Attachment 8

Risk Assessment Peer Review Comments

PTrutner
Fire Protection Engineering Inc.

June 5, 2020

Attachment 8a

Ms. Kathy Allen
Supervising Senior Planner
Planning and Environmental Review Department
City of Goleta
130 Cremona Drive, Suite B
Goleta, CA 93117

Re: Risk Assessment Peer Review
Cortona Drive Energy Storage Project
6864 Cortona Drive, Goleta CA 93117

Dear Ms. Allen:
Per your request, we have reviewed the submitted Risk Assessment for the Goleta Corona Drive Energy Storage Project, dated 01/27/2020, by MRS Environmental. The submitted Risk Assessment provided was reviewed in conjunction with all applicable codes and standards.

The intent of this peer review is to identify any gaps and/or items that may need further consideration with respect to the installation of the proposed energy storage systems and the Santa Barbara County Fire Department requirements and /or response.

The following reference materials were utilized in the assembly of the following review comments:

- 2019 Edition, California Fire Code (CFC)
- 2019 Edition, California Building Code (CBC)
- 2020 Edition, NFPA 855 Standard for the Installation of Stationary Energy Storage Systems
- UL9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
- Santa Barbara County Fire Department (SBCFD)Standards

The comments provided in this review will be divided into the following sections:

- Risk Assessment Review Comments
- Additional Recommendations / Considerations

Risk Assessment Review Comments

1.0 Introduction

1. The provided risk assessment only examines site malfunction scenarios for impact to public receptors. The risk assessment states that "*Potential impacts to onsite personnel or emergency response personnel are outside the scope of this analysis*".

   It is recommended that the risk assessment include site malfunction scenarios for the installation of the proposed energy storage systems for impact to site personnel and fire department response personnel.

2.0 Project Description

2. The Introduction section indicates that the approximate storage capacity for the project to be 60MW. The project description indicates the installation of self-contained energy storage and management system called Megapacks as manufactured by Tesla. Each cabinet is to hold 17 modules with 12,636 cells in each module.

   The project description does not indicate the number of storage cabinets to be located at the project site. Per the manufacturer website, each Megapack has a maximum energy capacity of 3MWh. This would imply the installation of (20) total Megapack "containers" at the site. Figure 1 of the assessment only provides the project site, not the specific container locations.

   It is recommended that a complete site plan for the proposed installation be included showing locations of all containers, the proposed operations and maintenance control enclosure and all relevant distances to exposures as outlined in Section 3.0, Table 1 of the assessment.

3. There is a statement that indicates there are no "*walk-in or inhabitable facilities in the proposed Projects design".*

   Clarify in the project description if the operations and maintenance control enclosure is an occupiable structure.

4. The assessment indicates that the fire prevention systems would include the *"cabinets being designed to limit or eliminate the threat of the spread of fire from one cabinet to another, infrared camera monitoring at the site and onsite hydrants.* ***See the project description for more details on the fire prevention systems****".*

There is no additional information provided in the project description about the proposed fire prevention measures.

It is recommended that a complete hazard mitigation analysis for the project be provided as outlined in the 2019 CFC Section 1206.2.3.

5. The assessment states that the "*Battery Maintenance System (BMS) would monitor all cell voltages, currents and temperatures and shut down equipment if unsafe conditions are detected".*

   Provide additional information on the BMS. Will each container have its own BMS system or are all Megapack containers monitored at the operations and maintenance control enclosure?

6. The assessment states that the *"the proposed battery cell type would be Lithium Nickel Cobalt Aluminum (NCA) manufactured by Tesla".* It then states that the *"analysis assumed an NCA-type battery".*

   It is recommended that the specific type of Lithium Ion battery be confirmed and utilized as the basis for this assessment. The supplier should be able to confirm the type of battery utilized within the Megapack containers.

3.0 Environmental and Regulatory Settings

7. This section refers to and describes UL 9540A and UL 1973 requirements.

   Per the requirements of the 2019 CFC, Section 1206.10.1, storage batteries and storage battery systems are required to be listed in accordance with these standards. The proposed battery storage system is to be listed per these requirements.

   1206.2.10.1 Listings. Storage batteries and battery storage systems shall comply with the following:
   1. Storage batteries shall be listed in accordance with UL 1973.
   2. Prepackaged and pre-engineered stationary storage battery systems shall be listed in accordance with UL 9540.

   It is recommended to confirm that the proposed Megapacks have been UL listed per the requirements above and the test data be included as part of this assessment.

8. This section refers to NFPA 855, Standard for the Installation of Stationary Energy Storage Systems, and indicates this document is under development and only a draft version is published.

This document is currently released and does provide guidance on minimizing hazards associates with the installation of energy storage systems. Although this document is not a CFC referenced standard due to its recent release, it provides specific guidelines with respect the outdoor storage installations, classifications of outdoor ESS installations, maximum sizes storage capacity based on location near exposures and other hazard mitigation measures.

It is recommended that the requirements of the 2020 Edition of NFPA 855 be utilized as part of this assessment and the hazard mitigation analysis recommended in Item 4 of these comments. See CFC Section 102.8.

9. Table 1 provides specific distances from the battery cabinets to public receptors.

   It is recommended to provide a site map clearly depicting the locations of the cabinets with respect to the specified receptors for clarity.

4.0 Assessment Methodology

10. For purposes of the assessment, the failure mode utilized as a "worst case scenario" involves a localized thermal runaway reaction and failure of the battery management system.

    Tables 2 and 3 provide potential toxic pollutants from battery malfunctions and results from studies on emissions from battery malfunctions.

    The toxic pollutants emitted from a battery malfunction are dependent on the battery type. As indicated in Section 3.0, the UL 9540A test methodology evaluates the fire characteristics of a battery storage system that undergoes thermal runaway.

    Per the requirements of the 2019 CFC Section 1206.10.1 the proposed batteries are to be listed per UL 9540A. The testing performed per UL 9540A should be able to identify the specific off gassing emissions being produced by a battery cell undergoing thermal runaway. The specific off gassing properties, for the proposed Megapack batteries, determined in the UL 9540A testing should be included as part of this assessment.

11. Table 5 identifies the off-gassing primary flammable components as part of the DNVGL 2019 study reflected in Table 3. Per Table 3, this study measured the characteristics of a Tesla Powerpack thermal runaway scenario.

