# Rebuttal of the National Committee for Saving the Sundarbans (NCSS) to the Maitree Power Plant Authority's 10 Point Q&A of July 2016

*Released along with a clear demand to cancel the Rampal Power Plant by Advocate Sultana Kamal, Convener of NCSS, on 6 September 2016 in Dhaka, Bangladesh.*

Note: The ten questions below relate to technical aspects of the proposed Rampal coal power plant, and posed by Arshad Mansoor (senior vice president at Electric Power Research Institute, a US-based power company) in the Bangladesh media in summer 2016, received due responses from the project promoters – Bangladesh-India Friendship Power Company Ltd (BIFCL).

The BIFCL responses are provided in italics below. Alongside them are follow-up responses prepared for NCSS by several international experts. For clarity, 'Maitree' refers to the Rampal coal power plant, as it is more commonly known.

***Q1. Is SCR (Selective Catalyst Reactor) or some other low NOx technology being used to reduce NOx emission?***

*Yes, BIFPCL is using an alternative proven technology to SCR for reduction of NOx emission. Maitree STPP will have low NOx emission (within the limit specified by International standards) by dint of this advanced technology adopted in boiler.*

*This will be achieved by controlling the combustion in such a manner that it results in low NOx generation. BIFPCL in Maitree STPP shall be utilizing French technology in the Boiler design to achieve this objective. In addition to this a low NOx burner of proven design will be used which will further reduce the NOx generation.*

**Response prepared for NCSS by Dr. Ranajit Sahu, Ph.D, QEP, CEM, Air Pollution Control Expert and Consultant on Energy Issues with 28 years of experience:**

It is simply not true that a low NOx boiler is an alternate or equivalent technology to Selective Catalytic Reduction (SCR) for NOx reduction.

Fundamentally, low NOx emissions from coal-fired units are achieved by employing a combination of two strategies: first, NOx generation in the boiler is minimized using a combination of low NOx burners, over-fire air, and adaptive controls using neural networks. Then, the resulting NOx from the boiler is subsequently further reduced using post-combustion technologies such as SCR. Therefore, a state-of-the art coal unit uses not just low NOx burners (no matter how good these burners might be), but also over-fire air,

adaptive technologies, and SCR. SCR alone typically reduces NOx by 80-90% or more depending on NOx levels leaving the boiler.

Maitree has absolutely no post-combustion NOx reduction technologies specified in the tender documents[i]; nor does it have the requirement for over-fire air and adaptive controls in the combustion zone within the boiler. Therefore, it is not "state-of-the-art". The proposed NOx controls are typical of coal-units that are roughly 30 years old. In fact, such a system could never be permitted in developed countries.

The claim about French technology is simply a distraction. Incidentally, France has very few thermal coal plants, as its grid is based primarily on nuclear power.

***Q2. Which technology will be used to reduce SOx emission?***

*Wet Limestone, Forced Oxidation type FGD system with very high efficiency shall be used to remove SO2 from flue gas. High purity (>95%) limestone shall be used by BIFPCL in FGD to make it more effective in SO2 reduction.*

*Low sulfur coal will be used which ab initio will check SOx formation. Besides modern Japanese technology based Flue Gas De-sulphurization system (FGD) will be used to strip off the flue gas of SO2.*

**Response prepared for NCSS by Dr. Ranajit Sahu, Ph.D, QEP, CEM:**

An FGD scrubber CAN be an effective $SO_2$ removal technology if it is properly designed and then properly operated, but it depends on the $SO_2$ removal efficiency, *which is not specified anywhere in the tender document.*

State of the art $SO_2$ removal in an FGD is around 99% or more depending on inlet $SO_2$ levels. The public deserves to know the SOx removal efficiency planned for the Maitree FGD, and there must be an enforceable standard in place to ensure that the scrubber is operated effectively. For example, while three or four or five sprayer levels within the FGD system may be installed, if it is considered too expensive to operate them, only one or two might be actually used, thus greatly increasing emissions.

