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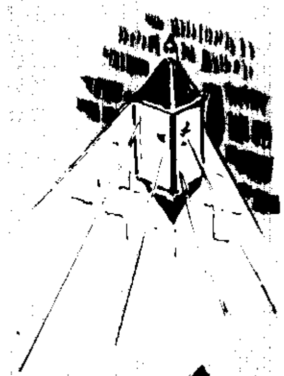
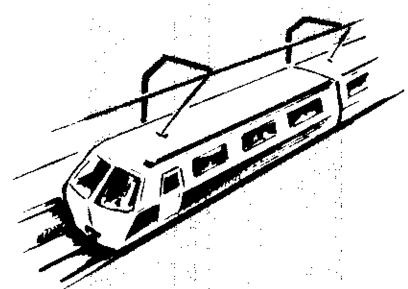
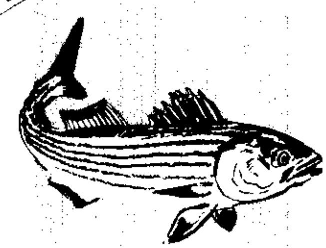


# POWER PLANT CUMULATIVE ENVIRONMENTAL IMPACT REPORT





January 1984


MARYLAND POWER PLANT SITING PROGRAM

DEPARTMENT OF NATURAL RESOURCES ■ DEPARTMENT OF HEALTH AND MENTAL HYGIENE ■ DEPARTMENT OF ECONOMIC AND COMMUNITY DEVELOPMENT ■ DEPARTMENT OF STATE PLANNING ■ DEPARTMENT OF TRANSPORTATION ■ DEPARTMENT OF AGRICULTURE ■ COMPTROLLER OF THE TREASURY ■ PUBLIC SERVICE COMMISSION

TORREY C. BROWN, M.D.
SECRETARY

STATE OF MARYLAND
DEPARTMENT OF NATURAL RESOURCES
TAWES STATE OFFICE BUILDING
ANNAPOLIS 21401

LOUIS N. PHIPPS, JR.
DEPUTY SECRETARY

December 19, 1983

The Honorable Harry Hughes
Governor, State of Maryland
State House
Annapolis, MD 21401

Dear Governor Hughes:

The fourth Cumulative Environmental Impact Report prepared pursuant to the Maryland Power Plant Siting Act is forwarded. The Report reviews the results of economic and environmental studies with respect to the cumulative impact of power plants on Maryland's environment.

With the completion of coal conversions of the Crane and Brandon Shore Power Plants by 1988, coal-fired generation will supply the majority of power generation for Maryland. Studies of existing and proposed plants to determine the environmental impacts of this generation have shown that, with proper design and operation, the potential effects of coal use can be mitigated.

Monitoring results show that releases from nuclear power facilities in and nearby Maryland are far below regulatory constraints. Concentrations of radionuclides in the environment although detectable, represent less than 20 percent of the NRC limits for maximum off-site exposure.

The information contained in this report demonstrates the importance of the State's capability to collect and analyze technical data to insure that Maryland continues to have an adequate supply of electricity without degrading its natural resources or the human environment. In addition, the methods and data developed for this purpose will help guide the formation of research and monitoring programs necessary for implementation of the Bay initiatives.

Sincerely,

Torrey

Torrey C. Brown, M.D.
Secretary

TCB:RAR:jw

Telephone:

TTY for Deaf - Annapolis - 269-2609 D.C. Metro - 565-0450

PPSP-CEIR-4

# POWER PLANT

# CUMULATIVE ENVIRONMENTAL

# IMPACT REPORT

JANUARY 1984

Maryland Department of Natural Resources

<u>Comments and requests for copies</u>
<u>should be addressed to</u>:

Editor, Cumulative Environmental Impact Report
Power Plant Siting Program
Maryland Department of Natural Resources
Tawes State Office Building
Annapolis, Maryland 21401

## FOREWORD

The Cumulative Environmental Impact Report is issued biannually as required by the Maryland Power Plant Siting Act. It is a compilation of all studies relating to the cumulative impact of power plants on Maryland's environment. Topic areas addressed in this edition are those presently under study by the Maryland Power Plant Siting Program. The reader is directed to earlier editions for coverage of topics in areas where impacts have changed little or no new information exists.

