March 8, 2016

Mr. Eric Paulson
Senior Staff Facilities Engineer
Aera Energy LLC
10000 Ming Avenue
Bakersfield, CA 93311-1302

Re: Master Fire Protection Plan Summary Report, Revision 2
East Cat Canyon Development Project
Santa Barbara County, California

Dear Mr. Paulson:
Per your request, we have developed this master fire protection plan evaluation summary report to address recommendations for site fire protection systems based upon the drilling and development of oil and natural gas production at the proposed East Cat Canyon lease in Santa Barbara County.

The information in this report is based upon our understanding of the project through our review of the documentation provided by the Aera Energy LLC regarding the project and communications with Aera Energy LLC staff. Its intent is to provide recommendations for inclusion in a comprehensive site safety plan for the protection of the facility and to provide firefighting resources for responding emergency personnel.

This report is divided into the following sections:

I. Project Description
II. Site Description
III. Aera Energy’s Emergency Response Policy
IV. Fluid Classification
V. Fire Hazard Scenarios
VI. Prescriptive & Performance Based Code Requirements
VII. Calculation of Preliminary Water Storage Requirements
VIII. Summary Recommendations

The references utilized in this review are as follows:

- California Fire Code, 2013 Edition (CFC)
- API 2021, Management of Atmospheric Storage Tank Fires
- Santa Barbara County Fire Department Requirements
- Aera Energy Project Description Narratives, Attachment A
- Preliminary TJ Cross Progress Project Drawings
- Collings & Associates Master Fire Protection Site Plan, Sheets MFPP-1 through -5
I. Project Description

Per the information provided by Aera Energy LLC, the East Cat Canyon Oil Field Redevelopment Project will re-establish oil production in an existing oil field by implementing a thermal enhanced oil recovery process that is technically, economically, and environmentally feasible for oil recovery.

Project plans include construction and restoration of approximately 72 well pads, construction and restoration of over nine miles of field access roads, and drilling of up to 296 wells. Planned wells include oil/gas production wells, steam injection wells, observation wells, water production wells, water injection wells, and fresh groundwater wells.

New processing facilities and field systems will be constructed to support the production. Processing facilities will include:

1) A production group station for bulk separation of produced gas and liquids.

2) A central processing facility for oil cleaning, water cleaning, water softening, oil storage and oil sales.

3) A steam generation site (up to six once through steam generators rated at 85 million BTU/hour each) for production of saturated steam to be used for thermal enhanced oil recovery. An additional 62.5 MMBTU/hr steam generator will be used to generate steam from the project’s produced gas. No fresh water will be used to generate steam; only non-potable water will be used.

Field systems will include:

1) A production gathering network.

2) A steam distribution network.

3) Electrical power distribution and supervisory control and data acquisition (SCADA) networks.

Project infrastructure will also include an office building, a multipurpose building, a warehouse and maintenance building, and a facility control building. A fresh water system with a 3,000 barrel tank and water distribution pipelines is also planned for utility purposes including fire protection, lavatories, showers, equipment cleaning, dust control, and minor landscape irrigation.

The Project has been designed to minimize grading and land disturbance by maximizing the use of existing roads, well pads, cleared areas, and contours wherever possible. Out of the approximate total 2,108-acre Project site, approximately 300 acres, or 14 percent will be graded. Earthwork volumes will be balanced across the Project site in order to minimize the need for import or export of significant amounts of soil.
The primary Project site entrance is located at 6516 Cat Canyon Road. Vehicles and equipment entering the Project site travel across Cat Canyon Creek via an existing culvert crossing located just outside of the Aera Energy LLC property boundary. As proposed, the Project would utilize the existing crossing during the initial Project construction, while concurrently constructing a new Project site entrance located approximately 300 feet north (upstream) of the existing entrance. The Project will also include construction of a secondary access located along Long Canyon Road, on the eastern boundary of the Project site along with two smaller east side entrances from Long Canyon Road, which will be constructed to provide adequate access new well pads. Project site entrances will be connected via a primary site access road, which will be graded and paved concurrently with site entrance construction activities.

The Project will be implemented in phases to maximize efficiency and help moderate construction peak activity levels. Phase I will include the construction of the production group station, central processing facility, steam generation site, fresh water distribution system, office building, main roadways and a beneficial reuse facility for soil and sand. Four of the seven steam generators will be installed. Some of the project’s well pads and wells will be restored/developed during Phase I, along with the roadways, electrical distribution lines, and gathering and distribution pipelines to support those wells. Phase I activities will last approximately four years.

During Phase II, the remaining well pads will be restored/developed, the new wells will be drilled, along with the construction of associated roadways, electrical distribution lines, and gathering and distribution pipelines. Phase II will also expand the processing facility capacities, and add three additional steam generators. Phase II construction will start approximately three years after Phase I completion and is expected to take up to two years. Phase II well drilling, along with the construction of roadways, electrical distribution lines, and gathering and distribution pipelines to support those wells, is planned to take place over a period of up to ten years. Production from the project is expected to continue for more than 30 years.

The Central Processing Facility (CPF) will consist of storage tanks, produced fluids separation equipment, support facilities and truck loading facilities. The CPF will be designed to separate and condition crude oil, water and natural gas. Pipelines will be constructed to process and transport crude oil and natural gas to commercial sales points via pipeline installations. Produced water will be separated from the crude oil and re-injected back into the producing zone where it was produced from via water injection wells. The associated produced natural gas will be consumed on site and used to fuel the steam generators, or flared if the generators are off line.

A permanent truck loading facility will be constructed to allow the sales oil to be trucked from the project site. In addition, an office building, a warehouse, an employee parking lot, fire protection systems, fencing and safety systems and other ancillary facilities will be constructed at the project site to support the oil and gas recovery facilities.
II. Site & Process Description

The detailed site information, including full site maps, topo maps, property lines, general layout and legal descriptions are not included within this report to avoid redundancy, but can be found in the Aera Energy LLC Oil and Gas Drilling/Production Plan Permit Application (Section 2.0 - Project Description).

As a supplemental reference to this report, a general fire protection master site plan drawing package has been developed by our firm to illustrate the fire protection requirements and resources described in this evaluation. Sheets MFPP-1 through 5 include an overall site plan with well sites, access roads and the planned facility areas. The drawing package also includes enlarged areas of the Central Process Facility, Steam Generator Site and the office building site.

