# Tampa Electric Company's Big Bend Utility Plant in Hillsborough County, Florida: A Case Study

by

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A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
Department of Criminology
College of Behavioral & Community Sciences
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Date of Approval:
July 7, 2015

Keywords: Coal fire power plants, coal fly ash, environmental crime, environmental justice, environmental racism, corporate environmental violence

ProQuest Number: 1596492



ProQuest 1596492

Published by ProQuest LLC (2015). 

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Ann Arbor, MI 48106 - 1346

## DEDICATION

This thesis is dedicated to my family who have supported my educational pursuits every step of the way. In particular, the unconditional love and support of my husband Paul Champagne, Jr., who has always been positive concerning any project that I have wanted to pursue, and my brother, Frank Hodalski III, whose knowledge and support were invaluable to my research. Your belief in my abilities has provided the impetus to continue my love of learning. I humbly thank you and give you my love.

## ACKNOWLEDGMENTS

This thesis was accomplished with the support I received from faculty, mentors, friends and future colleagues in criminology. This case study was enhanced by the contributions of Andrew Franz, Esq., whose legal expertise, particularly in environmental crime and the law, led to many interesting and complex conversations regarding environmental injustices.
Dr. Ráchael A. Powers provided her expertise on victimization and its application to environmental injustice, and criminological theories applicable to my study. Her assistance throughout the process of crafting the final document was invaluable.

The entire faculty of the Criminology Department has been generous with their time. A special thanks to Dr. Elizabeth S. Cass, for her guidance and support, Dr. Lorie Fridell, who took a chance on someone with no special background in criminology but a desire to learn and a passion for the subject, and Dr. Kathleen M. Heide, who has inspired me to be better, to do more, and always be professional; a reflection of my education, past, present and future.

Two of my colleagues in the criminology department gave their assistance and friendship throughout the process of creating this manuscript. My sincere thanks to Brittany Poyer and Norair Khachatryan for many hours of reading drafts and providing much needed positive reinforcement.

My major professor, Dr. Michael J. Lynch, stimulated my research interests in environmental justice. Thank you Dr. Lynch, for providing that inspiration through the body of work you have given students and scholars to draw from, and finally, for your mentorship throughout this process -- I endeavor to exceed your expectations.

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## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ALA | American Lung Association |
| ARI | Acute Respiratory Infection |
| As | Arsenic |
| ASL | Airway Surface Liquid |
| BACT | Best Available Control Technology |
| BTU | British Thermal Unit |
| CAA | Clean Air Act |
| CAIR | Clean Air Interstate Rule |
| CATF | Clean Air Task Force |
| CCP | Coal Combustion Products |
| CERCLA | Comprehensive Environmental Response, Conservation and Liability Act |
| CEV | Corporate Environmental Violence |
| CFA | Coal Fly Ash |
| CFJ | Consent Final Judgment |
| CFPP | Coal Fired Power Plant |
| CFR | Code of Federal Regulations |
| CO | Carbon Monoxide |
| COPD | Chronic obstructive pulmonary disease |
| CPP | Coal Preparation Plant |
| Cr(VI) | Hexavalent chromium |
| CrIII | Trivalent chromium |
| CWA | Clean Water Act |
| DNA | Deoxyribonucleic Acid |
| DOJ | Department of Justice |
| ECHO | Enforcement and Compliance History Online |
| ECRC | Environmental Cost Recovery Clause |
| EH&E | Environmental and Engineering Report |
| EJ | Environmental Justice |
| EPA | Environmental Protection Agency |
| F.A.C. | Face Amount Certificate |
| FDEP | Florida Department of Environmental Protection |
| FGD | Flue Gas Desulfurization System |
| HAP | Hazardous Air Pollutant |
| HCSO | Hillsborough County Sheriff's Office |
| HC1 | Hydrochloric Acid |

| | |
|---|---|
| Hg | Mercury |
| IECG | International Energy Coal Generation |
| IRB | Institutional Review Board |
| kg | kilogram |
| lb | pound |
| LLC | Limited Liability Company |
| MCL | Maximum Contaminant Level |
| mg | milligram |
| mg/L | milligrams per liter |
| MSR | Market Stability Reserve |
| MWh | MegaWatts per hour |
| NAACP | National Association for the Advancement of Colored People |
| NAAQS | National Ambient Air Quality Standards |
| Ni | Nickel |
| nm | nanoparticle |
| NMMAPS | National Morbidity, Mortality and Air Pollution Study |
| NO | Nitrogen |
| $NO_2$ | Nitrogen Dioxide |
| NOV | Notice of Violation |
| $NO_x$ | Nitrogen Oxide |
| NRC | Nuclear Regulatory Commission |
| NSR | New Source Review |
| NYSE | New York Stock Exchange |
| $O_3$ | Ozone |
| PAC | Political Action Committee |
| PAH | Polynuclear Aromatic Hydrocarbons |
| Pb | Lead |
| $Pb_3O_4$ | Lead oxide |
| PbO | Lead oxide |
| $PbO_2$ | Lead oxide |
| PERI | Political Economic Research Institute |
| PM | Particulate Matter |
| POTWS | Publicly Owned Treatment Water Stations |
| ppm | parts per million |
| PSD | Prevention of Significant Deterioration |
| PVC | PolyVinyl Chloride |
| RCRA | Resource Conservation and Recovery Act |
| RSEI | Risk Screening Environmental Indicators |
| Se | Selenium |
| SIP | State Implementation Plan |
| SMCL | Secondary Maximum Contaminant Level |
| SNC | Significant Noncompliance |
| $SO_2$ | Sulfur Dioxide |

| | |
|---|---|
| TECO | Tampa Electric Company |
| ToP | Treadmill of Production |
| TRI | Toxic Release Inventory |
| US | United States |
| USEPA | United States Environmental Protection Agency |
| UTM | Universal Transverse Mercator |
| WEPCO | Wisconsin Electric Power Company |
| WHO | World Health Organization |
| wt/% | Weight in Percentage |
| μg | microgram |
| μm | micrometer |

**ABSTRACT**

This is an in-depth analysis of coal fire burning power plants, their effects on human health and the environment. It also employed case study data from Tampa Electric Company's Big Bend facility to examine environmental infractions at that facility. Tampa Electric Company's Big Bend Utility Plant, violated the Clean Air Act, which led to a lawsuit filed by the Department of Justice on behalf of the United States Environmental Protection Agency and the Florida Department of Environmental Protection in 1997. This case study details the lawsuit, and subsequent settlement as well as Tampa Electric Company's record of compliance since 2000. This study examines the area surrounding the plant, and impacts the facility may cause local residents and the ecosystem in this part of Florida. Several questions are explored in this case study revolving around environmental justice and environmental racism. Did the actions taken by the Department of Justice in 2000 on behalf of the Environmental Protection Agency and the people of the State of Florida through its Department of Environmental Protection fit the corporate crimes that Tampa Electric were accused of in the lawsuit? Has this company been compliant with state and federal law as required by the settlement? Finally, has the Tampa Electric Company maintained their commitment to provide environmental justice for the communities surrounding the Big Bend Utility Plant or would their actions fit a definition for the crime of corporate environmental violence?

# CHAPTER ONE:

# INTRODUCTION

## Introduction to the Case Study

Coal power provides an inexpensive, reliable power source that is plentiful in the United States. Electricity has been essential in America's culture, business and economy since the eighteenth century. Coal has been a staple in the production of electricity through Coal Fire Power Plants (CFPPs), along with fossil fuels and natural gas. The United States (US) has the world's largest coal reserves and is a major exporter of coal. In 2013, US coal mine production supplied 90% of coal to power plants for the generation of electricity. Coal has previously been the largest source of electricity generation in the United States, but saw a decline in 2007 of 39% as some in the utility industry converted to natural gas as a cost saving measure. Concurrently, new environmental regulations at the federal level have made it more costly for utility companies to operate coal fired utility plants (Energy Information Administration, 2015; International Electric Coal Generation [IECG], 1996).

Environmental and health harms caused by the use of coal begin with coal mining. For example, "... coal mining creates erosion, resulting in the leaching of toxic chemicals into nearby streams, waterways and aquifers ... (IECG, 1996)" and has caused natural wildlife habitats to be destroyed (Goodell, 2010; IECG, 1996). In addition, coal fire plants produce approximately two thirds of sulfur dioxide, one third of carbon dioxide and one quarter of the nitrogen oxide emissions in the United States (US) as well as emission of fine particulate matter into the atmosphere (IECG, 1996). Along with environmental damage to the geographic location where the plant is located, the accompanying damage to humans can be measured in health effects such as asthma, reduced lung function, chronic obstructive pulmonary disease (COPD), respiratory diseases and premature death (IECG, 1996). All of these negative health effects can be attributed to the emission of airborne fine particulate matter, dioxin, sulfur dioxide, and nitrogen oxide found in the steam produced by CFPPs. In addition to human health risks, smog formed from this steam contains nitrogen oxide and reactive organic gases that can cause crop failure, deforestation and property damage to the ecological palette (Gore, 2009; IECG, 1996). In the atmosphere, the combination of water, sulfur dioxide and nitrogen oxides creates acid rain. This substance acidifies the soil and water sources surrounding the CFPP (Gore, 2009; IECG, 1996). Scientists predict that these changes in the stability of the environment, caused primarily by carbon emission pollutants, will cause irreversible damage and the eventual collapse of the earth's ecosystem (Bull & Goodell, 2011). These issues are reviewed in Chapters two, three and four.

Following a review of the health and ecological harms associated with CFPP, a case study examining the production of these pollutants at Big Bend Power Plant in Apollo Beach, Florida, a coal fire burning power plant owned and operated by the Tampa Electric Company (TECO) is presented. The Big Bend facility has four coal-fired units with a combined output of 1,790 megawatts. The first unit began service in 1970, the second and third were added in 1973 and 1976 respectively, and the final unit was added in 1985. A natural gas and fuel oil-fired peaking unit was installed in 2009 to provide additional power during periods of peak electrical demand. The Big Bend facility's four combustion units emit pollutants 24 hours a day, 7 days a week. The Tampa Bay Times ranked Florida third for worst power plant generating toxic air pollution, while TECO's Big Bend Plant was listed as one of the largest polluters in the state (Klas, 2011). Further details about the kinds of volume of pollution produced at the Big Bend facility will be reviewed.

At issue in part of this analysis is the effect of those pollutants on the communities that surround this CFPP including Apollo Beach, Ruskin, Gibsonton, Riverview, Brandon, sections of east St. Petersburg, as well as Parrish and Ellenton to the south. Due west of the facility is Tampa Bay and its tributaries. Airborne emissions from the facility may travel significant distances, and comprise an additional issue examined in the study.

Environmental justice is at the forefront of many community-based campaigns to force the government to address the unequal distribution of pollution. Environmental Justice is defined as "…the fair treatment of all races, cultures, incomes and educational levels with respect to the development, implementation and enforcement of environmental laws, regulations and policies" (Lynch, Patterson & Childs, 2008; USEPA, 1998). Affected communities, which are typically low income and African-American, began to address this issue beginning in the early 1980s, and there are numerous environmental justice groups in the US that seek remedies to threats in air and water quality, natural habitats for wildlife in community parks, and recreational areas in affected neighborhoods (Stretesky, Huss & Lynch, 2012; Stretesky & Lynch, 2011). One issue investigated in this case study is whether the adverse health effects caused by emissions from the plant are unequally distributed. In these communities, pollutants could impact the environment, health and welfare of the inhabitants. Moreover, given the population characteristics of the communities, the pollutants emitted from the TECO facility may present environmental justice concerns related to the unequal impacts of pollution.

The second issue examined in the study involves scrutiny of TECO's environmental violations and how the company has responded to the many environmental charges filed. In 1997, the Florida Department of Environmental Protection (FDEP) teamed with the US Environmental Protection Agency (EPA) to file a Notice of Violation (NOV) for plant infractions of the Clean Air Act (CAA) and permit violations related to the facility's allowable level of pollution. The NOV was given to TECO for its Big Bend and Gannon facilities. From 1971 to 1998, TECO modified their smoke stacks to increase wattage and to service more customers without the proper modification permits. The United States Department of Justice (DOJ), on behalf of the EPA, filed a lawsuit against TECO on November 3, 1999, alleging that TECO violated the Prevention of Significant Deterioration (PSD) requirements of the CAA. The FDEP filed a lawsuit against TECO on December 7, 1999 that mirrored the EPA lawsuit. FDEP and the EPA filed their lawsuits in joint action on December 23, 1999.

TECO entered into negotiations with DOJ to resolve the lawsuit. The details of the settlement will be thoroughly examined for an in-depth discussion of environmental justice as it applies to this case. The issues above have become a part of green criminology with the examination of environmental crime and forms of environmental justice that polluting facilities generate. In part, this case study addresses green criminological questions through an examination of environmental crimes committed at TECO's Big Bend Plant and its continued noncompliance with CAA and CWA regulations according to their settlement agreement in 2000. In addition, this study addresses green criminological concerns through an examination of environmental racism. Does an analysis of the demographic data indicate whether TECO's neglect of regulatory agency's efforts to monitor this facility constitute a form of environmental racism?

The outline of this case study examines these questions through a series of chapters that highlight each research inquiry. The introductory chapter introduces the general research inquiry and identifies this as a case study of one CFPP in Hillsborough County, Florida. Chapter two is a review of the current literature on environmental crime and justice as it relates to the coal industry. Additionally, relevant literature on environmental racism will be examined, related to coal fired power plants. Chapter three is a review of the literature on medical implications regarding adverse human and animal health effects. The health effects may be caused by airborne and/or water contaminants inherent in coal production, particularly those produced by CFPPs. The fourth chapter will detail TECO's Big Bend facility, the plant layout and the ensuing lawsuit and settlement conditions. The chapter concludes with a presentation of TECO's past and current settlement compliance history.

Chapter five will present the methods used to collect data from the time of the plant's construction to the present in order to either confirm or hinder a claim of environmental racism. Information from the Enforcement and Compliance History Online (ECHO) database presents demographic information from one, three, and five miles from the point source that is pertinent for analysis. In addition, medical evaluations are made of various pollutants emitted from this CFPP, and the effects on surrounding communities, including hospitalizations, emergency room visits, and morbidity rates for the areas surrounding Big Bend. The information on hazardous air pollutants from the Big Bend facility will be compared to National Ambient Air Quality Standards (NAAQS). Chapter six will present the data and results of the comparative analyses of National Air and Water Standards, Big Bend's emissions data, as well as state and local demographic and medical information within five miles of the point source. Chapter seven concludes this case study with a discussion of the data, current policies regulating CFPPs, and what effects the utility lobby has on current regulatory agencies.

Two relevant questions for discussion that follow the above analyses are as follows: Did the actions taken by the EPA in 2000 fit the crime committed by TECO in Apollo Beach? Finally, has there been a commitment to continued environmental justice in the communities surrounding the Big Bend facility undertaken by the Tampa Electric Company?

**The Research Questions**

In summary, the research questions investigated in this case study are:

1. Did the EPA actions taken in the Settlement Agreement fit the environmental crimes TECO was charged with?
2. Has TECO made a commitment to honor the Settlement Agreement and provide environmental justice to the communities that surround Big Bend?
3. Are infractions and noncompliance a form of environmental injustice through the unequal distribution of pollutants?
4. Do negative heath impacts from plant emissions constitute a form of injustice in the form of environmental racism against low income and minority populations in and around the site? Does the demographic data support this argument?
5. Did TECO choose the site for Big Bend based on their intent to build a CFPP in a rural area with a low-income level, or was this just a coincidence of population growth?
6. Do negative ecological impacts from plant emissions constitute a form of environmental injustice to the communities that surround Big Bend?

# CHAPTER TWO:

# LITERATURE REVIEW OF ENVIRONMENTAL JUSTICE

A discussion of CFPPs must include a detailed definition and description of environmental law and crime. The topics under discussion include criminological identifiers of this type of corporate crime, and the laws that impact the regulation and oversight of CFPPs and their emissions. In exploring CFPP emissions, it is also useful to refer to concepts such as environmental justice/injustice, green violence and the role corporations play in generating green crime and victimization. In that view, CFPP emissions can constitute a form of environmental injustice when those emissions are unevenly distributed and have unequal race, ethnicity and class effects and distribution parameters. Recently, CFPP emissions have been characterized as including a form of green violence that combines both corporate environmental crime and environmental injustice (Lynch & Barrett, 2015). Green violence, in the context of CFPPs, includes the health harms and toxic pollution exposure caused by CFPP waste. Environmental injustice examines the unequal distribution of pollution and its consequences. As green criminologists note, a major concern is the role corporations play in generating green violence and environmental injustice. Theoretically, some green criminologists suggest that these problems need to be addressed from the perspective of political economic theory, which is capable of linking green violence and environmental injustice to economic, class, and race structures found within society (Lynch, 1990; Lynch & Barrett, 2015; Stretesky, 2008). In this view, green violence is a form of corporate environmental violence (Stretesky & Lynch, 1999).

The view described above takes what is called a harms-based approach to the definition of green crime and violence. It is, however, also possible to adopt a more traditional criminological view of green crime as a violation of the law, and to explore these outcomes using legal analysis as well as more traditional forms of social, economic and political theory that place green crimes in context (Potter, 2010, 2015). These issues are described further below.

**Environmental Law and Regulation**

Environmental crime and criminal enforcement of laws through regulatory agencies started with the passage of the CAA in 1970 and the Federal Water Pollution Control Act Amendments of 1972, also known as the Clean Water Act (CWA). These laws were passed in response to strong public support for environmental issues in the late 1960s and 1970s. Closely following these regulatory acts were the Resource Conservation and Recovery Act (RCRA) in 1976 and the Comprehensive Environmental Response, Conservation and Liability Act (CERCLA) in 1980. These legislative responses provided the foundation of the environmental crime movement in the United States. The CAA and CWA allowed the executive branch to draft more stringent policies toward environmental crimes, addressed public attitudes toward this type of crime, and created a framework for the prosecution and incarceration of environmental polluters (Brickey, 2008).

A closer look at the CAA and CWA reveals that environmental crime did not possess a well-established theory or legal concepts at the time these regulatory laws were disseminated. The complex wording of both the CAA and CWA, as well as the diverse interpretations that are available by courts to implement these laws, show that the basic constructs and theory behind ecological crime had not yet been realized (Brickey, 2008).

Because of their unique nature, environmental laws are often considered to be hybrid regulations, incorporating civil, administrative/regulatory and criminal law powers. Many of these laws contain unique features imposed to track and regulate pollution. For example, RCRA regulations provide cradle to grave regulation of hazardous waste while CERCLA established the Superfund laws, providing a pathway for financing cleanups of the worst hazardous waste sites in the US (Brickey, 2008). Although these four laws provide a framework for regulatory action and oversight, they cultivate civil and administrative responses to green/environmental crime rather than criminal enforcement of environmental regulations. Congress, over time, has made many revisions to these laws, in order to define ecological endangerment and amend federal law to include felony prosecutions for environmental crimes. With criminality included, prosecutors had a more forceful tool to compel corporate entities to follow the regulatory framework provided by these four pieces of legislation.

The Environmental Protection Agency (EPA) is charged with implementing ecological regulation and oversight. Its success can be tracked over time as regulatory effectiveness is paralleled with court outcomes, revisions to existing law, and agency restructuring over that same time period. The efficacy of the EPA and the effectiveness of environmental law is in the concurrent in the US (Brickey, 2008). The implementation phase of new laws, and cases challenging the EPA's regulatory authority, have made it arduous to enforce existing laws and federal regulatory requirements for CFPPs. Criminal enforcement has been a tightly controlled balance between the principals of environmental law and theories of criminal law (Lynch, Burns & Stretesky, 2014).

Environmental law has three characteristics that make it distinctive from other forms of criminal law. These distinctions appear as the aspirational nature of the law, the evolutionary nature of the law since inception, and the extreme complexity of the legal language and judicial interpretations of that language in the courts (Lynch et al. 2014). In environmental law, the basic concepts of harm, culpability and deterrence were redefined to fit a legal model that created revisions to the original CAA and CWA legislation. The CAA Amendments of 1990, which expanded the scope of criminal provisions based on legal interpretation of the language, was largely due to new concepts introduced in environmental law, such as the "knowing endangerment" offenses (Brickey, 2008; Lynch & Michalowski, 2010).

**Green Victimization and Violence**

This case study highlights environmental crime, victimization and legislation within the realm of green criminology. An important aspect of that analysis is labeling and understanding the forms of victimization CFPP pollution produces. Lynch and Barrett (2015) describe the green victimization that CFPPs cause in their communities. The research cites three physical harms found in green criminology. First is harm to the ecosystem posed by the pollutants introduced by humans into the environment. A second harm is any "ecologically destructive" human behavior that affects the health of human beings in the ecosystem and the possible impacts on both physical and social environments. Finally, nonhuman animals living in polluted environments are also defined as victims of environmental crime. Although they live in the same physical and social environments as their human counterparts, nonhuman animal victims play no role in contributing to the addition of pollutants into the ecosystem (Lynch & Barrett, 2015).

Within green criminology, these forms of victimization can also be described as green violence. The inhabitants of any ecosystem who contracted physical, emotional and/or social ailments as a result of living in an environment adversely impacted by pollution can be described as suffering from green victimization. Lynch and colleagues (2014) focused on the volume of green victimization caused by CFPPs relative to street crime. CFPPs are not well regulated by the EPA, and as we shall see in Chapter three, cause significant health harms to human and animals alike. Current CAA and CWA regulatory laws are not meticulously examined and compliance is not strictly enforced (Clean Air Action Report, 2010). Previous studies examine why green crimes should not be neglected and suggest public policy changes be made to diminish corporate environmental violence (Lynch & Barrett, 2015).

Environmental crimes and corporate environmental violence (CEV) occur when a corporate entity pollutes the ecosystem through the introduction of toxins or withdrawal of raw materials from that ecosystem. The enforcement and deterrence of CEV lies in the regulatory agencies necessary to ensure that environmental laws are enforced (Lynch & Stretesky, 2014; Stretesky, Long & Lynch, 2013; Stretesky & Lynch, 1999). These pollutants generate "indirect" CEV when the pollutant affects human and non-human health through exposure to toxic by-products, and damage food supplies leading to an eventual decline in species population and the ecosystem health and stability (Lynch & Barrett, 2015; Lynch et al., 2014; Stretesky, Long & Lynch, 2013).

**Environmental Justice and Racism**

Environmental racism as defined by Bullard (2002) is "... environmental policies, practices, or directives that differentially affect or disadvantage (whether intentionally or unintentionally) individuals, groups, or communities based on race or color. Environmental racism is reinforced by governmental, legal, economic, political and military institutions..." (Bullard, 2002). Though the EPA is affected by policies that direct it to consider environmental justice concerns (USEPA, 2015), EPA does not have an unblemished record when it comes to addressing environmental justice and environmental racism. The EPA was investigated in 1992 for allegations of environmental racism resulting from selective enforcement of policies and procedures, based on race and class, by the National Law Journal (1992). This case study questions whether the regulatory agency tasked with oversight of CFPPs can effectively monitor corporate entities for CEV if it cannot prevent the prejudicial effects of environmental racism from within its own doors. Later, EPA Executive Director, Christie Todd Whitman challenged Executive Order 12898, leading the US Inspector General to criticize the EPA's commitment to environmental justice. In 2012, a legal article providing background for environmental racism concluded that "...the fox now guards the henhouse..." due to the environmental community's inability to effectively prove discriminatory actions by a corporation (Ewall, 2012). Legally, if one cannot prove the corporation's discriminatory practices are intentional, all the environmental group or individual can do is complain to the corporation, or through the EPA, request they hold themselves accountable for any environmentally racist and/or criminally negligent practices (Ewall, 2012).

**Environmental Impacts**

CFPPs produce a variety of ecological harms and victimization. Those harms begin with the mining of coal used to operate CFPPs. Coal mining, whether underground or mountaintop, results in toxic chemicals leaching into nearby streams and aquifers, and can cause severe erosion (Goodell, 2010; Osnos, 2014). Additionally, coal mining has caused natural wildlife habitats to be permanently destroyed (Bull & Goodell, 2011; Goodell, 2010). Chapter one revealed that two thirds of sulfur dioxide, one third of carbon dioxide, and one quarter of the nitrogen oxide emissions in the United States are produced by CFPPs (IECG, 1996). In addition to these pollutants, the coal combustion process (CCP) creates fine particulate matter, which is then released into the atmosphere. Nitrogen oxide and fine airborne particles exacerbate asthmatic conditions, reduce lung function and cause respiratory diseases and premature death for many Americans (Environmental Health & Engineering [EH&E], 2011; IECG, 1996). Smog formed by nitrogen oxide and reactive organic gases causes crop, forest and property damage. Sulfur dioxide and nitrogen oxide both combine with water in the atmosphere to create what is commonly known as acid rain. Acid rain acidifies the soils, sand and water subsequently killing indigenous plants, fish, and animals (Gore, 2009; IECG, 1996). Emission of these pollutants can also accelerate climate change. Some scientists predict that climate change will damage the ecosystem of the oceans, causing a collapse in the food chain within the next century. This collapse has been attributed to the carbon footprint left by the human race (Bull & Goodell, 2011; Gore, 2009; IECG, 1996). These issues are examined in greater detail in the following chapter.

**What is Coal and the Effects of the Coal Combustion Process?**

Coal is classified into one of four types based on its heating value, ash content and moisture, which in part reflect the extent of impurities present in the coal. The four types of coal include: Anthracite, Lignite, Bituminous and Sub-bituminous. Table 1 shows the various characteristics of major coal types used in CFPPs; coal type, principal characteristics, and the HAP breakdown for each type of coal. Bituminous and sub-bituminous coal account for over 90% of coal use in the US annually (EH&E, 2011). Pyrite, a mineral rich in iron and sulfur is a common impurity in bituminous coal and contains both arsenic and mercury. Sub-bituminous coal contains less sulfur and is preferred by power plants that desire lower emission rates of sulfur dioxide. Importantly, the burning of coal with these embedded impurities enhances the toxicity of coal-fired power plant emissions, and, as discussed later, may cause elevated rates of green victimization and disease among those exposed to these pollutants.

The forms of pollution generated by coal production also include those created during the process of preparing coal for use. Raw coal is typically washed with water and proprietary chemicals to remove impurities. Proprietary chemicals in the coal preparation process are those protected by patent law and the chemical breakdown of the wash belongs to the company that created it. The Big Bend facility employs this coal washing system. A coal preparation plant (CPP) washes the raw, mined coal of embedded soil and rock, crushing it into different size grades and creates coal washing toxins. Those toxins are stored as liquid slurry in coal ash ponds and impoundments.

**Table 1.** Characteristics of the Four Major Coal Types

| Characteristics of Major Coal Types Used to Generate Electricity in the United States | | | | |
|---|---|---|---|---|
| **Characteristic** | **Anthracite** | **Bituminous** | **Sub-bituminous** | **Lignite** |
| **Principal Characteristics [1]** | | | | |
| Percentage of U.S. Production | Less than 0.1% | 46.90% | 46.30% | 6.90% |
| Heating Value (BTU/lb) | 15 | 11 - 15 | 8 - 13 | 4 - 8 |
| Sulfur (%) | Less than 1% | 3 - 10% | Less than 1% | Less than 1% |
| **Hazardous Air Pollutants in Coal [2]** | | | | |
| Arsenic | NR | 0.5 | 0.1 | 0.3 |
| Beryllium | NR | 0.11 | 0.03 | 0.2 |
| Cadmium | NR | 0.03 | 0.01 | 0.06 |
| Chlorine | NR | 35 | 2.7 | 24 |
| Chromium | NR | 1.1 | 0.4 | 2.2 |
| Lead | NR | 0.6 | 0.2 | 1 |
| Manganese | NR | 1.8 | 1.3 | 20 |
| Mercury | NR | 0.007 | 0.006 | 0.03 |
| Nickel | NR | 0.9 | 0.4 | 1.2 |

BTU/lb - British Thermal Units per pound of coal; a measure of energy density of coal

NR - Not Reported

(1) NRC, 2010, Table 2-3.

(2) Geometric mean concentration of selected elements in coal; units are pounds per billion BTU (USEPA, 2010a).

Emissions of Hazardous Air Pollutants from Coal-Fired Plants, Environmental Health & Engineering, 2011

http://www.lung.org/assets/documents/healthy-air/coal-fired-plant-hazards.pdf

Three grades of raw coal are accumulated through the washing processes, known as "liberation" of the coal sample. The liberation process breaks down coal into low density or "clean" coal, intermediate density rock, referred to as middling, and materials of high density rock and sand that are rejected (EH&E, 2011).