The testing is not specific to the proposed Megapack. As indicated in Section 3.0 of the assessment, there are a number of different lithium battery types. Confirm that the batteries for the Tesla Powerpack are the same as what is being provided in the Tesla Megapack.

12. The CGA "Q" value calculations provided indicate that the calculations per CGA Publication P-23 utilize the off gassed materials as provided by the manufacturer as shown in Table 4.

    It appears this should read Table 5. Additionally, the CGA calculations provided in Attachment A, are slightly different than the off-gassing components reflected in Table 5. The CGA calculations in Attachment A are indicated to be NCA toxic emissions and are slightly different to the components indicated in Table 5.

    It is recommended that the calculations provided to determine the "Q" value should be specific to the off-gassing properties of the proposed type of battery utilized in the Megapacks as determined by the UL 9540A testing. See comment 10.

13. Per the Tesla Emergency Response Guide provided as attachment B, a battery fire may continue for several hours and it may take up to 24 hours or longer for the battery pack to cool after being fully consumed in a thermal runaway event. It also states that a lithium ion battery fire can re-ignite.

    The risk assessment assumes that the release of pollutants to the atmosphere would occur all within one hour as a reasonable worst case. If a battery fire occurs, products of combustion may be released for several hours per the documentation provided by the manufacturer. Additional consideration is recommended.

5.0 Environmental Consequences

14. In Section 5.3, the assessment outlines the results of UL1973 testing stating that *"in the event of a single cell undergoing thermal runaway there was no propagation to surrounding cells. In addition, the test showed that when an entire module was force-ignited, there was no propagation to surrounding modules".*

    Clarify if this testing specific to the proposed Megapack containers the project is proposing to install.

15. Section 5.3 references Attachment B, which is a copy of the Emergency Response Guide provided by Tesla.

The document states that Tesla Powerpack Systems and Powerwalls and their respective battery subassemblies are covered by the document. It does indicate the proposed Megapack containers. Provide the manufacturer emergency response guide specific to installation of the Megapack containers.

6.0 Quantitative Risk Analysis

16. The flammable impacts, under subsection Impacts and Level of Concern, are based on experiments done by Texas A&M Engineering Extension Service on flash fires for propane.

    As indicated in Section 4.0 of the assessment, off gassing could have varying degrees of flammability depending on the combination of flammable materials. It is recommended that further clarification be provided. Is propane the primary off-gassing materials for the proposed type of battery?

17. Per the information provided, the proposed Megapack containers are not currently installed at any other location. The assessment states that the Megapack containers are like the Tesla Powerpack containers, however, the Megapacks contain approximately 13 times more cells than the Powerpack containers.

    As part of the design features indicated for the Megapack containers, testing per UL standards is provided. The specific UL test results / listing should be provided within the assessment.

    Another design feature is indicated is that monitoring is to be provided by fire detection to ensure rapid response. There is no other additional information provided. The specific type of detection should be provided. Is the detection method pre-installed within the container, or is the detection an overall site detection system? Additional details should be provided.

7.0 Recommendations

18. The recommendations provided in the assessment include only (3) items to be considered for the installation of the proposed Megapack containers. The recommendations include discharging the batteries below 30% state of charge during the construction / installation phase, discharging the batteries below 30% state for replacement and/or maintenance, and providing vehicle bollards per NFPA 855 Section 4.3.7.

    It is recommended to include detailed summary recommendations for all fire protection mitigation measures being provided for the proposed installation for review by the Santa Barbara County Fire Department.

Additional Recommendations / Considerations

After review of the submitted Risk Assessment for the proposed project, we recommend the following:

1. The proposed installation far exceeds the maximum allowable battery quantities outlined in CFC Table 1206.2.9. Provide a complete hazard mitigation analysis as outlined in CFC Section 1206.2.3. It is recommended the hazard mitigation analysis include recommendations from the 2020 Edition of NFPA 855. See below for CFC Sections 1206.2.3 and 1206.2.3.1.

   1206.2.3 Hazard mitigation analysis. A failure modes and effects analysis (FMEA) or other approved hazard mitigation analysis shall be provided in accordance with Section 104.7.2 under any of the following conditions:

   1. Battery technologies not specifically identified in Table 1206.2 are provided.
   2. More than one stationary storage battery technology is provided in a room or indoor area where there is a potential for adverse interaction between technologies.
   3. Where allowed as a basis for increasing maximum allowable quantities in accordance with Section 1206.2.9.

   1206.2.3.1 Fault condition. The hazard mitigation analysis shall evaluate the consequences of the following failure modes, and others deemed necessary by the fire code official. Only single-failure modes shall be considered.

   1. Thermal runaway condition in a single-battery storage rack, module, or array.
   2. Failure of any energy management system.
   3. Failure of any required ventilation system.
   4. Voltage surges on the primary electric supply.
   5. Short circuits on the load side of the stationary battery storage system.
   6. Failure of the smoke detection, fire-extinguishing, or gas detection system.
   7. Spill neutralization not being provided or failure of the secondary containment systems.

   1206.2.3.3 Additional protection measures. Construction, equipment and systems that are required for the stationary storage battery system to comply with the hazardous mitigation analysis, including but not limited to those specifically described in Section 1206.2, shall be installed, maintained and tested in accordance with nationally recognized standards and specified design parameters.

2. It is recommended that an emergency operation plan, as outlined in NFPA 855 Section 4.1.3.2.1, be provided for the project, and submitted for review to the Santa Barbara County Fire Department. See below for Section 4.1.3.2.1.