Access to the project field site will be controlled at the two main entrances (from Cat Canyon Road and from Long Canyon Road) with electric rollaway, key pad operated gates. The gates will allow fire department emergency entrance utilizing Knox box units and will likely include continuous video surveillance. The CPF will be fenced and access to process areas will be controlled. The truck loading and unloading area will not be within this fence; its access will be controlled at the field entrances only. Entrance to the CPF process areas will be controlled by key pad electric gates. CPF entrance will likely require sign-in at the CPF control building.

The East Cat Canyon (ECC) oil cleaning plant (OCP) will receive gross oil production from a centralized production group station (GS). The GS will include vapor liquid separation equipment. The GS will be located adjacent to the field steam generation site (SGS).

Gross production leaving the GS facility will flow through two (2) production pipelines to the OCP into two (2) parallel treating trains. The OCP will be located in the CPF. One treating train and pipeline will be constructed during the first production development phase, and a second train and pipeline will be added during the second production development phase.

Per reservoir modeling forecasts, the gravity of the ultra-heavy bituminous EEC produced oil is expected to be about 9.0 API during the early years of the first production phase, and the oil gravity is expected to increase to around 7.6 API, during the later production years. To treat the ultra-heavy production, light crude oil (LCO) will be blended with the heavy produced oil entering each treating train to produce treatable oil having a target gravity of 12 API.

After LCO blending, the blended production to each train will undergo de-sanding. The degassing vessels will include de-sanding units to remove oily solids that will deposit in the degassing vessels. Produced gas will be treated in the SGTP. The treated gas will be used as supplemental fuel for the produced gas steam generator (PGSG). The oily solids from the vessels will be treated in the solids concentrating plant (SCP) to recover any residual oil from the oily solids.

Following desanding, the LCO blended production will undergo further dehydration in FVKO vessels. Gas from the FVKO vessels will be mixed with the degasser produced gas and treated in the SGTP. Produced water from the FVKO vessels will go to the clarifier tanks at the inlet of the water cleaning plant (WCP). The FVKO vessels will have de-sanding units that will transfer FVKO oily solids to the SCP for residual oil recovery. After primary
dehydration, emulsion from the FWKO vessels will be de-hydrated to sales oil specifications in electrostatic coalescer vessels.

The hot sales oil and produced water from the FWKO and coalescer outlets will be used as part of the plant heat integration system to heat softened produced water prior to steam generation. The coalescer heating system will be sized for cold startup situations.

The sales oil and produced water from the OCP will require further cooling upstream of the respective tanks that the streams go to. These streams will be cooled by fin-fan type heat exchangers. The crude oil coolers will be part of the crude oil storage (COS) plant equipment, and the produced water coolers will be part of the OCP equipment.

Detailed production and process descriptions planned for the site are not included within this report to avoid redundancy. A description of the planned oil production and subsequent processing is included in Attachment A of this report which was used as the basis of the fire protection recommendations included in this report.

The principal fire protection hazards in terms of potential fire size would be located at the COS at the crude and light oil storage tanks, due to quantities of flammable/combustible liquids to be stored in those tanks. The proposed tank summary is as follows:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Tag Number</th>
<th>Description</th>
<th>Plant</th>
<th>Capacity</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>1040</td>
<td>FWKO</td>
<td>OCP</td>
<td>18,000 BPD</td>
<td>12'-0&quot; DIA x 60'-0&quot; S/S</td>
</tr>
<tr>
<td>V</td>
<td>1060</td>
<td>Electrostatic Coalescer</td>
<td>OCP</td>
<td>6,000 BPD</td>
<td>12'-0&quot; DIA x 60'-0&quot; S/S</td>
</tr>
<tr>
<td>V</td>
<td>1070</td>
<td>Scrubber</td>
<td>OCP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>1220</td>
<td>Desanding Vessel</td>
<td>OCP</td>
<td>18,000 BPD</td>
<td>8'-0&quot; DIA x 16'-0&quot; S/S</td>
</tr>
<tr>
<td>V</td>
<td>1230</td>
<td>Desanding Vessel</td>
<td>OCP</td>
<td>18,000 BPD</td>
<td>8'-0&quot; DIA x 16'-0&quot; S/S</td>
</tr>
<tr>
<td>V</td>
<td>1240</td>
<td>FWKO</td>
<td>OCP</td>
<td>18,000 BPD</td>
<td>12'-0&quot; DIA x 60'-0&quot; S/S</td>
</tr>
<tr>
<td>V</td>
<td>1260</td>
<td>Electrostatic Coalescer</td>
<td>OCP</td>
<td>6,000 BPD</td>
<td>12'-0&quot; DIA x 60'-0&quot; S/S</td>
</tr>
<tr>
<td>V</td>
<td>1270</td>
<td>Scrubber</td>
<td>OCP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>2040</td>
<td>Tank</td>
<td>LOS</td>
<td>6,500 BBL</td>
<td>44'-0&quot; DIA x 24'-0&quot; H</td>
</tr>
<tr>
<td>T</td>
<td>2050</td>
<td>Tank</td>
<td>LOS</td>
<td>6,500 BBL</td>
<td>44'-0&quot; DIA x 24'-0&quot; H</td>
</tr>
<tr>
<td>T</td>
<td>2170</td>
<td>Tank</td>
<td>COS</td>
<td>10,000 BBL</td>
<td>55'-0&quot; DIA x 24'-0&quot; H</td>
</tr>
<tr>
<td>T</td>
<td>2180</td>
<td>Tank</td>
<td>COS</td>
<td>10,000 BBL</td>
<td>55'-0&quot; DIA x 24'-0&quot; H</td>
</tr>
<tr>
<td>T</td>
<td>7030</td>
<td>Sludge Tank</td>
<td>SCP</td>
<td>1,500 gpm</td>
<td>24'-0&quot; DIA x 36'-0&quot; (6'-0&quot; Cone)</td>
</tr>
<tr>
<td>T</td>
<td>7070</td>
<td>Skim Oil Tank</td>
<td>SCP</td>
<td>1,000 BBL</td>
<td>21'-6&quot; DIA x 16'-0&quot;</td>
</tr>
<tr>
<td>T</td>
<td>7140</td>
<td>Sludge Tank</td>
<td>SCP</td>
<td>1,500 gpm</td>
<td>24'-0&quot; DIA x 36'-0&quot; (6'-0&quot; Cone)</td>
</tr>
<tr>
<td>T</td>
<td>7180</td>
<td>Skim Oil Tank</td>
<td>SCP</td>
<td>1,000 BBL</td>
<td>21'-6&quot; DIA x 16'-0&quot;</td>
</tr>
<tr>
<td>V</td>
<td>7340</td>
<td>Electrostatic Coalescer</td>
<td>SCP</td>
<td>6,000 BPD</td>
<td>12'-0&quot; DIA x 60'-0&quot; (OAL)</td>
</tr>
<tr>
<td>V</td>
<td>9560</td>
<td>Tank</td>
<td>CPP</td>
<td>100 BBL</td>
<td>6'-0&quot; DIA x 20'-0&quot; S/S</td>
</tr>
<tr>
<td>V</td>
<td>9600</td>
<td>Tank</td>
<td>CPP</td>
<td>100 BBL</td>
<td>6'-0&quot; DIA x 20'-0&quot; S/S</td>
</tr>
</tbody>
</table>

