

Testimony

of

Rod Jones, President and Chief Executive Officer of the CSL
Group

before the

Subcommittee on Coast Guard and Marine Transportation
House of Representatives Committee on Transportation
and Infrastructure

regarding the

North American Emission Control Area Impacts

March 4, 2014

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I.

Introduction

Good morning Chairman Hunter, Representative Garamendi, and distinguished members of the Subcommittee. Thank you for inviting me to testify. I am Rod Jones, President and Chief Executive Officer of the CSL Group. I am privileged to speak with you today about the North American Emission Control Area *or* “ECA” and its potentially problematic unintended consequences to the industries which our company supports and its adverse impact on the environment and air quality which the ECA is, ironically, supposed to protect. CSL is a North American shipping company, serving the construction, manufacturing, energy, and agriculture industries. Our niche is small, self-unloading bulk ships on international short sea routes. I am pleased to represent our United States operations which are headquartered in Beverly, Massachusetts. I also represent the concerns of the Maritime Industrial Transportation Alliance and its members which is a coalition of industry members who rely on Short Sea Shipping.

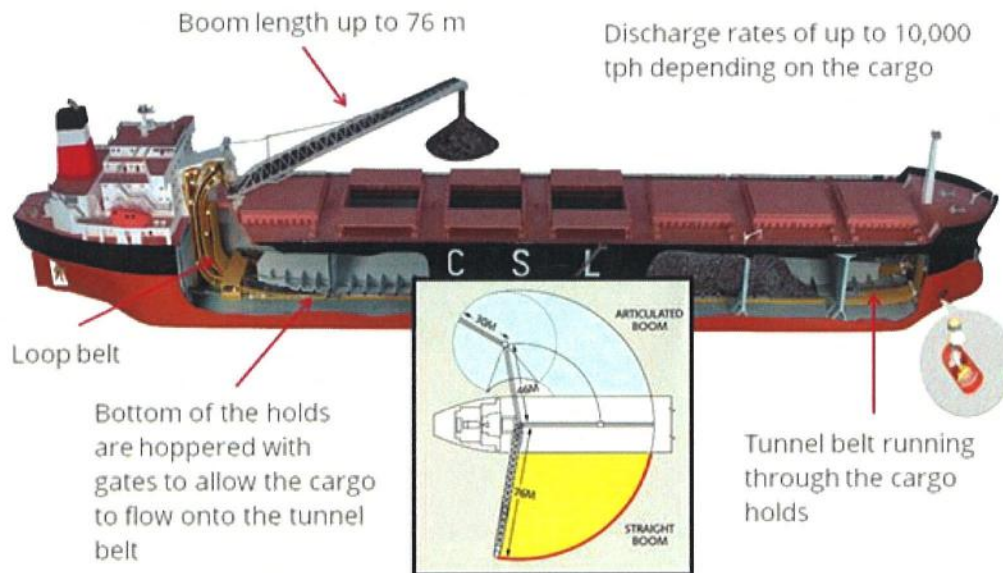
A. Prior Testimony

In April 2012, CSL addressed this Subcommittee regarding the environmental benefits of Short Sea Shipping and the looming unintended consequences that the North American ECA may have on coastal shipping in the United States. Eighteen months later, I am here to revisit the themes of our original testimony with updated information and observations on the ECA and its effect on the economy.

I am accompanied today by one of our valued customers, Mr. William Terry of Eagle Rock Aggregates, Incorporated. Mr. Terry is the CEO of Eagle Rock Aggregates and will speak to the very real impacts that his company has already seen as a result of the surge in fuel costs as the ECA implementation has begun. Eagle Rock is based in Northern California and serves the construction industry.

B. CSL Group

CSL specializes in the marine transportation and handling of over 70 million tons of dry-bulk cargoes annually. Examples of the strategically important cargoes that we carry include iron ore for steel manufacturers, aggregate for road building and repair, coal and petroleum coke for hydro-electric utilities, and gypsum for construction. CSL owns or operates over 60 ships and marine equipment all over the world. About one third of those ships are committed to serving the bulk cargo delivery needs of the U.S. market. Most of our North American trade requires coastal routing along the East and West coasts of the United States, typically well within 200 miles from shore. Our ships are specially designed to meet the very unique demands of our customers, with their relatively modest size for nimble operation and sophisticated self-unloading cargo gear, which eliminates the need for shore based cargo handling. Our ships are also fitted with distinctly designed cargo holds which leverage gravity to reduce the need for mechanical cargo transfer systems.



The graphic above highlights the very unique and environmentally friendly features of a typical self-unloading short sea ship.

II. ECA Regulatory Requirements

Our ships are required to meet all of the provisions of the International Convention on the Prevention of Pollution from Ships (MARPOL), including Annex VI of the convention. Annex VI defines measures to reduce air emissions from ships. Under the auspices of Annex VI, the North American ECA went into effect on August 1, 2012. The ECA is designed to reduce emissions of Nitrogen Oxides (NO_x), Particulate Matter (PM), and Sulfur Oxides (SO_x), the latter by limiting the sulfur content in fuel to set levels. Promulgated by the EPA and enforced by the Coast Guard, the ECA creates a 200 mile zone around the United States and Canada (with the exception of the Aleutian Islands and other limited outlying areas). Upon entering the 200 mile ECA, ships must switch from heavy marine fuel oil to a low sulfur fuel containing no more than 1% of sulfur to reduce air emissions on or after August 1,

2012. In 2015 the sulfur levels in marine fuel will be dramatically further lowered (by regulation) to 0.1% for all ships regardless of their size when operating inside of the ECA.

We are concerned that the current 200 mile ECA boundary was established without firm scientific rationale for all vessels; particularly vessels engaged in the short sea trade (that routinely or exclusively operate within the 200 mile ECA) or self-unloading vessels which, by competitive necessity, are typically smaller vessels, with corresponding smaller and less emitting propulsion systems that traditionally operate in short sea trades.

A. The ECA Revisited

I address this Subcommittee with a sense of urgency as our window for regulatory relief is closing with the pending regulations set to take effect on January 1, 2015. While we have had extensive dialogue with the Coast Guard and EPA, we remain at loggerheads over the critical issue of the ECA boundary for smaller and therefore lower emitting coastal vessels such as ours, or an equitable impact based equivalency standard.

We wholly support the ECA's provisions relating to NO_x reductions but object to the method in which certain ships must attain compliance with the SO_x (and PM) requirement. Since SO_x is directly related to the sulfur contained in fuel, the ECA requires ships to use reduced sulfur fuels within a 200 mile zone from the shore regardless of service, type, or size.

I will discuss why the broad, 200 mile ECA boundary is not warranted for all vessels that can achieve the EPA's clean air goals by alternative means. Moreover, I hope to clarify that our unique operational niche and purpose built ships were simply not factored into EPA's data collection and analysis that led to the creation of the 200 mile ECA boundary.

Our collective testimony will outline:

- The disparity between the EPA's predictions of fuel cost increases caused by the North American ECA, and actual cost increases;
- Our scientific justification for our proposal;
- The impacts on the economy that relies on clean, safe, and efficient Short Sea Shipping; and
- Potential regulatory action or pursuit of impact based equivalencies - not to avoid compliance with the ECA, but rather, tailor it in a manner that makes environmental and economic sense for our types of vessels and routes.

III.

EPA vs. Industry Predictions

In March 2010 the EPA released its regulatory announcement introducing the North American ECA and its mandated components. The announcement predicted that associated fuel cost increases resulting from the ECA were expected to be modest. Specifically, the document claimed “operating costs for a ship in a route that includes about 1,700 nautical miles of operation in the ECA may increase by about 3 percent.”¹

The announcement neglected to mention that most of the deep draft ships trading in major United States ports are making significant trans-ocean voyages of which, only a small portion (the 1700 nautical miles referred to by the EPA) is spent within the ECA. The rest of the voyage (5-10 thousand miles) would be spent at sea where higher sulfur fuels can be used. This simple example, indeed, supports the notion of a 3% cost increase for trans-ocean vessels. In the case of Short Sea Shipping, however, voyages are the opposite of trans-ocean trade. Most short sea voyages are largely or completely within the ECA, requiring exclusive use of higher-priced, low-sulfur fuel. Thus, the EPA’s announcement is simply irrelevant to short-sea ships and their voyage patterns.