The next sentence about high purity limestone is simply a distraction. While high purity limestone is important, it alone does not assure overall FGD $SO_2$ removal of 99% or more. Besides, in another case of tender documents specifying something quite different than what is stated here, the limestone purity is only required to be 90% in the tender documents.[ii]

***Q3. Is the plant designed with ESP (Electro Static precipitator) or other means to reduce emission of Solid Particulate Matter?***

*Yes the plant has been designed with highly efficient Electro Static Precipitator of latest proven technology for limiting Solid Particulate Matter (SPM) emission to less than 50mg/NM3 at the outlet of ESP, which is much lower than allowable standard.*

**Response prepared for NCSS by Dr. Ranajit Sahu, Ph.D, QEP, CEM:**

In the original questions from Mr. Arshad Mansoor (published in an Energy Bangla article on July 17, 2016), he asked if baghouse technology, which is state-of-the-art for PM and mercury removal, would be used at Rampal. That part of the question has been deleted and left unanswered, which indicates that a baghouse will not be used. Thus this proposed plant simply does not have state-of-the-art technology for PM and mercury removal.

ESP technology is much less robust than baghouses or fabric filters, and relies on proper operation and training. Unlike baghouses, it is also easier to switch off portions of the ESP thereby reducing operating costs and increasing emissions. ESPs are not state of the art technology for removal of PM.

The stated standard for solid particulate matter of 50 mg/NM3 is also not useful, as it is a concentration, and not a mass emission limit. And while we are discussing pollution concentrations vs. mass of pollution, I note that a tall smokestack simply disperses air pollutants *more* widely, and even *farther* towards the Sundarbans. If we wanted to protect the Sundarbans from air pollutants from Rampal, the plant should have a *shorter* smokestack in the hope that the pollutants would remain more local. Of course, that would impact local air quality more severely.

***Q4. Will Hg removal technology be used for this plant?***

*Yes, the FGD with modern wet limestone technology itself will serve the purpose of Hg removal. In addition to that, part of Hg will be absorbed in ash as normal phenomena. Both bottom ash and fly ash will be collected in dry form and will be sold to ash utility companies.*

**Response prepared for NCSS by Dr. Ranajit Sahu, Ph.D, QEP, CEM:**

This is a highly misleading answer to a question that is absolutely crucial for protecting the health of the Sundarbans ecosystem and public health, as mercury from Rampal will accumulate in the aquatic food chain of fish and crustaceans of the Sundarbans.

An FGD scrubber with modern wet limestone technology is only useful for removing certain forms of mercury (and then only when run properly). It is an incidental remover of certain forms of mercury such as oxidized mercury chloride, etc. It cannot remove elemental mercury, for example. The forms of mercury and how they are transformed in the combustion process depends on the type of coal and its other constituents such as its chlorine content.

Since Rampal proposes to use coal from a wide range of countries and mines, it cannot be assumed that all of the mercury from the various coal will be converted to oxidized forms, thereby allowing removal in the FGD if it is truly properly operated.

State-of-the-art technology for mercury control is sorbent injection in the boiler or in the flue gases followed by capture of the resultant particulates in a baghouse. These technologies are simply missing in the tender document.

In the United States, required mercury removal technologies are increasing the carbon content of coal ash and making it far less saleable. Perhaps BIFPCL is loath to add effective mercury control technology because it would make its coal ash less saleable as well.

***Q5. Is there Effluent treatment plant before discharging of liquid?***

*Yes, modern and multi stage effluent treatment plant is envisaged in this project.*

*Water from various sources inside the plant shall be treated and monitored to meet the international effluent norms before disposal into the Possur river. The effluents from various sources in the plant shall be treated for polluting components to make the water safer i.e neutral water having pH around 7. The effluents shall be disposed fully according to the stringent IFC effluent guidelines.*

**Response prepared for NCSS by Dr. Ranajit Sahu, Ph.D, QEP, CEM, and coal-fired power plant water pollution expert Donna Lisenby, Waterkeeper Alliance, USA:**

The International Finance Corporation (IFC)'s effluent guidelines[iii] have no limits for the following pollutants: aluminum, antimony, barium, boron, hexavalent chromium, manganese, magnesium, nickel, selenium, tin, thallium, vanadium, uranium. They allow the discharge of arsenic, cadmium, copper, chromium, iron, lead, mercury, total suspended solids, total residual chlorine, oil and grease.[iv] That means this facility will still pollute the waters of the Sundarbans with toxic heavy metals and other pollutants.