Tanks T-2040, T-2050, T-2170 and T-2180 represent the oil storage tanks in contained areas within the CPF (reference C&A Sheet MFPP-3). The tanks are to be located within subdivided
masonry containment areas, that in turn drain to a remote impound area containment basin at the CPF. The containment basin has a volumetric capacity of 3,181 cubic yards (15,300 bbl) and is designed for 1.5 times the largest tank volume. Vapor recovery systems will be installed for these tanks in accordance with AB 1960, with backup compressors and electrical power.

The remaining process equipment, tanks (water treatment), heater treaters, etc., are indicated in detail in the TJ Cross Engineers design documents and listed in referenced spread sheets.

III. Aera Energy’s Emergency Response Policy

Aera Energy’s fire protection priorities are, in order of importance:

1. Life safety
2. Environmental protection
3. Asset protection

Aera Energy employs a policy of fire prevention through proper design, equipment/process maintenance and strict safety procedures to protect life, the environment and assets. These include the following:

1. Prevention through design, safe practices and standard operating procedures
2. Immediate reporting of a fire incident to supervision
3. Fire department notification
4. Isolation of the fuel supply to a fire incident
5. Emergency process shut down procedures
6. Limited personnel firefighting (utilizing fire extinguishers or portable units), trained for incipient fire-fighting incidents
7. Coordination and support for responding local fire department agencies

Aera Energy LLC has an established Code of Safe Practices, which includes a section focused on fire prevention. Section 12 of the Aera Energy Program’s Code of Safe Practices includes guidelines for employees for the prevention, control and reporting of fire incidents. Subsection 12.3 of the Code of Safe Practices includes the following instructions for reporting fires:

12.3 Fire

1. Report fires to your supervisor right away. Report it directly to the fire department or follow local rules if your supervisor is not available.
2. Give the fire department the information below and stay on the line until the fire department tells you to hang up!
   • Your name, company, and purpose of your call,
   • Exact location of the fire,
   • Brief description of the type of fire (e.g., brush, well, or tank fire)
   • Your phone number if you are using a phone,
   • Location where someone will meet the fire department, and name of the person who will meet them. In remote areas, someone may have to lead them to the fire.
3. Stay out of the way when the fire department comes. Be ready to help if needed (if you have the right training and authorization).
4. Try to put out the fire if you have the proper equipment and know how to use it. Never put yourself at risk to fight a fire!
IV. Fluid Classifications:

As stated above, principal fire protection hazards in terms of potential fire size would be located at the CPF at the crude and light oil storage tanks due to quantities of flammable/combustible liquids to be stored in those tanks. Combustible liquids that are heated and/or maintained at temperatures exceeding their flash point can present fire protection challenges equivalent to flammable liquids.

The NFPA flammable and combustible liquid classifications for the produced fluids will be based upon the closed cup flash point data as provided by Aera Energy LLC for the anticipated crude oil produced at the lease, and also for the blend oil to be transported, stored and utilized at the CPF.

Per Aera Energy transmittals, the anticipated gravity of the crude oil to be produced from the formations will be approximately 7 to 9 API. The results of laboratory flashpoint analysis for the produced crude oil (from core samples) were above reporting limits. Consequently, the flash point of the produced crude oil will not be exceeded until the produced crude is blended with the light crude oil.

The light oil to be brought to the site for blending purposes will be approximately 29 API degrees with an anticipated flash point of less than 40 F. The final blended oil product will be approximately 12 API blend at anticipated flash point exceeding 350 F.

Combustible liquids that are heated and/or maintained at temperatures exceeding their flash point can present fire protection challenges equivalent to flammable liquids.

With respect to the process flow description and locations where crude oil flash points would be exceeded, per Aera Energy:

*As previously transmitted, the flash point for light crude oil is expected to be <40F. Consequently, this material will be above flash point where present in the process (receiving, storage and pre-blend pump and piping). Flash point for 12 API blend is expected to be >350F. Since we do not have process temperatures expected to exceed 300F, flash point will not be exceeded anywhere in the CPF, loading or transport for the blend. Flash point for native resource was not measureable and consequently will not be exceeded from well bores through gathering up to blending with LCO at the CPF.*
V. Fire Hazard Scenarios

A. Central Processing Facility:

The primary fire hazards requiring in-place fire protection resources will be at the proposed Central Processing Facility. In order to provide a performance based fire protection approach for the site, a risk assessment of the potential tank fire scenarios should be determined. The largest fire scenario incident would be based upon a failure in the crude oil storage tanks. The following Table (derived from API 2021) lists different types of tank fires which could be encountered based upon the fixed cone roof tanks proposed to be installed within the storage tank containment area:

The scenarios listed in the table assume an upset condition of the facility safeguards or an act of nature.