A. Marine Fuel Dilemma

Ships’ large propulsion engines typically use Intermediate Fuel Oil which is a residual oil that is a by-product from the refining process. The engines and their fuel delivery systems are designed for these heavy fuel oils. Our research indicates that the petroleum industry will not produce 0.1% sulfur intermediate marine fuel oil (IFO) which will force shippers to use a lighter distillate referred to as Marine Gas or Marine Diesel Oil (MGO/MDO). While Marine Gas Oil meets the 0.1% sulfur standard and is more commercially available, it is priced with a far greater premium.

When CSL last addressed this Subcommittee about a year and a half ago, we predicted that fuel costs would increase for our shipping sector by at least 40 percent from pre-ECA prices – based on current pricing and without the effect of supply and demand. Our predictions now prove to be accurate. Our fuel costs for 0.1% sulfur fuel have spiked as much as 40% (depending on the port) over the Intermediate Fuel Oil that is used beyond 200 miles from shore.

Even among the low sulfur fuels, Marine Gas Oil (0.1% sulfur) market prices alone are as much as 30% higher than ECA compliant 1% low sulfur fuel and as much 40% higher than Intermediate Fuel Oil which is used during the sea voyage. These aren’t predictions but actual market fuel prices; and far exceed the EPA’s inaccurate 3% prediction. We haven’t even reached the major milestone of January 1, 2015 when 0.1% sulfur fuel supplies will be in even higher demand potentially adding to such these already great price increases.

In August of 2013 CSL calculated that, on average, each ship would bear about \$815,000 of additional annual fuel costs (the cost differential of 1% and 0.1% sulfur fuel) to comply with the ECA.

¹ EPA Regulatory Announcement 420 F-10-015 March 2010

For CSL alone, the cost could exceed 14 million dollars per year, with no added benefit to the environment when using 0.1% fuel beyond 40 miles, according to our scientific study. Below is a table drawn from a fuel price index on February 11, 2014.

Fuel Type	Sulfur Content	Cost ¹ per Metric Ton	Premium per Metric Ton	Increase
New Orleans Intermediate Fuel Oil (IFO) 380	3.5%	613		N/A
New Orleans Low Sulfur (LS)	1%	719	+\$106 (over IFO)	+15% (over IFO)
New Orleans Marine Gas Oil	0.1%	1021	+\$302 (over LS) +\$408 (over IFO)	+30% (over LS) +40% (over IFO)
San Francisco Intermediate Fuel Oil (IFO) 380	3.5%	639		N/A
San Francisco Low Sulfur (LS)	1%	828	+\$189 (over IFO)	+23% (over IFO)
San Francisco Marine Gas Oil	0.1%	1050	+\$222 (over LS) +\$411 (over IFO)	+22% (over LS) +40% (over IFO)

¹Based on February 11, 2014 Platts Bunkerwire

On the date of our last testimony on April 26, 2012, the premium between Intermediate Fuel Oil and Marine Gas Oil in New Orleans and in San Francisco were both 33% and now are both at 40%.

B. Omission of Short Sea and self-unloading Vessels

Through our extensive dialogue with the EPA and U.S. Coast Guard, we have found that when creating the 200 mile boundary itself the EPA did not consider short sea shipping or the consequence of potential modal shift to truck and rail in their analysis.

We found that the Short Sea Shipping sector (more specifically in our testimony, self-unloading vessels) was completely omitted from their studies. The EPA focused its examination on large vessels engaged in trans-ocean trade for which modal shift is not a possibility or an issue.

In a June 12, 2012 letter, the EPA responded to questions of this Sub-Committee regarding adverse impacts on short sea shipping. In their response, the EPA detailed a flawed representation of short sea self-unloading vessels in their ECA justification, admitting that this vessel type was collectively gathered with “other bulk vessels.”² They cited the study of two trans-ocean routes (using a tank ship and container ship as test subjects traveling between the United States and Singapore). They also studied a cruise ship traveling between Vancouver and Alaska, claiming the cruise ship example as being closest to a coastwise vessel. In their study they cite that fuel cost increases would be easily absorbed by spreading

² June 12, 2013 EPA Response; Enclosure Paragraph 2.h

the cost over the vast passenger pool with an estimated increase in ticket price of about 1.7% - 6.6%.³ MITA objects to all of these comparisons to short sea self-unloading vessels (especially the cruise ship example) because of the completely different business model used by the self-unloading shipping industry to transport low value commodities at a far tighter economic margin than cruise ships. The example used by the EPA is synonymous comparing apples to oranges.

Therefore, precisely in an attempt to fill this technical data gap left by EPA, we commissioned the Sahu/Gray study, entitled "*Modeling the Air Quality Impacts of Short Sea Shipping Emissions and Implications for the North American Emission Control Area*" to focus on Short Sea Shipping.

IV. Independent Analysis

In order to gain a full appreciation of the ECA, its benefits and its consequences, CSL co-sponsored a study entitled "*Modeling the Air Quality impacts of Short Sea Shipping Emissions and Implications for the North American Emission Control Area.*" The analysis, led by Drs. Ranajit Sahu and H. Andrew Gray, formally studied CSL ships operating in the United States to measure the emissions impact of small horsepower ships as a sub-group within the larger maritime community. (Dr. Sahu's and Dr. Gray's curriculum vitae are included in Exhibit A of the Report) The study closely examined sulfur dioxide (SO_x), the main pollutant emitted that is directly a consequence of sulfur levels in the fuel – and hence the pollutant directly related to fuel choices. The study carefully and thoroughly analyzed East Coast and West Coast shipping routes and methodically used historical meteorological data consistent with EPA protocols.

In total, 12 ships were selected to represent the "typical short sea shipping vessel" (from a propulsion horsepower perspective and therefore emissions basis). The study analyzed the impact of "worst case" short sea shipping SO₂ emissions scenarios on shore air quality from the largest of these 12 ships. Their study, using the CALPUFF dispersion model, showed that air quality impacts from such ships on shore-based receptors diminished, as expected, as the ships moved further away from the coast - with a sharp drop in impact at about 40 miles offshore – i.e., well within the EPA's arbitrary 200 mile ECA boundary. That study was presented to this Subcommittee in April of 2012 and may be reviewed by visiting either of the links below:

Summary Report

<http://www.cslships.com/en/media-center/brochures/define-defend-and-promote-summary>

Full Report

<http://www.cslships.com/en/media-center/brochures/define-defend-and-promote-full-report>

³ June 12, 2013 EPA Response; Enclosure Paragraph 2.d

A. Analysis Conclusions

The study proves that smaller ships (with corresponding lower horsepower propulsion systems) used in short sea trades, have negligible environmental impact on the East or West Coasts of North America when operated beyond 40 miles from shore. More specifically, the results indicate that ships fitted with propulsion systems of 20,000 horsepower (14,913 kW) or lower had negligible air quality impacts on the shore even when using pre-2012 fuel with a typical sulfur content of 2.6%. Despite using a fuel assumption of 2.6% sulfur, (over twice the sulfur content permitted by the current ECA and 26 times the sulfur content of the pending 2015 ECA), the modeled vessels still performed exceptionally well indicating negligible SO_x concentrations at the coastline when the ship was 40 miles off-shore and beyond.

B. Post Study Dialogue

Following the release of the Sahu/Gray study, the EPA reviewed its findings and offered some strange and puzzling comments as well as comments on CSL's April 26, 2012 testimony before this Subcommittee. In a May 25, 2012 letter, the EPA asserted that the:

- i. Study only examined SO_x emissions from a single ship and didn't account for particulate matter or NO_x;
- ii. Study's comparison of one ship's data to the National Ambient Air Quality Standard (NAAQS) was not meaningful;
- iii. Study erroneously used the CALPUFF dispersion model rather than photochemical air quality modeling;
- iv. Study incorrectly concluded that Short Sea Shipping vessels do not affect air quality; and
- v. Study's claims about modal shift were unsubstantiated.

In order to better explain the study's conclusions, Dr. Sahu visited the EPA's Transportation and Air Quality staff at its Ann Arbor Michigan offices on June 12, 2012 to discuss their concerns. On August 20, 2012 CSL formally responded to the EPA's May 25, criticism by reiterating our commitment to meet our responsibility to improve air quality but strongly disagreed that 200 miles is the correct enforcement distance for all ships. Our response also clarified respectively that:

- i. The Sahu/Gray study specifically studied SO_x because it is the primary pollutant that is affected by the fuel's sulfur content. Additionally, there is no particular industry objection to the NO_x requirements and thus no focus was placed on studying NO_x. Particulate Matter was not specifically addressed in the study as we believe that Particulate Matter will behave substantially like the gaseous emissions such as SO_x which was studied.