4.1.3.2.1 Emergency Operations Plan.
4.1.3.2.1.1 An emergency operations plan shall be readily available for use by facility operations and maintenance personnel.
4. 1.3.2.1.2 For normally occupied facilities, the emergency operations plan shall be on site.
4.1.3.2.1.3 The plan shall be updated when conditions that affect the response considerations and procedures change.
4.1.3.2.1.4 The emergency operations plan shall include the following:

(1) Procedures for safe shutdown, de-energizing, or isolation of equipment and systems under emergency conditions to reduce the risk of fire, electric shock, and personal injuries, and for safe start-up following cessation of emergency conditions.
(2) Procedures for inspection and testing of associated alarms, interlocks, and controls
(3) Procedures to be followed in response to notifications from the energy storage management system (ESMS), when provided, that could signify potentially dangerous conditions, including shutting down equipment, summoning service and repair personnel, and providing agreed upon notification to fire department personnel for off-normal potentially hazardous conditions
(4) Emergency procedures to be followed in case of fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions
(5) Response considerations similar to a safety data sheet (SDS) that will address response safety concerns and extinguishment when an SDS is not required
(6) Procedures for dealing with ESS equipment damaged in a fire or other emergency event, including contact information for personnel qualified to safely remove damaged ESS equipment from the facility
(7) Other procedures as determined necessary by the AHJ to provide for the safety of occupants and emergency responders
(8) Procedures and schedules for conducting drills of these procedures

3. The risk assessment focuses on the toxic and flammable impacts to the public receptors with regards to the off gassing of materials due to battery cell malfunction. The only recommended mitigation for the off-gassing materials is that the Megapack containers are provided with ventilation. Off-gassing occurs prior to thermal runaway.

   It is recommended that a method of gas detection per the requirements of the CFC Section 1206.2.11.4 be included as part of the hazard mitigation requirements. Confirm the proposed ventilation meets the requirements of CFC Section 1206.2.11.3 and NFPA 855 Section 4.9.

4. Table 1 of the assessment indicates that there are receptors within 100'-0 of the proposed Megapack containers. NFPA 855 Section 4.4.3.1 provides (2) classifications for outdoor energy system storage and are as follows:

   (1) Remote locations: Remote outdoor locations include ESS located more that 100'-0 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.

   (2) Locations near exposures: Locations near exposures include all outdoor ESS locations that do not comply with remote outdoor locations requirements.

   As indicated in the report, some containers that will be located within 100'-0 of the receptors indicated in Table 1 of the assessment and would be classified as "Locations near exposures".

   Per the requirements of NFPA 855 Table 4.4.3, Section 4.8(2), and Table 4.8, the maximum stored energy for containers classified as "located near exposures" is 600 kWh. The proposed Megapack containers far exceed 600 kWh.

   It is recommended that all Megapack containers be located to meet the "Remote Location" classification with a minimum distance of 100'-0 from all exposures as prescribed in NFPA 855 Section 4.4.3.1.

5. Additional compliance requirements outlined in the provisions of NFPA 855, 2020 Edition, that need consideration within the recommended Hazard Mitigation Analysis include the following:

   (1) Vegetation Control: NFPA 855 Section 4.4.3.6
   4.4.3.6 Vegetation Control.

4.4.3.6.1 Areas within 10 ft (3 m) on each side of outdoor ESS shall be cleared of combustible vegetation and other combustible growth.

4.4.3.6.2 Single specimens of trees, shrubbery, or cultivated ground cover such as green grass, ivy, succulents, or similar plants used as ground covers shall be permitted to be exempt provided that they do not form a means of readily transmitting fire.

(2) Security of Installations: NFPA 855 Section 4.3.8

4.3.8 Security of Installations.

4.3.8.1 ESS shall be secured against unauthorized entry and safeguarded in an approved manner.

4.3.8.2 Security barriers, fences, landscaping, and other enclosures shall not inhibit the required air flow to or exhaust from the ESS and its components.

(3) Fire Department Access Roads: NFPA 855 Section 4.4.3.8

4.4.3.8 Access Roads. Fire department access roads shall be provided to outdoor ESS installations in accordance with the local fire code.

(4) Signage: NFPA 855 Section 4.3.5

4.3.5* Signage.

4.3.5.1 Approved signage shall 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 containers
(3) In approved locations on outdoor ESS that are not enclosed in occupiable containers or otherwise enclosed

4.3.5.2* The signage required in 4.3.5.1 shall be in compliance with ANSI Z535 and include the following information as shown in Figure 4.3.5.2:
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
5) Emergency contact information

(5) Smoke and Fire Detection: NFPA 855 Section 4.10

4.10.1 All fire areas containing ESS systems located within buildings or structures shall be provided with a smoke detection system in accordance with *NFPA 72*.

(6) Water Supply: NFPA 855 Section 4.13

4.13.3 Accessible fire hydrants shall be provided for site ESS installations where a public or private water supply is available.

4.13.4 Fire hydrants installed on private fire service mains shall be installed in accordance with NFPA 24.

(7) **Remediation Measures:** NFPA 855 Section 4.16

4.16.1 Authorized Service Personnel. In the event a fire or other event has damaged the ESS and ignition or reignition of the ESS is possible, the owner, agent, or lessee shall immediately dispatch authorized service personnel to mitigate the hazard or remove damaged equipment from the premises to a safe location.

4.16.2 Fire Mitigation Personnel.
4.16.2.1 When, in the opinion of the AHJ, it is essential for public safety that trained personnel be on site to respond to possible ignition or reignition of damaged the ESS, the owner, agent, or lessee shall provide one or more fire mitigation personnel, as required and approved, at their expense.

4.16.2.2 These personnel shall remain on duty continuously after the fire department leaves the premises until the damaged ESS is removed from the premises or the AHJ indicates they can leave.

4.16.2.3 On-duty fire mitigation personnel shall have the following responsibilities:

1) Keep diligent watch for fires, obstructions to means of egress, and other hazards
2) Immediately contact the fire department if their assistance is needed to mitigate any hazards
3) Take prompt measures for remediation of hazards and extinguishment of fires that occur

4) Take prompt measures to assist in the evacuation of the public from the structure

Thank you for the opportunity to provide this review. Please call our office with any questions.

