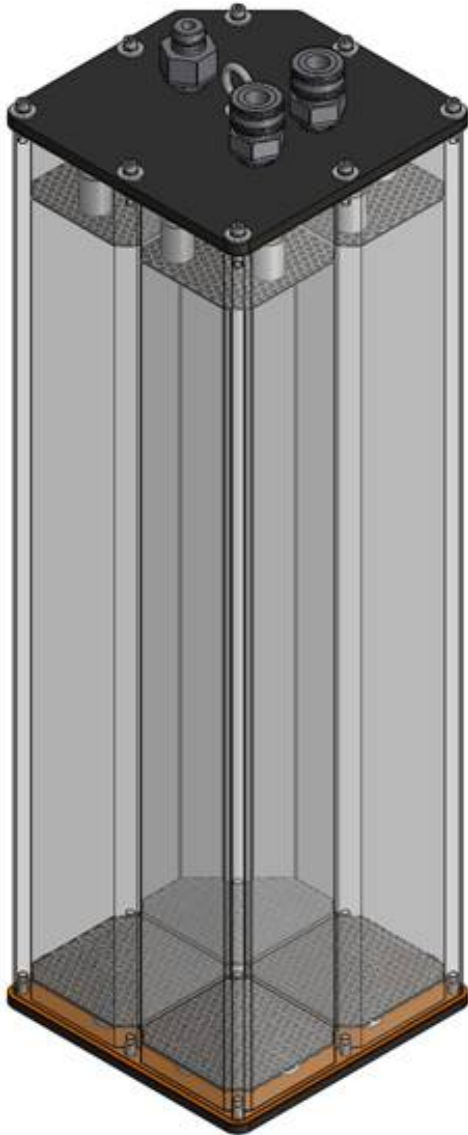
Each Bloom Energy Server Generation has a different Desulfurization Canister Design. All are designed for re-use and have auto shut off Quick Disconnect Coupling (QDC) Valves.

### BLOOM ENERGY SERVER ES 5 (YUMA)



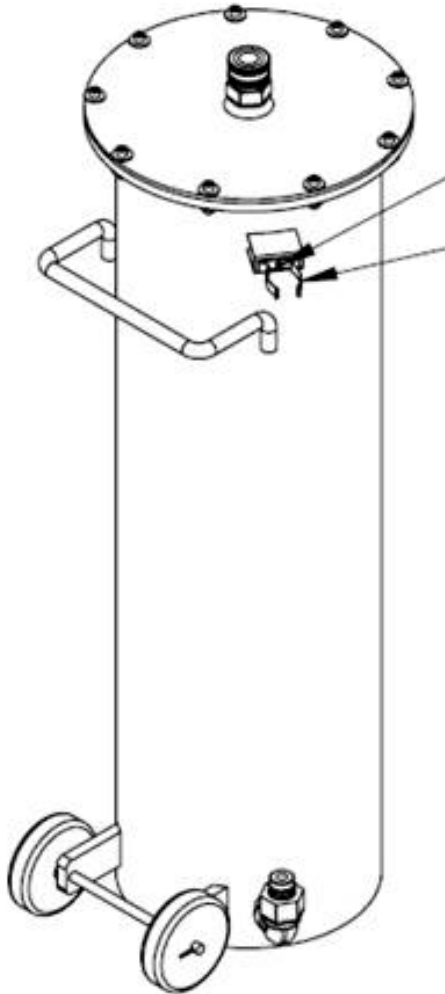
- Each Yuma canister assembly automatically seals shut upon disconnection and remains fully contained and sealed at all times
- The 2 quick disconnect valves are attached to stainless steel tubing via 1.25" threaded NPT coupling.
- The quick disconnect/quick coupling fittings have an internal valve that is closed and only opens when mated with a matching quick disconnect fitting.

**BLOOM ENERGY SERVER ES 2 AND ES 2.5 (CATALINA)**



- Each Catalina canister automatically seals shut upon disconnection and remains fully contained and sealed at all times
- The 3 quick disconnect valves are attached to aluminum plate directly via 1" threaded NPT coupling.
- The quick disconnect/quick coupling fittings have an internal valve that is closed and only opens when mated with a matching quick disconnect fitting.

