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## **ATTACHMENT #2**

# **Timesheet and Categorization**

**The Protect Our Communities Foundation**  
**Request for Intervenor Compensation for Contribution to D.21-08-006**

| <u>Issue</u> | <u>%</u> | <u>Description</u>                        |      |
|--------------|----------|---|------|
| A            | 55%      | On-Bill Financing                         |      |
| B            | 25%      | Non-Ratepayer Financing                   |      |
| C            | 10%      | Distributed Energy Resources              |      |
| D            | 10%      | General Participation                     | 100% |
| IC           |          | Intervenor Compensation Claim Preparation |      |

| <u>Person</u>     | <u>Date</u> | <u>Issue</u> | <u>Total</u> | <u>Description: 2021 Hours</u>             |
|-------------------|-------------|--------------|--------------|--|
| Bill Powers       | 2021-02-05  | D            | 2.00         | participate in PHC                         |
| Bill Powers       | 2021-04-14  | A, B, C      | 3.00         | read ruling, research for opening comments |
| Bill Powers       | 2021-04-15  | A, B, C      | 5.00         | prepare opening comments                   |
| Bill Powers       | 2021-04-16  | A, B, C      | 0.50         | finalize opening comments                  |
| Bill Powers       | 2021-04-29  | A, B         | 2.00         | draft reply comments                       |
| Bill Powers       | 2021-04-30  | A, B         | 0.50         | review other parties' reply comments       |
| Bill Powers       | 2021-05-26  | A            | 3.00         | prepare comments on SCE financing summary  |
| Bill Powers       | 2021-07-20  | A, B         | 2.00         | review PD and draft comments on PD         |
| Bill Powers       | 2021-07-21  | A, B         | 2.00         | finalize comments on PD                    |
| <b>Total 2020</b> |             |              | <b>20.00</b> |  |

| <u>Person</u>     | <u>Date</u> | <u>Issue</u> | <u>Total</u> | <u>Description: 2020 Hours</u>  |
|-------------------|-------------|--------------|--------------|---|
| Bill Powers       | 2020-10-03  | A            | 2.00         | read OIR and prepare outline of comments on OIR   |
| Bill Powers       | 2020-10-04  | A            | 2.00         | initial draft of comments on OIR  |
| Bill Powers       | 2020-10-05  | A            | 2.00         | final comments on OIR   |
| Bill Powers       | 2020-10-16  | A            | 1.00         | review of opening comments of other parties on OIR  |
| Bill Powers       | 2020-10-18  | A            | 3.00         | draft reply comments on OIR   |
| Bill Powers       | 2020-10-19  | A            | 2.50         | finalize reply comments on OIR  |
| Bill Powers       | 2020-11-05  | D            | 0.50         | prepared revised data requests  |
| Bill Powers       | 2020-11-20  | A            | 1.00         | research on IOU residential tariffed OBF - interview w Gwen Yamamoto, Hawaii OBF program director |
| <b>Total 2020</b> |             |              | <b>14.00</b> |   |

| <u>Person</u>  | <u>Date</u> | <u>Issue</u> | <u>Total</u> | <u>Description: 2021 Hours</u>   |
|----------------|-------------|--------------|--------------|--|
| Julia Severson |             | A, B, C, D   | 7.00         | attend clean energy financing workshop day 1, take notes               |
|                | 2021-01-28  |              |              |  |
| Julia Severson |             | A, B, C, D   | 4.50         | attend clean energy financing workshop day 2, take notes               |
|                | 2021-01-29  |              |              |  |
| Julia Severson | 2021-04-14  | A, B, C      | 0.50         | create template for comments on commissioner ruling                    |
| Julia Severson | 2021-04-16  | A, B, C      | 0.75         | edit first draft of comments on commissioner ruling                    |
| Julia Severson |             | A, B, C      | 2.50         | read and summarize opening comments on ruling questions 2 and 6 for BP |
|                | 2021-04-28  |              |              |  |
| Julia Severson |             | A, B         | 4.50         | read and summarize reply comments on ruling questions 2 and 6 for BP   |
|                | 2021-05-03  |              |              |  |
| Julia Severson | 2021-05-26  | A            | 3.00         | draft comments on SCE summary  |
| Julia Severson | 2021-07-19  | A, B         | 4.00         | review PD (1 hr) and draft comments on PD (3 hr)                       |
| Julia Severson | 2021-07-20  | A, B         | 3.25         | edit draft comments on PD  |
| <b>Total</b>   |             |              | <b>30.00</b> |  |

| <u>Person</u>     | <u>Date</u> | <u>Issue</u> | <u>Total</u> | <u>Description: 2020 Hours</u>                    |
|-------------------|-------------|--------------|--------------|---|
| Julia Severson    | 2020-10-05  | A            | 0.10         | Citation edits to comments on OIR                 |
| Julia Severson    | 2020-10-15  | A            | 5.20         | read and summarize other parties opening comments |
| Julia Severson    | 2020-10-19  | A            | 1.50         | research for reply comments                       |
| <b>Total 2020</b> |             |              | <b>6.80</b>  |   |

| <u>Person</u>  | <u>Date</u> | <u>Issue</u> | <u>Total</u> | <u>Description: Prepare Intervenor Comp. Claim</u>  |
|----------------|-------------|--------------|--------------|---|
| Julia Severson | 2021-10-04  | IC           | 4.00         | review final decision (.75), draft IC claim reasonableness and duplication section (3.25) |
| Julia Severson | 2021-10-05  | IC           | 4.75         | continue drafting IC claim, reasonableness and substantial contribution section           |
| Julia Severson | 2021-10-06  | IC           | 1.50         | finalize IC claim draft, attachments  |
| <b>Total</b>   |             |              | <b>10.25</b> |   |

**ATTACHMENT #3**

**Bill Powers Resume**

# BILL POWERS, P.E.

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## PROFESSIONAL HISTORY

Powers Engineering, San Diego, CA 1994-  
ENSR Consulting and Engineering, Camarillo, CA 1989-93  
Naval Energy and Environmental Support Activity, Port Hueneme, CA 1982-87  
U.S. Environmental Protection Agency, Research Triangle Park, NC 1980-81

## EDUCATION

Bachelor of Science – Mechanical Engineering, Duke University  
Master of Public Health – Environmental Sciences, University of North Carolina

## PROFESSIONAL AFFILIATIONS

Registered Professional Mechanical Engineer, California (Certificate M24518)  
Registered Professional Engineer, Missouri (Certificate 2018039156)  
American Society of Mechanical Engineers  
Institute of Electrical and Electronics Engineers

## TECHNICAL SPECIALTIES

Forty years of experience in:

- Air quality and utility commission proceedings - expert witness
- Distributed solar photovoltaics (PV) siting and regional renewable energy planning
- Power plant cooling system conversion and air emission control assessments
- Combustion equipment permitting, testing and monitoring
- Air pollution control equipment retrofit design/performance testing
- Petroleum refinery air engineering and testing
- Latin America environmental project experience

## RECENT AIR QUALITY AND UTILITY COMMISSION PROCEEDINGS

**Compressor Station Gas Turbine Air Emission Controls.** Assessed the air emission controls and siting issues related to two proposed pipeline compressor station projects in the vicinity of Nashville, Tennessee utilizing Solar Turbines, Inc Titan gas turbines. The result, based on application of a Reasonably Available Control Technology (RACT) requirement, was the reduction of the proposed air permit nitrogen oxides (NO<sub>x</sub>) emission limit from 25 parts per million (ppm) to 9 ppm.

**Combined Heat and Power Plant Gas Turbine Air Emission Controls.** Evaluated the air emission controls proposed for a combined heat and power (CHP) plant at Duke University that would utilize Solar Turbines, Inc Titan gas turbine. Applicant proposed a 25 ppm NO<sub>x</sub> limit using dry low-NO<sub>x</sub> combustion as Best Available Control Technology (BACT) in its Certificate of Public Convenience and Necessity (CPCN) application to the North Carolina Utilities Commission. Argued that NO<sub>x</sub> BACT for the CHP plant should be use of selective catalytic reduction (SCR) to achieve a 2 ppm NO<sub>x</sub> emission limit. Applicant withdrew its CPCN application.

**SDG&E 36-Inch Transmission Pipeline.** Expert witness for non-profit client advocating that existing 16-inch pipeline did not require replacement with new \$600 million 36-inch pipeline. Underscored in testimony that SDG&E had recently completed extensive inline inspection of existing 16-inch pipeline and found that pipeline was in good condition for long-term operation at 512 psig transmission pressure. Demonstrated that reduction of pressure to 320 psig would not increase safety of existing pipeline, as ILI could no longer be done periodically at lower pressure. Commission accepted this reasoning and denied SDG&E's application.

**Cove Point LNG Export Terminal.** Expert witness in two separate administrative proceedings before the Maryland Public Service Commission, in 2014 and 2017, regarding air permit conditions for the proposed Cove Point LNG export. The plant site is located in a non-attainment area for ozone. Testimony addressed deficiencies in the proposed air emission limits and proposed control technology for combustion equipment – including gas turbines, auxiliary boilers, and flares, fugitive emission sources, and marine loading vapor recovery systems.

**Corpus Christi LNG Expert Terminal.** Expert witness in Texas Commission on Environmental Quality contested air permit proceeding in 2013 before the State Office of Administrative Hearings. Testimony addressed deficiencies in the proposed control technology for compressor-drive gas turbines, flares, and fugitive emission sources, and marine loading vapor recovery systems.