If the Rampal plant had no environmental impact and was state of the art as claimed, it would have zero liquid discharge. Given the close proximity to the Sundarbans and the fact that any water pollution will flow downstream into breeding areas for rare and endangered aquatic life, the government should require this facility to have zero liquid discharge. To illustrate how common this truly state of the art technology is, the Aquatech company has made more than 160 zero liquid discharge installations on six continents. But more importantly, India has required zero liquid discharge in an effort to prevent pollution of its rivers.[v]

Praj Industries is one Indian company that provides zero liquid discharge technology. What is troubling about the Maitree plant being built by Indian interests is the double standard at work. Apparently India is willing to require zero liquid discharge to clean up and safeguard its rivers but is unwilling to do this for projects it undertakes in Bangladesh just a few

kilometers from the Sundarbans. The Government should require the Indian contractor BHEL to implement zero liquid discharge.[vi]

In addition, merely controlling the pH of the released water to around 7 does not assure that numerous other pollutants such as heavy metals will be removed.

***Q6. Is there provision to dispose ash in dry form?***

*Yes, 100% ash, both bottom ash and fly ash, will be collected in dry form.*

*This is one of the most modern plants across the world where latest dry bottom ash collection technology and system will be used to avoid effect on environment. Dry ash will be sold to ash utility companies. Further, it may be noted that Expression of Interest to buy dry ash from our plant has been received from Cement companies across various parts of Bangladesh. It is found that demand of dry ash by the ash utility companies from our plant is more than 100%.*

**Response prepared for NCSS by coal-fired power plant water pollution expert Donna Lisenby of Waterkeeper Alliance, USA:**

This answer is inconsistent with both the Environmental Impact Assessment (EIA)[vii] and the tender documents. Those documents call for the construction of a two-stage ash handling system. This answer describes only the first stage.

In a ploy to mislead people who haven't read the technical documents, it fails to describe the second stage that will add water to coal ash, create a wet coal ash slurry and pump it into a large wet coal ash pond. This wet coal ash handling system is described in detail in both the EIA and the tender documents.

Here are the references and direct quotes from these technical documents so journalists can properly publish the complete answer. The EIA says on page 110, "Therefore, about 3.035.112 cubic meters would be the capacity of the ash pond to retain generated ash from the power plant." It goes on to say, "It will fill 422 cubic meter volume of the ash pond in each day."[viii]

The ash pond is such a large feature of the Maitree coal plant, there is a separate and entire section of tender document B9 called "Ash Pond" that begins on page B9-51. This "Ash Pond" section describes in detail the wet ash handling systems and the wet ash pond that will be constructed at the site.

It says, "An Ash Pond of 25 acre shall be provided for storage of High Concentrated Slurry Disposal (HCSD). The system shall include starter dyke storage lagoons and overflow lagoon dyke construction, ash slurry pipe line, drainage system, ash water recirculation pump house, seepage water pump house and maintenance roads on top of dyke embankment & all around the outer perimeter of dyke at natural ground."[ix]

If 100 % of the ash will be kept dry and recycled as claimed then there is no need for BHEL to construct and pay for the wet coal ash slurry mixers, pumps, pipelines and a large coal

ash pond described in tender document B9. The cost associated with the equipment purchases and associated tax breaks, as well as the very high cost of construction and maintenance of the second stage wet ash handling systems and coal ash pond, should be eliminated.

No contracts should be finalized with BHEL until this change has been made with proof provided to the public by the government that it has removed the funding to construct any component that would enable the wet storage of coal ash. This is necessary to truly protect water resources and lower the cost of this $2.0 billion dollar coal plant that the IEEFA report says will cause electricity rates to increase for Bangladesh citizens.