Sincerely,

Paul Trutner, F.P.E.
Fire Protection Engineer (FP-1934)

Attachment 8b

June 5 Risk Assessment Peer Review by PTrutner Fire Protection Engineering - Responses

Item	Response	Rec
1 It is recommended that the risk assessment include site malfunction scenarios for the installation of the proposed energy storage systems for impact to site personnel and fire department response personnel.	The scope of the risk assessment was to address the compliance with the CEQA Risk Assessment requirements and for CEQA review. CEQA does not normally address potential impacts to site personnel. However, many of the components of a CEQA analysis indirectly address site personnel, such as toxic pollutant concentrations, flammable gas levels, detection, and fire response. OK	
2 It is recommended that a complete site plan for the proposed installation be included showing locations of all containers, the proposed operations and maintenance control enclosure and all relevant distances to exposures as outlined in Section 3.0, Table 1 of the assessment.	The detailed Site Plan shows the location of all Megapacks, switchgears and the substation. It does not show the location of the operations and maintenance control center. This should be added to the site plan, although it is small and not more than a computer hub-type system. The site plan could be added to the hazards report as well as the general application submissions. The report indicates that "*There will be no walk-in or inhabitable facilities in the proposed Project design*" OK	Add ops and maintenance control center to site plan. Include site plan in hazards report.
3 Clarify in the project description if the operations and maintenance control enclosure is an occupiable structure	Add text on the operations and control center to the hazards report. The report indicates that "*There will be no walk-in or inhabitable facilities in the proposed Project design*" OK	Add text to report.
4 It is recommended that a complete hazard mitigation analysis for the project be provided as outlined in the 2019 CFC Section 1206.2.3	2019 CFC Section 1206.2.3 states that: *A failure modes and effects analysis (FMEA) or other approved hazard mitigation analysis shall be provided in accordance with Section 104.7.2 under any of the following conditions:*	

	• *Battery technologies not specifically identified in Table 1206.2 are provided.* • *More than one stationary storage battery technology is provided in a room or indoor area where there is a potential for adverse interaction between technologies.* • *Where allowed as a basis for increasing maximum allowable quantities in accordance with Section 1206.2.9.* And, as per 1206.2.9 *1206.2.9 Maximum Allowable Quantities* *Fire areas <u>within buildings</u> containing stationary storage battery systems exceeding the maximum allowable quantities in Table 1206.2.9 shall comply with all applicable Group H occupancy requirements in this code and the California Building Code.* The proposed battery storage system is a lithium system, as listed in Table 1206.2, does not utilize more than one stationary battery technology, and is not located within a building. Note that Table 1206.2.9 is related to occupancy issues. There are no occupancy issues at the site. It therefore does not appear to qualify for a FMEA analysis requirement, although a hazards mitigation analysis under NFPA 855 may be applicable as discussed below. Agreed, not required per these bullet points, Code defines the minimum requirements. This was recommended due to the project seeking to increase the maximum stored energy for systems located near exposures as defined in NFPA 855 Section 4.4.3.1.	

5 Provide additional information on the BMS. Will each container have its own BMS system or are all Megapack containers monitored at the operations and maintenance control enclosure?	This information will be added to the project description and risk analysis. OK	Add info on BMS systems to the report.
6 It is recommended that the specific type of Lithium Ion battery be confirmed and utilized as the basis for this assessment. The supplier should be able to confirm the type of battery utilized within the Megapack containers.	The report states that the NCA battery type will be used in the MegaPacks Clarified: "assumed" was removed from text.	
7 It is recommended to confirm that the proposed Megapacks have been UL listed per the requirements above and the test data be included as part of this assessment.	UL listing data was previously requested from Tesla and it was indicated that "*While we have not performed third-party UL9540A testing on our products, we can provide the info you are looking for:* - *Each cell releases 7g of gas during runaway* - *The composition of cell gases is detailed in the attached deck*". Therefore, MRS utilized what information we had available, which was the DNV testing on a powerpacks and the offgassing levels as described by Tesla. Tesla indicates that UL testing should be available soon. Megapacks are to be UL listed per CFC 1206.10.1. Currently these units have not been listed per the response above and therefore, do not currently meet the requirements of the CFC for installation.	Confirm status of UL testing.
8 It is recommended that the requirements of the 2020 Edition of NFPA 855 be utilized as part of this assessment and the hazard mitigation analysis recommended in Item 4 of these comments. See CFC Section 102.8	The hazard report is not intended to be a complete audit of all applicable codes and standards. It addresses the potential impacts to the public of an accident scenario at the site. NFPA 855 was utilized as part of this analysis, although many parts of 855 are not applicable to an installation located outside with no	Add recommendation for audits and maintenance.

	walk-in or inhabitable facilities. For example, 855 Section 4.10 requirements for smoke detection are not applicable to outside installations. 855 Table 9.2 excludes outside installations from exhaust ventilation, spill control, neutralization, and safety caps (sections 4.9, 4.14, 4.15 and 9.4). 855 Section 4.1.4 requires a hazard mitigation analysis under the following circumstances: • *When technologies are specifically not addressed in Table 1.3* • *More than one ESS technology is provided in a room or indoor area where adverse interaction between the technologies is possible* • *When allowed as a basis for increasing the maximum stored energy as specified in 4.8.1 and 4.8.2.* The lithium technology is listed in Table 1.3 and the technology is not located inside of a room. Section 4.8.1 is applicable to areas in non-dedicated use buildings and is not applicable to this project. Section 4.8.2 allows for AHJ approval of an outdoor ESS installation that exceed 600 kWH if a hazard mitigation analysis in accordance with section 4.1.4 and large scale fire testing as per 4.1.5. Recommend obtaining documented results of large-scale fire testing for the Megapacks per NFPA 855 Section 4.1.5.4. **4.1.5.4*** The test report shall be provided to the AHJ for review and approval. **A.4.1.5.4** The test report will provide nonproprietary information that, among other things, describes the size and	Add discussion of this report satisfying the 855 Section 4.1.4 needs

	energy capacity rating of the unit being tested, model numbers of the modules and ESS units, orientation of ESS in the test facility, and proximity of the ESS unit under test to adjacent ESS, walls, and monitoring sensors. The test report also includes a complete set of test results and measurements. Section 4.1.4 has the following requirements for a hazard mitigation analysis: *4.1.4.2 The analysis shall evaluate the consequences of the following failure modes and other deemed necessary:* 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.* *4.1.4.3 The analysis should demonstrate the following:* 1. *Fire will be contained within unoccupied ESS rooms for the minimum duration of the fire resistance rate specified in 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 with not exceed the PEL in the area where the ESS is contained.* 5. *Toxic and highly toxic gases released during fires and other fault conditions will not reach IDLH concentrations 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 operations will not exceed 25 percent fot eh LFL* The hazard analysis report documents the failures that could lead to releases of toxic and flammable materials, and documents that the levels of toxic and flammable materials do not exceed the risk thresholds required under CEQA. The report indicates that its primary focus is on the worst-case reasonable scenario which could produce the largest impacts. The report indicates that "*However, to determine an unlikely, but reasonable worst-case public health impacts for this analysis, it is assumed that these control systems fail and do not control the battery cell malfunction"* in line with the requirements for a hazard mitigation analysis under NFPA 855. The report utilizes the Santa Barbara County and City of Goleta Risk Assessment Guidelines and CEQA thresholds to determine the acceptability of placing the systems within 100 feet of buildings. The report indicates that emissions are not anticipated during normal operations. CFC Section 102.8 refers to maintenance of safety systems. A recommendation has been added to ensure proper auditing and maintenance practices are documented and put in place.	
9 It is recommended to provide a site map clearly depicting the locations of the cabinets with respect to the specified receptors for clarity	See 2 above. A more detailed site plan will be added to the hazards report. OK	