- ii. We disagreed with the assertion that our comparison to the NAAQS was not meaningful as it was the best and most appropriate standard. The strict one hour SO₂ NAAQS is used by the EPA itself and is the most meaningful metric for judging SO₂ impacts. The EPA could not provide an alternative comparison that would be considered more meaningful. Our study compared the one hour NAAQS numerical value to the one hour impact from the largest (most emitting) vessel using 2.6% sulfur fuel as a test case, assuming for conservative test purposes, that the vessel was within a port area at 100% power (worst and improbable cases). To clarify, we propose that ships should use 1% sulfur fuel between 50-200 miles (i.e., with a margin of 10 miles beyond the study's 40 mile finding) from the coast and 0.1% sulfur fuel within 50 miles from the coast – not 2.6% sulfur fuel. Further, it is operationally infeasible (if not impossible) for a ship to be operated at 100% power within a port area, making this portion of the study exceptionally and purposely conservative.
- iii. Since we are not pursuing a change to the NO_x requirements, we found the use of photochemical air quality models to be unwarranted. The CALPUFF model was previously used by the EPA and is widely used by the modeling community. Moreover, the EPA's model choice does not guarantee that its results are more meaningful. Further, under the ECA, NO_x is controlled through engine design and is thus a component of engine manufacturing.
- iv. We contend that the use of our data in arriving at our conclusions is well supported and accurate unlike the EPA's analysis which, we point out, simply omits any consideration of such short sea ships. We attest that short sea ships, like any other ship or transportation mode consuming fossil fuel creates emissions. We do not state that there will be "no environmental impact." That is why we promote the use of 0.1% sulfur fuel within 50 miles of shore for ships of 20,000 horsepower or less. Further, we believe that the predicted impacts will be small and more importantly, the requested relief will be equivalent or better to the over-arching regional air quality sought through the ECA by avoiding modal shift to more polluting options such as rail or truck.
- v. We strongly disagree with the EPA's suggestion that our fear of modal shift is unsubstantiated. The Maritime Industrial Transportation Alliance was founded based on growing industry concern that modal shift is likely. Key industry members are now organizing to voice their apprehension of modal shift to rail and truck which will bring far greater impact much closer to population centers along the East, West, and Gulf coasts. The EPA referenced a study entitled Economic Impacts of the Category 3 Rule on Great Lakes Shipping in their suggestion of limited modal shift. Our concern with the EPA's assertion is three fold:
 - a. The EPA's referenced study examines the Great Lakes which is a very unique operating environment with its own infrastructure and regulations that are separate from the rest of the shipping world. The EPA has not demonstrated how the report's conclusions, even if accurate, has any bearing on short sea or coastal shipping along East, West and Gulf coasts.

- b. Since that report was completed, Canada has adopted a Fleet Averaging Program for the Great Lakes which gradually introduces lower sulfur fuels to the Great Lakes fleet between 2012 and 2020. The program was designed to balance modal shift concerns while continuing to support clean air goals. We note that in the United States, a complete exemption was provided, by EPA (pursuant to an appropriations rider), to steam ships with antiquated boiler systems that are incompatible with low sulfur fuels to better cope with the transition. The irony is that these obsolete vessels are arguably the most polluting of any in operation. Thus, modal shift would not be a viable factor on the Great Lakes.
- c. Their study examined voyages that contained a mix of rail and ship components. There are certain rail constraints in the Great Lakes that limit the ability of rail in that region, therefore, we do not believe that this can be compared to the wider volume of the coastal rail infrastructure which can and will directly compete with coastal ships as the operational costs for the ships rises with the expected dramatic rise in fuel prices, as the fuel sulfur content is lowered.

C. Exhaust Gas Cleaning (Scrubbers)

Annex VI of the MARPOL convention permits exhaust gas scrubbing as an option for alternative compliance to the ECA. Scrubbers, however, may be ineffective on smaller ships. Following the Sahu/Gray study, we now have a stronger understanding of the actual emissions impact of lower horsepower ships. The study indicates that if ships use ultra-low sulfur fuel (0.1% sulfur) at 40 miles offshore, it will deliver an equivalent level of protection as consuming high sulfur fuel with the use of a scrubber. Therefore, we feel that scrubbers won't be useful to short sea ships with horsepower of 20,000 or less. If lower horsepower ships meet the required low sulfur fuel levels from 200 miles offshore, and switch to an ultra-low sulfur fuel at 50 miles offshore, as we propose, ships will meet or exceed the environmental goals achieved by scrubbers. We believe this to be a more practical and environmentally sound solution.

Examining the issue deeper, Annex VI essentially offered technological relief that was not and is still not widely available to the industry as the technology is developing and its applicability to all classes of vessels, particularly smaller vessels, is not demonstrated. The shipping industry is experimenting with various scrubber manufacturers but as a whole there remain significant concerns in reliability and the capacity to retrofit these enormous systems into limited spaces on vessels that were not suited or designed for accommodating such equipment. There is also a fuel consumption penalty for using a gas scrubbing system, which, in a sense, is counterproductive to the goal of energy efficiency and reduced greenhouse gas emissions. Further, robust debate continues about ecological trade-offs regarding the heavy sludge waste that is created in the scrubbing process and how open loop systems discharge waste water back to the sea. In good faith, CSL has installed an exhaust gas scrubber prototype on one of our vessels and currently charts a vessel with gas scrubbing technology. I offer with practical certainty that the results are mixed and the technology has not matured to a level where we can commit to fleet wide-applications of scrubbers until some of these issues are addressed, which will not occur before 2015. Regardless, as the Sahu/Gray study details, the environmental benefit of exhaust gas

scrubbing technology is discouraged as it is irrelevant from pollution mitigation perspective for the smaller horse power engines of short sea ships.

Some cruise ship companies have committed to using exhaust gas scrubbers to comply with the North American ECA, but we point out key distinctions between cruise ships and typical short sea vessels:

- First, that cruise ships are far larger (and therefore far bigger emitters of air pollution) than short sea vessels of 20,000 horsepower (or less). Typical cruise ships cater to thousands of passengers and crew requiring large propulsion in addition to the emissions of significant auxiliary generators to maintain 24 hour hotel power loads. All combined, a current generation cruise ship can easily exceed 80,000 (or more) horsepower.
- Second, that modal shift, quite obviously, is simply not a competitive factor for cruise ships. There are no modal alternatives to a cruise. If a customer chooses to take a cruise, they either do so or not – they will not opt to take a train or a car.

D. Alternative Fuels

Annex VI of MARPOL also authorizes alternative fuels such as Liquefied Natural Gas (LNG) as a means to comply with the ECA. The retro-fit of such a unique fuel as LNG is not feasible for existing ships as the systems require very large and highly sophisticated fuel tanks to contain the cryogenic fuel which must remain below -260°F to remain in a liquid state. The option is far more feasible for new ships but leaves the option virtually unattainable for existing ships which have life cycles of 20-40 years. Also, and in addition, the fuel supply infrastructure in the United States, especially on the sea coasts, while making strides, certainly will not be in place in 2015 to meaningfully offer a realistic alternative fuel source in the markets that we serve. LNG as an alternative fuel has great promise as a long term potential but is far beyond the horizon in the United States.

V.

Understanding the Impacts

As a CEO, I predict that we will have to raise cargo rates by as much as 35% to manage the unprecedented fuel price premium of **\$400 per metric ton**. On short coast trades (4-5 days) the price increase is approximately 20-25% and increases to 35% for longer Coast Trades (example Halifax to Baltimore) to offset the cost increase per ton of fuel. This means that, eventually, my customers will be forced to seek other transportation options that are less safe, less efficient, and more harmful to our environment than shipping or cease production and/or sales altogether as they find alternate, offshore, sourcing of finished goods.

A. Short Sea Shipping Delivers

In the past year, short sea self-unloading ships have delivered the enormous volumes of aggregate that were used in the concrete for the iconic San Francisco Bay Bridge which

opened just over one month ago. Examples of other major projects supported by CSL's short sea ships are offered below.

- The Caldecott Tunnel (California State Highway 24, (Berkeley to Walnut Creek)).
- San Francisco's Millennium Tower and the new Trans Bay Transit Center.
- In Hawaii, products delivered by CSL will significantly contribute to a new light rail guide-way with pier blocks that will be formed over the next 18 months.
- On the East Coast, over 200,000 metric tons of aggregate have been delivered to the Greater New York area in support of the reconstruction effort following Hurricane Sandy.
- Short sea shipping delivered over 250,000 metric tons of construction material for use in the restoration of a 9000 foot runway at Charleston International Airport in South Carolina.

