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# Via E-Mail and Overnight Delivery

Chairman Steve Bennett and Board Members Board of Supervisors Ventura County Hall of Administration, 4th Floor 800 S. Victoria Avenue Ventura, California 93009-1920 Emails: <u>Steve.Bennett@ventura.org</u> <u>Linda.Parks@ventura.org</u>

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#### <u>Via E-Mail Only</u>

Michael Powers County Executive Officer <u>CountyExecutiveOfficer@ventura.org</u> Rosa Gonzalez Chief Deputy Clerk of the Board <u>Clerkoftheboard@ventura.org</u>

Re: <u>Comments on the December 17, 2019 Board of Supervisors Meeting</u> <u>Agenda Item No. 11: Approval of, and Authorization for the</u> <u>Department of Airports Director to Execute, a Twenty-Five Year</u> <u>Lease for Development of an Electric Energy Storage Facility at the</u> <u>Camarillo Airport Business Park with Silverstrand Grid, LLC; and</u> <u>Find that: the Project is Categorically Exempt from the California</u> <u>Environmental Quality Act; Supervisorial District No. 3.</u>

Dear Chairman Bennet, Board Members, Mr. Powers, and Ms. Gonzalez:

We write on behalf of California Unions for Reliable Energy regarding the Ventura County Board of Supervisors' ("Board") Meeting Agenda Item No. 11, Approval of, and Authorization for the Department of Airports Director to Execute, a Twenty-Five Year Lease for Development of an Electric Energy Storage Facility at <sup>4699-006acp</sup>

the Camarillo Airport Business Park with Silverstrand Grid, LLC.<sup>1</sup> The agendized action is related to the construction and operation of an electric energy storage facility ("Project") on an unimproved 13,961 square-foot parcel located at the corner of Houck Street and Willis Avenue.<sup>2</sup> The proposed Project is an 11 megawatt system capable of storing 44 megawatt hours of energy in the system's batteries.<sup>3</sup> When completed, the facility will consist of battery containers, concrete pads for inverters and transformers, and ancillary electrical equipment.<sup>4</sup>

The Director of Airports ("Director") contends the Project is categorically exempt from the California Environmental Quality Act ("CEQA")<sup>5</sup> because it is an in-fill development project under CEQA Guidelines section 15332.<sup>6</sup> He asserts the proposed Project (1) is consistent with the applicable general plan designation and policies and applicable zoning designation and regulations, (2) is within the city limits on a sub-five-acre site surrounded by urban uses, (3) is located on a site with no value as habitat for endangered, rare, or threatened species, (4) would not result in any significant traffic, noise, air quality, or water quality effects, (5) and can be adequately served by all required utilities and public services.<sup>7</sup> The Director also claims the City of Camarillo has made an initial assessment that the project would qualify for this categorical exemption, but he acknowledges the City has not issued a final assessment.<sup>8</sup>

The Director requests that the Board make the following findings:

(a) the proposed project is categorically exempt from the California Environmental Quality Act (CEQA) under CEQA Guidelines section 15332 (infill development); (b) there is no reasonable possibility that the project could

<sup>&</sup>lt;sup>1</sup> Board of Supervisors Ventura County, Regular Meeting Agenda (Dec. 17, 2019).

<sup>&</sup>lt;sup>2</sup> Letter from Kip Turner, Director of Airports to Board of Supervisors, County of Ventura re: Comments on the December 17, 2019 Board of Supervisors Meeting Agenda No. 11: Approval of, and Authorization for the Department of Airports Director to Execute, a Twenty-Five Year Lease for Development of an Electric Energy Storage Facility at the Camarillo Airport Business Park with Silverstrand Grid, LLC; and Find that: the Project is Categorically Exempt from the California Environmental Quality Act; Supervisorial District No. 3 (Requires 4/5ths Vote) (Dec. 17, 2019) (hereinafter "Turner Letter").

<sup>&</sup>lt;sup>3</sup> Turner Letter at p. 2.

 $<sup>^4</sup>$  Ibid.

<sup>&</sup>lt;sup>5</sup> Pub. Resources Code § 21000 et seq.

<sup>&</sup>lt;sup>6</sup> Turner Letter at p. 2.

<sup>&</sup>lt;sup>7</sup> *Id.* at pp. 2-3.

<sup>&</sup>lt;sup>8</sup> *Id.* at p. 3.

<sup>4699-006</sup>acp

have a significant effect on the environment due to unusual circumstances; and (c) that the project is not otherwise ineligible for a CEQA categorical exemption under CEQA Guidelines section 15300.2.<sup>9</sup>

Beyond these conclusory statements, the Director fails to produce any evidence showing that the Project qualifies for the proposed exemption. To the contrary, as explained by our technical expert, Dr. Phyllis Fox, Ph.D., PE, in the comments included as **Attachment 1**, there is substantial evidence that the proposed Project would have significant environmental effects relating to air quality.<sup>10</sup> Specifically, the Project's greenhouse gas ("GHG") emissions would exceed the applicable significance threshold. Therefore, the Board must delay consideration of the lease agreement until after it completes the necessary environmental review pursuant to CEQA.

# I. THE CLASS 32 EXEMPTION DOES NOT APPLY BECAUSE THE PROPOSED PROJECT WOULD RESULT IN SIGNIFICANT AIR QUALITY IMPACTS

CEQA is designed to inform decisionmakers and the public about the potential, significant environmental effects of a project.<sup>11</sup> "Its purpose is to inform the public and its responsible officials of the environmental consequences of their decisions before they are made."<sup>12</sup> Thus, the law "protects not only the environment but also informed self-government."<sup>13</sup>

CEQA exempts certain project classes from environmental review.<sup>14</sup> The CEQA Guidelines lists specific classes which have been generally determined not to have a significant effect on the environment, and are therefore, categorically exempt from CEQA.<sup>15</sup> Public agencies utilizing such exemptions must support their determination with substantial evidence.<sup>16</sup> Categorical exemptions are narrowly construed and "are not to be expanded beyond the reasonable scope of their

<sup>&</sup>lt;sup>9</sup> *Id.* at p. 1.

 <sup>&</sup>lt;sup>10</sup> Letter from Phyllis Fox, Ph.D., PE to Andrew Graf, Adams Broadwell Joseph &Cardozo re: Silverstrand Grid, LLC Energy Storage Project (Dec. 16, 2019) (hereinafter "Fox Comments").
<sup>11</sup> 14 Cal. Code Regs. ("CEQA Guidelines") § 15002(a)(1).

<sup>&</sup>lt;sup>12</sup> Citizens of Goleta Valley v. Board of Supervisors (1990) 52 Cal. 3d 553, 564.

 $<sup>^{13}</sup>$  Ibid.

 $<sup>^{\</sup>rm 14}$  Pub. Resources Code § 21084.

 $<sup>^{15}</sup>$  CEQA Guidelines § 15300.

<sup>&</sup>lt;sup>16</sup> Pub. Resources Code § 21168.5.

<sup>4699-006</sup>acp

statutory language."<sup>17</sup> Erroneous reliance by a lead agency on a categorical exemption constitutes a prejudicial abuse of discretion and a violation of CEQA.<sup>18</sup> "[I]f the court perceives there was substantial evidence that the project might have an adverse impact, but the agency failed to secure preparation of an EIR, the agency's action must be set aside because the agency abused its discretion by failing to follow the law."<sup>19</sup> An agency may not rely on a categorical exemption if it would require the imposition of mitigation measures to reduce potentially significant effects.<sup>20</sup>

CEQA Guidelines section 15332 identifies the Class 32 exemption, which consists of projects characterized as in-fill development projects.<sup>21</sup> Class 32 projects are those meeting the following conditions:

- (a) The project is consistent with the applicable general plan designation and all applicable general plan policies as well as with applicable zoning designation and regulations.
- (b) The proposed development occurs within city limits on a project site of no more than five acres substantially surrounded by urban uses.
- (c) The project site has no value as habitat for endangered, rare or threatened species.
- (d) Approval of the project would not result in any significant effects relating to traffic, noise, air quality, or water quality.
- (e) The site can be adequately served by all required utilities and public services.<sup>22</sup>

If a project fails to meet any of the specified conditions, then it cannot qualify for the exemption and must undergo environmental review consistent with CEQA's requirements.

The proposed Project does not qualify for the Class 32 exemption because there is substantial evidence that the Project would result in significant air quality impacts. Appendix G of the CEQA Guidelines states that a project would result in a significant impact to air quality from greenhouse gases if the project would

<sup>&</sup>lt;sup>17</sup> Mountain Lion Found. v. Fish & Game Com. (1997) 16 Cal.4th 105, 125.

<sup>&</sup>lt;sup>18</sup> Azusa Land Recl. Co. v. Main San Gabriel Basin Watermaster (1997) 52 Cal. App.4th 1165, 1192.

<sup>&</sup>lt;sup>19</sup> Dunn-Edwards Corp. v. Bay Area Air Quality Mgmt. Dist. (1992) 9 Cal.App.4th 644, 656.

<sup>&</sup>lt;sup>20</sup> Salmon Pro. & Watershed Network v. County of Marin (2004) 125 Cal.App.4th 1098, 1198-1201.

 $<sup>^{21}</sup>$  CEQA Guidelines § 15332.

<sup>&</sup>lt;sup>22</sup> *Ibid*.

<sup>4699-006</sup>acp

"[g]enerate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment" or "[c]onflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases."<sup>23</sup>

The Ventura County Air Pollution Control District ("Air District") has not adopted an approach to setting a threshold of significance of significance for land use development projects, nor has it developed its own method of determining significance in the area of project GHG emissions.<sup>24</sup> However, the Air District relies on guidance from the California Air Pollution Control Officers Association ("CAPCOA").<sup>25</sup> The CAPCOA prepared a white paper to assist lead agencies with evaluating GHGs pursuant to CEQA.<sup>26</sup> It determined that the appropriate significance threshold for GHG emissions stemming from industrial projects is 900 metric tons per year.<sup>27</sup> This threshold has been applied to battery storage projects.<sup>28</sup>

Here, the proposed Project's GHG emissions will exceed the CAPCOA significance threshold. Dr. Fox calculates that the Project's GHG emissions will be at least 909 metric tons per year.<sup>29</sup> Therefore, the Project would have a significant air quality impacts mandating that the Project undergo environmental review to identify feasible mitigation measures to reduce the Project's impacts to a level of insignificance.

# **II. CONCLUSION**

We strongly urge the Board to delay consideration of any discretionary contracts related to the Project until it completes the necessary environmental

<sup>&</sup>lt;sup>23</sup> *Id.*, appen. G.

 <sup>&</sup>lt;sup>24</sup> County of Ventura, Initial Study Assessment Guidelines (Apr. 26, 2011) pp. 133-37.
<sup>25</sup> Ventura Air Pollution Control District, Air Quality Assessment for CEQA,

http://www.vcapcd.org/environmental-review.htm (last accessed Dec. 16, 2019).

<sup>&</sup>lt;sup>26</sup> California Air Pollution Control Officers Association, CEQA & Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act (Jan. 2008), *available at* http://www.capcoa.org/wp-content/uploads/2012/03/CAPCOA-White-Paper.pdf.

<sup>&</sup>lt;sup>27</sup> *Id.* at pp. 43-44, 47.

<sup>&</sup>lt;sup>28</sup> Imperial County Planning and Development Services, Draft Supplemental Environmental Impact Report: Le Conte Battery Energy Storage System SCH No. 2010111056 (July 15, 2019) pp. 3.1-24 to 3.1-25.

<sup>&</sup>lt;sup>29</sup> Fox Comments at p. 2. 4699-006acp

review. If the Board ignores the potentially significant air quality impacts and approves the proposed lease agreement at the December 17, 2019 meeting, it would do so in violation of CEQA.

Thank you for your consideration of these comments.

Sincerely,

And got

Andrew J. Graf Associate

Attachments

AJG:acp

4699-006acp

# Attachment 1

Phyllis Fox, Ph.D, PE 745 White Pine Ave. Rockledge, FL 32955 321-626-6885

December 16, 2019

Andrew Graf Adams Broadwell Joseph & Cardozo 601 Gateway Boulevard South San Francisco, CA 94080

RE: Silverstrand Grid, LLC Electric Energy Storage Facility Project

Dear Mr. Graf:

As you requested, I reviewed the files provided<sup>1</sup> in response to your September 12, 2019 Public Records Act (PRA) Request.<sup>2</sup> The Applicant, Silverstrand Grid, LLC, applied to County of Ventura to lease 15,500 square feet of an existing unimproved parcel at the northeast corner of the intersection of Willis Avenue and Houck Street, Camarillo.<sup>3</sup> The parcel is located south of the Camarillo Airport. The Applicant proposes to construct a distribution-connected, stand-alone 11 MW (44 MWh), four-hour duration lithium ion battery storage facility (Project). It will consist of 15 battery containers, 4 concrete pads for inverters and transformers, and ancillary equipment. The facility will be surrounded by a 12 foot high stucco wall. The batteries will store power from Southern California Edison (SCE) and send it back to the grid during demand times via existing power lines. The Project is currently in SCE's Wholesale Distribution access Tariff (WDAT) Queue Cluster 11 interconnection process.<sup>4</sup>

The County proposes to approve the lease agreement<sup>5</sup> and a California Environmental Quality Act (CEQA) Section 15332 categorical exemption for the Project at the Ventura County Board of Supervisors (BOS) regular meeting on December 17, 2019.<sup>6</sup> The subject categorical exemption, for in-fill development projects, requires that

http://bosagenda.countyofventura.org/sirepub/agdocs.aspx?doctype=agenda&itemid=105553 and

<sup>&</sup>lt;sup>1</sup> Letter from Madeline Herrie, Lease Manager, County of Ventura, Re: Public Records Request – Silverstrand Grid Project, September 12, 2019.

<sup>&</sup>lt;sup>2</sup> Letter from Sheila M. Sannadan, Adams Broadwell Joseph & Cardozo, to Kip Turner, County of Ventura, and Rosa Gonzalez, County of Ventura, Re: Public Records Act Request – Silverstrand Grid Project, August 21, 2019.

<sup>&</sup>lt;sup>3</sup> Lease Agreement – Camarillo Airport, Silverstrand Grid, LLC, pdf 3.

<sup>&</sup>lt;sup>4</sup> PreApplication Review. See also: SCE, Welcome to Queue Cluster 11, March 29, 2019; available at: <u>https://www.sce.com/sites/default/files/inline-files/SCE%2BQC11%2BWorkshop%2B2018-</u>03%2B%281%29\_1.pdf.

<sup>&</sup>lt;sup>5</sup> Camarillo Airport Lease Agreement Between County of Ventura and Silverstrand Grid, LLC; available at: <u>http://bosagenda.countyofventura.org/sirepub/cache/2/gdfooqi2jwruptfiuwophkjp/14215141213201911245</u> 0687.PDF.

<sup>&</sup>lt;sup>6</sup> See: Letter from Kip Turner, Director of Airports, to County of Ventura Board of Supervisors, December 17, 2019; available at:

"[a]pproval of the project would not result in any significant effects relating to traffic, noise, air quality, or water quality."<sup>7</sup> The County asserts with no citation to any analysis that "...the project would not result in any significant traffic, noise, air-quality, or water-quality effects."<sup>8</sup> The County also asserts that "[t]he City of Camarillo has made an initial assessment that the project would qualify for this categorical exemption, and it is anticipated that its final assessment will affirm this."<sup>9</sup> However, the files that I reviewed do not contain either an initial or final environmental assessment.

Battery storage facilities, such as the Project proposed here, result in significant environmental impacts that must be reviewed under CEQA and mitigated. These include significant greenhouse gas (GHG) and criteria pollutant emissions; hazards and hazardous material impacts, including fire and explosion; and significant worker and public health impacts. I have analyzed the environmental impacts of several battery storage projects in the past two years. The environmental impacts of the Silverstrand Project will be similar to the impacts described in the comments I submitted on the Le Conte battery energy storage facility, which are attached as Exhibit 1.<sup>10</sup> Utilizing the same methodology discussed in the Le Conte comments, greenhouse gas emissions (GHG) from the proposed Project will be at least 909 MT CO2e/yr.<sup>11</sup> The California Air Pollution Control Officers Association (CAPCOA) GHG significant. Therefore, the subject lease agreement should not be approved until this Project undergoes CEQA review.

Sincerely,

Sui of

Phyllis Fox, Ph.D., PE

<sup>10</sup> Phyllis Fox and David Marcus, Comments on the Draft Supplemental Environmental Impact Report for the Le Conte Battery Energy Storage System, September 3, 2019, Exhibit 1.

<sup>11</sup> Project GHG emissions = (10,331MT CO2e/yr)(11/125) = 909 MT CO2e/yr.

<sup>12</sup> CAPCOA, CEQA & Climate Change. Evaluating and Addressing greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act, January 2008; available at: http://www.capcoa.org/wp-content/uploads/2012/03/CAPCOA-White-Paper.pdf.

http://bosagenda.countyofventura.org/sirepub/cache/2/gdfooqi2jwruptfiuwophkjp/14215141213201911245 0687.PDF.

<sup>&</sup>lt;sup>7</sup> CEQA Sec. 15332(d)

<sup>&</sup>lt;sup>8</sup> Letter from Kip Turner, Director of Airports, to County of Ventura Board of Supervisors, December 17, 2019.

<sup>9</sup> Ibid.

# **EXHIBIT 1**

Comments on the **Draft Supplemental Environmental Impact Report** for the Le Conte Battery Energy **Storage System** 

Imperial County, California

September 3, 2019

Phyllis Fox

and

David Marcus

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# 1. INTRODUCTION

Le Conte Energy Storage, LLC (the Applicant) proposes to construct and operate a battery energy storage facility (BESS) on 3 to 5 acres of land within the fence line of the existing Centinela Solar Energy (CSE) facility, located at 319 Brockman Road, Calexico, California (Project). The Project will be installed on already disturbed land and consists of 125 MW of electrical storage capacity to receive and store cheap<sup>1</sup> electricity and return this electricity to the grid at a later time. Imperial County has prepared a Draft Supplemental Environmental Impact Report (DSEIR) for this Project.<sup>2</sup>

We reviewed the DSEIR for this Project prepared by Imperial County, the CEQA lead agency. The analyses in the appendices supporting the conclusions in the DSEIR attempt to address highly technical issues yet are poorly supported. Based on the available material and limited Project description, in our opinion the DSEIR is substantially deficient and does not fulfill its mandate as an informational document under CEQA to inform the public of potential impacts. It has omitted sources of emissions and underestimated others, thus underestimating greenhouse gas (GHG) and public health impacts. The DSEIR also failed to include risk of upset analyses to evaluate the impact of battery fire and explosion on local residents and motorists on adjacent roadways. It has further failed to require adequate mitigation for significant impacts that it did identify. Our analysis indicates that:

- The Project description is inadequate to support the DSEIR's conclusions.
- GHG emissions are significant and unmitigated.
- Fire and explosion impacts are significant and unmitigated.
- Hazards and hazardous material impacts are significant and unmitigated.
- Worker and public health impacts were not evaluated and are potentially significant.

These comments were prepared by Dr. Fox, with assistance from David Marcus on GHG emissions. Dr. Fox's resume is included in Exhibit 1 to these Comments and Mr. Marcus's resume in Exhibit 2. In sum, in our opinion the DSEIR is substantially deficient. Our analyses below indicate that the Project will result in significant GHG emissions and health impacts that have not been identified and/or mitigated. We

<sup>&</sup>lt;sup>1</sup> The DSEIR contains no commitment to only use otherwise-curtailed renewable generation that would be "excess."

<sup>&</sup>lt;sup>2</sup> Imperial County Planning and Development Services, Draft Supplemental Environmental Impact Report, Prepared by Burns McDonnell, July 15, 2019; available at <a href="http://www.icpds.com/?pid=6973">http://www.icpds.com/?pid=6973</a>.

recommend that the County recirculate a revised DSEIR that addresses the issues discussed below.

# 2. THE PROJECT DESCRIPTION IS INADEQUATE

The Project will consist of one or more buildings, totaling about 85,000 square feet, which will contain lithium-ion batteries, racks, and related building and electrical control systems; bidirectional inverters with 480 V AC output, a medium voltage (MV) transformer which steps up the voltage to 34.5 kV, an on-site substation that aggregates AC energy from the MV transformers and steps it up to 230-kw for delivery to the Drew Switchyard, and an overhead 230 kilovolt (kV) electric line.<sup>3</sup> The inverters, on-site substation, and associated overhead electric tie-line will be located outdoors.<sup>4</sup> The Project will connect to the adjacent San Diego Gas & Electric (SDG&E) Drew Switchyard. It will receive, store, and return up to 125 MW of electric energy to the electric grid, including solar energy currently produced by projects interconnected at the Drew and IV substations.<sup>5</sup>

The Project will use battery energy storage technology to absorb and discharge electrical energy into the SDG&E power grid. The facilities will include batteries and enclosures, power conversion systems, a substation, and ancillary systems, including fencing, security, lighting, fire protection, and heating, ventilation, and air conditioning.<sup>6</sup> The description of the Project is not adequate to evaluate its environmental impacts.

First, the DSEIR does not contain a Material Safety Data Sheet (MSDS) for the batteries or otherwise disclose their chemical composition, a *sine qua non* for assessing the fire, explosion, health, and other risks of the battery storage facility. Rather, it only generally identifies some of the chemicals that will be present in the lithium-ion batteries, including cobalt oxide, manganese dioxide, nickel oxide, carbon, an unidentified electrolyte, polyvinylidene fluoride, aluminum foil, copper foil, aluminum, and unidentified "inert" materials. This list is sufficient to raise serious concerns about health and safety issues because fluoride compounds are highly toxic when released in fires and explosions. See Comment 5. However, the DSEIR failed to acknowledge and evaluate these potential impacts.

<sup>&</sup>lt;sup>3</sup> DSEIR, pp. ES-3, 2-2.

<sup>&</sup>lt;sup>4</sup> DSEIR, p. 2-11.

<sup>&</sup>lt;sup>5</sup> DSEIR, p. ES-1 and ES-5.

<sup>&</sup>lt;sup>6</sup> DSEIR, p. ES-3.

Second, the DSEIR does not include any information on the layout of the batteries within the facility or the fire suppression system that will be used. This information is essential to evaluate the risk of fire and explosion. All details of the fire suppression system are deferred to the time of building permit submission.<sup>7</sup> Third, accidents could occur during transport, on-site storage, and disposal. The DSEIR does not disclose where the batteries will be manufactured, how they will be transported to the site (ship, rail, or truck), the transportation routes, details of on-site storage during construction, where the batteries will be recycled and the routes and means of transport to the recycle center. Accidents can occur during transport, storage, and recycling.

Third, the DSEIR does not include any vendor specifications for the ancillary equipment required to support the batteries, including the cooling and control systems, 56 inverters, 56 transformers, and 40 rooftop heating, ventilation, and air conditioning (HVAC) units.<sup>8</sup> Substation equipment includes a step-up transformer and 2 HVAC units.<sup>9</sup> This equipment requires electricity to operate and the generation of this electricity emits criteria and GHG emissions.