<table>
<thead>
<tr>
<th>Fire Scenario</th>
<th>Potential Cause of Ignition</th>
<th>Resultant Fire</th>
<th>Recommended Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank Vent Fire</td>
<td>Lightning, Static Electricity, Hot Work</td>
<td>Small fire which can usually be extinguished with minimal damage and low risk to personnel</td>
<td>Extinguish fire by using dry chemical fire extinguishers or by reducing pressure in the tank</td>
</tr>
<tr>
<td>Leakage or Overfill Ground Fire</td>
<td>Open flame, Hot Work, Static Electricity, Lightning, Sparks</td>
<td>Liquids should be contained within diked area with potential for pool fire within containment area</td>
<td>Exposure protection (water cooling) for crude oil storage tanks should be first priority. Fire suppression of dike area with foam is second priority</td>
</tr>
<tr>
<td>Unobstructed full liquid surface area fire</td>
<td>Lightning, Static Electricity</td>
<td>Full surface area of tank will be involved. Unobstructed would assume the roof has separated from tank at the frangible seam joint and the surface is open to atmosphere</td>
<td>Suppression effort should focus on topside application of a compatible foam</td>
</tr>
<tr>
<td>Obstructed full liquid surface area fire</td>
<td>Lightning, Static Electricity</td>
<td>Partial or full surface area of tank may be involved. Obstructed assumes a portion of the roof is obstructing some of the burning surface area</td>
<td>Suppression effort should focus on topside application of a compatible foam with the potential for a greater amount required due to obstruction</td>
</tr>
</tbody>
</table>

Based upon the scenarios listed in Table 1, in the event of a fire, a fire suppression strategy would be evaluated and selected for the appropriate scenario. Referring to API 2021, Section 6.6, three general strategies may be used for tank fires, including “passive, defensive or offensive” strategies.
A passive strategy involves no firefighting activity, and allows the fire to burn out and the area evacuated for personnel safety. This philosophy would be applied in scenarios involving the potential boilover of a crude oil tank. Locations where passive fire protection may be adopted include “remote storage facilities and facilities without adequate water supply.” Aera Energy accepts a passive strategy in accordance with the fire protection priorities of life safety and environmental protection followed by asset protection.

A defensive strategy “protects personnel and exposed equipment and allows the fire to burn out.” Examples of defensive strategy situations include large diameter full liquid surface fires with no boilover potential.

An offensive strategy is an aggressive attempt to extinguish tank fires. An offensive strategy is considered to support rescue when life is endangered, when exposure dangers exist to adjacent facilities, and when adequate resources are available within acceptable time frames and a reasonable probability to extinguish a fire. Examples of situations that may be appropriate for these strategies are vent fires, ground fires, and unobstructed full liquid surface fires in small to medium diameter tanks.

In addition to tank fires, the potential for smaller localized fires at the CPF will be present in the oil dehydration equipment locations. Although rare, the potential for localized ground fires due to spills and subsequent vapor ignition from heat sources is possible.

The Santa Barbara County Fire Department’s typical policy requires the resources on site to provide an offensive firefighting strategy in the event of a fire incident at the tank battery. The SBCFD is requiring a fixed water supply and pressurized fire hydrants at the CPF and tank battery for firefighting in the event of a fire incident. Although Aera Energy believes in a passive strategy, the facility will be designed in accordance with SBCFD typical policy requirements for the option to respond to a fire incident if they choose to do so once on site.

In the event of a full surface tank fire or ground fire within a containment area, fire suppression tactics will most likely consist of the following:

- The initial attack response will likely be four Type 2 fire engines with 500 gallons of water and 10 gallons of Class B Foam on each plus one water tender with 2500 gallons of water. The total will be 4500 gallons of water and 40 gallons of foam on scene within 15 to 30 minutes. In addition, a second alarm can provide an additional 4 type 2 engines and additional water tender, which would double the aforementioned water and foam within 10-30 minutes of request by the incident commander. (This information has been provided by SBCFD)

- Mutual aid response from neighboring communities is available if necessary.

- Application of AFFF foam solution over small containment areas and liquid surface areas of a full surface tank fires. Foam will be applied using fixed monitors or fire department hand-lines with foam nozzles attached.

- Application of cooling water to adjacent tanks and equipment as necessary, from both pressurized hydrant supplies using hand lines, or from the fixed monitors from the pressurized water supply system.
B. Steam Generating Site:

Six pre-fabricated, “Once Through Steam Generator” (OTSG) units will be installed at the Steam Generator Site (SGS) as shown on C&A Sheets MFPP-1 and MFPP-4. An additional 62.5 MMBTU/hr steam generator will be used to generate steam from the project’s produced gas. These units will provide steam for continuous pattern injection and to cyclic steam stimulation (CSS) in the formation. CSS is used initially for production wells to develop early reservoir heat around producers, to provide void space for steam pattern development and to assist early resource production. A detailed description of the proposed OTGS installation and equipment is found in Attachment A of the Appendix.

The natural gas fired OTGS units are essentially non-combustible in general construction, and are located on a dedicated site pad indicated on Sheet MFPP-1. Natural gas fuel for steam generation will be obtained with new pipeline connection to Southern California Gas Company (SCG). A new 8-inch fuel line will be installed from the arriving location for SCG at the CPP to the SGS. The fuel gas may be preheated prior to pressure reduction in order to improve process thermal efficiency and to avoid hydrate formation during cold weather. A fuel gas scrubber, nominally operating at 100 psig will be provided to capture any free liquids.

Each OTSG will be provided with a programmable logic controller (PLC) and flame management system for process control, combustion control, and combustion safety. These controls will be located on each OTSG skid. An additional PLC will be provided to control of the balance of plant equipment. Operating data and alarms will be available on the field Local Area Network (LAN) in real time and on Aera’s Wide Area Network (WAN). A prefabricated communications building will house the balance of plant PLC and communications equipment.

The principal process hazard at this location would likely involve a gas fuel supply or burner failure at one or more units, resulting in a continuous natural gas fueled fire. With very limited combustible components and recommended brush clearances and vegetation management, emergency shutdown of the natural gas fuel supply to the entire OTGS site would be the obvious fire protection control scenario. This would be expected to be accomplished by two local emergency shutdown stations (ESD) with a remotely actuated location on the main gas supply line to the SGS as well.

Per Aera Energy’s current design documentation, automated shut-down valves will be provided on the fuel gas supply system at:

1) The point of receipt from So. Cal. Gas in the CPF area
2) The inlet to central fuel gas scrubber on the Steam Generation Site (SGS)
3) On each OTSG as part of the burner management system

With the expedient shutoff of the gas fuel supply, we would expect the risk of a continuing fire to be removed due to the non-combustible construction of the OTGS equipment. A fire protection water supply at the SGS would not be generally required. Localized fire protection for small incipient fires would be addressed through the use of fire extinguishers provided at the site and on personnel vehicles.
C. Office, Control and Warehouse Buildings:

The office, control and warehouse buildings present the usual types of fire hazards and risks associated with these types of general occupancies. The risks would be mitigated by proper code compliant construction and safe operations within the facilities. Monitored, automatic wet fire sprinkler systems will be installed to control an interior fire and to automatically communicate a system activation to the SBCFD.