## **DISTRIBUTED SOLAR PV SITING AND REGIONAL RENEWABLE ENERGY PLANNING**

**Roadmap to 100 Percent Local Solar by 2030 in the City of San Diego.** Author of the May 2020 *Roadmap to 100 Percent Local Solar Build-Out by 2030 in the City of San Diego* strategic energy plan for San Diego. The *Roadmap* outlines a strategy to maximize the use of solar energy and battery storage in the City of San Diego (City) to provide 100 percent clean electricity to all San Diegans by 2030. The City’s Climate Action Plan sets a mandatory target of 100 percent clean electricity by 2035. The *Roadmap* describes how the City can best deliver lower-cost electricity and provide local job growth by choosing local solar power paired with battery storage, complemented by smart energy efficiency and demand response programs, to reach 100 percent clean energy.

**North Carolina Clean Path 2025 Plan.** Author of the August 2017 *North Carolina Clean Path 2025* strategic energy plan for North Carolina. *NC Clean Path 2025* implements local solar power, battery storage, and energy efficiency measures to rapidly replace fossil fuel-generated electricity in the state. The plan is substantially less costly than the \$40 billion expansion of natural gas infrastructure, nuclear power, and transmission infrastructure being planned for North Carolina. Implementation of *NC Clean Path 2025* would reduce power generated by coal- and natural gas-fired plants by about 60 percent by 2025, and 100 percent by 2030. All in-state coal-fired plants would be closed and gas-fired plants would be used only for backup supply. Existing transmission and distribution infrastructure would be maintained and not expanded.

**Bay Area Smart Energy 2020 Plan.** Author of the March 2012 *Bay Area Smart Energy 2020* strategic energy plan for the nine-county region surrounding San Francisco Bay. This plan uses the zero net energy building targets in the *California Energy Efficiency Strategic Plan* as a framework to achieve a 60 percent reduction in GHG emissions from Bay Area electricity usage, and a 50 percent reduction in peak demand for grid electricity, by 2020. The 2020 targets in the plan include: 25 percent of detached homes and 20 percent of commercial buildings achieving zero net energy, adding 200 MW of community-scale microgrid battery storage and 400 MW of utility-scale battery storage, reduction in air conditioner loads by 50 percent through air conditioner cycling and targeted incentive funds to assure highest efficiency replacement units, and cooling system modifications to increase power output from The Geysers geothermal production zone in Sonoma County.

**Solar PV technology selection and siting for SDG&E Solar San Diego project.** Served as PV technology expert in California Public Utilities Commission proceeding to define PV technology and sites to be used in San Diego Gas & Electric (SDG&E) \$250 million “Solar San Diego” project. Recommendations included: 1) prioritize use of roof-mounted thin-film PV arrays similar to the SCE urban PV program to maximize the installed PV capacity, 2) avoid tracking ground-mounted PV arrays due to high cost and relative lack of available land in the urban/suburban core, 3) and incorporate limited storage in fixed rooftop PV arrays to maximizing output during peak demand periods. Suitable land next to SDG&E substations capable of supporting 5 to 40 MW of PV (each) was also identified by Powers Engineering as a component of this project.

**Rooftop PV alternative to natural gas-fired peaking gas turbines, Chula Vista.** Served as PV technology expert in California Energy Commission (CEC) proceeding regarding the application of MMC Energy to build a 100 MW peaking gas turbine power plant in Chula Vista. Presented testimony that 100 MW of PV arrays in the Chula Vista area could provide the same level of electrical reliability on hot summer days as an equivalent amount of peaking gas turbine capacity at approximately the same cost of energy. The final decision issued by the CEC in the case denied the application in part due to failure of the applicant or CEC staff to thoroughly evaluate the PV alternative to the proposed turbines.

**San Diego Smart Energy 2020 Plan.** Author of October 2007 *San Diego Smart Energy 2020*, an energy plan that focuses on meeting the San Diego region's electric energy needs through accelerated integration of renewable and non-renewable distributed generation, in the form of combined heat and power (CHP) systems and solar photovoltaic (PV) systems. PV would meet approximately 28 percent of the San Diego region's electric energy demand in 2020. Annual energy demand would drop 20 percent in 2020 relative to 2003 through use all cost-effective energy efficiency measures. Existing utility-scale gas-fired generation would continue to be utilized to provide power at night, during cloudy weather, and for grid reliability support.

## **COOLING SYSTEM CONVERSION AND POWER PLANT EMISSION CONTROL ASSESSMENTS**

### **Closed-Cycle Cooling Alternative at California Nuclear Plant.**

Lead engineer on review of Bechtel assessment of wedgewire screens and closed-cycle cooling for Diablo Canyon nuclear plant. Demonstrated that wedgewire screens were not likely to be effective in substantially reducing entrainment at the site, and that lower cost closed-cycle retrofit alternatives could be utilized to allow a "cost reasonable" cooling tower retrofit. Plume-abated back-to-back cooling towers located in secondary parking lots to the southeast of the turbine building were identified as the most cost-effective alternative.

### **Closed-Cycle Cooling Alternative at Florida Nuclear Plant.**

Evaluated closed cycle cooling tower feasibility assessment for Turkey Point Nuclear Units 3 and 4. Closed-cycle cooling would replace the existing closed-cycle cooling canals. Wet cooling towers for Units 3 and 4 are feasible and could be operational within four years of submittal of applications for the necessary permits.

**Utility Boilers – Conversion of Existing Once-Through Cooled Boilers to Wet Towers, Parallel Wet-Dry Cooling, or Dry Cooling.** Provided expert testimony and preliminary design for the conversion of four natural gas and/or coal-fired utility boilers (Unit 4, 235 MW; Unit 3, 135 MW; Unit 2, 65 MW; and Unit 1, 65 MW) from once-through river water cooling to wet cooling towers, parallel wet-dry cooling, and dry cooling. Major design constraints were available land for location of retrofit cooling systems and need to maintain maximum steam turbine backpressure at or below 5.5 inches mercury to match performance capabilities of existing equipment. Approach temperatures of 12 °F and 13 °F were used for the wet towers. SPX Cooling Technologies F-488 plume-abated wet cells with six feet of packing were used to achieve approach temperatures of 12 °F and 13 °F. Annual energy penalty of wet tower retrofit designs is approximately 1 percent. Parallel wet-dry or dry cooling was determined to be technically feasible for Unit 3 based on straightforward access to the Unit 3 surface condenser and available land adjacent to the boiler.

**Utility Boiler – Assessment of Air Cooling and Integrated Gasification/Combined Cycle for Proposed 500 MW Coal-Fired Plant.** Provided expert testimony on the performance of air-cooling and IGCC relative to the conventional closed-cycle wet cooled, supercritical pulverized coal boiler proposed by the applicant. Steam Pro™ coal-fired power plant design software was used to model the proposed plant and evaluate the impacts on performance of air cooling and plume-abated wet cooling. Results indicated that a conservatively designed air-cooled condenser could maintain rated power output at the design ambient temperature of 90 °F. The IGCC comparative analysis indicated that unit reliability comparable to a conventional pulverized coal unit could be achieved by including a spare gasifier in the IGCC design, and that the slightly higher capital cost of IGCC was offset by greater thermal efficiency and reduced water demand and air emissions.

**Utility Boiler – Assessment of Closed-Cycle Cooling Retrofit Cost for 1,200 MW Oil-Fired Plant.**

Prepared an assessment of the cost and feasibility of a closed-cycle wet tower retrofit for the 1,200 MW Roseton Generating Station. Determined that the cost to retrofit the Roseton plant with plume-abated closed-cycle wet cooling was well established based on cooling tower retrofit studies performed by the original owner (Central Hudson Gas & Electric Corp.) and subsequent regulatory agency critique of the cost estimate. Also determined that elimination of redundant and/or excessive budgetary line items in owners cost estimate brings the closed-cycle retrofit in line with expected costs for comparable new or retrofit plume-abated cooling tower applications.

**Nuclear Power Plant – Assessment of Closed-Cycle Cooling Retrofit Cost for 2,000 MW Plant.** Prepared an assessment of the cost and feasibility of a closed-cycle wet tower retrofit for the 2,000 MW Indian Point Generating Station. Determined that the most appropriate arrangement for the hilly site would be an inline plume-abated wet tower instead of the round tower configuration analyzed by the owner. Use of the inline configuration would allow placement of the towers at numerous sites on the property with little or need for blasting of bedrock, greatly reducing the cost of the retrofit. Also proposed an alternative circulating cooling water piping configuration to avoid the extensive downtime projected by the owner for modifications to the existing discharge channel.

**Power Plant Dry Cooling Symposium – Chair and Organizer.** Chair and organizer of the first symposium held in the U.S. (May 2002) that focused exclusively on dry cooling technology for power plants. Sessions included basic principles of wet and dry cooling systems, performance capabilities of dry cooling systems, case studies of specific installations, and reasons why dry cooling is the predominant form of cooling specified in certain regions of North America (Massachusetts, Nevada, northern Mexico).

**Ameren Missouri Coal Units – Causes of Opacity and Opacity Reduction Alternatives.**

Lead engineer to assess the root causes of opacity exceedances and evaluate potential alternatives to eliminate opacity violations from the Labadie, Meramec, and Rush Island power plants.