***Q7. Is there online monitoring system for emission?***

*Yes, there will be Continuous Emission Monitoring System (CEMS) for online monitoring of various parameter of flue gas like flue gas temperature, NOx, SOx, O2 and Oxide of Carbon etc. It will Monitor, track and analyze the plant emissions, assessed via the CEMS system in real time.*

**Response prepared for NCSS by Dr. Ranajit Sahu, Ph.D, QEP, CEM:**

Continuous Emission Monitoring System (CEMS) are standard requirements for thermal power plants. Not only should the stack gases be monitored for NOx, $SO_2$, $O_2$, $CO_2$, flow, and temperature using CEMS, the units should also have CEMS for filterable PM, acid gases such as HCl, ammonia (assuming SCR is used), volatile organic gases, and mercury. In addition, additional $SO_2$ CEMS should be located upstream of the FGD is order to demonstrate it is removing $SO_2$ to the required levels.

In addition, merely installing a CEMS will not ensure compliance with air quality standards or indeed effective monitoring. All CEMS need to be calibrated and periodically audited against reference methods in order to substantiate their accuracy and precision. Performance specifications and quality assurance procedures must also be in place and followed to ensure that the CEMS operate at 95% or more of the operating time of the boiler and to provide reliable data.

Most coal-fired boilers also use Predictive Emission Monitoring Systems (PEMS) as a back-up to CEMS.

Of course, periodic stack tests are also essential since there are numerous pollutants that cannot be directly measured by CEMS.

***Q8. Is there any provision to reduce thermal effect on marine life nearby the plant?***

*Yes, due care in design has been taken so that there is no thermal effect on marine life nearby the plant. Total water requirement for this plant is only 0.05% of lean flow period*

*in the leanest season, through Possur River. Hence the quantum of water being discharged is negligible (like "a drop in the pond"). A closed cycle cooling water system is envisaged. That means quantity of discharge water to river is much less. Further, water from plant will be treated in Effluent Treatment plant and quality of water will be monitored at central monitoring basin before discharging to river. Temperature of discharge water shall never be more than two degree Centigrade (2OC) above river water temperature at the edge of mixing zone which is as per stringent IFC norms.*

**Response prepared for NCSS by coal-fired power plant water pollution expert Donna Lisenby of Waterkeeper Alliance, USA:**

This answer is crafted to mislead people who do not know what a mixing zone is or how large they can be.

It says it will discharge water not more than 2 degrees centigrade "at the edge of mixing zone." The mixing zone from a large coal-fired power plant can extend down the river for many meters. By failing to disclose the size of the mixing zone and how far it will extend down river towards the Sundarbans they fail to disclose the full extent of the thermal impact.

If this plant was a state-of-the-art plant with zero environmental impact to surrounding waterways as claimed, it would have a mandatory requirement of zero liquid discharge and use reclaimed water for cooling, not river water. If there was a requirement to use reclaimed water, then no additional water would be taken from the rivers or from the ground and there would be no mixing zones.

This is a double standard being imposed on Bangladesh by a predominantly Indian project, as earlier this year the 1320 MW NTPC Solapur coal plant in Maharashtra was required to use recycled sewage water (reclaimed water) instead of withdrawing river water from the Ujjani dam on Bhima river, a tributary of the Krishna river.[x]

***Q9. Will there be provision to reduce effect on surrounding environment due to coal transportation and unloading?***

*Yes, due consideration has been taken to carry out coal transportation for the project in an environment friendly manner. Imported coal will be shipped through the existing maritime channel of Mongla Port Authority in Possur river. Daily requirement of coal is estimated to be 12000Ton. BIFPCL plans to use up to 12000Ton size modern sea-worthy vessel ("mini-ship"), tailor made as per IMO classifying norms, environmental friendly and designed for zero effluent discharge, low SOx emission, low noise pollution, night vision and GPS. Coal will be transported through covered hatches in such mini ships up to jetty. Coal will be unloaded at site jetty by Grab type environment friendly unloader. The coal conveyors shall be enclosed type. Further, there would be water sprinkler, de-dusting system to prevent pollution. Further coal will then be stored in a fully covered coal*

*stock yard. Hence, there will be no effect on surrounding environment due to coal transportation and unloading.*

**Response from NCSS:**

The answer that "consideration has been taken to carry out coal transportation in an environmentally friendly manner" and "there will be no effect on surrounding environment due to coal transportation and unloading" is demonstrably false.