10 The testing performed per UL 9540A should be able to identify the specific off gassing emissions being produced by a battery cell undergoing thermal runaway. The specific off gassing properties, for the proposed Megapack batteries, determined in the UL 9540A testing should be included as part of this assessment.	UL9540A testing was not provided by Tesla as part of the analysis. However, as per 855 Section 4.1.5.1, large scale fire testing on a representative ESS (the PowerPack) was utilized and the levels of toxic and flammable off gassed materials were utilized to estimate the potential impacts. The PowerPacks utilize the same battery cells as those proposed for the MegaPacks and were therefore deemed representative as per 855 Section 4.1.5.1. Text clarifying this has been added to the report. The testing indicated in the report was done by DNVGL. However, the report does not indicate the specific standards the DNVGL testing utilized. UL 9540A is the test method for evaluating thermal runaway fire propagation on battery storage systems. The Megapack systems are approximately 13 times larger than the Powerpack systems. Clarify how the Powerpack systems would be defined as representative solely based on the battery type. Megapacks are to be UL listed per CFC 1206.10.1. Currently these units have not been listed per the response to item 7 above, and do not meet the requirements of the CFC for installation. See Item 8 comments.	Clarifying text on representative systems.
11 The testing is not specific to the proposed Megapack. As indicated in Section 3.0 of the assessment, there are a number of different lithium battery types. Confirm that the batteries for the Tesla Powerpack are the	As indicated in 855 Section 4.1.5.1, a representative system should be utilized. As the PowerPacks utilize the same battery cells as a PowerPack, they are considered to be representative. As they use the same battery cells, offgassing of materials in terms of the toxic pollutant concentrations and the flammable material concentrations would be identical if a battery cell	

same as what is being provided in the Tesla Megapack.	malfunctioned and off gassed. The flowrates of the materials were scaled based on the size of the MegaPack, however, and the frequencies of failures were also scaled in order to determine the potential dispersion and impacts and risk assessment results. Megapacks are approx. 13 times the size of the Powerpacks. Clarify how Powerpack can be considered a representative sample of the Megapack system. Actual test data should be specific to actual proposed energy storage system.	
12 It is recommended that the calculations provided to determine the "Q" value should be specific to the off-gassing properties of the proposed type of battery utilized in the Megapacks as determined by the UL 9540A testing.	The values used in the CGA calculation in Attachment A on page A-10 utilize the flammable concentrations as listed in the main report Table 5. However, concentrations of non-flammable materials such as Nitrogen and Carbon Dioxide, are also included in the CGA analysis based on information received from Tesla. Table 5 in the main report only lists the flammable components. Text has been revised to refer to Table 5. OK	Modify text to refer to table 5 instead of table 4.
13 The risk assessment assumes that the release of pollutants to the atmosphere would occur all within one hour as a reasonable worst case. If a battery fire occurs, products of combustion may be released for several hours per the documentation provided by the manufacturer. Additional consideration is recommended.	While the release of toxic or flammable materials may occur over a longer period of time, the maximum downwind concentrations of toxic pollutants occurs when the same amount of material is released over a shorter duration. Text has been added to the report to indicate that longer durations may occur, but would produce lower downwind concentrations and therefore a worst case analysis was presented. OK	Add a discussion of longer duration scenarios.
14 Clarify if this testing specific to the proposed Megapack containers the project is proposing to install.	As indicated in the report, the testing conducted by DNVGL was conducted on a PowerPack, which is considered representative of a MegaPack as the same battery cells are used in each configuration. Off gassed materials would be the same for a MegaPack vs a Powerpack.	Note page numbering

	Megapacks are to be UL listed per CFC 1206.10.1. Currently these units have not been listed per the response above and therefore, do not currently meet the requirements of the CFC for installation.	
15 The document states that Tesla Powerpack Systems and Powerwalls and their respective battery subassemblies are covered by the document. It does indicate the proposed Megapack containers. Provide the manufacturer emergency response guide specific to installation of the Megapack containers.	A Megapack specific emergency response guide will be provided. OK	Include Megapack specific emergency response guide from Tesla in Attachment
16 As indicated in Section 4.0 of the assessment, off gassing could have varying degrees of flammability depending on the combination of flammable materials. It is recommended that further clarification be provided. Is propane the primary off- gassing materials for the proposed type of battery?	Additional text has been added. Propane is a minor component of offgassing from the battery systems. Testing associated with flash fire research was conducted with propane to estimate the level of thermal exposure generated by a flash fire and to support the use of the LFL and ½ LFL as reasonable fatality and serious injury impact zones. It is not meant to be specific to the flammable gas mixtures presented in this analysis. OK	
17 The specific UL test results / listing should be provided within the assessment. Another design feature is indicated is that monitoring is to be provided by fire detection to ensure rapid response. There is no other additional information provided. The specific type of detection should be provided. Is the detection method pre-installed within the container, or is the detection an overall site detection system? Additional details should be provided.	As per Tesla, the UL testing on the MegaPacks has not been completed at this time. The text has been revised to include a recommendation to ensure that listing should be provided to the Fire Department prior to installation. Monitoring would be composed of UV detectors similar to Det-Tronics X3302 system. Gas detection has not been proposed, but could be similar to a Det-Tronics CGS system. Gas detection has been added as a recommendation. Additional information has been added to the project description. OK	Add recommendation for the installation of gas detection. Add detection description to project description