**Utility Boilers – Evaluation of Correlation Between Opacity and PM<sub>10</sub> Emissions at Coal-Fired Plant.**

Provided expert testimony on whether correlation existed between mass PM<sub>10</sub> emissions and opacity during opacity excursions at large coal-fired boiler in Georgia. EPA and EPRI technical studies were reviewed to assess the correlation of opacity and mass emissions during opacity levels below and above 20 percent. A strong correlation between opacity and mass emissions was apparent at a sister plant at opacities less than 20 percent. The correlation suggests that the opacity monitor correlation underestimates mass emissions at opacities greater than 20 percent, but may continue to exhibit a good correlation for the component of mass emissions in the PM<sub>10</sub> size range.

**IGCC as BACT for Air Emissions from Proposed 960 MW Coal Plant.** Presented testimony on IGCC as BACT for air emissions reduction from 960 MW coal plant. Applicant received air permit for a pulverized coal plant to be equipped with a baghouse, wet scrubber, and wet ESP for air emissions control. Use of IGCC technology at the emission rates permitted for two recently proposed U.S. IGCC projects, and demonstrated in practice at a Japanese IGCC plant firing Chinese bituminous coal, would substantially reduce potential emissions of NO<sub>x</sub>, SO<sub>2</sub>, and PM. The estimated control cost-effectiveness of substituting IGCC for pulverized coal technology in this case was approximately \$3,000/ton.

**Analysis of Proposed Air Emission Limits for 600 MW Pulverized Coal Plant.** Project engineer tasked with evaluating sufficiency of air emissions limits and control technologies for proposed 600 MW coal plant Arkansas. Determined that the applicant had: 1) not properly identified SO<sub>2</sub>, sulfuric acid mist, and PM BACT control levels for the plant, and 2) improperly utilized an incremental cost effectiveness analysis to justify air emission control levels that did not represent BACT.

**Eight Pulverized Coal Fired 900 MW Boilers – IGCC Alternative with Air Cooling.** Provided testimony on integrated gasification combined cycle (IGCC) as a fully commercial coal-burning alternative to the pulverized coal (PC) technology proposed by TXU for eight 900 MW boilers in East Texas, and East Texas as an ideal location for CO<sub>2</sub> sequestration due to presence of mature oilfield CO<sub>2</sub> enhanced oil recovery opportunities and a deep saline aquifer underlying the entire region. Also presented testimony on the major increase in regional consumptive water use that would be caused by the evaporative cooling towers proposed for use in the PC plants, and that consumptive water use could be lowered by using IGCC with evaporative cooling towers or by using air-cooled condensers with PC or IGCC technology. TXU ultimately dropped plans to build the eight PC plants as a condition of a corporate buy-out.

**Utility Boilers – Retrofit of SCR and FGD to Existing Coal-Fired Units.**

Expert witness in successful effort to compel an existing coal-fired power plant located in Massachusetts to meet an accelerated NO<sub>x</sub> and SO<sub>2</sub> emission control system retrofit schedule. Plant owner argued the installation of advanced NO<sub>x</sub> and SO<sub>2</sub> control systems would generate > 1 ton/year of ancillary emissions, such as sulfuric acid mist, and that under Massachusetts Dept. of Environmental Protection regulation ancillary emissions > 1 ton/year would require a BACT evaluation and a two-year extension to retrofit schedule. Successfully demonstrated that no ancillary emissions would be generated if the retrofit NO<sub>x</sub> and SO<sub>2</sub> control systems were properly sized and optimized. Plant owner committed to accelerated compliance schedule in settlement agreement.

**Utility Boilers – Retrofit of SCR to Existing Natural Gas-Fired Units.**

Lead engineer in successful representation of interests of California coastal city to prevent weakening of an existing countywide utility boiler NO<sub>x</sub> rule. Weakening of NO<sub>x</sub> rule would have allowed a merchant utility boiler plant located in the city to operate without installing selective catalytic reduction (SCR) NO<sub>x</sub> control systems. This project required numerous appearances before the county air pollution control hearing board to successfully defend the existing utility boiler NO<sub>x</sub> rule.

**Biomass Plant NO<sub>x</sub> and CO Air Emissions Control Evaluation.** Lead engineer for evaluation of available nitrogen oxide (NO<sub>x</sub>) and carbon monoxide (CO) controls for a 45 MW Aspen Power biomass plant in Texas where proponent had identified selective non-catalytic reduction (SNCR) for NO<sub>x</sub> and good combustion practices for CO as BACT. Identified the use of tail-end SCR for NO<sub>x</sub> control at several operational U.S. biomass plants, and oxidation catalyst in use at two of these plants for CO and VOC control, as BACT for the proposed biomass plant. Administrative law judge concurred in decision that SCR and oxidation catalyst is BACT. Developer added SCR and oxidation catalyst to project in subsequent settlement agreement.

**Biomass Plant Air Emissions Control Consulting.** Lead expert on biomass air emissions control systems for landowners that will be impacted by a proposed 50 MW biomass to be built by the local East Texas power cooperative. Public utility agreed to meet current BACT for biomass plants in Texas, SCR for NO<sub>x</sub> and oxidation catalyst for CO, in settlement agreement with local landowners.

**Combined-Cycle Power Plant Startup and Shutdown Emissions.** Lead engineer for analysis of air permit startup and shutdown emissions minimization for combined-cycle power plant proposed for the San Francisco Bay Area. Original equipment was specified for baseload operation prior to suspension of project in early 2000s. Operational profile described in revised air permit was load following with potential for daily start/stop. Recommended that either fast start turbine technology be employed to minimize start/stop emissions or that “demonstrated in practice” operational and control software modifications be employed to minimize startup/shutdown emissions.

## **NON-WIRES ALTERNATIVES TO TRANSMISSION LINES**

**Ameren Missouri Mark Twain 345 kV Transmission Line.** Responsible for evaluating: 1) the expected peak load growth of Ameren Missouri (MO) in general and in Northeast MO specifically over the next decade, 2) the likelihood of wind projects moving forward in the Northeast MO over the next decade, 3) the feasibility and cost of reconductoring with high capacity composite conductors the three 161 kV line segments that would experience NERC violations if 450 to 500 MW of wind power was constructed in Northeast MO, and 4) the feasibility and cost-effectiveness of substituting local solar for wind power to allow Ameren MO to meet its 2021 Renewable Portfolio Standard (RPS) obligation without building the proposed 345 kV transmission line or upgrading the three existing 161 kV lines interconnecting at the Adair Substation.

**American Transmission Corporation Badger-Coulee 345 kV Line.** Responsible for evaluating: 1) the expected peak load growth of Wisconsin utilities over the next decade, and 2) the feasibility and cost-effectiveness of alternatives including load management, energy efficiency, local solar, biogas, and energy storage as viable no-wires alternatives to the proposed ATC Badger-Coulee 345 kV transmission line.

### **San Diego Gas & Electric Wood Pole to Steel Pole Replacement Project.**

Lead engineer assessing need and alternatives to replacement of existing wooden 69 kV poles with larger steel 69 kV poles as a response to the fire hazard potential of wooden poles in rural, high fire risk areas. Wooden poles in good condition and not a source of fire ignition. Utility would continue to shut off power to customers during low humidity, high wind conditions. Prepared alternative, solar with batteries for the ~10,000 affected customer meters, to allow customers to ride-through high fire hazard preventive grid power shut-offs at far less cost than replacing wood poles with steel poles.

### **San Diego Gas & Electric 500 kV Sunrise Transmission Line.**

Lead engineer assessing the validity of load growth forecasts used by the utility to justify the need for the 500 kV line, and for developing a no-wires alternative, net-metered solar power with some battery support, to meet the identified reliability need at little or no net cost to the utility customer base.

## **COMBUSTION EQUIPMENT PERMITTING, TESTING AND MONITORING**

### **EPRI Gas Turbine Power Plant Permitting Documents – Co-Author.**

Co-authored two Electric Power Research Institute (EPRI) gas turbine power plant siting documents. Responsibilities included chapter on state-of-the-art air emission control systems for simple-cycle and combined-cycle gas turbines, and authorship of sections on dry cooling and zero liquid discharge systems.

### **Air Permits for 50 MW Peaker Gas Turbines – Six Sites Throughout California.**

Responsible for preparing all aspects of air permit applications for five 50 MW FT-8 simple-cycle turbine installations at sites around California in response to emergency request by California state government for additional peaking power. Units were designed to meet 2.0 ppm NO<sub>x</sub> using standard temperature SCR and innovative dilution air system to maintain exhaust gas temperature within acceptable SCR range. Oxidation catalyst is also used to maintain CO below 6.0 ppm.

**Kauai 27 MW Cogeneration Plant – Air Emission Control System Analysis.** Project manager to evaluate technical feasibility of SCR for 27 MW naphtha-fired turbine with once-through heat recovery steam generator. Permit action was stalled due to questions of SCR feasibility. Extensive analysis of the performance of existing oil-fired turbines equipped with SCR, and bench-scale tests of SCR applied to naphtha-fired turbines, indicated that SCR would perform adequately. Urea was selected as the SCR reagent given the local availability of urea. Unit is first known application of urea-injected SCR on a naphtha-fired turbine.

### **Microturbines – Ronald Reagan Library, Ventura County, California.**

Project manager and lead engineer or preparation of air permit applications for microturbines and standby boilers. The microturbines drive the heating and cooling system for the library. The microturbines are

certified by the manufacturer to meet the 9 ppm NO<sub>x</sub> emission limit for this equipment. Low-NO<sub>x</sub> burners are BACT for the standby boilers.