B. Maritime Industrial Transportation Alliance (MITA)

The MITA, of which CSL is a member, is comprised of major North American businesses in the United States and Canada that rely on Short Sea Shipping. The MITA is an outspoken advocate of practical environmental regulation that sensibly considers industry impact.

The MITA and its proposal for a balanced ECA is supported by the following members.

- U.S. Gypsum / Gypsum Transportation Ltd
- Georgia Pacific
- National Stone, Sand and Gravel Association
- National Gypsum Company
- Polaris Minerals / Eagle Rock Aggregates
- Road and Highway Builders
- Atlantic Coast Materials LLC
- Canadian Manufacturers & Exporters
- Chamber of Marine Commerce
- Portland Cement Association

C. Environmental Performance Comparison

Considering an average long haul truck can carry 26 tons of cargo and a Panamax short sea vessel can carry a cargo load of 50,000 to 74,000 tons, the short sea voyage removes, at minimum, 1,923 trucks from roads, easing congestion and the emissions they produce right in people's backyards. Similarly, the same ship would remove 819 rail cars, assuming a capacity of about 61 tons per rail car.

Citing the U.S. Maritime Administration's 2011 America's Marine Highway Report to Congress:

- "Trucks, on average, can carry one ton of freight for approximately 155 miles on a gallon of diesel fuel (i.e., 155 ton-miles of freight per gallon - equivalent to 842 British Thermal Units (BTU) per ton-mile);
- Rail achieves 413 ton-miles of freight per gallon (i.e., 316 BTU per ton-mile); and
- A tug-and-barge operation can get as much as 576 ton-miles of freight to a gallon of fuel (227 BTU per ton-mile)."⁴

By comparison, our vessels achieve 1,100 ton-miles of freight per gallon of fuel which outperforms all other competing modes, including tug and barge.

An International Maritime Organization *Marine Environment Protection Committee* paper cited "that examining the range of typical CO₂ efficiencies for various loaded cargo carriers; bulk ships produce an average of 2.7 grams of CO₂ per ton-mile while trains range from 10-119 grams per ton-mile. Trucks, by comparison, are the most inefficient of the transportation options ranging from 80-181 grams of CO₂ per ton-mile."⁵

D. Economic Impact

While CSL doesn't regularly serve customers there, the State of Alaska has publicly expressed frustration over the ECA as nearly all of its goods arrive via ship. Most of the dedicated shipping lines between the continental United States and Alaska transit virtually 100% through the ECA. Additionally, the cruise ship industry, which is a major contributor to the Alaskan tourism economy, will be hard hit and have also publicly promoted alternatives.

In the United Kingdom, large commercial ferry services that operate exclusively within their respective ECA, are showing concern over potential modal shift due to current and predicted fuel price increases between \$275-\$350 per ton in the United Kingdom.

Closer to home, the National Stone, Sand and Gravel Association, which represents an industry that produced nearly two billion metric tons of aggregate accounting for over 90% of the crushed stone and 70% of the sand consumed in the United States, has publicly raised their concern over the ECA and its impact on the transportation of narrow margin cargoes such as construction aggregates.

E. Modal Shift

Despite the well documented social, environmental, and air quality benefits of Short Sea Shipping, there is concern that consumers with a choice, will be forced to pursue less efficient modes of transportation that are more damaging to the environment.

⁴ America's Marine Highway Report to Congress: Maritime Administration, April 2011, Page 22

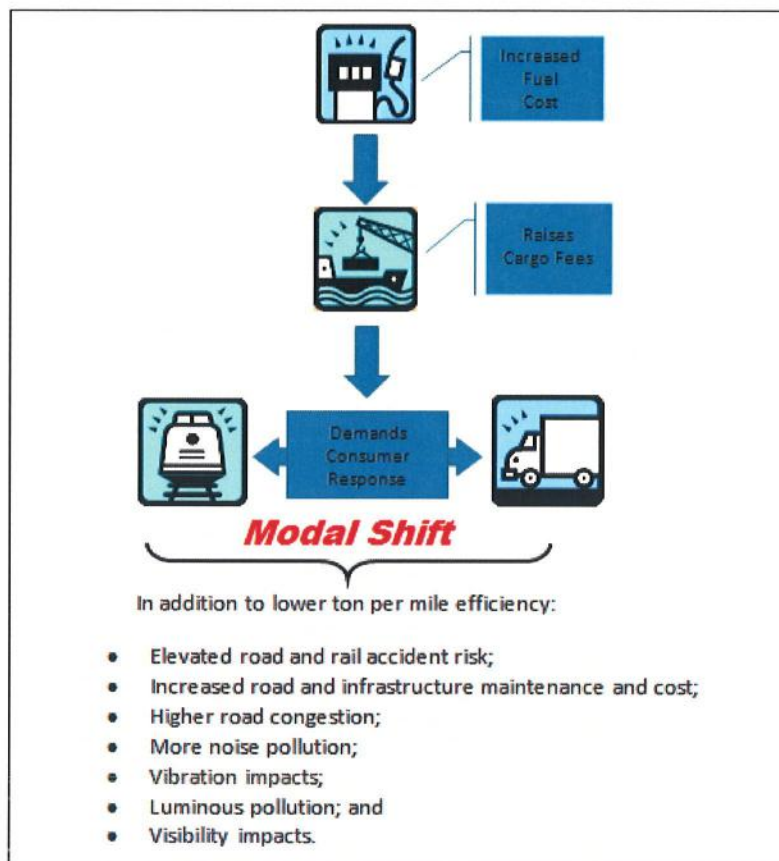
⁵ MEPC Paper 59/INF.10 Annex

Again, citing the June 12, 2013 response letter, the EPA dismisses the notion of modal shift caused by the forced increase in fuel related costs to cheaper, land based and higher emitting modes. Relying on a very regionalized study of the Great Lakes, the EPA determined that there would be no threat of modal shift on the coasts. When this Sub-Committee asked specifically if the EPA studied potential East and West coast modal impacts, they simply provided a one line response claiming they don't believe a modal shift is probable based on their Great Lakes review.⁶

The unintended consequences will conflict with the Maritime Administration's 2010 Marine Highway Program, which will increase truck and rail demand leading to:

- Elevated road and rail accident risk;
- Increased road and infrastructure maintenance;
- Higher road congestion;
- More noise pollution;
- Vibration impacts;
- Luminous pollution; and
- Visibility impacts.

The impact of the added shore-side congestion will be felt in regions that already have overstressed transportation infrastructure.



⁶ June 12, 2013 EPA Response; Enclosure Paragraph 2.j & K

The issue isn't front page news because it impacts a small population of shipping companies. However, the issue is real for those that rely on coastal shipping that requires extensive operation within the ECA.

In addition to modal shift is source shift. As an example: gypsum is currently mined and produced by our trade partners in Canada and Mexico and shipped to American manufacturers in California, New Hampshire, and Maryland. The increases in short-sea shipping freight rates could transfer supply of that material to Chinese or European producers supplying American homes with wallboard.

VI. Environmental Stewardship

At CSL we are proud to responsibly serve our customers and provide environmental leadership to our industry. We look at environmental challenges as opportunities to improve our operations and earnestly believe in preserving our marine habitat as a lasting natural resource to benefit future generations as well as to sustain our mission of marine transportation.

As an industry, the maritime domain has been modest in promoting its inherent value to the environment as not one of the most efficient but *THE* most efficient bulk cargo transportation option. From a fuel efficiency perspective, our ships are:

- 7 times more efficient than truck; and
- 2.5 times more efficient than rail.

A. Corporate Environmental Initiatives

We exceed environmental regulations and break industry standards by annually measuring our environmental performance and transparently share our results publicly. We use the data gathered in our environmental metrics to develop ambitious and well intentioned projects to improve fuel efficiency, reduce operational impacts, as well as improve the health of the marine habitat and the coastal communities which we serve.

CSL has made extensive commitments to systematically improve our performance including enrollment in the Green Marine Program which delivers a challenging and critical unbiased third party report card on company and ship environmental performance in six categories including air emissions.

Moreover, CSL volunteers time, people, assets, and millions of dollars in financial resources to explore emerging technology for marine applications including energy efficiency projects, alternative fuels, bio-diversity, and specific to this topic, exhaust gas scrubbing technology.