The washing process used to clean coal includes water and chemicals, including coagulants, flocculants and surfactants. The chemical ingredients contained in the washing solutions are protected by patent law, and are therefore protected from scrutiny by environmental groups and the federal government. The byproducts in wastewater that remain from this process are known as coal slurry or coal sludge. In this case study, the toxic wastewater from the coal production process will be referred to as slurry. Coal slurry contains this chemically saturated water and left over particles of coal, rock and clay from the raw materials. The raw materials contain a variety of heavy metals, including lead, arsenic, cadmium, chromium, iron, aluminum, nickel and manganese. All of these heavy metals can dissolve in water, also in hydrocarbons, and some organic chemicals (EH&E, 2011).

Patent law, and the passage of the Energy Law of 2005, which contains the "Halliburton Loophole" prevents federal and state regulatory agencies as well as environmental groups, from accessing information regarding the chemicals used in the coal washing production process (Bull & Goodell, 2011). Prior studies, however, indicate the presence of the following pollutants in coal wash slurry: acrylamides, lime, starches, sulfuric acid, nitric acid, aluminum sulfate, iron oxide, diesel fuel, polynuclear aromatic hydrocarbons (PAHs) and anhydrous ammonia (EH&E, 2011). Many of the possible pollutants contained in coal slurry are unknown. What is known, concerns general categories of possible environmental toxins including coagulants, surfactants and flocculants. Coagulants are those chemicals that can alter a fluid into a more thick mass for the purpose of separation. Surfactants are chemical compounds that lower the surface tension between liquids or between a liquid and solid. Surfactants are used as wetting agents in chemical washing processes. Flocculants are chemical compounds that produce flocculation of suspended particulate matter in a substance. The process of flocculation separates individual particles into masses or clumps that can be separated. It is a chemical reaction to clay particles and other chemical substances (Merriam-Webster, 2003). The chemicals comprising the materials in all three of these agents are protected by the patent law proprietary rules. Some of the chemicals have been identified through investigations led by environmentalists and investigative journalists seeking to uncover the particular chemical base that forms the coal washing process (Fox, 2010).

Table 2 shows a list of toxic chemicals and heavy metals that has been found in coal slurry (Ohio Valley Environmental Coalition, 2015). Many of the chemical compounds are known carcinogens, neurotoxins and genotoxins. To expedite further discussions, the medical definitions of these terms are listed, "... carcinogens are cancer-causing substances or agents..." (American Heritage Medical Dictionary, 2007); "... neurotoxins are substances that damage, destroy or impair the function of nerve tissue..." (Gale Encyclopedia of Medicine, 2008); and "... genotoxins are any substances or agents that damage DNA..." (Farlex Partner Medical Dictionary, 2012). The health implications of chronic exposure to heavy metals found in coal slurry are discussed in detail in Chapter two, but include a plethora of health problems from cancer to intestinal lesions, miscarriages and birth defects (Aurora Lights Appalachian Mountaintop Removal, 2015; Ohio Valley Environmental Coalition, 2015 SourceWatch, 2015). The toxicity of the coal slurry is dependent on the type of chemicals used in the CPPs washing process. Toxins can include acrylamide, butyl benzyl phthalate, hexachlorobenzene, naphthalene, chlorophenyl, phenyl ether, and dichlorobenzidine in addition to heavy metals such as mercury, arsenic, lead and nickel (Ohio Valley Environmental Coalition, 2015).

**Table 2.** Chemicals and Heavy Metals Found in Coal Slurry

| **Chemicals Found in Slurry and Sludge** | | |
|---|---|---|
| Aniline | Dibenzofuran | Acrylamide |
| Acenaphthene | Dibutyl phtalate | Hexachloro-1,3-Butadiene |
| Acenapthylene | Diethyl phthalate | Hexa-Cl-1,3-Cyclopentadiene |
| Anthracene | Dimethyl phthalate | 1,2,4-trichlorobenzene |
| Benzidine | Dioctylphthalate | 1,2-Dichlorobenzene |
| Benzo(a)anthracene | Fluoranthene | 1,3-Dichlorobenzene |
| Benzo(a)pyrene | Fluorene | 1,4-Dichlorobenzene |
| Benzo(b)fluoranthene | Hexachlorobenzene | 2,4-Dinitrotoluene |
| Benzo(ghi)perylene | Hexachloroethane | 2,6-Dinitrotoluene |
| Benzo(k)fluoroanthene | Indeno(1,2,3-c,d)pyrene | 2-Chloronaphtalene |
| Benzyl alcohol | Isophorone | 2-Methylnapthalene |
| bis(2-ethylhexyl)phthalate | N-Nitrosodi-n-propylamine | 2-Nitroaniline |
| bis(2-chloroethoxy)-methane | N-Nitrosodiphenylamine | 3-3'-Dichlorobenzidine |
| bis(2-chloroethyl)ether | Naphthalene | 3-Nitroaniline |
| bis(2-chloroisopropyl)ether | Nitrobenzene | 4-Bromophenyl phenyl ether |
| Butyl benzyl phthalate | Phenanthrene | 4-Chloroaniline |
| Chrysene | Pyrene | 4-Chhlorophenyl phenyl ether |
| Dibenzo(a,h)anthracene | | 4-Nitroaniline |
| **Heavy Metals Found in Coal Slurry** | | |
| Aluminum | Copper | Potassium |
| Antimony | Iron | Selenium |
| Arsenic | Lead | Silver |
| Barium | Magnesium | Sodium |
| Beryllium | Manganese | Strontium |
| Cadmium | Mercury | Tin |
| Calcium | Molybdenum | Vanadium |
| Chromium | Nickel | Zinc |
| Cobalt | | |

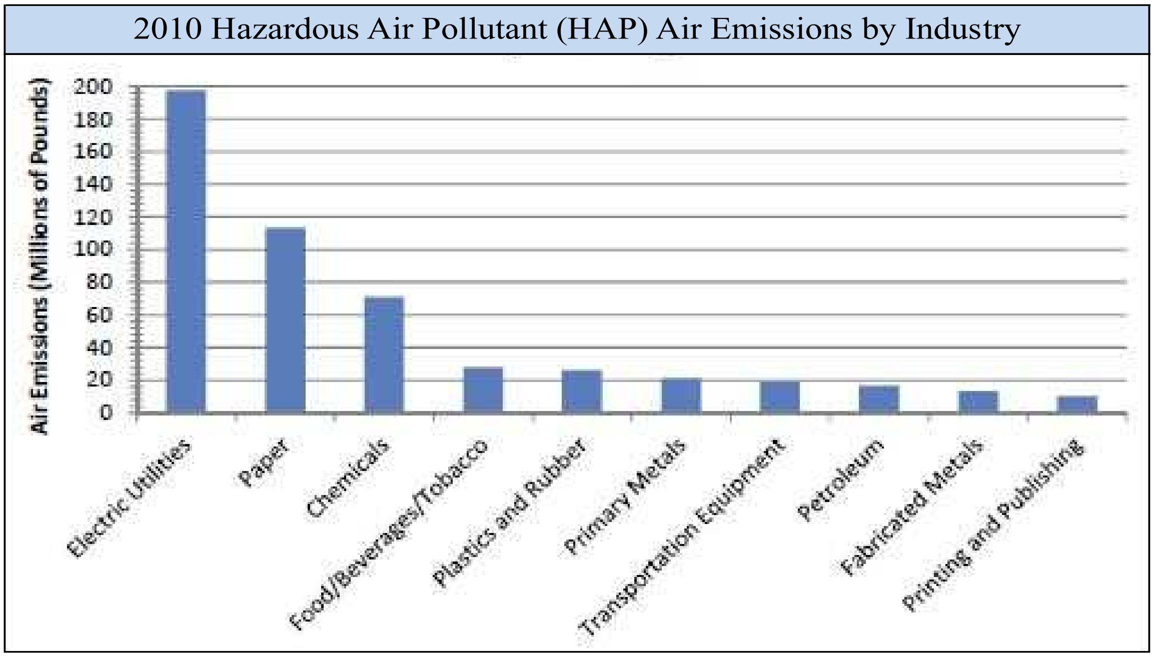
Source: Kentucky Division of Water. DOW-DES Analytical Data File. Martin Co.Coal.Co.Slurry Release Data.xls
http://www.sludgesafety.org/what-coal-slurry/chemicals-found-coal-sludge-and-slurry

Coal processing also includes acrylamides, some of which are known carcinogens. The toxic levels of many of these chemicals produce coal slurry that cannot be released directly into the environment, it must be stored on site at the facility where it was produced. The Big Bend facility has coal ash and slurry, which are stored within site disposal ponds, the majority of which are unlined, on the land in Apollo Beach (EPA Site Certification Big Bend, 1980).

Pollution from coal consumption is also generated from burning coal at CFPPs. If these impurities are not captured by pollution control equipment, they are released into the atmosphere. Sub-bituminous coal has a lower heating value than bituminous coal, and power plants often choose to burn bituminous coal despite its higher toxicity. Pound per pound, the bituminous coal provides more power (EH&E, 2011; Union of Concerned Scientists, 2010). This means that CFPPs that use bituminous and sub-bituminous coal produce more pollution during the process of burning coal. The least efficient form of coal in energy per pound (BTU/lb) is lignite coal. TECO burns some lignite coal, mined from a processing facility it owns and operates in Corbin, Kentucky (TECO, 2014).

**Government Responses to Coal Fire Plants**

In 2005, the US Environmental Protection Agency set new limits on hazardous air pollutants released into the atmosphere from coal and oil-fired power plants. Figure 1 shows HAP air emission by Industry, revealing that electric utilities produce a significant amount of air pollutants introduced into the atmosphere. Electric utilities produce 57% more HAPs than the closest competing industrial sector (Environmental Integrity Project, 2011). This legislation, known as the Utility Air Toxic Rule, set new limits on emissions of hazardous air pollutants. This represented the first time that the EPA placed federal limits on mercury, arsenic, lead, hydrochloric acid, hydrofluoric acids, dioxins and other toxic substances from CFPPs (USEPA, 2014). Table 3 shows the specific HAP emissions that contribute to CFPP pollution. Additionally, the American Lung Association (ALA) commissioned a report on the public health and environmental impacts of Hazardous Air Pollutant (HAP) emissions from CFPPs that acts as




Source: America's Top Power Plant Toxic Air Polluters, Environmental Integrity Project, 2011.

http://www.environmentalintegrity.org/documents/Report-TopUSPowerPlantToxicAirPolluters.pdf

**Figure 1.** Hazardous Air Pollutant Emissions by Industry

**Table 3.** Contributions of Coal-Fired Power Plants to Selected Hazardous Air Pollutants

| **Contributions of Coal-Fired Power Plants to Selected Hazardous Air Pollutant Emissions** | |
|---|---|
| **Data obtained from USEPA, 2007** | |
| **Hazardous Air Pollutant** | **Percentage of Point Source Emissions** |
| Acid Gases (Hydrochloric Acid and Hydrofluoric Acid) | 76% |
| Arsenic | 60% |
| Beryllium | 28% |
| Cadmium | 30% |
| Chromium | 20% |
| Cobalt | 34% |
| Lead | 15% |
| Manganese | 11% |
| Mercury | 46% |
| All Non-Mercury Metal HAPs E mitted by Coal-Fired Power Plants | 25% |

Emissions of Hazardous Air Pollutants from Coal-Fired Plants, Environmental Health & Engineering, 2011

http://www.lung.org/assets/documents/healthy-air/coal-fired-plant-hazards.pdf

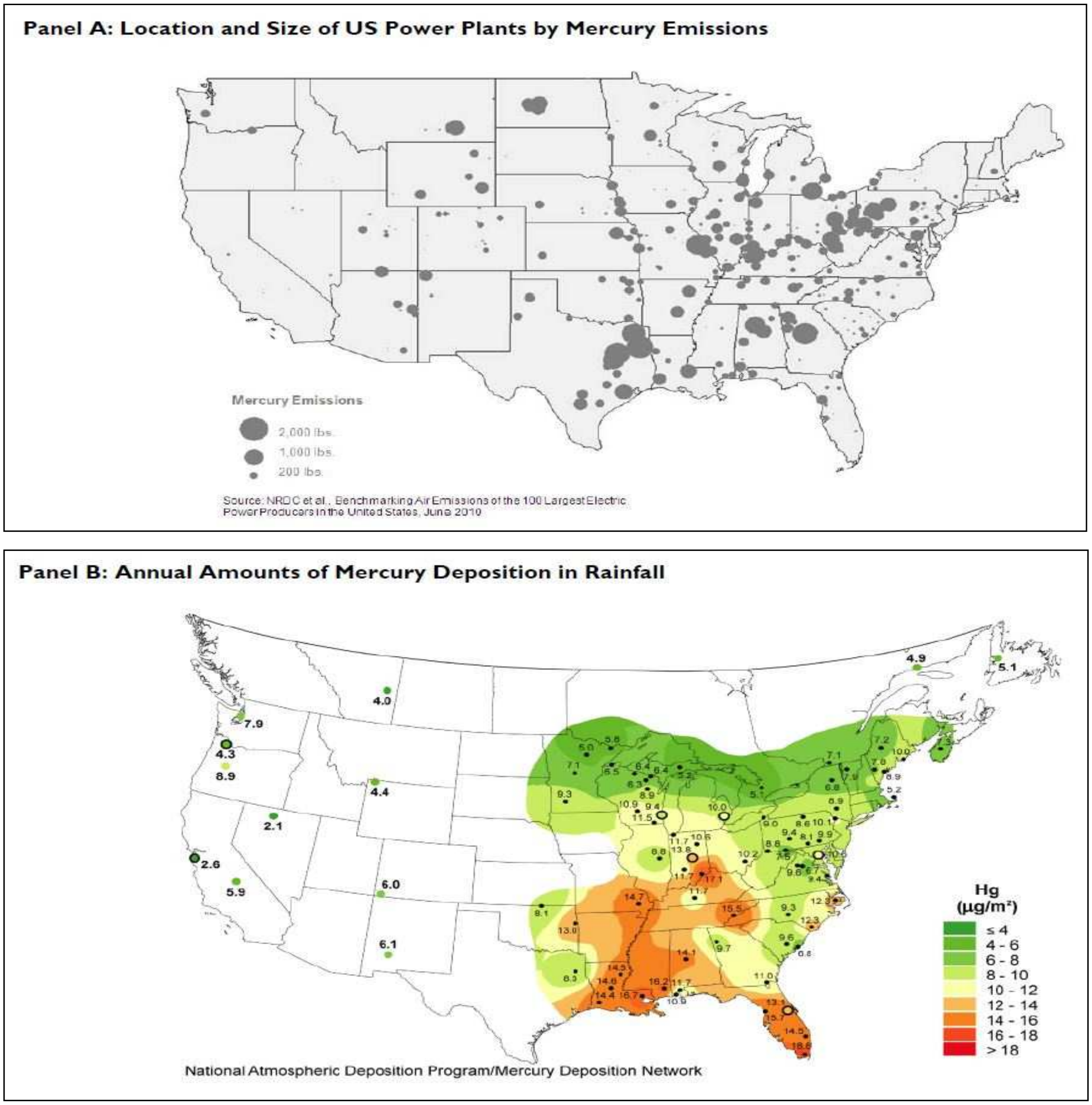
a useful resource for the general public (ALA, 2011). Adverse effects reported included: damage to eyes, skin and breathing passages; negative effects on the kidneys, lungs and nervous system; potential to cause cancer; impairment of neurological function, and the ability to learn; and pulmonary and cardiovascular disease (USEPA 1998, 2011a, 2011b, 2014)

Public health risks associated with exposure to mercury in food and metal in airborne fine particulate matter are notable. CFPPs significantly contribute to deposits of mercury in soil and water. Mercury deposits to the earth's surface from the air can make its way into waterways where it is converted into methyl-mercury (USEPA, 2014). Figure 2 illustrates Mercury emissions in both air and rainfall. The Figure shows the location and size of the CFPPs responsible for these emissions as well as the annual amounts deposited by rainfall into waterways, surface, and groundwater sources (EH&E, 2011).

The EPA has also found fine particulate matter to be a cause of cardiovascular disease. Hazardous air pollutants such as arsenic, beryllium, cadmium, chromium, lead, manganese, nickel, radium, selenium, and other metals, are found in the particulate matter emitted from CFPPs. In recent population-based health impact studies, particulate matter was estimated to account for an average of $3.7 billion in annual health care costs (NRC, 2010; USEPA, 2014). In addition, the environmental impacts of powerful hazardous air pollutant emissions include acidification of the environment, accumulation of toxic metals, contamination of water supplies, reduced visibility due to haze and the degradation of buildings close to the point source (Cordiano, 2011; FDEP Emission Inventory, 2011).

As previously noted, Florida currently ranks third in the nation for worst power plant generated toxic air emissions, particularly carbon pollutants. A report released by Environment Florida using 2011 federal Toxic Release Inventory (TRI) data ranked these CFPPs nationwide.

Mercury Emissions in Air and Rainfall




| |
|---|
| Panel A - Location and Size of Annual Mercury Emissions to Air (MJ Bradley, 2010) |
| Panel B - Annual Amounts of Mercury Deposition in Rainfall (NADP, 2007) |

Emissions of Hazardous Air Pollutants from Coal-Fired Plants, Environmental Health & Engineering, 2011

http://www.lung.org/assets/documents/healthy-air/coal-fired-plant-hazards.pdf

**Figure 2.** Mercury Emissions in Air and Water

Florida's power plants produce 49% of statewide emissions of carbon pollutants. Even more relevant for this study was TECO's ranking in the state. The Big Bend facility was second for carbon emissions (Klas, 2011; Ramos, 2013). A further environmental concern is the level of water pollutants that harm drinking water and damage natural habitats for wildlife in and around the CFPPs. This occurs due to the leaching of toxic chemicals from a variety of sources including coal slurry, coal fly ash, as well as a variety of airborne pollutants from the facility's stacks that are introduced into waterways surrounding the source point (EH&E, 2011).

In 2013 the Political Economy Research Institute (PERI), produced a *Toxic 100 Index* that included the Big Bend facility in Apollo Beach. PERI describes their methodology for arriving at their data and subsequent conclusions. Big Bend is listed as a significant polluter, with toxic release inventory data from the EPA collected in 2010. They incorporate three factors into their risk screening assessment tool. The "fate and transport" which is how the chemical spreads from the point source to a geographic area. The actual toxicity of the chemical and the danger it poses, based on a per-pound scale. The third element in the equation is the actual population affected in the geographic area (PERI, 2013).

The PERI report further breaks down this population by minority and poor shares in a community. Based on the 2013 PERI report, TECO's Big Bend facility contains a 13.6% Poor Share and a 36.6% Minority Share for purposes of environmental justice reporting. The PERI report cites the EPA data on the local meteorological patterns, temperature and ground topography, combined with data on the height of the Stacks and exit velocity of toxic gases for up to a 31 mile or 50 km radius from the point source to obtain the percentage of population affected.

The Toxic Release Inventory (TRI) program also tracks chemicals that can specifically cause cancers or other chronic human health effects, significant adverse acute health effects in humans, as well as significant environmental effects classified as adverse. Electric companies that use combustible coal or oil to generate power must report their data for the toxic release inventory. Of the 567 companies that reported to the EPA in 2013, based on data obtained in 2010, Big Bend ranked 471 of those 567, with number one on that list being the CFPP emitting the most toxic pollutants. The EPA updates the TRI, as chemicals are labeled hazardous by the Food and Drug Administration and federally legislated. TRI's list is complete through 2014 with changes sent to each reporting facility. The EPA currently tracks 689 toxic chemicals emitted from CFPPs through this TRI program (EPA Toxic Release Inventory, 2013).

In this case study, water pollutants have been examined due to the violations of the CWA at the previously mentioned Big Bend facility. Table 4 presents a list of the Top Ten Industrial Sectors with the most hazardous Water Pollution. Electrical utilities top the list, as they did in

**Table 4.** Industrial Sectors with the Most Hazardous Water Pollution

**Industrial Sectors with the Most Hazardous Water Pollution**

| Rank | Industrial Sector [1] | Total Number of Facilities | Hazard Share (% of Total) | Amount of Chemicals Released to Surface Water (pounds) | Amount of Chemicals Transferred to POTWS [2] |
|---|---|---|---|---|---|
| 1 | Electric Utilities | 370 | 55.81 | 2,672,902 | 6,756 |
| 2 | Chemicals | 1267 | 17.37 | 29,014,457 | 87,113,726 |
| 3 | Primary Metals | 763 | 12.21 | 28,001,950 | 12,104,662 |
| 4 | National Security | 51 | 8.01 | 15,176,990 | 75,496 |
| 5 | Paper | 247 | 3.05 | 17,864,769 | 24,020,189 |
| 6 | Petroleum | 179 | 1.34 | 21,039,437 | 3,551,759 |
| 7 | Wood Products | 99 | 0.62 | 30,868 | 44,194 |
| 8 | Metal Mining | 34 | 0.30 | 486,766 | 6,847 |
| 9 | Electrical Equipment | 227 | 0.29 | 5,089 | 1,295,405 |
| 10 | Fabricated Metals | 1029 | 0.21 | 1,463,015 | 12,079,890 |

(1) As classified under the North American Industry Classification System (NACS).

(2) Publicly owned treatment works.

Source: Food & Water Watch/PERI analysis of data from the USEPA Toxics Release Inventory and Risk Screening Environmental Indicators.

http://documents.foodandwaterwatch.org/doc/Toxic_Flood.pdf the air pollutant sector. This table lists not only the amount of chemical released into surface water, either through direct discharge or atmospheric release producing acid rain, it also lists chemicals that can be transferred to Publicly Owned Treatment Water Stations (POTWS). What is compelling in this Table is the percent share of the total Hazard. Although the electric utilities may not necessarily produce the highest level in pounds of pollution emitted to waterways, it has the highest hazard share total due to the number, and output of the stations. 55.81% of the total hazardous emissions are directly attributable to utility companies (EPA Toxic Release Inventory, 2013).

Table 5 provides information on the Top 10 Hazardous Industrial Water Pollutants. It provides the ranking of the pollutant, percent hazard share in the waterways, health risks

**Table 5.** Top Ten Industrial Hazardous Water Pollutants

| Top Hazardous Industrial Water Pollutants, 2009 | | | | |
|---|---|---|---|---|
| **Rank** | **Pollutant** | **Hazard Share (%)** | **Health Risks** | **Industrial Sources** |
| 1 | Arsenic and Arsenic Compounds | 60.60 | Cancer | Waste product from glass and electronics manufacturing and from electricity generation |
| 2 | Hydrazine Compounds | 11.69 | Cancer | Pesticides, rocket fuel, boiler water treatments, pharmaceuticals |
| 3 | Nitroglycerin | 7.97 | Harm to cardiovascular and central nervous system | Explosives, rocket fuels and medicines |
| 4 | Acrylamide | 4.85 | Cancer, nervous system and blood problems | Used in plastics, adhesives and cosmetics |
| 5 | Polycyclic Aromatic Compounds | 2.62 | Cancer, disruption of endocrine system | Tire manufacturing, paper mills, electricity generation, and oil refineries |
| 6 | Acetaldehyde | 2.15 | Cancer | Manufacturing of many food additives |
| 7 | Acrylonitrile | 2.05 | Cancer | Manufacuring of acrylic/modacrylic fibers and some other products (i.e., plastics) |
| 8 | 4,4'-Methylenedianiline | 1.38 | Cancer | Chemical used to make polyurethane foams and other industrial products |
| 9 | Ethylene Oxide | 1.09 | Cancer | Manufacturing of a variety of industrial products (i.e., solvents) |
| 10 | Dioxane | 1.07 | Cancer, liver and kidney damage | Solvent in chemical manufacturing |

Source: Food & Water Watch/PERI analysis of data from the USEPA Toxics Release Inventory and Risk Screening Environmental Indicators.

http://documents.foodandwaterwatch.org/doc/Toxic_Flood.pdf associated with each pollutant, as well as the industrial sources that significantly contribute to their emission.

When analyzing the information in Table 5, it is interesting to note that the contaminants listed as primarily associated with CFPP emissions are the most prevalent. All of the pollutants listed can come into contact with the water supply through atmospheric fallout, groundwater run-off, and POTWS pollution, which can occur as a result of this run-off from leaching into existing waterways and groundwater from disposal ponds located in and around the point source.

**Theoretical Implications**

Issues of environmental and corporate/white collar crime have been overlooked by criminologists despite research which suggests that these issues are important for understanding this type of criminal behavior, and how crimes that involve the wealthy and powerful affect the public. Environmental crime is absent from a majority of criminology journals and textbooks, and when it materializes, it is a generalization of the theory and literature on the subject. The basic tenets of environmental crime involve corporate entities rather than individuals as the perpetrators of deviant behavior. The victimization of people as a "community" of individuals rather than as a single individual as a victim of crime is the basis of green victimization. The community health and welfare is violated by a larger corporate entity and that should concern the individuals that make up a community or neighborhood. A study of peer reviewed journals in criminology by Lynch and colleagues (2004) revealed that only 4% of articles dealt with issues of environmental harm and "1 in 1,568 pages" in 16 criminology textbooks had sections related to environmental crime (Lynch, McGurrin, and Fenwick, 2004).

There are three criminological theories that are applicable to environmental issues included in this case study. Rational Choice (RC) theory is based on the principles of a freemarket economic structure (Lynch, Burns & Stretesky, 2008; Stretesky, 2006). The theory proposes that environmental crimes will occur when the benefits (profits) of the act outweigh the penalties if discovered by law enforcement. The corporation will act in a way that promotes the most benefit for itself and stakeholders, the defining concept in a rational corporate climate. Criminologists accept RC as an explanation for deviant behavior and that its application to a company is well documented. Corporate crime is rarely done individually but in the pursuit of company interests, and Cressey (1995) refers to the "corporate citizen" and the biological citizen, again referring to the corporation as an entity made up of many individuals acting as a unit as well as the individual citizen acting as a member of the community entity. (Cressey, 1995; Michalowski & Kramer, 2007). Deterrence theory explores rational choice with added deterrents which include the following: 1) The establishment of punishment(s) with speed and severity; 2) The notoriety of a crime permeates through mainstream and social media outlets moments after an announcement; and 3) Name recognition of the type of environmental crime with a corporation, through the "court of public opinion" is universal in current society. Social media has become a preventative measure for law enforcement and a powerful deterrent for corporate malfeasance. "Corporations are more rational than an individual," (Lynch, Patterson & Childs, 2010) and are more likely to be swayed from a criminal act, due to the potential criminal, civil and public relations penalties that result from litigation (Lynch et al. 2008; Lynch et al. 2010; Paternoster & Simpson, 1996; Tittle & Paternoster, 2000). In another study it was tendered that corporations, like individuals have a social conscience that can be motivated positively and negatively, by publicity (Maitland, 1986).

Routine Activities Theory (RAT) is also applicable to environmental crime, particularly corporate environmental crime. RAT is generally applied to an individual; however, it is applicable when a large, multi-faceted corporation is viewed by the public, as an individual entity, just as RC theories have postulated. At this point, the three tenets of this theory are applicable. (1) A motivated offender. A large corporate entity, with fiscal year profits and shareholder interests, could be considered a motivated offender, with a profit margin as the end result of the criminal act; (2) A suitable target or potential victim. In environmental crimes, these can include but would not be limited to - humans, domestic animals, wildlife, and the ecosystem of the area; (3) The absence of capable guardians, or those who stand against the victimization. In the case of corporate environmental crimes the absence of regulatory agency action(s) and adequate legal representation for members of the public against the corporate entity, would qualify. Everyday life has potential victims, and the combination of these three elements lead to actual victimization in the case of corporate environmental crime (Kubrin, Stucky & Krohn, 2009). Any of these three criminological theories could be applied to environmental crime committed by a corporation for profit. The RC concept that the company will put its potential gains ahead of the possible repercussions of those actions for the benefit of the company fits with the RAT concept of a motivated offender, this case the company choosing an act of environmental crime in pursuit of potential profit with the deterrent in both cases being the possibility of negative mass media exposure as well as association with a particular type of environmental injustice. The RAT concept of the suitable target or potential green victims in the case currently under study, is synonymous with the potential victim having no alternative to the victimization through the lack of guardianship. The three elements of RAT must coordinate together for the corporate entity to be successful in the environmental injustice to be not only successful in profits, but also in its invisibility to those it victimizes. If that invisibility were shattered, the possible deleterious effects on the company would be a plausible deterrent to the commission of an environmental crime.