**Hospital Cogeneration Microturbines – South Coast Air Quality Management District.**

Project manager and lead engineer for preparation of air permit application for three microturbines at hospital cogeneration plant installation. The draft Authority To Construct (ATC) for this project was obtained two weeks after submittal of the ATC application. 30-day public notification was required due to the proximity of the facility to nearby schools. The final ATC was issued two months after the application was submitted, including the 30-day public notification period.

**Gas Turbine Cogeneration – South Coast Air Quality Management District.** Project manager and lead engineer for preparation of air permit application for two 5.5 MW gas turbines in cogeneration configuration for county government center. The turbines are equipped with selective catalytic reduction (SCR) and oxidation catalyst to comply with SCAQMD BACT requirements. Aqueous urea is used as the SCR reagent to avoid trigger hazardous material storage requirements. The NO<sub>x</sub> and CO continuous emissions monitoring systems are covered by a separate permit.

**Peaker Gas Turbines – Evaluation of NO<sub>x</sub> Control Options for Installations in San Diego County.**

Lead engineer for evaluation of NO<sub>x</sub> control options available for 1970s vintage simple-cycle gas turbines proposed for peaker sites in San Diego County. Dry low-NO<sub>x</sub> (DLN) combustors, catalytic combustors, high-temperature SCR, and NO<sub>x</sub> absorption/conversion (SCONO<sub>x</sub>) were evaluated for each candidate turbine make/model. High-temperature SCR was selected as the NO<sub>x</sub> control option to meet a 5 ppm NO<sub>x</sub> emission requirement.

**Hospital Cogeneration Plant Gas Turbines – San Joaquin Valley Unified Air Pollution Control District.**

Project manager and lead engineer for preparation of air permit application and Best Available Control Technology (BACT) evaluation for hospital cogeneration plant installation. The BACT included the review of DLN combustors, catalytic combustors, high-temperature SCR and SCONO<sub>x</sub>. DLN combustion followed by high temperature SCR was selected as the NO<sub>x</sub> control system for this installation. The high temperature SCR is located upstream of the heat recovery steam generator (HRSG) to allow the diversion of exhaust gas around the HRSG without compromising the effectiveness of the NO<sub>x</sub> control system.

**1,000 MW Coastal Combined-Cycle Power Plant – Feasibility of Dry Cooling.**

Expert witness in on-going effort to require use of dry cooling on proposed 1,000 MW combined-cycle “repower” project at site of an existing 1,000 MW utility boiler plant. Project proponent argued that site was too small for properly sized air-cooled condenser (ACC) and that use of ACC would cause 12-month construction delay. Demonstrated that ACC could easily be located on the site by splitting total of up to 80 cells between two available locations at the site. Also demonstrated that an ACC optimized for low height and low noise would minimize or eliminate proponent claims of negative visual and noise impacts.

**Industrial Cogeneration Plant Gas Turbines – Upgrade of Turbine Power Output.**

Project manager and lead engineer for preparation of Best Available Control Technology (BACT) evaluation for proposed gas turbine upgrade. The BACT included the review of DLN combustors, catalytic combustors, high-, standard-, and low-temperature SCR, and SCONO<sub>x</sub>. Successfully negotiated air permit that allowed facility to initially install DLN combustors and operate under a NO<sub>x</sub> plantwide “cap.” Within two major turbine overhauls, or approximately eight years, the NO<sub>x</sub> emissions per turbine must be at or below the equivalent of 5 ppm. The 5 ppm NO<sub>x</sub> target will be achieved through technological in-combustor NO<sub>x</sub> control such as catalytic combustion, or SCR or SCR equivalent end-of-pipe NO<sub>x</sub> control technologies if catalytic combustion is not available.

**Gas Turbines – Modification of RATA Procedures for Time-Share CEM.**

Project manager and lead engineer for the development of alternate CO continuous emission monitor (CEM) Relative Accuracy Test Audit (RATA) procedures for time-share CEM system serving three 7.9 MW turbines located in San Diego. Close interaction with San Diego APCD and EPA Region 9 engineers was required to receive approval for the alternate CO RATA standard. The time-share CEM then passed the annual RATA without problems as a result of changes to some CEM hardware and the more flexible CO RATA standard.

**Gas Turbines – Evaluation of NO<sub>x</sub> Control Technology Performance.** Lead engineer for performance review of dry low-NO<sub>x</sub> combustors, catalytic combustors, high-, standard-, and low-temperature selective catalytic reduction (SCR), and NO<sub>x</sub> absorption/conversion (SCONO<sub>x</sub>). Major turbine manufacturers and major manufacturers of end-of-pipe NO<sub>x</sub> control systems for gas turbines were contacted to determine current cost and performance of NO<sub>x</sub> control systems. A comparison of 1993 to 1999 “\$/kwh” and “\$/ton” cost of these control systems was developed in the evaluation.

**Lead engineer for evaluation for proposed combined cycle gas turbine NO<sub>x</sub> and CO control systems.**

Project was in litigation over contract terms, and there was concern that the GE Frame 7FA turbine could not meet the 3 ppm NO<sub>x</sub> permit limit using a conventional combustor with water injection followed by SCR. Operations personnel at GE Frame 7FA installations around the country were interviewed, along with principal SCR vendors, to corroborate that the installation could continuously meet the 3 ppm NO<sub>x</sub> limit.

**Gas Turbines – Title V "Presumptively Approvable" Compliance Assurance Monitoring Protocol.**

Project manager and lead engineer for the development of a "presumptively approval" NO<sub>x</sub> parametric emissions monitoring system (PEMS) protocol for industrial gas turbines. "Presumptively approvable" means that any gas turbine operator selecting this monitoring protocol can presume it is acceptable to the U.S. EPA. Close interaction with the gas turbine manufacturer's design engineering staff and the U.S. EPA Emissions Measurement Branch (Research Triangle Park, NC) was required to determine modifications necessary to the current PEMS to upgrade it to "presumptively approvable" status.

**Environmental Due Diligence Review of Gas Turbine Sites – Mexico.** Task leader to prepare regulatory compliance due diligence review of Mexican requirements for gas turbine power plants. Project involves eleven potential sites across Mexico, three of which are under construction. Scope involves identification of all environmental, energy sales, land use, and transportation corridor requirements for power projects in Mexico. Coordinator of Mexican environmental subcontractors gathering on-site information for each site, and translator of Spanish supporting documentation to English.

**Development of Air Emission Standards for Gas Turbines - Peru.** Served as principal technical consultant to the Peruvian Ministry of Energy in Mines (MEM) for the development of air emission standards for Peruvian gas turbine power plants. All major gas turbine power plants in Peru are currently using water injection to increase turbine power output. Recommended that 42 ppm on natural gas and 65 ppm on diesel (corrected to 15% O<sub>2</sub>) be established as the NO<sub>x</sub> limit for existing gas turbine power plants. These limits reflect NO<sub>x</sub> levels readily achievable using water injection at high load. Also recommended that new gas turbine sources be subject to a BACT review requirement.

**Gas Turbines – Title V Permit Templates.** Lead engineer for the development of standardized permit templates for approximately 100 gas turbines operated by the oil and gas industry in the San Joaquin Valley. Emissions limits and monitoring requirements were defined for units ranging from GE Frame 7 to Solar Saturn turbines. Stand-alone templates were developed based on turbine size and NO<sub>x</sub> control equipment. NO<sub>x</sub> utilized in the target turbine population ranged from water injection alone to water injection combined with SCR.

**Gas Turbines – Evaluation of NO<sub>x</sub>, SO<sub>2</sub> and PM Emission Profiles.** Performed a comparative evaluation of the NO<sub>x</sub>, SO<sub>2</sub> and particulate (PM) emission profiles of principal utility-scale gas turbines for an independent power producer evaluating project opportunities in Latin America. All gas turbine models in the 40 MW to 240 MW range manufactured by General Electric, Westinghouse, Siemens and ABB were included in the evaluation.

**Stationary Internal Combustion Engine (ICE) RACT/BARCT Evaluation.** Lead engineer for evaluation of retrofit NO<sub>x</sub> control options available for the oil and gas production industry gas-fired ICE population in the San Joaquin Valley affected by proposed RACT and BARCT emission limits. Evaluation centered on lean-burn compressor engines under 500 bhp, and rich-burn constant and cyclically loaded (rod pump) engines under 200 bhp. The results of the evaluation indicated that rich burn cyclically-loaded rod pump engines comprised 50 percent of the affected ICE population, though these ICEs accounted for only 5 percent of the uncontrolled gas-fired stationary ICE NO<sub>x</sub> emissions. Recommended retrofit NO<sub>x</sub> control strategies included: air/fuel ratio adjustment for rod pump ICEs, Non-selective catalytic reduction (NSCR) for rich-burn, constant load ICEs, and "low emission" combustion modifications for lean burn ICEs.

**Development of Air Emission Standards for Stationary ICEs - Peru.** Served as principal technical consultant to the Peruvian Ministry of Energy in Mines (MEM) for the development of air emission standards for Peruvian stationary ICE power plants. Draft 1997 World Bank NO<sub>x</sub> and particulate emission limits for stationary ICE power plants served as the basis for proposed MEM emission limits. A detailed review of ICE emissions data provided in PAMAs submitted to the MEM was performed to determine the level of effort that would be required by Peruvian industry to meet the proposed NO<sub>x</sub> and particulate emission limits. The draft 1997 WB emission limits were revised to reflect reasonably achievable NO<sub>x</sub> and particulate emission limits for ICEs currently in operation in Peru.