Committed to the environment, CSL is recapitalizing its fleet with seven new state-of-the-art energy efficient *Trillium* class ships. Our first *Trillium* ship (delivered in mid-June 2012) earned the International Bulk Journal's 2012 *Bulk ship of the Year Award* in a world-wide competition which judges ships' safety, efficiency, and environmental features. Our ships

operating on the West Coast consistently earn the Port of Los Angeles/Long Beach Green Flag award for voluntary fuel efficiency measures which contribute to improvements in regional air quality. We are also committed partners with the World Wildlife Fund.

VII. Balanced Proposal

CSL leads our industry in environmental stewardship, which is why we support the ECA. We simply disagree, based on scientific evidence, that smaller, cleaner, ships such as ours, should be lumped together and painted with the same broad brush as ships with propulsion plants that are 2-5 times larger.

To best achieve the goals of the ECA, while recognizing the industrial impacts, we continue to propose that Congress and the EPA, in consultation with the U.S. Coast Guard and MarAd, to revisit the ECA boundary and:

- Maintain the 200 (nautical) mile North American ECA for all ships using 1% sulfur fuels; however;
- **Reduce** the 200 (nautical) mile ECA to **50** miles for **0.1 %** sulfur fuels (in **2015**) for lower emitting ships of 20,000 horsepower and below.

This revision will move away from the current "one size fits all" regulation and align with a scientifically based approach which achieves the same environmental protection goals.

CSL stands proudly with the EPA, Coast Guard, and the International Maritime Organization as advocates of the ECA as a valuable regulatory tool to help improve air quality. Clean air is the responsibility of all users of fossil fuels, and the shipping industry is no different. We support the ECA, but vigorously challenge the 200 mile boundary.

As a practical approach, MITA continues to avail itself to dialogue with the EPA to explore other impact based alternatives.

We urge the Coast Guard and the EPA to work together in finding a regulatory or equivalent grounded solution which doesn't punish smaller, cleaner ships and the customers that they serve.

Exhibit A

RANAJIT (RON) SAHU, Ph.D, QEP, CEM (Nevada)

CONSULTANT, ENVIRONMENTAL AND ENERGY ISSUES

311 North Story Place

Alhambra, CA 91801

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EXPERIENCE SUMMARY

Dr. Sahu has over twenty one years of experience in the fields of environmental, mechanical, and chemical engineering including: program and project management services; design and specification of pollution control equipment; soils and groundwater remediation; combustion engineering evaluations; energy studies; multimedia environmental regulatory compliance (involving statutes and regulations such as the Federal CAA and its Amendments, Clean Water Act, TSCA, RCRA, CERCLA, SARA, OSHA, NEPA as well as various related state statutes); transportation air quality impact analysis; multimedia compliance audits; multimedia permitting (including air quality NSR/PSD permitting, Title V permitting, NPDES permitting for industrial and storm water discharges, RCRA permitting, etc.), multimedia/multi-pathway human health risk assessments for toxics; air dispersion modeling; and regulatory strategy development and support including negotiation of consent agreements and orders.

He has over nineteen years of project management experience and has successfully managed and executed numerous projects in this time period. This includes basic and applied research projects, design projects, regulatory compliance projects, permitting projects, energy studies, risk assessment projects, and projects involving the communication of environmental data and information to the public. Notably, he has successfully managed a complex soils and groundwater remediation project with a value of over \$140 million involving soils characterization, development and implementation of the remediation strategy, regulatory and public interactions and other challenges.

He has provided consulting services to numerous private sector, public sector and public interest group clients. His major clients over the past twenty one years include various steel mills, petroleum refineries, cement companies, aerospace companies, power generation facilities, lawn and garden equipment manufacturers, spa manufacturers, chemical distribution facilities, and various entities in the public sector including EPA, the US Dept. of Justice, California DTSC, various municipalities, etc.). Dr. Sahu has performed projects in over 44 states, numerous local jurisdictions and internationally.

Dr. Sahu's experience includes various projects in relation to industrial waste water as well as storm water pollution compliance include obtaining appropriate permits (such as point source NPDES permits) as well development of plans, assessment of remediation technologies, development of monitoring reports, and regulatory interactions.

In addition to consulting, Dr. Sahu has taught numerous courses in several Southern California universities including UCLA (air pollution), UC Riverside (air pollution, process hazard analysis), and Loyola Marymount University (air pollution, risk assessment, hazardous waste management) for the past seventeen years. In this time period he has also taught at Caltech, his alma mater (various engineering courses), at the University of Southern California (air pollution controls) and at California State University, Fullerton (transportation and air quality).

Dr. Sahu has and continues to provide expert witness services in a number of environmental areas discussed above in both state and Federal courts as well as before administrative bodies.

EXPERIENCE RECORD

- 2000-present **Independent Consultant.** Providing a variety of private sector (industrial companies, land development companies, law firms, etc.) public sector (such as the US Department of Justice) and public interest group clients with project management, air quality consulting, waste remediation and management consulting, as well as regulatory and engineering support consulting services.
- 1995-2000 Parsons ES, **Associate, Senior Project Manager and Department Manager for Air Quality/Geosciences/Hazardous Waste Groups**, Pasadena. Responsible for the management of a group of approximately 24 air quality and environmental professionals, 15 geoscience, and 10 hazardous waste professionals providing full-service consulting, project management, regulatory compliance and A/E design assistance in all areas.
- Parsons ES, **Manager for Air Source Testing Services.** Responsible for the management of 8 individuals in the area of air source testing and air regulatory permitting projects located in Bakersfield, California.
- 1992-1995 Engineering-Science, Inc. **Principal Engineer and Senior Project Manager** in the air quality department. Responsibilities included multimedia regulatory compliance and permitting (including hazardous and nuclear materials), air pollution engineering (emissions from stationary and mobile sources, control of criteria and air toxics, dispersion modeling, risk assessment, visibility analysis, odor analysis), supervisory functions and project management.
- 1990-1992 Engineering-Science, Inc. **Principal Engineer and Project Manager** in the air quality department. Responsibilities included permitting, tracking regulatory issues, technical analysis, and supervisory functions on numerous air, water, and hazardous waste projects. Responsibilities also include client and agency interfacing, project cost and schedule control, and reporting to internal and external upper management regarding project status.
- 1989-1990 Kinetics Technology International, Corp. **Development Engineer.** Involved in thermal engineering R&D and project work related to low-NOx ceramic radiant burners, fired heater NOx reduction, SCR design, and fired heater retrofitting.
- 1988-1989 Heat Transfer Research, Inc. **Research Engineer.** Involved in the design of fired heaters, heat exchangers, air coolers, and other non-fired equipment. Also did research in the area of heat exchanger tube vibrations.

EDUCATION

- 1984-1988 Ph.D., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.
- 1984 M. S., Mechanical Engineering, Caltech, Pasadena, CA.
- 1978-1983 B. Tech (Honors), Mechanical Engineering, Indian Institute of Technology (IIT) Kharagpur, India

TEACHING EXPERIENCE

Caltech

"Thermodynamics," Teaching Assistant, California Institute of Technology, 1983, 1987.

"Air Pollution Control," Teaching Assistant, California Institute of Technology, 1985.

"Caltech Secondary and High School Saturday Program," - taught various mathematics (algebra through calculus) and science (physics and chemistry) courses to high school students, 1983-1989.

"Heat Transfer," - taught this course in the Fall and Winter terms of 1994-1995 in the Division of Engineering and Applied Science.

"Thermodynamics and Heat Transfer," Fall and Winter Terms of 1996-1997.

U.C. Riverside, Extension

"Toxic and Hazardous Air Contaminants," University of California Extension Program, Riverside, California. Various years since 1992.

"Prevention and Management of Accidental Air Emissions," University of California Extension Program, Riverside, California. Various years since 1992.

"Air Pollution Control Systems and Strategies," University of California Extension Program, Riverside, California, Summer 1992-93, Summer 1993-1994.

"Air Pollution Calculations," University of California Extension Program, Riverside, California, Fall 1993-94, Winter 1993-94, Fall 1994-95.

"Process Safety Management," University of California Extension Program, Riverside, California. Various years since 1992-2010.

"Process Safety Management," University of California Extension Program, Riverside, California, at SCAQMD, Spring 1993-94.

"Advanced Hazard Analysis - A Special Course for LEPCs," University of California Extension Program, Riverside, California, taught at San Diego, California, Spring 1993-1994.

"Advanced Hazardous Waste Management" University of California Extension Program, Riverside, California. 2005.