	Note that 855 Section Table 9.2 (and Section 4.9.1), exhaust ventilation is not required for Lithium systems. Section 6.0 of the report indicates the MegaPack do have dedicated venting systems to direct off gassing vertically.	
18 It is recommended to include detailed summary recommendations for all fire protection mitigation measures being provided for the proposed installation for review by the Santa Barbara County Fire Department	This recommendation is not clear. However, additional recommendations have been added to the text to include gas detection, code audits and compliance, an emergency operations plan, etc. Additional recommendations have been provided in Section 7.0.	Add additional recommendations for a site plan and emergency plan.
Rec 1 The proposed installation far exceeds the maximum allowable battery quantities outlined in CFC Table 1206.2.9. Provide a complete hazard mitigation analysis as outlined in CFC Section 1206.2.3. It is recommended the hazard mitigation analysis include recommendations from the 2020 Edition of NFPA 855. 1206.2.3 Hazard mitigation analysis. 1206.2.3.1 Fault condition 1206.2.3.3 Additional protection measures	The hazard report presents a discussion of the following, addressing the NFPA 855 requirements for a hazard mitigation analysis: 1. Toxic and highly toxic gases released during normal charging, discharging, and operation 2. Toxic and highly toxic gases released during fires and other fault conditions 3. Flammable gases released during charging, discharging and normal operations See item 4 response.	Add text discussing the requirements for a hazard mitigation analysis.
Rec 2 It is recommended that an emergency operation plan, as outlined in NFPA 855 Section 4.1.3.2.1, be provided for the project, and submitted for review to the Santa Barbara County Fire Department.	An emergency operations plan will be prepared and submitted OK	Add recommendation to prepare an emergency plan.
Rec 3 It is recommended that a method of gas detection per the requirements of the CFC	Gas detection has been added to the recommendations. OK	Add gas detection as a recommendation.

Section 1206.2.11.4 be included as part of the hazard mitigation requirements. Confirm the proposed ventilation meets the requirements of CFC Section 1206.2.11.3 and NFPA 855 Section 4.9.	Note that ventilation as per Section 4.9 is not applicable for Lithium systems as per 855 Table 9.2. Section 6.0 of the report indicates the MegaPack do have dedicated venting systems to direct off gassing vertically.	
Rec 4 Per the requirements of NFPA 855 Table 4.4.3, Section 4.8(2), and Table 4.8, the maximum stored energy for containers classified as "located near exposures" is 600 kWh. The proposed Megapack containers far exceed 600 kWh. It is recommended that all Megapack containers be located to meet the "Remote Location" classification with a minimum distance of 100'-0 from all exposures as prescribed in NFPA 855 Section 4.4.3.1.	Containers are allowed to be placed closer than 100 feet if a hazard mitigation analysis is provided. (pending AHJ approval) The hazard analysis report documents the requirements detailed in NFPA 855 Section 4.1.4.3 and follows the risk assessment guidelines of the City of Goleta and the County of Santa Barbara. As indicated in the report, NFPA 855 Section 4.8.2 allows the AHJ to approve outdoor ESS installations exceeding the amounts in Table 8, 600kWh, in outdoor installations based on a Hazard Mitigation Analysis in accordance with 4.1.4 and large scale fire testing in accordance with 4.1.5. Section 4.1.5 states that large scale fire testing in accordance with 4.1.5 shall be conducted on a representative ESS in accordance with UL9540A or equivalent test standard. Section 4.1.5.4 states that the test report shall be provided to the AHJ for review and approval. Per information provided in the report and in the response comments, the MegaPacks have not currently been tested per UL 9540A. Previous responses indicated that the Powerpacks are a representative ESS. The testing utilized was performed by DVNGL but does not specify the standards utilized for the	

	testing and the test data report was not provided for review to confirm the large scale fire testing. The project is seeking AHJ approval to locate these MegaPack units closer than 100 ft to exposures for the Megapack system which currently has not been UL9540A tested.	
Rec 5 Additional compliance requirements outlined in the provisions of NFPA 855, 2020 Edition, that need consideration within the recommended Hazard Mitigation Analysis include the following 4.4.3.6 Vegetation Control 4.3.8 Security of Installations 4.4.3.8 Access Roads 4.3.5* Signage 4.10 Smoke and Fire Detection: NFPA 855 4.13 Water Supply: NFPA 855 4.16 Remediation Measures: NFPA 855	A recommendation for a complete NFPA 855 audit has been added as a recommendation for completion prior to startup of the facility. Vegetation control is part of the project. This has been added as a recommendation Security is a part of the project design. This has been added as a recommendation. Access roads have been designed as per the local fire department requirements Signage requirements as per 855 have been added to the recommendations. Note that smoke detection is not required for outdoor facilities as per Section 4.10.1. Flammable gas and gas detection are included as recommendations. Water Supply requirements are part of the project design and are developed in consideration of local fire department requirements. Remediation measures, including authorized service personnel and fire mitigation personnel, are added to the recommendation listed. OK	Add audit recommendation.

PTrutner
Fire Protection Engineering Inc.

December 16, 2020

Attachment 8c

Ms. Kathy Allen
Supervising Senior Planner
Planning and Environmental Review Department
City of Goleta
130 Cremona Drive, Suite B
Goleta, CA 93117

Re: Risk Assessment Peer Review _ Rev. 3
Cortona Drive Energy Storage Project
6864 Cortona Drive, Goleta CA 93117

Dear Ms. Allen:
Per your request, we have reviewed the revised Risk Assessment for the Goleta Corona Drive Energy Storage Project, dated 09/21/2020, by MRS Environmental. The submitted Risk Assessment provided was reviewed in conjunction with all applicable codes and standards.

1. Per the requirements of the 2019 CFC, Section 1206.2.10.1, storage batteries and storage battery systems are required to be listed.

   1206.2.10.1 Listings. *Storage batteries and battery storage systems shall comply with the following:*
   1. Storage batteries shall be listed in accordance with UL 1973.
   2. Prepackaged and pre-engineered stationary storage battery systems shall be listed in accordance with UL 9540.

   The revised report provides UL1973 and UL9540 certification by TUV Rheinland, an OSHA Approved National Recognized Testing Laboratory (NRTL), based on large scale fire testing performed at Tesla's full-scale fire testing center as witnessed by TUV Rheinland.

   Comment: Provide complete full scale test report as part of the submittal. Provide documentation of the Megapack UL listing.