Chapters were prepared under contract with principal responsibility of content vested in a member of the Power Plant Siting Program staff. Principal authors and their PPSP staff counter parts are herewith acknowledged for their contribution to this effort:

| | | |
|---|---|---|
| Chapter I | - | Matt Kahal, Exeter Associates, Inc.; Suzanne Bachur Watkins, PPSP |
| Chapter II | - | Matt Kahal, Exeter Associates, Inc. and Michael Bowman, PPSP; Suzanne Bachur Watkins, PPSP |
| Chapter III | - | Maria Arlauskas, MMC; Randy Roig, PPSP |
| Chapter IV | - | A. F. Holland, MMC; Randy Roig, PPSP |
| Chapter V | - | Richard McLean, Thomas Magette, and Steven Long, PPSP |
| Chapter VI | - | Suzanne Bachur Watkins, PPSP |
| Chapter VII | - | Thomas Magette, PPSP; Fred Mack, MGS |
| Chapter VIII | - | Edward Simek, ERM; Peter Dunbar and Suzanne Bachur Watkins, PPSP |
| Appendix A | - | Matt Kahal, Exeter Associates, Inc. and Michel Lettre, DSP; Suzanne Bachur Watkins, PPSP |

I gratefully acknowledge Mr. Jorgen Jensen for his contributions in putting this publication together; Karen Spencer, Carole Duley, Joann Wheeler, Charles Lester, and Colleen Miller for their patient, competent, and cheerful typing of numerous drafts; and the many reviewers without whose contribution this publication could never have been completed. Thank you.

PE Miller

Paul E. Miller
Editor, CEIR-IV

SUMMARY

## Chapter I - Electric Power Supply and Demand

Over the past two decades energy usage in Maryland has closely followed nationwide trends. Rapid increases in both consumption and production occurred in the years prior to the 1973 Arab oil embargo. Since then, energy demand growth has slowed considerably in response to large increases in energy prices and a sluggish economy. This growth slowdown has resulted in greater security of energy supply (and less oil dependency), but it has left the State's electric utilities with excess generating capacity.

For the 1980s the U.S. Department of Energy is projecting slow growth in nationwide energy usage (1.5 percent per year) and energy price increases in excess of the rate of inflation. Electricity, however, is expected to grow in use more rapidly than most other forms of energy. It is further expected that coal and nuclear energy will continue their recent trends of displacing oil and gas as electric utility boiler fuels.

This Chapter presents a detailed discussion of the electric utility industry in Maryland and the plans of Maryland utilities for expanding their generating capacity. Three of the four major electric utilities operating in Maryland are multistate, and all four formulate their capacity plans on a system basis rather than a Maryland basis. Reductions in projected demand growth have led to plant deferrals. Baltimore Gas & Electric Company (BG&E) is currently constructing two coal-fired units at Brandon Shores, expected to be in-service in the mid and late 1980s, and some additional hydroelectric capacity will be added in the mid 1980s. Potomac Edison will receive some capacity in 1986 from the Bath County Pumped Storage Project currently being constructed by another utility. All four major utilities are considering or planning additional coal-fired capacity for the early or mid-1990s.

The future adequacy of service is evaluated in Chapter I by comparing each utility's capacity plan with its load forecast and with load forecasts independently prepared by PPSP. The companies and PPSP are projecting long-range load growth of about 2 to 3 percent per year (except 1.2% for PEPCO), with PPSP projections being slightly above Company figures. The capacity/load projections comparison indicates that capacity will be adequate at least until the early 1990s. In fact, there is excess capacity. After 1990 it is difficult to assess the situation due to the uncertainty in both the load forecasts and utility construction plans.

## Chapter II - New Approaches to Meeting Power Demands

The rapidly escalating costs of new power plants along with sharply increased costs of boiler fuel in recent years have prompted interest in alternatives to the building of conventional central generating stations. These alternatives can be generally classified as "demand side" or "supply side." Several programs and studies concerning these activities have recently been undertaken in Maryland and are reported on in this Chapter.