VI. Prescriptive & Performance Based Code Requirements:

CFC Section 5704.2.9.2 requires aboveground storage tanks holding flammable or combustible liquids (other than pressure tanks operating at or above 1 psig) to be protected by foam fire protection when required by the fire code official when a tank or group of tanks placed less than 50 feet apart measured shell to shell, has a liquid surface area in excess of 1,500 sf and is in accordance with one of the following criteria:

- Used for the storage of Class I or Class II liquids.
- Used for the storage of Crude Oil.
- Used for in-process products and is located within 100 feet of a fire still, heater, related processing apparatus or similar device at a processing plant as here defined.
- Considered by fire code official as posing an unusual exposure hazard because of topographical conditions, the nature of the occupancy, character of the liquids stored and the facilities of the fire department to cope with flammable liquid fires.

At this time, the CPF design includes two blended oil stock tanks and two light crude oil storage tanks, located in the CPF and indicated on C&A Sheet MFPP-3. The tanks all exceed 1,500 sf in area, and are within 50 feet of each other between shells. Per the CFC and SBCFD requirements, this area would require foam fire protection.

The tanks are within a common primary containment area, but have drain lines to a secondary containment remote impound area also indicated on C&A Sheet MFPP-3. The design intent is for the drain lines to be sized adequately to conduct a primary tank contents release away from the tanks and into the remote impound area.

NFPA recognizes two types of secondary containment structures. One type is a diked area that surrounds the existing tanks. The other is a remote impoundment area in which the liquid is drained into a pond area away from the tank field. Remote impounding is an acceptable secondary containment method under NFPA 30 because the code primarily focuses on fire safety and emphasizes the importance of moving leaked or spilled flammable liquids away from the tank by adequate draining. A remote impoundment must be able to contain the contents of the largest tank.

Section 7-22 of the 20th edition of the NFPA Handbook recognizes that remote impound areas are an acceptable fire protection method when an area can be created and states “divert spillage away from all tanks and into an impounding basin where the liquid could burn safely without exposing other tanks, property or water ways.”
Section 22.11.1 of the 2010 edition of NFPA 30 delineates the requirements for a remote impound containment system, which must include the following:

- Constructed so that spills cannot collect around tanks
- Drainage route shall have a minimum slope of 1% away from the tank for at least 50 feet toward the impound area
- Impounding area must be able to contain the maximum contents of the largest tank
- The drainage route shall be located so that if the liquid in the drainage system is ignited, the fire will not seriously expose tanks or adjoining property
- The impound area shall be located such that contained liquid will not be within 50 feet from any property line that is or can be built upon, or from any tank.

Fixed fire protection systems are not required for remote impound areas, when designed and constructed in accordance with the provisions of NFPA 30.

VII. Calculation of Preliminary Water Storage Requirements:

A. Central Processing Facility:

Based upon the above scenarios, pressurized fire protection water supplies would be required to support the CPF storage tanks for both cooling, extinguishment and foam system application. The provisions of NFPA 11, Low, Medium, and High Expansion Foam would be utilized to establish the required foam firefighting system requirements. The following application rates and discharge times would apply to the identified fire scenario along with the required amount of foam concentrate and water:

1. Tank Liquid Surface Area Fire

   ✤ .16 gpm/s.f. for 65 minutes (Largest Crude Oil Storage Tank)

   ✤ Foam Monitor Application of 3% AFFF solution to containment area: (Foam solution application by foam monitors)

   ✤ Based upon the largest tanks (T-2170 and T-2180, 10,000 bbl, 55’-0” diameter x 24’-0” height):
     3% AFFF Solution Flow Rate: 380 gpm
     Minimum Required Water Storage: 24,710 gallons
     (65 Minute Duration)
     Minimum Required AFFF Concentrate: 741 gallons

2. Ground Fire in Remote Impound Containment Area

   ✤ Foam fire protection system resources not required by NFPA.
3. **Cooling Water for the Largest Un-involved Tanks (API RP 2030 Sec. 7.3.13)**

   - .10 gpm/s.f. for 65 minutes (Worst case assumption, assume full surface areas cooling of tanks)
   
   - Total water required, based upon cooling two largest adjacent tanks:
     
     **Minimum Flow Rate:** 840 gpm x Duration (65 minutes)
     
     **Minimum Required Water Storage:** 53,900 gallons of water
     
     (65 Minute Duration)

**B. Office, Control, Shop and Warehouse Buildings:**

Per the provisions of NFPA 13, the warehouse and shop area occupancies represent the highest fire sprinkler hazard category of the proposed buildings. We would anticipate an Ordinary Hazard Group 2 fire sprinkler system basis of design to be required for these buildings.

Based upon the requirements of the 2013 edition NFPA 13, the minimum design discharge density for these areas will be .20 gpm/sf over a minimum 1,500 sf design area. The fire sprinkler system design area is also required to be increased by an additional 30% for ceiling pitches exceeding 2:12 pitch. The expected maximum sprinkler demand will be approximately 507 gpm which includes a 30% design cushion. Additional combined hose stream demand would be 250 gpm based upon an Ordinary Hazard Group II requirement.

Two sets of fire flow storage calculations are permitted by the NFPA 13, both of which are contingent upon the installation of a central station fire alarm system. An un-monitored system requires a 90 minute fire flow water storage, and a monitored system requires a 60 minute duration. If the sprinkler system is monitored by a central station alarm firm, it is anticipated that the local fire department will be quickly notified in the event of a fire and be able to attack the fire at an earlier stage of fire growth. A monitored fire sprinkler system will be required to be installed for the proposed buildings, allowing the 60 minute duration calculation.

Assuming a combined fire sprinkler system/hose stream discharge demand of 757 gpm for the described scenario for a 60 minute duration (reference 2013 NFPA 13, Table 11.2.3.1.2), a minimum of 45,600 gallons of stored fire protection water would be required for the buildings’ fire sprinkler systems.