The DSEIR also fails to explain the function of the various components of the Project. Some are obvious, like the HVAC units, but others are not generally understood by the reviewing public. Electricity from the batteries is generated as low voltage direct current (DC). Inverters convert the DC current to 480-volt alternating current (AC). Transformers increase the voltage to the 34.5 kV voltage level. This is done for each of 56 subgroups of batteries. The 34.5 kV AC output of the 56 transformers is then combined and run through another transformer to raise it to the 230 kV high voltage level at which it is delivered to the grid. When charging, the whole thing runs in reverse. The incoming high voltage AC is run through a transformer to become 34.5 kV voltage AC, which is run through 56 inverters to produce 2.5 MW of 480 volt AC, which is then run through 56 inverters to produce low voltage DC that is used to charge 56 separate groupings of batteries.<sup>10</sup>

In fact, the description of the ancillary equipment in the noise appendix suggests the DSEIR may have understated the generating capacity of the facility. The noise

<sup>&</sup>lt;sup>7</sup> DSEIR, Section 2.6.4.1.

<sup>&</sup>lt;sup>8</sup> DSEIR, Appendix F, Section 7.1, Table 7-1.

<sup>&</sup>lt;sup>9</sup> DSEIR, Appendix F, Section 7.1, Table 7-1.

<sup>&</sup>lt;sup>10</sup> DSEIR, pp. ES-3, 2-2.

section discloses 56 2.5-MW inverters and 56 2.5-MW transformers.<sup>11</sup> This indicates a gross capacity of 56 x 2.5 = 140 MW, not the 125 MW capacity disclosed in the DSEIR. This implies a combined loss of slightly over 10% from the transformers and inverters, which may be excessive and is unsupported by vendor specification, or suggests that the BESS would generate 140 MW instead of 125 MW because there is no mitigation that limits generation to 125 MW.

Fourth, the DSEIR contains no information on the gross or net generation of electricity needed to operate the facility, storage capacity, storage efficiency, and expected energy output of the batteries. This information is essential to estimate emissions from operating the facility.

The environmental impacts of the Project cannot be accurately determined without this information. Thus, the DSEIR is substantially deficient and does not fulfill its mandate as an informational document under CEQA to inform the public of potential impacts.

# 3. OPERATIONAL GREENHOUSE GAS EMISSIONS ARE SIGNIFICANT

The DSEIR states that "CO2e emissions generated from the Project would primarily be from construction and to a lesser extent from operations.... All GHG emissions will be calculated using CalEEMod (Version 2016.3.1) which has been approved for use within Imperial County."<sup>12</sup> This is incorrect for three reasons. First, it ignores the greenhouse gas (GHG) emissions from charging the batteries. CEQA requires that all GHG emissions generated either directly or indirectly must be considered.<sup>13</sup> Second, the CalEEMod model only includes emissions from electricity usage and vehicle trips to service the facility. Third, the CalEEMod does not include GHG emissions from electricity usage at battery storage facilities.<sup>14</sup> Instead, the DSEIR used an energy intensity for "General Light Industry" of 2.31 kilowatt hours per 1,000 square feet per year.<sup>15</sup> A BESS is not "General Light Industry" because significantly more electricity would be required to operate the ancillary cooling and control systems in a BESS, including the 56 2.5 MW inverters, 56 2.5 MW transformers, and 40 rooftop HVAC units; and in the substation, a step-up transformer and 2 HVAC units.<sup>16</sup> As

<sup>&</sup>lt;sup>11</sup> DSEIR, Appendix E, Table 7-1.

<sup>&</sup>lt;sup>12</sup> DSEIR, p. 3.1-17.

<sup>&</sup>lt;sup>13</sup> CEQA Guidelines, Appendix G, Section VIII(a), Greenhouse Gas Emissions and SDEIR, Appendix B, p. 2-11.

<sup>&</sup>lt;sup>14</sup> See <u>http://www.aqmd.gov/caleemod/user's-guide</u>.

<sup>&</sup>lt;sup>15</sup> DSEIR, Appendix B, Section 4.2, p. 4-2 and Appendix A or Appendix B, pdf 35.

<sup>&</sup>lt;sup>16</sup> DSEIR, Appendix F, Section 7.1.

demonstrated below, GHG emissions from the Project are significant when properly calculated.

The DSEIR states that "The Project will allow for efficient storage of energy available on the wholesale power grid, including renewable energy generated in the County so that it is available when needed most."<sup>17</sup> It also states that "Charging energy will be provided from the electric grid which will include solar energy currently produced by projects interconnected at the Drew and IV substations."<sup>18</sup>

The environmental impacts of the Project from pollutant emissions during operation depends on how many megawatt hours (MWh) of generation are required to charge the Project batteries, which grid sources are the marginal sources<sup>19</sup> of supply during the hours when Project charging or discharging is occurring, and the emission rates of those grid sources. The number of MWh of charging energy required will in turn depend on the expected Project generation and the Project efficiency (the percentage of charging energy which can be recovered as generation during discharge).

The DSEIR contains no information on the net generation of electricity needed to operate the facility. Absent regulatory requirements or mitigation measures to the contrary, battery storage facilities store whatever energy is the cheapest and displace whatever is the most expensive, with no concern for emissions that would result from this exchange because there is no price on carbon or any other pollutant.

If the charging energy is from conventional sources, such as gas or coal-fired generation, charging will generate emissions as those sources would not otherwise operate because there would be no market for them. That fraction is likely quite low because only a small fraction of solar generation (and virtually no non-solar renewable generation) is curtailed<sup>20</sup> generation that could have been used for battery charging.

<sup>20</sup> Renewable energy is "curtailed" when it could have been physically produced (e.g., the sun is shining or the wind is blowing), but it was not produced due to economic (e.g., prices too low to be worth generating) or electrical system factors (e.g., the renewable generation would cause a nonrenewable generator to be turned off that is expected to be needed in the near future, without adequate time to restart it if it is turned off, and thus the CAISO orders renewable curtailment to avoid nonrenewable curtailment). The great majority of curtailment in California to date has been economic (over 99% in 2017, in 2018, and in 2019 to date; see <a href="http://www.caiso.com/Documents/Wind\_SolarReal-TimeDispatchCurtailmentReportDec31\_2017.pdf">http://www.caiso.com/Documents/Wind\_SolarReal-TimeDispatchCurtailmentReportDec31\_2017.pdf</a>, <a href="http://www.caiso.com/Documents/Wind\_SolarReal-TimeDispatchCurtailmentReportDec31\_2019.pdf">http://www.caiso.com/Documents/Wind\_SolarReal-TimeDispatchCurtailmentReportDec31\_2019.pdf</a>, and <a href="http://www.caiso.com/Documents/Wind\_SolarReal-TimeDispatchCurtailmentReportDec31\_2019.pdf">http://www.caiso.com/Documents/Wind\_SolarReal-TimeDispatchCurtailmentReportDec31\_2019.pdf</a>).

<sup>&</sup>lt;sup>17</sup> DSEIR, p. ES-3.

<sup>&</sup>lt;sup>18</sup> DSEIR, p. 2-4.

<sup>&</sup>lt;sup>19</sup> The marginal source of supply in a given hour is the source whose output would be increased if demand increases in that hour from the previous hour, or whose output would be decreased in that hour if demand decreases in that hour from the previous hour.

Thus, if charging occurs in hours when the marginal fuel in the CAISO-controlled grid is a fossil fuel, the facility would increase GHG and criteria pollutant emissions that were not included in the DSEIR's analyses.

The DSEIR makes no commitment that the batteries will be charged with renewable energy. The DSEIR states: "The Project will allow for efficient storage of energy available on the wholesale power grid, including renewable energy generated in the County so that it is available when needed most."<sup>21</sup> Elsewhere, the DSEIR states: "Charging energy will be provided from the electric grid which will include solar energy currently produced by projects interconnected at the Drew and IV substations."<sup>22</sup> The phrases "including renewable energy generated in the County" and "include solar energy" say nothing about how often or how much renewable energy will be used for charging, let alone renewable energy generated on site. As the facility is a net consumer of electricity, operation of the Project will increase GHG and criteria pollutant emissions when the batteries are charged with nonrenewable energy sources, which will occur whenever incremental<sup>23</sup> wind and solar are not available to meet incremental charging loads because they are already being fully used.

The DSEIR fails to provide any of the information required to estimate charging emissions, including the storage capacity, storage efficiency, and expected energy output of the batteries. The storage capacity is the amount of energy the batteries can store, usually measured in MWh or in hours of full capacity (125 MW) output. The expected energy output of the Project is the number of MWh of generation expected over the course of a typical year,<sup>24</sup> which will be less than 125 MW x 8760<sup>25</sup> hours due to hours when the Project will be either charging or not operating, or generating at less than full capacity. The storage efficiency (sometimes also called "round-trip efficiency") depends on the battery technology used and is relevant to the environmental impacts of the Project because lower efficiency means more grid generation required for each MWh of expected energy output. It is the ratio of energy output per MWh of charging energy (i.e., MWh of battery generation divided by MWh of battery charging energy).

<sup>23</sup> "Incremental" is analogous to marginal. Incremental wind and solar means solar and wind in addition to what is already generating; incremental charging loads means charging loads in addition to whatever charging loads if any are already happening. Marginal can refer to small changes either up or down from the status quo ante, while incremental refers to upward changes only ("decremental" refers to small downward changes).

<sup>24</sup> Energy output = capacity factor x 8,760 hr/yr x 125 MW.

<sup>&</sup>lt;sup>21</sup> DSEIR, p. ES-3.

<sup>&</sup>lt;sup>22</sup> DSEIR, p. 2-4.

<sup>&</sup>lt;sup>25</sup> 8,760 is the number of hours in a year.

All of this information is required to estimate emissions from Project operation. Thus, the DSEIR fails as an informational document under CEQA.

Because the DSEIR does not provide any data on the expected efficiency, capacity factor, or its expected charging energy requirements or energy generation, we used CAISO data for existing energy storage projects. The CAISO currently has about the same level of operating battery storage as the Project. Specifically, during four 1-week periods in the middle of each of the last four seasons (fall 2018, winter 2018–19, spring 2019, and summer 2019), the maximum CAISO storage generation was 119 MW,<sup>26</sup> very close to the 125 MW proposed generating capacity of the Project.

The CAISO provides data at 5- minute intervals for the MW of storage generation (positive numbers) or charging (negative numbers). We downloaded the 5-minute data for 28 days over the last year, selected to represent one week each in the middle of each of the four seasons of the year. The use of a full week of data for each season accounts for day-of-the-week variation and also for multi-day responses to weather, where generation on one day may reflect charging on the previous day.<sup>27</sup> The use of data from each of the seasons of the year accounts for seasonal variation in insolation and loads.

We aggregated the CAISO 5-minute data by day, by season, and for the full year represented by the data.<sup>28</sup> From the aggregated data, we calculated an overall annual capacity (119 MW), generation capacity factor (9.7%), efficiency (80.7%), and charging energy (125,551 MWh, or 126 gigawatt hours (GWh)).<sup>29</sup> Assuming the proposed 125 MW Project will have the same efficiency and capacity factor as the existing 119 MW of CAISO storage, the corresponding expected charging energy requirements for the Project will be 132 GWh per year.<sup>30</sup> The net increase in energy generation, after taking account of hours when the Project would be discharging, will be 25.5 GWh per year.<sup>31</sup>

The CAISO does not provide any data on the marginal sources of supply for storage charging on its system. Nor does it provide any data on marginal sources of supply for individual time periods, which could be cross-matched with the 5-minute

<sup>&</sup>lt;sup>26</sup> See the attached spreadsheet of CAISO storage data, column E.

<sup>&</sup>lt;sup>27</sup> See, e.g., Exhibit 3 (Storage Data Spreadsheet, lines 3, 4, 7, 18, 24, and 37), where daily generation exceeded charging. This is only possible if some of the generation relied upon charging in the prior day(s).

<sup>&</sup>lt;sup>28</sup> See Exhibit 3: Storage Data Spreadsheet, columns C-G.

<sup>&</sup>lt;sup>29</sup> See Exhibit 3: Storage Data Spreadsheet, line 49.

<sup>&</sup>lt;sup>30</sup> See Exhibit 3: Storage Data Spreadsheet, line 53.

<sup>&</sup>lt;sup>31</sup> See Exhibit 3 Storage Data Spreadsheet, line 54.

storage charging data to calculate the marginal sources of charging energy. The DSEIR also provides no information on the sources of charging energy, other than to suggest that some unspecified fraction will come from renewable energy resources.<sup>32</sup> That fraction is likely quite low because only a small fraction of solar generation (and virtually no non-solar renewable generation) is curtailed generation that could have been used for battery charging.<sup>33</sup>

The CAISO grid covers most of California, and because of the Western Energy Imbalance Market<sup>34</sup> marginal sources of generation outside the CAISO are also available from a wide swath of the Western U.S. grid. Thus, the CAISO's marginal source of generation is likely to be gas-fired generation in the great majority of hours. Therefore, we assumed that the most reasonable approximation to the expected emissions associated with battery charging are the emissions from a modern natural gas-fired combined cycle plant. Such plants are the most efficient gas-fired plants, and gas is the cleanest fossil fuel with the lowest emissions. Thus, for any hour in which gas (or coal) is the marginal fuel, the emissions from a gas-fired combined cycle plant are a lower-bound emissions estimate. There will be a small number of hours in which solar or wind are the marginal resources, as shown by their being curtailed in the absence of battery charging to absorb their generation. In those hours, assuming a combined cycle plant as the marginal resource will overstate the emissions associated with battery charging. That overstatement is offset by the hours in which the marginal source is a combustion turbine or steam plant, whose emissions are greater than those of a combined cycle plant.

The Project would interconnect to SDG&E-owned facilities on the CAISOcontrolled grid. The most recent combined cycle gas plant connected to SDG&E-owned transmission lines is the Otay Mesa project, which began operation in October 2009. California Energy Commission (CEC) data for the five most recent years show that the average Otay Mesa heat rate over the 2014–2018 period was 7,183 Btu/kWh.<sup>35</sup> Based on that heat rate, and EIA data on emissions from Otay Mesa for the years 2013–2017,<sup>36</sup> we

<sup>&</sup>lt;sup>32</sup> DSEIR, p. ES-5, ES-11/12, 2-4, 5-2.

<sup>&</sup>lt;sup>33</sup> In 2018, only 1.4% of solar generation and 0.2% of wind generation were curtailed, and no other renewable generation. The corresponding figures for January–July 2019, which are biased high because most curtailment occurs in the spring months, are 3.6% for solar and 0.3% for wind.

<sup>&</sup>lt;sup>34</sup> The Western Energy Imbalance Market is a real-time, wholesale energy trading market that enables participants anywhere in the West to buy and sell energy when needed. See <a href="https://www.westerneim.com/pages/default.aspx">https://www.westerneim.com/pages/default.aspx</a>.

<sup>&</sup>lt;sup>35</sup> See Exhibit 4, Otay Mesa Data Spreadsheet, bottom left.

<sup>&</sup>lt;sup>36</sup> The most recent 5 years of available data (2013–2017), from <u>https://www.eia.gov/electricity/data/</u> <u>emissions/</u>. Otay Mesa is plant #55345 in the EIA database.

have calculated emission factors for Otay Mesa of 420 tons of CO2 per GWh, 3.33 pounds of SO2 per GWh, and just under 30 pounds of NOx per GWh.<sup>37</sup>

Assuming 25.5 GWh per year of net charging energy for the Project, as discussed above, and further assuming emission rates for that energy equivalent to those for the Otay Mesa combined cycle project, the net emissions increases that would occur to operate the Project are:<sup>38</sup>

- 10,716 tons of CO2e per year
- 85 pounds of SO2 per year
- 756 pounds of NOx per year

The DSEIR estimated CO2e emissions from operating the Project of 579.68 metric tons per year (MT/yr) using the CalEEMod model, which does not include charging energy for the batteries. The CalEEMod also underestimates GHG emissions from electricity used at the facility to operate ancillary equipment, including cooling and control systems, the inverters, transformers, and HVAC equipment<sup>39</sup> but we did not estimate those due to the lack of any equipment specification.

Thus, total GHG emissions for the Project are at least 10,331 MT/yr.<sup>40</sup> The DSEIR used the CAPCOA GHG significance threshold of 900 MT/yr<sup>41</sup> to evaluate the significance of GHG emissions from Project operation.<sup>42</sup> Thus, Project GHG emissions are highly significant, requiring mitigation. This is a new significant impact not disclosed in the DSEIR. The DSEIR must be modified to included GHG mitigation and recirculated for public review.

The Project should be modified to require no net increase in GHG emissions over the baseline by implementing projects to reduce GHG emissions as follows:

- (1) project design features/on-site reduction measures;
- (2) offsets off-site within Imperial County;

<sup>&</sup>lt;sup>37</sup> Exhibit 4, Otay Mesa Data Spreadsheet, bottom left, Excel cells C33-C35.

<sup>&</sup>lt;sup>38</sup> Exhibit 4, Otay Mesa Data Spreadsheet, bottom left, Excel cells C40-C42. Note that these emissions are based on net emissions of 25.5 GWh per year, which is the net of the 131.9 GWh of increased generation to provide charging energy and the 106.4 GWh of reduced generation that would be displaced by battery generation. See Exhibit 3, Storage Data Spreadsheet, lines 53-54.

<sup>&</sup>lt;sup>39</sup> DSEIR, Appendix F, Section 7.1.

<sup>&</sup>lt;sup>40</sup> Total GHG emissions = (10,716 ton/yr)(0.91 MT/ton) + 579.68 MT/yr (DSEIR, Table 3.1-8) = **10,331 MT/yr**.

<sup>&</sup>lt;sup>41</sup> DSEIR, p. 3.1-25.

<sup>&</sup>lt;sup>42</sup> DSEIR, p. 3.1-25 and Appendix B, Section 4.2.1.

- (3) offsets off-site within the State of California;
- (4) offsets off-site within the United States;
- (5) offsets off-site internationally; and
- (6) charging restrictions that constrain battery charging to hours when CAISO renewable resources would otherwise be curtailed, but the curtailment would be demonstrably avoided by using otherwise curtailed generation as battery-charging energy, or if such demonstrations are not feasible
- (7) charging restrictions that constrain battery charging to hours when solar generation is potentially being curtailed, which would at a minimum mean no charging during night time hours.

# 4. HAZARDS AND HAZARDOUS MATERIAL IMPACTS WERE NOT EVALUATED AND ARE SIGNIFICANT

CEQA Guidelines, Appendix G, states that agencies should ask whether the project will result in any of the following:

- "Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?" or
- "Create a significant hazard to the public or the environment through the reasonably foreseeable upset or accident conditions involving the release of hazardous materials into the environment?"<sup>43</sup>

The batteries could result in a number of significant hazard and hazardous material impacts including fire, explosion, and the release of toxic chemicals. Hazards associated with battery systems are normally analyzed by identifying all feasible failure modes, identifying the consequences of each failure mode (e.g., fire, explosion, specific chemicals and the rates at which they could be released) and resulting impacts in surrounding areas and the consequences (e.g., chronic, acute, and cancer impacts). The DSEIR contains no analysis at all of the hazards and hazardous material impacts of the battery storage facility, thus failing as an informational document under CEQA. Instead, it generally discusses fire without performing any Project-specific analysis and plucks mitigation – compliance with existing codes and an undisclosed Emergency Response Plan (ERP) – out of thin air.

Thus, the DSEIR fails as an informational document under CEQA for failing to disclose the details of the fire protection system, for failing to include the ERP in the DSEIR, and for failing to include a hazard analysis to evaluate the impacts to nearby

<sup>&</sup>lt;sup>43</sup> See CEQA Guidelines, Appendix G, Evaluation of Environmental Impacts, Section IX(a)-(b), Hazards and Hazardous Materials.

residents and facilities in the event of a fire. A fire at the Project could result in significant damage to the adjacent solar facility and nearby homes.

# 4.1. Fire and Explosion Impacts Were Not Evaluated and Are Significant

The batteries contain flammable materials that can ignite and cause fires and explosions, resulting in irreversible damage in the surrounding area, including to the nearby CSE facility, local residents, agricultural and solar plant workers, and motorists on adjacent roadways. CEQA Guidelines Section 15126.2(c) requires a discussion of any significant irreversible environmental change that would be caused by a project. A project would result in significant irreversible changes if it involves uses in which irreversible damage could result from any potential environmental accidents associated with the project.<sup>44</sup> The DSEIR fails to include any analysis of fire and explosion impacts of the BESS.

The batteries contain hazardous chemicals that would be released in fires, resulting in potentially significant health impacts to nearby farm and solar plant workers, local residents, motorists on adjacent roadways, and responding firefighters, as well as potential impacts to agricultural crops grown in surrounding farmlands. Fires also could occur during battery transportation to the site, during construction of the BESS, during BESS commissioning and decommissioning, as well as during operation. The DSEIR only generally discusses the risk of fire during operation of the BESS, tacitly assuming that Project design and compliance with local fire and other codes will mitigate operational fire impacts.<sup>45</sup> The DSEIR fails to analyze or even discuss the risk of transporting the batteries to the site and the risks of constructing, commissioning, and decommissioning the BESS when operational safety measures discussed in the DSEIR would not be present.

The DSEIR lacks substantial evidence to conclude that there will be no fire or explosion during transport, construction, commissioning, operation, and decommissioning. Instead of identifying the specific risks and conducting a conventional risk of upset analysis for battery transport and BESS construction, commissioning, operation, and decommissioning, the DSEIR skips this step entirely and leaps directly to a general "fire protection plan" for the battery facility that only includes compliance with 2016 Fire Codes (that have been demonstrated to be ineffective against BESS fires) and other measures that will be developed in the future, outside of CEQA review, without describing the Project in sufficient detail to evaluate

<sup>&</sup>lt;sup>44</sup> DSEIR, p. ES-8.

<sup>&</sup>lt;sup>45</sup> DSEIR, Section 3.5.2.4.

their effectiveness. See Comment 2. The SDEIR, for example, states: "The fire protection system **will be designed**..."The fire protection plan **is anticipated** to include.....", "the Applicant **will work** closely...."<sup>46</sup> This is not enforceable mitigation. See Comment 2. The mitigation must be in the CEQA document, not developed in the future, outside of CEQA review.

In fact, there is substantial evidence to conclude that the Project will have a significant impact due to fires, explosions, and the release of toxic gases that could occur during transport, construction, commissioning, operation, and decommissioning. These events could result in significant damage at the adjacent CSE facility, nearby residences, motorists on adjacent and other roadways, agricultural workers, and crops grown in the surrounding area. Yet the DSEIR fails to analyze these risks, leaping to general mitigation that will be developed in the future, outside of CEQA review. Thus, the DSEIR fails as an informational document under CEQA.

The DSEIR downplays the risk of fires by comparing Project battery fires to battery fires in electric vehicles, arguing that the Project batteries "will be stationary, whereas electric vehicle battery fires often occur as the result of a crash where the battery is crushed or penetrated in a way that bypasses safety mechanisms."<sup>47</sup> However, this is wrong. Fires in cars with lithium-ion batteries also have occurred while the vehicles are parked and during charging.<sup>48,49</sup> About 40 fires involving lithium-ion batteries in electric cars have been reported.<sup>50,51</sup> The DSEIR fails to acknowledge these occurrences or explain how the Project BESS will be designed to avoid them.