**Air Toxics Testing of Natural Gas-Fired ICEs.** Project manager for test plan/test program to measure volatile and semi-volatile organic air toxics compounds from fourteen gas-fired ICEs used in a variety of oil and gas production applications. Test data was utilized by oil and gas production facility owners throughout California to develop accurate ICE air toxics emission inventories.

## **AIR ENGINEERING/AIR TESTING PROJECT EXPERIENCE – GENERAL**

**Reverse Air Fabric Filter Retrofit Evaluation – Coal-Fired Boiler.** Lead engineer for upgrade of reverse air fabric filters serving coal-fired industrial boilers. Fluorescent dye injected to pinpoint broken bags and damper leaks. Corrosion of pneumatic actuators serving reverse air valves and inadequate insulation identified as principal causes of degraded performance.

**Pulse-Jet Fabric Filter Performance Evaluation – Gold Mine.** Lead engineer on upgrade of pulse-jet fabric filter and associated exhaust ventilation system serving an ore-crushing facility at a gold mine. Fluorescent dye used to identify bag collar leaks, and modifications were made to pulse air cycle time and duration. This marginal source was in compliance at 20 percent of emission limit following completion of repair work.

**Pulse-Jet Fabric Filter Retrofit - Gypsum Calciner.** Lead engineer on upgrade of pulse-jet fabric filter controlling particulate emissions from a gypsum calciner. Recommendations included a modified bag clamping mechanism, modified hopper evacuation valve assembly, and changes to pulse air cycle time and pulse duration.

**Wet Scrubber Retrofit – Plating Shop.** Project engineer on retrofit evaluation of plating shop packed-bed wet scrubbers failing to meet performance guarantees during acceptance trials, due to excessive mist carryover. Recommendations included relocation of the mist eliminator (ME), substitution of the original chevron blade ME with a mesh pad ME, and use of higher density packing material to improve exhaust gas distribution. Wet scrubbers passed acceptance trials following completion of recommended modifications.

**Electrostatic Precipitator (ESP) Retrofit Evaluation – MSW Boiler.** Lead engineer for retrofit evaluation of single field ESP on a municipal solid waste (MSW) boiler. Recommendations included addition of automated power controller, inlet duct turning vanes, and improved collecting plate rapping system.

**ESP Electric Coil Rapper Vibration Analysis Testing - Coal-Fired Boiler.** Lead engineer for evaluation of ESP rapper effectiveness test program on three field ESP equipped with "magnetically induced gravity return" (MIGR) rappers. Accelerometers were placed in a grid pattern on ESP collecting plates to determine maximum instantaneous plate acceleration at a variety of rapper power setpoints. Testing showed that the rappers met performance specification requirements.

**Aluminum Remelt Furnace Particulate Emissions Testing.** Project manager and lead engineer for high temperature (1,600 °F) particulate sampling of a natural gas-fired remelt furnace at a major aluminum rolling mill. Objectives of test program were to: 1) determine if condensable particulate was present in stack gases, and 2) to validate the accuracy of the in-stack continuous opacity monitor (COM). Designed and constructed a customized high temperature (inconel) PM<sub>10</sub>/Mtd 17 sampling assembly for test program. An onsite natural gas-fired boiler was also tested to provide comparative data for the condensable particulate portion of the test program. Test results showed that no significant levels of condensable particulate in the remelt furnace exhaust gas, and indicated that the remelt furnace and boiler had similar particulate emission rates. Test results also showed that the COM was accurate.

**Aluminum Remelt Furnace CO and NO<sub>x</sub> Testing.** Project manager and lead engineer for continuous week-long testing of CO and NO<sub>x</sub> emissions from aluminum remelt furnace. Objective of test program was to characterize CO and NO<sub>x</sub> emissions from representative remelt furnace for use in the facility's criteria pollution emissions inventory. A TECO Model 48 CO analyzer and a TECO Model 10 NO<sub>x</sub> analyzer were utilized during the test program to provide ±1 ppm measurement accuracy, and all test data was recorded by an automated data acquisition system.

## **PETROLEUM REFINERY AIR ENGINEERING/TESTING EXPERIENCE**

**Big West Refinery Expansion EIS.** Lead engineer on comparative cost analysis of proposed wet cooling tower and fin-fan air cooler for process cooling water for the proposed clean fuels expansion project at the Big West Refinery in Bakersfield, California. Selection of the fin-fan air-cooler would eliminate all consumptive water use and wastewater disposal associated with the cooling tower. Air emissions of VOC and PM<sub>10</sub> would be reduced with the fin-fan air-cooler even though power demand of the air-cooler is incrementally higher than that of the cooling tower. Fin-fan air-coolers with approach temperatures of 10 °F and 20 °F were evaluated. The annualized cost of the fin-fan air-cooler with a 20 °F approach temperature is essentially the same as that of the cooling tower when the cost of all ancillary cooling tower systems are considered.

**Criteria and Air Toxic Pollutant Emissions Inventory for Proposed Refinery Modifications.** Project manager and technical lead for development of baseline and future refinery air emissions inventories for process modifications required to produce oxygenated gasoline and desulfurized diesel fuel at a California refinery. State of the art criteria and air toxic pollutant emissions inventories for refinery point, fugitive and mobile sources were developed. Point source emissions estimates were generated using onsite criteria pollutant test data, onsite air toxics test data, and the latest air toxics emission factors from the statewide refinery air toxics inventory database. The fugitive volatile organic compound (VOC) emissions inventories were developed using the refinery's most recent inspection and maintenance (I&M) monitoring program test data to develop site-specific component VOC emission rates. These VOC emission rates were combined with speciated air toxics test results for the principal refinery process streams to produce fugitive VOC air toxics emission rates. The environmental impact report (EIR) that utilized this emission inventory data was the first refinery "Clean Fuels" EIR approved in California.

**Development of Air Emission Standards for Petroleum Refinery Equipment - Peru.** Served as principal technical consultant to the Peruvian Ministry of Energy in Mines (MEM) for the development of air emission

standards for Peruvian petroleum refineries. The sources included in the scope of this project included: 1) SO<sub>2</sub> and NO<sub>x</sub> refinery heaters and boilers, 2) desulfurization of crude oil, particulate and SO<sub>2</sub> controls for fluid catalytic cracking units (FCCU), 3) VOC and CO emissions from flares, 4) vapor recovery systems for marine unloading, truck loading, and crude oil/refined products storage tanks, and 5) VOC emissions from process fugitive sources such as pressure relief valves, pumps, compressors and flanges. Proposed emission limits were developed for new and existing refineries based on a thorough evaluation of the available air emission control technologies for the affected refinery sources. Leading vendors of refinery control technology, such as John Zink and Exxon Research, provided estimates of retrofit costs for the largest Peruvian refinery, La Pampilla, located in Lima. Meetings were held in Lima with refinery operators and MEM staff to discuss the proposed emission limits and incorporate mutually agreed upon revisions to the proposed limits for existing Peruvian refineries.

**Air Toxic Pollutant Emissions Inventory for Existing Refinery.** Project manager and technical lead for air toxic pollutant emissions inventory at major California refinery. Emission factors were developed for refinery heaters, boilers, flares, sulfur recovery units, coker deheading, IC engines, storage tanks, process fugitives, and catalyst regeneration units. Onsite source test results were utilized to characterize emissions from refinery combustion devices. Where representative source test results were not available, AP-42 VOC emission factors were combined with available VOC air toxics speciation profiles to estimate VOC air toxic emission rates. A risk assessment based on this emissions inventory indicated a relatively low health risk associated with refinery operations. Benzene, 1,3-butadiene and PAHs were the principal health risk related pollutants emitted.

**Air Toxics Testing of Refinery Combustion Sources.** Project manager for comprehensive air toxics testing program at a major California refinery. Metals, Cr<sup>+6</sup>, PAHs, H<sub>2</sub>S and speciated VOC emissions were measured from refinery combustion sources. High temperature Cr<sup>+6</sup> stack testing using the EPA Cr<sup>+6</sup> test method was performed for the first time in California during this test program. Representatives from the California Air Resources Board source test team performed simultaneous testing using ARB Method 425 (Cr<sup>+6</sup>) to compare the results of EPA and ARB Cr<sup>+6</sup> test methodologies. The ARB approved the test results generated using the high temperature EPA Cr<sup>+6</sup> test method.

**Air Toxics Testing of Refinery Fugitive Sources.** Project manager for test program to characterize air toxic fugitive VOC emissions from fifteen distinct process units at major California refinery. Gas, light liquid, and heavy liquid process streams were sampled. BTXE, 1,3-butadiene and propylene concentrations were quantified in gas samples, while BTXE, cresol and phenol concentrations were measured in liquid samples. Test results were combined with AP-42 fugitive VOC emission factors for valves, fittings, compressors, pumps and PRVs to calculate fugitive air toxics VOC emission rates.

## **OIL AND GAS PRODUCTION AIR ENGINEERING/TESTING EXPERIENCE**

**Air Toxics Testing of Oil and Gas Production Sources.** Project manager and lead engineer for test plan/test program to determine VOC removal efficiency of packed tower scrubber controlling sulfur dioxide emissions from a crude oil-fired steam generator. Ratfish 55 VOC analyzers were used to measure the packed tower scrubber VOC removal efficiency. Tedlar bag samples were collected simultaneously to correlate BTX removal efficiency to VOC removal efficiency. This test was one of hundreds of air toxics tests performed during this test program for oil and gas production facilities from 1990 to 1992. The majority of the volatile air toxics analyses were performed at in-house laboratory. Project staff developed thorough familiarity with the applications and limitations of GC/MS, GC/PID, GC/FID, GC/ECD and GC/FPD. Tedlar bags, canisters, sorbent tubes and impingers were used during sampling, along with isokinetic tests methods for multiple metals and PAHs.