**C. Fire Protection Water Supply Requirements Summary:**

In summary, the above calculations for the water required for fire suppression efforts would be based upon the most demanding condition of a full tank liquid surface area fire and cooling water for exposure protection of adjacent uninvolved tanks. The calculated storage requirements for this condition exceed the building fire sprinkler requirements. Based upon the above, our recommendations for the dedicated on-site fire water storage are as follows:

**Minimum Recommended Fire Protection Water Storage:** 76,500 gallons

(This is addition to domestic and process stored water)
Water would be delivered to the required site locations from a new dedicated fire protection piping system connected to an elevated 3,000 BBL (126,000 gallon) on-site water tank. New 8” dedicated fire service piping would be connected to the water tank, which would be routed to an 8” fire loop serving the CPF and the site buildings (see C&A Sheets MFPP-1 through -5). The loop would provide pressurized water delivery to the following:

- Site Hydrants
- Fire Protection Monitors
- Building Fire Sprinkler Systems.

VIII. Summary Recommendations

The following recommendations are focused upon providing a readily available water supply, AFFF foam concentrate supply and firefighting resources for emergency responders in the event of a fire emergency at the lower tank battery. The following recommendations are not intended as a substitute for or to preclude safe operating procedures, proper equipment maintenance or code compliant operation of electrical equipment in hazardous areas.

Section 5706.3 of Article 57, Flammable and Combustible Liquids, of the CFC contains specific requirements for the drilling, operation and maintenance of oil and natural gas wells. This section specifically addresses well and equipment locations, clearances, sumps, storage tanks, signs, and other related provisions. The provisions of this section will apply to the proposed drilling operations including ignition source control, signage, waste control, blowout prevention and field loading racks.

Based upon the above summary analysis, our recommendations for the lower tank battery include the following (see Collings & Associates, Sheets MFPP-1 through -5 for corresponding descriptions and locations):

1. The CPF area would be provided with a dedicated fire protection system which would include the following:
   - Dedicated fire water storage (tank) supply
   - Nine (9) new SBCFD compliant fire hydrant connections
   - Five (5) new fixed monitors with eductors to be installed to apply either water or 3% AFFF foam solutions to the tanks and loading rack areas, with a single 265 gallon AFFF concentrate tote located adjacent to each monitor, with weatherproof coverings. This would provide a minimum fixed on-site 1,060 gallon bulk supply of AFFF foam concentrate maintained at the monitor locations indicated on the attached drawings.

2. We recommend a minimum of 76,500 gallons of dedicated fire protection water storage for this proposed project. We recommend the following to be implemented:
   - The tank is to be provided with automatic fill capability and sight gages
   - The tank is to be equipped with low level fill controls and low level notification, arranged to maintain the required minimum water storage supply at all times.
3. The CPF hydrants and monitors will be hard piped and supplied by a new 8” dedicated fire service water supply line/looped system serving the site. The piping sizes and suggested routes are indicated on C&A Sheets MFPP-1 through -5, and are to be installed in accordance with NFPA Standards 13 and 24.

4. The pressurized hydrant piping system would include new hydrants as indicated on Sheets MFPP-1 through -5. The new hydrants shall contain one 4-inch outlet and two 2 ½-inch outlets and shall be spaced not to exceed 500-foot intervals (300 feet in noted areas near buildings), and to be in accordance with SBCFD standards. Minimum fire flow will be 750 gpm.

5. The application of the foam solution shall be accomplished by on-site foam delivery systems. We recommend the installation of five fixed master water/foam monitors with self-educing nozzles, to provide firefighting resources for a tank surface area fire, for containment area fires, loading rack area fire, for the application of cooling water, and for the extinguishments of minor spill fires. The fixed master foam monitors (Ansul Model 427469 Monitor & Ansul Model 427461 Self-Educting Master Foam Nozzle, or approved equivalent) would utilize AFFF foam concentrate totes at their individual locations. We recommend providing a minimum of one 265 gallon tote or the equivalent amount in 55 gallon protected drums at each master foam monitor. SBCFD personnel will also be able to utilize their normal truck foam supplies with the monitors. Each of the new foam monitors will be capable of providing up to 170 feet of total throw based on a 500 gpm water supply at 100 psi, and a 30’ high vertical throw with at a 140’ range. The nozzles are user adjustable between a 120° wide fog and a straight stream.

6. The existing emergency access roads must meet SBCFD requirements, including the following:
   - Primary fire access roads to be 24 feet in width and 13’-6” vertical clearance, minimum.
   - Secondary fire access roads to be 20 feet in width and 13’-6” vertical clearance, minimum.
   - Fire lanes shall be provided as set forth in CFC Section 902.
   - Fire access to be provided within 150 feet of outside building perimeter.
   - Fire access road to be able to support 40,000 pound emergency vehicles.
   - Install Knox box with proper access at the main entrance gate as required by SBCFD standards.

7. Brush and vegetation clearance must be maintained in accordance SBCFD Standard 6, which specifies that clearances must be as follows:
   - Ground areas must be kept free of weeds, trash and other combustible materials
   - Remove vegetation within 10 feet from power poles
   - Remove flammable vegetation within 10 feet from roads, or reduce to a maximum of 4” stubble height.
• Remove vegetation within 30 feet from structures, tanks and containment areas (exception: vegetation less than 18” in height above the ground need not be removed where necessary to stabilize the soil and prevent erosion.)

Exceptions:
(a) If protected species vegetation occurs within the clearance areas noted above, then Aera shall coordinate with a County approved biologist, Aera and the SBCFD is to ensure that disturbance to protected species is minimized to the extent possible.
(b) If specific site conditions prevent the implementation of the above clearances, location specific coordination between Aera and the SBCFD is to take place to address these areas.

8. With regard to the truck loading rack station, operational compliance with CFC Section 3406.5 must be confirmed regarding the transfer of crude oil from the shipping tank to the tanker trucks. Most of the compliance requirements involve the prevention of overflow and spills, with related requirements concerning the avoidance of static charges through appropriate grounding.

9. Electrical grounding or bonding must be provided in accordance with sections 6.5.4.1 through 6.5.4.5 of NFPA 30. This will apply to all tanks and associated piping at the site.