There are two major types of demand-side programs -- conservation which reduces total usage of energy, and load management which focuses on shifting electricity demand from the on-peak to off-peak period. The largest, most visible conservation program in the State is the Residential Conservation Service (RCS), operated by the utilities. As of late 1982, utilities had provided detailed on-site energy audits to more than 3 percent of Maryland households under this program. The utilities also conduct a number of other programs, largely of an informational and promotional nature. PPSP has conducted a multiphase study to determine the potential impacts of programs under which the utility would provide customers with financial incentives and extensive technical assistance to weatherize their homes.

In the area of load management several initiatives have been taken. PEPCO and BG&E have recently introduced time-of-use pricing for their largest non-residential customers, and expansion to additional customers is being contemplated. All four of the State's major utilities are actively studying direct load control techniques, and pilot programs have been conducted or are planned. The Southern Maryland Electric Cooperative (SMECO) has introduced direct load control on a regular basis.

There is also considerable interest in non-utility sources of electric power in Maryland. This has been encouraged by federal law and Maryland Public Service Commission rulings that require the State's utilities to purchase all power that a non-conventional source may wish to sell. The rates paid by the utility must reflect the utility's "avoided costs." The greatest development to date has been in the use of municipal solid waste and small-scale hydroelectricity for additional power. A 47-megawatt solid waste facility is being constructed in BG&E's service area, and other such projects are under consideration elsewhere in Maryland. There are several small-scale hydroelectric facilities in Maryland at various stages in the licensing and/or construction process.

Other sources of additional power supply include industrial cogeneration, wind energy and photovoltaics. Although some industrial cogeneration exists in Maryland, there has been virtually no expansion in recent years. Both photovoltaics and wind energy are largely in the research and development stage at present.

## Chapter III - Air Impact

Power plants contribute about 56 percent of the sulfur oxides, 30 percent of the particulates, and 23 percent of the nitrogen oxides emitted by all sources in Maryland, but only negligible amounts of carbon monoxide and hydrocarbons.

The current trend among Maryland power plants is toward a reduction in oil capacity and a substantial increase in coal capacity. Assuming efficient control equipment, the increase in ground-level concentrations (GLCs) due to coal-fired operations should be minimal. Modeling results predict a slight increase in current GLCs at locations near a coal-fired plant, with little or no change observed elsewhere.

Use of air quality models has been specifically cited by EPA as a regulatory requirement in certain circumstances. Thus, greater accuracy and consistency among models is necessary to provide air pollution control agencies, industry, and the general public with a common basis for estimating air quality, assessing emission control strategies, and determining specific emission limitations.

Certain changes have occurred in the regulatory environment which may affect power plant siting and operations. These include changes in the Prevention of Significant Deterioration (PSD) regulations, current deadlines for achieving NAAQS, establishment of a Federal Emissions Trading Policy statement, and the State's acquisition of PSD Authority. The PSD changes may restrict options as plants seek to expand or modify their facilities. The transfer of PSD authority from Federal to State will allow Maryland somewhat more control over the State's air quality. Maryland has met the December 31, 1982 deadline for achievement of NAAQS for sulfur dioxide and nitrogen oxides, and has submitted the necessary requests for extensions for ozone and carbon monoxide. The State is also listed by EPA as a region for which data probably is adequate to show attainment of the particulate standard, and the State should therefore not be subject to the regulatory consequences of not achieving the standards by deadline dates.

A relationship between power plant emissions and "acid rain" exists. Sulfur and nitrogen emissions from fossil fuel-fired plants (as well as from other anthropogenic and from natural sources) have been implicated in the acidification of rainfall in the Northeast, including Maryland. Research is continuing in Maryland so that the extent of the problem and any remedial action can be determined.

## Chapter IV - Aquatic Impact

Steam and hydroelectric power plants can affect water quality and aquatic biota by: (1) impinging fish and crabs on intake screens; (2) entraining fish eggs and larvae and other plankton in cooling or turbine systems; (3) discharge effects and associated habitat modifications.