**Air Toxics Testing of Glycol Reboiler – Gas Processing Plant.** Project manager for test program to determine emissions of BTXE from glycol reboiler vent at gas processing facility handling 12 MM/cfd of produced gas. Developed innovative test methods to accurately quantify BTXE emissions in reboiler vent gas.

**Air Toxics Emissions Inventory Plan.** Lead engineer for the development of generic air toxics emission estimating techniques (EETs) for oil and gas production equipment. This project was performed for the Western States Petroleum Association in response to the requirements of the California Air Toxics "Hot Spots" Act. EETs were developed for all point and fugitive oil and gas production sources of air toxics, and the specific air toxics associated with each source were identified. A pooled source emission test methodology was also developed to moderate the cost of source testing required by the Act.

**Fugitive NMHC Emissions from TEOR Production Field.** Project manager for the quantification of fugitive Nonmethane hydrocarbon (NMHC) emissions from a thermally enhanced oil recovery (TEOR) oil production field in Kern County, CA. This program included direct measurement of NMHC concentrations in storage tank vapor headspace and the modification of available NMHC emission factors for NMHC-emitting devices in TEOR produced gas service, such as wellheads, vapor trunklines, heat exchangers, and compressors. Modification of the existing NMHC emission factors was necessary due to the high concentration of CO<sub>2</sub> and water vapor in TEOR produced gases.

**Fugitive Air Emissions Testing of Oil and Gas Production Fields.** Project manager for test plan/test program to determine VOC and air toxics emissions from oil storage tanks, wastewater storage tanks and produced gas lines. Test results were utilized to develop comprehensive air toxics emissions inventories for oil and gas production companies participating in the test program.

**Oil and Gas Production Field – Air Emissions Inventory and Air Modeling.** Project manager for oil and gas production field risk assessment. Project included review and revision of the existing air toxics emission inventory, air dispersion modeling, and calculation of the acute health risk, chronic non-carcinogenic risk and carcinogenic risk of facility operations. Results indicated that fugitive H<sub>2</sub>S emissions from facility operations posed a potential health risk at the facility fence line.

## **TITLE V PERMIT APPLICATION/MONITORING PLAN EXPERIENCE**

**Title V Permit Application – San Diego County Industrial Facility.** Project engineer tasked with preparing streamlined Title V operating permit for U.S. Navy facilities in San Diego. Principal emission units included chrome plating, lead furnaces, IC engines, solvent usage, aerospace coating and marine coating operations. For each device category in use at the facility, federal MACT requirements were integrated with District requirements in user friendly tables that summarized permit conditions and compliance status.

**Title V Permit Application Device Templates - Oil and Gas Production Industry.** Project manager and lead engineer to prepare Title V permit application “templates” for the Western States Petroleum Association (WSPA). The template approach was chosen by WSPA to minimize the administrative burden associated with listing permit conditions for a large number of similar devices located at the same oil and gas production facility. Templates are being developed for device types common to oil and gas production operations. Device types include: boilers, steam generators, process heaters, gas turbines, IC engines, fixed-roof storage tanks, fugitive components, flares, and cooling towers. These templates will serve as the core of Title V permit applications prepared for oil and gas production operations in California.

**Title V Permit Application - Aluminum Rolling Mill.** Project manager and lead engineer for Title V permit application prepared for largest aluminum rolling mill in the western U.S. Responsible for the overall direction of the permit application project, development of a monitoring plan for significant emission units, and development of a hazardous air pollutant (HAP) emissions inventory. The project involved extensive onsite data gathering, frequent interaction with the plant's technical and operating staff, and coordination with legal counsel and subcontractors. The permit application was completed on time and in budget.

**Title V Model Permit - Oil and Gas Production Industry.** Project manager and lead engineer for the comparative analysis of regional and federal requirements affecting oil and gas production industry sources

located in the San Joaquin Valley. Sources included gas turbines, IC engines, steam generators, storage tanks, and process fugitives. From this analysis, a model applicable requirements table was developed for a sample device type (storage tanks) that covered the entire population of storage tanks operated by the industry. The U.S. EPA has tentatively approved this model permit approach, and work is ongoing to develop comprehensive applicable requirements tables for each major category of sources operated by the oil and gas industry in the San Joaquin Valley.

**Title V Enhanced Monitoring Evaluation of Oil and Gas Production Sources.** Lead engineer to identify differences in proposed EPA Title V enhanced monitoring protocols and the current monitoring requirements for oil and gas production sources in the San Joaquin Valley. The device types evaluated included: steam generators, stationary ICEs, gas turbines, fugitives, fixed roof storage tanks, and thermally enhanced oil recovery (TEOR) well vents. Principal areas of difference included: more stringent Title V O&M requirements for parameter monitors (such as temperature, fuel flow, and O<sub>2</sub>), and more extensive Title V recordkeeping requirements.

## **RACT/BARCT/BACT EVALUATIONS**

**RACT/BARCT Reverse Jet Scrubber/Fiberbed Mist Eliminator Retrofit Evaluation.** Project manager and lead engineer on project to address the inability of existing wet electrostatic precipitators (ESPs) and atomized mist scrubbers to adequately remove low concentration submicron particulate from high volume recovery boiler exhaust gas at the Alaska Pulp Corporation mill in Sitka, AK. The project involved thorough on-site inspections of existing control equipment, detailed review of maintenance and performance records, and a detailed evaluation of potential replacement technologies. These technologies included a wide variety of scrubbing technologies where manufacturers claimed high removal efficiencies on submicron particulate in high humidity exhaust gas. Packed tower scrubbers, venturi scrubbers, reverse jet scrubbers, fiberbed mist eliminators and wet ESPs were evaluated. Final recommendations included replacement of atomized mist scrubber with reverse jet scrubber and upgrading of the existing wet ESPs. The paper describing this project was published in the May 1992 TAPPI Journal.

**Aluminum Smelter RACT Evaluation - Prebake.** Project manager and technical lead for CO and PM<sub>10</sub> RACT evaluation for prebake facility. Retrofit control options for CO emissions from the anode bake furnace, potline dry scrubbers and the potroom roof vents were evaluated. PM<sub>10</sub> emissions from the coke kiln, potline dry scrubbers, potroom roof vents, and miscellaneous potroom fugitive sources were addressed. Four CO control technologies were identified as technologically feasible for potline CO emissions: potline current efficiency improvement through the addition of underhung busswork and automated puncher/feeders, catalytic incineration, recuperative incineration and regenerative incineration. Current efficiency improvement was identified as probable CO RACT if onsite test program demonstrated the effectiveness of this approach. Five PM<sub>10</sub> control technologies were identified as technologically feasible: increased potline hooding efficiency through redesign of shields, the addition of a dense-phase conveying system, increased potline air evacuation rate, wet scrubbing of roof vent emissions, and fabric filter control of roof vent emissions.

**RACT/BACT Testing/Evaluation of PM<sub>10</sub> Mist Eliminators on Five-Stand Cold Mill.** Project manager and lead engineer for fiberbed mist eliminator and mesh pad mist eliminator comparative pilot test program on mixed phase aerosol (PM<sub>10</sub>)/gaseous hydrocarbon emissions from aluminum high speed cold rolling mill. Utilized modified EPA Method 5 sampling train with portion of sample gas diverted (after particulate filter) to Ratfisch 55 VOC analyzer. This was done to permit simultaneous quantification of aerosol and gaseous hydrocarbon emissions in the exhaust gas. The mesh pad mist eliminator demonstrated good control of PM<sub>10</sub> emissions, though test results indicated that the majority of captured PM<sub>10</sub> evaporated in the mesh pad and was emitted as VOC.

**Aluminum Remelt Furnace/Rolling Mill RACT Evaluations.** Lead engineer for comprehensive CO and PM<sub>10</sub> RACT evaluation for the largest aluminum sheet and plate rolling mill in western U.S. Significant

sources of CO emissions from the facility included the remelt furnaces and the coater line. The potential CO RACT options for the remelt furnaces included: enhanced maintenance practices, preheating combustion air, installation of fully automated combustion controls, and energy efficiency modifications.

**BARCT Low NO<sub>x</sub> Burner Conversion – Industrial Boilers.** Lead engineer for evaluation of low NO<sub>x</sub> burner options for natural gas-fired industrial boilers. Also evaluated methanol and propane as stand-by fuels to replace existing diesel stand-by fuel system. Evaluated replacement of steam boilers with gas turbine co-generation system.

**BACT Packed Tower Scrubber/Mist Eliminator Performance Evaluations.** Project manager and lead engineer for Navy-wide plating shop air pollution control technology evaluation and emissions testing program. Mist eliminators and packed tower scrubbers controlling metal plating processes, which included hard chrome, nickel, copper, cadmium and precious metals plating, were extensively tested at three Navy plating shops. Chemical cleaning and stripping tanks, including hydrochloric acid, sulfuric acid, chromic acid and caustic, were also tested. The final product of this program was a military design specification for plating and chemical cleaning shop air pollution control systems. The hydrochloric acid mist sampling procedure developed during this program received a protected patent.