10. A means to quickly shut down the facility in the event of an emergency shall be provided. Emergency operations procedures (EOP) shall be developed and provided to the SBCFD for inclusion in their emergency response plans.

11. Provide accessible, well-labeled emergency gas line shutoff valves on supply lines to all gas fired equipment at the site.

12. Portable Fire Extinguishers with a minimum rating of 20-A:B:C shall be provided where required by SBCFD, at a maximum of 75’ between extinguisher locations. Extinguishers mounted on trucks may be approved in lieu of fixed locations if approved by the SBCFD in site specific locations.

13. Provide premises identification at the main gate entrance to the facility in accordance with SBCFD Standard 2. Provide site MSDS sheets in secure box or container at main gate entrance for SBCFD use in an emergency condition.

14. All new tanks holding hazardous, toxic, flammable or combustible liquids are to be provided with NFPA 704 identification, with markings located where they can be readily seen by the SBCFD on approach from fire department access roads.

15. Install new NFPA 13 compliant monitored fire sprinkler systems in the control, warehouse, shop and office buildings.

16. A fire sprinkler fire alarm monitoring system, which has central station water flow alarm monitoring service, must be installed and maintained for automatic fire department notification in the event of flow switch activation for all buildings.
17. The steam generator site is to be provided with portable fire extinguishers in accordance with CFC and SBCFD requirements. A fixed fire protection water supply will not be required at this location. Local and remote emergency shutdown of the natural gas fuel supply to the entire OTSG site will be required and accomplished by two local emergency shutdown stations (ESD) in addition to a remotely actuated location on the main gas supply line to the SGS.

18. A pre-incident plan is to be developed and provided to SBCFD. Items addressed in the plan should include but not be limited to the following:
   - Staging area for emergency vehicle response
   - Plans to handle the accumulation and drainage of fire suppression water
   - Traffic control plan
   - Mutual aid agreement
   - Established training at site
   - Documentation of all Hazardous Materials on-site

19. Aera Energy and the SBCFD will coordinate and schedule operational fire drills on an annual or bi-annual basis. These drills will include resource deployment and exercising of the ICS.

Thank you for the opportunity to submit this preliminary fire protection master site plan evaluation with recommendations. Please contact our office with any questions.

Sincerely,

Jack Collings, FPE
1 OIL PROCESSING INFRASTRUCTURE

The following is a summary of the oil processing facilities and infrastructure planned for East Cat Canyon Field Redevelopment.

1.1 OVERVIEW OF PROCESSING SYSTEMS

Produced fluids and brackish water production are gathered from production well pads. Gas is separated from produced fluids at the Group Station (GS). From the group station, separated liquids flow to the Central Processing Facility (CPF) for oil cleaning, water cleaning, water softening, oil storage and oil sales. Separated gas from the GS also flows to the Produced Gas Treatment Plant (PGTP) for treatment and use in thermal enhanced oil recovery steam generation. From the CPF softened produced water and softened brackish water are sent to the Steam Generation Site (SGS) where once through steam generators create a wet, saturated steam. The steam is then distributed back to well pads for thermal enhanced oil recovery (TEOR) injection.

1.2 PRODUCTION GATHERING

The production gathering system connects the well pads to the CPF. Production gathering includes: the production gathering system pipe network, the upper Sisquoc brackish water production gathering system pipe network and the Production Group Station (GS).
1.2.1 PRODUCTION GATHERING SYSTEM (GS)

The reservoir fluids will be brought to the surface and routed into a common Production Gathering System. Below is a summary of the operations of the GS:

1. Reservoir fluids will be pumped to the surface using artificial lift systems.
2. Once on the surface, produced fluids (and vapors) from individual wells will be routed through insulated carbon steel flowlines.
3. Well flowlines will combine into a piping network routing field fluid production to the Production Group Station.

1.2.2 PRODUCTION GROUP STATION (GS)

The Production Group Station consists of two vessels, one installed in Phase I, and the second installed in Phase II. The GS receives produced fluids from the Production Gathering System, separates liquid and gas and routes the liquids to the Oil Cleaning Plant (OCP) within the CPF and the gas to the PGTP. Below is a summary of the treating operations in the OCP:

1. Degassing vessels will separate produced gas within the production stream
2. Produced gas will be cooled and transferred to the PGTP for sulfur removal.

1.3 CENTRAL PROCESSING FACILITY (CPF)

With the exception of gas-liquid separation, produced gas treatment, and steam generation, fluid processing will take place within a single complex of process called the Central Processing Facility (CPF). CPF oil processing will include:

- Oil Cleaning Plant (OCP)
- Light Oil Storage and unloading (LOS)
- Clean Oil Storage and loading (COS)
- Solids Concentrating Plant (SCP)

The following processes are also part of the CPF but are not part of the oil processing systems.
1.3.1 OIL CLEANING PLANT (OCP)

The Oil Cleaning Plant receives fluids from the GS. The OCP will consist of two equipment “trains”, one train will be constructed during Phase I, and the second will be added during Phase II. The primary function of the OCP is to remove water and solids from the produced crude. Clean oil leaving the OCP will be sent to storage tanks at the Crude Oil Storage (COS) and separated produced water will be sent to Water Cleaning Plant (WCP). Produced gas from the PGS and OCP will be cooled and transferred to the PGTP. Below is a summary of the treating operations in the OCP:

1. Field production will be blended with light crude oil to form a blended, approximately 12° API production to enhance gravity separation of oil and produced water
2. De-sanding vessels will settle and remove produced sand and solids from the blended production
3. Most produced water will be separated from blended production in horizontal, free water knockout (FWKO) vessels
4. Remaining produced water will be separated from blended production in horizontal coalescer vessels

1.3.2 CRUDE OIL STORAGE (COS)

The Crude Oil Storage (COS) plant receives and stores clean blended crude from the OCP. The primary functions of the COS is to store clean blended crude prior to sales. Below is a summary of the treating operations in the OCP:
1. Clean crude will be inventoried in oil stock tanks
2. Haulers will remove clean oil at Truck Loading Stations (sales point)
3. Tank vapors will be collected and transferred to the PGTP.