Long-term effects on biota have been found in the immediate discharge areas of several power plants. These changes generally are localized and frequently consist of increases in production rather than decreases. Relative to natural variation or long-term changes associated with other perturbations, long-term power plant effects are small and do not appear to have any adverse consequences for ecological system stability or food-web dynamics.

There is low probability of cumulative impact of power plant operations on biota in mesohaline (higher salinity) habitats. Consistent depletions of phytoplankton and zooplankton have not been observed in the discharge area although entrainment losses are large. Entrainment losses of ichthyoplankton have little economic significance because no important commercial or recreational species spawn in the mesohaline zone. Entrainment of forage fish ichthyoplankton is of little consequence since no mesohaline power plant is located in a unique spawning area for these species. The large numbers of juvenile fish and blue crabs impinged at mesohaline facilities cause no adverse impact on regional populations because most impinged organisms survive. Discharge effects in mesohaline habitats are generally localized and related to the dilution capacity of the receiving water body.

Plant-related thermal discharge effects are frequently detected in oligohaline-tidal freshwater habitats during summer. At Possum Point and Vienna, entrainment losses due to plant operations affect striped bass and other finfish resources. However, these impacts, even under the most adverse assumptions, could result in the loss of a few percent of baywide catches. Impingement effects at facilities in these habitats are small.

Entrainment and impingement impacts are small at riverine power plants, and discharge effects are localized. Long-term river-wide changes in water quality from other sources has a far greater environmental impact than any observed cumulative or long-term power plant effects. Dam operations at the Conowingo hydroelectric facility control water level, flow, and water quality in aquatic habitats downstream of the dam, and may, therefore, severely affect the abundance and type of biota that can utilize these habitats. The dam also denies anadromous fish access to upstream spawning areas. The effects of small-scale hydroelectric facilities on Maryland's rivers are anticipated to be small as long as downstream fluctuations in river flow are minimized.

Chlorine injection for biofouling control is a major source of entrainment mortality at some power plants in Maryland. Chlorine alternatives (chemical or non-chemical) are either expensive or are not sufficiently developed for implementation. Therefore, chlorine will probably continue to be used to control biofouling for the next decade. The allowable chlorine discharge limits have recently been lowered from 0.5 ppm to 0.2 ppm or less, and mechanical cleaning of condenser tubes is strongly recommended to reduce chlorination. For plants using continuous chlorination, studies have been required to determine the effectiveness of lower dosage. These discharge requirements are sufficiently strict to protect spawning and nursery habitats and preserve ecosystem integrity.

A wide variety of work is currently being conducted to find methods that reduce impingement and entrainment levels at Maryland power plants. Two promising devices (barrier nets and wedge-wire screens) are currently being field tested. Biofouling of these devices is the major operating problem which must be overcome before these technologies can be recommended for application at new facilities or retrofit to old ones.

## Chapter V - Radiological Impact

The nuclear power plants with a potential for environmental impact in Maryland are Calvert Cliffs on the Chesapeake Bay (the only nuclear plant operating in Maryland), Peach Bottom, and Three Mile Island, both on the Susquehanna River in Pennsylvania. Data used in the assessment of the radiological impact of these plants come from monitoring programs conducted by several agencies.

Environmental levels of radioactivity detected through these monitoring programs indicate that all plants are in compliance with their operating license requirements.

At Calvert Cliffs, nearfield sediments have consistently contained low levels of Co-58 and Co-60. Several plant-related bioaccumulable radionuclides (Co-58, Co-60, Zn-65, and Ag-110m) are routinely detected at low levels in Bay biota, although not in edible finfish. The maximum detected concentrations in biota would result in radiation doses to man which are orders of magnitude below doses resulting from the natural radioactive sources in the Bay environment. Consumption of seafood containing the highest radionuclide concentrations measured would result in a plant-related radiation dose of less than 10 percent of the allowable limit (10 CFR 50, Appendix I).