The DSEIR fails to explain (or even acknowledge) the history of fires at similar battery storage facilities and how the proposed Project design will guard against similar fires. Instead, the DSEIR only acknowledges fires that have occurred in similar lithiumion batteries used in cars, which have burst into flames in collisions, and asserts that the

<sup>&</sup>lt;sup>46</sup> DSEIR, pp. 3-20 to 3-22 (emphasis added).

<sup>&</sup>lt;sup>47</sup> DSEIR, p. 3.5-7.

<sup>&</sup>lt;sup>48</sup> Jonathon Klein, Parked Teslas Keep Catching on Fire Randomly, and There's No Recall In Sight, *The Drive*, June 18, 2019; available at <u>https://www.thedrive.com/news/28420/parked-teslas-keep-catching-on-fire-randomly-and-theres-no-recall-in-sight</u>.

<sup>&</sup>lt;sup>49</sup> Dongxu Ouyang et al., A Review on the Thermal Hazards of the Lithium-Ion Battery and the Corresponding Countermeasures, *Applied Sciences*, June 18, 2019, Table 1, Exhibit 5.

<sup>&</sup>lt;sup>50</sup> Ibid. See also Ashlee Vance, *Elon Musk: Tesla, SpaceX, and the Quest for a Fantastic Future,* Harper Collins, 2015.

<sup>&</sup>lt;sup>51</sup> <u>https://www.google.com/search?q=tesla+battery+fire&oq=telsa+battery+fire&aqs=chrome.</u> <u>1.69i57j0l5.12984j0j4&sourceid=chrome&ie=UTF-8</u>. See also <u>https://electrek.co/2018/06/16/tesla-model-s-battery-fire-investigating/</u>.

battery cells and modules will have "automotive grade anti-crush and anti-penetration safety technologies built in, designed to disable the battery cell in the event that the cell housing is damaged due to improper handling or any other type of accident."<sup>52</sup>

The DSEIR further asserts that "the likelihood of a stationary storage BESS getting crushed or penetrated through a collision with an exterior object would be comparatively less." Setting aside for the moment that collision is not the main cause of lithium-ion battery failure, the facility is located less than 500 feet from a freeway (SR-98) and is immediately adjacent to a local road (Drew Road) where traffic accidents could impact the battery storage facility. Figure 1.<sup>53</sup> The DSEIR indicates that average daily traffic on SR 98 is 1,953 trips and on Drew Road, 321 trips, with capacities of 20,900 and 16,200 trips.<sup>54</sup> Thus, a traffic accident involving the BESS cannot be ruled out. Regardless of the built-in protections, which are not disclosed in sufficient detail to evaluate their effectiveness, the risk of fire from battery malfunctions or traffic collisions is not zero because the technology is new and there is still much to learn.



# **Figure 1: Project Location**

Proposed Battery Energy Storage System

<sup>&</sup>lt;sup>52</sup> DSEIR, p. 2-17, 3.5-6/7.

<sup>&</sup>lt;sup>53</sup> DSEIR, Figure 2-1.

<sup>&</sup>lt;sup>54</sup> DSEIR, Appendix G, Table 4.1.



The electrolytes used in lithium-ion batteries are flammable in the presence of oxygen. While the batteries are sealed from external sources of oxygen, some cathodes can release oxygen within the cell under high temperatures.<sup>55,56</sup> These batteries are susceptible to thermal runaway, which is a chain reaction leading to self-heating and release of stored energy.<sup>57</sup> As described in a recent refereed journal article:<sup>58</sup>

<sup>&</sup>lt;sup>55</sup> Brian Eckhouse and Mark Chediak, Explosions Threatening Lithium-Ion's Edge in a Battery Race, Bloomberg, April 24, 2019; available at <u>https://www.bloomberg.com/news/articles/2019-04-</u>23/explosions-are-threatening-lithium-ion-s-edge-in-a-battery-race.

<sup>&</sup>lt;sup>56</sup> Thomas F. Armistead, Fire at Arizona Energy Storage Battery Bank Draws Scrutiny, *Engineering News-Record*, July 7/8, 2019, p. 18. Exhibit 6.

<sup>&</sup>lt;sup>57</sup> Todd M. Bandhauer, Srinivas Garimella, and Thomas F. Fuller, A Critical Review of Thermal Issues in Lithium-Ion Batteries, *The Journal of the Electrochemical Society*, v. 158 R-21-R25, January 2011; available at <a href="https://wiki.aalto.fi/download/attachments/91692283/a\_critical\_review\_of\_thermal\_issues\_in\_li-ion\_batteries.pdf?version=1&modificationDate=1398443780029&api=v2">https://wiki.aalto.fi/download/attachments/91692283/a\_critical\_review\_of\_thermal\_issues\_in\_li-ion\_batteries.pdf?version=1&modificationDate=1398443780029&api=v2</a>.

<sup>&</sup>lt;sup>58</sup> Fredrik Larsson et al., Toxic Fluoride Gas Emissions from Lithium-ion Battery Fires, *Scientific Reports*, v. 7, 2017; available at <a href="https://www.nature.com/articles/s41598-017-09784-z">https://www.nature.com/articles/s41598-017-09784-z</a>.

An irreversible thermal event in a lithium-ion battery can be initiated in several ways, by spontaneous internal or external short-circuit, overcharging, external heating or fire, mechanical abuse etc. This may result in a thermal runaway caused by the exothermal reactions in the battery<sup>6,7,8,9,10</sup>, eventually resulting in a fire and/or explosion. The consequences of such an event in a large Li-ion battery pack can be severe due to the risk for failure propagation<sup>11,12,13</sup>. The electrolyte in a lithium-ion battery is flammable and generally contains lithium hexafluorophosphate (LiPF6) or other Li-salts containing fluorine. In the event of overheating the electrolyte will evaporate and eventually be vented out from the battery cells. The gases may or may not be ignited immediately. In case the emitted gas is not immediately ignited the risk for a gas explosion at a later stage may be imminent. Li-ion batteries release a various number of toxic substances14,15,16 as well as e.g. CO (an asphyxiant gas) and CO2 (induces anoxia) during heating and fire. At elevated temperature the fluorine content of the electrolyte and, to some extent, other parts of the battery such as the polyvinylidene fluoride (PVdF) binder in the electrodes, may form gases such as hydrogen fluoride HF, phosphorus pentafluoride (PF5) and phosphoryl fluoride (POF<sub>3</sub>). Compounds containing fluorine can also be present as e.g. flame retardants in electrolyte and/or separator17, in additives and in the electrode materials, e.g. fluorophosphates18,19, adding additional sources of fluorine.

It is well known that lithium-ion battery fires are some of the most difficult fires to suppress. Lithium-ion batteries have high power-to-density ratios that allow them to store large amounts of energy. When a lithium-ion battery catches fire, this stored energy coupled with the materials in the battery makes it difficult to suppress or extinguish.<sup>59</sup> Fires in lithium-ion batteries are generally hotter than a standard fire and can reignite days after they are extinguished, presenting unique firefighting challenges. See discussion of individual fires in Comment 4.1.2.

Fires in battery storage facilities can start in the batteries themselves, be ignited from foreign materials, a ground arc fault electrical surge, an external fire, or be triggered by a failure of the control system. A recent summary of the fire history of BESS facilities concluded that: "What we're learning over time is that it's not necessarily always a battery problem ... There are other systems that make up an energy storage system, which can result in failures, and those failures can result in further failures of

<sup>&</sup>lt;sup>59</sup> Jeremy Snow, Suppressing Lithium Ion Battery Fires; available at <u>http://venturaaerospace.com/</u>news/suppressing-lithium-ion-battery-fires/.

the battery."<sup>60</sup> Conventional sprinkler systems have failed in similar applications because water is a poor fire retardant for the chemicals present in lithium-ion batteries. The DSEIR indicates it will use water combined with a cleaning agent such as FM-200 or Novatech, but fails to provide an MSDS and offers no evidence that this would be effective in controlling a BESS fire.<sup>61</sup>

The DSEIR also indicates that measures will be taken "to reduce the risk of potential lithium-ion battery fires at the site."<sup>62</sup> However, "reducing the risk" does not eliminate the risk. The risk of a fire is not zero and the consequences potentially catastrophic, even when "reduced." The risks include explosions, adverse health impacts, and damage to nearby facilities and equipment. The DSEIR did not disclose or evaluate these risks and thus fails as an informational document under CEQA.

The DSEIR discusses a "fire protection plan" that is "anticipated" to include using water and/or an unidentified suppression agent (e.g., FM-200, Novatech) and complying with applicable fire codes and other standards.<sup>63</sup> However, the DSEIR does not include the "fire protection plan," deferring it to the future outside of CEQA review. The layout of battery facilities can prevent adequate firefighting access.

The DSEIR does not contain any information on battery system layout, other than to note batteries would be placed in cabinets and installed in separate battery rooms.<sup>64</sup> The design of the fire protection plan is deferred to the future.<sup>65</sup> Existing fire codes<sup>66</sup> (which are currently being updated to specifically address BESS systems) and fire tests on Li-ion batteries indicate that the layout of the batteries and ancillary facilities is critical to preventing fires – including separation between batteries, separation between the batteries and other noncombustible and combustible objects, use of and location of thermal barriers, design of rack enclosures, materials of construction, and design of the sprinkler system.<sup>67</sup> The DSEIR, for example, fails to

<sup>62</sup> DSEIR, p. 3.5-20.

<sup>&</sup>lt;sup>60</sup> Armistead 2019, p. 18, Exhibit 6.

<sup>&</sup>lt;sup>61</sup> DSEIR, p. 3.5-20.

<sup>&</sup>lt;sup>63</sup> DSEIR, p. 3.5-20.

<sup>&</sup>lt;sup>64</sup> DSEIR, Sections 0.4, 2.6.

<sup>&</sup>lt;sup>65</sup> Conditional Use Permit (CUP), pdf 7, June 21, 2018.

<sup>&</sup>lt;sup>66</sup> <u>https://www.iccsafe.org/wp-content/uploads/Energy-Storage-Systems-Fire-Safety-Concepts-in-the-2018-IFC-and-IRC.pdf</u>.

<sup>&</sup>lt;sup>67</sup> Klaus Bruckner and Associates, Lithium-Ion Battery Energy Storage Systems, June 17, 2019; available at <u>http://www.klausbruckner.com/blog/lithium-ion-based-energy-storage-systems/</u>; R. Thomas Long and Amy M. Misera, Sprinkler Protection Guidance for Lithium-Ion Based Energy Storage System, NFPA

state how close the batteries will be placed to each other, other Project components, or the building walls, or to disclose the material of construction. In addition, the DSEIR fails to state how much wattage may be contained in a single enclosure. This failure makes it impossible to determine the fire risk associated with the Project.

Fire conditions within a battery storage facility are distinct from those addressed in existing fire codes and require site-specific analysis and mitigation design, which is missing from the DSEIR. A recent article explained it this way:<sup>68</sup>

> Moving and storing energy in any form carries inherent risks: Fuel depots can catch on fire. Transmission lines can fall and cause shocks. Gas pipelines can explode. Liquid fuels can leak. But rescue workers have decades of experience fighting these challenges, and the industry has established procedures to prevent problems.

> Grid-level energy storage, on the other hand, is a new frontier, and establishing safety standards is crucial not just to protect human life and the environment, but also to safeguard expensive energy investments.

There are many causes of battery storage fires that are not disclosed or mitigated in the DSEIR. These are discussed in Comment 4.1.1, followed by a discussion of some of the fires that have occurred.

# 4.1.1. Causes of BESS Fires

The DSEIR fails to identify and analyze the numerous ways that a fire at the proposed BESS could be triggered. The DSEIR asserts that fire risks of traditional lithium-ion batteries are predominantly associated with overcharging or through short circuiting, due to age.<sup>69</sup> This is incorrect. There are many additional causes of fires at battery storage facilities – including manufacturing defects, battery aging, thermal runaway, malfunction of the cooling system, and charging a severely discharged cell – which can result in internal cell breakdown and damage to neighboring cells. Li-ion

Research Foundation, June 2019; available at <a href="https://www.nfpa.org//-/media/Files/News-and-Research/Fire-statistics-and-reports/Suppression/RFESSSprinklerProtection.pdf">https://www.nfpa.org//-/media/Files/News-and-Research/Fire-statistics-and-reports/Suppression/RFESSSprinklerProtection.pdf</a>.

<sup>&</sup>lt;sup>68</sup> Umair Irfan, Battery Fires Pose New Risks to Firefighters, *E&E News*, February 27, 2015 ("The vast majority of codes were not developed for energy storage."); available at <a href="https://www.scientificamerican.com/article/battery-fires-pose-new-risks-to-firefighters/">https://www.scientificamerican.com/article/battery-fires-pose-new-risks-to-firefighters/</a>. See also Umair Irfan, Electricity Storage Booms as Regulators Race to Develop Standards, E&E News Reported in Scientific American, February 27, 2015; available at <a href="https://www.scientificamerican.com/article/battery-fires-pose-new-risks-to-firefighters/">https://www.scientificamerican.com/article/battery-fires-pose-new-risks-to-firefighters/</a>. See also Umair Irfan, Electricity Storage Booms as Regulators Race to Develop Standards, E&E News Reported in Scientific American, February 27, 2015; available at <a href="https://www.scientificamerican.com/article/battery-fires-pose-new-risks-to-firefighters/">https://www.scientificamerican.com/article/battery-fires-pose-new-risks-to-firefighters/</a>.

<sup>&</sup>lt;sup>69</sup> DSEIR, p. 2-16, 3.5-20.

batteries are sensitive to abusive conditions such as high temperatures, crashing, overcharge, over-discharge, and short circuit.<sup>70</sup> The DSEIR is silent on how these conditions would be prevented during transport, construction, and operation. The DSEIR fails as an informational document under CEQA for failing to identify these failure modes, failing to evaluate their impact on the environment, and failing to identify mitigation measures to protect against them.

The major risk of lithium-ion batteries is thermal runaway, a cycle in which excessive heat keeps creating more heat. Thermal runaway can be caused by a battery having internal cell defects, mechanical failures/damage, or overvoltage. These lead to high temperatures, gas build-up, and potential explosive rupture of the battery cell, resulting in fire and/or explosion. Without disconnection, thermal runaway can also spread from one cell to the next, causing further damage.<sup>71</sup> The DSEIR does not even mention this failure mode or explain how the proposed fire control measures (proposed with no analysis at all of the actual risk) would address it.

Lithium-ion batteries are stabilized by an ultrathin protective film that coats both electrodes. Studies have demonstrated that when this film is destroyed, which could happen in a battery large enough to overheat beyond 80 C, such as those proposed for this Project, the reaction of the battery electrolyte with the material of the unprotected positive electrode results in the formation of toxic fluoro-organic compounds.

The negative electrode in these batteries is usually graphite and the positive electrode contains lithium and a transition metal; cobalt in this case. However, with a lead voltage of about 4 volts, no electrolyte is thermodynamically stable, so operation relies on a combination of ethylene carbonate and LiPF<sub>6</sub> or other similar compound producing a continuous film to assure adequate ionic conductivity and electronic insulation. However, above 80 C, thermal runaway can occur spontaneously as a result of the breakup of this protective film.<sup>72</sup> The DSEIR is silent on the design of the batteries – critical information required to evaluate hazards – thus failing as an informational document under CEQA.

Another cause of fire is failure of the protection and control system. No matter the design, failure is still possible. For example, a battery management system failure

<sup>&</sup>lt;sup>70</sup> Ouyang et al., 2019, Exhibit 5.

<sup>&</sup>lt;sup>71</sup> Siemens AG, Fire Protection for Li-ion Battery Energy Storage Systems, White Paper, January 2019; available at <u>https://www.downloads.siemens.com/download-center/Download.aspx?pos=</u> <u>download&fct=getasset&id1=A6V11636417</u>.

<sup>&</sup>lt;sup>72</sup> Amer Hammami, Nathalie Raymond, and Michel Armand, Runaway Risk of Forming Toxic Compounds, *Nature*, v. 424, August 7, 2003, p. 635. Exhibit 7. Abstract available at <a href="https://www.nature.com/articles/424635b">https://www.nature.com/articles/424635b</a>.

can lead to overcharging and the inability to monitor the operating environment, such as temperature or cell voltage.<sup>73</sup> There are currently no publicly available data that prove any particular type of fire protection can prevent or control thermal runaway in battery storage systems.

Lithium-ion batteries are also very sensitive to mechanical damage and electrical surges. This type of damage can result in internal battery short circuits that lead to internal battery heating, battery explosions, and fires. The loss of a single battery can rapidly cascade to surrounding batteries, resulting in a large fire.<sup>74</sup>

Further, the battery facility is located in a moderate fire hazard severity zone<sup>75</sup> and a seismically active zone.<sup>76</sup> In the event of a fire, which could be triggered by natural conditions, a seismic event, or accidents along the electrical infrastructure in the area,<sup>77</sup> the battery storage facility could be engulfed in flames. A typical trigger accident, for example, could be separation of a power line conductor from a connector, as occurred in the recent "Blue Fire."<sup>78</sup> Of particular concern here is that when lithiumion batteries are exposed to heat, such as from an external fire, the substances inside the batteries react and explode.<sup>79</sup> Equipment owned by California's three largest utilities ignited more than 2,000 fires in three and a half years. Investigations indicate that electrical lines making contact with vegetation and other line malfunctions sparked

<sup>77</sup> DSEIR, Figures 2-4 and 2-5.

<sup>&</sup>lt;sup>73</sup> See, for example, Paul Hesler and Kenneth A. Travers, Lithium-ion Battery Energy Storage Systems – The Risks and How to Manage Them, July 17, 2019; available at <a href="http://www.hazardexonthenet.net/">http://www.hazardexonthenet.net/</a> article/171930/Lithium-ion-Battery-Energy-Storage-Systems-The-risks-and-how-to-manage-them.aspx.

<sup>74</sup> Ibid.

<sup>&</sup>lt;sup>75</sup> DSEIR, p. 3.5-6; CPUC Fire-Threat Map, Adopted by CPUS January 19, 2018; available at <u>http://cpuc.ca.gov/general.aspx?id=6442454972.</u>

<sup>&</sup>lt;sup>76</sup> DSEIR, Section 4.2.4 and p. 4-19 ("Long term impacts associated with the project include potential damage to proposed BESS facility due to seismic hazards that could occur over the operational life of the Project.... The Project site is located in a seismically active area which would make it susceptible to seismic ground shaking in the event of an earthquake. Exposure of the site to strong seismic ground shaking is a potentially significant site-specific impact.").

<sup>&</sup>lt;sup>78</sup> John Ross Ferrara, PG&E Power Lines Tied to 12 Northern California Wildfires that Killed 18 Last Fall, Calfire Says; Eight Fire Investigations Sent to DAs' Offices for "Evidence of Alleged Violations of State Law," *Lost Coast Outpost*, June 10, 2018; available at <u>https://lostcoastoutpost.com/2018/jun/10/pge-power-lines-connected-12-northern-californias/</u>.

<sup>&</sup>lt;sup>79</sup> Cameron Polom, Solar Storage Facilities Present Unique Hazard for Firefighters, West Valley News, April 21, 2019; available at <u>https://www.abc15.com/news/region-west-valley/surprise/solar-storage-facilities-present-unique-hazard-for-firefighters</u>.

most of the fires.<sup>80</sup> Alternatively, a fire at the battery facility could trigger a major fire in the surrounding area.

In fact, the risk of fire at a battery storage facility such as the Project is a nonzero risk, regardless of the facility's design and the fire codes that are followed. Due to the potentially significant consequences, including release of toxic gases and damage to the adjacent CSE facility, the risk of fire and its consequences should have been quantitatively evaluated in a risk of upset analysis and mitigation proposed to minimize the risk. The DSEIR does not include a risk of upset analysis, or any analysis at all, of the likelihood of a fire and its consequences. Instead, it lays out a general fire protection plan, asserting that it reduces fire risk to less than significant, without ever estimating the unmitigated risk or demonstrating that the general mitigation (not disclosed in the DSEIR) will reduce the risk to an insignificant level.<sup>81</sup>

The DSEIR asserts that fire impacts will be addressed by using a monitoring and fire suppression system that will include water and/or other suppression agents, smoke detectors, control panels, alarms, piping, and nozzles that will comply with all codes in effect at the time of building permit submission<sup>82</sup> as well as an Emergency Response Plan (ERP) to protect against and respond to fires, should they occur.<sup>83</sup> However, the ERP is not included in the DSEIR, preventing review. Further, the details of the fire suppression system are not disclosed in the DSEIR, but deferred to the future, outside of CEQA review. Instead, "[t]he Applicant will work with the fire marshal to design the Project in compliance with all local codes and standards."<sup>84</sup> These are critical omissions because one of the major environmental issues that has been experienced with existing battery storage systems is fire. There is no guarantee that following existing or future fire codes, using an undisclosed fire suppression system, and following an undeveloped ERP will prevent fire and its consequences, as demonstrated by accidents at similar facilities, discussed in Comment 4.1.2.

<sup>&</sup>lt;sup>80</sup> Taryn Luna, California Utility Equipment Sparked More Than 2,000 Fires in Over Three Years, Los Angeles Times, January 28, 2019; available at <u>https://www.latimes.com/politics/la-pol-ca-california-utilities-wildfires-regulators-20190128-story.html</u>.

<sup>&</sup>lt;sup>81</sup> DSEIR, pp. 3.5-21/23.

<sup>&</sup>lt;sup>82</sup> DSEIR, p. 2-16.

<sup>&</sup>lt;sup>83</sup> DSEIR, p. 3.5-6/7.

<sup>&</sup>lt;sup>84</sup> DSEIR, p. 2-16, 2.5-20.

# 4.1.2. Fires at Existing Battery Storage Facilities Demonstrate That Lithium-Ion Battery Fires Pose a Serious Risk to Human Health and the Environment

Fires at existing battery storage facilities demonstrate the severe risk lithium-ion battery fires pose to human health and the environment. Fires have occurred at 23 battery storage facilities in Korea, caused by faulty battery management, system control, or battery protection systems, and faulty installation practices.<sup>85</sup> Fires have also occurred at battery storage facilities in the European Union, including in Belgium,<sup>86</sup> and in a Dreamliner 787 at Heathrow Airport.<sup>87</sup>

Several battery fires have occurred in Hawaii and Arizona. These fires can result in significant impacts that are not addressed by the DSEIR, including significant worker and public health impacts from hazardous air pollutants (HAPs) and damage to the adjacent solar facility. The DSEIR failed to even mention these existing fires.

For example, in describing firefighting challenges at a Hawaiian 10-MW battery storage system supporting a 12-turbine, 30-MW wind farm, the Honolulu Fire Department reported: <sup>88,89</sup>

<sup>&</sup>lt;sup>85</sup> Andy Colthorpe, Korea's ESS Fires: Batteries Not to Blame But Industry Takes Hit Anyway, PVTech, June 19, 2019; available at <u>https://www.energy-storage.news/news/koreas-ess-fires-batteries-not-to-blame-but-industry-takes-hit-anyway</u>.

<sup>&</sup>lt;sup>86</sup> Jason Deign, Engie Investigates Source of Belgian Battery Blaze, Energy Storage, December 18, 2017; available at <u>https://www.greentechmedia.com/articles/read/engie-investigates-source-of-belgian-battery-blaze#gs.y25569</u>.