Three types of research would be relevant in addressing the environmental crimes produced at TECO's Big Bend power plant. They include research on: (1) corporate crime; (2) state-corporate crime; and (3) green criminology. This typology requires a definition of environmental crime, and is still being debated by the criminological community. Corporate/white collar crime by its name implies a class inequality. Environmental criminologists define crime as an inherently deviant act that is universal across time and place. The corporation that owns a CFPP in China has the same responsibility as one located in Africa, South America or the United States (Lynch et al. 2010). State-corporate crime has been identified as "crimes of the powerful" (Lynch & Michalowski, 2006). Michalowski has referred to these corporate powerhouses as "crimes of capital" which include those institutions that facilitate the accumulation of capital (Michalowski, 1985). This is in reference to "... legal acts that cause harm equal to or greater than that caused by crime..." (Michalowski, 1985). In the 1980's the EPA evaluated the cost of workplace illness due to toxins and pollution damages at an annual rate of $23 billion dollars (Michalowski, 1985). The cost of treatment of controllable toxins in human disease cause by environmental HAPs is $40 billion (Green & Berry, 1985). Further, the loss of income and lost tax revenues is estimated at an additional $1.2 billion (Green & Berry, 1985). Researchers suggest that lax regulatory enforcement of laws that apply to corporate crime and criminals emboldens corporate environmental criminals who put the profit margin before public safety and security. In this case study the EPA, FDEP and the DOJ, which brokered the Settlement Agreement between the parties is, in part, responsible for the misappropriation of environmental justice.

State-corporate crimes examine how state and corporate behavior intersect to produce crime, or the ways in which the state and corporations interact to produce crime. These crimes include "... environmental crimes, bribery, price fixing, violations of work-place safety, fraud... cost between $174 and $231 billion annually..." (Kramer, 1984). These crimes can be quite costly, and though dated, Reiman (1995) estimated their costs to be $1 trillion annually.

Green criminologists have undertaken studies of a wide range of green crimes, law and injustice. Of particular relevance to the current discussion is the use of political economic theory and in particular the use of treadmill of production theory (ToP). ToP theory is a political economic theory that describes how the economic system of production (i.e., the treadmill of production) that emerged following World War II changed, leading to accelerating production and ecological destruction. The ToP produces ecological destruction, or what ToP theory calls ecological disorganization in two ways. First through ecological withdrawals of raw materials needed for the treadmill production process. As the treadmill accelerates, more and more raw materials input is needed, including the fossil fuel and chemical energy used to run the treadmill Second, the increased level of production also causes the volume of pollution or ecological additions to expand.

In recent years, green criminologists have used this approach to examine a number of ways in which the ToP affects pollution, environmental justice, and the enforcement and effectiveness of law. For example, Long and colleagues (2012) hypothesize that treadmill organization and its political expression allowed CFPPs to use political campaign contributions to respond to environmental punishments.

The general theoretical structure how ToP produces pollution, green crime, environmental injustice, and affects legal processes has been pieced together from prior empirical studies by (Lynch et al. 2013). Those prior green studies have produced important empirical results related to a variety of political economic questions related to green criminological theory. For example, Lynch & Stretesky (2013) analyzed the distribution of informal water monitoring programs across the US, and whether community characteristics were useful in predicting that distribution. Predicting the distribution of community water monitoring programs has important environmental justice implications since the US EPA helps assist communities in establishing those programs and uses information from those programs to enforce environmental regulations. Lynch & Stretesky (2013) found that African-American and Hispanic communities were less likely to have community water monitoring organizations, and that the higher a community's income, the more likely it was to have a community water monitoring program. These results suggest the existence of two forms of environmental injustice relating to water monitoring programs: one with a race and ethnicity dimension, and another with a class dimension (Stretesky & Lynch, 2013). Prior green criminological studies also indicate the existence of environmental injustice in the enforcement of laws (Lynch, Stretesky & Burns, 2004a, 2004b; Stretesky & Lynch, 1999, 2002, 2011). Prior green criminological studies have also assessed whether EPA's self-audit policies are effective, finding that this program does not work as suggested in improving the self-reporting of significant environmental crimes (Stretesky & Lynch, 2009a). Green criminologists have also produced empirical evidence that the US, a central driver in the international treadmill of production, facilitates the expanded production of carbon dioxide pollution through its trade and consumption associations with other nations (Stretesky & Lynch, 2009b). Though the number of relevant empirical green criminological studies related to political economic explanations of green crime and justice are limited, to date these studies have provided empirical support for ToP arguments.

**Conclusion**

Over the past two decades, green criminology has drawn increased attention to environmental pollution, green crime, green victimization and green violence as important criminological issues. In the present study, the focus is on these concerns in relation to CFPPs, a topic that has only recently received the attention of green criminologists (Lynch & Barrett, 2015). The larger threat that CFPPs can impose on the ecosystem around the point source is threefold. First, a determination of when the harms become criminal acts, and when are they controlled by either state of federal regulatory agencies. Relevant research focuses on the roles played by economics and politics in shaping and enforcing these laws that determine future levels of harm and CEV in the communities that surround CFPPs. If our ecosystem is treated as a commodity, then the misuse of that commodity should be penalized by criminal law, just as in trade (Gore, 2009).

Second, green criminological research has called attention to environmental justice/injustice as important green criminological concerns, including efforts to examine corporate responsibilities toward the prevention of environmental racism. It identifies specifically how race, class, and ethnicity shape environmental hazards and could assess the scope and impact of environmental racism in communities where CFPPs are located throughout the United States. In November 2012, a report generated by the National Association for the Advancement of Colored People (NAACP), the Indigenous Environmental Network, and the Little Village Environmental Justice Organization, noted that the EPA found certain members of a population were more immediately impacted by climate changes, including HAPs in air and water. Those affected included people living in poverty, the elderly, those already in failing or poor health conditions, the disabled, those living with few natural resources such as indigenous populations to a region, and the percentage of minority populations in a geographic region close to a CFPP. Additionally, environmental racism can occur in residential areas where high temperatures require air conditioning and the inability of those below the poverty line to have access to this or any air filtration system (NAACP, 2012).

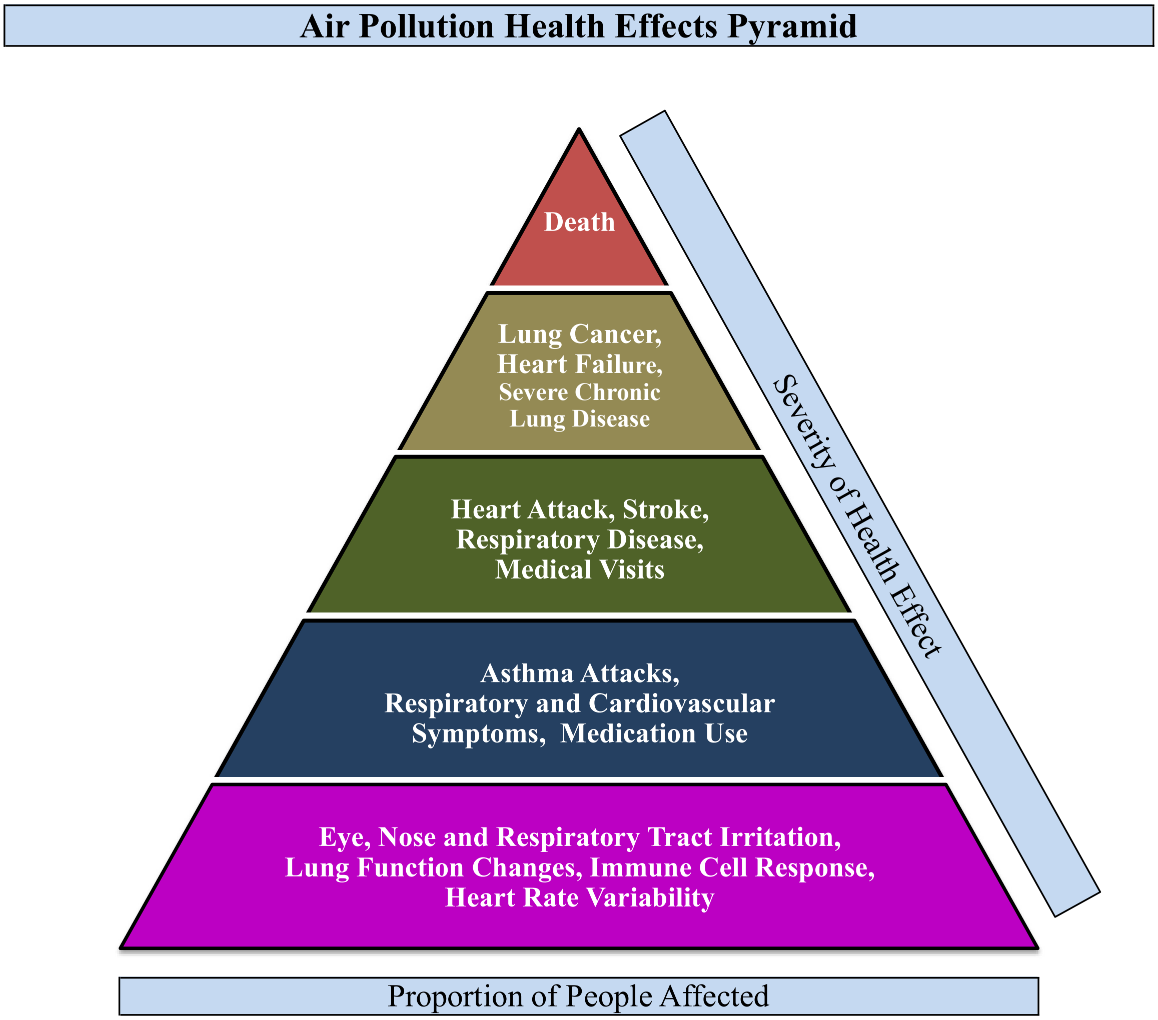
Finally, and most critical to survival, are the adverse affects that CFPPs can cause for ecosystem stability, humans and non-humans alike. Green criminologists have argued for the need to examine adverse health consequences and ecological destruction as indicators of green crime and victimization (Lynch & Stretesky, 2014).

## CHAPTER THREE:

## LITERATURE REVIEW of MEDICAL EFFECTS of CFPP EMISSIONS

CFPPs emit 84 of the 187 Hazardous Air Pollutants (HAP) identified by the EPA as a threat to human health and the environment (EH&E, 2011). According to a report by the Clean Air Task Force, CFPPs account for 40% of all HAPs released into the atmosphere, more than any other point source category (Clean Air Task Force [CATF], 2010). A Point Source refers to emissions from a stationary source such as a CFPP. Two types of HAPs can be produced from a plant of this type. The first is fuel-based, in which pollutants are a direct result of contaminants found in the coal that is used in combustion. The second, a combustion-based type, are pollutants formed during the burning of the coal and emitted as a result of the combustion process (USEPA, 2011a). Figure 3 is an Air Pollution Health Effects Pyramid that shows the severity of health effects and the proportion of the population affected by the hazardous pollutant (ALA, 2011; USEPA, 2010b).

There are several types of coal combustion products (CCPs) that are hazardous to human health and the environment. Types of CCPs produced in the coal fired utility plants include fly ash, bottom ash, boiler slag, and flue gas desulfurization materials. Fly ash refers to non-combustible materials and ash that "fly" out of the boiler with flue gases (the public often confuses this with "steam"); bottom ash and boiler slag are heavy, non-combustible particles that are retained on the bottom of the boilers; flue gas desulfurization materials are the residues left by air emissions control devices that remove sulfur dioxide from flue gases (Babbitt, 2008).




Health effects of air pollution are portrayed as a pyramid, with the mildest and most common effects at the bottom of the pyramid, and the more severe but less frequent effects at the top of the pyramid. The pyramid shows that as severity decreases, the number of people affected increases. Exposure to air pollution can affect both the respiratory and the cardiac systems.
Adapted from USEPA, 2010b.

http://www.lung.org/assets/documents/healthy-air/coal-fired-plant-hazards.pdf

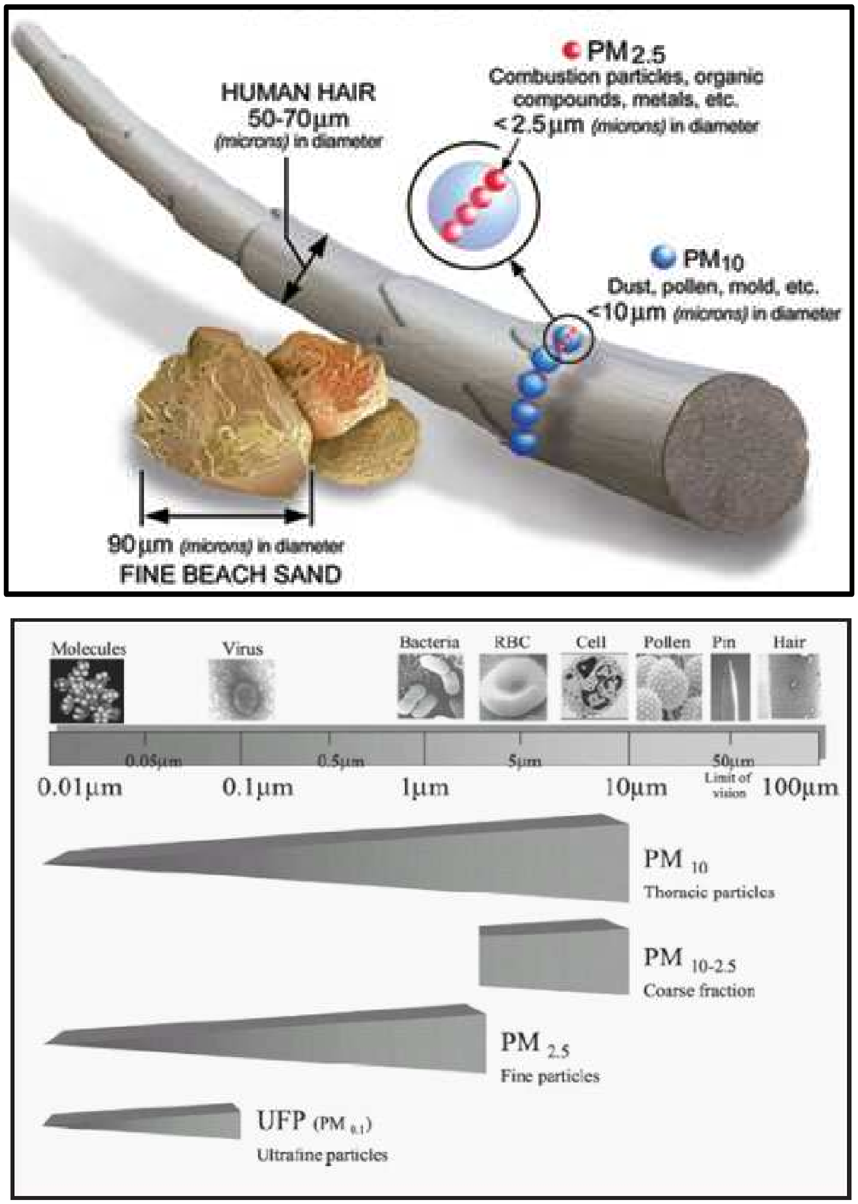
**Figure 3.** Air Pollution Health Effects Pyramid

The contaminants emitted during combustion include, but are not limited to, arsenic, chromium, cobalt, HCI, lead, nickel, and selenium. Particulates of these contaminants are reduced down to microscopic particulate matter (PM) of different sizes that are airborne and invisible to the eye. PM can be further reduced into particulate matter (PM > 10 µm) fine particulate matter (PM >2.5 µm), and ultrafine particulate matter (PM > 0.1 nm; there are 2,500 nm per 2.5 µm; (Biswas & Wu, 2005). The ultrafine PM 2.5 is the most dangerous to the environment, human health and communities that surround CFPPs. Figure 4 illustrates the relative sizes of particulate matter. The second section of the figure illustrates ultrafine particles and their relationship to known objects, with nanoparticles even smaller. (Biswas & Wu, 2005).

The immediate health impact of these contaminants depends on several factors: (a) how long the pollutant is airborne, (b) physical dynamics of the power plant emitting the toxin, (c) the weather conditions around the plant, and (d) how close the population is to the source point. The distribution of HAPs into the environment and the average length of time they remain airborne depend on the "atmospheric residence time" (EH&E, 2011) that varies for different types of CFPPs, due to the weather systems and ground speed of the wind in and around the facility. The immediate impact is within one mile from the point source. If there is a normal ground-level wind speed in the area, HAPs can travel between five and ten miles from their point source in an hour (EH&E, 2011). The HAPs can also be deposited on the ground or in the water and can be transformed through chemical reactions into acid rain. This type of atmospheric conditions is two to three hours in duration and limited to a fifteen to thirty mile radius from the point source (EH&E, 2011).

Table 6 elucidates residence time of HAPs in the atmosphere. Some of these contaminants travel farther in the atmosphere and become global pollutants, traveling hundreds of thousands of miles on wind and air currents (EH&E, 2011). The table indicates not only the residence time the pollutant can stay active in the atmosphere as a hazard to human and non-human species, but also the range of a pollutant's impact in travel time. A CFPP now has the

## Relative Sizes of Particulate Matter




http://www.epa.gov/ord/ca/quick-finder/particulate-matter.htm

http://www.aqfairbanks.com/science/

**Figure 4.** Relative Sizes of Particulate Matter

potential to become not only a local hazard, but as mentioned earlier, a state, national and global polluter. A study of CFPPs in New England discovered that public health damages were two to five times greater for communities near the facilities (5 miles or less to the point source) than those living at distances farther from the plant (Levy & Spengler, 2002). Atmospheric residual contamination can be generated by CFPPs for hundred of miles, carried on wind and sea currents. Although the immediate environmental effects are within thirty miles of a point source,

**Table 6.** Residence Time of Hazardous Air Pollutants in the Atmosphere

**Residence Time of Hazardous Air Pollutants in the Atmosphere**

| HAP Group | Indicator Pollutant(s) | Residence Time [1] | Likely Range of Transport |
|---|---|---|---|
| **Mercury** | Methylmercury | 7-10 days | Local, regional, global |
| **Metals** | Arsenic | 7-9 days (lifetime) | Local, regional, global |
| | Beryllium | 10 days (lifetime) | Local, regional, global |
| | Cadmium | 1-10 days (lifetime) | Local, regional, global |
| | Chromium | Up to 7-10 days | Local, regional, global |
| | Nickel | Up to 30 days (half-life) | Local, regional, global |
| | Manganese | Several days (half-life) | Local, regional |
| | Selenium | 1-10 days | Local, regional, global |
| | Lead | Up to 10 days | Local, some regional |
| **Radioisotopes** | Uranium, Radium | Not reported | Local, regional, global [2] |
| **Dioxins/Furans** | Chlorinated Dibenzo-P-Dioxins | 0.5 - 9.6 days (lifetime) | Local, regional, global |
| | Dibenzofurans | 4 days (half-life) | Local, regional |
| | Chlorodibenzofuran (CDFs) | More than 10 days (half-life) | Local, regional, global |
| **Aldehydes** | Formaldehyde | <20 hours (half-life) | Local |
| **Volatile Organic Compounds** | Benzene | 4-6 hour (half-life in presence of Nox and SO2) | Local |
| | Xylene | 8-14 hours (half-life) | Local |
| | Toluene | 13 hours (half-life) | Local |
| | Ethylbenzene | 2 days (half-life) | Local |
| **Acid Gases** | HCl/HF | 1-5 days (half-life) | Local, regional, global |
| | HCN | 530 days (half-life) | Local, regional, global |
| **Polycyclic Aromatic Hydrocarbons (PAHs)** | Benzo-A-Anthracene, Benzo-A-Pyrene, Flruoranthene, Chrysene, Dibenzo-A-Anthracene | Up to several days (lifetime) | Local, regional, global |

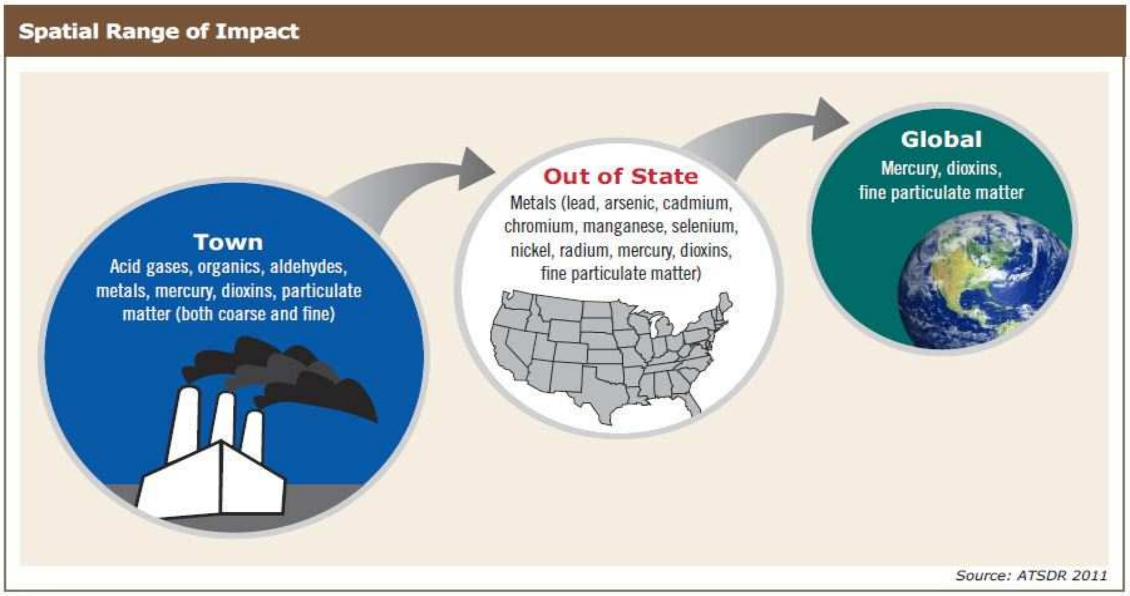
(1) Atmospheric residence time based upon lifetime or half-life as reported in chemical specific profiles published by the Agency for Toxic Substances and Disease Registry and the World Health Organization available on-line (ATSDR, 2011; WHO, 2011).

(2) Assumed to be a component of fine particles.

Emissions of Hazardous Air Pollutants from Coal-Fired Plants, Environmental Health & Engineering, 2011

http://www.lung.org/assets/documents/healthy-air/coal-fired-plant-hazards.pdf

CFPPs are global polluters (ALA, 2011).  Figure 5 illustrates the Spatial Range of Impact, which presents the succession of emission from the point source to creation of a global pollutant.




http://www.lung.org/assets/documents/healthy-air/toxic-air-report.pdf

**Figure 5.**  Spatial Range of Impact

CFA and PM have been discussed in an earlier section, but it should be noted that fine particulate matter is broken down into various categories and have quite different EPA regulatory guidelines based on their breakdown and absorption rates.  Emissions are referred to as primary particulate matter, and secondary particulate matter. These chemicals react in the atmosphere.  Primary particulate matter is released directly into the atmosphere from a point source and a reaction occurs from interaction with atmospheric conditions.  Secondary particulate matter is formed in the atmosphere after the initial release from the point source when a chemical reaction takes place between the primary particle emissions.  Secondary particle emissions are noteworthy due to their ability to form at a variety of distances from the point source. CFPPs produce the fine PM that contains secondary particle emissions, and the danger resides in the effect of the spatial range of impact (USEPA, 2004).

CFPP emissions produce a class of air pollutants known as fine PM. Fine PM is defined as aerosols that are smaller than 2.5 micrometers - smaller than the width of a human hair. In addition to posing a hazard to human health and the environment, many of the metal HAPs emitted from CFPPs become part of the fine particulate matter pollution in the United States (USEPA 2009a, 2011). Inhalation of the PM (2.5 $_{\mu m}$) over both short and long periods of time is recognized to cause cardiovascular effects, including heart attacks and death, chronic lung tissue damage and changes in blood chemistry that can cause clots. When inhaled, some particles deposit along the respiratory tract, while others penetrate deeply into the lungs where they can enter the bloodstream. Chronic exposure is also a likely cause of hospital admissions for breathing problems and worsening of existing respiratory illnesses such as asthma (EH&E, 2011; USEPA, 2009a).

The physical and chemical properties of coal fly ash (CFA) account for many of the carcinogens listed at dangerous levels in the Apollo Beach plant. A discussion of the overall health effects of coal fly ash show that the CFA assimilates many of these fine particulates, and the HAPs accumulated during the fuel-combustion process are subsequently released into the atmosphere. The concentration of hazardous waste in coal fly ash is dependent on the type coal used, mineral content and composition, source of the coal (environmental area where it was removed) as well as the conditions of the boiler in which the fuel combustion takes place. Four major components are silica, aluminum oxide, calcium oxide, and iron oxide. Minor components include magnesium oxide, sodium oxide and titanium oxide, potassium oxide, phosphorus oxide, and sulfur trioxide (Cantrell, Brye, Miller, Mason & Fairey, 2014). The emissions of sulfur trioxide from CFPP's are currently being studied as a hazardous pollutant (Sporl et al., 2014) as the rate of absorption of this HAP is dependent on the flue gas desulfurization process employed by the utility. High levels of this compound can also have an effect on the operation of the boilers and combustion units of the CFPP (Srivastava, Miller, Erickson, & Jambhekar, 2004).

Trace amounts of heavy metals such as arsenic, barium cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, strontium, vanadium and zinc, are also found in coal fly ash (ALA, 2011; EH&E, 2011). The health effects of these HAPs are shown in Table 7. This table shows the effects on human health and the environment by the Class of HAP and the notable HAPs within each class. All of the pollutants produced at the Big Bend facility can be found on this Table. The most direct influence on the community and surrounding environment are from emissions of PM found in CFA content.

**Health and Environmental Effects of CFPP Pollutants**

There are two types of fly ash, Class C, which is produced from sub-bituminous coal and has concentrated PM contaminants (20/50%). Class F ash is normally produced from bituminous and anthracite coal combustion facility and has equally concentrate forms of PM contaminants in different chemical combinations (10/70%). The study, conducted by Cantrell and colleagues (2014), focused on selenium concentrations in CFPP fly ash in Arkansas and its effect on the atmosphere and water supply of communities surrounding the plant. The water solubility of selenium that had accumulated in the landfill was found to be higher and a significant health hazard (Cantrell et al. 2014).

**Table 7.** Properties of Hazardous Air Pollutants Emitted From Coal Fired Utilities

**Toxicological and Environmental Properties of Hazardous Air Pollutants (HAPs)**
**Emitted from Electric Generating Stations Fueled By Coal**

Hazardous information compiled from toxicological profiles and concise chemical assessment documents for specific pollutants published by the Agency for Toxic Substances and Disease Registry and World Health Organization and available on-line (ATSDR, 2011; WHO, 2011).

| Class of HAP | Notable HAPs | Human Health Hazards | Environmental Hazards |
|---|---|---|---|
| **Acid Gases** | Hydrogen Chloride, Hydrogen Fluoride | Irritation to skin, eye, nose, throat, breathing passages. | Acid precipitation, damage to crops and forests. |
| **Dioxins and Furans** | 2, 3, 7, 8- Tetrachlorodioxin (TCDD) | Probable carcinogen: soft tissue sarcomas, lymphomas, and stomach carcinomas. May cause reproductive and developmental problems, damage to the immune system, and interference with hormones. | Deposits into rivers, lakes and oceans and is taken up by fish and wildlife. Accumulates in the food chain. |
| **Mercury** | Methylmercury | Damage to brain, nervous system, kidneys and liver. Causes neurological and developmental birth defects. | Taken up by fish and wildlife. Accumulates in the food chain. |
| **Non-Mercury Metals and Metalloids (excluding radioisotopes)** | Arsenic, Beryllium, Cadmium, Chromium, Nickel, Selenium, Manganese | Carcinogens: lung, bladder, kidney, skin. May adversely affect nervous, cardiovascular, dermal, respiratory and immune systems. | Accumulates in soil and sediments. Soluble forms may contaminate water systems. |
| | Lead | Damages the developing nervous system, may adversely affect learning, memory, and behavior. May cause cardiovascular and kidney effects, anemia and weakness of ankles, wrists, and fingers. | Harms plants and wildlife; accumulates in soils and sediments. May adversely affect land and water ecosystems. |
| **Polynuclear Aromatic Hydrocarbons (PAH)** | Naphthalene, Benzo-A-Anthracene, Benzo-A-Pyrene, Benzo-B-Fluoranthene, Chrysene, Dibenzo-A-Anthracene | Probable carcinogens. May attach to small particulate matter and deposit in the lungs. May have adverse effects to the liver, kidney, and testes. May damage sperm cells and cause impairment of reproduction. | Exists in the vapor or particulate phase. Accumulates in soil and sediments. |
| **Radioisotopes** | Radium | Carcinogen: lung and bone. Bronchopneumonia, anemia, brain abcess. | Deposits into rivers, lakes and oceans and is taken up by fish and wildlife. Accumulates in soils, sediments, and in the food chain. |
| | Uranium | Carcinogen: lung and lymphatic system. Kidney disease. | |
| **Volatile Organic Compounds** | Aromatic Hydrocarbons including Benzene, Toluene, Ethylbenzene, Xylene | May cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; impaired function of the lungs; delayed response to a visual stimulus; impaired memory; stomach discomfort; and effects to the liver and kidneys. May also cause adverse effects to the nervous system. Benzene is a known carcinogen. | Degrade through chemical reactions in the atmosphere and contribute to carbon based radicals that contribute to formation of ground-level ozone and its human health effects. |
| | Aldehydes including Formaldehyde | Probable carcinogen: lung and nasopharyngeal cancer. Eye, nose and throat irritation, respiratory symptoms. | |

http://www.lung.org/assets/documents/healthy-air/coal-fired-plant-hazards.pdf

A study conducted by Gilmour and colleagues (2004), concluded that CFA containing fine and ultrafine particles were more capable of causing chronic pulmonary inflammation. For CFPPs using a sub-bituminous coal system, ultrafine PM is more toxic than fine PM. This study was conducted on female mice of breeding age as well as male rats. The toxicity found in the lungs and pulmonary inflammation were consistent with previous studies but produced evidence that the chemical composition of the aerosol of ultrafine PM was dependent on the coexistence of type of coal used, as well as the amount of zinc present in the samples. The results suggest that ultrafine PM particles were far more toxic to lung and pulmonary health than fine or course PM particles (Gilmour, O'Connor, Dick, Miller, & Linak, 2004).