Atmospheric and terrestrial monitoring in the Peach Bottom vicinity indicated no detectable radioactivity from that source. I-131, detected in air and milk during the previous (1978-1980) subject period was not detected in 1981 or 1982.

Liquid releases by the Peach Bottom Atomic Power Station have produced detectable concentrations (of Zn-65, Cs-134, and Cs-137) in sediments and biota of the Conowingo Pond, the lower Susquehanna River, and the upper Bay. Consumption of Conowingo Pond water and finfish containing the highest radionuclide concentrations would, even under the most adverse assumptions, represent about one-half of one percent of the natural background radiation dose, and about 17 percent of the permissible dose (10 CFR 5b, Appendix I).

The ongoing cleanup of TMI Unit 2 and routine, non-operational maintenance of Unit 1 resulted in releases of extremely low levels of radioactivity to the atmospheric and aquatic environment during 1981 and 1982. While very low levels of plant-attributable radioactivity were detected in the Susquehanna in the plant vicinity, no environmental impact to Maryland has occurred during these years.

This chapter also presents information on nuclear wastes, and the status of emergency plans for each of the three plants.

## Chapter VI - Socioeconomic Impact

The construction and operation of an electric generating station may have significant economic, demographic and social effects upon the community where it is located. Socioeconomic effects of power plant construction stem from the sudden increase in the local work force during plant construction. The influx of workers who relocate within the area, as well as those who commute to the plant site, can create demands that exceed the capacity of the public and private services, facilities, markets, and institutions which serve a given community, county, or region. During the operation of a power plant (and its attendant transmission facilities) the local county government receives significant increases in the revenues from the utility. These tax payments vary substantially, and depend largely on the size, age, and fuel type of the facilities owned by the utilities in each county, as well as on local tax rates. The presence of power plants is most evident in the budgets of Calvert and Charles Counties.

## Chapter VII - Coal Ash Management

Since 1950, approximately 21 million wet tons of coal ash were collected at power plants in and adjacent to the State of Maryland. Some of this ash was successfully marketed, but most was landfilled as waste or placed in managed storage for future use. About 700 acres of land, divided among 40 sites in the state, contain ash emplaced either separately or in combination with commercial, industrial, or domestic wastes. An additional 500 acres are currently devoted to ash landfilling operations.

Coal ash is not presently classified as a hazardous substance, but certain ash constituents are potentially harmful to organisms and can be found in significant concentrations in ash leachate. The constituents can be various ions (salts, including sulfate and chloride) and certain metals (including arsenic, barium, cadmium, lead, mercury, chromium, and selenium).

The potential for impairment of ground or surface waters at all ash sites statewide has been evaluated cursorily to determine where site-specific investigations might be warranted. At two ash sites where detailed environmental assessments have been completed, ash constituents do appear to be entering the environment locally, but they are currently causing no detectable impact to the ecosystem nor are they affecting human health. Investigations are in progress at other sites primarily to determine environmental impact and assess structural integrity.

There exists a long-term need to develop beneficial uses for these past ash sites and to reduce the future demand for relatively scarce landfill space by encouraging the use of ash as a resource. Findings indicate that the potential exists for marketing considerably more ash than at present, but the projected revenues from ash sales, even under extremely optimistic conditions, would not be high. The quantities of ash that could be marketed would reduce, but not eliminate, the need for ash landfills. The major institutional barriers to increased use of ash have been identified, and progress is being made to eliminate them.

## Chapter VIII - Groundwater Impact

Four Maryland power plants use groundwater as a source of freshwater: Calvert Cliffs, Vienna, Morgantown, and Chalk Point. Calvert Cliffs withdraws water from the Aquia aquifer, Vienna from the Federalsburg aquifer and an unconfined Pleistocene aquifer, Morgantown from the Patapsco aquifer, and Chalk Point from the Magothy and Patapsco aquifers. Aquifer water level data in the vicinity of the plant is collected for each plant except Vienna. These data indicate some reduction of the water levels associated with pumpage for plant operation. The water levels are closely correlated with pumping rates. However, there is no permanent depletion of a non-reusable resource as the groundwater would be expected to return to pre-operation levels if pumpage ceased.