<sup>&</sup>lt;sup>87</sup> AIG, Lithium-ion Battery Energy Storage Systems: The Risks and How to Manage Them; available at <u>https://www.aig.co.uk/content/dam/aig/emea/united-kingdom/documents/Insights/battery-</u>storage-systems-energy.pdf.

<sup>&</sup>lt;sup>88</sup> Fire at Kahuku Wind Farm Destroys Crucial Building, *Hawaii News Now*, August 1, 2012; available at <u>https://www.hawaiinewsnow.com/story/19173811/hfd-battling-kahuku-wind-farm-blaze/</u>.

<sup>&</sup>lt;sup>89</sup> Michael A. Stosser, What Are the Risks and What Regulations Should We Consider, DOE Energy Storage Safety Meeting, 2014. See also <u>https://www.energy.gov/sites/prod/files/</u> 2014/12/f19/OE%20Safety%20Strategic%20Plan%20December%202014.pdf; <u>http://www. hawaiinewsnow.com/story/19173811/hfd-battling-kahuku-wind-farm-blaze/; <u>https://www. scientificamerican.com/article/battery-fires-pose-new-risks-to-firefighters/.</u></u>

"This is a very dangerous environment to fight a fire in because of the confined nature of the warehouse. It's a big warehouse, but what's inside are rows of racks of batteries that have very small aisles in between"



"The risks from scalding heat, poisonous fumes, a collapsing structure and the potential for battery explosions kept firefighters outside the warehouse."<sup>90</sup> Firefighters at this site faced thick smoke, toxic fumes, and other hazards.<sup>91,92</sup> "The August ... fire, the third since opening in March 2011, was so fierce that firefighters could not enter the building for 7 hours."<sup>93</sup>

The typical layout for battery storage facilities is rows of batteries with narrow separating aisles. The DSEIR contains no information on the layout of batteries in the storage facility and thus fails as an informational document under CEQA. The DSEIR should have included a diagram showing facility layout, including number of battery storage buildings (one or two?), battery spacing, design of sprinkler system, and location of ancillary facilities. Other fire departments have reported: "Basically you need to overwhelm it with more water than you think you need."<sup>94</sup>

Responding to a fire at the proposed site, which is 2 miles from the nearest fire station,<sup>95</sup> could be challenging. In the case of the Hawaii fires discussed above, a recent

<sup>&</sup>lt;sup>90</sup> Irfan 2015.

<sup>91</sup> Ibid.

<sup>92</sup> Ibid.

<sup>&</sup>lt;sup>93</sup> Ros Davidson, Analysis: First Wind Project Avoids Storage After \$30m Fire, *Wind Power*, March 6, 2014; available at <a href="https://www.windpowermonthly.com/article/1284038/analysis-first-wind-project-avoids-storage-30m-fire">https://www.windpowermonthly.com/article/1284038/analysis-first-wind-project-avoids-storage-30m-fire</a>. See also Eric Wesoff, Battery Room Fire at Kahuku Wind-Energy Storage Farm, Energy Storage, August 3, 2012; available at <a href="https://www.greentechmedia.com/article/read/battery-room-fire-at-kahuku-wind-energy-storage-farm#gs.xdxv6h">https://www.greentechmedia.com/article/1284038/analysis-first-wind-project-avoids-storage-30m-fire</a>. See also Eric Wesoff, Battery Room Fire at Kahuku Wind-Energy Storage Farm, Energy Storage, August 3, 2012; available at <a href="https://www.greentechmedia.com/articles/read/battery-room-fire-at-kahuku-wind-energy-storage-farm#gs.xdxv6h">https://www.greentechmedia.com/articles/read/battery-room-fire-at-kahuku-wind-energy-storage-farm#gs.xdxv6h</a>.

<sup>&</sup>lt;sup>94</sup> Cameron Polom, Solar Storage Facilities Present Unique Hazard for Firefighters, *West Valley News*, April 21, 2019; available at <u>https://www.abc15.com/news/region-west-valley/surprise/solar-storage-facilities-present-unique-hazard-for-firefighters</u>.

<sup>&</sup>lt;sup>95</sup> Based on Google Maps, the nearest fire station is El Centro Fire Department Station 1, which is located about 2 miles from the Project site. See:

https://www.google.com/search?q=imperial+county+fire+station&npsic=0&rflfq=1&rlha=0&rllag=3278 2454,-

<sup>115106377,44480&</sup>amp;tbm=lcl&ved=2ahUKEwjRye2Iz6vkAhWJr54KHdCQBMUQtgN6BAgKEAQ&tbs=lrf:!2

article in Scientific American reported: "By the time you get enough firefighting forces and the right extinguishing sources, the fire is going to progress quite a bit."<sup>96</sup> It also explained: "One important lesson is to have fire response resources on-site, like dry chemicals and deployment systems." Further, in the case of the Project, the facility would be unmanned<sup>97</sup> in a rural location. This means firefighters from a distant location may have to extinguish a blaze without knowing what chemicals to use, where the electrical shutoffs are, or what kind of fire retardant to use.

The Hawaii fire occurred in August 2012 at a 12-turbine, 30-MW Kahuku wind farm, supported by a 15-MW battery from Xtreme Power. Firefighters did not enter the building until 7 hours after the flames started due to questions about the toxicity of the 12,000 batteries. Two other fires occurred in the battery storage building, attributed to ECI capacitors in inverters from Dynapower.<sup>98,99</sup>

Another major fire in the US recently occurred on April 19, 2019 in Surprise, Arizona at the APS McMicken Energy Storage Facility, equipped with two 2-MW AES Advancion battery arrays.<sup>100,101</sup> An explosion in the McMicken battery system led to a fire.<sup>102,103</sup> This event injured eight firefighters, one critically.<sup>104</sup> Four firefighters were

<sup>99</sup> *Hawaii News Now*, August 1, 2012.

<sup>100</sup> Ibid.

 $<sup>\</sup>frac{m1!1e2!3sIAE,lf:1,lf\_ui:2\&rldoc=1\#rlfi=hd:;si:;mv:!1m2!1d32.80983505834799!2d-115.53286897802207!2m2!1d32.76199462120436!2d-115.64659464025351!4m2!1d32.785918055927596!2d-115.58973180913779!5i14.$ 

<sup>&</sup>lt;sup>96</sup> Irfan 2015.

<sup>&</sup>lt;sup>97</sup> DSEIR, pp. 2-15, 3.1-16, 3.1-18, 3.7-15, 5-11, 5-18.

<sup>&</sup>lt;sup>98</sup> Eric Wesoff, Battery Room Fire at Kahuku Wind-Energy Storage Farm, GTM, August 3, 2012; available at <u>https://www.greentechmedia.com/articles/read/battery-room-fire-at-kahuku-wind-energy-storage-farm#gs.9exghx</u>.

<sup>&</sup>lt;sup>101</sup> Jennifer Runyon, APD Battery Energy Storage Facility Explosion Injures Four Firefighters; Industry Investigates, *Renewable Energy World*, April 23, 2019; available at <u>https://www.renewableenergy</u> world.com/articles/2019/04/aps-battery-energy-storage-facility-explosion-injures-four-firefighters-industry-investigates.html.

<sup>&</sup>lt;sup>102</sup> Arizona Public Service, Equipment Failure at McMicken Battery Facility, April 26, 2019; available at <u>https://www.aps.com/en/ourcompany/news/latestnews/Pages/mcmicken-battery-facility-notes.aspx</u>.

<sup>&</sup>lt;sup>103</sup> Julian Spector, What We Know and Don't Know About the Fire at an APS Battery Facility, April 23, 2019; available at <u>https://www.greentechmedia.com/articles/read/what-we-know-and-dont-know-about-the-fire-at-an-aps-battery-facility#gs.9czowd</u>.

<sup>&</sup>lt;sup>104</sup> Eight AZ Firefighters Hurt, One Critically, in Explosion, Firehouse.Com News, April 20, 2019; available at <u>https://www.firehouse.com/safety-health/news/21077221/eight-az-firefighters-injured-one-critically-in-a-large-utility-battery-explosion</u>.

hospitalized for chemical inhalation burns.<sup>105</sup> Of the firefighters injured, three required an extended hospital stay. The most serious injuries included a firefighter who had a "nose fracture, skull fracture, collapsed lung, rib fractures, broken tibia and fibula and an artery cut in his left leg." Others sustained multiple fractures, burns, and concussions.<sup>106</sup>

Firefighters are a significant at-risk population because batteries may rupture when exposed to extreme heat/fire, leaking corrosive materials, and/or emit toxic fumes. Burning batteries may emit acrid smoke, irritating fumes, and toxic fumes of fluoride, resulting in acute and chronic health effects in responding firefighters (and any nearby workers and residents). Acute health hazards include chemical inhalation burns and damage to lungs, eyes, and skin. Cobalt, present in the Project's batteries, is a suspected human carcinogen.<sup>107</sup>

The McMicken Facility fire was not the first APS battery fire. Another smaller fire has been reported at another APS system.<sup>108</sup> In November 2012, a 1.5-MW system at the APS Elden Substation near Flagstaff, Arizona, also caught fire.<sup>109</sup> The root cause analysis for this fire identified a near miss in May 2012 when a battery cell was severely discharged and the cell was continuously charged against its intended design.<sup>110</sup> Arizona Public Service recently shut down two other battery systems following the explosion.<sup>111</sup>

<sup>&</sup>lt;sup>105</sup> Julian Spector, What We Know and Don't Know About the Fire at an APS Battery Facility, GTM, April 23, 2019; available at <u>https://www.greentechmedia.com/articles/read/what-we-know-and-dont-know-about-the-fire-at-an-aps-battery-facility#gs.w82d63.</u>

<sup>&</sup>lt;sup>106</sup> Chris Dubay, Vice President/Chief Engineer, National Fire Protection Association, ENR Letters, August 21, 2019; available at <u>https://www.enr.com/articles/47377-letter-battery-storage-fire-risks-need-greater-attention</u>.

<sup>&</sup>lt;sup>107</sup> Honeywell, Material Safety Data Sheet, Lithium-ion Battery; available at <u>https://www.analog.com/</u> media/en/technical-documentation/application-notes/hdr202li hd220rli battery msds.pdf.

<sup>&</sup>lt;sup>108</sup> Karl-Erik Stromsta, APS and Fluence Investigating Explosion at Arizona Energy Storage Facility, GTM, April 22, 2019; available at <u>https://www.greentechmedia.com/articles/read/aps-and-fluence-investigating-explosion-at-arizona-energy-storage-facility#gs.9cnh9x</u>.

<sup>&</sup>lt;sup>109</sup> H. J. Mai, APS Storage Facility Explosion Raises Questions about Battery Safety, Utility Dive, April 30, 2019; available at <u>https://www.utilitydive.com/news/aps-storage-facility-explosion-raises-questions-about-battery-safety/553540/</u>. See also Eckhouse and Chediak, April 24, 2019; and Colthorpe, June 2019.

<sup>&</sup>lt;sup>110</sup> Sandra D. Kennedy, Commissioner, Re: In the Matter of the Commission's Inquiry of Arizona Public Service Battery Incident at the McMicken Energy Storage Facility Pursuant to Arizona Administrative Code R14-2-101, Docket No. E-01345A-19-076, August 2, 2019, p. 2; available at <u>https://docket.images.azcc.gov/E000002248.pdf</u>.

<sup>&</sup>lt;sup>111</sup> Mai, April 30, 2019.
The Arizona Corporation Commission (ACC) recently reviewed the 2019 APS McMicken Energy Storage Facility and 2012 APS Elden Substation near miss and concluded that "utility scale lithium ion batteries using the chemistries in those types of lithium ion batteries are not prudent and create unacceptable risks, particularly those with chemistries that include compounds that can release hydrogen fluoride in the event of a fire and/or explosion."<sup>112</sup> My review of the limited available information in the DSEIR indicates that the proposed BESS will use batteries with similar chemistries, mostly notably chemicals that include compounds that can release hydrogen fluoride.

The DSEIR indicates that the chemical composition of the lithium-ion batteries planned to be installed includes cobalt oxide; manganese dioxide; nickel oxide; carbon; unidentified electrolyte; polyvinylidene fluoride; aluminum foil; copper foil; aluminum; and inert materials.<sup>113</sup> However, the DSEIR failed to support this information with an MSDS from the battery supplier, to indicate the relative amounts of each compound present in the battery, or to confirm that no other chemicals were present. A recent letter from Tesla to the Arizona Corporation Commission explained that the term "lithium-ion batteries":<sup>114</sup>

actually encompasses a broad set of storage technologies – there are many different subchemistries of ithium-ion batteries, each with their own unique characteristics. Common lithium-ion sub-chemistries for stationary storage include nickel manganese cobalt oxide (NMC) and lithium iron phosphate (LFP) but there are many other sub-chemistries such as lithium manganese oxide (LMO) and nickel cobalt aluminum oxide (NCA). Different types of lithium-ion battery systems have different properties and associated risks.

Polyvinylidene fluoride decomposes into hydrogen fluoride gas in fires.<sup>115</sup> Hydrogen fluoride is an extremely poisonous gas.<sup>116</sup> As there are residences within 500 feet of the facility, a fire in the BESS would likely result in significant health impacts to

<sup>&</sup>lt;sup>112</sup> 8/2/19 APS Report.

<sup>&</sup>lt;sup>113</sup> DSEIR, pdf 78, Sec. 2.6.3.9.

<sup>&</sup>lt;sup>114</sup> Letter from Sarah Van Cleve, Manager, US Energy Policy, Tesla, Inc., to Arizona Corporation Commission, Re: Tesla Response to Commissioner Kennedy's August 2<sup>nd</sup> Letter Regarding Lithium-Ion Battery Safety/Docket No. E-01345A-19-0076, August 19, 2019; available at <u>https://docket.images.</u> azcc.gov/E000002454.pdf.

<sup>&</sup>lt;sup>115</sup> Craig L. Beyler and Marcelo M. Hirschler, Thermal Decomposition of Polymers, Chapter 7, Table 1-7.1; available at <u>https://pdfs.semanticscholar.org/d3fa/4a1616fd1457c02d4f477dcbdae706c9667f.pdf</u>; Material Safety Data Sheet, Poly(vinylidene fluoride), ("Combustion products include carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), **hydrogen fluoride**, and other pyrolysis products typical of burning organic material" (emphasis added)), pdf 3; available at <u>http://datasheets.scbt.com/sc-264080.pdf</u>.

<sup>&</sup>lt;sup>116</sup> CDC, Facts About Hydrogen Fluoride (Hydrofluoric Acid): "Breathing in hydrogen fluoride at high levels or in combination with skin contact can cause death from an irregular heartbeat or from fluid buildup in the lungs"; available at <u>https://emergency.cdc.gov/agent/hydrofluoricacid/basics/facts.asp</u>. See also ATSDR, Medical Guidelines for Hydrogen Fluoride; available at <u>https://www.atsdr.cdc.gov/MMG/MMG.asp?id=1142&tid=250</u>.

nearby residents, as well as workers at the adjacent solar facility. Thus, the DSEIR fails as an informational document under CEQA for failing to include an MSDS and other characterization data on the batteries that would be used and for failing to evaluate the health and other impacts of a BESS fire.

Further, the cobalt, nickel, copper, aluminum, and manganese in these batteries could be volatilized at the very high temperatures encountered in battery fires and result in significant environmental impacts, including adverse health impacts to firefighters, workers, and residents; and toxicity to vegetation, including farm crops in surrounding fields. These potential impacts are not disclosed or analyzed in the DSEIR.

The 2019 Kennedy analysis of the Arizona fires discloses fires with flame lengths of 10 to 15 feet that grew into flame lengths of 50 to 75 feet. The Flagstaff Fire Department Report for the 2012 incident expressed concerns about "a serious risk of a large-scale explosion." The ACC concluded that "a similar fire event at a very large lithium ion battery facility (250 MW+) would have very severe and potentially catastrophic consequences, and that responders would have a very difficult time trying to handle such an incident." The 2019 Kennedy report goes on to conclude:

To appropriately plan for such a catastrophic event, the large-scale lithium ion battery facility using the same chemistries as the APS Elden Substation (Flagstaff) facility fire and the McMicken facility would need to be built in isolation far from everything else, because an explosion could potentially level buildings at some distance from the battery facility site. The energy stored at a 2 MW battery facility is equivalent to 1.72 tons of TNT. The energy stored at a 250 MW battery facility is equivalent to 215 tons of TNT. Also, large amounts of hydrogen fluoride could be released and dispersed that would affect and harm the public at a substantial distance downwind. There would be concerns also about lingering hydrogen fluoride contamination in the affected areas.

Based on this analysis, an explosion at the proposed BESS would be equivalent to 108 tons of TNT. This is sufficient to seriously damage the adjacent solar facility and result in mortality of nearby residents and solar plant and agricultural workers. The DSEIR fails as an informational document under CEQA for failing to disclose and evaluate the risk and consequences of explosions at the proposed BESS.

#### 4.2. Handling and Transportation Accidents

CEQA Guidelines Section 15126.2(c) requires a discussion of any significant irreversible environmental change that would be caused by a project. A project would result in significant irreversible changes if it involves uses in which irreversible damage could result from any potential environmental accidents associated with the project.<sup>117</sup> The batteries will likely be shipped from warehouses in unknown location(s) and

<sup>&</sup>lt;sup>117</sup> 14 CCR § 15126.2; DSEIR, p. ES-8.

transported to the site from these undisclosed locations by undisclosed means (rail, truck, ship?), over undisclosed routes and roadways. These routes could include sensitive desert habitat that would be irreversibly damaged in the event of a transportation accident. Further, an explosion triggered by a fire during handling and transportation could result in injuries and deaths of workers and motorists and could irreversibly damage the immediately adjacent CSE facility, as well as other nearby solar facilities.<sup>118</sup>

Lithium-ion batteries are sensitive to damage, especially during handling and transport.<sup>119</sup> They are also sensitive to high ambient temperatures,<sup>120</sup> which will be experienced by the Project's batteries as they will have to pass through the desert areas of Imperial County. It is well known that battery accidents occur during handling, loading, and unloading in warehouses and during transportation.<sup>121</sup> The DSEIR fails to discuss the risk of accidents during battery storage, handling, and transportation to the site and thus fails as an informational document under CEQA.

## 5. HEALTH IMPACTS WERE NOT EVALUATED AND ARE POTENTIALLY SIGNIFICANT

The DSEIR did not evaluate health impacts of Project construction, operation, or decommissioning. As to Project construction, the DSEIR states that "[t]he construction activities and overall size of the proposed Project footprint is so small that cancer health risks from diesel particulate matter would not be anticipated. Decommissioning emissions are assumed to be similar to construction emissions."<sup>122</sup> The DSEIR is silent as to health impacts of Project operation.

In the event of a fire, which is possible given the history of similar facilities (Comment 4.1.2), toxic chemicals will be released. The DSEIR indicates that the chemical composition of the lithium-ion batteries planned to be installed is cobalt oxide, manganese dioxide, nickel oxide, carbon, unidentified electrolyte, polyvinylidene

<sup>&</sup>lt;sup>118</sup> DSEIR, pdf 289.

<sup>&</sup>lt;sup>119</sup> Kjell-Arne Jonsson, The Dangerous Consequences of Taking Shortcuts When Shipping Lithium Ion Batteries, March 9, 2018; available at <u>http://info.nefab.com/lib-blog/lithium-ion-batteries-shipping-shortcuts</u>.

<sup>&</sup>lt;sup>120</sup> Allianz Risk Consulting, Lithium-Ion Batteries, Risk Bulletin, 2017; available at <u>https://www.agcs.allianz.com/content/dam/onemarketing/agcs/agcs/pdfs-risk-advisory/risk-bulletins/ARC-Lithium-Ion-Batteries.pdf</u>.

<sup>&</sup>lt;sup>121</sup> FAA Office of Security and Hazardous Materials Safety, Lithium Batteries & Lithium Battery-Powered Devices, August 1, 2019; available at <u>https://www.faa.gov/hazmat/resources/lithium\_batteries/media/Battery\_incident\_chart.pdf</u>.

<sup>&</sup>lt;sup>122</sup> DSEIR, p. 3.1-16.

fluoride, aluminum foil, copper foil, aluminum, and inert materials.<sup>123</sup> As discussed below, the release of hydrogen fluoride (HF) during Li-ion battery fires is a well-known health risk.

# 5.1. Exposed Populations

The DSEIR does not contain a map that locates sensitive receptors (e.g., residences and workers). This is a critical omission. The on-site exposed populations include construction workers and support personnel at the BESS. Off-site exposed parties include workers at the adjacent CSE facility, agricultural workers in nearby agricultural fields, passengers in vehicles on adjacent roadways, and nearby residences. The facility will be located adjacent to Hwy 98. See Figure 1. The battery building will be located 489 feet south of Hwy 98 and 222 feet southwest of Drew Road.<sup>124</sup> A few rural residences and mobile homes are located about 500 feet east of the site and additional mobile homes are located to the north along SR 98 and Brockman Road. Motorists will be present on SR 98 and Brockman Road.<sup>125</sup> The Phase I ESA Reports in Appendix H disclose other rural residential properties.<sup>126</sup> Construction and operation of the Project will expose these populations to Hazardous Air Pollutants (HAPs).

# 5.2. Hazardous Air Pollutants

All of these sensitive receptors will be exposed to hazardous air pollutants (HAPs) from Project construction, operation, and decommissioning. Diesel particulate matter (DPM) will be emitted from on-road and off-road equipment during Project construction and decommissioning. DPM is a potent human carcinogen. It is also chronically<sup>127</sup> and acutely<sup>128</sup> toxic. California's Office of Environmental Health Hazard Assessment (OEHHA) concluded that "[e]xposure to diesel exhaust can have immediate health effects," which include "inflammation in the lungs, which may aggravate chronic respiratory symptoms and increase the frequency or intensity of

<sup>&</sup>lt;sup>123</sup> DSEIR, pdf 78, Sec. 2.6.3.9.

<sup>&</sup>lt;sup>124</sup> Scaled from DSEIR, Figure 2-3. See also Figure 2-6.

<sup>&</sup>lt;sup>125</sup> DSEIR, p. ES-4, 2-10.

<sup>&</sup>lt;sup>126</sup> DSEIR, Appendix H, pdf 134, 136.

<sup>&</sup>lt;sup>127</sup> OEHHA Acute, 8-hour and Chronic Reference Exposure Level (REL) Summary, June 28, 2016; available at <u>https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary</u>.

<sup>&</sup>lt;sup>128</sup> Government of Canada, Human Health Risk Assessment for Diesel Exhaust, March 4, 2016; available at <u>http://publications.gc.ca/collections/collection\_2016/sc-hc/H129-60-2016-eng.pdf.</u>

asthma attacks."<sup>129</sup> A fire or explosion at the battery storage facility would release other HAPs that could result in significant acute health impacts. See Comment 5.3.

The construction emission calculations of DPM (expressed as PM2.5) assumed the use of Tier 2 engines in all equipment.<sup>130</sup> However, the DSEIR does not make any commitment, as in a mitigation measure, requiring the use of Tier 2 equipment. In all instances in the DSEIR where Tier 2 is cited, it is cited as "expected to be Tier 2 compliant."<sup>131</sup> Thus, there is no requirement that Tier 2 equipment will be used. Tier 1 or other older equipment could be substituted,<sup>132</sup> which has DPM emissions that are at least three times higher than those from Tier 2 equipment.<sup>133</sup> Construction equipment DPM emissions could result in significant cancer, acute, and chronic health impacts to on-site workers and nearby off-site workers and residents.