First, when the authorities claim that coal will be shipped using "an existing maritime channel", they fail to mention that that channel must undergo massive dredging in order for ships to reach the power plant. Specifically, 26 kilometers from the Bay of Bengal to the project site must be dredged, removing over 34 million cubic meters of river bottom that provides habitat for fish, crustaceans, and dolphins. Every year the dredging would have to be redone to maintain access, removing 1.8 million cubic meters of river bottom each year.

The EIA for Rampal admits that the environmental impacts of dredging the Passur River and dumping of dredge spoil may increase turbidity of water, reduce fish catch, change fish habitat, migration, feeding, spawning, and diversity, and contaminate the river with spillage of oil, grease and effluent from dumping sites. Dredging may impact the dolphins of Passur and Maidara rivers, and dredging and increased shipping without "properly maintained regulations" may "impact the Sundarbans ecosystem especially Royal Bengal tiger, deer, crocodile, dolphins, mangroves, etc."[xi]

In both 2014 and 2015, the World Heritage Committee urged Bangladesh to complete "[a] separate EIA/morphological study … for coal transportation and river dredging to develop sound environmental management plan towards conservation of ecosystem and biodiversity."

Instead, the government shifted responsibility for that EIA to the Mongla Port authority. On August 17, 2016, BIFPCL published an executive summary of an EIA on dredging, half in Bengali, half in English, making it impossible for monolingual people to interpret.

The government has also allocated funds to complete the dredging in 2016-2017, even without understanding the potential threats to river dolphins, fish, shrimp and crabs.

**Additional response on coal dust prepared for NCSS by Dr. Deb Niemeier, Ph.D., PE, Sustainable Systems Research LLC, Professor & Chair, University of California at Davis Department of Civil and Environmental Engineering, Davis, CA, USA:**

Regarding coal dust, the tender documents for the Rampal power plant require a water-only sprinkler system[xii], which has been shown to be relatively ineffective at controlling dust.[xiii]

Coal dust escapes from stockpiles even with more stringent pollution control technologies, including chemical surfactants, which are not required at Rampal.[xiv] My calculations indicate that at typical levels of moisture content, roughly between 2.0 to 3.8 tons of fugitive coal dust will escape into the air and water each year at Rampal.[xv] In addition, if

the dust control wastewater from the Rampal plant is discharged into the Passur River, it could result in significant biological impacts due to high amounts of suspended coal particles. [xvi]

Coal dust that reaches water deposits on or washes into water can have adverse physical effects on exposed aquatic organisms including abrasion, smothering, reduction in availability of light and clogging of respiratory and feeding organs.[xvii] In one study, young steelhead and cutthroat trout exposed to coal washings (coal dust and slate particles) experienced 100% mortality after only 0.5 to 2.5 hours of exposure.[xviii] In another study, juvenile salmon exposed to coal dust experienced activation of genes that convert toxic polycyclic aromatic hydrocarbons (PAHs) to carcinogenic and mutagenic metabolites.[xix] Coal dust leachates reduce the growth rate of trout, cause oocyte atresia (resorption of ova), reduce ovarian growth in crayfish, promote DNA adduct formation (where DNA binds to a cancer causing chemical), and hepatocellular carcinoma (liver cancer) in fish.[xx]