Loyola Marymount University

"Fundamentals of Air Pollution - Regulations, Controls and Engineering," Loyola Marymount University, Dept. of Civil Engineering. Various years since 1993.

"Air Pollution Control," Loyola Marymount University, Dept. of Civil Engineering, Fall 1994.

"Environmental Risk Assessment," Loyola Marymount University, Dept. of Civil Engineering. Various years since 1998.

"Hazardous Waste Remediation" Loyola Marymount University, Dept. of Civil Engineering. Various years since 2006.

University of Southern California

"Air Pollution Controls," University of Southern California, Dept. of Civil Engineering, Fall 1993, Fall 1994.

"Air Pollution Fundamentals," University of Southern California, Dept. of Civil Engineering, Winter 1994.

University of California, Los Angeles

"Air Pollution Fundamentals," University of California, Los Angeles, Dept. of Civil and Environmental Engineering, Spring 1994, Spring 1999, Spring 2000, Spring 2003, Spring 2006, Spring 2007, Spring 2008, Spring 2009.

International Programs

"Environmental Planning and Management," 5 week program for visiting Chinese delegation, 1994.

"Environmental Planning and Management," 1 day program for visiting Russian delegation, 1995.

"Air Pollution Planning and Management," IEP, UCR, Spring 1996.

"Environmental Issues and Air Pollution," IEP, UCR, October 1996.

PROFESSIONAL AFFILIATIONS AND HONORS

President of India Gold Medal, IIT Kharagpur, India, 1983.

Member of the Alternatives Assessment Committee of the Grand Canyon Visibility Transport Commission, established by the Clean Air Act Amendments of 1990, 1992-present.

American Society of Mechanical Engineers: Los Angeles Section Executive Committee, Heat Transfer Division, and Fuels and Combustion Technology Division, 1987-present.

Air and Waste Management Association, West Coast Section, 1989-present.

PROFESSIONAL CERTIFICATIONS

EIT, California (# XE088305), 1993.

REA I, California (#07438), 2000.

Certified Permitting Professional, South Coast AQMD (#C8320), since 1993.

QEP, Institute of Professional Environmental Practice, since 2000.

CEM, State of Nevada (#EM-1699). Expiration 10/07/2011.

PUBLICATIONS (PARTIAL LIST)

"Physical Properties and Oxidation Rates of Chars from Bituminous Coals," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **67**, 275-283 (1988).

"Char Combustion: Measurement and Analysis of Particle Temperature Histories," with R.C. Flagan, G.R. Gavalas and P.S. Northrop, *Comb. Sci. Tech.* **60**, 215-230 (1988).

"On the Combustion of Bituminous Coal Chars," PhD Thesis, California Institute of Technology (1988).

"Optical Pyrometry: A Powerful Tool for Coal Combustion Diagnostics," *J. Coal Quality*, **8**, 17-22 (1989).

"Post-Ignition Transients in the Combustion of Single Char Particles," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **68**, 849-855 (1989).

"A Model for Single Particle Combustion of Bituminous Coal Char." Proc. ASME National Heat Transfer Conference, Philadelphia, **HTD-Vol. 106**, 505-513 (1989).

"Discrete Simulation of Cenospheric Coal-Char Combustion," with R.C. Flagan and G.R. Gavalas, *Combust. Flame*, **77**, 337-346 (1989).

"Particle Measurements in Coal Combustion," with R.C. Flagan, in "**Combustion Measurements**" (ed. N. Chigier), Hemisphere Publishing Corp. (1991).

"Cross Linking in Pore Structures and Its Effect on Reactivity," with G.R. Gavalas in preparation.

"Natural Frequencies and Mode Shapes of Straight Tubes," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Optimal Tube Layouts for Kamui SL-Series Exchangers," with K. Ishihara, Proprietary Report for Kamui Company Limited, Tokyo, Japan (1990).

"HTRI Process Heater Conceptual Design," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Asymptotic Theory of Transonic Wind Tunnel Wall Interference," with N.D. Malmuth and others, Arnold Engineering Development Center, Air Force Systems Command, USAF (1990).

"Gas Radiation in a Fired Heater Convection Section," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1990).

"Heat Transfer and Pressure Drop in NTIW Heat Exchangers," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1991).

"NO_x Control and Thermal Design," Thermal Engineering Tech Briefs, (1994).

"From Purchase of Landmark Environmental Insurance to Remediation: Case Study in Henderson, Nevada," with Robin E. Bain and Jill Quillin, presented at the AQMA Annual Meeting, Florida, 2001.

"The Jones Act Contribution to Global Warming, Acid Rain and Toxic Air Contaminants," with Charles W. Botsford, presented at the AQMA Annual Meeting, Florida, 2001.

PRESENTATIONS (PARTIAL LIST)

"Pore Structure and Combustion Kinetics - Interpretation of Single Particle Temperature-Time Histories," with P.S. Northrop, R.C. Flagan and G.R. Gavalas, presented at the AIChE Annual Meeting, New York (1987).

"Measurement of Temperature-Time Histories of Burning Single Coal Char Particles," with R.C. Flagan, presented at the American Flame Research Committee Fall International Symposium, Pittsburgh, (1988).

"Physical Characterization of a Cenospheric Coal Char Burned at High Temperatures," with R.C. Flagan and G.R. Gavalas, presented at the Fall Meeting of the Western States Section of the Combustion Institute, Laguna Beach, California (1988).

"Control of Nitrogen Oxide Emissions in Gas Fired Heaters - The Retrofit Experience," with G. P. Croce and R. Patel, presented at the International Conference on Environmental Control of Combustion Processes (Jointly sponsored by the American Flame Research Committee and the Japan Flame Research Committee), Honolulu, Hawaii (1991).

"Air Toxics - Past, Present and the Future," presented at the Joint AIChE/AAEE Breakfast Meeting at the AIChE 1991 Annual Meeting, Los Angeles, California, November 17-22 (1991).

"Air Toxics Emissions and Risk Impacts from Automobiles Using Reformulated Gasolines," presented at the Third Annual Current Issues in Air Toxics Conference, Sacramento, California, November 9-10 (1992).

"Air Toxics from Mobile Sources," presented at the Environmental Health Sciences (ESE) Seminar Series, UCLA, Los Angeles, California, November 12, (1992).

"Kilns, Ovens, and Dryers - Present and Future," presented at the Gas Company Air Quality Permit Assistance Seminar, Industry Hills Sheraton, California, November 20, (1992).

"The Design and Implementation of Vehicle Scrapping Programs," presented at the 86th Annual Meeting of the Air and Waste Management Association, Denver, Colorado, June 12, 1993.

"Air Quality Planning and Control in Beijing, China," presented at the 87th Annual Meeting of the Air and Waste Management Association, Cincinnati, Ohio, June 19-24, 1994.

Exhibit B

H. ANDREW GRAY

EDUCATION

Ph.D. environmental engineering science, California Institute of Technology, Pasadena, California, 1986

M.S. environmental engineering science, California Institute of Technology, Pasadena, California, 1980

B.S. civil engineering/engineering and public policy, Carnegie-Mellon University, Pittsburgh, Pennsylvania, 1979

EXPERIENCE

Dr. H. Andrew Gray has been performing research in air pollution for over 30 years, within academic, governmental, and consulting environments. He has made significant contributions in the areas of airborne particles and visibility, including the development and application of computer-based air quality models. His areas of expertise are air pollution control strategy design and evaluation, computer modeling of the atmosphere, characterization of ambient air quality and air pollutant source emissions, aerosol monitoring and modeling, visibility analysis, receptor modeling, statistical data analysis, mathematical programming, numerical methods, and analysis of environmental public policy. Dr. Gray is currently an independent contractor focusing on particulate matter and visibility related research issues. Previous Gray Sky Solutions projects include assessment of Clean Air Act and other regulations on visibility in Class I (park and wilderness) areas, development of air pollution control plans and emission inventories for tribal lands, review and development of guidelines for modeling long-range transport impacts using the CALPUFF model, evaluation of particulate air quality impacts associated with diesel exhaust emissions, air quality management plan modeling protocol review, a critical review of Clean Air Mercury Rule (CAMR) documents, and assessment of the regional air quality impacts of power plant emissions. Most recently, Dr. Gray has been carrying out dispersion modeling studies to determine the impacts associated with mercury emissions in the Chesapeake Bay region.