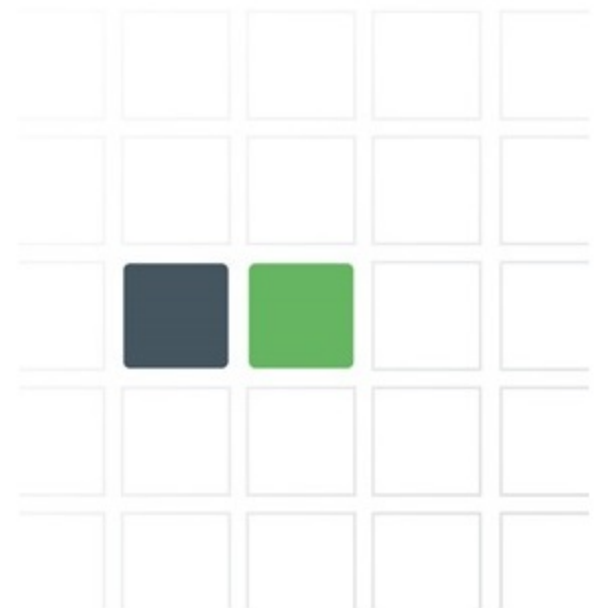
## BLOOM ENERGY SERVER ES 1 (TUCSON)



- Each Tucson canister automatically seals shut upon disconnection and remains fully contained and sealed at all times
- 1x quick disconnect is attached to aluminum plate directly via 1" threaded NPT threaded port.
- 1x quick disconnect is attached to canister via 1" NPT elbow/coupling combination
- The quick disconnect/quick coupling fittings have an internal valve that is closed and only opens when mated with a matching quick disconnect fitting.



## Section 4: Removal Process for Desulfurization Canisters



## **Bloom Energy Desulfurization Canisters**

### **Replacement Process Overview**

This document is intended to summarize all typical process steps taken at a Bloom Energy (Bloom) customer site, when desulfurization canisters no longer provide full system protection and need to be replaced with new canisters. While this document contains, in as much detail as possible, a typical process description, there are site to site differences at Bloom Energy customer sites which may change this process slightly.

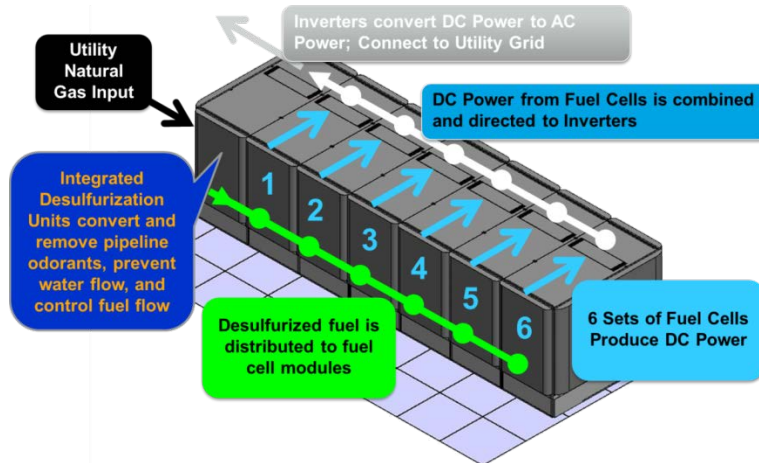
**The spent Composite Copper Catalyst removed from the desulfurization canisters from Bloom Energy Servers is an Excluded Recyclable Material (ERM) under 40 CFR 261.2(e)(1)(i) as set forth under California Health and Safety Code, section 25143.2, subsection (b). For all California locations the material is reported in the California Environmental Reporting System (CERS) in the location's Hazardous Material Inventory to meet the requirement of Health and Safety Code 24143.9.**