In the United States, coal dust has been documented in soil over 20 kilometers from the nearest coal stockpile, where it contaminated soils with arsenic up to five time higher than background levels.[xxi] In another study, coal dust plumes from a stockpile correlated with significantly higher soil temperatures, increased soil acidity, increased heavy metal concentrations, and decreased plant diversity.[xxii] Coal dust has also been shown to deplete soil nutrients; damage sensitive forests and farm crops; and affect the diversity of ecosystems.[xxiii] When coal dust settles in waterbodies, it increases acidity and change nutrient balances. [xxiv] Other studies have noted that coal dust significantly reduced carbon dioxide exchange by plant leaves.[xxv] Coal dust from mines in Bangladesh has been shown to pollute downwind soils with lead, zinc, titanium and manganese.[xxvi]

Coal handlers in the ships and stockyard will also be exposed to fine particles of coal dust (PM10 and PM2.5) which are directly linked to health problems, including premature death, heart attacks, asthma and other problems.[xxvii] Known health effects from coal dust exposure include skin damage, circulatory system problems, and increased risk of developing cancer. [xxviii]

The power plant authority states that coal in ships, transfer points and stockpiles for Rampal will be covered, but we know that containing coal in a limited space poses a severe safety risk for workers, as coal emits carbon monoxide that can kill without warning, and methane, which can cause spontaneous heating and combustion.[xxix] Sophisticated monitoring systems to monitor carbon monoxide, oxygen, methane and acidity of bilge waters on a daily basis would need to be in place in all covered coal ships and other covered coal storage at the power plant in order to prevent loss of life.[xxx] These risks are never discussed in the Rampal plant's EIA or tender documents.[xxxi]

***Q10. Has the Environmental Impact Assessment (EIA) study during pre-construction stage been displayed publicly?***

*Yes, the EIA study conducted for the project has been disclosed with public/stakeholders on several occasions and the report is accessible to all for ready reference.*

*During the EIA Study a number of Public consultation meeting were arranged through Stakeholder meeting, Focus Group discussion, etc. The outcome of the EIA Study has been disclosed in local level (Rampal Upazila) and National level (Dhaka). Moreover, EIA study is available in BIFPCL web-site (https//bifpcl.com) which is accessible to public. Quarterly environmental monitoring plan is also available in BIFPCL web-site.*

**Response from NCSS:**

Simply disclosing the incomplete and inaccurate EIA and results of inadequate public consultation meetings is not sufficient.

NCSS has repeatedly asked for Government to incorporate the science based recommendations made by academic researchers and citizens of Bangladesh.

**References:**

[i] The tender documents are available at: http://www.bpdb.gov.bd/bpdb/index.php?option=com_content&view=article&id=347&Itemid=113

[ii] See Tender Document B3 at B3-18.

[iii] International Finance Corporation, *Environmental, Health, and Safety Guidelines for Thermal Power Plants*, (December 2008), http://www.ifc.org/wps/wcm/connect/dfb6a60048855a21852cd76a6515bb18/FINAL_Thermal%2BPower.pdf?MOD=AJPERES&id=1323162579734

[iv] See IFC guidelines for thermal power plants, Table 5, page 18.

[v] See http://inspiredeconomist.com/2015/01/14/india-uses-zld-ganges-river/

[vi] For more information on state of the art zero liquid discharge systems provided by multiple companies and available for use at coal plants, see: http://www.aquatech.com/solutions/zero-liquid-discharge/; http://www.powermag.com/fundamentals-of-zero-liquid-discharge-system-design/; and http://www.gewater.com/zero-liquid-discharge-zld.html.

[vii] Available at: http://www.bpdb.gov.bd/bpdb/index.php?option=com_content&view=article&id=299 .

[viii] Maitree EIA vol. 1 (2013) at page 110, available at: http://www.bpdb.gov.bd/bpdb/index.php?option=com_content&view=article&id=299 .

[ix] Tender Document B9 at B9-51.

[x] *See* http://indianexpress.com/article/cities/mumbai/ntpc-nod-to-use-recycled-waste-water-for-power-plants-cm-devendra-fadnavis/.

[xi] EIA pages 271-274.

[xii] BIFPCL, *Tender Document, B4- Fuel and Ash Systems* (2015), http://www.bpdb.gov.bd/download/bangladeshIndiaFriendship/TenderDocument/FTS%20Section-V/B4-Fuel-and-Ash-Systems-Specification.pdf.