# 5.3. Construction Health Impacts

The DSEIR did not evaluate construction health impacts. Project construction could result in significant health impacts from three sources: (1) diesel particulate matter (DPM) emitted by construction equipment; (2) HAPs released by battery accidents during battery building setup; and (3) pesticides and herbicides in disturbed soils.

First, the Office of Environmental Health Hazard Assessment's (OEHHA's) risk assessment guidelines require a formal health risk assessment for short-term construction exposures lasting longer than 2 months.<sup>134</sup> The OEHHA risk assessment guidelines, which are used throughout California for assessing health risks under CEQA, state:

<sup>&</sup>lt;sup>129</sup> OEHHA and the American Lung Association of California, Health Effects of Diesel Exhaust, available at <u>https://oehha.ca.gov/media/downloads/calenviroscreen/indicators/diesel4-02.pdf</u>.

<sup>&</sup>lt;sup>130</sup> DSEIR, Section 2.6.3.1 and Appendix B.

<sup>&</sup>lt;sup>131</sup> DSEIR, p. 2-12, 3.1-16, 3.1-20, 3.1-21, 3.1-22, 4-10, 4-11.

<sup>&</sup>lt;sup>132</sup> Compliance Guide to Construction Vehicles and Equipment, January 2019, pdf 4; available at <u>http://media.metro.net/projects\_studies/gcp/images/gcp\_arbscaqmd\_compliance\_guide\_to\_construction\_vehicles\_equipment.pdf</u>.

<sup>&</sup>lt;sup>133</sup> Emission Standards, Nonroad Diesel Engines, Table 1; available at <u>https://dieselnet.com/standards/us/nonroad.php</u>.

<sup>&</sup>lt;sup>134</sup> Office of Environmental Health Hazard Assessment (OEHHA), Risk Assessment Guidelines: Guidance Manual for Preparation of Health Risk Assessments, February 2015 (OEHHA 2015), Section 8.2.10: Cancer Risk Evaluation of Short Term Projects, pp. 8-17/18; available at <a href="https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0">https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0</a>.

Due to the uncertainty in assessing cancer risk from very short-term exposures, we do not recommend assessing cancer risk for projects lasting less than two months at the MEIR. We recommend that exposure from projects longer than 2 months but less than 6 months be assumed to last 6 months (e.g., a 2-month project would be evaluated as if it lasted 6 months). Exposure from projects lasting more than 6 months should be evaluated for the duration of the project. In all cases, for assessing risk to residential receptors, the exposure should be assumed to start in the third trimester to allow for the use of the ASFs (OEHHA, 2009). Thus, for example, if the District is evaluating a proposed 5-year mitigation project at a hazardous waste site, the cancer risks for the residents would be calculated based on exposures starting in the third trimester through the first five years of life.

For the MEIW, we recommend using the same minimum exposure requirements used for the residential receptor (i.e., no evaluation for projects less than 2 months; projects longer than 2 months but less than 6 months are assumed to last 6 months; projects longer than 6 months would be evaluated for the duration of the project). Although the off-site worker scenario assumes that the workers are 16 years of age or older with an Age-Sensitivity Factor of 1, another risk management consideration for short-term project cancer assessment is whether there are women of child bearing age at the worksite and whether the MEIW receptor has a daycare center. In this case, the Districts may wish to treat the off-site MEIW in the same way as the residential scenario to account for the higher susceptibility during the third trimester of pregnancy, and for higher susceptibility of infants and children.

Finally, the risk manager may want to consider a lower cancer risk threshold for risk management for very short-term projects. Typical District guidelines for evaluating risk management of Hot Spots facilities range around a cancer risk of 1 per 100,000 exposed persons as a trigger for risk management. Permitting thresholds also vary for each District. There is valid scientific concern that the rate of exposure may influence the risk – in other words, a higher exposure to a carcinogen over a short period of time may be a greater risk than the same total exposure spread over a much longer time period. In addition, it is inappropriate from a public health perspective to allow a lifetime acceptable risk to accrue in a short period of time (e.g., a very high exposure to a carcinogen over a short period of time resulting in a  $1 \times 10^{-5}$  cancer risk). Thus, consideration should be given for very short term projects to using a lower cancer risk trigger for permitting decisions.

The DSEIR does not contain the type of information normally relied upon to determine if the OEHHA risk assessment guidance is complied with, including a detailed construction schedule and maps that locate each project construction site and identify all nearby sensitive receptors, as well as their distance from construction work and duration of exposure. The conceptual construction schedule indicates that construction will last for about 12 months.<sup>135</sup>

Health risk assessments are routinely performed for construction projects. The proximity of identified sensitive receptors and the duration of construction indicate that

<sup>&</sup>lt;sup>135</sup> DSEIR, Section 0.2, p. ES-1 and Section 2.2, p. 2-4.

a health risk assessment should have been prepared for this Project. Based on my experience, I expect that cancer and acute health impacts from DPM would be significant for on-site construction workers and nearby residents.

Second, an accident could occur; for example, during offloading of the Li-ion batteries, their on-site storage, or setting up the batteries in the storage buildings. These accidents would release toxic compounds that could result in significant health impacts to construction workers, solar plant workers, agricultural workers, motorist on nearby roadways, and adjacent residents. The emissions of toxic gases can be a larger threat than heat if a battery fire occurred during battery building setup. See discussion of toxic emissions in Comment 5.2.

Third, the site was historically farmed and the soils may be contaminated with pesticides from these prior agricultural uses.<sup>136</sup> The DSEIR relies on studies conducted for the adjacent CSE facility, where pesticide residues were below regulatory levels.<sup>137</sup> Thus, the DSEIR concluded that hazards associated with exposure to pesticide and herbicide residues during construction, operation, and decommissioning are less than significant.<sup>138</sup> However, the DSEIR concluded that "there is a potential for the discovery of unidentified hazards during construction" and imposed Mitigation Measure HM-1,<sup>139</sup> which describes procedures for managing unidentified hazards and reducing potential impacts during construction to less than significant levels.<sup>140</sup>

Mitigation Measure HM-1 requires that "If during grading or excavation work, the contractor observes visual or olfactory evidence of contamination or if soil contamination is otherwise suspected, work near the excavation site shall be terminated, the work area cordoned off, and appropriate health and safety procedures implemented..."<sup>141</sup> Pesticide and herbicide contamination cannot be detected by visual observation or smell, but only by collecting soil samples and analyzing them for pesticides that were historically used in the area. Thus, this mitigation measure does nothing.

<sup>&</sup>lt;sup>136</sup> DSEIR, p. 3.5-1.

<sup>&</sup>lt;sup>137</sup> DSEIR, p. 3.5-5.

<sup>&</sup>lt;sup>138</sup> DSEIR, p. 3.5-18 ("Therefore, impacts associated with hazards through upset/release of hazardous materials resulting from exposure to pesticide residue and herbicides during construction, operation and decommissioning are considered less than significant.").

<sup>&</sup>lt;sup>139</sup> DSEIR, p. ES-33.

<sup>&</sup>lt;sup>140</sup> DSEIR, p. 3.5-18.

<sup>&</sup>lt;sup>141</sup> DSEIR, p. 3.5-18, Impact 3.5-2, MM HM-1.

Construction workers, nearby residents, and motorists will be exposed to residual pesticide contamination during construction. Thus, the DSEIR must be modified to require pesticide and herbicide testing in advance of construction and the results used to estimate health risks to workers and to determine if contaminated soils need to be removed prior to the start of construction.

# 5.4. Operational Health Impacts

As discussed in Comment 4.1, the DSEIR fails to discuss or evaluate the health impacts of thermal runaway or fire at the battery storage buildings. The fire history reviewed in Comment 4.1 indicates that there is a nonzero risk of thermal runaway and fires. Studies have demonstrated that the emission of toxic gases can be a larger threat to public health than the heat from a fire.<sup>142</sup>

Toxic compounds released during thermal runaway, for example, include primarily hydrogen fluoride (HF), carbon monoxide (CO), nitric oxide (NO), sulfur dioxide (SO2), hydrogen chloride (HCl), and hydrogen (H2).<sup>143</sup>

Many other toxic chemicals also have been identified in the combustion products of Li-ion batteries including:<sup>144,145</sup>

<sup>&</sup>lt;sup>142</sup> Jie Sun et al., Toxicity, a Serious Concern of Thermal Runaway from Commercial Li-ion Battery, *Nano Energy*, v. 27, pp. 313–319, 2016. Abstract at available at <u>https://www.infona.pl/resource/</u> <u>bwmeta1.element.elsevier-170baaf8-bfbd-35ed-b122-66f7a76c6e87</u>. Exhibit 8.

<sup>&</sup>lt;sup>143</sup> Ouyang et al. 2019, pp. 9–10. Exhibit 5.

<sup>&</sup>lt;sup>144</sup> Jie Sun et al. 2016, pp. 313–319. Exhibit 8.

<sup>&</sup>lt;sup>145</sup> Antonio Nedjalkov et al., Toxic Gas Emissions from Damaged Lithium Ion Batteries – Analysis and Safety Enhancement Solution, Batteries, 2016, Table 1. Exhibit 9.

Substance	Hazards According to EU Regulation (EG) Act 1272/2008
EMC	Eye irritation; flammable liquid; H226; H315; H319; H335; Skin irritation, specific target organ toxicity-single exposure.
DEC	Eye irritation; flammable liquid; H226; H315; H319; H335; skin irritation; specific target organ toxicity-single exposure.
EC	Eye irritation; H315; H319; H335; skin irritation; specific target organ toxicity-single exposure.
Benzene	Aspiration hazard; carcinogenicity; eye irritation; H225; H304; H315; H319; H340; H350; H372; germ cell mutagenicity.
Toluene	Aspiration hazard; flammable liquid; H225; H304; H315; H336; H361d; H373; reproductive toxicity; skin irritation; specific target organ toxicity-repeated exposure.
Styrene	Acute toxicity; eye irritation; flammable liquid.; H226; H315; H319; H332; H361d; H372; Skin irritation; Specific target organ toxicity-repeated exposure.
Biphenyl	Aquatic acute toxicity; aquatic chronic toxicity; eye irritation; H315; H319; H335; H400; H410.
Acrolein	Acute toxicity; aquatic acute toxicity; aquatic chronic toxicity; carcinogenicity; corrosive to the respiratory tract; eye damage; flammable liquid; H225; H300; H300 + H330; H302;H311;H314;H317;H318;H330;H341; H351; H400; H410; germ cell mutagenicity; skin corrosion; skin sensitization.
со	Acute toxicity; flammable gases; H220; H280; H331; H360DM H372M gases under pressure; reproductive toxicity; specific target organ toxicity-repeated exposure.
COS	Acute toxicity; eye irritation; flammable gases; H220; H280; H315; H319; H331; H335; Gases under pressure.
łydrogen fluoride	Acute toxicity; corrosive to the respiratory tract; H300; H310; H314; H330; skin corrosion.

Table 1: Toxic Chemicals Released During Thermal Runaway<sup>146</sup>

Among these, HF is generally present in the largest amount and is the most toxic. Studies have demonstrated that large amounts of HF may be generated during a battery fire, ranging between 20 and 200 mg/Wh of nominal battery energy capacity.<sup>147</sup> In addition, 15–22 mg/Wh of phosphoryl fluoride (POF<sub>3</sub>) is generated during fires. These are highly toxic chemicals. The Project consists of 125 MW of electrical storage capacity. Thus, a fire could generate 6 to 55 lb of HF and its derivate hydrofluoric acid,<sup>148</sup> and 4 to 6 lb of POF<sub>3</sub>.<sup>149</sup> The toxicity of HF and hydrofluoric acid is well known.<sup>150,151,152</sup> Hydrogen fluoride is one of the substances for which emissions must be

<sup>&</sup>lt;sup>146</sup> EMC = ethyl methyl carbonate; DEC = diethyl carbonate; EC = ethylene carbonate; CO = carbon monoxide; and COS = carbonyl sulfide.

<sup>&</sup>lt;sup>147</sup> Larson et al. 2017.

<sup>&</sup>lt;sup>148</sup> Amount of HF that could be generated during a fire: (20 mg/Wh)(125 MW)(1000 Wh/MW)/(1000 mg/g)(454 g/lb) = 5.5 lb. (200 mg/Wh)(125 MW)(1000 Wh/MW)/(1000 mg/g)(454 g/lb) = 55 \text{ lb}.

<sup>&</sup>lt;sup>149</sup> Amount of POF<sub>3</sub> that could be generated during a fire: (15 mg/Wh)(125 MW)(1000 Wh/MW)/(1000 mg/g)(454 g/lb) =**4.1 lb**. (22 mg/Wh) ((125 MW)(1000 Wh/MW)/(1000 mg/g)(454 g/lb) =**6.1 lb**.

<sup>&</sup>lt;sup>150</sup> Centers for Disease Control and Prevention, Hydrogen Fluoride (as F), Immediately Dangerous to Life or Health Concentrations (IDLHs), 1994; available at <a href="https://www.cdc.gov/niosh/idlh/7664393.html">https://www.cdc.gov/niosh/idlh/7664393.html</a>.

<sup>&</sup>lt;sup>151</sup> National Research Council, Committee on Toxicology, Acute Exposure Guideline Levels for Selected Airborne Chemicals, Volume 4, Subcommittee on Acute Exposure Guideline Levels, 2004; available at https://www.ncbi.nlm.nih.gov/books/NBK207732/.

quantified under the California Air Toxics Hot Spots Program.<sup>153</sup> Further, the use of water as an extinguishing agent may promote the formation of additional toxic gases and increase the production of HF.<sup>154</sup> The DSEIR indicates that the fire suppression system will include water.<sup>155</sup> Thus, the DSEIR fails as an informational document under CEQA. Experimental studies in which HF was measured indicate that "HF can pose a serious toxic threat, especially for large Li-ion batteries and in confined environments.... The release of hydrogen fluoride from a Li-ion battery fire can therefore be a severe risk and an even greater risk in confined or semi-confined spaces."<sup>156</sup> Another study concluded as follows:

Reaction of a widely used electrolyte salt –  $\text{LiPF}_6$  – upon contact with water is known to result in the generation of gaseous HF. This very toxic and corrosive compound poses a serious health risk upon exposure to it. Our assessment shows that at room temperature a release of ca. 20 ml of 1M LiPF<sub>6</sub> electrolyte into a room of ca. 62 m<sup>3</sup> may generate sufficient HF to reach an acute exposure concentration limit, such as PAC-2 level, where irreversible and other serious health effects are expected to occur. In

If the toxic chemicals in battery electrolytes are released in an enclosed space during thermal runaway, such as would be encountered during on-site battery storage, transportation and recycling and by maintenance workers or fire fighters at the facility, significant health impacts would result.<sup>157</sup> One recent study, for example, concluded as follows:<sup>158</sup>

<sup>&</sup>lt;sup>152</sup> OEHHA, OEHHA Acute, 8-hour and Chronic Reference Exposure Level (REL) Summary, June 28, 2015; available at <u>https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary</u>. See also: OEHHA, Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments, Appendices A, B, and C, 2015; available at <u>https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0</u>.

<sup>&</sup>lt;sup>153</sup> OEHHA, Air Toxics Hot Spots Program, Appendices A-F, p. A-10; available at <u>https://oehha.ca.gov/</u>media/downloads/crnr/2015gmappendicesaf.pdf.

<sup>&</sup>lt;sup>154</sup> Larson et al. 2017, Figure 5.

<sup>&</sup>lt;sup>155</sup> DSEIR, Section 2.6.4.1.

<sup>&</sup>lt;sup>156</sup> Larson et al. 2017.

<sup>&</sup>lt;sup>157</sup> Natalia P. Lebedeva and Lois Boon-Brett, Considerations on the Chemical Toxicity of Contemporary Li-Ion Battery Electrolytes and Their Components, *Journal of The Electrochemical Society*, v. 163, no. 6, 2016, p. A829, 2016, Exhibit 10.

<sup>&</sup>lt;sup>158</sup> Lebedeva and Boon-Brett 2016, p. A829, Exhibit 10.

Many of the currently used solvents are (very) volatile. Our calculations show that at room temperature a small solvent release, typically below ca. 250 ml, can evaporate and in a room of ca. 62 m<sup>3</sup> can result in the formation of a toxic atmosphere with concentration of the released compound reaching an acute exposure limit, such as PAC-2 level, where irreversible and other serious health effects are expected to occur.

The DSEIR fails to identify the solvent used in the batteries or to evaluate the health impacts of an accidental release. The available research indicates worker and public health impacts would be significant in the event of a fire or release of electrolytes during thermal runaway. Thus, the DSEIR fails as an informational document under CEQA for failing to identify and analyze health risks of thermal runaways and fires at the BESS.

#### 5.5. Aquatic Impacts

Finally, if an accident occurred during transport of the batteries to the site, releases into a waterway could result in acute and chronic toxicity.<sup>159</sup> The DSEIR is silent on aquatic toxicity and thus fails as an informational document under CEQA.

<sup>&</sup>lt;sup>159</sup> F. Gschwind et al., Fluoride Ion Batteries: Theoretical Performance, Safety, Toxicity, and a Combinatorial Screening of New Electrodes, *Journal of Fluorine Chemistry*, v. 182, Table 6. Exhibit 11.

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Dr. Fox has over 40 years of experience in the field of environmental engineering, including air pollution control (BACT, BART, MACT, LAER, RACT), greenhouse gas emissions and control, cost effectiveness analyses, water quality and water supply investigations, hydrology, hazardous waste investigations, environmental permitting, nuisance investigations (odor, noise), environmental impact reports, CEQA/NEPA documentation, risk assessments, and litigation support.

#### EDUCATION

- Ph.D. Environmental/Civil Engineering, University of California, Berkeley, 1980.
- M.S. Environmental/Civil Engineering, University of California, Berkeley, 1975.
- B.S. Physics (with high honors), University of Florida, Gainesville, 1971.

## REGISTRATION

Registered Professional Engineer: Arizona (2001-2014: #36701; retired), California (2002present; CH 6058), Florida (2001-present; #57886), Georgia (2002-2014; #PE027643; retired), Washington (2002-2014; #38692; retired), Wisconsin (2005-2014; #37595-006; retired) Board Certified Environmental Engineer, American Academy of Environmental Engineers, Certified in Air Pollution Control (DEE #01-20014), 2002-present

Qualified Environmental Professional (QEP), Institute of Professional Environmental Practice (QEP #02-010007), 2001-present

#### **PROFESSIONAL HISTORY**

Environmental Management, Principal, 1981-present Lawrence Berkeley National Laboratory, Principal Investigator, 1977-1981 University of California, Berkeley, Program Manager, 1976-1977 Bechtel, Inc., Engineer, 1971-1976, 1964-1966

#### **PROFESSIONAL AFFILIATIONS**

American Chemical Society (1981-2010) Phi Beta Kappa (1970-present) Sigma Pi Sigma (1970-present)

*Who's Who Environmental Registry*, PH Publishing, Fort Collins, CO, 1992. *Who's Who in the World*, Marquis Who's Who, Inc., Chicago, IL, 11th Ed., p. 371, 1993-present. *Who's Who of American Women*, Marquis Who's Who, Inc., Chicago, IL, 13th Ed., p. 264, 1984-

present. Who's Who in Science and Engineering, Marquis Who's Who, Inc., New Providence, NJ, 5<sup>th</sup> Ed., p. 414, 1999-present.

Who's Who in America, Marquis Who's Who, Inc., 59th Ed., 2005.

*Guide to Specialists on Toxic Substances*, World Environment Center, New York, NY, p. 80, 1980.

National Research Council Committee on Irrigation-Induced Water Quality Problems (Selenium), Subcommittee on Quality Control/Quality Assurance (1985-1990).

National Research Council Committee on Surface Mining and Reclamation, Subcommittee on Oil Shale (1978-80)

#### REPRESENTATIVE EXPERIENCE

Performed environmental and engineering investigations, as outlined below, for a wide range of industrial and commercial facilities including: petroleum refineries and upgrades thereto; reformulated fuels projects; refinery upgrades to process heavy sour crudes, including tar sands and light sweet crudes from the Eagle Ford and Bakken Formations; petroleum distribution terminals; coal, coke, and ore/mineral export terminals; LNG export, import, and storage terminals; crude-by-rail projects; shale oil plants; crude oil/condensate marine and rail terminals; coal gasification & liquefaction plants; conventional and thermally enhanced oil production; oil and gas production, including hydraulic fracking and acid stimulation treatments; underground storage tanks; pipelines; compressor stations; gasoline stations; landfills; railyards; hazardous waste treatment facilities; nuclear, hydroelectric, geothermal, wood, biomass, waste, tire-derived fuel, gas, oil, coke and coal-fired power plants; transmission lines; airports; hydrogen plants; petroleum coke calcining plants; coke plants; activated carbon manufacturing facilities; asphalt plants; cement plants; incinerators; flares; manufacturing facilities (e.g., semiconductors, electronic assembly, aerospace components, printed circuit boards, amusement park rides); lanthanide processing plants; ammonia plants; nitric acid plants; urea plants; food processing plants; almond hulling facilities; composting facilities; grain processing facilities; grain elevators; ethanol production facilities; soy bean oil extraction plants; biodiesel plants; paint formulation plants; wastewater treatment plants; marine terminals and ports; gas processing plants; steel mills; iron nugget production facilities; pig iron plant, based on blast furnace technology; direct reduced iron plant; acid regeneration facilities; railcar refinishing facility; battery manufacturing plants; pesticide manufacturing and repackaging facilities; pulp and paper mills; olefin plants; methanol plants; ethylene crackers; desalination plants; selective catalytic reduction (SCR) systems; selective noncatalytic reduction (SNCR) systems; halogen acid furnaces; contaminated

property redevelopment projects (e.g., Mission Bay, Southern Pacific Railyards, Moscone Center expansion, San Diego Padres Ballpark); residential developments; commercial office parks, campuses, and shopping centers; server farms; transportation plans; and a wide range of mines including sand and gravel, hard rock, limestone, nacholite, coal, molybdenum, gold, zinc, and oil shale.