Borcherding and colleagues (2013) discovered that CFA is considered a poorly soluble particle comprised of various carcinogenic metals. This is important since the majority of CFA (up to 99%) are collected and deposited in landfills, providing a potential environmental harm due to the deposit of transition metals into the water supply and redistribution into the atmosphere leading to global environmental impacts. Epidemiological studies show strong correlations between respiratory infections and fine PM resulting in cystic fibrosis, and COPD. CFA's can also be a source for bacteria in biological fluids, as those found in airway surfaces. Airway surface liquids (ASL) can be found in the sweat glands, the porous membranes surrounding the lungs, and in the ducts of the pancreas, and are therefore potentially detrimental to human health (Borcherding, Chen, Caraballo, Baltrusaitis, Pezzulo, Zabner, et al. 2013). The World Health Organization (WHO) reported that acute respiratory infections (ARIs) are the leading cause of acute illnesses worldwide and one of the most important causes of morbidity across the age spectrum. Ambient air pollutants are one of the main components in particulate matter and are responsible for the development of ARIs. Particulate matter can cause a chemical reaction with ambient air in the atmosphere, resulting in either primary or secondary PM. WHO concluded by stating that CFA concentrations in fine particulate matter are related to daily exposure in humans and pose potential public health risks, such as impaired lung function and immune mechanisms in the body (Borcherding et al. 2013).

Another study, commissioned by the Health Effects Institute, used data from the National Morbidity, Mortality and Air Pollution Study (NMMAPS), which is the largest time-series study of adverse health consequences associated with exposure to environmental pollutants to date (Samet, Zeger, Dominici, Curriero, Coursac, Dockery, et al. 2000). Results from the Samet and colleagues study (2000), show a positive relationship between fine particular matter and pulmonary mortality, cardiovascular disease, COPD, and pneumonia in patients over 65 years of age. These findings were comparable to those found in the Harvard Six Cities Study (Dockery, Pope, Xu, Spengler, Ware, Fay, et al. 1993; Laden, Neas, Dockery & Schwartz, 2000) which showed associations between ultrafine particulate matter (PM $2.5_{\mu m}$) that were two times higher in areas surrounding a CFPP compared to those in a large urban area with heavy traffic and automobile emissions. The Harvard Six Cities Study exhibited that PM $2.5_{\mu m}$ was associated with risk of mortality from cardiopulmonary diseases. An increase in the absorption of ultrafine particulate matter was associated with an 8-18% increase in mortality from illnesses ranging from heart disease to cardiac arrest. This PM absorption was associated with chest pain and an increase in lifestyles considered sedentary with little to no physical activity (Dockery et al. 1993; Laden et al. 2000).

Residual fly ash containing high concentrations of transitional metals has been shown to induce changes in human skin cells, while dogs exposed to similar CFA in a Boston study showed increased problems in lung tissue and circulatory system due to the inhalation of vanadium and nickel (Clarke, Couli, Renisch, Catalano, Killingsworth & Koutrakis, 2000). The composition of the PM is important to assess the human and environmental risks in ambient air and water supplies. The combustion from a CFPP can reach target sites within the human body through ASLs, adding to known lifestyle risk factors for cardiovascular disease such as diet, tobacco smoke and stress (DelFino, Sioutas, & Malik, 2005).

Personal exposure to a pollutant, particularly those found in fine and ultrafine types of particulate matter, will depend on the proximity to the source of the pollutant and the level of exposure in the microenvironment. A study involving 22 students in Kampur, India, measured fine, ultrafine, course and inhalable PM exposures, and proximity of the ambient air that was closest to the point source. In the study, students walked a specified distance close to a point source that emitted ultrafine PM. Proximity to the point source was seen as the single largest contributing factor to pollutant exposure and possible health risk (Devi, Gupta, Jat & Tripathi, 2013). For decades the scientific community has been aware of the hazards of PM, however, the emerging field of nanotechnology has the ability to measure even smaller nanoparticles and their possible adverse effects on human health and the environment.

There is growing concern that nanoparticles could be potentially detrimental to the environment and to human health (Biswas & Wu, 2005). Sulfates and hydrocarbons are the major components of the particle. Ultrafine particles that contain metals could be producing lethal nanoparticles as a by-product (Biswas & Wu, 2005). The human body has three major contact points with the environment to intake nanoparticles: the skin, the lungs and the gastrointestinal tract (Hussain, Ullah, Rehman, Khan, Muhammad, & Kahn, F., et al. 2009). Recommendations from this and other studies suggest the need to develop control techniques that reduce mass concentration of coarse and fine PM, thereby preventing the formation of ultrafine PM and nanoparticles. Further recommendations from multiple studies encourage the development of new sampling methods for PM, further research into the characterization of metals contained in ultrafine PM and finally, the identification and classification of indoor and outdoor ambient sources of ultrafine PM that could develop into dangerous and potentially lethal nanoparticles (Biswas & Wu, 2005).

Dioxins represent the most toxic of all man-made chemicals. CFPPs produce dioxin during the fuel-combustion process. Dioxin exposure causes a wide variety of adverse effects from lethal outcomes to biochemical changes within the body as well as introduction of drug metabolizing enzymes in the body. All species display sensitivity to lethal dioxin levels. Death in the adult of a species is preceded by severe body weight loss known as "wasting syndrome" (Birnbaum, 2015). Biochemical effects to dioxin exposure can be shown in responses to enzymes, growth factors and hormones in the body (Birnbaum, 2015). Increases in thyroid hormones are associated with exposure to dioxins as well as birth defects in pregnant women (Birnbaum, 2015). Dioxin exposure has been linked to cancer, endometriosis, embryo/fetal malformations and birth defects, and chronic respiratory illnesses, in both animals and humans (Birnbaum, 2015).

**Effects of CFPP Pollutants on Wildlife**

Freshwater contamination is also a major concern for the health and welfare of wildlife, and in the case of the Big Bend facility, particularly the manatees that congregate below the Apollo Beach plant. The manatee viewing center located at the south side of the facility, directly below the stacks is a popular tourist attraction at the facility. It has been established that the air with the most density of HAPs occurs within one mile of a point source, therefore, the manatee viewing station would be at risk for airborne as well as water-soluble contaminants. A study conducted by Harmon & Wiley (2011), sampled freshwater organisms and the effects of water contaminants on their health and morbidity. The study focused on groundwater, storm water, and non-point source pollution including metals, hydrocarbons, aromatic hydrocarbons and polycyclic hydrocarbons (Harmon & Wiley, 2011). Fish were more sensitive and showed significant decreases in survival when exposed to water pollutants containing metal contaminants (McQueen, Johnson, Rogers & English, 2010). Freshwater and sediments contaminated with trace amounts of cadmium, nickel, chromium, lead, titanium, zinc, and manganese were biologically accumulated in the bodies of fish, by species and were influenced by feeding strategies of the species studied, and the particles ingested in a given area (Cid, Ibanez, Palanques & Prat, 2010). Arsenic toxicity has also been reported in several aquatic organisms (Daus, Weiss & Altenburger, 2010). Hexavalent chromium showed changes in enzyme activity, DNA damage, as well as liver and kidney damage in several species studied (Velma & Tchounwou, 2010). Increased lead intake was found on the skin, gills, eyes, liver, and intestines of the organisms studied. If these organisms are a source in the natural food chain, human intake may follow (Ahmed & Bibi, 2010). Stream dwelling organisms exposed to mercury suffer DNA changes and transfer from mother to fetus. Noticeable accumulation of mercury in fish tissues, delayed development and decreased motor activity in fish, as well as genotoxins were noted in mullet in Portugal (Pereira, Guilherme, Barroso, Verschaeve, Pacheco & Mendo, 2010a). Nickel and selenium exposure also result in toxicity to the existing environments of fish and microorganisms studied (Browne & Lutz, 2010; Cloran, Burton, Hammerschmidt, Taulbee, Custer & Bowman, 2010). Zinc accumulation in tissues of freshwater organisms has been found to affect the rate of fish population increases and density of a species in a given area (Sanchez-Ortiz, Sarma & Nandini, 2010; Wang & Guan, 2010).

The protection of freshwater aquifers and ultimately the drinking water supplies of areas surrounding CFPPs continue to be a primary concern for activists and members of communities within the critical atmospheric contaminant radius of the facility. Table 8 shows the top hazardous drinking water contaminants. This table not only indicates the type of contaminant in the water supply, but supplies information on the health effects from exposure to the contaminant. In addition, it indicates the most common point source for the contaminant entering the drinking water supply.

**Conclusion**

Pollutants associated with burning coal cause numerous adverse health consequences for humans and non-humans alike. Among the lethal consequences of ingesting coal fire pollutants are cancers of all types, particularly of the liver, kidney and lungs. Included in this list of additional health effects are pulmonary diseases, asthmatic conditions, gastro-intestinal lesions, skin abrasions and several types of dermatitis. All of these conditions have been associated with ingesting CFA pollutants through airborne PM as well as through the weathering and leaching of toxins through groundwater.

Monitoring the source points of these contaminants is vital for the health and welfare of the human population as well as the continued care of domestic animals, wildlife, and endangered species in the affected areas. In the waters of Tampa Bay surrounding the Big Bend facility, manatees are a state and federally protected endangered species (FWS, North Florida Ecological Services Office, 2015). The negative effects of the contaminants in CFPPs on freshwater organisms that serve as part of the food chain for the manatee, will ultimately affect the overall sustainability of the species in this area.

**Table 8.** Top Hazardous Drinking Water Contaminants

| Top Hazardous Drinking Water Contaminants, 2009 | | | | |
|---|---|---|---|---|
| **Contaminant** | **Max Contaminant Level Goal (mg/L)[1]** | **Max Contaminant Level (mg/L)[2]** | **Potential Health Effects from Long-term Exposure above the MCL** | **Common Sources of Contaminant in Drinking Water** |
| Arsenic | 0 | 0.010 as of 01/23/06 | Skin damage or problems with circulatory systems, and may have increased risk of getting cancer | Erosion of natural deposits; runoff from orchards, runoff from glass and electronicsproduction wastes |
| Beryllium | 0.004 | 0.004 | Intestinal lesions | Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries |
| Cadmium | 0.005 | 0.005 | Kidney damage | Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints |
| Chromium (total) | 0.1 | 0.1 | Allergic dermatitis | Discharge from steel and pulp mills; erosion of natural deposits |
| Copper | 1.3 | TT[7]; Action Level=1.3 | Short term exposure: Gastrointestinal distress<br>Long term exposure: Liver or kidney damage<br>People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level | Corrosion of household plumbing systems; erosion of natural deposits |
| Lead | 0 | TT[7]; Action Level=0.015 | Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities<br>Adults: Kidney problems; high blood pressure | Corrosion of household plumbing systems; erosion of natural deposits |
| Mercury (inorganic) | 0.002 | 0.002 | Kidney damage | Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands |
| Selenium | 0.05 | 0.05 | Hair or fingernail loss; numbness in fingers or toes; circulatory problems | Discharge from petroleum refineries; erosion of natural deposits; discharge from mines |
| Dioxin (2,3,7,8-TCDD) | zero | 0.00000003 | Reproductive difficulties; increased risk of cancer | Emissions from waste incineration and other combustion; discharge from chemical factories |

| National Secondary Drinking Water Standards | |
|---|---|
| **Contaminant** | **Secondary Standard** |
| Copper | 1.0 mg/L |
| Iron | 0.3 mg/L |
| Manganese | 0.05 mg/L |
| Zinc | 5 mg/L |

(1) Maximum Contaminant Level Goal (MCLG) - The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals. Maximum Contaminant Level (MCL) - The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards. Maximum Residual Disinfectant Level Goal (MRDLG) - The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.) Treatment Technique (TT) - A required process intended to reduce the level of a contaminant in drinking water.

(2) Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (PPM).

(7) Lead and copper are regulated by a treatment technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

http://water.epa.gov/drink/contaminants/

Airborne contaminants and those that are weathered into the water through acidification, air current travel, or leaching through the soil need to be closely monitored. The Big Bend facility has toxic levels of several contaminants discussed in this chapter, including lead, nickel, and ultrafine particulate matter containing heavy metals, and the resulting negative health effects on the communities up to five miles from the plant (CATF, 2011). Negative effects, both in the environment and immediate health risks to human and non-humans have been found to be most concentrated at one mile from the point source (EH&E, 2011). The residual effects from five to thirty miles from the CFPP will present health and environmental effects that the EPA monitors for environmental justice infractions as well as data that can be used to investigate allegations of environmental racism in these communities (PERI, 2013).

# CHAPTER FOUR:

# THE BIG BEND FACILITY

## Tampa Electric Company: A Business Profile

It is important to understand how a CFPP functions to dissect the environmental problems associated with electrical production from a CFPP. Electricity has been essential in American culture, business, and its economy since discovery and development in the 18th century. The background of TECO as a business entity is critical in understanding the operations of the facility. The following information is from their 2014 Corporate Sustainability Report to Shareholders.

TECO Energy (TE) is listed on the NYSE and is an investor-owned public utility holding company, headquartered in Tampa, Florida. The company has been supplying utility needs in Florida for 120 years. TECO Energy has holdings in regulated electric and natural gas utilities. The company has three other utility-based holdings and serves 700,000+ customers in West Central Florida. TECO Coal Corporation, an unregulated coal mining and processing facility headquartered in Corbin, Kentucky that mine coal in Kentucky, Tennessee and Virginia and ship nearly 6 million tons of coal annually to domestic utilities (other than Tampa Electric) as well as customers in Asia and Europe.

The final holding is TECO People's Gas Company, established when TECO formed an agreement with Continental Energy Systems LLC to purchase the New Mexico Gas Company. New Mexico Gas Company was a natural gas utility headquartered in Albuquerque, New

Mexico. TECO has absorbed this company and as of the last quarter of 2014 it is TECO People's Gas, supplying natural gas to 350,000 residential consumers in many of Florida's metropolitan areas.

TECO's base holdings are quite diversified and have a regulated electric utility capacity of almost 4,700 megawatts. The Big Bend facility has a 1,730 megawatt capacity with Stacks 1, 2, 3, and 4 with an additional 60 megawatts of capacity using a separate natural gas and fuel oil-fired peaking unit. Big Bend has a 38% share of TECO's total energy capacity (TECO Corporate Sustainability Report, 2014). TECO Energy, Inc. (TE) is currently trading at $19.5 a share on the New York Stock Exchange with a 31% positive stock rating (FlashRatings, Oil and Gas Investment, 2015).

**The Operation of a Coal Fire Plant**

"Coal power is a rather simple process. In most plants, the chunks of coal are crushed into a fine powder, fed into a combustion unit, and burned at high temperature. Heat from the burning coal is used to produce steam, which powers turbines that generate electricity." (IECG, 1996) In the early days of steam-produced electricity, wood fires were used. The labor hours necessary to gather the wood for such high heat combustion along with constant demand made this system impractical. In the 1920s, a process known as pulverized coal firing was developed. Advantages of this system were a higher combustion temperature yielding more steam. Improved thermal efficiency and lowered requirements for ambient air usage provided a constant flow of steam to power the turbines and created continuous electricity. By the 1940s the cyclone furnace was in operation. This technology, which was considered revolutionary, allowed the combustion of poorer grade coal with less ash production from the fine powder and a more efficiently run turbine system. Currently, coal fire power plant technologies are still based on the same methods used in the 1920s through the 1940s. Technological improvements in computer operations have made coal power the most common method of modern electricity production. Cyclone furnaces required even less processing of the raw coal. Cyclone furnaces have the capacity to burn poorer grade coal with up to twenty-five percent additional moisture and ash content. A poorer grade of coal is more cost efficient for the coal combustion process (CCP). The cyclone furnace is a large cylinder, jacketed with water piping that absorbs extremely high heat, creating steam. This steam is then converted to electricity. Additionally, steam protects the burner from melting down due to the extreme temperatures (IECG, 1996; Union of Concerned Scientists, 2010).

In coal production systems, the raw coal is pulverized into a fine powder that burns as easily and efficiently as gas. Computers control the "feeding rate" of coal into the boiler, the amount of air needed for drying, and transportation of the pulverized coal. Pieces of the coal are crushed between cylindrical rollers that move between two tracks. The coal is washed in a chemical solution to remove impurities and fed into the pulverizing unit, along with air heated to 650 degrees Fahrenheit. As the coal becomes crushed by the rolling actions, the hot air dries it and blows the usable fine coal powder out to be used as fuel (Union of Concerned Scientists, 2010).

A high powered fan blows the heated air into pulverized coal at one end of the cylinder and at the same time additional heated air is injected along the cylinder causing the coal/air mixture to swirl in a "cyclone" motion. The whirling of the air and the coal enhances the burning properties producing extremely high heat and high combustion temperatures (The cylinder is synonymous with a turbine.) Steam spins the turbine blades. The turbine, connected to a cylinder of insulated wire coils inside magnets, or to magnets inside of wire coils (whichever the manufacturer prefers) that spin in relation to each other. As it moves through the magnetic field, a current is induced in the generator's coil. High voltage power transmitted from multiple utility power generation plants is synchronized and interconnected, forming the North American Power Grid (Gore, 2009). Electricity from the grid is distributed through a network of disconnects, circuit breakers, protective relays and step-down transformers to utility substations that deliver the power to end-users. Homeowners are one type of end-user that consumes this electricity.

With the cyclone process, slag remains on the walls insulating the burner, retaining heat, while the rest drains through a trench in the bottom to a collection tank where it solidifies and can then either be collected for recycling or disposal. The collection of coal ash is a significant financial incentive for the use of cyclone furnace technology. Cyclone technology empties approximately 40% of the coal ash with the exhaust fumes, while pulverizing methods empty approximately 80% of the coal ash with the exhaust fumes. For greater efficiency and profitability, the goal is to have more coal powder burned with less accumulated ash (Abresist Corporation, 2013).

There are distinct disadvantages to cyclone technology. The coal requires low sulfur content in order for the ash to melt for collection in the tanks. High power fans are necessary to move the larger raw coal chunks and air through the furnace, producing additional nitrogen oxide pollutants compared to the pulverized combustion method. Coal burners require annual replacement due to erosion of the liners in the turbines.

The Tampa Bay Times ranked Florida as the third worst in the nation for power plant generated toxic air, while Tampa Electric's Big Bend Power Plant was listed by name in the article as one of the largest polluters in the state, even as the industry continues to sanitize their environmental image with residents of Florida and environmental action groups around the United States (Klas, 2011; Ramos, 2013; TECO, 2014). In 2000, owing to previous violations at the Big Bend Facility, TECO and the USEPA entered into an agreement to settle prior environmental violations. This settlement has drawn public criticism. Environmental protests and rallies have occurred at the Big Bend facility since the EPA settlement in 2000. The most recent protest was in 2011 when 150 protesters blocked the main entrance into the Big Bend facility. Occupy Wall Street and EarthFirst, a small environmental group, based in St. Petersburg, joined forces. Six protesters chained themselves to PVC pipe and blocked US 41 and Wyandotte Road near the entrance of the facility. TECO officials were quick to point out that the protest did not cause any disruption in the daily operation of its Big Bend Facility (Klas, 2011). The Apollo Beach Plant has become a rallying point for environmentalists who wish to see coal-fired power plants shut down in the state of Florida, and across the United States.

**The Big Bend Facility**

TECO describes its Big Bend facility as follows:

> "…. Big Bend has four coal-fired units with a combined output of more than 1,700 megawatts. The first unit began service in 1970; the second and third generating units were added in 1973 and 1976 respectively; and Unit Four was added in 1985. A natural gas- and fuel oil-fired peaking unit was installed in 2009 to provide additional power during periods of peak demand. Big Bend uses flue gas desulfurization systems or scrubbers, which remove sulfur dioxide when the coal is burned. The scrubber for Unit Four began operation in 1984 and since 1995 has simultaneously scrubbed Unit Three as well. The scrubber for Units One and Two began operation at the end of 1999. The scrubber system complies with standards set by US CAA amendments of 1990 and removes 95% of sulfur dioxide from all four units. Use of electrostatic precipitators to remove particulate matter from the stacks was completed in 2004. In 2009, a 60 megawatt natural gas and fuel oil-fired peaking unit at Big Bend support TECO's commitment to power for its customers. During the scrubbing process coal combustion gases are sprayed with a mixture of water and limestone. Sulfur oxides react with the spray to form gypsum. TECO recycles all of its gypsum. Gypsum is used in drywall for construction, in cement and concrete and in agriculture as a soil nutrient or fertilizer. Fly ash, a fine particulate matter that results from the combustion of coal and is collected in the electrostatic precipitators in all four Big Bind Units, is used in the cement and

concrete industries. Slag, which is collected at the bottom of the furnace, is a hard, glass-like material with many reuses, including cement production. The hard quality of the slag makes it valuable to use as a high-velocity blast material to clean ships, storage tanks and other large metal surfaces…" (TECO, 2015).

TECO promotional materials relay that recycling these hazardous materials is beneficial for the environment. Gypsum can be produced in two forms, naturally occurring and FGD or flue-gas desulfurization. FGD Gypsum is a byproduct of desulfurization of flue gasses from the stacks of CFPPs. Pollutants captured from the smoke stack can be purified into a hard substance and manufactured into gypsum, generally for use in drywall and plaster. The chemical composition of both natural and FGD gypsum are the same. Natural gypsum is a non-toxic mineral. Environmentalists see FGD gypsum differently, as the stack is releasing many more pollutants and the gypsum is not considered pure when it is captured (Gypsum Association, 2015).

Slag, as indicated on the company site (TECO, 2015) is a glass-like by-product, collected on the bottom of the coal furnaces. Coal slurry, also known as coal sludge, is the product produced when slag begins funneling out of the furnace collection area. The slag forms at high temperature at the bottom of the boilers, it is channeled out of the furnace and water and chemicals are poured over it. With rapid cooling, a chemical reaction takes place and gives the slag a cement-like consistency. The slag has now become coal slurry and can be pumped into ponds or beds for recycling. The dangers of coal slurry and the HAPs associated with this substance have been discussed in detail in Chapter two. CFA has been discussed at length in Chapter three. Sections on gypsum and slag from the TECO company site are promotions to induce consumer confidence that these materials are not hazardous. Coal fly ash has been on environmental watch lists since the CAA became law in the l970's. Gypsum and slag are other byproducts that have been on many environmental watch lists and according to the Environmental Integrity Project "have no good use" (Environmental Integrity Project, 2011).

Florida is ranked 14th in the nation in morbidity due to HAP's produced by CFPPs (CATF, 2007). The toxins identified as hazardous to both human health and the environment, are in Chapter three listed on Table 7. PM and the detrimental health effects of dioxins have been discussed in Chapter three. These HAPs are emitted from the CFPP in Apollo Beach, but fall within EPA boundaries of an "acceptable" level of pollutant. CFPPs in particular produce Hydrochloric Acid (HCl), hydrofluoric acids, dioxins, as well as sulfur dioxide and nitrogen oxide that contribute to atmospheric acidity and water contamination (EH&E, 2011).

**Toxins of Concern at TECO's Big Bend Facility**

In December 2011, The Environmental Integrity Project released a report that indicated electric utilities produced over 200 million pounds of toxic air emissions in a single year. Florida ranked 11th in excesses of arsenic, chromium, cobalt, hydrochloric acid (HCI), lead, mercury, nickel, and selenium emissions and in several areas the Big Bend Plant is mentioned by name.

Table 9 shows the national rankings for lead emissions by CFPPs. Big Bend ranked 29th in the nation for emitting excesses of lead into the air (Environmental Integrity Project, 2011). In 2010, Big Bend released 710 pounds of lead (Pb) into the atmosphere. Exposure to lead affects the blood, the nervous, immune, renal and cardiovascular systems. Lead exposure can also cause gastrointestinal symptoms, severely damage the brain and kidneys, and may cause reproductive effects. Early childhood and prenatal exposures are associated with slowed cognitive development, and learning deficits such as ADHD. Large doses of some lead compounds are known to cause cancer (Barbosa, Tanus-Santos, Gerlach & Parsons, 2005; EH&E, 2011).

**Table 9.** Top Lead Emitters, Big Bend Ranked 29th

| Top Power Plant Lead Emitters - 2010 | | | | |
|---|---|---|---|---|
| **Rank** | **Facility** | **State** | **Owner** | **Lead (lbs)** |
| 1 | Paradise Fossil Plant | KY | U.S. Tennessee Valley Authority | 2,607 |
| 2 | Milton R Young Station | ND | Minnkota Power Cooperative, Inc. | 1,557 |
| 3 | Brunner Island Steam Electric Station | PA | PPL | 1,513 |
| 4 | Montour Steam Electric Station | PA | PPL | 1,379 |
| 5 | San Miguel | TX | San Miguel TX San Miguel Electric Cooperative, Inc. | 1,374 |
| 6 | J H Campbell Generating Plant | MI | Consumers Energy | 1,371 |
| 7 | Bowen Steam Electric Generating Plant | GA | Southern Co | 1,348 |
| 8 | Bruce Mansfield Power Plant | PA | FirstEnergy Generation Corp | 1,348 |
| 9 | Gibson Generating Station | IN | Duke Energy Corp | 1,291 |
| 10 | Wabash River Generating Station | IN | Duke Energy Corp | 1,289 |
| 11 | Ghent Station | KY | LG&E & KU Energy LLC | 1,230 |
| 12 | Mill Creek Station | KY | LG&E & KU Energy LLC | 1,201 |
| 13 | Chena Power Plant | AK | Aurora Energy LLC | 1,127 |
| 14 | Hatfield Power Station | PA | Allegheny Energy, Inc. | 1,062 |
| 15 | Walter Scott Jr Energy Center | IA | Berkshire Hathaway | 1,060 |
| 16 | Big Sandy Plant | KY | American Electric Power | 1,059 |
| 17 | Shawville Station | PA | Genon Energy, Inc. | 1,043 |
| 18 | DE Karn JC Weadock Generating Plant | MI | Consumers Energy | 1,022 |
| 19 | EME Homer City Generation LP | PA | Edison International | 905 |
| 20 | Bonanza Power Plant | UT | Deseret Power Electric Cooperative | 857 |
| 21 | IPL Petersburg | IN | AES Corp | 823 |
| 22 | Clifty Creek Station | IN | Ohio Valley Electric Corp | 805 |
| 23 | Wansley Steam Electric Generating Plant | GA | Georgia Power Co | 799 |
| 24 | George Neal North | IA | Berkshire Hathaway | 780 |
| 25 | Birchwood Power Facility | VA | Birchwood Power Partners LLC | 772 |
| 26 | Colstrip Steam Electric Station | MT | PPL Montana LLC | 772 |
| 27 | Plum Point Energy Station | AR | Plum Point Services Company, LLC | 759 |
| 28 | Cope Station | SC | Cope Station SC SCAN | 724 |
| 29 | Big Bend Power Station | FL | TECO Energy, Inc. | 710 |
| 30 | Harrison Power Station | WV | Allegheny Energy, Inc. | 668 |
| 31 | Boswell Energy Center | MN | Allete, Inc. | 665 |
| 32 | Baldwin Energy Complex | IL | Dynegy, Inc. | 663 |
| 33 | Gavin Plant | OH | American Electric Power | 660 |
| 34 | Wateree Station | SC | SCANA | 659 |
| 35 | JM Stuart Station | OH | The Dayton Power & Light Company | 656 |
| 36 | Branch Steam Electric Generating Plant | GA | Southern Co | 655 |
| 37 | Amos Plant | WV | American Electric Power | 642 |
| 38 | Kammer/Mitchell Plant | WV | American Electric Power | 641 |
| 39 | Labadie Energy Center | MO | Ameren Corp | 636 |
| 40 | Riverton Generating Station | KS | The Empire District Electric Co | 589 |

Lead is emitted in two forms as a pollutant: metallic and chemical. Airborne lead most commonly appears in particulate matter as an oxide ($PbO$, $Pb_3O_4$, and $PbO_2$) and can come from a variety of sources, including coal mining and non-ferrous metal production (Meng, 2014). These emissions are the primary causes of lead exposure in communities close to a CFPP and the health consequences of that proximity (Shea, 2007). The lead particulates can enter the body through inhalation or the ingestion of lead-contaminated food, water, soil, dust and paint (Ayres & Olsen, 2011). Lead absorbed through inhalation accounts for up to 90% of lead absorption and is the primary intake method for both adults and children. Children absorb lead at a higher rate and are more susceptible to its effects compared to the adult population. The respiratory rates of children are higher than adults; higher heart rate and $O_2$ saturation levels in the blood may contribute to the effect between childhood and adult lead absorption levels in the bloodstream (Meng, 2014).