1.3.3 LIGHT OIL STORAGE (LOS)

Lighter, higher API gravity crude oil will be handled in the Light Oil Storage (LOS) plant. The primary functions of the LOS are to receive and inventory light crude oil prior to blending with production in the OCP. Below is a summary of the treating operations in the OCP:

1. Haulers will deliver light crude oil to Truck Unloading Stations (sales point)
2. Light crude will be inventoried in light oil stock tanks
3. Light crude oil will be metered and pumped to the OCP for blending with field production
4. Tank vapors will be collected and transferred to the PGTP.

1.3.4 SOLIDS CONCENTRATING PLANT (SCP)

The Solids Concentrating Plant (SCP) serves two roles: 1) dewater solids collected in and 2) recover residual oil from various processes in the CPF. Slop oil and solids from various plant processes will be directed to skim oil or sludge tanks. Wet oil will
be cleaned in a “slop oil” treater. Recovered oil will be transferred to Crude Oil Storage. Wet solids will be dewatered with a centrifugal process and collected for beneficial re-use. Separated water will be returned to the WCP. Below is a summary of treating operations in the SCP:

1. Wet, separated solids are further concentrated in sludge tanks
2. Sludge is mechanically dewatered and deposited into transport bins
3. Wet oil streams are collected in “slop oil” tanks
4. Water is removed from wet oil with a steam-heated coalescing treater.
1 STEAM GENERATION INFRASTRUCTURE

The following is a summary of the steam generation infrastructure planned for East Cat Canyon Field Redevelopment.

1.1 STEAM GENERATION SITE (SGS)

The Steam Generation Site burns natural gas to convert soft water from the WSP into high pressure steam for distribution to individual wells. The SGS consists of six (6) once-through steam generators (OTSG), three installed in Phase I, and three installed in Phase II, each fitted with 85 mmbtu/hr gas fired burners. The site also contains a (1) smaller 62.5 mmbtu/hr steam generator design for continuous consumption of field produced gases or utility grade gas. The SGS includes associated ancillary equipment to support the OTSGs, such as high-pressure feedwater pumps, and feedwater pre-heaters. The steam will be routed to the downstream steam distribution system.

Below is a summary of the operations in the SGS:

1. The six 85 mmbtu/hr OTSG will have a dedicated feedwater pump and pre-heater.
2. The feedwater pump will boost the pressure sufficiently to allow for steam generation and subsequent injection.
3. The pre-heater will reclaim waste heat from the produced gas by preheating the cooler OTSG feed water.

1.2 STEAM DISTRIBUTION AND INJECTION

The steam from the SGS is distributed to the injection sites via a carbon steel piping network. Each well requiring steam injection will be connected to the distribution system with a Steam Injection Measurement Skid (SIMS) which will monitor, measure, and control steam injection pressure and volume.
1.3 SGS EQUIPMENT

Pre-fabricated, OTSG units will be installed at the Steam Generator Site (SGS), provide steam for continuous pattern injection and to cyclic steam stimulation (CSS). Softened feedwater from the CPP Water Softening Plant (WSP) will be delivered to the SGS through an insulated feedwater distribution pipelines. Soft water distribution will operate at approximately 100 psig and 160°F. Steam quality will be determined in operation as a function of feedwater composition (e.g., silica content, hardness) and generator operating pressure. A target set-point of 70% steam quality has been found to represent a good balance in OTSG reliability and reservoir performance.

Each OTSG at the SGS will have an individual feedwater pump, individual steam separator and individual heat exchanger. Saturated liquids will be separated from steam vapor and used to preheat OTSG feedwater. Separated, sub-cooled liquids will then be used for water injection in the Sisquoc formation reservoirs.

Design basis for the SGS includes the following equipment, components and features:

- Six (6) 85 MMBTU/hr high efficiency, once through, split-flow steam generators with Low NOx burners.
  - 2,600 psig MAWP
  - ASME B31.1 ANSI Class 1500 piping
  - 60% - 75% steam quality
  - 85% steam generator thermal efficiency based on fuel gas HHV.
- One (1) 62.5 MMBTU/hr high efficiency, once through, split-flow steam generators with Low NOx burners.
  - 2,600 psig MAWP
  - ASME B31.1 ANSI Class 1500 piping
  - 60% - 75% steam quality
- 33,000 barrels per day (BWPD) of softened feedwater converted to saturated steam. New feedwater supply pipeline from new CPP
- Individual positive displacement feedwater pumps, up to 300 HP (5900 BPD at 2,600 psig).
- Individual feedwater/steam liquids heat exchangers.
- One utility fuel gas scrubber (12 MMSCFD); One produced gas scrubber (2 MMSCFD)
- Drain/blow down Tank (40 BBL) HOLD
- Control/SCADA building: (10’ by 15’ by 9’)
- MCC/switchgear: outdoor rated 480 VAC
- Power transformers:
- Instrument air skid: 125 psi; 276 acfm
- Chemical injection skids; set-up for multiple chemicals (up to four)

1.4 FUEL GAS SYSTEM

Natural gas fuel for steam generation will be obtained with new pipeline connection to Southern California Gas Company (SCG). A new 8-inch fuel line will be installed from the arriving location for SCG at the CPP to the SGS. Fuel gas may be preheated prior to pressure reduction in order to improve process thermal efficiency and to avoid hydrate formation during cold weather. A fuel gas scrubber, nominally operating at 100 psig will be provided to capture any free of condensed liquids.

1.5 STEAM GENERATION PROCESS CONTROL

Each OTSG will be provided with a programmable logic controller (PLC) and flame management system for process control, combustion control and combustion safety. These control will be located on each OTSG.
An additional PLC will be provided to control of the balance of plant equipment. Operating data and alarms will be available on the field Local Area Network (LAN) in real time and on Aera's wide Area network (WAN). A prefabricated 10 ft. by 15. Communications building will house the balance of plant PLC and communications equipment.

1.6 STEAM GENERATION PROCESS SAFETY

The OTSG will be in full accordance with the latest edition of ASME Boiler and Pressure Vessel Code Section I, California Building Code, National Electric Code, National Fire Protection Association NFPA 85: Boiler and Combustion Systems Hazards Code latest edition, Rules and Best Performance Standards (as approved) of the San Joaquin Valley Air Pollution Control District and shall meet OSHA and all other fire, electrical and safety codes and orders of applicable city, county, State of California and United States governments.

Aera conducts regular inspection and testing of fired equipment safety and pressure protection systems. A mechanical integrity program specifying the frequency and procedures for additional testing and inspection of steam equipment will also be put into place.