Before starting Gray Sky Solutions, Dr. Gray was the manager of the PM₁₀ and Visibility Program at Systems Applications International (SAI / ICF Inc.). At SAI, Dr. Gray conducted and managed a number of varied air pollution research projects. In the early 1990s, Dr. Gray directed a large (over \$1 million) air-quality modeling program to determine the impact of SO₂ emissions from a large coal-fired power plant on Grand Canyon sulfate and visibility levels. He managed projects to develop carbon particle emission data for the Denver area, designed a PM₁₀ monitoring and modeling program for the El Paso area, determined the appropriate tradeoffs between direct PM₁₀ emissions and emissions of PM₁₀ precursors, estimated the visibility effects in federal Class I areas due to the 1990 Clean Air Act Amendments (results of which were incorporated into EPA's 1993 Report to Congress on the expected visibility consequences of the 1990 Clean Air Act Amendments), and provided assistance to EPA Region VIII's tribal air programs. Other projects include emission inventory development for Sacramento and carbon monoxide modeling of Phoenix, Arizona to support federal and regional implementation plans in those regions, systematic evaluation of the Interagency Workgroup on Air Quality Modeling (IWAQM) recommendations for the use of MESOPUFF II, a critical assessment of exposures to particulate diesel exhaust in California, and an evaluation of PM_{2.5} and PM₁₀ air quality data in support of EPA's review of the federal particulate matter air quality standards. Later projects included a study of micrometeorology and modeling of low wind speed stable conditions in the San Joaquin Valley (CA), an assessment of the reductions in nationwide ambient particulate nitrate exposures due to mobile source NO_x emission reductions, an evaluation of visibility conditions in the Southern Appalachian Mountains region, a review of cotton ginning emission factors, and a critical review and assessment of the PM₁₀ Attainment Demonstration Plan for the San Joaquin Valley. Dr. Gray was a member of the modeling subcommittee of the technical committee of the Grand Canyon Visibility Transport Commission.

Previous to his tenure at SAI, Dr. Gray was responsible for the PM₁₀ and visibility programs at the South Coast Air Quality Management District which involved directing monitoring, analysis, and modeling efforts to

support the design of air pollution control strategies for the South Coast Air Basin of California. He developed and applied the methodologies for assessing PM₁₀ concentrations that have continued to be used by the District through numerous subsequent air quality management plan revisions. Dr. Gray authored portions of the 1989 Air Quality Management Plan issued by the District that describe the results of modeling and data analyses used to evaluate particulate matter control strategies. Dr. Gray was instrumental in promoting the development and application of state-of-science models for predicting particulate matter concentrations. His responsibilities included direction and oversight of numerous aerosol-related contracts, including development of the SEQUILIB and SAFER models, construction of an ammonia emission database, and development of sulfate, nitrate and organic chemical mechanisms. In addition, Dr. Gray was responsible for initiating the District's visibility control program.

In research performed at the California Institute of Technology, Dr. Gray studied control of atmospheric fine primary carbon particle concentrations and performed computer programming tasks for acquisition and analysis of real-time experimental data. He designed, constructed, and operated the first long-term fine particle monitoring network in Southern California in the early 1980s. He also developed and applied deterministic models to predict source contributions to fine primary carbon particle concentrations and constructed objective optimization procedures for control strategy design. In research carried out for the Department of Mechanical Engineering at Carnegie-Mellon University, Dr. Gray developed fuel use data for input to an emission simulation model for the northeastern United States.

SPECIALIZED PROFESSIONAL COMPETENCE

- Air pollution control strategy design
- Atmospheric air quality characterization
- Aerosols and visibility
- Computer modeling and data analysis
- Dispersion modeling for particulate matter and visibility
- Receptor modeling including Chemical Mass Balance (CMB) and factor analysis
- Analysis of environmental public policy

PROFESSIONAL EXPERIENCE

- Systems Applications International (SAI)—PM₁₀ and visibility program manager— participated in and managed numerous air quality modeling and analysis projects for public and private sector clients, with emphasis on particulate matter and visibility research
- South Coast Air Quality Management District, El Monte, California—air quality specialist—developed and applied air quality modeling analyses to support air pollution control strategy design for the South Coast Air Basin of California
- California Institute of Technology, Pasadena, California—research assistant—Ph.D. candidate in environmental engineering science. Thesis: Control of atmospheric fine primary carbon particle concentrations (thesis advisors: Dr. Glen Cass, Dr. John Seinfeld, and Dr. Richard Flagan)
- California Institute of Technology, Pasadena, California—laboratory assistant—performed computer programming tasks for acquisition and analysis of real-time experimental data
- Department of Mechanical Engineering, Carnegie-Mellon University, Pittsburgh, Pennsylvania—research assistant—developed fuel use data for an emissions simulation model for the northeastern United States. Grant from the U.S. Department of Energy for evaluation of national energy policy
- Department of Civil Engineering, Carnegie-Mellon University, Pittsburgh, Pennsylvania—consultant—analyzed structural retrofit design for Ferrari Dino import automobile for United States five mph crash test

HONORS AND AWARDS

Harold Allen Thomas Scholarship Award, Carnegie-Mellon University
University Honors, Carnegie-Mellon University

PROFESSIONAL AFFILIATIONS

Air and Waste Management Association
American Association for Aerosol Research

SELECTED PUBLICATIONS AND PRESENTATIONS

The Deposition of Airborne Mercury within the Chesapeake Bay Region from Coal-fired Power Plant Emission in Pennsylvania, in press (2010)

Source Contributions to Atmospheric Fine Carbon Particle Concentrations (with G.R. Cass), *Atmospheric Environment*, 32:3805-3825 (1998)

"Monitoring and Analysis of the Surface Layer at Low Wind Speeds in Stable PBL's in the Southern San Joaquin Valley of California" (with others), presented at the American Meteorological Society's 12th Symposium on Boundary Layers and Turbulence, Vancouver, British Columbia (July 1997)

"Estimation of Current and Future Year NO_x to Nitrate Conversion for Various Regions of the United States" (with A. Kuklin), presented at the 90th Meeting of the Air and Waste Management Association, Toronto, Ontario (June 1997)

Integrated Monitoring Study (IMS) 1995: Characterization of Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Stable Conditions: Study Design and Preliminary Results (with others), in *Measurement of Toxic and Related Air Pollutants*, Air and Waste Management Association, Pittsburgh, Pennsylvania, pp. 484-500 (1996)

Regional Emissions and Atmospheric Concentrations of Diesel Engine Particulate Matter: Los Angeles as a Case Study (with G.R. Cass), in *Diesel Exhaust: A Critical Analysis of Emissions, Exposure, and Health Effects*, Health Effects Institute, Cambridge, Massachusetts, pp. 125-137 (1995)

"Assessment of the Effects of the 1990 Clean Air Act Amendments on Visibility in Class I Areas", presented at the 86th Annual Meeting & Exhibition of the Air and Waste Management Association, Denver, Colorado (June 1993)

"Source Contributions to Atmospheric Carbon Particle Concentrations" (with others), presented at the Southern California Air Quality Study Data Analysis Conference, Los Angeles, California (July 1992)

"Modeling Wintertime Sulfate Production in the Southwestern United States" (with M. Ligocki), presented at the AWMA/EPA International Specialty Conference on PM₁₀ Standards and Nontraditional Particulate Source Controls, Scottsdale, Arizona (January 1992)

"Deterministic Modeling for the Navajo Generating Station Visibility Impairment Study: An Overview," presented at the 84th Meeting of the Air and Waste Management Association, Vancouver, British Columbia (June 1991)

"Receptor and Dispersion Modeling of Aluminum Smelter Contributions to Elevated PM₁₀ Concentrations" (with R. G. Ireson and A. B. Hudischewskyj), presented at the 84th Meeting of the Air and Waste Management Association, Vancouver, British Columbia (June 1991)

Visibility and PM-10 in the South Coast Air Basin of California (with J.C. Marlia), in *Visibility and Fine Particles*, Air and Waste Management Association, Pittsburgh, Pennsylvania, pp. 468-477 (1990)

Chemical characteristics of PM10 aerosols collected in the Los Angeles area (with others), *J. Air Pollut. Control Assoc.*, 39:154-163 (1989)

Atmospheric carbon particles and the Los Angeles visibility problem (with others), *Aerosol Sci. Technol.*, 10:118-130 (1989)

Receptor modeling for PM10 source apportionment in the South Coast Air Basin of California (with others), in *PM-10: Implementation of Standards*, Air Pollution Control Association, Pittsburgh, Pennsylvania, pp. 399-418 (1988)