Big Bend is also a leader in the production of environmental nickel emissions. Nickel (Ni) is described as a transitional metal that is discharged into the air, water, and soil through a variety of natural and industrial methods including CFPP, combustion and incineration. The EPA has suggested that the inhalation health risks associated with consumption of nickel (Ni) to the maximum individual risk, exceeded that from all other HAPs, due to its relatively high concentration, generally 1-4 wt%. It has known carcinogenic properties and is found in high concentrations in fly ash from the plumes exiting CFPP stacks. This prompted EPA to impose limits on the concentration of Ni allowed in fly ash; 0.0002 lb./MWh output, as a basis for residual electrical power plants (Galbreath, Schultz, Toman, Nyberg, Huggins, Huffman, et al. 2005). EPA began rigorous investigations of Ni concentrations in CFPP input and output levels. Nickel dermatitis, consisting of itching of the fingers, hands, and forearms, is the most common effect in humans following skin contact with nickel. Human and animal studies have reported an increased risk of lung and nasal cancers from exposure to nickel dusts (EH&E, 2011). The EPA has classified nickel dust, nickel sub-sulfide, and nickel carbonyl as human carcinogens (USEPA, 2014). Table 10 shows top nickel emitters in the US. The Big Bend facility appears

44th on this national list.  The plant emitted 970 pounds of nickel byproduct into the atmosphere in 2010 (EH&E, 2011).  The EPA had originally estimated the Ni compound mixture to have a 50% carcinogenic effect on human health.  A 2002 study of two electric utility steam-generated plants found that this percentage was over-estimated and that further research is needed to determine the exact percentage of Ni compound mixtures in nitrogen oxide and nickel sulfate in the atmosphere and its impact on human health (Galbreath et al. 2005).

Major pollutants found at Big Bend also include arsenic (As), which the EPA has classified as a carcinogen.  As an air pollutant, it has been shown to be associated with lung cancer, while ingestion has been linked to skin cancer and also bladder, liver and lung cancers. Acute high-level inhalation exposure to arsenic dust or fumes can cause central and peripheral nervous system disorders. Chronic exposure is associated with gastrointestinal effects, anemia, neuropathy, skin lesions and liver or kidney damage (EH&E, 2011).

Arsenic is a known by-product of fly ash (EH&E, 2011) and it becomes airborne through absorption into fine particulate matter and is released through the steam-generated plumes emanating from the CFPP stacks.  Of great concern is the water-soluble state arsenic compounds maintain in coal fly ash storage ponds near the plant.  As the compound degrades, environmental harm and exposure occur due to leaching of the pollutant into groundwater sources and subsequent soil absorption (Cantrell et al. 2014).  CFPP waste includes two forms of Chromium: Trivalent Chromium (CrIII) and Hexavalent Chromium Cr(VI).   CrIII is an essential element in humans and is much less toxic that Cr(VI).  Acute and inhalation exposure to Cr(VI) can cause shortness of breath, coughing, and wheezing.  Chronic exposure can cause perforations and ulcerations of the membranes in the nose and heart, and other diseases of the respiratory system (EH&E, 2011).  Hexavalent chromium has been found in fly ash concentrate

**Table 10.** Top Nickel Emitters, Big Bend Ranked 44th

| Top Power Plant Nickel Emitters - 2010 | | | | |
|---|---|---|---|---|
| **Rank** | **Facility** | **State** | **Owner** | **Nickel (lbs)** |
| 1 | Yorktown Power Station | VA | Dominion Resources, Inc. | 27,000.0 |
| 2 | Aguirre Power Generation Complex | PR | Puerto Rico Electric Power Authority | 25,271.0 |
| 3 | South Coast Power Plant | PR | Puerto Rico Electric Power Authority | 23,410.0 |
| 4 | Kahe Generating Station | HI | Hawaiian Electric Industries, Inc. | 23,000.0 |
| 5 | Palo Seco Steam Plant | PR | Puerto Rico Electric Power Authority | 20,747.0 |
| 6 | FPL Manatee Power Plant | FL | Nextera Energy | 4,809.6 |
| 7 | Brame Energy Center | LA | Cleco Corp | 3,095.0 |
| 8 | Laramie River Station | WY | Basin Electric | 2,204.0 |
| 9 | Roxboro Steam Electric Plant | NC | Progress Energy, Inc. | 2,104.0 |
| 10 | Paradise Fossil Plant | KY | U.S. Tennessee Valley Authority | 1,910.0 |
| 11 | George Neal North | IA | George Neal North IA Berkshire Hathaway | 1,840.0 |
| 12 | Riverton Generating Station | KS | The Empire District Electric Co | 1,804.4 |
| 13 | Bowen Steam Electric Generating Plant | GA | Southern Co | 1,800.0 |
| 14 | Bruce Mansfield Power Plant | PA | FirstEnergy Generation Corp | 1,739.0 |
| 15 | J H Campbell Generating Plant | MI | Consumers Energy | 1,707.2 |
| 16 | Amos Plant | WV | American Electric Power | 1,650.0 |
| 17 | Gibson Generating Station | IN | Duke Energy Corp | 1,649.0 |
| 18 | Bayshore Plant | OH | FirstEnergy Generation Corp | 1,608.0 |
| 19 | De Karn – Jc Weadock Generating Plant | MI | Consumers Energy | 1,601.9 |
| 20 | Antelope Valley Station | ND | Basin Electric | 1,601.0 |
| 21 | Gavin Plant | OH | American Electric Power | 1,550.0 |
| 22 | Rockport Plant | IN | American Electric Power | 1,550.0 |
| 23 | St Johns River/Northside Generating Station | FL | JEA | 1,505.0 |
| 24 | AES Puerto Rico LP | PR | AES Corp | 1,477.0 |
| 25 | Keystone Power Plant | PA | Genon Energy, Inc. | 1,403.0 |
| 26 | EME Homer City Generation LP | PA | Edison International | 1,402.0 |
| 27 | A B Brown Generating Station | IN | Vectren Corp | 1,400.0 |
| 28 | Monticello Steam Electric Station | TX | Luminant Generation Co, LLC | 1,386.0 |
| 29 | Frank E Ratts Generating Station | IN | Hoosier Energy Rec, Inc. | 1,306.0 |
| 30 | Conemaugh Power Plant | PA | Genon Energy, Inc. | 1,303.0 |
| 31 | Big Sandy Plant | KY | American Electric Power | 1,250.0 |
| 32 | Labadie Energy Center | MO | Ameren Corp | 1,247.0 |
| 33 | Ghent Station | KY | LG&E & KU Energy LLC | 1,239.0 |
| 34 | Walter Scott Jr Energy Center | IA | Berkshire Hathaway | 1,221.0 |
| 35 | Coal Fired Complex | OK | Grand River Dam Authority | 1,196.0 |
| 36 | Milton R Young Station | ND | Minnkota Power Cooperative Inc | 1,158.0 |
| 37 | Cemex Construction Materials | FL | LLC FL Cemex Inc | 1,142.0 |
| 38 | Mill Creek Station | KY | LG&E & KU Energy LLC | 1,129.0 |
| 39 | Nebraska City Station | NE | Omaha Public Power District | 1,123.0 |
| 40 | Brunner Island Steam Electric Station | PA | PPL | 1,043.0 |
| 41 | Kammer/Mitchell Plant | WV | American Electric Power | 1,030.0 |
| 42 | IPL Petersburg | IN | AES Corp | 1,023.7 |
| 43 | Montour Steam Electric Station | PA | PPL | 989.0 |
| 44 | Big Bend Power Station | FL | TECO Energy, Inc. | 970.0 |
| **Total** | | | | **180,594.0** |

Source: America's Top Power Plant Toxic Air Polluters, Environmental Integrity Project, 2011.

http://www.environmentalintegrity.org/documents/Report-TopUSPowerPlantToxicAirPolluters.pdf from CFPPs. Recent studies have established that Cr(VI) is a carcinogen, resulting in an increased risk of lung cancer and can be found in high concentrations of up to fifty percent in fly ash. Cr(VI) is water-soluble, and is accessible to the ground water through particulate matter dissemination and absorption into the lungs and stomach fluids through water solubility (Finkelman, 2007).

Mercury (Hg) is a toxic heavy metal that is a by-product of the fuel combustion process (Jardine, Predy & MacKenzie, 2007). The three forms of mercury emitted by CFPPs are elemental, inorganic (mercuric chloride) and organic mercury compounds (methyl mercury). Each is toxic and exhibits different health effects. Elemental mercury causes central nervous system effects such as tremors, mood changes, and slowed sensory and motor nerve functions. Inorganic mercury induces kidney damage. Methyl-mercury can cause central nervous system effects such as blindness, deafness, impaired level of consciousness and developmental disorders in infants (EH&E, 2011). Mercury and compounds containing it accumulate in the environment through airborne transmission as well as water solubility. Another concern is mercury consumption in the food chain. The fish consume water and food containing high levels of the contaminant and has been related to mercury poisoning in humans and wildlife exposed to fish containing carcinogenic levels of mercury.

A study in Alberta, Canada focused on mercury levels at four CFPPs, the communities and surrounding waterways around the plant (Jardine et al. 2007). Results indicated that a majority of residents in these areas were concerned about health and the general air and water pollution in their community from the plant. The public wanted a general monitoring program of the health impacts to their communities from these plant emissions, particularly mercury, as the fishing industry was a major contributor to the local economy (Jardine et al. 2007). Mercury controls in the atmosphere are dependent on the CFPPs operating characteristics and design. As the EPA began to maintain stricter control, options for CFPPs ability to achieve the reductions diminished, due to high cost of construction, and the costs associated with the implementation of new technologies (Brown, Smith, Hargis & O'Dowd, 1999). The EPA report on HAPs suggested that mercury emissions were of particular concern for CFPP operators and the communities that surround them (Finkelman, 2007).

Selenium (Se) is a naturally occurring essential element. In high concentrations, exposure to inhaled elemental selenium, hydrogen selenide, and selenium dioxide can result in respiratory effects such as irritation of mucous membranes, pulmonary edema, severe bronchitis, and bronchial pneumonia. Chronic exposure to selenium, in food and water, causes skin discoloration, deformation and loss of nails, loss of hair, excessive tooth decay and discoloration, lack of mental alertness, and listlessness. Selenium sulfide has been shown to have carcinogenic effects in animals (EH&E, 2011). Se is a potential groundwater and airborne carcinogen due to its presence in coal fly ash. Of all the inorganic CCPs, particularly in fly ash, selenium is hazardous due to the transference of Se from the coal to the ash through a physical, condensation-absorption process. Se has the narrowest range between what is considered beneficial and detrimental to both species occupying land and sea. Human exposure has a narrow range, and is biologically accumulated, through both the food chain and the water supply. Recreational water use such as those found in pools, natural waterways, and groundwater runoff are examples of how this contaminant can be absorbed through the skin and find its way into waterways. As a result, the water in a community's drinking supply is often in danger from high levels of Se as well (Cantrell et al. 2014; EH&E, 2011).

Current levels considered acceptable by the EPA are 50 ug Se/L in drinking water. Fly ash has a mean Se concentration of 14 mg Se/kg (about 280 times the EPA MCL level for drinking water) and can range between 5.5 and 46.9 mg of Se/kg (Cantrell et al., 2014). Se can be released from the over 43,900,000 metric tons of bottom and fly ash stored in coal ash landfills (some of which are protectively lined and many that are unlined) in the US annually. The leaching of Se from a coal ash landfill could contribute to environmental harm to fish, wildlife and human health, through weathering or leaching through these ponds. Se can also be released from stored fly ash and become airborne and mobile in groundwater if the landfill does not have a proper liner (Cantrell et al. 2014). There are eleven landfills on site at Big Bend and ten are unlined at this time (Clean Air Coalition, 2010).

Hydrochloric Acid (HCl) is corrosive to the eyes, skin and mucous membranes. Acute exposure can cause eye, nose and respiratory tract irritation and inflammation and pulmonary edema in humans. Acute oral exposure can cause damage to the mucous membranes and contact with the human skin can produce severe burns and scarring. Chronic exposure to HCl has been reported to cause gastritis, chronic bronchitis, and skin abrasions. Electric utilities are the top industrial source of HCl emissions, releasing 164,839,701 pounds of HCI into the air in 2010 (EH&E, 2011).

As illustrated above the Big Bend facility emits a number of pollutants known to affect human health. Appendix A, Table A1 shows HAP emission totals from 2005 to 2013 for the Big Bend facility. Also, this review indicates that the Big Bend facility ranks poorly (a top polluter) among CFPPs in the nation. This level of emission has caused TECO to be sited for federal environmental violations. The next section reviews those violations.

**The Lawsuits**

This section addresses federal environmental violations at TECO's Big Bend power station. Figure 6, TECO Big Bend Timeline of Significant Events, gives a visual illustration of the actions taken by the EPA, FDEP and Big Bend, that influenced or impacted the lawsuits, settlement, compliance and enforcement issues referenced within this study. Although both the Gannon and Big Bend facilities are part of the lawsuit, the list of sanctions will only be examined for Big Bend.

The FDEP teamed with the EPA to file a Notice of Violation (NOV) for plant infractions of the CAA and Permit Violations. The NOV was given to TECO for the Big Bend and Gannon power stations pursuant to sections 113(a)(1) of the Clean Air Act (CAA), 42 U.S.C. §7413(a)(1). These are permit violations by TECO were for modifications to the plant that were not properly permitted.

From 1971 to 1998 TECO modified their smoke stacks to increase wattage and service more customers. The DOJ, on behalf of the EPA, filed a lawsuit against TECO on November 3, 1999, alleging TECO violated the Prevention of Significant Deterioration (PSD) requirements of Part C of the CAA, 42. U.S.C. §§ 7470-7492. The EPA alleged that TECO failed to obtain a PSD permit and apply Best Available Control Technology (BACT) before proceeding with various power plant modifications completed between 1991 and 1996. Modifications included replacements of boiler equipment, high temperature re-heater, water wall, cyclone, and the furnace floor.

The FDEP filed a lawsuit against TECO on December 7, 1999, which mirrored the EPA lawsuit. The lawsuit was filed on behalf of the state of Florida for Region 4 and re-delegated to the Director of the Air, Pesticides and Toxics Management Division of the Environmental

| Regulatory Agency Action | Date | Year | TECO Action |
|---|---|---|---|
| Congress Passes ECRA, Emergency Planning and Right To Know Act for chemical safety. | 10/17/86 | 1986 | |
| Wetlands Ecosystem Protection by EPA. | 10/6/86 | | |
| Safe Drinking Water Act amendments, EPA regulates over 100 contaminants and expanded enforcement power. | 6/19/86 | | |
| Discovery of ozone depletion. | 5/16/85 | 1985 | TECO Big Bend Unit Four (Stack 4) becomes operational as a coal burner. |
| Amendments to RCRA of hazardous and solid waste. | 12/4/84 | 1984 | TECO installs FGD (Scrubber) for Unit 4. |
| Environmental justice movement starts. | 9/15/82 | 1982 | |
| Congress creates Superfund Program (CERCLA). | 12/10/80 | 1980 | TECO applies for site license to build Unit Four (Stack 4). |
| EPA adopts the Bubble Policy. | 12/3/79 | 1979 | |
| EPA sets new lead air pollution standards. | 9/29/78 | 1978 | |
| Clean Water Act amended to include toxic pollution controls. | 12/28/77 | 1977 | |
| Clean Air Act amendments, CFPPs required to adopt scrubber technology. | 8/8/77 | | |
| National drinking water standards go into effect. | 6/25/77 | | |
| Toxic Substances Control Act passed by congress. | 10/11/76 | 1976 | Big Bend Unit Three (Stack 3) begins service. |
| Resource Conservation and Recovery Act passed by congress. | 9/30/76 | | |
| EPA prohibits polluters from receiving federal money. | 4/17/75 | 1975 | |
| Congress passes Safe Drinking Water Act. | 12/16/74 | 1974 | |
| First waste water permits Issued by EPA. | 3/2/73 | 1973 | Big Bend Unit Two (Stack 2) begins service. |
| Congress passes Clean Water Act. | 10/8/72 | 1972 | |
| EPA defines air pollution levels. | 10/1/71 | 1971 | Big Bend Unit One (Stack 1) begins service. |
| National Action on Air Quality. | 4/30/71 | | |
| Clean Air Act passed by Congress, NAAQS initial standards set. | 12/31/70 | 1970 | TECO issued site license to build Big Bend Facility. |
| EPA established. | 12/3/70 | | |

**Figure 6.** TECO Big Bend Timeline of Significant Events

| Regulatory Agency Action | Date | Year | TECO Action |
|---|---|---|---|
| EPA Adminsitrator signs Global Persistent Organic Pollutants Treaty. | 5/23/01 | 2001 | TECO agrees to update existing electrostatic precipitators. |
| Florida Public Service Commission closes docket without addressing Consent Final Judgment agreed to. | 2/29/2000 | 2000 | TECO signs settlement agreement (Consent Decree). 6/2 TECO petitions for cost recovery, Units 1-3 FGD Plan. 8/18 TECO petitions for approval of cost recovery for reduction programs in PM and NOx Emission, Units 1-3. TECO required to implement $5 million in EPA approved projects demonstrating emissions reduction of HAPs, $2 million in research and pollution measurement in the Tampa Bay estuary. |
| EPA reaches Settlement Agreement. | 2/29/2000 | | |
| FDEP settles lawsuit with Consent Final Judgment. | 12/16/1999 | 1999 | TECO installs FGD (Scrubbers) for Units 1 & 2. TECO receives Notice of Violation from EPA and FDEP. TECO Files petition for FPC to approve plan to comply with Clean Air Act and implementation of Consent Final Judgment with FDEP only. |
| FDEP files lawsuit mirorring EPA lawsuit. | 12/7/1999 | | |
| EPA issues Notice of Violation to TECO on behalf of Florida DEP. | 11/3/1999 | | |
| EPAiIssues more stringent NAAQS standards for smog and soot. | 7/17/97 | 1997 | |
| NAAQS standards for ozone, PM. | 8/8/96 | 1996 | |
| Safe Drinking Water Act amendments. Affirmed customers right to be informed by industry of chemicals in drinking water. | 8/6/96 | | |
| | 1995 | 1995 | TECO Uses FGD (Scrubber) from Unit 4 to scrub Unit 3 simultaneously. |
| EPA establishes online presence. | 11/10/94 | 1994 | Modifications and permit violation on Unit 1, and additions for Unit 2 without permit. |
| Brownfields Program started. | 6/30/94 | | |
| EPA has new standards for chemical plants, toxic air pollutants. | 3/1/94 | | |
| President Clinton issues Exxecutive Order prioritizing environmental justice for minorities in low income populations. | 2/16/94 | | |
| EPA Passes the Interim Enhanced Surface Water Treatment Rule | 6/30/93 | 1993 | |
| EPA Rules sulfur dioxide acid rain ingredient. Will become a commodity for sale. Emission rights could be traded. | 3/5/93 | | |
| Carol M. Browner becomes EPA Adminstrator under President Clinton. | 1/21/93 | | |
| | 1991 | 1991 | Modifications to Unit 2 conducted without permit. |
| Congress passes the Clean Air Act amendments, acid rain controls, and sulfur dioxide emission from power plants. | 11/15/90 | 1990 | |
| Pollution Prevention Act is signed. | 11/5/90 | | |
| Toxic Waste Control. Hazardous waste must be treated before disposal. | 5/8/90 | | |
| EPA launches the Toxic Release Inventory. | 4/19/90 | | |

**Figure 6. (continued)** TECO Big Bend Timeline of Significant Events

| Regulatory Agency Action | Date | Year | TECO Action |
|---|---|---|---|
| Cross State Air Pollution Rule replaces Clean Air Interstate Rule (aka CATR). | 1/1/15 | 2015 | ECHO reports High Priority CAA Violation for Total PM, and undeclared violation of CWA. |
| EPA establishes first guidelines to cut carbon pollution from existing power plants. | 6/2/14 | 2014 | ECHO reports High Priority Violation of CAA for Total PM (2nd through 4th quarters), CWA Violation (all four quarters) with significant non-compliance in 2nd Quarter. Title V Permit Violation, 1st Quarter. |
| Supreme Court rules that under CAA, EPA has authority to regulate CFPPs across state lines. | 4/29/14 | | |
| | 2013 | 2013 | ECHO reports Unspecified Federally Reportable Facility CAA Violation in 4th Quarter. Title V Permit Violation, 4th Quarter. CWA Violation all four quarters. |
| EPA establishes new Clean Air Standards for boilers. | 12/20/12 | 2012 | ECHO reports CWA violation all four quarters, with significant non-compliance in 1st Quarter. |
| EPA establishes more stringent NAAQS standards for PM. | 12/14/12 | | |
| EPA updates standards for oil and natural gas HAPs. | 8/28/12 | | |
| EPA proposes first carbon pollution standards for new power plants. | 3/27/12 | | |
| EPA issues national standards for mercury emissions from power plants. | 12/21/11 | 2011 | ECHO reports 2 CWA "Schedule Event Unachieved and not Reported: Achieve Final Compliance with Emission or Discharge Limts", 2nd through 4th Quarters. |
| Cross State Air Pollution rule established. | 7/7/11 | | |
| Greenhouse gas reporting becomes mandatory. | 11/22/10 | 2010 | TECO required to comply with all settlement conditions by end of year. Settlement provides TECO Big Bend with an Opt-Out clause. |
| EPA Establises stricter ozone standards. | 1/6/10 | | |
| EPA regulates greenhouse gases under the Clean Air Act. | 12/7/09 | 2009 | Natural gas and fuel oil fired peaking unit installed and operationalized. |
| TVA Kingston coal fly ash slurry spill. EPA scrutinizes all CFPPs. | 12/27/08 | 2008 | |
| EPA establishes mew national lead standards, Tenfold Decrease. | 10/16/08 | | |
| EPA establishes social media presence. | 7/26/07 | 2007 | |
| EPA Issues Groundwater Rule. | 10/12/06 | 2006 | |
| EPA strengthens NAAQS Standards for PM. | 9/21/06 | | |
| Energy Act of 2005 passed by congress. Contains "Halliburton Loophole" restricting EPA, and establishing Proprietary Rule. | 7/29/05 | 2005 | TECO prohibited from burning coal in anygeneration system shut down or converted to natural gas. TECO required to surrender allocation credits to barter or sell to other utilities. |
| | 2004 | 2004 | TECO operationalizes electrostatic precipitators to remove PM from all units. |
| | 2002 | 2002 | TECO ordered to install $3 million worth of combustion controls to limit NO2 emissions. |

**Figure 6. (continued)** TECO Big Bend Timeline of Significant Event

Protection Agency, Region 4. Shortly after FDEP filed its lawsuit, TECO and FDEP settled the suit by entering a Consent Final Judgment (CFJ). The CFJ became effective on December 16, 1999. On December 23, 1999, TECO filed a petition for Commission approval of its plan to comply with CAA (docket # 992014-EI). TECO's proposed CAA compliance plan outlined the implementation requirements and timetables of the CFJ. The EPA lawsuit remained unresolved even though TECO and FDEP had reached settlement.

TECO continued independent negotiations with the EPA to resolve their concerns. On February 29, 2000, TECO and EPA signed a settlement agreement (Consent Decree) that was filed with the US Circuit Court in Tampa. After TECO signed the Consent Decree with the EPA the Commission closed the docket without addressing TECO's proposed plan to implement the CFJ agreed to by the state DEP. On June 2, 2000, TECO petitioned for approval of cost recovery of the Big Bend Units 1, 2, and 3 Flue Gas Desulfurization System Optimization System and Utilization Program (FDG plan) through the Environmental Cost Recovery Clause. The Commission found that the plan qualified for recovery through the Environmental Cost Recovery Clause. On August 18, 2000, TECO petitioned for approval of cost recovery of two programs, the PM program and the Reduction of Nitrogen Oxide Emissions Program at Big Bend Units 1, 2, and 3. TECO states that both the PM and $NO_x$ program costs will be allocated to rate classes on an energy basis because the programs are CAA compliance activities. Put simply, the responsibility for all Settlement costs would shift to the TECO consumer base. The Commission approved the plans to open a docket number to address the eligibility of TECO PM and N0x program for recovery through the Environmental Cost Recovery Clause (FDEP Case File, 10/2000).

The Clean Air Act (CAA), passed in 1970, saw Congress exempt existing facilities like Big Bend from the new regulations whose permits passed in 1970 for construction. However, it was clear that this grandfathering would not last forever and that older facilities would eventually have to make modifications to meet CAA standards (see *Alabama Power v Castle*, 1979*).* In cases of major modifications, the source must obtain a PSD permit or a nonattainment MSR permit in order to achieve the lowest possible emission rate.

One of the issues with the Big Bend facility was its non-attainment status with the NAAQS. A listing of the NAAQS standards, for the toxins of concern at Big Bend, appears in Appendix A, Table A2. What is the difference between attainment and non-attainment? Florida SIP 62-402.340 designates attainment, nonattainment and maintenance areas. Attainment areas meet Ambient Air Quality Standards, while nonattainment areas do not. Some are, however, also listed as "unclassifiable" areas by the State. Once classified, the EPA is the governing body over a facility, and EPA can change the attainment status of an area. Hillsborough County is currently unclassifiable for the pollutant, sulfur dioxide. Hillsborough and Pinellas counties are under Air Quality Maintenance area classification for ozone air pollutants. For particulate matter, the portion of Hillsborough County that falls within the area of the circle having a center-point at the intersection of U.S. 41 South and State Road 60, and a radius of 7.46 miles, is designated as an air quality maintenance area. As of January 1, 1996, the area within a radius of 3.12 miles centered at UTM coordinates 226.18 miles east, 1922.21 miles north; zone 17, in Hillsborough County is designated as an air quality maintenance area for lead pollutants (ECHO, 2013).

Another issue in the suit against TECO involved modifications and construction of a facility in attainment and non-attainment areas. The Florida SIP requires that no construction or operation on a major modification project on a stationary source, such as a stack or scrubber, can occur in an area designated as attainment or nonattainment without first obtaining a permit (A40). The Florida SIP also stipulates the same for non-attainment areas. SIP requires obtaining an air construction permit that meets all requirements of the rule 62-402.340. These rules are all state and federally enforceable, pursuant to Sections 110 and 113 of the Clean Air Act.

The Big Bend plant was classified as follows with respect to attainment and non-attainment: (1) in attainment for $NO_2$ and $SO_2$ from 1980 to the present; (2) non-attainment for particulate matter from 1980 to April 2, 1990; (3) EPA, Region 4 area has been designated as attainment since 1990; (4) for Ozone the area has been classified as non-attainment from 1980 to February 5, 1996 and attainment thereafter.

**Specific Legal Violations**

The Notice of Violation was filed in 1997 and went to trial in 1999 in Civil Court. The following sections detail the various legal violations at TECO's Big Bend Facility as noted in the following: *United States Environmental Protection Agency, Region 4 v Tampa Electric Company,* (1997); Notice of Violation EPA – CAA – 2000 – 04 – 0007 (EPA, 2007).

Article 19. "On numerous occasions between 1979 and the date of this notice TECO has made modifications at its Big Bend Station as defined by both 40 CFR Section 52.21 and Florida SIP Rule 62-212.400, F.A.C. These modifications included, but are not limited to, the following individual internals on Units 1 and 2 in 1994 and 1991 respectively; and high temperature re-heater replacement and water wall addition for Unit 2 in 1994." (EPA, 2007)

Article 20. "For each of the modifications that occurred at the Big Bend Station, TECO did not obtain a PSD permit pursuant to 40 CFR Section 52.21 and Florida SIP Rule 62-212.400, F.A.C.; a nonattainment NSR per pursuant to a 40 CFR Section 52.24 and Rule 62-212.400, F.A.C.; or a minor NSR permit pursuant to Rule 62-212.300, F.A.C. In addition, for modifications after 1992, no information was provided to the permitting agency of actual emissions after the modification as required by 40 CFR Section 52.21(b)(21)(v) and Rule 62-210.200(12)(d), F.A.C." (EPA 2007)

Article 21. None of these modifications fall within the "routine maintenance, repair and replacement" exemption found at 40 CFR Section 52.21 (b)(2)(iii)(a) and Florida SIP Rule 62-210.200 (183)(a)1a, F.A.C. Each of these changes was an expensive capital expenditure performed infrequently at the plant that constituted the replacement and/or redesign of a boiler component with a long useful life. In each instance, the change was performed to increase capacity, regain lost capacity, and/or extend the life of the unit. In many instances, the original component was replaced with a component that was substantially redesigned in a manner that increased emissions. That the "routine maintenance, repair and replacement" exemption does not apply where construction activity is at issue was known to the utility industry since at least 1988 when EPA issued a widely publicized applicability determination regarding utility modifications at a Wisconsin Electric Power Co. ("WEPCO") facility. EPA's interpretation of this exemption was upheld by the court of appeals in 1990. *Wisconsin Electric Power Co. v. Reilly, 893 F.2d 901* ($7^{th}$ Cir. 1990).