**BACT Packed Tower Scrubber/UV Oxidation System Pilot Test Program.** Technical advisor for pilot test program of packed tower scrubber/ultraviolet (UV) light VOC oxidation system controlling VOC emissions from microchip manufacturing facility in Los Angeles. The testing was sponsored in part by the SCAQMD's Innovative Technology Demonstration Program, to demonstrate this innovative control technology as BACT for microchip manufacturing operations. The target compounds were acetone, methylethylketone (MEK) and 1,1,1-trichloroethane, and compound concentrations ranged from 10-100 ppmv. The single stage packed tower scrubber consistently achieved greater than 90% removal efficiency on the target compounds. The residence time required in the UV oxidation system for effective oxidation of the target compounds proved significantly longer than the residence time predicted by the manufacturer.

**BACT Pilot Testing of Venturi Scrubber on Gas/Aerosol VOC Emission Source.** Technical advisor for project to evaluate venturi scrubber as BACT for mixed phase aerosol/gaseous hydrocarbon emissions from deep fat fryer. Venturi scrubber demonstrated high removal efficiency on aerosol, low efficiency on VOC emissions. A number of VOC tests indicated negative removal efficiency. This anomaly was traced to a high hydrocarbon concentration in the scrubber water. The pilot unit had been shipped directly to the jobsite from another test location by the manufacturer without any cleaning or inspection of the pilot unit.

**Pulp Mill Recovery Boiler BACT Evaluation.** Lead engineer for BACT analysis for control of SO<sub>2</sub>, NO<sub>x</sub>, CO, TNMHC, TRS and particulate emissions from the proposed addition of a new recovery furnace at a kraft pulp mill in Washington. A "top down" approach was used to evaluate potential control technologies for each of the pollutants considered in the evaluation.

**Air Pollution Control Equipment Design Specification Development.** Lead engineer for the development of detailed Navy design specifications for wet scrubbers and mist eliminators. Design specifications were based on field performance evaluations conducted at the Long Beach Naval Shipyard, Norfolk Naval Shipyard, and Jacksonville Naval Air Station. This work was performed for the U.S. Navy to provide generic design specifications to assist naval facility engineering divisions with air pollution control equipment selection. Also served as project engineer for the development of Navy design specifications for ESPs and fabric filters.

## **CONTINUOUS EMISSION MONITOR (CEM) PROJECT EXPERIENCE**

**Process Heater CO and NO<sub>x</sub> CEM Relative Accuracy Testing.** Project manager and lead engineer for process heater CO and NO<sub>x</sub> analyzer relative accuracy test program at petrochemical manufacturing facility. Objective of test program was to demonstrate that performance of onsite CO and NO<sub>x</sub> CEMs was in compliance with U.S. EPA "Boiler and Industrial Furnace" hazardous waste co-firing regulations. A TECO

Model 48 CO analyzer and a TECO Model 10 NO<sub>x</sub> analyzer were utilized during the test program to provide ±1 ppm measurement accuracy, and all test data was recorded by an automated data acquisition system. One of the two process heater CEM systems tested failed the initial test due to leaks in the gas conditioning system. Troubleshooting was performed using O<sub>2</sub> analyzers, and the leaking component was identified and replaced. This CEM system met all CEM relative accuracy requirements during the subsequent retest.

**Performance Audit of NO<sub>x</sub> and SO<sub>2</sub> CEMs at Coal-Fired Power Plant.** Lead engineer on system audit and challenge gas performance audit of NO<sub>x</sub> and SO<sub>2</sub> CEMs at a coal-fired power plant in southern Nevada. Dynamic and instrument calibration checks were performed on the CEMs. A detailed visual inspection of the CEM system, from the gas sampling probes at the stack to the CEM sample gas outlet tubing in the CEM trailer, was also conducted. The CEMs passed the dynamic and instrument calibration requirements specified in EPA's Performance Specification Test - 2 (NO<sub>x</sub> and SO<sub>2</sub>) alternative relative accuracy requirements.

## **LATIN AMERICA ENVIRONMENTAL PROJECT EXPERIENCE**

**Assessment of operational deficiencies of Camisa pipeline – Peru.** Project leader of multi-year assessment of root causes of ruptures on Camisea 14-inch natural gas liquids pipeline for non-profit client. Determined that primary causes of hurried construction in difficult and unstable terrain, unstable right-of-way in the jungle sector due to inadequate erosion control practices, and inadequate pipe wall thickness to withstand external lateral forces. Two assessments were developed during the course of the project documenting deficiencies and recommending remedial actions.

**Evaluation of U.S.-Mexico Border Region Copper Smelter Compliance with Treaty Obligations – Mexico.** Project manager and lead engineer to evaluate compliance of U.S. and Mexican border region copper smelters with the SO<sub>2</sub> monitoring, recordkeeping and reporting requirements in Annex IV [Copper Smelters] of the La Paz Environmental Treaty. Identified potential problems with current ambient and stack monitoring practices that could result in underestimating the impact of SO<sub>2</sub> emissions from some of these copper smelters. Identified additional source types, including hazardous waste incinerators and power plants, that should be considered for inclusion in the La Paz Treaty process.

**Development of Air Emission Limits for ICE Cogeneration Plant - Panamá.** Lead engineer assisting U.S. cogeneration plant developer to permit an ICE cogeneration plant at a hotel/casino complex in Panama. Recommended the use of modified draft World Bank NO<sub>x</sub> and PM limits for ICE power plants. The modification consisted of adding a thermal efficiency factor adjustment to the draft World Bank NO<sub>x</sub> and PM limits. These proposed ICE emission limits are currently being reviewed by Panamanian environmental authorities.

**Mercury Emissions Inventory for Stationary Sources in Northern Mexico.** Project manager and lead engineer to estimate mercury emissions from stationary sources in Northern Mexico. Major potential sources of mercury emissions include solid- and liquid-fueled power plants, cement kilns co-firing hazardous waste, and non-ferrous metal smelters. Emission estimates were provided for approximately eighty of these sources located in Northern Mexico. Coordinated efforts of two Mexican subcontractors, located in Mexico City and Hermosillo, to obtain process throughput data for each source included in the inventory.

**Translation of U.S. EPA Scrap Tire Combustion Emissions Estimation Document – Mexico.** Evaluated the Translated a U.S. EPA scrap tire combustion emissions estimation document from English to Spanish for use by Latin American environmental professionals.

**Environmental Audit of Aluminum Production Facilities – Venezuela.** Evaluated the capabilities of existing air, wastewater and solid/hazardous waste control systems used by the aluminum industry in eastern Venezuela. This industry will be privatized in the near future. Estimated the cost to bring these control systems into compliance with air, wastewater and solid/hazardous waste standards recently promulgated in

Venezuela. Also served as technical translator for team of U.S. environmental engineers involved in the due diligence assessment.

**Assessment of Environmental Improvement Projects – Chile and Peru.** Evaluated potential air, water, soil remediation and waste recycling projects in Lima, Peru and Santiago, Chile for feasibility study funding by the U.S. Trade and Development Agency. Project required onsite interaction with in-country decisionmakers (in Spanish). Projects recommended for feasibility study funding included: 1) an air quality technical support project for the Santiago, Chile region, and 2) soil remediation/metals recovery projects at two copper mine/smelter sites in Peru.

**Air Pollution Control Training Course – Mexico.** Conducted two-day Spanish language air quality training course for environmental managers of assembly plants in Mexicali, Mexico. Spanish-language course manual prepared by Powers Engineering. Practical laboratory included training in use of combustion gas analyzer, flame ionization detector (FID), photoionization detector (PID), and occupational sampling.

**Stationary Source Emissions Inventory – Mexico.** Developed a comprehensive air emissions inventory for stationary sources in Nogales, Sonora. This project requires frequent interaction with Mexican state and federal environmental authorities. The principal Powers Engineering subcontractor on this project is a Mexican firm located in Hermosillo, Sonora.

**VOC Measurement Program – Mexico.** Performed a comprehensive volatile organic compound (VOC) measurements program at a health products fabrication plant in Mexicali, Mexico. An FID and PID were used to quantify VOCs from five processes at the facility. Occupational exposures were also measured. Worker exposure levels were above allowable levels at several points in the main assembly area.

**Fluent in Spanish.** Studied at the Universidad de Michoacán in Morelia, Mexico, 1993, and at the Colegio de España in Salamanca, Spain, 1987-88. Have lectured (in Spanish) on air monitoring and control equipment at the Instituto Tecnológico de Tijuana. Maintain contact with Comisión Federal de Electricidad engineers responsible for operation of wind and geothermal power plants in Mexico, and am comfortable operating in the Mexican business environment.

## PUBLICATIONS

Bill Powers, “*More Distributed Solar Means Fewer New Combustion Turbines,*” Natural Gas & Electricity Journal, Vol. 29, Number 2, September 2012, pp. 17-20.

Bill Powers, “*Federal Government Betting on Wrong Solar Horse,*” Natural Gas & Electricity Journal, Vol. 27, Number 5, December 2010,

Bill Powers, “*Today’s California Renewable Energy Strategy—Maximize Complexity and Expense,*” Natural Gas & Electricity Journal, Vol. 27, Number 2, September 2010, pp. 19-26.

Bill Powers, “*Environmental Problem Solving Itself Rapidly Through Lower Gas Costs,*” Natural Gas & Electricity Journal, Vol. 26, Number 4, November 2009, pp. 9-14.

Bill Powers, “*PV Pulling Ahead, but Why Pay Transmission Costs?*” Natural Gas & Electricity Journal, Vol. 26, Number 3, October 2009, pp. 19-22.