#### EXPERT WITNESS/LITIGATION SUPPORT

- For the California Attorney General, assist in determining compliance with probation terms in the matter of People v. Chevron USA.
- For plaintiffs, assist in developing Petitioners' proof brief for National Parks Conservation Association et al v. U.S. EPA, Petition for Review of Final Administrative Action of the U.S. EPA, In the U.S. Court of Appeals for the Third Circuit, Docket No. 14-3147.
- For plaintiffs, expert witness in civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for historic modifications (1997-2000) at the Cemex cement plant in Lyons, Colorado. Reviewed produced documents, prepared expert and rebuttal reports on PSD applicability based on NOx emission calculations for a collection of changes considered both individually and collectively. Deposed August 2011. United States v. Cemex, Inc., In U.S. District Court for the District of Colorado (Civil Action No. 09-cv-00019-MSK-MEH). Case settled June 13, 2013.
- For plaintiffs, in civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for historic modifications (1988 2000) at James De Young Units 3, 4, and 5. Reviewed produced documents, analyzed CEMS and EIA data, and prepared netting and BACT analyses for NOx, SO2, and PM10 (PSD case). Expert report February 24, 2010 and affidavit February 20, 2010. *Sierra Club v. City of Holland, et al.*, U.S. District Court, Western District of Michigan (Civil Action 1:08-cv-1183). Case settled. Consent Decree 1/19/14.
- For plaintiffs, in civil action alleging failure to obtain MACT permit, expert on potential to
  emit hydrogen chloride (HCl) from a new coal-fired boiler. Reviewed record, estimated HCl
  emissions, wrote expert report June 2010 and March 2013 (Cost to Install a Scrubber at the
  Lamar Repowering Project Pursuant to Case-by-Case MACT), deposed August 2010 and
  March 2013. Wildearth Guardian et al. v. Lamar Utilities Board, Civil Action No. 09-cv02974, U.S. District Court, District of Colorado. Case settled August 2013.
- For plaintiffs, expert witness on permitting, emission calculations, and wastewater treatment for coal-to-gasoline plant. Reviewed produced documents. Assisted in preparation of comments on draft minor source permit. Wrote two affidavits on key issues in case. Presented direct and rebuttal testimony 10/27 - 10/28/10 on permit enforceability and failure to properly calculate potential to emit, including underestimate of flaring emissions and

omission of VOC and CO emissions from wastewater treatment, cooling tower, tank roof landings, and malfunctions. *Sierra Club, Ohio Valley Environmental Coalition, Coal River Mountain Watch, West Virginia Highlands Conservancy v. John Benedict, Director, Division of Air Quality, West Virginia Department of Environmental Protection and TransGas Development System, LLC*, Appeal No. 10-01-AQB. Virginia Air Quality Board remanded the permit on March 28, 2011 ordering reconsideration of potential to emit calculations, including: (1) support for assumed flare efficiency; (2) inclusion of startup, shutdown and malfunction emissions; and (3) inclusion of wastewater treatment emissions in potential to emit calculations.

- For plaintiffs, expert on BACT emission limits for gas-fired combined cycle power plant.
   Prepared declaration in support of CBE's Opposition to the United States' Motion for Entry of Proposed Amended Consent Decree. Assisted in settlement discussions. U.S. EPA, Plaintiff, Communities for a Better Environment, Intervenor Plaintiff, v. Pacific Gas & Electric Company, et al., U.S. District Court, Northern District of California, San Francisco Division, Case No. C-09-4503 SI.
- Technical expert in confidential settlement discussions with large coal-fired utility on BACT control technology and emission limits for NOx, SO2, PM, PM2.5, and CO for new natural gas fired combined cycle and simple cycle turbines with oil backup. (July 2010). Case settled.
- For plaintiffs, expert witness in remedy phase of civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for historic modifications (1998-99) at Gallagher Units 1 and 3. Reviewed produced documents, prepared expert and rebuttal reports on historic and current-day BACT for SO2, control costs, and excess emissions of SO2. Deposed 11/18/09. United States et al. v. Cinergy, et al., In U.S. District Court for the Southern District of Indiana, Indianapolis Division, Civil Action No. IP99-1693 C-M/S. Settled 12/22/09.
- For plaintiffs, expert witness on MACT, BACT for NOx, and enforceability in an administrative appeal of draft state air permit issued for four 300-MW pet-coke-fired CFBs. Reviewed produced documents and prepared prefiled testimony. Deposed 10/8/09 and 11/9/09. Testified 11/10/09. Application of Las Brisas Energy Center, LLC for State Air Quality Permit; before the State Office of Administrative Hearings, Texas. Permit remanded 3/29/10 as LBEC failed to meet burden of proof on a number of issues including MACT. Texas Court of Appeals dismissed an appeal to reinstate the permit. The Texas Commission on Environmental Quality and Las Brisas Energy Center, LLC sought to overturn the Court of Appeals decision but moved to have their appeal dismissed in August 2013.
- For defense, expert witness in unlawful detainer case involving a gasoline station, minimart, and residential property with contamination from leaking underground storage tanks. Reviewed agency files and inspected site. Presented expert testimony on July 6, 2009, on

causes of, nature and extent of subsurface contamination. *A. Singh v. S. Assaedi*, in Contra Costa County Superior Court, CA. Settled August 2009.

- For plaintiffs, expert witness on netting and enforceability for refinery being upgraded to process tar sands crude. Reviewed produced documents. Prepared expert and rebuttal reports addressing use of emission factors for baseline, omitted sources including coker, flares, tank landings and cleaning, and enforceability. Deposed. In the Matter of Objection to the Issuance of Significant Source Modification Permit No. 089-25484-00453 to BP Products North America Inc., Whiting Business Unit, Save the Dunes Council, Inc., Sierra Club., Inc., Hoosier Environmental Council et al., Petitioners, B. P. Products North American, Respondents/Permittee, before the Indiana Office of Environmental Adjudication.
- For plaintiffs, expert witness on BACT, MACT, and enforceability in appeal of Title V
  permit issued to 600 MW coal-fired power plant burning Powder River Basin coal. Prepared
  technical comments on draft air permit. Reviewed record on appeal, drafted BACT, MACT,
  and enforceability pre-filed testimony. Drafted MACT and enforceability pre-filed rebuttal
  testimony. Deposed March 24, 2009. Testified June 10, 2009. *In Re: Southwestern Electric
  Power Company*, Arkansas Pollution Control and Ecology Commission, Consolidated
  Docket No. 08-006-P. Recommended Decision issued December 9, 2009 upholding issued
  permit. Commission adopted Recommended Decision January 22, 2010.
- For plaintiffs, expert witness in remedy phase of civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for historic modifications (1989-1992) at Wabash Units 2, 3 and 5. Reviewed produced documents, prepared expert and rebuttal report on historic and current-day BACT for NOx and SO2, control costs, and excess emissions of NOx, SO2, and mercury. Deposed 10/21/08. United States et al. v. Cinergy, et al., In U.S. District Court for the Southern District of Indiana, Indianapolis Division, Civil Action No. IP99-1693 C-M/S. Testified 2/3/09. Memorandum Opinion & Order 5-29-09 requiring shutdown of Wabash River Units 2, 3, 5 by September 30, 2009, run at baseline until shutdown, and permanently surrender SO2 emission allowances.
- For plaintiffs, expert witness in liability phase of civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for three historic modifications (1997-2001) at two portland cement plants involving three cement kilns. Reviewed produced documents, analyzed CEMS data covering subject period, prepared netting analysis for NOx, SO<sub>2</sub> and CO, and prepared expert and rebuttal reports. *United States v. Cemex California Cement*, In U.S. District Court for the Central District of California, Eastern Division, Case No. ED CV 07-00223-GW (JCRx), Settled 1/15/09.
- For intervenors Clean Wisconsin and Citizens Utility Board, prepared data requests, reviewed discovery and expert report. Prepared prefiled direct, rebuttal and surrebuttal testimony on cost to extend life of existing Oak Creek Units 5-8 and cost to address future regulatory requirements to determine whether to control or shutdown one or more of the units. Oral testimony 2/5/08. Application for a Certificate of Authority to Install Wet Flue

Gas Desulfurization and Selective Catalytic Reduction Facilities and Associated Equipment for Control of Sulfur Dioxide and Nitrogen Oxide Emissions at Oak Creek Power Plant Units 5, 6, 7 and 8, WPSC Docket No. 6630-CE-299.

- For plaintiffs, expert witness on alternatives analysis and BACT for NOx, SO2, total PM10, and sulfuric acid mist in appeal of PSD permit issued to 1200 MW coal fired power plant burning Powder River Basin and/or Central Appalachian coal (Longleaf). Assisted in drafting technical comments on NOx on draft permit. Prepared expert disclosure. Presented 8+ days of direct and rebuttal expert testimony. Attended all 21 days of evidentiary hearing from 9/5/07 10/30/07 assisting in all aspects of hearing. *Friends of the Chatahooche and Sierra Club v. Dr. Carol Couch, Director, Environmental Protection Division of Natural Resources Department, Respondent, and Longleaf Energy Associates, Intervener.* ALJ Final Decision 1/11/08 denying petition. ALJ Order vacated & remanded for further proceedings, Fulton County Superior Court, 6/30/08. Court of Appeals of GA remanded the case with directions that the ALJ's final decision be vacated to consider the evidence under the correct standard of review, July 9, 2009. The ALJ issued an opinion April 2, 2010 in favor of the applicant. Final permit issued April 2010.
- For plaintiffs, expert witness on diesel exhaust in inverse condemnation case in which Port expanded maritime operations into residential neighborhoods, subjecting plaintiffs to noise, light, and diesel fumes. Measured real-time diesel particulate concentrations from marine vessels and tug boats on plaintiffs' property. Reviewed documents, depositions, DVDs, and photographs provided by counsel. Deposed. Testified October 24, 2006. Ann Chargin, Richard Hackett, Carolyn Hackett, et al. v. Stockton Port District, Superior Court of California, County of San Joaquin, Stockton Branch, No. CV021015. Judge ruled for plaintiffs.
- For plaintiffs, expert witness on NOx emissions and BACT in case alleging failure to obtain necessary permits and install controls on gas-fired combined-cycle turbines. Prepared and reviewed (applicant analyses) of NOx emissions, BACT analyses (water injection, SCR, ultra low NOx burners), and cost-effectiveness analyses based on site visit, plant operating records, stack tests, CEMS data, and turbine and catalyst vendor design information.
  Participated in negotiations to scope out consent order. *United States v. Nevada Power*. Case settled June 2007, resulting in installation of dry low NOx burners (5 ppm NOx averaged over 1 hr) on four units and a separate solar array at a local business.
- For plaintiffs, expert witness in appeal of PSD permit issued to 850 MW coal fired boiler burning Powder River Basin coal (Iatan Unit 2) on BACT for particulate matter, sulfuric acid mist and opacity and emission calculations for alleged historic violations of PSD. Assisted in drafting technical comments, petition for review, discovery requests, and responses to discovery requests. Reviewed produced documents. Prepared expert report on BACT for particulate matter. Assisted with expert depositions. Deposed February 7, 8, 27, 28, 2007. *In Re PSD Construction Permit Issued to Great Plains Energy, Kansas City Power & Light – Iatan Generating Station, Sierra Club v. Missouri Department of Natural Resources, Great*

*Plains Energy, and Kansas City Power & Light.* Case settled March 27, 2007, providing offsets for over 6 million ton/yr of CO2 and lower NOx and SO<sub>2</sub> emission limits.

- For plaintiffs, expert witness in remedy phase of civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for historic modifications of coal-fired boilers and associated equipment. Reviewed produced documents, prepared expert report on cost to retrofit 24 coal-fired power plants with scrubbers designed to remove 99% of the sulfur dioxide from flue gases. Prepared supplemental and expert report on cost estimates and BACT for SO2 for these 24 complaint units. Deposed 1/30/07 and 3/14/07. *United States and State of New York et al. v. American Electric Power*, In U.S. District Court for the Southern District of Ohio, Eastern Division, Consolidated Civil Action Nos. C2-99-1182 and C2-99-1250. Settlement announced 10/9/07.
- For plaintiffs, expert witness on BACT, enforceability, and alternatives analysis in appeal of PSD permit issued for a 270-MW pulverized coal fired boiler burning Powder River Basin coal (City Utilities Springfield Unit 2). Reviewed permitting file and assisted counsel draft petition and prepare and respond to interrogatories and document requests. Reviewed interrogatory responses and produced documents. Assisted with expert depositions. Deposed August 2005. Evidentiary hearings October 2005. In the Matter of Linda Chipperfield and Sierra Club v. Missouri Department of Natural Resources. Missouri Supreme Court denied review of adverse lower court rulings August 2007.
- For plaintiffs, expert witness in civil action relating to plume touchdowns at AEP's Gavin coal-fired power plant. Assisted counsel draft interrogatories and document requests. Reviewed responses to interrogatories and produced documents. Prepared expert report "Releases of Sulfuric Acid Mist from the Gavin Power Station." The report evaluates sulfuric acid mist releases to determine if AEP complied with the requirements of CERCLA Section 103(a) and EPCRA Section 304. This report also discusses the formation, chemistry, release characteristics, and abatement of sulfuric acid mist in support of the claim that these releases present an imminent and substantial endangerment to public health under Section 7002(a)(1)(B) of the Resource Conservation and Recovery Act ("RCRA"). *Citizens Against Pollution v. Ohio Power Company*, In the U.S. District Court for the Southern District of Ohio, Eastern Division, Civil Action No. 2-04-cv-371. Case settled 12-8-06.
- For petitioners, expert witness in contested case hearing on BACT, enforceability, and emission estimates for an air permit issued to a 500-MW supercritical Power River Basin coal-fired boiler (Weston Unit 4). Assisted counsel prepare comments on draft air permit and respond to and draft discovery. Reviewed produced file, deposed (7/05), and prepared expert report on BACT and enforceability. Evidentiary hearings September 2005. *In the Matter of an Air Pollution Control Construction Permit Issued to Wisconsin Public Service Corporation for the Construction and Operation of a 500 MW Pulverized Coal-fired Power Plant Known as Weston Unit 4 in Marathon County, Wisconsin*, Case No. IH-04-21. The Final Order, issued 2/10/06, lowered the NOx BACT limit from 0.07 lb/MMBtu to 0.06

lb/MMBtu based on a 30-day average, added a BACT SO2 control efficiency, and required a 0.0005% high efficiency drift eliminator as BACT for the cooling tower. The modified permit, including these provisions, was issued 3/28/07. Additional appeals in progress.

- For plaintiffs, adviser on technical issues related to Citizen Suit against U.S. EPA regarding failure to update New Source Performance Standards for petroleum refineries, 40 CFR 60, Subparts J, VV, and GGG. *Our Children's Earth Foundation and Sierra Club v. U.S. EPA et al.* Case settled July 2005. CD No. C 05-00094 CW, U.S. District Court, Northern District of California Oakland Division. Proposed revisions to standards of performance for petroleum refineries published 72 FR 27178 (5/14/07).
- For interveners, reviewed proposed Consent Decree settling Clean Air Act violations due to historic modifications of boilers and associated equipment at two coal-fired power plants. In response to stay order, reviewed the record, selected one representative activity at each of seven generating units, and analyzed to identify CAA violations. Identified NSPS and NSR violations for NOx, SO<sub>2</sub>, PM/PM10, and sulfuric acid mist. Summarized results in an expert report. United States of America, and Michael A. Cox, Attorney General of the State of Michigan, ex rel. Michigan Department of Environmental Quality, Plaintiffs, and Clean Wisconsin, Sierra Club, and Citizens' Utility Board, Intervenors, v. Wisconsin Electric Power Company, Defendant, U.S. District Court for the Eastern District of Wisconsin, Civil Action No. 2:03-CV-00371-CNC. Order issued 10-1-07 denying petition.
- For a coalition of Nevada labor organizations (ACE), reviewed preliminary determination to issue a Class I Air Quality Operating Permit to Construct and supporting files for a 250-MW pulverized coal-fired boiler (Newmont). Prepared about 100 pages of technical analyses and comments on BACT, MACT, emission calculations, and enforceability. Assisted counsel draft petition and reply brief appealing PSD permit to U.S. EPA Environmental Appeals Board (EAB). Order denying review issued 12/21/05. *In re Newmont Nevada Energy Investment, LLC, TS Power Plant*, PSD Appeal No. 05-04 (EAB 2005).
- For petitioners and plaintiffs, reviewed and prepared comments on air quality and hazardous waste based on negative declaration for refinery ultra low sulfur diesel project located in SCAQMD. Reviewed responses to comments and prepared responses. Prepared declaration and presented oral testimony before SCAQMD Hearing Board on exempt sources (cooling towers) and calculation of potential to emit under NSR. Petition for writ of mandate filed March 2005. Case remanded by Court of Appeals to trial court to direct SCAQMD to reevaluate the potential environmental significance of NOx emissions resulting from the project in accordance with court's opinion. California Court of Appeals, Second Appellate Division, on December 18, 2007, affirmed in part (as to baseline) and denied in part. *Communities for a Better Environment v. South Coast Air Quality Management District and ConocoPhillips.* Certified for partial publication 1/16/08. Appellate Court opinion upheld by CA Supreme Court 3/15/10. (2010) 48 Cal.4th 310.

- For amici seeking to amend a proposed Consent Decree to settle alleged NSR violations at Chevron refineries, reviewed proposed settlement, related files, subject modifications, and emission calculations. Prepared declaration on emission reductions, identification of NSR and NSPS violations, and BACT/LAER for FCCUs, heaters and boilers, flares, and sulfur recovery plants. U.S. et al. v. Chevron U.S.A., Northern District of California, Case No. C 03-04650. Memorandum and Order Entering Consent Decree issued June 2005. Case No. C 03-4650 CRB.
- For petitioners, prepared declaration on enforceability of periodic monitoring requirements, in response to EPA's revised interpretation of 40 CFR 70.6(c)(1). This revision limited additional monitoring required in Title V permits. 69 FR 3203 (Jan. 22, 2004). *Environmental Integrity Project et al. v. EPA* (U.S. Court of Appeals for the District of Columbia). Court ruled the Act requires all Title V permits to contain monitoring requirements to assure compliance. *Sierra Club v. EPA*, 536 F.3d 673 (D.C. Cir. 2008).
- For interveners in application for authority to construct a 500 MW supercritical coal-fired generating unit before the Wisconsin Public Service Commission, prepared pre-filed written direct and rebuttal testimony with oral cross examination and rebuttal on BACT and MACT (Weston 4). Prepared written comments on BACT, MACT, and enforceability on draft air permit for same facility.
- For property owners in Nevada, evaluated the environmental impacts of a 1,450-MW coalfired power plant proposed in a rural area adjacent to the Black Rock Desert and Granite Range, including emission calculations, air quality modeling, comments on proposed use permit to collect preconstruction monitoring data, and coordination with agencies and other interested parties. Project cancelled.
- For environmental organizations, reviewed draft PSD permit for a 600-MW coal-fired power plant in West Virginia (Longview). Prepared comments on permit enforceability; coal washing; BACT for SO<sub>2</sub> and PM10; Hg MACT; and MACT for HCl, HF, non-Hg metallic HAPs, and enforceability. Assist plaintiffs draft petition appealing air permit. Retained as expert to develop testimony on MACT, BACT, offsets, enforceability. Participate in settlement discussions. Case settled July 2004.
- For petitioners, reviewed record produced in discovery and prepared affidavit on emissions of carbon monoxide and volatile organic compounds during startup of GE 7FA combustion turbines to successfully establish plaintiff standing. *Sierra Club et al. v. Georgia Power Company* (Northern District of Georgia).
- For building trades, reviewed air quality permitting action for 1500-MW coal-fired power plant before the Kentucky Department for Environmental Protection (Thoroughbred).
- For petitioners, expert witness in administrative appeal of the PSD/Title V permit issued to a 1500-MW coal-fired power plant. Reviewed over 60,000 pages of produced documents, prepared discovery index, identified and assembled plaintiff exhibits. Deposed. Assisted

counsel in drafting discovery requests, with over 30 depositions, witness cross examination, and brief drafting. Presented over 20 days of direct testimony, rebuttal and sur-rebuttal, with cross examination on BACT for NOx, SO<sub>2</sub>, and PM/PM10; MACT for Hg and non-Hg metallic HAPs; emission estimates for purposes of Class I and II air modeling; risk assessment; and enforceability of permit limits. Evidentiary hearings from November 2003 to June 2004. *Sierra Club et al. v. Natural Resources & Environmental Protection Cabinet, Division of Air Quality and Thoroughbred Generating Company et al.* Hearing Officer Decision issued August 9, 2005 finding in favor of plaintiffs on counts as to risk, BACT (IGCC/CFB, NOx, SO<sub>2</sub>, Hg, Be), single source, enforceability, and errors and omissions. Assist counsel draft exceptions. Cabinet Secretary issued Order April 11, 2006 denying Hearing Offer's report, except as to NOx BACT, Hg, 99% SO2 control and certain errors and omissions.

- For citizens group in Massachusetts, reviewed, commented on, and participated in permitting of pollution control retrofits of coal-fired power plant (Salem Harbor).
- Assisted citizens group and labor union challenge issuance of conditional use permit for a 317,000 ft<sup>2</sup> discount store in Honolulu without any environmental review. In support of a motion for preliminary injunction, prepared 7-page declaration addressing public health impacts of diesel exhaust from vehicles serving the Project. In preparation for trial, prepared 20-page preliminary expert report summarizing results of diesel exhaust and noise measurements at two big box retail stores in Honolulu, estimated diesel PM10 concentrations for Project using ISCST, prepared a cancer health risk assessment based on these analyses, and evaluated noise impacts.
- Assisted environmental organizations to challenge the DOE Finding of No Significant Impact (FONSI) for the Baja California Power and Sempra Energy Resources Cross-Border Transmissions Lines in the U.S. and four associated power plants located in Mexico (DOE EA-1391). Prepared 20-page declaration in support of motion for summary judgment addressing emissions, including CO<sub>2</sub> and NH<sub>3</sub>, offsets, BACT, cumulative air quality impacts, alternative cooling systems, and water use and water quality impacts. Plaintiff's motion for summary judgment granted in part. U.S. District Court, Southern District decision concluded that the Environmental Assessment and FONSI violated NEPA and the APA due to their inadequate analysis of the potential controversy surrounding the project, water impacts, impacts from NH<sub>3</sub> and CO<sub>2</sub>, alternatives, and cumulative impacts. *Border Power Plant Working Group v. Department of Energy and Bureau of Land Management*, Case No. 02-CV-513-IEG (POR) (May 2, 2003).
- For Sacramento school, reviewed draft air permit issued for diesel generator located across from playfield. Prepared comments on emission estimates, enforceability, BACT, and health impacts of diesel exhaust. Case settled. BUG trap installed on the diesel generator.
- Assisted unions in appeal of Title V permit issued by BAAQMD to carbon plant that manufactured coke. Reviewed District files, identified historic modifications that should have triggered PSD review, and prepared technical comments on Title V permit. Reviewed

responses to comments and assisted counsel draft appeal to BAAQMD hearing board, opening brief, motion to strike, and rebuttal brief. Case settled.