Article 22. None of these modifications fall within the "increase in hours of operation or in the production rate" exemption found at 40 CFR § 52.21(b)(2)(iii)(f), or Florida regulation 62-210.200 (183)(a)2., F.A.C. This exemption is limited to stand-alone increases in operating hours or production rates, not where such increases follow or are otherwise linked to construction activity. That the hours of operation/rates of production exemption does not apply where construction activity is at issue was known to the utility industry since at least 1988 when EPA issued a widely publicized applicability determination regarding utility modifications at a Wisconsin Electric Power Co. ("WEPCO") facility. EPA's interpretation of this exemption was upheld twice by the court of appeals, in 1989 and in 1990*, Puerto Rican Cement Co. v EPA, 889 F. 2D 292* (1[st] Cir. 1989) and *Wisconsin Electric Power Co. v Reilly, 893 F. 2d 901* (7[th] Cir. 1990).

Article 23. None of these modifications fall within the "demand growth" exemption found at 40 CFR Section 52.21 (b)(33)(ii) and Florida SIP Rule 62-210.200 (12) (d), F.A.C., because for each modification a physical change was performed which resulted in the emissions increase.

Article 24. Each of these modifications resulted in a net significant increase in emissions from Big Bend Station for $NO_x$, $SO_2$ and/or PM as defined by 40 CFR Sections 52.21 (b)(3) and (23) and Florida SIP Rule 62-212.400 (2)(e) 2, F.A.C.

Article 25. "Therefore, TECO violated and continues to violate 40 CFR Section 52.21 and Florida SIP Rule 62-212.400, F.A.C., for the prevention of significant deterioration; 40 CFR Section 52.24 and Rule 62-212.500, F.A.C., for preconstruction review for non-attainment areas; and /or Rule 62-212.300, F.A.C., by constructing and operating modifications at the Big Bend Station without the necessary permit required by the Florida SIP."

Article 26. Each of these violations exists from the date of start of construction of the modification until the time that TECO obtains the appropriate NSR permit and operates the necessary pollution control equipment to satisfy the Florida SIP.

The Enforcement Section of the Lawsuit relays that the EPA will fine TECO $25,000 per day for each violation on or before January 30, 1997 and $27,500 for each violation after January

30, 1997. Respondents can confer with the EPA concerning these charges in an effort to reach an informal settlement of the charges (USEPA, 2007).

**Limitations of the Lawsuits**

It is interesting to note that no actions by TECO at Big Bend prior to 1997 are addressed in this NOV, despite the fact that the power plant had been operational since 1971. Potential penalties are suggested, but no clear indication of CAA violations are mentioned, and there are no indications of violations to the CAA or the National Drinking Water Standards. Coal ash from unlined ponds has been contaminating waterways and aquifers surrounding the facility which could impact the drinking water supply (Clean Water Coalition, 2011). This is not mentioned in the lawsuit or addressed in any subsequent motions, even though CWA regulations were enacted in 1972 and the Safe Drinking Water Act provided for regulations in 1974. Environmental groups monitoring the Big Bend facility estimate that in 1997, when the lawsuit was brought forward, the Big Bend Plant was one of the leading polluters in the state of Florida, emitting in excess of 31,764 tons of nitrogen oxide, and 84,491 excess tons of sulfur dioxide, both air and water soluble (EH&E, 2011).

Big Bend benefited for years under a loophole in the 1970 CAA and its 1977 Amendments. It allowed existing plants and those under construction to be exempt from pollution standards for new sources. Utility companies convinced Congress that existing power plants, with an expected life of 25-30 years would soon retire and it would be a waste to retrofit them with pollution control equipment. Although the 1990 CAA Amendments required reductions of $SO_2$ and $NO_x$, older plants like Big Bend still polluted at four to ten times that of new plants (CATF, 2007). In 1997, just prior to the lawsuit, Big Bend was still exempt from basic clean air standards, while it continued to be ranked among the dirtiest 100 CFPPs in the nation (Florida Clean Power Coalition, 1997).

**Settlement of the Lawsuits**

Two months later, in February 2000, the EPA announced a landmark CAA case settlement against Tampa Electric Company in President Clinton's National Enforcement Initiative. Administrator Carol M. Browner represented the government in the Clinton-Gore administration's efforts to provide the people of Florida with cleaner, healthier air. No court action was taken, and a settlement with TECO was reached. The settlement required TECO to: (1) pay a $3.5 million dollar civil penalty; (2) install permanent emission-control equipment; (3) implement a series of interim pollution reduction measures to reduce emissions while the permanent controls were designed and installed; and (4) retire pollution emission allowances that TECO or others could use or sell to others to emit additional pollutants into the environment. The settlement requires TECO to spend $10-11 million dollars on environmentally beneficial projects in the region to mitigate the impact of emissions from the company's plants.

An interesting caveat to the settlement is that requirements are conditional on whether or not Florida law allows the company to pass on the cost of compliance in the settlement to its customer base. Currently, TECO charges three fees to its utility customers. Basic charges are calculated based on kilowatt hours used, the cost of maintaining equipment such as meters and electrical wiring, meter reading, and maintaining customer records. Basic charges are incurred even if no electricity is used in a given month. An Energy Charge includes all other costs of producing electricity, except fuel. Here is the caveat: it includes conservation, environmental and capacity cost recovery charges. That cost is 5.4 cents per kilowatt-hour up to 1,000, and 6.6 cents for anything after 1000 kilowatt-hours.

As with most corporate penalties, TECO has been able to pass their settlement penalties along to their customers. The lawsuit and subsequent settlement assert that this power plant had illegally released massive amounts of air pollutants contributing to some of the most severe environmental problems in the ecosystem. Yet, legally, through the ECRC, TECO could recover those costs from its customers.

As noted, under the Department of Justice agreement, TECO was required to pay all penalties, install first class pollution control equipment, and develop interim pollution control measures, while final permanent controls are selected, designed and installed. Furthermore, improved scrubbers to trap more sulfur dioxide were stipulated. In 2001 the company has mandatory updates to the optimization, operation, and maintenance of existing electrostatic precipitators, which will keep more particulate matter from reaching the atmosphere. Starting in 2002, TECO was to install $3 million dollars worth of combustion controls to reduce $NO_2$ emissions. TECO was to continue stringent emission limits for key pollutants $NO_x$, $SO_2$ and PM during the decree and after. Starting in 2005, TECO was not to burn coal at any Big Bend electric generation system that TECO either shuts down or changes over to natural gas.

These settlement conditions were phased in over a ten-year period, to end in 2010. The settlement provides an opt-out clause for Big Bend. They can choose to shut down the power plants if their obligations cannot be met, or if business conditions call for restoring electric generating capacity that cannot meet the requirements of the law.

**TECO's Compliance to the Settlement: What Have They Done?**

As of December 2, 2014, TECO's Big Bend Plant has significant violations of the CAA. When inspected in December of 2012, the plant was cited for three consecutive quarters in noncompliance and one quarter was in significant violation. TECO has had one informal enforcement action within the last 5 years. Penalties assessed on these infractions amount to $0. The 2011 on-site inspection found current significant violation of the Harmful Particle Emission standards through the first quarter of 2015. There have been no penalties assessed in the twelve consecutive quarters of noncompliance and for four significant violations. The EPA website lists TECO's current significant violation as "Violation Unaddressed." The FDEP has issued multiple Notices of Violation that have not been addressed or resolved. Significant air pollutants are ozone, lead and particulate matter.

TECO was not cited for violation of the CWA for many years. In the past five years TECO has had the following CWA violations and actions: one informal enforcement action, three formal enforcement actions and one case (referred) to the EPA for settlement. Penalties assessed on these infractions total $0. This lack of the legal enforcements by EPA and FDEP with regard to significant violations in toxic emissions and permitting violations indicates that TECO does not fear the regulatory deterrents currently available to the state and federal government. The precedent being set with this lack of regulatory oversight is one in which TECO will continue to be out of compliance with the law and have no fear of reprisal from government agencies. With respect to water violations and pollution, TECO's Big Bend plant has had significant violations since 2011 for excessive nitrogen levels in the water up to 114% over legal limits. Since July 1, 2011, TECO has been in violation of CWA with permits and resolutions pending. Table 11 is an EPA Civil Enforcement Case Report on the TECO facility addressing one of the many CWA infractions. It is interesting to note that EPA lists the CWA infractions, its non-voluntarily disclosure, and the penalties assessed to date at $0, with TECO paying $100 for the cost of the EPA filing the Action with the Court (ECHO, 2014). This is another example of a deterrent relegated to an ineffective measure for law enforcement agencies that protect the communities surrounding the plant and for TECOs continued green victimization of those communities.

**Table 11.** Clean Water Act Case Report

| EPA Civil Enforcement Case Report, TECO Big Bend Power Plant | | | |
|---|---|---|---|
| **Basic Information** | | | |
| Case Number: | 04-2014-4755 | Relief Sought: | -- |
| Case Name: | TAMPA, FLORIDA, CITY OF / BIG BEND STATION | Enforcement Outcome: | Unilateral Administrative Order Without Adjudication |
| Case Category: | Administrative - Formal | Headquarters Division: | -- |
| Case Status (as of 06/02/2014): | Final Order Issued | Branch: | -- |
| Case Lead: | EPA | Result of Voluntary Disclosure? | No |
| Court Docket Number: | CWA-04-2014-4755 | Multi-media Case? | -- |
| DOJ Docket Number: | -- | Enforcement Type: | CWA 309A AO For Compliance |
| | | Violations: | Violations Of Reporting Requirements |
| **Penalties - Case Level** | | | |
| Total Federal Penalty Assessed or Agreed To: | $0 | | |
| Total State/Local Penalty Assessed: | $0 | | |
| Total SEP Cost: | $0 | | |
| Total Compliance Action Cost: | $100 | | |
| Total Cost Recovery: | $0 | | |
| **Case Summary** | | | |
| 6/2/14 - ADMINISTRATIVE ORDER ISSUED. THE ANNUAL DMR-QA STUDY FOR 2014 IS KNOWN AS STUDY 34. ON FEB 12, 2014, RESPONDENT RECEIVED A CERTIFIED LETTER FROM EPA ISSUED PURSUANT TO CWA SEC 308 ALONG WITH FORMS AND INSTRUCTIONS ON HOW TO FILL OUT THE DMR-QA FOR STUDY 34. THE SECTION 308 LETTER REQUIRED THAT RESPONDENT SUBMIT TO EPA THE RESULTS OF CERTAIN TEST INFO, INCLUDING THE NAME AND ADDRESS OF THE LAB PERFORMING THE ANALYSIS FOR RESPONDENT AND THE IDENTITY OF THE ANALYTES SPECIFIED IN THEIR NPDES PERMIT. THE DEADLINE FOR RESPONDENT TO SUBMIT ITS DMR-QA STUDY 34 TO EPA REGION 4 WAS MARCH 21, 2014. ON MARCH 13, 2014, EPA, BY MEMORANDUM SENT TO THE DMR-QA REGIONAL AND STATE COORDINATORS EXTENDED THE DEADLINE TO RESPOND TO THE SECTION 308 LETTER TO APR 4, 2014. BASED ON RECORDS MAINTAINED BY EPA, RESPONDENT HAS FAILED TO SUBMIT THE REQUIRED INFO IN THE TIMEFRAME REQUIRED BY EPA'S SECTION 308 LETTER. THEREFORE, EPA HAS DETERMINED THAT RESPONDENT IS IN VIOLATION OF SECTION 308(a) OF THE CWA. ORDER REQUIRES: RESPONDENT SHALL HAVE 45 DAYS AFTER THE EFFECTIVE DATE TO CONDUCT THE DMR-QA STUDY AND/OR SUBMIT THE REPORT TO EPA. | | | |
| **Enforcement Conclusion Settlement** | | **Enforcement Conclusion Dollar Amounts** | |
| Enforcement Conclusion Type: | Administrative Compliance Orders | Federal Penalty Assessed or Agreed To: | $0 |
| Enforcement Conclusion Name: | TAMPA, FLORIDA, CITY OF / BIG BEND STATION | State/Local Penalty Assessed: | -- |
| Facilities in Settlement (FRS ID): | 110008319505 | SEP Cost: | -- |
| Settlement Lodged Date: | -- | Compliance Action Cost: | $100 |
| Settlement Entered Date: | 6/2/14 | Cost Recovery: | $0 |

http://echo.epa.gov/enforcement-case-report?id=04-2014-4755

In the Plant's twelfth quarter of noncompliance, they reverted back to a "Significant Violation" level in nitrogen emission totals. The EPA lists these as significant non-compliance violations, Category 1. To date penalties assessed by the EPA to TECO are $0. On June 2, 2014, the state DEP filed a lawsuit with the EPA for CWA violations unaddressed by TECO, and the website indicates that the case was settled the same day. No penalties were incurred for the suit filed in June 2014. These violations are significant to the extent that they impact Tampa Bay's watershed. Tampa Bay is the watershed under this facility, along with Hillsborough Bay, and the Alafia River as receiving waterways. In 2013, TECO reported that its Big Bend facility released 81,818 pounds of toxic chemicals at the site as surface water discharges and total Toxic Air Emissions totaling 329,492 pounds (ECHO, 2013). These examples confirm TECOs continued assurance that no deterrent measures will be fully executed and they can continue to pollute without serious legal ramifications.

Figure 7, TECO Big Ben Site Layout, highlights an aerial view of the layout of the Big Bend facility with all of the intake and outlets sites as well all of the storage and disposal areas for HAPs, including coal fly ash.

**Assessments from Environmental Groups**

Big Bend is cited in several conservation reports for non-compliance with settlement conditions. EarthJustice (2012) listed TECO's Big Bend Facility as having 11 Coal Ash ponds (10 unlined) and 1 slag landfill located in Hillsborough County. They further list the amount of coal ash generated per year in Florida at 6.1 million tons, 7th in the U.S. for coal ash generation. According to the EPA database, the ponds at Big Bend cover a total of 50 acres of surface area, flanked by Tampa Bay, Hillsborough Bay, and the Alafia River. EarthJustice (2012) further reports that TECO's Big Bend Station's off-site groundwater pollutants exceed federal drinking water standards and Florida cleanup target levels for thallium, sulfate, chloride and manganese. Arsenic in on-site groundwater was measured at 11 times the drinking water standard, and many other pollutants were also measured at levels far above Florida groundwater cleanup target levels at on-site locations. Thallium was measured in off-site groundwater at more than twice the federal standard, and at groundwater monitoring locations closer to coal ash disposal areas, at 8 times the federal standard (ECHO, 2015; EarthJustice, 2012; Environmental Integrity Project, 2011).

The Clean Water Action Coalition of Florida has also performed a Waste Profile of the Big Bend Station focusing on its coal ash production. Total ash generated by the facility in 2010 was 1.05 billion pounds. In 2011, 9.79 billion pounds – an 830% increase in one year. Very little of this ash is stored offsite or sold. In 2011, almost 9 billion of the 9.79 billion pounds was stored on site at the Big Bend facility. In 2011, 83,575 pounds of HAPs in the air and water that were produced at Big Bend were disclosed to regulatory agencies, with accompanying warnings about the ingestion of the dust produced as a byproduct of CFA.

Off site, Big Bend uses Plant Polk which has one disposal pond without any protective measures to prevent toxic contamination and one landfill with minimally acceptable environmental protections (EarthJustice, 2012). Even with these disclosures, the plant contends that is in full compliance with all EPA safety standards, according to the company website and recent report to Shareholders (TECO, 2014).

TECO Big Bend Site Layout


http://www.epa.gov/wastes/nonhaz/industrial/special/fossil/surveys2/tec_big_bend_final.pdf

**Figure 7.** TECO Big Bend Plant Layout

# CHAPTER FIVE:

# METHODS

This chapter presents a case study analysis of legal violation, environmental justice, and health effects associated with TECO's Big Bend facility. The broader research questions related to environmental justice addressed whether communities surrounding this CFPP are adversely impacted, and whether this situation can be defined as an instance of environmental injustice/racism.

## Research Philosophy

The case study represents a unique presentation of data for analysis and discussion. The case study is a qualitative methodology that can be approached in a variety of ways based on the research questions. The two approaches to case study methodology that have been emulated here are those of Stake (1995) and Yin (2003, 2009). Both of these methods cover the topic of the case study, but focus on a different set of questions than those in this thesis. Stake (1995) employed interviews or focus groups, but selected specific boundaries for the research in both the time, and the type of action(s) applicable to the case study.

Case studies have boundaries in time and the actions being researched. In this case, the boundary is set in time with TECO's Big Bend facility from 1970 to the present, and their actions since their operationalization. These are research areas where data collection was compiled over a specific period of time and from a variety of sources for comparative analysis.

Yin's (2003, 2009) methodology uses the same premise and lists five basic elements for an effective case study; 1) Research question(s); 2) Purpose of the study; 3) Unit(s) of analysis; 4) Suppositions based on the logical analyses that link the data collected to the purpose of the study; 5) Specific criteria for the interpretation of the data (Yin, 2003, 2009). The research questions, purpose of study and unit of analysis for this study were reviewed above. Issues related to the data selected for analysis are examined below.

The case study unit of analysis is a CFPP. At issue is whether the pollutants emitted by the Big Bed facility have adverse, unequally distributed potential health impacts. The unit of analysis was limited to a 5 mile radius around the Big Bend facility. It has been established that the 1, 3, and 5 mile radius from the CFPP create the most hazardous conditions for human health and the environment through the emission of toxic HAPs (EH&E, 2011).

The final aspect of case study research is the basic criteria necessary to make fair and impartial observations that will reflect an unbiased interpretation of the data collected (Yin, 2003, 2009). The data collected for this case study was used for comparative analysis, and came from a variety of sources. These include federal and state level government data, research documents from non-governmental organizations (such as the ALA), not-for-profit organizations (such as the NAACP), Tampa Electric Company, and companies designated by TECO to collect data and compile research on their behalf.

This is a descriptive case study that attempts to describe an event and the real-life context in which it occurred (Baxter and Jack, 2008; Yin, 2003). Many medical case studies have used this type of methodology effectively (Baxter and Jack, 2008). The medical effects described in Chapters two and three give ample reason to use this comparative qualitative typology. Not only is it widely used in medical and psychological case studies, it provides the author an opportunity to research the entire background of CFPPs for descriptive purposes. The data collection was significantly expanded to include various types of hazardous air and water pollutants resulting from plant operations that contribute to both human and environmental hazards.

**Research Site and Demographics**

Tampa Electric's Big Bend CFPP is located on Wyandette Road, Apollo Beach, Florida, EPA Region 4. TECO employs 3,799 in their workforce, and occupies close to 1,500 acres of land in south Hillsborough County, Florida. Fifty acres of that land has been designated for storage, disposal, and transport of hazardous waste.

Demographic data included public information on residents living near the TECO facility, and could be used to address environmental justice/racism issues. Demographic and environmental data used in this case study included: total persons within the area; land area; water area; population density (in square miles); percent minority; persons below the poverty level (poor share); households on pubic assistance; households in area, housing units in the area; racial composition; age compositions; education level (persons 25 and older), and income breakdown by household (ECHO, 2015). These data were collected for 1,3, and 5 miles from Big Bend. Five miles from the point source is the scale used by government reporting agencies to gather data for research and analysis on a wide variety of concerns, including pollutant levels. It is the standard by which other nongovernmental organizations measure and replicate the data collected by the government. Demographic data on the percentage minority and percentage of those below the poverty level were obtained from PERI sources (PERI, 2013). Other information from this site includes toxic air releases (in pounds) and a "toxic score." The toxic score is calculated by quantity of pollutants, multiplied by the exposure of pollutants, multiplied by the population density of the area affected. PERI also lists the company's TRI ratings on each pollutant that is reported to the government.

**Data Collection Methods**

This study used secondary data from existing source materials and did not require Internal Review Board approval, as the data is public and no individual identifiers are included. There were no direct contacts with any individuals in the documents, nor any interviews conducted for this case study. A request for secondary data from FDEP is included as Appendix A.

Data collection and comparative analysis were the primary method applied to the study. Document review from a variety of sources was used to examine the data and prevent bias in the analysis and presentation of results. Many sources, including previous studies, newspaper articles, documentary films, court documents, reports by government agencies, private individuals, corporate documents, private organizations, not-for-profit agencies, and educational reference materials were analyzed. Table 12, titled "Document Inventory," lists the source of the data, the method by which it was obtained, and most importantly why it was selected and incorporated into the array of data for analysis (Dodge, 2011; Gordin, 2006).

**Data Analysis Process**

In the social sciences, the qualitative nature of the case study method lends itself to a more interpretive analytical procedure. It is a creative, continuous process that begins with the collection of the data and should remain uninterrupted through to analysis and the presentation of results. The concept of using steps in the qualitative data analysis process provides the researcher with the necessary transparency and validity; the data can be replicated for analysis,

**Table 12.** Document Inventory

| Document Resource | Document Title | Distribution Media | Source | Rationale for Inclusion |
|---|---|---|---|---|
| American Lung Association | Toxic Air: The Case for Cleaning Up CFPPs, 3/2011 | Internet | http://www.lung.org/assets/documents/healthy-air/toxic-air-report.pdf | Human and environmental hazards of HAPs |
| Center for Investigative Reporting | Dirty Business, 2009 | Internet | http://www.cultureunplugged.com/play/6861/Dirty-Business--Clean-Coal-and-the-Battle-for-Our-Energy-Future | Information on coal industry from mining to CFPP polluting |
| Clean Air Task Force | The Toll From Coal, 9/2010 | Internet | http://www.catf.us/resources/publications/files/The_Toll_from_Coal.pdf \ | Morbidity rates from CFPPs |
| Clean Water Action Florida | Big Bend Power Station : A Waste Profile of Coal Ash, 2012 | Internet | http://cleanwater.org/files/ccapp@cleanwater.org/Big%20Bend%20Coal%20Ash%20Waste%20Profile%20Clean%20Water%20Action%202012.pdf | Toxic water pollutants emitted from Big Bend |
| Dewberry & Davis, LLC | Coal Combustion Residue Impoundment Round 9 – Dam Assessment Report | Internet | http://www.epa.gov/wastes/nonhaz/industrial/special/fossil/surveys2/tec_big_bend_final.pdf http://www.epa.gov/osw/nonhaz/industrial/special/fossil/surveys2/tec_big_bend_comments.pdf http://www.epa.gov/osw/nonhaz/industrial/special/fossil/surveys2/tec_big_bend_draft.pdf | Third Party Engineering Study Final, Commentary, and Draft |
| DOJ | Settlement Agreement | Internet | http://www.justice.gov/archive/opa/pr/2000/February/085enrd.htm | Conditions of settlement agreement USEPA |
| Earthjustice | Florida and Coal Ash: Disposal, Contamination, and Inadequate Regulation, 2012 | Internet | http://earthjustice.org/sites/default/files/files/Florida-Ash-Fact-Sheet-2014-12.pdf | TECO Big Bend coal ash ponds and landfill |
| Earthjustice, Clean Air Task Force | Comments on the US EPA's CCW Damage Case Assessment, 2/11/2008 | Internet | http://www.catf.us/resources/filings/power_plant_waste/NODA082907_Appendix_C_EPA_s_Damage_Case_Assessment_Contamination_Ignored.pdf | Environmental watchdog group response to EPA regarding TECO non-compliance at Big Bend |
| EH&E, Inc. | Emissions of Hazardous Air Pollutants from CFPPs, 3/2011 | Internet | http://www.lung.org/assets/documents/healthy-air/coal-fired-plant-hazards.pdf | CFPP emissions, HAPs, health and environmental impacts |

**Table 12. (continued)** Document Inventory

| Document Resource | Document Title | Distribution Media | Source | Rationale for Inclusion |
|---|---|---|---|---|
| Environmental Integrity Project | Dirty Kilowatts: America's Most Polluting Power Plants, 7/2007 | Internet | http://www.dirtykilowatts.org/dirty_kilowatts2007.pdf | Explanation of HAPs |
| Environmental Integrity Project | America's Top Power Plant Toxic Air Polluters, 2011 | Internet | http://www.environmentalintegrity.org/documents/Report-TopUSPowerPlantToxicAirPolluters.pdf | Top HAP emitting states and plants, Big Bend listed by name |
| Environmental Working Group | New Clean Air Standards are No Sweat in Florida, 1997 | Internet | http://static.ewg.org/reports/1997/New-Clean-Air-Standards-Are-No-Sweat-in-Florida.pdf?_ga=1.148070071.143114383.1433192448 | Utility lobby effect on environmental standards |
| EPA | Coal Cleaning | Internet | http://www.epa.gov/ttnchie1/ap42/ch11/final/c11s10.pdf | Description of Coal Production Process |
| EPA | Notice of Violation, TECO Big Bend and Gannon Stations | Internet | http://www2.epa.gov/sites/production/files/documents/nov-coal-teco.pdf | Legal justification for subsequent lawsuit |
| EPA | Counties Designated "Nonattainment" for Clean Air Act's NAQQS, 1/2015 | Internet | http://www.epa.gov/airquality/greenbook/mapnpoll.html | Nonattainment standards |
| EPA | Enforcement and Compliance History Online (ECHO) | Internet | https://echo.epa.gov/ | ECHO data on Big Bend |
| EPA | Overview of the Clean Power Plan, 6/2014 | Internet | http://www2.epa.gov/sites/production/files/2014-05/documents/20140602fs-overview.pdf | New EPA guidelines for CFPP emissions |
| EPA | By the Numbers – Cutting Carbon Pollution from Power Plants, 6/2014 | Internet | http://www2.epa.gov/sites/production/files/2014-06/documents/20140602fs-important-numbers-clean-power-plan.pdf | New EPA guidelines for CFPP emissions |
| EPA | Civil Lawsuit, 1997 | Internet | http://www2.epa.gov/sites/production/files/documents/tecocp.pdf | Confirmation of Information in the Notice of Violation |

**Table 12. (continued)** Document Inventory

| Document Resource | Document Title | Distribution Media | Source | Rationale for Inclusion |
|---|---|---|---|---|
| FDEP | Mercury TMDL for the State of Florida | Internet | http://www.dep.state.fl.us/water/tmdl/docs/tmdls/mercury/Mercury-TMDL.pdf | CWA, FDEP Air Regulation for CFPPs |
| FDEP | Final Orders Modifying Conditions of Certification | Internet | http://publicfiles.dep.state.fl.us/Siting/Outgoing/Web/Big_Bend/Modifications/ | FDEP Legalizing Changes to Site Certification |
| FDEP | Big Bend Power Station State Facility Documents | Internet | http://dep.state.fl.us/siting/certified_facilities_map/power_plants/SWD/big_bend.htm | Response from FDEP to request for Big Bend Unit 4 Natural Gas Conversion |
| FDEP | Conditions of Certification, TECO Big Bend Unit 4, 2013 | Internet | http://publicfiles.dep.state.fl.us/Siting/Outgoing/Web/Certification/pa79_12_2013_R.pdf | Design and performance criteria |
| Florida Clean Power Coalition | Florida's Dirty Dinosaurs, 1997 | Internet | http://www.fcan.org/Clean_Air/dirty_dinosaurs.htm | HAP emissions timeline |
| Florida Public Service Commission | Review of Coal Combustion Residual Storage and Disposal Processes of the Florida Electric Industry, 12/2011 | Internet | http://www.psc.state.fl.us/publications/pdf/electricgas/ReviewCoal_2011.pdf | Coal CCR sales/storage/disposal for TECO Big Bend |
| HBO Documentary | Gasland, Fox, 2010 | Internet | https://www.youtube.com/watch?v=6mp4ELXKv-w | Oil and gas industry background, trade secret and proprietary information within 2005 Energy Act |
| IECG | Coal Fired Power Generation | Internet | http://www.rst2.edu/ties/acidrain/IEcoal/how.htm | History of CFP generation |
| Independent Science News | How EPA Faked the Entire Science of Sewage Sludge Safety: A Whistleblower's Story, 6/2014 | Internet | http://www.independentsciencenews.org/health/how-epa-faked-the-entire-science-of-sewage-sludge-safety-a-whistleblowers-story/ | Exposure of coal slurry hazards from within EPA |