#### **Contents**

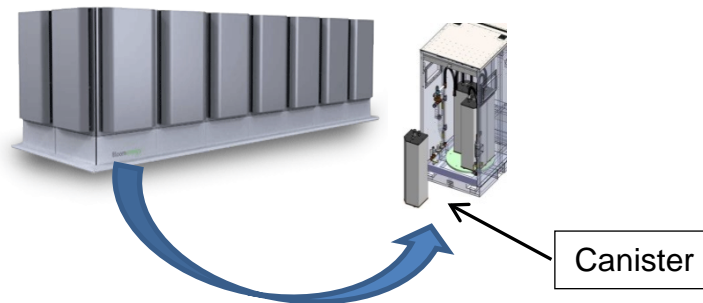
- 1. Background**
- 2. Field Service Procedure at Bloom Customer Sites**
- 3. Frequency of Removal**
- 4. Transportation**
- 5. Recycling**

- 1. Background - Equipment basic function / capacity and fuel and how energy is generated in this process.**

Bloom Energy, founded in 2001, produces electricity from natural gas using an innovative fuel cell technology. Its Servers are more efficient and have dramatically lower greenhouse gas and criteria pollutant emissions than traditional power sources. Bloom's proprietary platform processes natural gas (or biogas) into electricity through an electrochemical process without combustion, resulting in very high conversion efficiencies and lower greenhouse gas (GHG) emissions than conventional fossil fuel generation. Bloom Servers manufacture electricity from a single raw material—natural gas. The natural gas passes through a series of electrochemical processing units where it is converted into electricity.



Bloom desulfurization canisters - the first processing units in the server array – are designed to remove sulfur odorants from the natural gas feedstock. The sulfur odorants, if not removed, would rapidly and irreversibly damage the fuel cells, disabling the production of electricity.



## 2. Field Service Procedure at Bloom Customer Sites

When the desulfurization canisters no longer provide adequate protection of the fuel cell modules, they are removed from service and replaced with units containing fresh desulfurization media. Below is a detailed description of each process step taken in this servicing procedure.

- Bloom Remote Monitoring Control Center and advanced automated software systems indicate that canisters are depleted and that sulfur is reaching the fuel cell modules
- Bloom Remote Monitoring Control Center activates the desulfurization back-up systems remotely
- Bloom Remote Monitoring Control Center determines quantity of replacement canisters needed and creates Quickbase record and Service Request for replacement tracking

- Quickbase software notifies Field Service Manager that a record is created
- Field Service Manager ensures that adequate material supply is available and approves replacement action at customer site
- Quickbase software system notifies regional Bloom Field Service Lead that he needs to schedule desulfurization canister replacements at Bloom customer site
- Bloom Field Service Lead schedules appropriate time and date for delivery of fresh canisters and pick up spent canisters (same day)
- Bloom Field Service Lead schedules a rental forklift for delivery the day before service and pick up of the fork lift the day after
- Bloom Field Service Lead procures appropriate tooling kit from Bloom parts depot per procedure
- Bloom Logistics gets Quickbase software notification and enters pickup and delivery information in Bloom logistics provider's (Expeditors) Expo system and records confirmation (Bill of Lading – BOL) number in Quickbase. Each replacement order consists of adequate number of replacement canisters required plus one paper pleated fuel filter according to process manual.
- Bloom logistics provider (Expeditors) delivers replacement materials to Bloom customer site at appointed date and time. It is offloaded and brought to correct server by Bloom forklift operator. Transportation crates are opened once they are in a place close to and convenient for the service operation.
- Bloom Field Service Personnel perform Product Support procedure CAT-FPM-1032 (1 bed), CAT-FPM-1022 (2 bed), CAT-FPM-1023 (3 bed), or CAT-FPM-1033 (4 bed) as directed by service request. Procedures are substantially similar except for number of canisters replaced.
- All replaced used canister and re-crated in same transportation crates
- Bloom Field Service Personnel complete all necessary record keeping and Oracle transactions according to Bloom Operating Procedure. This includes completing return labels for each canister, applying the Excluded Recyclable Material label (if in CA), and marking any unused canisters. Some portions of this happen after the pickup BOL has arrived on site.
- Bloom Field Service Personnel waits for Bloom logistics provider (Expeditors) to arrive at the appointment time (+/-30 mins) and makes sure the crates get loaded on to the truck.
- Bloom Field Service Personnel collects any trash remaining from the service, discards it appropriately, closes any open server doors, announces in Skype that he's leaving and departs.
- Bloom Field Service Personnel meets the company to enable the forklift pick up by the rental company the next business day

### 3. Frequency of removal

Based on field conditions, canister replacement will occur every 12 to 18 months.