[xiii] *See*, e.g., J. McCoy et al., *Evaluation of charged water sprays for dust control*, U.S. Bureau of Mines Pittsburgh (1983), http://www.cdc.gov/niosh/nioshtic-2/10002927.html ("Laboratory tests were made showing charged spray is considerably more effective at reducing dust on a unit water basis than hydraulic spray.").
[xiv] SK Nicol & JB Smitham, *Coal Stockpile Dust Control*, International Coal Engineering Conference (1990), https://search.informit.com.au/documentSummary;dn=832334232851298;res=IELENG.
[xv] See Dr. Niemeier's formal statement for NCSS with appendix of calculations of coal dust emissions.
[xvi] Phyllis Fox, Ph.D., PE Consulting Engineer, *Environmental, Health And Safety Impacts Of The Proposed Oakland Bulk And Oversized Terminal* (September 21, 2015), http://nocoalinoakland.info/wp-content/uploads/2016/02/05-Earthjustice-Exh-B-Phyllis-Fox-Report-9-21-2015.pdf.
[xvii] Michael J. Ahrens and Donald J. Morrisey, *Biological Effects of Unburnt Coal in the Marine Environment*, Oceanography and Marine Biology: An Annual Review, v. 43 (2005), https://www.researchgate.net/publication/236876904_Biological_Effects_of_Unburnt_Coal_in_the_Marine_Environment.
[xviii] C.F. Pautzke, *Studies on the Effect of Coal Washings on Steelhead and Cutthroat Trout*, Transactions of the American Fisheries Society, v. 67 (1937), http://www.tandfonline.com/doi/abs/10.1577/1548-8659(1937)67%5B232%3ASOTEOC%5D2.0.CO%3B2.
[xix] P.M. Campbell and R.H. Devlin, *Increased CYP1A1 and Ribosomal Protein L5 Gene Expression in a Teleost: The Response of Juvenile Chinook Salmon to Coal Dust Exposure*, Aquatic Toxicology, v. 38 (1997), http://www.sciencedirect.com/science/article/pii/S0166445X9600848X.
[xx] *Id.*
[xxi] William Bounds and Karen Johannesson, *Arsenic addition to soils from airborne coal dust originating at a major coal shipping terminal*, 185 Water Air and Soil Pollution 1, 195 (2007), available at http://link.springer.com/content/pdf/10.1007%2Fs11270-007-9442-9.
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[xxiii] Phyllis Fox, Ph.D., PE Consulting Engineer, *Environmental, Health And Safety Impacts Of The Proposed Oakland Bulk And Oversized Terminal* (September 21, 2015), http://nocoalinoakland.info/wp-content/uploads/2016/02/05-Earthjustice-Exh-B-Phyllis-Fox-Report-9-21-2015.pdf
[xxiv] *Id.*
[xxv] G Naidoo & D Chirkoot, *The effects of coal dust on photosynthetic performance of the mangrove, Avicennia marina in Richards Bay, South Africa*, Environmental Pollution,127,3 (2004)http://www.sciencedirect.com/science/article/pii/S0269749103003178.
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[xxviii] *Id.*
[xxix] Samuel Grossman et al., *Emission of toxic and fire hazardous gases from open air coal stockpiles*, Fuel 73.7 (1994): 1184-1188.
[xxx] *See, e.g.*, UK P& I, *Carefully to Carry* (2002) http://www.ukpandi.com/fileadmin/uploads/uk-pi/LP%20Documents/Carefully_to_Carry/Coal%20Cargoes.pdf.
[xxxi] See the Maitree/Rampal EIA (2013) at http://www.bpdb.gov.bd/download/EIA_report_24_10_2013/EIA%20of%202%20x%20(500-600)%20MW%20Coal%20Based%20Thermal%20Power%20Plant_Volume_I.pdf and Tender documents (2015) at http://www.bpdb.gov.bd/bpdb/index.php?option=com_content&view=article&id=347&Itemid=113.