- Assisted California Central Coast city obtain controls on a proposed new city that would straddle the Ventura-Los Angeles County boundary. Reviewed several environmental impact reports, prepared an air quality analysis, a diesel exhaust health risk assessment, and detailed review comments. Governor intervened and State dedicated the land for conservation purposes April 2004.
- Assisted Central California city to obtain controls on large alluvial sand quarry and asphalt plant proposing a modernization. Prepared comments on Negative Declaration on air quality, public health, noise, and traffic. Evaluated process flow diagrams and engineering reports to determine whether proposed changes increased plant capacity or substantially modified plant operations. Prepared comments on application for categorical exemption from CEQA. Presented testimony to County Board of Supervisors. Developed controls to mitigate impacts. Assisted counsel draft Petition for Writ. Case settled June 2002. Substantial improvements in plant operations were obtained including cap on throughput, dust control measures, asphalt plant loadout enclosure, and restrictions on truck routes.
- Assisted oil companies on the California Central Coast in defending class action citizen's lawsuit alleging health effects due to emissions from gas processing plant and leaking underground storage tanks. Reviewed regulatory and other files and advised counsel on merits of case. Case settled November 2001.
- Assisted oil company on the California Central Coast in defending property damage claims arising out of a historic oil spill. Reviewed site investigation reports, pump tests, leachability studies, and health risk assessments, participated in design of additional site characterization studies to assess health impacts, and advised counsel on merits of case. Prepare health risk assessment.
- Assisted unions in appeal of Initial Study/Negative Declaration ("IS/ND") for an MTBE phaseout project at a Bay Area refinery. Reviewed IS/ND and supporting agency permitting files and prepared technical comments on air quality, groundwater, and public health impacts. Reviewed responses to comments and final IS/ND and ATC permits and assisted counsel to draft petitions and briefs appealing decision to Air District Hearing Board. Presented sworn direct and rebuttal testimony with cross examination on groundwater impacts of ethanol spills on hydrocarbon contamination at refinery. Hearing Board ruled 5 to 0 in favor of appellants, remanding ATC to district to prepare an EIR.
- Assisted Florida cities in challenging the use of diesel and proposed BACT determinations in prevention of significant deterioration (PSD) permits issued to two 510-MW simple cycle peaking electric generating facilities and one 1,080-MW simple cycle/combined cycle facility. Reviewed permit applications, draft permits, and FDEP engineering evaluations, assisted counsel in drafting petitions and responding to discovery. Participated in settlement discussions. Cases settled or applications withdrawn.

- Assisted large California city in federal lawsuit alleging peaker power plant was violating its federal permit. Reviewed permit file and applicant's engineering and cost feasibility study to reduce emissions through retrofit controls. Advised counsel on feasible and cost-effective NOx, SOx, and PM10 controls for several 1960s diesel-fired Pratt and Whitney peaker turbines. Case settled.
- Assisted coalition of Georgia environmental groups in evaluating BACT determinations and permit conditions in PSD permits issued to several large natural gas-fired simple cycle and combined-cycle power plants. Prepared technical comments on draft PSD permits on BACT, enforceability of limits, and toxic emissions. Reviewed responses to comments, advised counsel on merits of cases, participated in settlement discussions, presented oral and written testimony in adjudicatory hearings, and provided technical assistance as required. Cases settled or won at trial.
- Assisted construction unions in review of air quality permitting actions before the Indiana Department of Environmental Management ("IDEM") for several natural gas-fired simple cycle peaker and combined cycle power plants.
- Assisted coalition of towns and environmental groups in challenging air permits issued to 523 MW dual fuel (natural gas and distillate) combined-cycle power plant in Connecticut. Prepared technical comments on draft permits and 60 pages of written testimony addressing emission estimates, startup/shutdown issues, BACT/LAER analyses, and toxic air emissions. Presented testimony in adjudicatory administrative hearings before the Connecticut Department of Environmental Protection in June 2001 and December 2001.
- Assisted various coalitions of unions, citizens groups, cities, public agencies, and developers in licensing and permitting of over 110 coal, gas, oil, biomass, and pet coke-fired power plants generating over 75,000 MW of electricity. These included base-load, combined cycle, simple cycle, and peaker power plants in Alaska, Arizona, Arkansas, California, Colorado, Georgia, Florida, Illinois, Indiana, Kentucky, Michigan, Missouri, Ohio, Oklahoma, Oregon, Texas, West Virginia, Wisconsin, and elsewhere. Prepared analyses of and comments on applications for certification, preliminary and final staff assessments, and various air, water, wastewater, and solid waste permits issued by local agencies. Presented written and oral testimony before various administrative bodies on hazards of ammonia use and transportation, health effects of air emissions, contaminated property issues, BACT/LAER issues related to SCR and SCONOx, criteria and toxic pollutant emission estimates, MACT analyses, air quality modeling, water supply and water quality issues, and methods to reduce water use, including dry cooling, parallel dry-wet cooling, hybrid cooling, and zero liquid discharge systems.
- Assisted unions, cities, and neighborhood associations in challenging an EIR issued for the proposed expansion of the Oakland Airport. Reviewed two draft EIRs and prepared a health risk assessment and extensive technical comments on air quality and public health impacts. The California Court of Appeals, First Appellate District, ruled in favor of appellants and

plaintiffs, concluding that the EIR "2) erred in using outdated information in assessing the emission of toxic air contaminants (TACs) from jet aircraft; 3) failed to support its decision not to evaluate the health risks associated with the emission of TACs with meaningful analysis," thus accepting my technical arguments and requiring the Port to prepare a new EIR. See *Berkeley Keep Jets Over the Bay Committee, City of San Leandro, and City of Alameda et al. v. Board of Port Commissioners* (August 30, 2001) 111 Cal.Rptr.2d 598.

- Assisted lessor of former gas station with leaking underground storage tanks and TCE contamination from adjacent property. Lessor held option to purchase, which was forfeited based on misrepresentation by remediation contractor as to nature and extent of contamination. Remediation contractor purchased property. Reviewed regulatory agency files and advised counsel on merits of case. Case not filed.
- Advised counsel on merits of several pending actions, including a Proposition 65 case involving groundwater contamination at an explosives manufacturing firm and two former gas stations with leaking underground storage tanks.
- Assisted defendant foundry in Oakland in a lawsuit brought by neighbors alleging property contamination, nuisance, trespass, smoke, and health effects from foundry operation. Inspected and sampled plaintiff's property. Advised counsel on merits of case. Case settled.
- Assisted business owner facing eminent domain eviction. Prepared technical comments on a negative declaration for soil contamination and public health risks from air emissions from a proposed redevelopment project in San Francisco in support of a CEQA lawsuit. Case settled.
- Assisted neighborhood association representing residents living downwind of a Berkeley
  asphalt plant in separate nuisance and CEQA lawsuits. Prepared technical comments on air
  quality, odor, and noise impacts, presented testimony at commission and council meetings,
  participated in community workshops, and participated in settlement discussions. Cases
  settled. Asphalt plant was upgraded to include air emission and noise controls, including
  vapor collection system at truck loading station, enclosures for noisy equipment, and
  improved housekeeping.
- Assisted a Fortune 500 residential home builder in claims alleging health effects from faulty installation of gas appliances. Conducted indoor air quality study, advised counsel on merits of case, and participated in discussions with plaintiffs. Case settled.
- Assisted property owners in Silicon Valley in lawsuit to recover remediation costs from insurer for large TCE plume originating from a manufacturing facility. Conducted investigations to demonstrate sudden and accidental release of TCE, including groundwater modeling, development of method to date spill, preparation of chemical inventory, investigation of historical waste disposal practices and standards, and on-site sewer and storm drainage inspections and sampling. Prepared declaration in opposition to motion for summary judgment. Case settled.

- Assisted residents in east Oakland downwind of a former battery plant in class action lawsuit alleging property contamination from lead emissions. Conducted historical research and dry deposition modeling that substantiated claim. Participated in mediation at JAMS. Case settled.
- Assisted property owners in West Oakland who purchased a former gas station that had leaking underground storage tanks and groundwater contamination. Reviewed agency files and advised counsel on merits of case. Prepared declaration in opposition to summary judgment. Prepared cost estimate to remediate site. Participated in settlement discussions. Case settled.
- Consultant to counsel representing plaintiffs in two Clean Water Act lawsuits involving selenium discharges into San Francisco Bay from refineries. Reviewed files and advised counsel on merits of case. Prepared interrogatory and discovery questions, assisted in deposing opposing experts, and reviewed and interpreted treatability and other technical studies. Judge ruled in favor of plaintiffs.
- Assisted oil company in a complaint filed by a resident of a small California beach community alleging that discharges of tank farm rinse water into the sanitary sewer system caused hydrogen sulfide gas to infiltrate residence, sending occupants to hospital. Inspected accident site, interviewed parties to the event, and reviewed extensive agency files related to incident. Used chemical analysis, field simulations, mass balance calculations, sewer hydraulic simulations with SWMM44, atmospheric dispersion modeling with SCREEN3, odor analyses, and risk assessment calculations to demonstrate that the incident was caused by a faulty drain trap and inadequate slope of sewer lateral on resident's property. Prepared a detailed technical report summarizing these studies. Case settled.
- Assisted large West Coast city in suit alleging that leaking underground storage tanks on city property had damaged the waterproofing on downgradient building, causing leaks in an underground parking structure. Reviewed subsurface hydrogeologic investigations and evaluated studies conducted by others documenting leakage from underground diesel and gasoline tanks. Inspected, tested, and evaluated waterproofing on subsurface parking structure. Waterproofing was substandard. Case settled.
- Assisted residents downwind of gravel mine and asphalt plant in Siskiyou County, California, in suit to obtain CEQA review of air permitting action. Prepared two declarations analyzing air quality and public health impacts. Judge ruled in favor of plaintiffs, closing mine and asphalt plant.
- Assisted defendant oil company on the California Central Coast in class action lawsuit alleging property damage and health effects from subsurface petroleum contamination. Reviewed documents, prepared risk calculations, and advised counsel on merits of case. Participated in settlement discussions. Case settled.

- Assisted defendant oil company in class action lawsuit alleging health impacts from remediation of petroleum contaminated site on California Central Coast. Reviewed documents, designed and conducted monitoring program, and participated in settlement discussions. Case settled.
- Consultant to attorneys representing irrigation districts and municipal water districts to evaluate a potential challenge of USFWS actions under CVPIA section 3406(b)(2).
   Reviewed agency files and collected and analyzed hydrology, water quality, and fishery data. Advised counsel on merits of case. Case not filed.
- Assisted residents downwind of a Carson refinery in class action lawsuit involving soil and groundwater contamination, nuisance, property damage, and health effects from air emissions. Reviewed files and provided advise on contaminated soil and groundwater, toxic emissions, and health risks. Prepared declaration on refinery fugitive emissions. Prepared deposition questions and reviewed deposition transcripts on air quality, soil contamination, odors, and health impacts. Case settled.
- Assisted residents downwind of a Contra Costa refinery who were affected by an accidental release of naphtha. Characterized spilled naphtha, estimated emissions, and modeled ambient concentrations of hydrocarbons and sulfur compounds. Deposed. Presented testimony in binding arbitration at JAMS. Judge found in favor of plaintiffs.
- Assisted residents downwind of Contra Costa County refinery in class action lawsuit alleging
  property damage, nuisance, and health effects from several large accidents as well as routine
  operations. Reviewed files and prepared analyses of environmental impacts. Prepared
  declarations, deposed, and presented testimony before jury in one trial and judge in second.
  Case settled.
- Assisted business owner claiming damages from dust, noise, and vibration during a sewer construction project in San Francisco. Reviewed agency files and PM10 monitoring data and advised counsel on merits of case. Case settled.
- Assisted residents downwind of Contra Costa County refinery in class action lawsuit alleging
  property damage, nuisance, and health effects. Prepared declaration in opposition to summary
  judgment, deposed, and presented expert testimony on accidental releases, odor, and nuisance
  before jury. Case thrown out by judge, but reversed on appeal and not retried.
- Presented testimony in small claims court on behalf of residents claiming health effects from hydrogen sulfide from flaring emissions triggered by a power outage at a Contra Costa County refinery. Analyzed meteorological and air quality data and evaluated potential health risks of exposure to low concentrations of hydrogen sulfide. Judge awarded damages to plaintiffs.
- Assisted construction unions in challenging PSD permit for an Indiana steel mill. Prepared technical comments on draft PSD permit, drafted 70-page appeal of agency permit action to

the Environmental Appeals Board challenging permit based on faulty BACT analysis for electric arc furnace and reheat furnace and faulty permit conditions, among others, and drafted briefs responding to four parties. EPA Region V and the EPA General Counsel intervened as amici, supporting petitioners. EAB ruled in favor of petitioners, remanding permit to IDEM on three key issues, including BACT for the reheat furnace and lead emissions from the EAF. Drafted motion to reconsider three issues. Prepared 69 pages of technical comments on revised draft PSD permit. Drafted second EAB appeal addressing lead emissions from the EAF and BACT for reheat furnace based on European experience with SCR/SNCR. Case settled. Permit was substantially improved. See *In re: Steel Dynamics, Inc.*, PSD Appeal Nos. 99-4 & 99-5 (EAB June 22, 2000).

- Assisted defendant urea manufacturer in Alaska in negotiations with USEPA to seek relief from penalties for alleged violations of the Clean Air Act. Reviewed and evaluated regulatory files and monitoring data, prepared technical analysis demonstrating that permit limits were not violated, and participated in negotiations with EPA to dismiss action. Fines were substantially reduced and case closed.
- Assisted construction unions in challenging PSD permitting action for an Indiana grain mill. Prepared technical comments on draft PSD permit and assisted counsel draft appeal of agency permit action to the Environmental Appeals Board challenging permit based on faulty BACT analyses for heaters and boilers and faulty permit conditions, among others. Case settled.
- As part of a consent decree settling a CEQA lawsuit, assisted neighbors of a large west coast port in negotiations with port authority to secure mitigation for air quality impacts. Prepared technical comments on mobile source air quality impacts and mitigation and negotiated a \$9 million CEQA mitigation package. Represented neighbors on technical advisory committee established by port to implement the air quality mitigation program. Program successfully implemented.
- Assisted construction unions in challenging permitting action for a California hazardous waste incinerator. Prepared technical comments on draft permit, assisted counsel prepare appeal of EPA permit to the Environmental Appeals Board. Participated in settlement discussions on technical issues with applicant and EPA Region 9. Case settled.
- Assisted environmental group in challenging DTSC Negative Declaration on a hazardous waste treatment facility. Prepared technical comments on risk of upset, water, and health risks. Writ of mandamus issued.
- Assisted several neighborhood associations and cities impacted by quarries, asphalt plants, and cement plants in Alameda, Shasta, Sonoma, and Mendocino counties in obtaining mitigations for dust, air quality, public health, traffic, and noise impacts from facility operations and proposed expansions.

- For over 100 industrial facilities, commercial/campus, and redevelopment projects, developed the record in preparation for CEQA and NEPA lawsuits. Prepared technical comments on hazardous materials, solid wastes, public utilities, noise, worker safety, air quality, public health, water resources, water quality, traffic, and risk of upset sections of EIRs, EISs, FONSIs, initial studies, and negative declarations. Assisted counsel in drafting petitions and briefs and prepared declarations.
- For several large commercial development projects and airports, assisted applicant and counsel prepare defensible CEQA documents, respond to comments, and identify and evaluate "all feasible" mitigation to avoid CEQA challenges. This work included developing mitigation programs to reduce traffic-related air quality impacts based on energy conservation programs, solar, low-emission vehicles, alternative fuels, exhaust treatments, and transportation management associations.

# SITE INVESTIGATION/REMEDIATION/CLOSURE

- Technical manager and principal engineer for characterization, remediation, and closure of waste management units at former Colorado oil shale plant. Constituents of concern included BTEX, As, 1,1,1-TCA, and TPH. Completed groundwater monitoring programs, site assessments, work plans, and closure plans for seven process water holding ponds, a refinery sewer system, and processed shale disposal area. Managed design and construction of groundwater treatment system and removal actions and obtained clean closure.
- Principal engineer for characterization, remediation, and closure of process water ponds at a former lanthanide processing plant in Colorado. Designed and implemented groundwater monitoring program and site assessments and prepared closure plan.
- Advised the city of Sacramento on redevelopment of two former railyards. Reviewed work plans, site investigations, risk assessment, RAPS, RI/FSs, and CEQA documents.
   Participated in the development of mitigation strategies to protect construction and utility workers and the public during remediation, redevelopment, and use of the site, including buffer zones, subslab venting, rail berm containment structure, and an environmental oversight plan.
- Provided technical support for the investigation of a former sanitary landfill that was redeveloped as single family homes. Reviewed and/or prepared portions of numerous documents, including health risk assessments, preliminary endangerment assessments, site investigation reports, work plans, and RI/FSs. Historical research to identify historic waste disposal practices to prepare a preliminary endangerment assessment. Acquired, reviewed, and analyzed the files of 18 federal, state, and local agencies, three sets of construction field notes, analyzed 21 aerial photographs and interviewed 14 individuals associated with operation of former landfill. Assisted counsel in defending lawsuit brought by residents

alleging health impacts and diminution of property value due to residual contamination. Prepared summary reports.

- Technical oversight of characterization and remediation of a nitrate plume at an explosives manufacturing facility in Lincoln, CA. Provided interface between owners and consultants. Reviewed site assessments, work plans, closure plans, and RI/FSs.
- Consultant to owner of large western molybdenum mine proposed for NPL listing. Participated in negotiations to scope out consent order and develop scope of work. Participated in studies to determine premining groundwater background to evaluate applicability of water quality standards. Served on technical committees to develop alternatives to mitigate impacts and close the facility, including resloping and grading, various thickness and types of covers, and reclamation. This work included developing and evaluating methods to control surface runoff and erosion, mitigate impacts of acid rock drainage on surface and ground waters, and stabilize nine waste rock piles containing 328 million tons of pyrite-rich, mixed volcanic waste rock (andesites, rhyolite, tuff). Evaluated stability of waste rock piles. Represented client in hearings and meetings with state and federal oversight agencies.

#### REGULATORY (PARTIAL LIST)

- In April 2016, prepared supplemental comments on Valero Benicia Crude by Rail Project, focused on on-site impacts and impacts at the unloading terminal, in response to request for a stay to appeal Planning Commission decision.
- In February 2016, prepared comments on Final Environmental Impact Report, Santa Maria Rail Spur Project.
- In February 2016, prepared comments on Final Environmental Impact Report, Valero Benicia Crude by Rail Project.
- In January 2016, prepared comments on Draft Programmatic Environmental Impact Report for the Southern California Association of Government's (SCAG) 2016-2040 Regional Transportation Plan/Sustainable Communities Strategy.
- In November 2015, prepared comments on Final Environmental Impact Report for Revisions to the Kern County Zoning Ordinance – 2015(C) (Focused on Oil and Gas Local Permitting), November 2015.
- In October 2015, prepared comments on Revised Draft Environmental Report, Valero Benicia Crude by Rail Project.
- In September 2015, prepared report, "Environmental, Health and Safety Impacts of the Proposed Oakland Bulk and Oversized Terminal, and presented oral testimony on September 21, 2015 before Oakland City Council on behalf of the Sierra Club.

- In September 2015, prepared comments on revisions to two chapters of EPA's Air Pollution Control Cost Manual: Docket ID No. EPA-HQ-OAR-2015-0341.
- In June 2015, prepared comments on DEIR for the CalAm Monterey Peninsula Water Supply Project.
- In April 2015, prepared comments on proposed Title V Operating Permit Revision and Prevention of Significant Deterioration Permit for Arizona Public Service's Ocotillo Power Plant Modernization Project (5 GE LMS100 105-MW simple cycle turbines operated as peakers), in Tempe, Arizona.
- In March 2015, prepared "Comments on Proposed Title V Air Permit, Yuhuang Chemical Inc. Methanol Plant, St. James, Louisiana".
- In January 2015, prepared cost effectiveness analysis for SCR for a 500-MW coal fire power plant, to address unpermitted upgrades in 2000.
- In January 2015, prepared comments on Revised Final Environmental Impact Report for the Phillips 66 Propane Recovery Project.
- In December 2014, prepared "Report on Bakersfield Crude Terminal Permits to Operate." In response, the U.S. EPA cited the Terminal for 10 violations of the Clean Air Act.
- In December 2014, prepared comments on Revised Draft Environmental Impact Report for the Phillips 66 Propane Recovery Project.
- In November 2014, prepared comments on Revised Draft Environmental Impact Report for Phillips 66 Rail Spur Extension Project and Crude Unloading Project, Santa Maria, CA to allow the import of tar sands crudes.
- In November 2014, prepared comments on Draft Environmental Impact Report for Phillips 66 Ultra Low Sulfur Diesel Project, responding to the California Supreme Court Decision, *Communities for a Better Environment v. South Coast Air Quality Management Dist. (2010) 48 Cal.4th* 310.
- In November 2014, prepared comments on Draft Environmental Impact Report for the Tesoro Avon Marine Oil Terminal Lease Consideration.
- In October 2014, prepared: "Report on Hydrogen Cyanide Emissions from Fluid Catalytic Cracking Units", pursuant to the Petroleum Refinery Sector Risk and Technology Review and New Source Performance Standards, 79 FR 36880.
- In October 2014, prepared technical comments on Final Environmental Impact Reports for Alon Bakersfield Crude Flexibility Project to build a rail terminal to allow the import/export of tar sands and Bakken crude oils and to upgrade an existing refinery to allow it to process a wide range of crudes.

- In October 2014, prepared technical comments on the Title V Permit Renewal and three De Minimus Significant Revisions for the Tesoro Logistics Marine Terminal in the SCAQMD.
- In August 2014, for EPA Region 6, prepared technical report on costing methods for upgrades to existing scrubbers at coal-fired power plants.
- In July 2014, prepared technical comments on Draft Final Environmental Impact Reports for Alon Bakersfield Crude Flexibility Project to build a rail terminal to allow the import/export of tar sands and Bakken crude oils and to upgrade an existing refinery to allow it to process a wide range of crudes.
- In June 2014, prepared technical report on Initial Study and Draft Negative Declaration for the Tesoro Logistics Storage Tank Replacement and Modification Project.
- In May 2014, prepared technical comments on Intent to Approve a new refinery and petroleum transloading operation in Utah.
- In March and April 2014, prepared declarations on air permits issued for two crude-by-rail terminals in California, modified to switch from importing ethanol to importing Bakken crude oils by rail and transferring to tanker cars. Permits were issued without undergoing CEQA review. One permit was upheld by the San Francisco Superior Court as statute of limitations had run. The Sacramento Air Quality Management District withdrew the second one due to failure to require BACT and conduct CEQA review.
- In March 2014, prepared technical report on Negative Declaration for a proposed modification of the air permit for a bulk petroleum and storage terminal to the allow the import of tar sands and Bakken crude oil by rail and its export by barge, under the New York State Environmental Quality Review Act (SEQRA).
- In February 2014, prepared technical report on proposed modification of air permit for midwest refinery upgrade/expansion to process tar sands crudes.
- In January 2014, prepared cost estimates to capture, transport, and use CO2 in enhanced oil recovery, from the Freeport LNG project based on both Selexol and Amine systems.
- In January 2014, prepared technical report on Draft Environmental Impact Report for Phillips 66 Rail Spur Extension Project, Santa Maria, CA. Comments addressed project description (piecemealing, crude slate), risk of upset analyses, mitigation measures, alternative analyses and cumulative impacts.
- In November 2013, prepared technical report on 3333 the Phillips 66 Propane Recovery Project, Rodeo, CA. Comments addressed project description (piecemealing, crude slate) and air quality impacts.
- In September 2013, prepared technical report on the Draft Authority to Construct Permit for the Casa Diablo IV Geothermal Development Project Environmental Impact Report and Declaration in Support of Appeal and Petition for Stay, U.S. Department of the Interior,

Board of Land Appeals, Appeal of Decision Record for the Casa Diablo IV Geothermal Development Project.