**Table 12. (continued)** Document Inventory

| Document Resource | Document Title | Distribution Media | Source | Rationale for Inclusion |
|---|---|---|---|---|
| NAACP, IEN, LVEJO | Coal Blooded: Putting Profits Before People | Internet | http://www.naacp.org/page/-/Climate/CoalBlooded.pdf | Environmental Justice |
| National Institute on Money in State Politics | Powering The Sunshine State, Barber, 4/2009 | Internet | http://classic.followthemoney.org/press/Reports/FloridaClimate.pdf | State utility lobby influences on environmental legislation of CFPPs |
| OpenSecrets | Influence and Lobbying, Electric Utilities, 2013-2014 | Internet | http://www.opensecrets.org/industries/indus.php?Ind=E08 | Impact of electric utility lobby on federal lawmakers |
| PERI | Toxic 100 Index, 2013 | Internet | http://grconnect.com/tox100/2013/index.php?search=yes&database=t1&detail=1&datype=T&reptype=a&company2=&company1=&parent=TECO&chemfac=fac&advbasic=bas | TRI data on Big Bend with environmental justice data |
| PERI | Toxic Flood, 5/2013 | Internet | http://documents.foodandwaterwatch.org/doc/Toxic_Flood.pdf#_ga=1.40061220.708338430.1433188654 | Hazardous water pollutants, industrial water polluters |
| Powermag | Big Bend's Multi-Unit SCR Retrofit | Internet | http://www.powermag.com/big-bends-multi-unit-scr-retrofit/ | Power industry trade publication on TECO Big Bend |
| Right To Know Network | Toxic Release Inventory, 2013 | Internet | http://www.rtknet.org/db/tri/tri.php?dbtype=C&combined_name=Tampa+Electric+Co+Big+Bend+Power+Station&rsei=y&sortp=D&reporting_year=2013&datype=T&reptype=f&detail=3&submit=GO | Big Bend facility detailed TRI report |
| Rolling Stone Magazine | The Dark Lord of Coal Country, Goodell, 2010 | Internet | http://www.rollingstone.com/politics/news/the-dark-lord-of-coal-country-20101129 | Background on coal mining industry |
| Sourcewatch | Big Bend Station,2/2011 | Internet | http://www.sourcewatch.org/index.php/Big_Bend_Station | Death and disease attributable to fine PM from Big Bend |

**Table 12. (continued)** Document Inventory

| Document Resource | Document Title | Distribution Media | Source | Rationale for Inclusion |
|---|---|---|---|---|
| State of Florida Public Service Commission | Memorandum RE: Cost Recovery Clause, 10/2000 | Internet | http://www.floridapsc.com/library/filings/00/12649-00/12649-00.pdf#search=001186 | TECO request to pass on cost of settlement to consumer base |
| Tampa Bay Online | 150 Protesters, Law Enforcement Face Off at Big Bend Plant | Internet | http://tbo.com/ap/politics/-protesters-law-enforcement-face-off-at-big-bend-plant-478783 | Environmental protest against CFPPs |
| Tampa Bay Times | Dirty Air: Florida Ranks Third Worst for Power Plant Generated Toxic Air, Klas 7/20/2011 | Internet | http://www.tampabay.com/blogs/the-buzz-florida-politics/content/dirty-air-florida-ranks-third-worst-power-plant-generated-toxic-air | Florida CFPP general information, Big Bend listed by name |
| Tampa Bay Times | Under Scott, DEP Undergoes Drastic Change, 10/18/2014 | Internet | http://www.tampabay.com/news/environment/under-scott-department-of-environmental-protection-undergoes-drastic-change/2202776 | Changes in FDEP permitting |
| TECO | 2014 Corporate Sustainability Report | Internet | http://www.tecoenergy.com/files/executivesummary.pdf | TECO Corporate Viewpoint |
| TECO | Site Certification Application, Big Bend Station Unit 4, 1980 | Internet | http://publicfiles.dep.state.fl.us/Siting/Outgoing/Web/Big_Bend/SCA/TECO_BB_SCA.pdf | Demographic Data, Sequence of Operation |
| TECO | Big Bend Power Station Home Page | Internet | http://www.tampaelectric.com/company/ourpowersystem/powerstations/bigbend/ | General information on TECO Big Bend |
| WUSF News | Study: Florida Third-Worst for Power Plant Pollution, Ramos, 9/2013 | Internet | http://wusfnews.wusf.usf.edu/post/study-florida-third-worst-power-plant-pollution | Information on CFPPs in Florida, Big Bend mentioned by name |

further application, and defense of the results. The six steps can be reproduced in a linear fashion (Dodge, 2011), but do not necessarily have to be followed in a linear manner. This is a creative element for the researcher and a process can be followed without strict adherence to linear movement. In descriptive case studies, where data is continuously added and/or amended as the availability of new information is accessed, the steps in the process of dissemination fluctuate constantly. The six steps (Cresswell, 2005) are as follows: (1) Organization and preparation of the data for analysis. (2) Read through the collection of data thoroughly. (3) Begin a detailed analysis with coding of data, if necessary. Although coding was not necessary for this comparative analysis; separation of different categories of data that were applicable for the study were applied. (4) Descriptions and categories are generated for analysis. For this case study, categories were generated including Environmental Justice, TECO legal materials, and Health effects while compiling the data and updated as new information was obtained. (5) Demonstrate how the categories will be presented in the qualitative, descriptive analysis. For this step, the categories of data were collected, compared, and data tables created for the reader to easily interpret a discussion of the results. Chapter six presents several tables that show this comparative analysis using the combination of the collective data, particularly demographic data and information on particular hazardous pollutants of concern at the Big Bend facility. (6) Interpret the meaning of the data. Through the categorization of the data, and analysis of the wide variety of source materials, the author was able to present results. Generalizations on the causal inferences could then be initiated regarding the primary research questions presented at the conclusion of Chapter one.

## Ethics

The research did not harm the subject of the case study, and all materials were collected through public domain sites. Data acquired for this study were of a secondary analytic nature therefore the confidentiality and privacy of subjects was not in question. As no human subjects were used in the study, no interviews or focus groups were conducted, and the researcher did no formal field observations at the Big Bend facility, Institutional Review Board (IRB) approval was not required.

## Limitations

Limitations of the case study are inherent in the amount of information that can be obtained on the Big Bend facility through public domain outlets. The Internet has a vast amount of public documentation, however, certain proprietary information could not be obtained and therefore a complete picture of the activities and pollutants from this facility cannot be reported. The author used multiple sources to confirm information on the portions of the Big Bend facility that are open to public scrutiny. Government reporting of toxic emissions is done by the facility, and therein is the limitation; the current regulatory reporting process. The reporting facility can omit sections of data, with no explanation. The 2013 TRI report for Big Bend, the most current reporting to EPA, contains sections of missing data and TECO is not legally compelled to produce this information. EPA and FDEP rely on the facility to report accurately, therefore the accuracy of data is contingent upon the reliability and validity of reports furnished by TECO.

## Conclusion

In summary, the methods used in this case study have been identified in order to answer the research questions posed regarding Tampa Electric's history of compliance with the Settlement condition of the lawsuit. The questions of environmental justice and racism within the communities surrounding Big Bend are issues on a larger scale that require thorough investigation and analysis of data from multiple sources. The use of unobtrusive methods using existing data with the collection and analysis of these secondary sources allowing for an unbiased look at the facility and its effect on the communities that surround it.

The presentation of the findings through investigation and analysis of the data are reported in Chapter six and a discussion of these findings with the larger issues of environmental justice and environmental racism explored in Chapter seven.

# CHAPTER SIX:

# THE BIG BEND CASE STUDY: RESEARCH QUESTIONS AND RESULTS OF INQUIRY

This chapter reviews the results of the analysis of this study's research questions. Table 13 shows the various research inquiries, documents used in the comparison and analysis of data, and the specific research questions identified in those documents. Each of these inquiries is discussed in turn below.

**Research Question 1**

The first research question examined whether the EPA actions in the 2000 settlement agreement fit the environmental crimes that TECO had been charged with. TECO appears to have operated without much regulatory oversight from its initiation in 1970 to the FDEP NOV filed in November 1997. This is due to grandfathering clauses in the original CAA under which TECO qualified by a matter of months. Older power plants were not held to the same regulatory standards as newer facilities, as the EPA felt they would be out of operation within 25 years. The NOV cites multiple permitting violations and toxic emissions from modification to Big Bend Units 1 and 2 from 1991 to 1996. FDEP and TECO reach a CFJ in December 1999 wherein TECO agrees to multiple emissions controls and penalties for its Big Bend facility. In late December 1999, TECO filed a petition for approval of compliance with the FDEP implementations of CAA and CFD timetables.

**Table 13.** Document Relevance to Research Questions

| Document Resource | Document Title | Relates to Research Question(s) |
|---|---|---|
| American Lung Association | Toxic Air: The Case for Cleaning Up CFPPs, 3/2011 | 4 |
| Center for Investigative Reporting | Dirty Business, 2009 | 3, 6 |
| Clean Air Task Force | The Toll From Coal, 9/2010 | 4 |
| Clean Water Action Florida | Big Bend Power Station : A Waste Profile of Coal Ash, 2012 | 3, 4, 6 |
| Dewberry & Davis, LLC | Coal Combustion Residue Impoundment Round 9 – Dam Assessment Report | 6 |
| DOJ | Settlement Agreement | 1, 2 |
| Earthjustice | Florida and Coal Ash: Disposal, Contamination, and Inadequate Regulation, 2012 | 3, 4, 6 |
| Earthjustice, Clean Air Task Force | Comments on the US EPA's CCW Damage Case Assessment, 2/11/2008 | 3, 6 |
| EH&E, Inc. | Emissions of Hazardous Air Pollutants from CFPPs, 3/2011 | 3, 4, 6 |
| EIA | Frequently Asked Questions | 4 |
| Environmental Integrity Project | Dirty Kilowatts: America's Most Polluting Power Plants, 7/2007 | 4 |
| Environmental Integrity Project | America's Top Power Plant Toxic Air Polluters, 2011 | 4, 6 |
| Environmental Working Group | New Clean Air Standards are No Sweat in Florida, 1997 | 3 |
| EPA | Coal Cleaning | 6 |
| EPA | Notice of Violation, TECO Big Bend and Gannon Stations | 1, 2 |
| EPA | Counties Designated "Nonattainment" for Clean Air Act's NAQQS, 1/2015 | 3, 6 |
| EPA | Enforcement and Compliance History Online (ECHO) | 1, 2, 3 |
| EPA | Overview of the Clean Power Plan, 6/2014 | 3, 6 |
| EPA | By the Numbers – Cutting Carbon Pollution from Power Plants, 6/2014 | 3, 4, 6 |
| EPA | Civil Lawsuit, 1997 | 1, 2 |
| FDEP | Mercury TMDL for the State of Florida | 4, 6 |
| FDEP | Final Orders Modifying Conditions of Certification | 2 |
| FDEP | Big Bend Power Station State Facility Documents | 1, 2, 3, 5 |
| FDEP | Conditions of Certification, TECO Big Bend Unit 4, 2013 | 2 |

**Table 13. (continued)** Document Relevance to Research Questions

| Document Resource | Document Title | Relates to Research Question(s) |
|---|---|---|
| Florida Clean Power Coalition | Florida's Dirty Dinosaurs, 1997 | 4, 6 |
| Florida Public Service Commission | Review of Coal Combustion Residual Storage and Disposal Processes of the Florida Electric Industry, 12/2011 | 2, 6 |
| HBO Documentary | Gasland, Fox, 2010 | 3, 6 |
| IECG | Coal Fired Power Generation | 2 |
| Independent Science News | How EPA Faked the Entire Science of Sewage Sludge Safety: A Whistleblower's Story, 6/2014 | 4 |
| NAACP, IEN, LVEJO | Coal Blooded: Putting Profits Before People | 3, 4, 6 |
| National Institute on Money in State Politics | Powering The Sunshine State, Barber, 4/2009 | 2, 3 |
| OpenSecrets | Influence and Lobbying, Electric Utilities, 2013-2014 | 2, 3 |
| PERI | Toxic 100 Index, 2013 | 3, 4, 6 |
| PERI | Toxic Flood, 5/2013 | 4, 6 |
| Powermag | Big Bend's Multi-Unit SCR Retrofit | 2 |
| Right To Know Network | Toxic Release Inventory, 2013 | 3, 4, 6 |
| Rolling Stone Magazine | The Dark Lord of Coal Country, Goodell, 2010 | 6 |
| Sourcewatch | Big Bend Station,2/2011 | 2, 3, 4, 6 |
| State of Florida Public Service Commission | Memorandum RE: Cost Recovery Clause, 10/2000 | 1, 2 |
| Tampa Bay Online | 150 Protesters, Law Enforcement Face Off at Big Bend Plant | 3, 6 |
| Tampa Bay Times | Dirty Air: Florida Ranks Third Worst for Power Plant Generated Toxic Air, Klas 7/20/2011 | 2, 3, 6 |
| Tampa Bay Times | Under Scott, DEP Undergoes Drastic Change, 10/18/2014 | 2, 6 |
| TECO | 2014 Corporate Sustainability Report | 2 |
| TECO | Site Certification Application, Big Bend Station Unit 4, 1980 | 1, 2, 5 |
| TECO | Big Bend Power Station Home Page | 2 |
| WUSF News | Study: Florida Third-Worst for Power Plant Pollution, Ramos, 9/2013 | 2, 3, 6 |

TECO reached agreements to settle these issues with EPA (Consent Decree, February, 2000) and FDEP. The consent decree includes the requirements of the CFJ but altered the timeline for compliance dates. Additionally, a civil penalty was assessed, which banned TECO from selling or banking $SO_2$ emission allocation credits, and TECO was required expenditures of up to $9 million on $NO_x$ emission controls. After TECO signed this landmark settlement with the EPA, it filed for a closure of the CFJ with FDEP. The Docket was closed in April 2000, without TECO having to address specifics of the FDEP's CFJ.

In June 2000, TECO filed and received approval for recovery costs associated with complying with prior environmental violations. Costs recovery was allowed despite the existence of prior and current violations.

Despite prior violations, in March 2000, TECO was awarded a government contract for services until September 2007 from the Air Force to provide electric services and refrigeration and air conditioning components in the amount of $44.2 million. In addition, TECO was awarded a contract for electric services from the Department of Veterans Affairs from July to September 2000, in the amount of $1.16 million. Total contracts for FY 2000 from the federal government exceeded $45 million.

The civil penalty assessed in the Settlement was $3.5 million with an additional $10 million to be spent in improvements to facilities and emissions controls. The environmental allotment for the Tampa Bay estuary was $2 million dollars. All of these penalties were phased in over a 10 year period ending December 31, 2010. The federal government also allowed an opt-out clause in the original settlement agreement of February 2000 that stipulated if it could not adequately provide the monetary support to complete Settlement provisions, TECO could shut down the Big Bend facility with no further penalty.

Given the numerous violations, one can conclude that the settlement agreement did not appear to fit the crimes with which TECO was charged. The civil penalties did not pose a financial burden to the company. TECO did not admit any wrongdoing either to the communities that surround the plant or the ecosystem of the affected area. In addition, they passed the cost of settlement onto the customers through the ECRC as well as a final opt-out clause written into the agreement should they not meet their legal obligations to the communities surrounding Big Bend. Some might argue that a $13.5 million settlement is substantial, and certainly, with respect to fines received by other corporate violators with a smaller operation and fewer FY profits for similar offenses, the fine is substantial. Currently, there is no objective mechanism for determining whether penalties received for an environmental crime are substantial or adequate within the legal system. The judge hands down a ruling in a case of this nature, and the disposition of the court on the imposition of damages and/or penalties, can leave this assessment open to subjective interpretations.

**Research Question 2**

The second research query investigated whether TECO's commitment to honor the terms of the settlement agreement and provide environmental justice to the communities that surround the Big Bend facility had been honored.

TECO's noncompliance history under both CAA and CWA legislation indicates that TECO is not providing environmental justice to these communities. The settlement stipulated that TECO would comply with emissions regulations through the original settlement deadline and beyond its termination. This is clearly not the case, as noncompliance with both permitting and emissions are documented in ECHO's compliance records. The outside firm of Dewberry and Davis, LLC, hired by TECO to assess their waste management, originally gave them a "poor" rating in April 2011 with an amended rating of "fair" in the final report by December of that same year. The report cites a lack of supporting documentation for disposal sites and ash pond analysis. Visual inspection and photographic reporting were the basis of the report and the company lists TECO's documentation as an area for improvement in future inspections. They indicated an ash pond with a split liner that could be an environmental hazard. Additionally, TECO's use of the ECRC to pass the cost of settlement conditions onto its customers would qualify as an environmental injustice to these communities through economic hardship.

**Research Question 3**

The third research question explored whether non-compliance issues create a form of environmental injustice through unequal distribution of pollutants. Figure 8 shows an aerial view of Communities that are affected by Big Bend within a 10 mile radius.

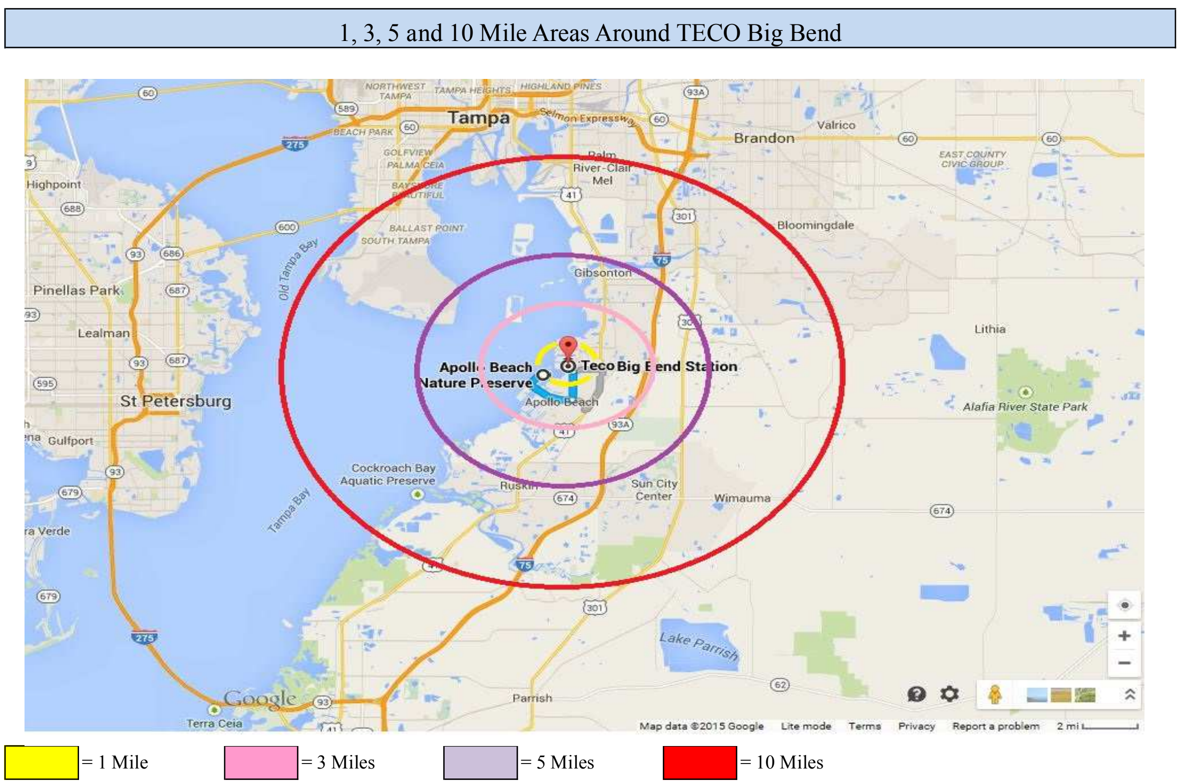



**Figure 8.** Communities That Surround Big Bend within a Ten Mile Radius

The TECO plant has been in noncompliance with CAA and CWA regulatory emissions for PM and significant violations and non-compliance for 13 consecutive quarters since 2011. Chapter three explored the health hazard and impacts of PM matter in both the air and water. It was established that one to five miles from the point source was most hazardous to human health, wildlife, and the environment. The most affected communities are Apollo Beach, areas of

Gibsonton, and Ruskin. It has been shown that the most detrimental effects occur within this radius, these communities would be prone to the health hazards of air and groundwater contamination. The manatee population situated directly below the emission stacks in the viewing station is particularly vulnerable to PM and HAPs emitted through the plumes in air and water.

**Research Question 4**

The fourth research inquiry focused on plant emissions and negative health impacts. Do they constitute environmental injustices in the form of environmental racism against low income and minority population in and around the site? Does the demographic data support this conclusion?

Table 14 shows demographic data for 1, 3, and 5 miles from the point source. In addition, PERI data indicates the poor and minority share of the community in this area. A link to this information can be found in the Table 10 document inventory found in Chapter five. Big Bend affects over 45,000 persons within a five mile radius and ECHO reports that 42% of that population are racial and ethnic minorities. In comparison, Census data indicates that 17% of Hillsborough County residents are African-American, and that 25% are Hispanic. Clearly the percentage of minority resident near the Big Bend facility has a disproportionate minority concentration. Whether that constitutes definitive evidence of environmental injustice cannot be determined without further, future analysis.

In addition, 27% of that population lives below the poverty level. This is significantly higher than the mean percentage of persons below poverty level for Hillsborough County, which

**Table 14.** Demographic Proile of Area Surrounding Big Bend Power Station

TECO Big Bend Power Station

Demographic Profile of Surrounding Area (1, 3 and 5 Miles from Source Point)

| | 1 Mile | 3 Miles | 5 Miles |
|---|---|---|---|
| Radius of Area | 1 | 3 | 5 |
| Center Latitude | 27.795252 | 27.795252 | 27.795252 |
| Center Longitude | -82.403209 | -82.403209 | -82.403209 |
| Total Persons | 178 | 17,579 | 45,530 |

| | 1 Mile | 3 Miles | 5 Miles |
|---|---|---|---|
| Land Area | 68% | 57% | 59% |
| Water Area | 32% | 43% | 41% |
| Population Density | 84/sq.mi. | 1,085/sq.mi. | 992/sq.mi. |
| Percent Minority | 10% | 32% | 42% |

| | 1 Mile | 3 Miles | 5 Miles |
|---|---|---|---|
| Households in Area | 89 | 6,741 | 16,216 |
| Housing Units in Area | 118 | 7,827 | 18,657 |
| Household on Public Assistance | 1 | 211 | 467 |
| Persons Below Poverty Level | 52 | 4,659 | 12,030 |

| | Persons (%) | | | | Persons (%) | | |
|---|---|---|---|---|---|---|---|
| **Race Breakdown** | **1 Mile** | **3 Miles** | **5 Miles** | **Age Breakdown** | **1 Mile** | **3 Miles** | **5 Miles** |
| White: | 164 (92.13%) | 14,218 (80.88%) | 33,341 (73.23%) | Child 5 years and younger | 5 (2.81%) | 1,300 (7.4%) | 3,971 (8.72%) |
| African-American | 3 (1.69%) | 1,799 (10.23%) | 6,626 (14.55%) | Minors 17 years and younger | 15 (8.43%) | 4,276 (24.32%) | 12,800 (28.11%) |
| Hispanic Origin | 5 (2.81%) | 3,173 (18.05%) | 10,326 (22.68%) | Adults 18 years and older | 162 (91.01%) | 13,303 (75.68%) | 32,730 (71.89%) |
| Asian/Pacific | 8 (4.49%) | 430 (2.45%) | 1,169 (2.57%) | Seniors 65 years and older | 93 (52.25%) | 2,307 (13.12%) | 4,477 (9.83%) |
| American Indian | 1 (.56%) | 64 (.36%) | 170 (.37%) | | | | |
| Other/Multiracial | 3 (1.69%) | 1,068 (6.08%) | 4,224 (9.28%) | | | | |

| | Persons (%) | | | | Households (%) | | |
|---|---|---|---|---|---|---|---|
| **Education Level (Persons 25 & Older)** | **1 Mile** | **3 Miles** | **5 Miles** | **Income Breakdown** | **1 Mile** | **3 Miles** | **5 Miles** |
| Less than 9th Grade | 4 (2.38%) | 453 (3.88%) | 1,217 (4.59%) | Less than $15,000 | 6 (6.25%) | 426 (6.55%) | 1,019 (6.83%) |
| 9th through 12th Grade | 15 (8.93%) | 1,043 (8.94%) | 2,604 (9.82%) | $15,000 - $25,000 | 13 (13.54%) | 532 (8.18%) | 1,308 (8.76%) |
| High School Diploma | 57 (33.93%) | 3,292 (28.2%) | 7,656 (28.88%) | $25,000 - $50,000 | 32 (33.33%) | 1,681 (25.85%) | 3,897 (26.11%) |
| Some College/2-year | 52 (30.95%) | 3,903 (33.44%) | 8,689 (32.78%) | $50,000 - $75,00 | 16 (16.67%) | 1,447 (22.25%) | 3,306 (22.15%) |
| B.S./B.A. or More | 40 (23.81%) | 2,982 (25.55%) | 6,342 (23.92%) | Greater than $75,000 | 29 (30.21%) | 2,418 (37.18%) | 5,397 (36.16%) |

http://echo.epa.gov/detailed-facility-report?fid=110008319505#TRIinfo

is 15%. Again, whether or not this difference specifically constitutes definitive evidence of environmental injustice require further, complex GIS analysis.

Within the five-mile radius, 14% of the population has not achieved a high school education and 20% live on an annual income of less than $25,000. For Hillsborough County 13% of the population have less than a high school education, and a mean income of $27,149. These indicators suggest that it is unlikely that there is a form of environmental injustice in this case related to income and education. For the year studied (2011), Census reporting used the federal standards for the poverty level. This figure represents a two parent household with four children and the level the government considered the poverty line for that year.

Finally, the number of minors is significant with ECHO reporting 28% of those persons listed within the five-mile radius are 17 years of age or younger. Children five and younger constitute 9% of the population living in the affected area. The figures for Hillsborough County are 23% and 6% respectively. These figures indicate that the young are not unequally impacted by the facility.

Of the 178 persons listed as living within one mile of the point source, 52 people (29%) within this population are in the most hazardous area for health effects. Ten percent of this population is minority, with 11% of these persons, 17 years or younger, and 11% in this area without a high school diploma. Further breakdown of the poverty levels in this region indicated that 20% of the population who live within one mile has an annual income of $25,000 or less.

The elderly population of this area, those 65 years and older are a population of concern for the disproportionate effects of toxic pollutants. Research indicates that this population is as vulnerable to toxic emissions as the very young. For this case study, the five mile radius was used to determine significant impacts on environmental justice issues. The senior citizen communities, including assisted living facilities and retirement communities within the geographic area around Big Bend, were 10%. If the research radius had been expanded to 10 or 15 miles this number would have increased. This warrants further research into the impacts on the elderly and infirm residents of this community who are particularly vulnerable to HAPs in the atmosphere.

PERI indicated scores for environmental justice research. The basis for their reporting is the TRI index of HAPs reported by each facility. The most recent PERI breakdowns for TECO Big Bend indicated the following: EJ Poor Share 13.6% and EJ Minority Share 36.7%, calculated based on information from the 2010 Census information. Poor share is percentage of people living below the federal poverty line, while EJ Minority Share is the percentage of racial and ethnic minorities. The EPA also provides a "Toxic Score" for the facility. According to

PERI, TECO Energy Inc. released 517,850 pounds of toxic emissions into the atmosphere in 2010. Big Bend was responsible for 299,110 pounds of these emissions, accounting for 58% of total emissions and over all TECO Big Bend accounts for 91% of the Company's toxic score emissions. The data provided from PERI indicates environmental injustices in both non-compliance issues as well as negative health impacts to the communities that surround Big Bend. The PERI data serves to answer research question four and supports the conclusions drawn for research questions one and three.

Additionally, health impacts are shown in Table 15. Florida ranked 14th in the nation in mortality rates, hospital admissions, and heart attacks attributable to HAP emissions from CFPPs. Table 15 reveals those directly attributable to the Big Bend facility. These figures, acquired in February 2011, show 17 fatalities directly attributable to Big Bend toxic emissions. In comparison, the Hillsborough County Sheriff's Office Homicide Section investigated 35 fatalities in 2011 (HCSO, 2011). In a community profile compiled for the health department in 2010/2011, the death rate is higher in Hillsborough County than for the State of Florida; 728 v 656 per 100,000 persons (Hillsborough County Health Profile 2010/2011). The value of negative health impacts for 2010 directly attributable to Big Bend were estimated to be over $127 million dollars. Appendix A, Table A3 lists health impacts from CFPPs on a national scale for comparison to state and local data, which appears in Table 15. The total expenses for death and disease attributed nationally estimated at $619 million for 2010. The dollar amount for Big Bend is almost 20% of the national scale.