Bill Powers, “*Unused Turbines, Ample Gas Supply, and PV to Solve RPS Issues,*” Natural Gas & Electricity Journal, Vol. 26, Number 2, September 2009, pp. 1-7.

Bill Powers, “*CEC Cancels Gas-Fed Peaker, Suggesting Rooftop Photovoltaic Equally Cost-Effective,*” Natural Gas & Electricity Journal, Vol. 26, Number 1, August 2009, pp. 8-13.

Bill Powers, "San Diego Smart Energy 2020 – The 21<sup>st</sup> Century Alternative," San Diego, October 2007.

Bill Powers, "Energy, the Environment, and the California – Baja California Border Region," Electricity Journal, Vol. 18, Issue 6, July 2005, pp. 77-84.

W.E. Powers, "Peak and Annual Average Energy Efficiency Penalty of Optimized Air-Cooled Condenser on 515 MW Fossil Fuel-Fired Utility Boiler," presented at California Energy Commission/Electric Power Research Institute Advanced Cooling Technologies Symposium, Sacramento, California, June 2005.

W.E. Powers, R. Wydrum, P. Morris, "Design and Performance of Optimized Air-Cooled Condenser at Crockett Cogeneration Plant," presented at EPA Symposium on Technologies for Protecting Aquatic Organisms from Cooling Water Intake Structures, Washington, DC, May 2003.

P. Pai, D. Niemi, W.E. Powers, "A North American Anthropogenic Inventory of Mercury Emissions," presented at Air & Waste Management Association Annual Conference in Salt Lake City, UT, June 2000.

P.J. Blau and W.E. Powers, "Control of Hazardous Air Emissions from Secondary Aluminum Casting Furnace Operations Through a Combination of: Upstream Pollution Prevention Measures, Process Modifications and End-of-Pipe Controls," presented at 1997 AWMA/EPA Emerging Solutions to VOC & Air Toxics Control Conference, San Diego, CA, February 1997.

W.E. Powers, et. al., "Hazardous Air Pollutant Emission Inventory for Stationary Sources in Nogales, Sonora, Mexico," presented at 1995 AWMA/EPA Emissions Inventory Specialty Conference, RTP, NC, October 1995.

W.E. Powers, "Develop of a Parametric Emissions Monitoring System to Predict NO<sub>x</sub> Emissions from Industrial Gas Turbines," presented at 1995 AWMA Golden West Chapter Air Pollution Control Specialty Conference, Ventura, California, March 1995.

W. E. Powers, et. al., "Retrofit Control Options for Particulate Emissions from Magnesium Sulfite Recovery Boilers," presented at 1992 TAPPI Envr. Conference, April 1992. Published in *TAPPI Journal*, July 1992.

S. S. Parmar, M. Short, W. E. Powers, "Determination of Total Gaseous Hydrocarbon Emissions from an Aluminum Rolling Mill Using Methods 25, 25A, and an Oxidation Technique," presented at U.S. EPA Measurement of Toxic and Related Air Pollutants Conference, May 1992.

N. Meeks, W. E. Powers, "Air Toxics Emissions from Gas-Fired Internal Combustion Engines," presented at AIChE Summer Meeting, August 1990.

W. E. Powers, "Air Pollution Control of Plating Shop Processes," presented at 7th AES/EPA Conference on Pollution Control in the Electroplating Industry, January 1986. Published in *Plating and Surface Finishing* magazine, July 1986.

H. M. Davenport, W. E. Powers, "Affect of Low Cost Modifications on the Performance of an Undersized Electrostatic Precipitator," presented at 79th Air Pollution Control Association Conference, June 1986.

## **AWARDS**

Engineer of the Year, 1991 – ENSR Consulting and Engineering, Camarillo

Engineer of the Year, 1986 – Naval Energy and Environmental Support Activity, Port Hueneme

Productivity Excellence Award, 1985 – U. S. Department of Defense

## **PATENTS**

Sedimentation Chamber for Sizing Acid Mist, Navy Case Number 70094

**ATTACHMENT #4**

**Julia Severson Resume**

# Julia Severson

(858) 922-1133 | [julia@protectourcommunities.org](mailto:julia@protectourcommunities.org)

[www.linkedin.com/in/juliaseverson](http://www.linkedin.com/in/juliaseverson)

## . EDUCATION

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### University of Redlands 2018 - 2020

Bachelor of Arts in Philosophy with minor in Spanish

GPA: 3.781

- Advanced Seminar in Philosophy Thesis: “Language, Representationalism, and Non-Human Animals’ Beliefs”
- Concentration in biomedical ethics, environmental ethics, and animal welfare ethics and policy.
- Dean’s List Fall 2018, Spring 2019, Spring 2020
- Omicron Delta Kappa National Leadership Honor Society March 2019 – December 2020
- National Society of Leadership and Success September 2020 – December 2020

### University of Oregon 2016 – 2018

GPA: 3.55

- Dean’s List Winter 2018

## . EMPLOYMENT

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### Protect Our Communities Foundation

June 2020 - Present

Advocate

San Diego, CA

- Actively participate in proceedings at the California Public Utilities Commission (CPUC) by compiling data to be utilized in filings, tracking deadlines and relevant rules, and attending workshops and Commission meetings.
- Assists participation in legal proceedings and court cases by conducting legal research, reviewing legal citations, managing documents and exhibits, and providing support with filings.
- Write research memos to inform team members’ work in CPUC proceedings.
- Analyze decisions and fulfill intervenor compensation requests to be submitted to the CPUC.
- Provide public comment at City Council, Committee, and Board meetings.

## . LEGAL EXPERIENCE

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### Summer Pre-Law Intern

June 2019 – August 2019

### Center for Public Interest Law (CPIL)

University of San Diego School of Law

- Researched and analyzed proposed and approved state legislation that affected the Bureau for Private Postsecondary Education.
- Drafted a report on Vertical Enforcement practices in the Medical Board of California for CPIL attorneys to utilize in correspondence by tracking changes in legislation and enforcement statistics and analyzing enforcement program summaries presented in board and committee meetings.
- Edited the *California Regulatory Law Reporter* and other pieces for publication.
- Drafted a report on the Department of Business Oversight for law students that work with the center about proposed legislation that affected them and what they regulate.
- Researched grants for the CPIL office to apply for to gain funds for advocacy efforts.

### Summer Intern

June 2018 - August 2018

### Aguirre & Severson LLP

San Diego, CA

- Conducted legal research of cases and statute using LexisNexis.
- Collaborated with lawyers and clerks about the significance of research findings to aid in the development of motions.
- Prepared files and evidence from fact investigation for use at hearings and client meetings.
- Developed a new website platform for the firm in order to promote easier methods of contact and expose relevant media.

## . PUBLICATIONS

### **Editorial Assistant**

- Robert C. Fellmeth, R. (Spring 2019). *California Regulatory Law Reporter*. San Diego, CA. Center for Public Interest Law University of San Diego School of Law.

## . LEADERSHIP EXPERIENCE

### **Associated Students of the University of Redlands (ASUR)**

Redlands, CA

#### **Judicial Chair**

April 2019 – April 2020

- Lead the Judicial Council to actively interpret and revise the ASUR constitution to ensure it best represented the student body.
- Acted as the Director of the Clubs and Organizations Advisory Board (COAB) to guide the creation of new organizations, present and approve new club constitutions with ASUR Senate, and regulate funds distributed to all clubs and organizations on campus.
- Organized annual presidential and senatorial elections through advertising, facilitating a presidential debate, hosting information sessions, and implementing an online voting platform for all University students.
- Organized the annual COAB Awards and the bi-annual event for clubs regarding funding, programming, and site management.
- Constructed the first ASUR Judicial Chair Annual Report and made it available to the University student body, faculty, and administration.

#### **Presidential Cabinet Member**

April 2019 – April 2020

- Actively worked alongside the ASUR President Elect and other cabinet members to resolve issues on campus regarding diversity, inclusion, sustainability, and more.
- Advised the ASUR President on financial, academic, social, and administrative issues.
- Represented student interests to University administration, faculty, and staff regarding academics, social life, student life, and University policies.
- Planned campus projects that have included renovations of spaces, investments into mental health initiatives, and sustainable practices with the University food provider.

#### **Judicial Council Member**

September 2018 - March 2019

- Reviewed and revised the Presidential and Senatorial Elections Code of the ASUR Constitution with regards to advertising and engagement.
- Assisted in the presidential debate by developing debate topics and setting up the event.
- Advertised presidential and senatorial elections through tabling and media distribution.

#### **Club and Organization Advisory Board (COAB) Member**

September 2018 - March 2019

- Aided in organizing the annual COAB Awards Banquet to honor students, advisors, and organizations through researching and selecting qualified candidates across the campus.
- Proposed revisions of prospective organizations' constitutions with the Judicial Chair and other members of COAB.
- Reviewed applications for club funding and voted on clubs and organizations' operational budgets.

#### **University of Redlands Women's Club Soccer**

September 2018 – April 2020

#### **Head of Fundraising, Defender**

- Coordinated fundraisers with vendors to raise funds for uniforms, referees, and travel.
- Advertised fundraisers to the community on and off campus to attract the greatest possible attendance.

## . SKILLS

- Moderate proficiency in reading, writing, and speaking Spanish.
- Proficient in Microsoft Office, including Excel, PowerPoint, and Word.
- Have public speaking experience in front of crowds exceeding 200 attendees.
- Strong writer of informational and persuasive pieces.