2. Under the test results section of the Fisher Engineering assessment, it is indicated that a maximum heat flux was measured between 38-43 minutes into the test.

   a. 20'-0 distance from the unit: 10.5-28.8 kW/m^2

   b. 30'-0 distance from the unit: 1.5-9.8 kW/m^2

As defined in the NFPA Fire Protection Handbook:
Heat Flux: *"The rate of heat transferred per unit area perpendicular to the direction of heat flow is referred to heat flux. Heat Flux is the measure for potential damage. For example, most combustibles ignite when exposed to a heat flux of 0.9-1.8 BTU/sec-ft^2 (10-20 kW / m^2)."*

Section 3.0 of the risk assessment includes Table 1 that specifies the distance from the battery cabinets to receptors.

Table 1 Distance to Receptors

Receptor	Distance to Battery Cabinets*, feet
Parking Area and M-Special Outside Areas	9
Proposed Apartments	50
M-Special Brewery building	80
Storke Road	92
6868 Cortona	197
6860 Cortona	253
Residences west of Storke	250
Hotel	477

* Distance to actual battery cells within cabinets.

As indicated, the distance is only 9'-0 to the parking area and the M-Special Outside areas and 50'-0 to the proposed apartments. There is potential for damage due to imposed heat flux.

The site plan provided in the assessment, Sheet A2.0, indicates an ornamental, metal, no climb fence to be provided at the perimeter of the site.

Comment: Providing a 4-hour rated wall of appropriate height at the north and east perimeter of the site could potentially mitigate damage to adjacent receptors due to the heat fluxes measured during the full-scale fire testing.

3. The risk assessment provides CANARY software modeling and AERMOD modeling as a basis for determining impact of toxic and flammable emission to receptors. Per Section 4.0, the CANARY model is designed to estimate thermodynamic properties of gas mixtures and estimate impact distance of thermal exposure, explosions, vapor clouds and toxic effects. AERMOD modeling considers meteorological data with the emission source as the point source to thoroughly assess the potential for offsite toxic impacts.

Comment: Full scale fire testing has now been performed as described in the Fisher Engineering Assessment. Smoke plume modeling should be performed incorporating the actual test data from the full-scale fire test to assess impact to receptors.

4. The Tesla emergency response guide recommends defensive firefighting measures only to protect neighboring units or exposures. The site plan provided does not show any hydrant locations.

   Comment: Recommend providing hydrant locations on the site plan for review.

5. The Fisher Engineering assessment references a Megapack Site Design Manual.

   Comment: The Megapack Site Plan Design Manual should be submitted for review to confirm manufacturer recommendations.

6. Goleta Energy Fire Water Discussion:
   The study indicates an estimated flow rate of 250-750 gpm. Fire Department response performing defensive firefighting measures (i.e., cooling adjacent units / exposures) would utilize an actual flow rate of 750 – 1500 gpm and potentially (2) engines responding. At a 4-hour duration, and at these flow rates, the total water applied would range from 360,000 gallons - 720,000 gallons. Note: The 4-hour duration is based on the duration of the full scale fire testing.

   Per the discussion document, the bioretention basin for the project can only hold approximately 28,000 gallons. All additional water would overflow into the storm drain system.

   The discussion states that the water that could enter the storm drain system would not have contaminates that would exceed those encountered at an industrial, commercial, or residential fire situation and is therefore considered to be within the range of normal fire water runoff from response situations.

   Comment: Further evaluation should be considered based on the potential contaminates from a fire event and the potential quantity of water indicated above.

Thank you for the opportunity to provide this review. Please call our office with any questions.

Sincerely,

Paul Trutner, F.P.E.
Fire Protection Engineer (FP-1934)

PTrutner
Fire Protection Engineering Inc.

03/03/2021

Attachment 8d

Ms. Kathy Allen
Supervising Senior Planner
Planning and Environmental Review Department
City of Goleta
130 Cremona Drive, Suite B
Goleta, CA 93117

Re: Risk Assessment Peer Review _ Rev. 4
Cortona Drive Energy Storage Project
6864 Cortona Drive, Goleta CA 93117

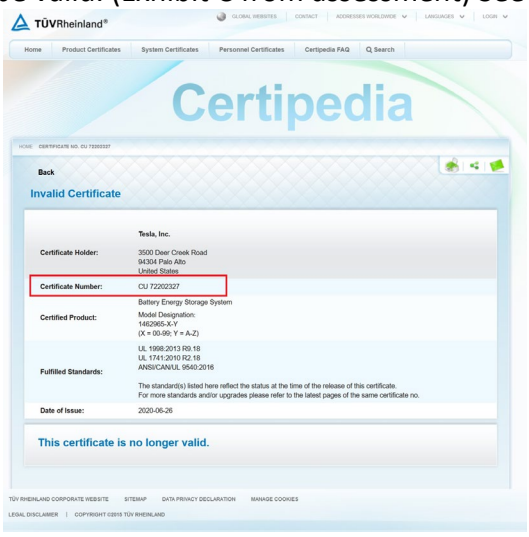
Dear Ms. Allen:
Per your request, we have reviewed the revised Risk Assessment for the Goleta Corona Drive Energy Storage Project, dated 01/21/2021, by MRS Environmental. The submitted Risk Assessment provided was reviewed in conjunction with all applicable codes and standards.

1. Per the requirements of the 2019 CFC, Section 1206.2.10.1, storage batteries and storage battery systems are required to be listed in accordance with UL 1973 and UL 9540.

   The revised report provides UL1973 and UL9540 certification by TUV Rheinland, an OSHA Approved National Recognized Testing Laboratory (NRTL), based on large scale fire testing performed at Tesla's full-scale fire testing center as witnessed by TUV Rheinland.

   - Per TUV Rheinland Website, the submitted certification, CU 72202325 is valid. (Exhibit B from assessment)

   - Per TUV Rheinland Website, the submitted certification, CU 72202327 does not appear to be valid. (Exhibit C from assessment) See below:



Comment:
Confirm validity of certificate provided.

2. Section 5.5 indicates that "heat flux impact to humans can generally be tolerated below 5 kw/m2 and below 10 kw/m2 if sufficient time to escape is feasible". Additionally, Table 8 indicates that emergency actions lasting several minutes can be performed without shielding with an incident heat flux of 4.7 kW /m2.