Optimization of PM10 control strategy in the South Coast Air Basin (with others), in *PM-10: Implementation of Standards*, Air Pollution Control Association, Pittsburgh, Pennsylvania, pp. 589-600 (1988)

Quantitative high-resolution gas chromatography and high-resolution gas chromatography/mass spectrometry analyses of carbonaceous fine aerosol particles (with others), *Int. J. Environ. Anal. Chem.*, 29:119-139 (1987)

"Development of an Objective Ozone Forecast Model for the South Coast Air Basin" (with others), presented at the 80th Meeting of the Air Pollution Control Association, New York (June 1987)

"PM10 Modeling in the South Coast Air Basin of California" (with others), presented at the 79th Annual Meeting of the Air Pollution Control Association, Minneapolis, Minnesota (1986)

Characteristics of atmospheric organic and elemental carbon particle concentrations in Los Angeles (with others), *Environ. Sci. Technol.*, 20:580-589 (1986)

"Chemical Speciation of Extractable Organic Matter in the Fine Aerosol Fraction" (with others), presented at the 1984 International Chemical Congress of Pacific Basin Societies, Honolulu, Hawaii (1984)

"Source Contributions to Atmospheric Carbon Particle Concentrations" (with others), presented at the First International Aerosol Conference, Minneapolis, Minnesota (1984)

Elemental and organic carbon particle concentrations: A long term perspective (with others), *Sci. Total Environ.*, 36:17-25 (1984)

"Meteorological and Chemical Potential for Oxidant Formation" (with others), presented at the Conference on Air Quality Trends in the South Coast Air Basin, California Institute of Technology, Pasadena, California (1980)

Containing recombinant DNA: How to reduce the risk of escape (with others), *Nature*, 281:421-423 (1979)

OTHER PUBLICATIONS

"Cypress Creek Power Plant Modeling: Pollutant Deposition to the Chesapeake Bay and Sensitive Watersheds within the Commonwealth of Virginia," prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2009)

"Virginia City Power Plant Modeling," prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2008)

"Chesterfield Power Plant Modeling," prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2008)

"The Deposition of Airborne Mercury in Pennsylvania," prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2007)

"The Deposition of Airborne Mercury in Virginia," prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2007)

"Pollutant Deposition from Maryland Sources," prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2006)

"Air Quality Modeling and Visibility Impacts Associated with Sammis Power Plant Emissions," prepared on behalf of the United States of America, Washington, D.C. (2003)

"Air Quality Modeling and Visibility Impacts Associated with Baldwin Power Plant Emissions," prepared on behalf of the United States of America, Washington, D.C. (2002)

"Assessment of the Impacts of Clean Air Act and Other Provisions on Visibility in Class I Areas" (with others), prepared for American Petroleum Institute, Washington, D.C. (1998)

"California Regional PM10 Air Quality Study: 1995 Integrated Monitoring Study Data Analysis: Time and Length Scales for Mixing Secondary Aerosols During Stagnation Periods" (with others), prepared for California Air Resources Board, Sacramento (1997)

"San Joaquin Valley Regional PM10 Study: *Characterizing Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Conditions Phase III: Monitoring and Data Analysis*" (with others), prepared for California Air Resources Board, Sacramento (1997)

"Cotton Gin Particulate Emission Factors," prepared for U.S. Environmental Protection Agency, Region VIII, San Francisco, California (1997)

"Benefits of Mobile Source NO_x Related Particulate Matter Reductions" (with A. Kuklin), SYSAPP-96/61, prepared for Office of Mobile Sources, U.S. Environmental Protection Agency, Ann Arbor, Michigan (1996)

"Evaluation of Existing Information on the Effects of Air Pollutants on Visibility in the Southern Appalachians" (with D. Kleinhesselink), SYSAPP-96-95/060, prepared for Southern Appalachian Mountains Initiative, Asheville, North Carolina (1996)

"Statistical Support for the Particulate Matter NAAQS" (with others), SYSAPP-96-95/039, prepared for Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1996)

"San Joaquin Valley Regional PM10 Study Support Study 5A: *Characterizing Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Conditions Phase II: Detailed Recommendations for Experimental Plans*" (with others), prepared for California Air Resources Board, Sacramento (1995)

"San Joaquin Valley Regional PM10 Study Support Study 5A: *Characterizing Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Conditions Phase I: Literature Review and Draft Program Recommendations*" (with others), prepared for California Air Resources Board, Sacramento (1995)

"Class I Grouping for Subsequent Assessment of Regional Haze Rules" (with others), SYSAPP-94/129, prepared for Air Quality Strategies and Standards Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1994)

"Retrospective Analysis of the Impact of the Clean Air Act on Urban Visibility in the Southwestern United States" (with C. Emery and T.E. Stoeckenius), SYSAPP-94/108, prepared for Office of Policy Analysis and Review, Office of Air and Radiation, U.S. Environmental Protection Agency, Washington, D.C. (1994)

"Evaluation of Ambient Species Profiles, Ambient Versus Modeled NMHC:NO_x and CO:NO_x Ratios, and Source-Receptor Analyses" (with G. Yarwood, M. Ligocki, and G. Whitten), SYSAPP-94/081, prepared for Office of Mobile Sources, U.S. Environmental Protection Agency, Ann Arbor, Michigan (1994)

"Diesel Particulate Matter in California: Exposure Assessment" (with M. Ligocki and A. Rosenbaum), SYSAPP-94/077, prepared for Engine Manufacturers Association, Chicago, Illinois (1994)

“Interagency Workgroup on Air Quality Modeling (IWAQM): Assessment of Phase I Recommendations Regarding the Use of MESOPUFF II” (with M. Ligocki and C. Emery), SYSAPP-94/030, prepared for Source Receptor and Analysis Branch, Technical Services Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1994)

“Analysis of the 1991-1992 Pine Bend Monitoring Data” (with others), SYSAPP-94/007, prepared for Minnesota Pollution Control Agency, St. Paul, Minnesota (1994)

“Assessment of the Effects of the 1990 Clean Air Act Amendments on Visibility in Class I Areas” (with others), SYSAPP-93/162, prepared for Ambient Standards Branch, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1994)

“Revised Base Case and Demonstration of Attainment for Carbon Monoxide for Maricopa County, Arizona” (with others), SYSAPP-94-93/156s, prepared for Maricopa Association of Governments, Phoenix, Arizona (1994)

“Sacramento FIP 2005 Modeling Inventory” (with others), SYSAPP-93/237, prepared for Pacific Environmental Services, North Carolina, and U.S. Environmental Protection Agency, Region IX, San Francisco, California (1993)

“Carbon Monoxide Modeling in Support of the 1993 State Implementation Plan for Maricopa County, Arizona” (with others), SYSAPP-93/156, prepared for Maricopa Association of Governments, Phoenix, Arizona (1993)

“Air Quality Modeling of Carbon Monoxide Concentrations in Support of the Federal Implementation Plan for Phoenix, Arizona” (with others), SYSAPP-93/039, prepared for Pacific Environmental Services, North Carolina, and U.S. Environmental Protection Agency, Region IX, San Francisco, California (1993)

“Base Case Carbon Monoxide Emission Inventory Development for Maricopa County, Arizona” (with others), SYSAPP-93/077, prepared for Maricopa Association of Governments, Phoenix, Arizona (1993)

“Sacramento FIP Modeling 3: Future Emissions Inventory” (with others), SYSAPP-93/036, prepared for Pacific Environmental Services, Inc., North Carolina and U.S. Environmental Protection Agency, San Francisco (1993)

“Emissions Inventory Development for the Tribal Air Program” (with M. Causley and S. Reid), SYSAPP-92/146, prepared for U.S. Environmental Protection Agency, Region VIII, Denver, Colorado (1992)

“Carbon Particle Emissions Inventory for Denver Brown Cloud II: Development and Assessment” (with S. B. Reid and L. R. Chinkin), prepared for Colorado Department of Health, Denver, Colorado (1992)

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"Air Pollution Control Analyses for State Implementation Plan Revisions in Allegheny County," project report, Department of Engineering and Public Policy, Carnegie-Mellon University, Pittsburgh, Pennsylvania (1978)

EMPLOYMENT HISTORY

Systems Applications International	Manager, PM ₁₀ and Visibility Program	1989–1997
South Coast Air Quality Management District	Air Quality Specialist	1985–1989
California Institute of Technology, Pasadena, California	Research Assistant Laboratory Assistant	1979–1985 1979
Carnegie-Mellon University, Dept. of Mechanical Engineering Pittsburgh, Pennsylvania	Research Assistant	1978–1979