Part of addressing environmental justice issues relates to determining the unequal exposure of a population to pollutants. Above it was noted that the population near the Big Bend facility has high concentrations of African Americans and Hispanics. Part of assessing whether

**Table 15.** Health Impacts Attributable to Big Bend Facility

State Health Impacts (Annual 2010 est.)

| Rank | State | Mortality | Hospital Admissions | Heart Attacks |
|---|---|---|---|---|
| 14 | Florida | 313 | 228 | 435 |

http://www.catf.us/resources/publications/files/The_Toll_from_Coal.pdf

Death and Disease Attributable to Big Bend

| Type of Impact | Annual Incidence | Valuation |
|---|---|---|
| Mortality | 17 | $120,000,000 |
| Hospital Admissions | 13 | $290,000 |
| ER Visits for Asthma | 14 | $5,000 |
| Heart Attacks | 23 | $2,500,000 |
| Chronic Bronchitis | 9 | $4,200,000 |
| Asthma Attacks | 240 | $12,000 |

http://www.sourcewatch.org/index.php/Big_Bend_Station
Source: "Find Your Risk from Power Plant Pollution," Clean Air Task Force interactive table, accessed February 2011

they are subject to environmental injustice includes examining their exposure to environmental toxins. Table 16 shows total releases into air and surface groundwater from Big Bend from 2005 to 2013. Blank cells indicated a failure by TECO to report an emission. With the exception of emissions for HCl, sulfuric acid and zinc, which declined, and dioxin, hydrogen fluoride, and Nickel, which remained constant, there were increases in emissions in the remaining nine reported pollutants, while insufficient data were available to assess the quantity of five emitted pollutants. Table 16 reveals a similar pattern of toxic air emissions and total surface water discharge TRI pollutants for total pollution at Big Bend. TRI for total air emissions has decreased 35% since 2005, while surface water discharges have increased by over 70%. Total offsite releases have increased from 6,531 pounds to 61,677 pounds, or by 944%.

**Table 16.** Toxic Release Inventory Pollution Report Big Bend Facility, 2005 - 2013

| TRI Pollution Prevention Report, TECO Big Bend Power Station | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TRI Facility ID | Year | Total Air Emissions | Surface Water Discharges | Off-Site Transfers to POTWs | Underground Injections | Releases to Land | Total On-site Releases | Total Off-site Releases |
| 33572TMPLC13031 | 2005 | 1,163,130 | 11,656 | 0 | | 7,637 | 1,182,423 | 6,531 |
| 33572TMPLC13031 | 2006 | 1,178,001 | 7,171 | 0 | | 18,222 | 1,203,394 | 28,846 |
| 33572TMPLC13031 | 2007 | 1,193,976 | 11,882 | 0 | | 17,700 | 1,223,558 | 103,749 |
| 33572TMPLC13031 | 2008 | 1,317,176 | 36,595 | 0 | | 1,886 | 1,355,657 | 81,674 |
| 33572TMPLC13031 | 2009 | 1,130,910 | 5,458 | 0 | | 16,895 | 1,153,263 | 67,767 |
| 33572TMPLC13031 | 2010 | 921,696 | 9,768 | 0 | | 1,874 | 933,338 | 77,411 |
| 33572TMPLC13031 | 2011 | 881,645 | 8,377 | 0 | | 0 | 890,022 | 75,350 |
| 33572TMPLC13031 | 2012 | 286,225 | 872 | 0 | | 0 | 287,097 | 92,239 |
| 33572TMPLC13031 | 2013 | 329,492 | 81,818 | 0 | | 0 | 411,310 | 61,677 |

http://echo.epa.gov/detailed-facility-report?fid=110008319505#TRIinfo

These figures question TECO's environmental commitment to communities surrounding the Big Bend facility. Since the settlement agreement compliance deadline of 12/31/2010, current groundwater contaminants remain a significant hazard. Total PM emissions have not been in compliance for 5 quarters. These issues have been present since 2011 and continue to the first quarter of 2015. In 2008, EarthJustice reported significant groundwater contaminants with elevated levels of boron, sulfate, and heavy metals in coal ash disposal area 2. Arsenic was reported at 11 times the maximum contaminant level (MCL), thallium at 8 times the MCL and fluoride at 4 times the MCL. Secondary maximum contaminant levels (SMCLs) were much higher with Boron in groundwater at 700 times the SMCL, manganese was 240 times its SMCL and sulfate was 128 times the SMCL level for Florida guidance concentrations. EarthJustice also found contaminants measure in groundwater at the gypsum storage area at Big Bend exceeded boron standard by 40 times the SMCL and 66 times for iron and manganese by 11 times the SMCL for Florida guidance concentrations. In light of the gross contamination in primary and secondary MCLs they recommended that EPA investigate the facility for its potential threat to health and the environment, and list it as a damage case.

Over all, these rudimentary assessments suggest some potential evidence of environmental injustice for residents near the Big Bend facility. Further and more complex analysis is, however, required to reach a more definitive conclusion on this matter.

**Research Question 5**

The fifth inquiry lies at the heart of environmental racism. Did TECO intentionally choose the Big Bend site due to the expected population demographics, or is this environmental dilemma a consequence of normal population growth? This is the most difficult question to quantify in a single case study. Internal documents from TECO indicated company awareness that potential population growth in the area surrounding the plant was probable. In their 1980 application for Site Licensing for Unit 4, TECO goes into detail about the regional demography within a five- mile radius of the proposed facility. They calculate population growth in Hillsborough County from 1960 to 1970 and approximate the population growth in surrounding towns. They continue to estimate population growth through 1977 for this report. They projected a 69% increase in Hillsborough County population from 1970 to 1977 and a 74% increase in the Gibsonton population. Ruskin was calculated at an even higher 116.5%. With these figures included in a report dated August 1980, it would appear that TECO was well aware that this area would have a population surge that could impact the health and welfare of persons living within that five-mile radius. One cannot speculate on the intent of the company. But, the figures that TECO presented to the Florida DEP for Site Certification, would certainly indicate that they knew the area was going to have a "substantial increase in population" (TECO Site Certification, 1980, p. 2.2-1). Whether or not TECO had any indications that the deleterious environmental impacts of the plant might change the racial and ethnic composition of the affected area cannot be ascertained from these data. The available data, therefore, do not allow conclusions to be reached on this question.

**Research Question 6**

The final research inquiry explores whether negative ecological impacts from CFPP emissions constitute a form of environmental injustice to the communities that surround Big Bend. The number of endangered species listed in the TECO Site Certification Report of 1980 indicates that TECO was aware of how many land, air, and water species would be affected by toxic emissions from the plant. In this report, Section 2.3 lists regional, historic, scenic, cultural and natural landmarks that could be affected. Section 2.7 lists the ecology affected with terrestrial and aquatic species listed by name and type. The manatee population discussed in Chapter two is included in this report, however, there is no data predicting adverse effects on the population. The report deals with operations for monitoring the wildlife and ecosystems but makes no predictions on adverse effects to the wildlife population. Current data on wildlife health for Hillsborough County, such as a broad-based wildlife health survey, does not currently exist, and limits the ability to answer this question.

**Conclusion**

In sum, the research questions have been identified and information pertinent to the discussion presented for review. The data can be replicated from more than one source (e.g., Table 12, and Table 13). As noted above, there is some preliminary evidence of certain forms of environmental injustice in the area. This suggests that further research on this question is warranted.

## CHAPTER SEVEN:

## DISCUSSION, FUTURE RESEARCH AND CONCLUSION

### Discussion

Three main themes have been repeated within this case study. First is TECO's response to the charges brought against their Big Bend facility in the initial NOV and subsequent lawsuits, as well as their compliance history since the settlement in 2000. The second involved questions of environmental justice. The third included an analysis of detrimental health effects associated with CFPPs.

### TECO's Responses and Compliance History

TECO's rapid response to the original lawsuit raised some interesting questions. The FDEP filed in November 1997, proceeded with formal legal action in 1999, and was joined by the EPA in November 1999. Both filings, and the FDEP response by a CFJ occurred within one month. By the conclusion of December 1999, TECO had formalized its CFJ with the FDEP and was left to deal with only formal charges brought by the EPA. The DOJ, on behalf of the EPA, announced just two months later that it had settled with TECO in a landmark environmental agreement.

TECO settled with both state and federal regulatory agencies in rapid succession. In a judicial system where lawsuits can take months and years to settle, TECO managed to conclude regulatory concerns in what can only be described as record time. The conditions of the settlement agreement between TECO and EPA are public knowledge, but how the parties arrived at the agreement so expeditiously are a matter for speculation. TECO's monetary investment in improvements and civil penalties assessed by the government amounted to just short of $15 million dollars. TECO's legal maneuvering included the closure of the Docket on its FDEP case. TECO was not held accountable for the provisions of the Florida CFJ, only the provision of the CFJ that the EPA included in their lawsuit. In addition to this legal injustice to the state, TECO then filed for reimbursement for all the pollution controls and monitoring equipment stipulated in the final settlement with the EPA. In October 2000, TECO filed for relief through the Environmental Cost Recovery Clause. The court approved the request. TECO was allowed to pass the cost of all renovations, pollution controls, and monitoring onto its customers through systematic rate increases. The government's settlement agreement included a ten year time frame for all compliance issues as well as an opt-out clause for TECO in the event it could not complete the necessary renovations and remain financially solvent.

In the investigation of the legal timing of proceedings, research uncovered a few interesting caveats. TECO began legal proceedings in November 1999 and concluded an agreement to settle in February 2000. Cost recovery was requested in October 2000 and a legal agreement reached by the end of 2000. Curiously, TECO had government contracts pending with both the Department of Defense and the Department of Veterans Affairs that were set to begin in 2000. TECO would have been vetted thoroughly and in the final stages of the contract bidding process for any companies that desired those government contracts. However, despite these time constraints, TECO was awarded two large government contracts immediately following the settlement agreement. In March 2000, the Department of Defense awarded TECO a seven year contract to supply electric services and refrigeration and air conditioning components for the Air Force in the amount of $44.2 million dollars. The Department of

Veterans Affairs entered into a $l.16 million dollar contract with TECO in July 2000. The timing of these contracts, so close to the settlement agreement with the EPA and the DOJ's involvement, present a possible conflict of interest.

TECO has been regularly awarded government contracts throughout the settlement period. The total obligation amount to TECO in government contracts from 2000 to the present day is $87.7 million dollars. Was it necessary for the government to provide a ten year window for compliance and an opt-out clause for TECO? With over $45.36 million dollars in government contracts already in the bidding process, the settlement posed no danger to TECO's financial stability. TECO received financial assistance through the ECRC and passed on costs to its customers. With the amount of money in government contractual obligations pending for an additional six years, was the ECRC necessary, and did the communities around Big Bend suffer a financial hardship due to rate increases? This is an argument that the community should have been made aware of at the time of the settlement agreement. TECO had received and completed their contract to the Department of Veterans Affairs when it applied for ECRC assistance. These actions by TECO were not in the interests of the communities that surround Big Bend.

The second research question involved TECO's compliance history with the conditions of the settlement. TECO promoted its environmental record, and compliance history as being up-to-date (TECO, 2014). However, reports compiled by government oversight agencies, third party contractors for TECO, as well as environmental watchdog groups, indicated a different reality. TECO's historic and current non-compliance in CAA and CWA regulations show a disregard for the health concerns of the communities surrounding the plant. Significant noncompliance in PM emissions, as well as CWA violations for 13 consecutive quarters, shows a lack of environmental responsibility for wildlife and human health issues. Various reports have cited 10 unlined ash ponds as well as damage in the protective liner of the single ash pond that contains a protective liner.

TECO has been cited in the past for a lack of documentation to support their maintenance schedules, lack of proper documentation on pollution monitoring equipment, and permit violations. In 2008, EarthJustice reported significant groundwater contamination at the Big Bend location, but EPA did not investigate the allegations. No cases seeking damages were filed, no violations issued, and no penalties were assessed on TECO. Clearly, TECO has not shown consistency in regulatory compliance, but demonstrates a continued lack of commitment to the long term health and welfare of the communities surrounding Big Bend through these inconsistencies in compliance history. The question of effective deterrence for large corporations involved in environmental crimes is highlighted in this case study. Without effective deterrent programs implemented and vigorously enforced, the corporate crimes committed against the environment will continue unimpeded. The regulatory agencies are responsible for this arm of law enforcement for the constituency of this area. Without any deterrence, the crimes will simply continue.

**Environmental Justice Issues**

The current levels of HAP emission make a strong case for environmental injustice, particularly to those communities within a five-mile radius of Big Bend. In the past 10 years, there has been significant residential and business development in Apollo Beach, Ruskin and western portions of Gibsonton. The housing units occupying the eastern shores of Tampa Bay are within one to three miles of the point source. The continued residential development in this area, along with the construction of a large hospital, is of concern as they are all within the five-mile radius of the facility.

Further investigation of the current demographic constituency would provide a more accurate picture for those pursuing the environmental justice issues regarding the unequal distribution of toxic air and water emissions surrounding Big Bend, as some of the events listed here have occurred since the last Census.

The current demographic data supplied by ECHO and PERI would suggest further investigation into alleged environmental racism by TECO is needed. ECHO reported a 42% minority base and PERI gave TECO a 36% minority share. The differences in percentages could be due to the breakdown of ethnic and minority demographics in the community and the calculated distances from the point source. ECHO maintains its search within the five-mile radius while the minority share of PERI is up to a 31 miles from the point source. This could account for the differences in percentage of minority population. The poverty shares and demographics in level of household income are calculated in the same way. The data reported on poverty levels in this area, as well as those who do not have a high school education, are disturbing at 26%, and provide additional support for an allegation of environmental racism.

These data indicate an environmental justice issue in these communities. Further research to expand the range of demographic information would solidify the argument. The PERI data should be narrowed to the same demographic area as the ECHO data, or ECHO data expanded to a wider area, in order to confirm what each agency has calculated as poor and minority affected areas of concern, however, both sets of data suggest that environmental injustices have occurred to the poor and minority populations. Ten to fifteen miles from the point source the population is largely residential and has a considerable number of senior citizens, 65 and over. As the data has shown, the elderly and children have the most significant health concerns with regard to HAPs in the air and water. Further study is warranted to determine if there is an unequal distribution of pollutants effecting this vulnerable population as the current five mile radius is not sufficient for a conclusion to be reached regarding this population.

The current study cannot state that TECO intended to commit any environmental justice infractions. TECO's internal documentation indicated that the company was aware of the potential for expansion in this demographic region. Additional internal documentation needs to be reviewed in order to come to a more decisive conclusion on TECO's motivation for choosing the site at Big Bend as opposed to other sites that were proposed in 1970. Those records were not obtainable through the public domain, however, all site applications are public record and this information should be obtained for further research and scrutiny. The motives behind the choice of this location may not ever be known. Therefore, criminal intent with regard to environmental justice would be difficult to prove in court without a direct witness or statement from within TECO. The mens rea of TECO management is purely subjective, however, reports suggest that there were indicators of significant population increases in the area surrounding the plant contained in the report and subsequent site application.

Ecological impacts have been documented throughout the case study. Health and environmental impacts on non-human life forms and specifically endangered species through the HAPs emitted in air and water within the five mile radius of Big Bend are well documented. These HAPs can have effects beyond the five mile radius through the atmospheric residual times specific to each toxin. The danger to freshwater, groundwater and specifically the waters of Tampa Bay, Hillsborough Bay and the Alafia River are a concern for there are many species that depend on the land and water resources to sustain life. The manatee population is of great concern as they congregate directly below the stacks in the southeastern section of the Bay closest to the point source. TECO has planned to open a Conservation and Technology Center in cooperation with the Tampa Aquarium. It will be interesting to note what species will be included in this new Center and what impacts the HAPs from Big Bend will have on that community of wildlife. The Center will be located in a piece of land adjacent to the current manatee viewing station.

With respect to the third major question about health impacts, a significant number of studies were reviewed on that issue. As noted throughout that review, CFPP pollutants have extensive and significant health impacts that appear to warrant further environmental regulation to protect pubic health.

**The Utility Lobby**

The final area for discussion is the utility lobby, at both the federal and state levels. The Oil and Gas Lobby is influential. It is one of the largest lobbying organizations, both in corporation participation, and political PAC contributions to both political parties. Recently, politicians were supported with PAC contributions from the Oil and Gas Lobby in excess of $368,000 dollars in the 2012 mid-term elections (OpenSecrets.org, 2014).

Florida imports coal to burn in CFPPs around the state at a cost of over $307 million dollars annually (Union of Concerned Scientists, 2010). Renewable energy sources are not promoted in the state of Florida as sustainable for the future. Solar and wind energy are not on the lobbying agenda for our State politicians. For consumers wanting to use renewables, the costs are exorbitant, and renewables are even prohibited in some areas. Solar panels, for instance, are not permitted in certain residential areas and many homeowners find it cost prohibitive to install solar in their homes. The utility lobby in the State Legislature has donated in excess of $2 million dollars to various campaigns in Florida's 2013-14 midterm elections.

PAC lobbying efforts have increased, with $5 million donated in 1990 to over $18 million dollars in total campaign contributions donated through 2014. Whether this affects the ability of our regulatory agencies to effectively monitor utility companies presents an interesting research topic.

Under our current legislative leadership, the FDEP has less time to review a claim and no time to consider a claimant before issuing an environmental permit in the state. Permitting turnaround time has changed from 44 days to 2 days. Duke, Florida Power and Light, and TECO are all financial contributors to this large political action committee, which state legislators are eligible to receive; " ... Following an established pattern, Republicans will continue to promote less regulation than Democrats, although public opinion has been, and will be, a wild card in this trend. Few presidents (or politicians) have been able to ignore public concern for the environment though some have tried..." (Lynch et al. 2014; p.291). The representative for state Congressional District 11 in the House of Representatives, where the Big Bend plant is located, is Richard B. Nugent. According to Insidegov.com and based on ratings from various national interest groups between 2012 and 2014. Representative Nugent's agenda was "strongly pro-business, strongly against animal rights, strongly against environmental regulation. According to inside.gov resources, Representative Nugent, "strongly opposes" prioritizing green energy issues. He received $9,000 of his estimated $211,830 in PAC contributions from utility companies in Florida including TECO (insidegov.com, 2015).

On June 2, 2014, President Obama proposed the Clean Action Plan, to cut carbon emissions from CFPPs like Big Bend. On April 17, 2015, the EPA enacted CFR Parts 257 and 261 in a final rule that deal with hazardous and solid waste management systems, and the disposal of coal combustion residuals from electric utilities. These new regulations will fall under sections of RCRA and are of the overall Clean Action Plan to reduce emissions and HAPs into the atmosphere (gpo.gov, 2015). It remains to be seen if Congress will support the President in efforts to clean up CFPP waste and emission of HAPs.

**Implications for Future Research and Conclusion**

There are several issues raised in this case study that warrant further research. First, are the regulatory responses by the EPA and FDEP to CFPP violations of the CAA and the CWA. How can environmental justice be implemented when the agencies dedicated to oversight are not enforcing current laws? At the very least, penalties should be paid for infractions TECO's Big Bend facility has displayed. How are the utility lobby efforts putting pressure on the nation's regulatory agencies through PAC contributions to legislators? These questions hold a host of potential research inquiries. Who is contributing? How much money is devoted to utility concerns, particularly legislation that affects CFPPs?

Further research into CEV and green victimization need to be addressed within current criminological theory. Green criminologists have tasked themselves with the application of current criminological theory to the broader interpretation necessary to apply these theories to environmental law and crime. Deviant behaviors by corporations, state-corporate crime and crimes committed by nations against the environment need to be vigorously researched in order to establish a global consensus of the definition of crime and punishment in this very broad area of criminology. This study has focused on three distinct criminological theories that can be applied to corporate environmental crime on a global scale. The RC and Deterrence theories have been applied to green violence and explored extensively in the literature by scholars in green criminology such as Lynch, Michalowski, Stretesky, Burns, Barrett and colleagues. RAT has shown itself to be an equally viable explanation for corporate malfeasance and further research using this criminological premise is warranted for questions regarding the crime and punishments for environmental injustice, including the environmental crime committed by TECO and those of similar typology.

A broader study of issues concerning environmental racism around CFPPs at Big Bend, and a broader study of the CFPPs in Florida that have the same megawatt capacity or higher, would be a contribution to the environmental justice literature. Are the demographics in these areas the same as those at Big Bend, or are there significant differences between them? The comparison would provide a clearer picture of possible environmental racism and injustices to communities around a CFPP such as Big Bend. Future studies could expand the five-mile radius to a 10, 15 or even 30 miles radius to investigate environmental injustices to a broader spectrum of communities. Additionally, further research on impacts to minorities, or the impoverished of these communities to determine specific instances of environmental racism could be explored.

Future research on the complete CWA profile at the Big Bend facility would provide a wider profile of ecological harm to human and non-humans. More information on groundwater contamination and the potential for pollutants to enter the drinking water supply of the communities within the five mile radius would provide more information to environmentalists who study environmental justice and corporate malfeasance. Many rural communities rely on well water, which can be contaminated by groundwater pollutants and further effect the health and welfare of the inhabitants. Research into specific contaminants found in the drinking water supply that are in areas surrounding CFPPs such as Big Bend would be advantageous for the completion of the larger environmental justice picture.

In conclusion, this study of Big Bend revealed many inconsistencies in regulation and oversight of this facility. In order for the inhabitants of these communities to receive proper environmental protection, an immediate, decisive response from EPA and FDEP is necessary. When infractions occur, penalties should be assessed and fines paid in accordance with the law. Until then, communities surrounding Big Bend will continue to pay the price in poor health, morbidity rates, and a declining ecosystem. Researching this case found no grassroots or environmental organizations directly involved in the investigation of either environmental injustices or environmental racism in the affected communities that surround Big Bend. Suggestions for future research include a focus on community activism that promotes a dialogue between TECO and the affected communities. A study on the direct impacts of HAPs produced at Big Bend on the wildlife in the area, particularly the manatee population, coupled with wildlife in the new Conservation Center is warranted. Baxter and Jack (2008) said, "...the case study is an excellent opportunity to gain tremendous insight into a case...enables the researcher to gather data...to illuminate the case." I could not agree more with this statement, with respect to the study of TECO's Big Bend utility plant. The businesses, property owners, homeowners, and the general public surrounding Big Bend have a right to know exactly what is in the air and water of their community.

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# APPENDICES

## Appendix A:  Florida Department of Environmental Protection Communication

Florida Department of Environmental Protection   Inbox x

**Gibbs, Ana** <Ana.Gibbs@dep.state.fl.us>   May 21

to me

Good Evening,

Thank you for contacting the Florida Department of Environmental Protection.  Here is the link to the information provided by the applicant:

http://dep.state.fl.us/siting/certified_facilities_map/power_plants/SWD/big_bend.htm

This is the information the Department has associated with the Big Bend application.

Best regards,

*Ana Gibbs*

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## Appendix B: Supplementary Tables

**Table B1.** Toxic Release Inventory of Big Bend Facility, 2005 - 2013

| TRI Total Releases and Transfers in Pounds by Chemical and Year, TECO Big Bend Power Station | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** |
| AMMONIA | | | 9,958 | 30,991 | | | | | 104,250 |
| ARSENIC COMPOUNDS | 314 | 610 | 1,379 | 1,046 | 1,007 | 986 | 1,044 | 1,234 | 867 |
| BARIUM COMPOUNDS | 2,515 | 6,820 | 16,060 | 10,720 | 10,899 | 10,350 | 9,680 | 11,890 | 10,426 |
| BERYLLIUM COMPOUNDS | 89 | 215 | 520 | 366 | 358 | 347 | 338 | 418 | 385 |
| CHROMIUM COMPOUNDS(EXCEPT CHROMITE ORE MINED IN THE TRANSVAAL REGION) | 1,362 | 3,437 | 7,643 | 5,467 | 5,373 | 5,205 | 4,939 | 6,142 | 5,452 |
| COBALT COMPOUNDS | 323 | 870 | 1,930 | 1,366 | 1,312 | 1,246 | 1,190 | 1,479 | 1,440 |
| COPPER COMPOUNDS | 1,266 | 2,050 | 3,410 | 2,780 | 2,748 | 2,660 | 2,630 | 3,137 | 2,730 |
| DIOXIN AND DIOXIN-LIKE COMPOUNDS | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| HYDROCHLORIC ACID (1995 AND AFTER ACID AEROSOLS ONLY) | 265,427 | 300,000 | 270,000 | 273,488 | 250,000 | 260,000 | 280,000 | 91,000 | 133,000 |
| HYDROGEN FLUORIDE | 22,782 | 26,000 | 23,000 | 23,474 | 22,000 | 23,000 | 24,000 | 25,600 | 24,000 |
| LEAD COMPOUNDS | 1,218 | 2,621 | 6,322 | 4,552 | 4,462 | 4,332 | 4,422 | 5,284 | 2,051 |
| MANGANESE | | | | | | | | | |
| MANGANESE COMPOUNDS | 2,120 | 5,400 | 11,380 | 7,930 | 7,978 | 7,680 | 7,030 | 8,930 | 7,530 |
| MERCURY COMPOUNDS | 139 | 166 | 160 | 154 | 111 | 93 | 92 | 36 | 42 |
| MOLYBDENUM TRIOXIDE | | | | | | | | | |
| NAPHTHALENE | | 59 | 53 | 53 | 50 | 54 | 55 | 56 | 50 |
| NICKEL COMPOUNDS | 3,086 | 8,170 | 17,280 | 12,530 | 12,180 | 11,500 | 10,760 | 13,479 | 3,352 |
| NITRIC ACID | | | | | | | | 0 | 0 |
| POLYCYCLIC AROMATIC COMPOUNDS | | | | | | | | | |
| SULFURIC ACID (1994 AND AFTER ACID AEROSOLS ONLY) | 866,063 | 840,000 | 890,000 | 1,006,122 | 850,000 | 629,484 | 568,570 | 157,000 | 142,000 |
| VANADIUM COMPOUNDS | 5,309 | 14,900 | 34,700 | 24,080 | 24,230 | 22,770 | 21,900 | 27,450 | 24,600 |
| XYLENE (MIXED ISOMERS) | | 120 | 110 | 110 | 110 | 140 | 120 | 119 | 110 |
| ZINC COMPOUNDS | 16,939 | 20,800 | 33,400 | 32,100 | 28,210 | 30,900 | 28,600 | 26,080 | 10,700 |

http://echo.epa.gov/detailed-facility-report?fid=110008319505#TRIinfo

## Appendix B: Supplementary Tables (continued)

**Table B2.** National Ambient Air Quality Standards

**National Ambient Air Quality Standards (NAAQS)**

EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. They are listed below. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air (µg/m3). As of October 2011.

| Pollutant [final rule cite] | | Primary/Secondary | Averaging Time | Level | Form |
|---|---|---|---|---|---|
| **Carbon Monoxide** [76 FR 54294, Aug 31, 2011] | | primary | 8-hour | 9 ppm | Not to be exceeded more than once per year |
| | | | 1-hour | 35 ppm | |
| **Lead** [73 FR 66964, Nov 12, 2008] | | primary and secondary | Rolling 3 month average | 0.15 µg/m3 (1) | Not to be exceeded |
| **Nitrogen Dioxide** [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996] | | primary | 1-hour | 100 ppb | 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years |
| | | primary and secondary | Annual | 53 ppb (2) | Annual Mean |
| **Ozone** [73 FR 16436, Mar 27, 2008] | | primary and secondary | 8-hour | 0.075 ppm (3) | Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years |
| **Particle Pollution** 12/14/2012 | $PM_{2.5}$ | primary | Annual | 12 µg/m$^3$ | annual mean, averaged over 3 years |
| | | secondary | Annual | 15 µg/m$^3$ | annual mean, averaged over 3 years |
| | | primary and seondary | 24-hour | 35 µg/m$^3$ | 98th percentile, averaged over 3 years |
| | $PM_{10}$ | primary and secondary | 24-hour | 150 µg/m$^3$ | Not to be exceeded more than once per year on average over 3 years |
| **Sulfur Dioxide** [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973] | | primary | 1-hour | 75 ppb (4) | 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years |
| | | secondary | 3-hour | 0.5 ppm | Not to be exceeded more than once per year |

(1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(2) The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(3) Final rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

(4) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation

http://www.epa.gov/air/criteria.html

**Appendix B: Supplementary Tables (continued)**

**Table B3.** National Health Impacts from Coal Fired Power Plants

National Power Plant Impacts (2010 est.)

| Health Impact | Incidence (Annual) | Valuation ($ Millions) |
|---|---|---|
| Mortality | 13,200 | $96,300 |
| Hospital Admissions | 9,700 | $230 |
| ER Visits for Asthma | 12,300 | $5 |
| Heart Attacks | 20,400 | $2,230 |
| Chronic Bronchitis | 8,000 | $3,560 |
| Asthma Attacks | 217,600 | $11 |
| Lost Work Days | 1,627,800 | $150 |

http://www.catf.us/resources/publications/files/The_Toll_from_Coal.pdf