- In September 2013, prepared technical report on Effluent Limitation Guidelines for Best Available Technology Economically Available (BAT) for Bottom Ash Transport Waters from Coal-Fired Power Plants in the Steam Electric Power Generating Point Source Category.
- In July 2013, prepared technical report on Initial Study/Mitigated Negative Declaration for the Valero Crude by Rail Project, Benicia, California, Use Permit Application 12PLN-00063.
- In July 2013, prepared technical report on fugitive particulate matter emissions from coal train staging at the proposed Coyote Island Terminal, Oregon, for draft Permit No. 25-0015-ST-01.
- In July 2013, prepared technical comments on air quality impacts of the Finger Lakes LPG Storage Facility as reported in various Environmental Impact Statements.
- In July 2013, prepared technical comments on proposed Greenhouse Gas PSD Permit for the Celanese Clear Lake Plant, including cost analysis of CO2 capture, transport, and sequestration.
- In June/July 2013, prepared technical comments on proposed Draft PSD Preconstruction Permit for Greenhouse Gas Emission for the ExxonMobil Chemical Company Baytown Olefins Plant, including cost analysis of CO2 capture, transport, and sequestration.
- In June 2013, prepared technical report on a Mitigated Negative Declaration for a new rail terminal at the Valero Benicia Refinery to import increased amounts of "North American" crudes. Comments addressed air quality impacts of refining increased amounts of tar sands crudes.
- In June 2013, prepared technical report on Draft Environmental Impact Report for the California Ethanol and Power Imperial Valley 1 Project.
- In May 2013, prepared comments on draft PSD permit for major expansion of midwest refinery to process 100% tar sands crudes, including a complex netting analysis involving debottlenecking, piecemealing, and BACT analyses.
- In April 2013, prepared technical report on the Draft Supplemental Environmental Impact Statement (DSEIS) for the Keystone XL Pipeline on air quality impacts from refining increased amount of tar sands crudes at Refineries in PADD 3.
- In October 2012, prepared technical report on the Environmental Review for the Coyote Island Terminal Dock at the Port of Morrow on fugitive particulate matter emissions.
- In October 2012-October 2014, review and evaluate Flint Hills West Application for an expansion/modification for increased (Texas, Eagle Ford Shale) crude processing and related modification, including netting and BACT analysis. Assist in settlement discussions.

- In February 2012, prepared comments on BART analysis in PA Regional Haze SIP, 77 FR 3984 (Jan. 26, 2012). On Sept. 29, 2015, a federal appeals court overturned the U.S. EPA's approval of this plan, based in part on my comments, concluding "...we will vacate the 2014 Final Rule to the extent it approved Pennsylvania's source-specific BART analysis and remand to the EPA for further proceedings consistent with this Opinion." Nat'l Parks Conservation Assoc. v. EPA, 3d Cir., No. 14-3147, 9/19/15.
- Prepared cost analyses and comments on New York's proposed BART determinations for NOx, SO2, and PM and EPA's proposed approval of BART determinations for Danskammer Generating Station under New York Regional Haze State Implementation Plan and Federal Implementation Plan, 77 FR 51915 (August 28, 2012).
- Prepared cost analyses and comments on NOx BART determinations for Regional Haze State Implementation Plan for State of Nevada, 77 FR 23191 (April 18, 2012) and 77 FR 25660 (May 1, 2012).
- Prepared analyses of and comments on New Source Performance Standards for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units, 77 FR 22392 (April 13, 2012).
- Prepared comments on CASPR-BART emission equivalency and NOx and PM BART determinations in EPA proposed approval of State Implementation Plan for Pennsylvania Regional Haze Implementation Plan, 77 FR 3984 (January 26, 2012).
- Prepared comments and statistical analyses on hazardous air pollutants (HAPs) emission controls, monitoring, compliance methods, and the use of surrogates for acid gases, organic HAPs, and metallic HAPs for proposed National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units, 76 FR 24976 (May 3, 2011).
- Prepared cost analyses and comments on NOx BART determinations and emission reductions for proposed Federal Implementation Plan for Four Corners Power Plant, 75 FR 64221 (October 19, 2010).
- Prepared cost analyses and comments on NOx BART determinations for Colstrip Units 1-4 for Montana State Implementation Plan and Regional Haze Federal Implementation Plan, 77 FR 23988 (April 20, 2010).
- For EPA Region 8, prepared report: Revised BART Cost Effectiveness Analysis for Tail-End Selective Catalytic Reduction at the Basin Electric Power Cooperative Leland Olds Station Unit 2 Final Report, March 2011, in support of 76 FR 58570 (Sept. 21, 2011).
- For EPA Region 6, prepared report: Revised BART Cost-Effectiveness Analysis for Selective Catalytic Reduction at the Public Service Company of New Mexico San Juan Generating Station, November 2010, in support of 76 FR 52388 (Aug. 22, 2011).

- For EPA Region 6, prepared report: Revised BART Cost-Effectiveness Analysis for Flue Gas Desulfurization at Coal-Fired Electric Generating Units in Oklahoma: Sooner Units 1 & 2, Muskogee Units 4 & 5, Northeastern Units 3 &4, October 2010, in support of 76 FR 16168 (March 26, 2011). My work was upheld in: *State of Oklahoma v. EPA*, App. Case 12-9526 (10th Cri. July 19, 2013).
- Identified errors in N<sub>2</sub>O emission factors in the Mandatory Greenhouse Gas Reporting Rule, 40 CFR 98, and prepared technical analysis to support Petition for Rulemaking to Correct Emissions Factors in the Mandatory Greenhouse Gas Reporting Rule, filed with EPA on 10/28/10.
- Assisted interested parties develop input for and prepare comments on the Information Collection Request for Petroleum Refinery Sector NSPS and NESHAP Residual Risk and Technology Review, 75 FR 60107 (9/29/10).
- Technical reviewer of EPA's "Emission Estimation Protocol for Petroleum Refineries," posted for public comments on CHIEF on 12/23/09, prepared in response to the City of Houston's petition under the Data Quality Act (March 2010).
- Prepared comments on SCR cost effectiveness for EPA's Advanced Notice of Proposed Rulemaking, Assessment of Anticipated Visibility Improvements at Surrounding Class I Areas and Cost Effectiveness of Best Available Retrofit Technology for Four Corners Power Plant and Navajo Generating Station, 74 FR 44313 (August 28, 2009).
- Prepared comments on Proposed Rule for Standards of Performance for Coal Preparation and Processing Plants, 74 FR 25304 (May 27, 2009).
- Prepared comments on draft PSD permit for major expansion of midwest refinery to process up to 100% tar sands crudes. Participated in development of monitoring and controls to mitigate impacts and in negotiating a Consent Decree to settle claims in 2008.
- Reviewed and assisted interested parties prepare comments on proposed Kentucky air toxic regulations at 401 KAR 64:005, 64:010, 64:020, and 64:030 (June 2007).
- Prepared comments on proposed Standards of Performance for Electric Utility Steam Generating Units and Small Industrial-Commercial-Industrial Steam Generating Units, 70 FR 9706 (February 28, 2005).
- Prepared comments on Louisville Air Pollution Control District proposed Strategic Toxic Air Reduction regulations.
- Prepared comments and analysis of BAAQMD Regulation, Rule 11, Flare Monitoring at Petroleum Refineries.
- Prepared comments on Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary

Sources: Electricity Utility Steam Generating Units (MACT standards for coal-fired power plants).

- Prepared Authority to Construct Permit for remediation of a large petroleum-contaminated site on the California Central Coast. Negotiated conditions with agencies and secured permits.
- Prepared Authority to Construct Permit for remediation of a former oil field on the California Central Coast. Participated in negotiations with agencies and secured permits.
- Prepared and/or reviewed hundreds of environmental permits, including NPDES, UIC, Stormwater, Authority to Construct, Prevention of Significant Deterioration, Nonattainment New Source Review, Title V, and RCRA, among others.
- Participated in the development of the CARB document, *Guidance for Power Plant Siting and Best Available Control Technology*, including attending public workshops and filing technical comments.
- Performed data analyses in support of adoption of emergency power restoration standards by the California Public Utilities Commission for "major" power outages, where major is an outage that simultaneously affects 10% of the customer base.
- Drafted portions of the Good Neighbor Ordinance to grant Contra Costa County greater authority over safety of local industry, particularly chemical plants and refineries.
- Participated in drafting BAAQMD Regulation 8, Rule 28, Pressure Relief Devices, including
  participation in public workshops, review of staff reports, draft rules and other technical
  materials, preparation of technical comments on staff proposals, research on availability and
  costs of methods to control PRV releases, and negotiations with staff.
- Participated in amending BAAQMD Regulation 8, Rule 18, Valves and Connectors, including participation in public workshops, review of staff reports, proposed rules and other supporting technical material, preparation of technical comments on staff proposals, research on availability and cost of low-leak technology, and negotiations with staff.
- Participated in amending BAAQMD Regulation 8, Rule 25, Pumps and Compressors, including participation in public workshops, review of staff reports, proposed rules, and other supporting technical material, preparation of technical comments on staff proposals, research on availability and costs of low-leak and seal-less technology, and negotiations with staff.
- Participated in amending BAAQMD Regulation 8, Rule 5, Storage of Organic Liquids, including participation in public workshops, review of staff reports, proposed rules, and other supporting technical material, preparation of technical comments on staff proposals, research on availability and costs of controlling tank emissions, and presentation of testimony before the Board.

- Participated in amending BAAQMD Regulation 8, Rule 18, Valves and Connectors at Petroleum Refinery Complexes, including participation in public workshops, review of staff reports, proposed rules and other supporting technical material, preparation of technical comments on staff proposals, research on availability and costs of low-leak technology, and presentation of testimony before the Board.
- Participated in amending BAAQMD Regulation 8, Rule 22, Valves and Flanges at Chemical Plants, etc, including participation in public workshops, review of staff reports, proposed rules, and other supporting technical material, preparation of technical comments on staff proposals, research on availability and costs of low-leak technology, and presentation of testimony before the Board.
- Participated in amending BAAQMD Regulation 8, Rule 25, Pump and Compressor Seals, including participation in public workshops, review of staff reports, proposed rules, and other supporting technical material, preparation of technical comments on staff proposals, research on availability of low-leak technology, and presentation of testimony before the Board.
- Participated in the development of the BAAQMD Regulation 2, Rule 5, Toxics, including participation in public workshops, review of staff proposals, and preparation of technical comments.
- Participated in the development of SCAQMD Rule 1402, Control of Toxic Air Contaminants from Existing Sources, and proposed amendments to Rule 1401, New Source Review of Toxic Air Contaminants, in 1993, including review of staff proposals and preparation of technical comments on same.
- Participated in the development of the Sunnyvale Ordinance to Regulate the Storage, Use and Handling of Toxic Gas, which was designed to provide engineering controls for gases that are not otherwise regulated by the Uniform Fire Code.
- Participated in the drafting of the Statewide Water Quality Control Plans for Inland Surface Waters and Enclosed Bays and Estuaries, including participation in workshops, review of draft plans, preparation of technical comments on draft plans, and presentation of testimony before the SWRCB.
- Participated in developing Se permit effluent limitations for the five Bay Area refineries, including review of staff proposals, statistical analyses of Se effluent data, review of literature on aquatic toxicity of Se, preparation of technical comments on several staff proposals, and presentation of testimony before the Bay Area RWQCB.
- Represented the California Department of Water Resources in the 1991 Bay-Delta Hearings before the State Water Resources Control Board, presenting sworn expert testimony with cross examination and rebuttal on a striped bass model developed by the California Department of Fish and Game.
- Represented the State Water Contractors in the 1987 Bay-Delta Hearings before the State Water Resources Control Board, presenting sworn expert testimony with cross examination and rebuttal on natural flows, historical salinity trends in San Francisco Bay, Delta outflow, and hydrodynamics of the South Bay.
- Represented interveners in the licensing of over 20 natural-gas-fired power plants and one coal gasification plant at the California Energy Commission and elsewhere. Reviewed and prepared technical comments on applications for certification, preliminary staff assessments, final staff assessments, preliminary determinations of compliance, final determinations of compliance, and prevention of significant deterioration permits in the areas of air quality, water supply, water quality, biology, public health, worker safety, transportation, site contamination, cooling systems, and hazardous materials. Presented written and oral testimony in evidentiary hearings with cross examination and rebuttal. Participated in technical workshops.
- Represented several parties in the proposed merger of San Diego Gas & Electric and Southern California Edison. Prepared independent technical analyses on health risks, air quality, and water quality. Presented written and oral testimony before the Public Utilities Commission administrative law judge with cross examination and rebuttal.
- Represented a PRP in negotiations with local health and other agencies to establish impact of subsurface contamination on overlying residential properties. Reviewed health studies prepared by agency consultants and worked with agencies and their consultants to evaluate health risks.

# WATER QUALITY/RESOURCES

- Directed and participated in research on environmental impacts of energy development in the Colorado River Basin, including contamination of surface and subsurface waters and modeling of flow and chemical transport through fractured aquifers.
- Played a major role in Northern California water resource planning studies since the early 1970s. Prepared portions of the Basin Plans for the Sacramento, San Joaquin, and Delta basins including sections on water supply, water quality, beneficial uses, waste load allocation, and agricultural drainage. Developed water quality models for the Sacramento and San Joaquin Rivers.
- Conducted hundreds of studies over the past 40 years on Delta water supplies and the impacts of exports from the Delta on water quality and biological resources of the Central Valley, Sacramento-San Joaquin Delta, and San Francisco Bay. Typical examples include:
  - 1. Evaluate historical trends in salinity, temperature, and flow in San Francisco Bay and upstream rivers to determine impacts of water exports on the estuary;

- 2. Evaluate the role of exports and natural factors on the food web by exploring the relationship between salinity and primary productivity in San Francisco Bay, upstream rivers, and ocean;
- 3. Evaluate the effects of exports, other in-Delta, and upstream factors on the abundance of salmon and striped bass;
- 4. Review and critique agency fishery models that link water exports with the abundance of striped bass and salmon;
- 5. Develop a model based on GLMs to estimate the relative impact of exports, water facility operating variables, tidal phase, salinity, temperature, and other variables on the survival of salmon smolts as they migrate through the Delta;
- 6. Reconstruct the natural hydrology of the Central Valley using water balances, vegetation mapping, reservoir operation models to simulate flood basins, precipitation records, tree ring research, and historical research;
- 7. Evaluate the relationship between biological indicators of estuary health and down-estuary position of a salinity surrogate (X2);
- 8. Use real-time fisheries monitoring data to quantify impact of exports on fish migration;
- 9. Refine/develop statistical theory of autocorrelation and use to assess strength of relationships between biological and flow variables;
- 10. Collect, compile, and analyze water quality and toxicity data for surface waters in the Central Valley to assess the role of water quality in fishery declines;
- 11. Assess mitigation measures, including habitat restoration and changes in water project operation, to minimize fishery impacts;
- 12. Evaluate the impact of unscreened agricultural water diversions on abundance of larval fish;
- 13. Prepare and present testimony on the impacts of water resources development on Bay hydrodynamics, salinity, and temperature in water rights hearings;
- 14. Evaluate the impact of boat wakes on shallow water habitat, including interpretation of historical aerial photographs;
- 15. Evaluate the hydrodynamic and water quality impacts of converting Delta islands into reservoirs;
- 16. Use a hydrodynamic model to simulate the distribution of larval fish in a tidally influenced estuary;
- 17. Identify and evaluate non-export factors that may have contributed to fishery declines, including predation, shifts in oceanic conditions, aquatic toxicity from

pesticides and mining wastes, salinity intrusion from channel dredging, loss of riparian and marsh habitat, sedimentation from upstream land alternations, and changes in dissolved oxygen, flow, and temperature below dams.

- Developed, directed, and participated in a broad-based research program on environmental issues and control technology for energy industries including petroleum, oil shale, coal mining, and coal slurry transport. Research included evaluation of air and water pollution, development of novel, low-cost technology to treat and dispose of wastes, and development and application of geohydrologic models to evaluate subsurface contamination from in-situ retorting. The program consisted of government and industry contracts and employed 45 technical and administrative personnel.
- Coordinated an industry task force established to investigate the occurrence, causes, and solutions for corrosion/erosion and mechanical/engineering failures in the waterside systems (e.g., condensers, steam generation equipment) of power plants. Corrosion/erosion failures caused by water and steam contamination that were investigated included waterside corrosion caused by poor microbiological treatment of cooling water, steam-side corrosion caused by ammonia-oxygen attack of copper alloys, stress-corrosion cracking of copper alloys in the air cooling sections of condensers, tube sheet leaks, oxygen in-leakage through condensers, volatilization of silica in boilers and carry over and deposition on turbine blades, and iron corrosion on boiler tube walls. Mechanical/engineering failures investigated included: steam impingement attack on the steam side of condenser tubes, tube-to-tube-sheet joint leakage, flow-induced vibration, structural design problems, and mechanical failures due to stresses induced by shutdown, startup and cycling duty, among others. Worked with electric utility plant owners/operators, condenser and boiler vendors, and architect/engineers to collect data to document the occurrence of and causes for these problems, prepared reports summarizing the investigations, and presented the results and participated on a committee of industry experts tasked with identifying solutions to prevent condenser failures.
- Evaluated the cost effectiveness and technical feasibility of using dry cooling and parallel dry-wet cooling to reduce water demands of several large natural-gas fired power plants in California and Arizona.
- Designed and prepared cost estimates for several dry cooling systems (e.g., fin fan heat exchangers) used in chemical plants and refineries.
- Designed, evaluated, and costed several zero liquid discharge systems for power plants.
- Evaluated the impact of agricultural and mining practices on surface water quality of Central Valley steams. Represented municipal water agencies on several federal and state advisory committees tasked with gathering and assessing relevant technical information, developing work plans, and providing oversight of technical work to investigate toxicity issues in the watershed.

# AIR QUALITY/PUBLIC HEALTH

- Prepared or reviewed the air quality and public health sections of hundreds of EIRs and EISs on a wide range of industrial, commercial and residential projects.
- Prepared or reviewed hundreds of NSR and PSD permits for a wide range of industrial facilities.
- Designed, implemented, and directed a 2-year-long community air quality monitoring
  program to assure that residents downwind of a petroleum-contaminated site were not
  impacted during remediation of petroleum-contaminated soils. The program included realtime monitoring of particulates, diesel exhaust, and BTEX and time integrated monitoring for
  over 100 chemicals.
- Designed, implemented, and directed a 5-year long source, industrial hygiene, and ambient monitoring program to characterize air emissions, employee exposure, and downwind environmental impacts of a first-generation shale oil plant. The program included stack monitoring of heaters, boilers, incinerators, sulfur recovery units, rock crushers, API separator vents, and wastewater pond fugitives for arsenic, cadmium, chlorine, chromium, mercury, 15 organic indicators (e.g., quinoline, pyrrole, benzo(a)pyrene, thiophene, benzene), sulfur gases, hydrogen cyanide, and ammonia. In many cases, new methods had to be developed or existing methods modified to accommodate the complex matrices of shale plant gases.
- Conducted investigations on the impact of diesel exhaust from truck traffic from a wide range
  of facilities including mines, large retail centers, light industrial uses, and sports facilities.
  Conducted traffic surveys, continuously monitored diesel exhaust using an aethalometer, and
  prepared health risk assessments using resulting data.
- Conducted indoor air quality investigations to assess exposure to natural gas leaks, pesticides, molds and fungi, soil gas from subsurface contamination, and outgasing of carpets, drapes, furniture and construction materials. Prepared health risk assessments using collected data.
- Prepared health risk assessments, emission inventories, air quality analyses, and assisted in the permitting of over 70 1 to 2 MW emergency diesel generators.
- Prepare over 100 health risk assessments, endangerment assessments, and other health-based studies for a wide range of industrial facilities.
- Developed methods to monitor trace elements in gas streams, including a continuous realtime monitor based on the Zeeman atomic absorption spectrometer, to continuously measure mercury and other elements.

• Performed nuisance investigations (odor, noise, dust, smoke, indoor air quality, soil contamination) for businesses, industrial facilities, and residences located proximate to and downwind of pollution sources.

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Coal-to-Liquids - A Timely Revival, 9th Electric Power, 4/30/07 Advances in Multi-Pollutant and CO<sub>2</sub> Control Technologies, 9<sup>th</sup> Electric Power, 4/30/07 McIlvaine Hot Topic Hour, Measurement & Control of PM2.5, 5/17/07 McIlvaine Hot Topic Hour, Co-firing and Gasifying Biomass, 5/31/07 McIlvaine Hot Topic Hour, Mercury Cost and Performance, 6/14/07 Ethanol 101: Points to Consider When Building an Ethanol Plant, BBI International, 6/26/07 Low Cost Optimization of Flue Gas Desulfurization Equipment, Fluent, Inc., 7/6/07. McIlvaine Hot Topic Hour, CEMS for Measurement of NH3, SO3, Low NOx, 7/12/07 McIlvaine Hot Topic Hour, Mercury Removal Status & Cost, 8/9/07 McIlvaine Hot Topic Hour, Filter Media Selection for Coal-Fired Boilers, 9/13/07 McIlvaine Hot Topic Hour, Catalyst Performance on NOx, SO3, Mercury, 10/11/07 PRB Coal Users Group, PRB 101, 12/4/07 McIlvaine Hot Topic Hour, Mercury Control Update, 10/25/07 Circulating Fluidized Bed Boilers, Their Operation, Control and Optimization, Power-Gen, 12/8/07 Renewable Energy Credits & Greenhouse Gas Offsets, Power-Gen, 12/9/07 Petroleum Engineering & Petroleum Downstream Marketing, PDH K117, 1/5/08 Estimating Greenhouse Gas Emissions from Manufacturing, PDH C191, 1/6/08 McIlvaine Hot Topic Hour, NOx Reagents, 1/17/08 McIlvaine Hot Topic Hour, Mercury Control, 1/31/08 McIlvaine Hot Topic Hour, Mercury Monitoring, 3/6/08 McIlvaine Hot Topic Hour, SCR Catalysts, 3/13/08 Argus 2008 Climate Policy Outlook, 3/26/08 Argus Pet Coke Supply and Demand 2008, 3/27/08 McIlvaine Hot Topic Hour, SO3 Issues and Answers, 3/27/08 McIlvaine Hot Topic Hour, Mercury Control, 4/24/08 McIlvaine Hot Topic Hour, Co-Firing Biomass, 5/1/08 McIlvaine Hot Topic Hour, Coal Gasification, 6/5/08 McIlvaine Hot Topic Hour, Spray Driers vs. CFBs, 7/3/08 McIlvaine Hot Topic Hour, Air Pollution Control Cost Escalation, 9/25/08 McIlvaine Hot Topic Hour, Greenhouse Gas Strategies for Coal Fired Power Plant Operators, 10/2/08McIlvaine Hot Topic Hour, Mercury and Toxics Monitoring, 2/5/09 McIlvaine Hot Topic Hour, Dry Precipitator Efficiency Improvements, 2/12/09 McIlvaine Hot Topic Hour, Coal Selection & Impact on Emissions, 2/26/09 McIlvaine Hot Topic Hour, 98% Limestone Scrubber Efficiency, 7/9/09 McIlvaine Hot Topic Hour, Carbon Management Strategies and Technologies, 6/24/10 McIlvaine Hot Topic Hour, Gas Turbine O&M, 7/22/10 McIlvaine Hot Topic Hour, Industrial Boiler MACT – Impact and Control Options, March 10, 2011

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