### 4. Transportation

Removed desulfurization canisters are transported by Bloom logistics provider (Expeditors) to ShoreMet, L.L.C. (ShoreMet) in Indiana. Canisters are transported on a standard Bill of Lading.

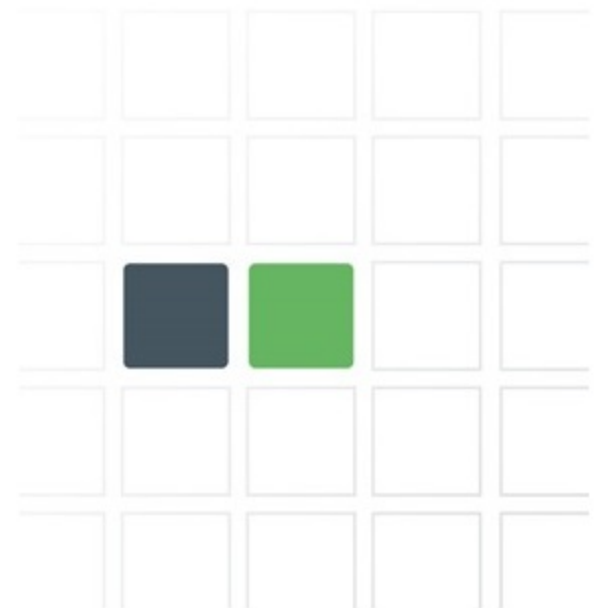
### 5. Recycling

Upon arrival at the Shoremet L.L.C facility crates are offloaded and moved into warehouse hold area until they are processed in ShoreMet's copper recycling process. Each canister arriving at ShoreMet is tracked throughout each process step. Details of canister tracking at Shoremet:

- Upon arrival at ShoreMet Canisters and shipping crates are inspected
- Each Canister is assigned unique receiver number (RR) through registering canister serial number in internal receiver system
- Expeditors BOL numbers, crate numbers and canister serial numbers are scanned into the master tracking log receiving report
- ShoreMet Program and Compliance Manager reviews master tracking log - once approved the canisters are added to the master tracking log to be processed
- The processing employee opens the crate, scans the crate number, serial number and part number into the processing log
- Canisters are processed following the Bloom Energy SOP
- After processing all canister materials are packed up in crates - the crate is sealed, and a packing slip and QC sticker are applied to the crate – crate is ready for shipment to Bloom
- For a shipment, a list of crates is created and placed onto a packing slip. The master log is updated with ship date for the canister completing the canister processing cycle at ShoreMet.
- The Program & Compliance Manager reviews the master tracking log weekly to determine canisters that have been processed and need a certificate issued
- The Program & Compliance Manager runs the certificates to show the media has been recycled and shares the certificates with Bloom for issuing to their customers

After completion of all process steps the empty canisters are shipped to Bloom Energy's Delaware factory where they are inspected, refilled with fresh catalyst, tested, and once passing all Quality Assurance steps sent back to the field for reuse.

## Section 5: Containment & Cleanup



## Handling Procedures

### A) Refer to the instructions on the attached Safety Data Sheet:

- Section 3: Composition/information on ingredients
- Section 4: First aid measures
- Section 6: Accidental release measures
- Section 7: Handling and storage
- Section 13: Disposal considerations



### B) Understanding the hazards:

- 1) Immediate hazards to health:
  - Potential exposure to toxic vapors
  - Avoid breathing vapors
- 2) Risk of Fire or Explosion:
  - Do not open canister lids at any time.
  - No smoking or open flames during canister change-outs

### C) Wear the proper Personal Protective Equipment (PPE):

- Safety glasses
- Dust masks
- Standard work gloves or latex (if material spills)
- Work clothes

## Containment and Cleanup Procedures

### A) Prevention:

- Monitor for leaks, ruptures, pressure build-up, etc.