   Table 8: The impact of a 6.3 kW/m2 indicates that emergency actions lasting several minutes can be performed without shielding. However, the duration indicates 1 minute.

   Comment:
   Other sources, to include SFPE Handbook of Fire Protection Engineering and NIST Fire Dynamics, indicate pain to skin within seconds from a heat flux range of 3-5 kw/m2. Clarify.

3. The revised assessment indicates that although thermal impacts extend offsite, the installation complies with the required setback is 10'-0 to lot lines and public ways per NFPA 855 Section 4.4.3.3. This indicated setback is for installations near exposures and the maximum stored energy for an ESS near exposures is 600 kW. Reference NFPA 855 Tables 4.4.3 and 4.8.

   The Megapack exceeds this quantity and per the assessment, the project is seeking approval based on the hazard mitigation analysis and full-scale fire test results as permitted by NFPA 855 Section 4.8.2.

   The assessment indicates that a firewall along the perimeter of the site is feasible but not considered necessary for the following reasons:
   - The battery fire in the UL9540A tests took 38 minutes to develop, which, along with the detection systems proposed for the site, would allow for ample time to notify the fire department, and evacuate persons from the areas near the MegaPack installations.
   - The areas along the fence lines are protectable space, meaning the authorities would have access to these spaces for fire water applications and evacuations.
   - The intense fire period was of short duration (10 minutes) during the UL9540A tests during a 3.5-hour test including off gassing.
   - The areas immediately around the project site and within the 10 kw/m2 areas are all parking lots and do not include buildings or other structures, which could be subject to damage a higher thermal flux levels.

Comment:
As can be seen in Figure 3 of the assessment, thermal heat flux of 5 kW/m^2 will extend across the property line north toward the proposed apartment complex and east into the parking lot areas of M-Special Brewery with potential impact to receptors that would also include vegetation.

Additionally, there is no information regarding the site development proposed for the backside of the apartments adjacent to the Energy Storage Site that may be impacted by the thermal radiation.

With the thermal radiation extending across the property line to the north and into the parking lot areas to the east of the site, providing a 4-hour rated wall of appropriate height at the north and east perimeter of the site could potentially mitigate damage to adjacent receptors due to the heat fluxes measured during the full-scale fire testing and as calculated in the assessment.

It should be noted that in the TUV Rheinland test results, Section 9.8.1 Remark Item C, it states that these units are "not intended for installation near exposures". All feasible mitigation efforts should be made to reduce impacts to exposures.

4. Section 5.6 Combustion Products references the Fisher report for combustion product as part of the fire testing which includes low levels of carbon monoxide and carbon dioxide (83-680 ppm) and low levels of toxins (HF less than 1.0 ppm)

   Comment:
   Per the Fisher Engineering report, this data was obtained from module level testing, not full-scale fire testing. Clarify applicability of Figure 4 and provide narrative summary of results.

5. PDF page 36, Figure 8, appears to be out of sequence within the assessment. Revise.

6. The revised submittal does not include the Fisher Engineering UL 9540A Test Results attachment as submitted with the previous submittal.

   Comment:
   This document should be provided with the assessment as it is referenced in the assessment.

7. Exhibit A- 9540A Unit level Test Report:
   a. The test method requirements for Outdoor Ground Mounted units is detailed Section 9.3.
      - Section 9.3.1 indicates that outdoor ground mounted non-residential use BESS being evaluated for installation in close proximity to buildings shall

use the test method described in Section 9.2 for Indoor Floor Mounted BESS Units. The test results verdict indicates P (pass)

- Section 9.2 requires instrumented wall section with the walls representative of the intended installation.
- Section 9.2.14 indicates that separation distances shall be specified by the manufacturer for distance between the BESS and the instrumented wall section.

Comment:
Section 9.2 test results indicate N/A for the testing criteria outlined in Section 9.2 to include the requirement instrumented wall sections. It does not appear that the test data is applicable to the proposed installation.

Is there further testing planned for installation in close proximity to a structure as described in the test requirements where instrumented wall sections will be provided?

Are there any manufacturer recommendations on the separation distance between the Megapack and structures that can be provided? This information could not be found in the Tesla site design manual.

b. Based on Table 1. Test Results per Clause 9.7 as provided by TUV Rheinland, it is stated that gas generation and composition data, item q, and peak smoke release rate and total smoke release data, item r, are not applicable.

Comment:
The TUV Rheinland test results, Section 9.8.1 Remark Item C, states that these units are “not intended for installation near exposures”. Based on review of the test data, it appears the full-scale fire testing was for an installation in a remote location. There was no data with respect to gas generation / composition or smoke release rate / duration documented during the testing that could be utilized as part of the required hazard analysis. Clarify applicability of the provided full scale fire test data, as required by NFPA 855 Sections 4.8.2 and 4.1.5, with respect to the proposed installation.

8. Section 5.7 Fire Water Contamination:
   a. This section states that the water that would enter the storm drain system, would not have contaminants that would exceed those encountered at an industrial, commercial, or residential fire situation and is therefore considered to be with the range of normal fire water runoff from response situations.

Comment:
A response situation would be different at the proposed energy storage system site in that the response tactics would be defensive as recommended in the Tesla ERG. In a response to a commercial of residential fire, the typical fire department response would be to extinguish the fire. Runoff would flow into the storm drain for a longer duration at the proposed BESS site compared to a typical residential or commercial structure fire. As can be referenced in the test data, a Megapack fire could last up to 4-hours. Recommend further review.

b. Table 9 in the assessment outlines potential fire water contaminates that could be absorbed into the fire water. The contaminates are based on studies of residential and non-residential fire, based on a fire flow of 750 gpm, and assumes all of the off gassed pollutants are absorbed by the water. These values are then compared to the NPDES permit limits for instantaneous concentrations.

Comment:
Given the duration of a Megapack fire could last up to 4-hours, an increased release duration should be considered. Additionally, a 750 gpm fire flow would be the minimum that would be provided. Actual fire flow would be in the 1,500 gpm range. Recommend further review. Utilizing actual Megapack test data for contaminants is recommended.

Thank you for the opportunity to provide this review. Please call our office with any questions.

Sincerely,

Paul Trutner, F.P.E.
Fire Protection Engineer (FP-1934)