### B) Response:

- 1) Stop processes and/or operations
- 2) Activate automatic shut-off
- 3) Eliminate sources of ignition for flammable hazards
- 4) Assess the size of spill

Spill Response Procedure
<ol style="list-style-type: none"><li>1. Wear nitrile gloves, and safety glasses</li><li>2. Contain the spill with the absorbent material</li><li>3. Sweep and collect the spill using the broom and dust pan</li><li>4. Collect waste in the disposal bags.</li><li>5. Label waste bag(s) with "Hazardous Waste" label</li><li>6. Contact Bloom EHS personnel for proper disposal</li><li>7. In the unlikely event the spill becomes uncontrolled, activate emergency response system with your personal safety horn or verbally instruct others within the threatened areas</li></ol>

### 1. Listing of Emergency Equipment

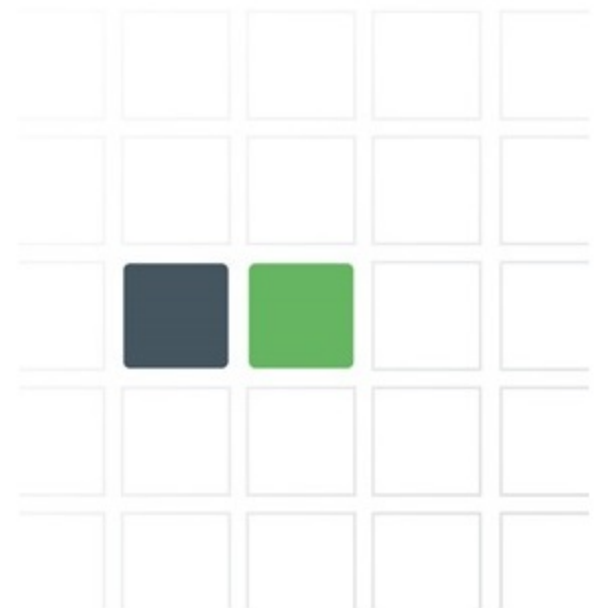
- a. Communication and Alarm Systems:
  - Personal Cellular Phones
  - Verbal Evacuation signals from coworkers and/or supervisor and/or personal safety horn
- b. Safety and First Aid:
  - Nitrile gloves
  - Safety glasses / goggles
  - Portable first aid kit
  - Portable eyewash
- c. Fire fighting:
  - Portable fire extinguisher
- d. Spill control and clean-up:
  - Nitrile gloves
  - Safety glasses / goggles
  - Absorbent Material, brush, dust pan/broom
  - Disposal bags

### 2. Methods or procedures for avoiding accidents

- No smoking or open flames is allowed in the working area.
- Do not open the canisters lids at any time.
- If there is a leak from canisters, avoid breathing vapors.



## Section 6: Employee Training



## **Employee Training**

All Bloom Field Service Personnel is trained annually in handling **Bloom Composite Copper Catalyst**. Training content includes:

- 1) **Hazard Communication**, including:
  - a. Safety Data Sheet
  - b. Hazards of material and processes
- 2) **Proper handling of hazardous materials** (including Personal Protective Equipment)
- 3) **Hazard mitigation, prevention, and abatement procedures**
- 4) **Emergency Response Procedures / Contingency Plan**, including:
  - a. Identification of facility areas, equipment and systems vulnerable to earthquakes and other natural disasters.
  - b. Communication and alarm systems.
  - c. Coordination of emergency response actions.
  - d. Notification procedures for local emergency responders, CUPA, Cal OES, and on-site personnel.
  - e. Use and maintenance of emergency response equipment and supplies (e.g. fire extinguisher, spill control materials, etc.).
  - f. Evacuation and procedures and evacuation staging locations.
- 5) **Transportation and Shipping Requirements**

## **Employee Training Frequency**

**Employee Training will be:**

- Provided initially for new employees within 30 days following the date of hire;
- Ongoing and provided at least annually;
- Amended prior to a change in process or work assignment; and,
- Given upon modification to the Emergency Response/Contingency Plan.