## RECOMMENDATIONS

The following recommendation requires either legislation or action at the Cabinet level to be implemented effectively:

1. Present requirements for a 10-year plan from each electric utility should be extended to 15 years for information related to generation capacity, transmission investments, and load forecasts.

The following recommendations are being implemented at the Departmental or Utility level based on the results of this report.

1. Efforts should continue to develop economically beneficial uses for past coal ash sites and to reduce the future demand for relatively scarce landfill space by encouraging the reuse of ash as a resource.

2. Although studies to date indicate that statewide implementation of a comprehensive residential energy conservation program cannot be expected to provide a substitute for significant amounts of additional generating capacity, conservation programs should be viewed as one facet of a coordinated and comprehensive approach to utility system planning. Generating capacity reductions resulting from conservation programs are being combined with potential savings from time-of-use retail rates, direct load control, cogeneration development, and other programs which might permit generation capacity reductions or deferrals. The potential benefits (in terms of reducing generating capacity requirements) which are associated with these utility programs should continue to be assessed and evaluated as possible alternatives to building conventional central generating stations.

3. The issue of acid deposition has emerged as a major environmental concern. In order that the State will be able to evaluate the effect of this deposition on its resources, the recommendations of the Working Group on Acid Deposition should be implemented.

## CONVERSION TABLE

| | |
|---|---|
| 1 inch = 2.54 cm | 1 acre = 4,047 $m^2$ |
| 1 foot = 0.305 m | 1 lb = 0.454 kg |
| 1 st. mile = 1,609 m | 1 Btu = 252 calories |

1 cu ft = 28.3 liter = 28.3 x $10^{-3}$ $m^3$

1 gallon = 0.134 cu ft = 3.785 x $10^{-3}$ $m^3$

1 cfs = 449 gpm = 28.3 x $10^{-3}$ $m^3$/sec

$10^6$ gpm = 2.233 x $10^3$ cfs = 63 $m^3$/sec

1 acre = 0.4 hectare

1 acre foot = 4.36 x $10^6$ cu ft = 123 x $10^3$ $m^3$

1 hectare = $10^4$ $m^2$ = 2.47 acres

Concentration:

1 ppb by weight in water = 1 g/$m^3$

$$1 \text{ ppm by volume in air} = \frac{0.0224}{\text{gram mol. weight}} \times \text{concentration in ug/m}^3$$

Gram molecular weight:

$O_2$ = 32; $O_3$ = 48; $SO_2$ = 64; NO = 30; $NO_2$ = 46; CO = 28

The following values depend on many factors and vary a great deal.

Approximate values:

Heat value for coal = 12,500 Btu/lb

oil = 148,000 Btu/gallon

gas = 1,000 Btu/cu ft

One barrel of oil = 42 gallons

A coal burning plant operating at full capacity burns about 10 tons of coal per day per MW of capacity and requires about 900 gpm = 2 cfs = 0.057 $m^3$/sec of once-through cooling water (heated by 10°F) per MW.

## GLOSSARY

- Base Load Plants are generating units designed to be run at high operational efficiency on a continuous basis over long periods of time.

- Cycling Plants are units designed to operate at relatively high efficiency, but which can be adjusted to meet changing loads and can operate well under relatively frequent on-off cycles.

- Peaking Plants are units designed to operate only for short periods of peak demand, usually for only a brief part of the day during a few months of the year.

- Demand is the amount of electric power required by customers at any given instant in time, usually stated in megawatts (MW) or kilowatts (KW). One KW is the amount of power needed to light ten 100-watt light bulbs, and a megawatt is 1,000 kilowatts.

- Peak Demand is a maximum demand experienced during some time interval, such as a day or year. Peak demand in the tables in this chapter is the average power used over the 60-minute period of heaviest demand during a given year.

- Load Factor is the ratio of the average load (MW) to the peak load during the time period being measured. An annual system load factor, SLFa, is defined as:

$$SLFa = \frac{SEa}{SPLa \times 8760}$$

where: SLFa = annual system load factor
SEa = annual system energy output (MWh) (energy sales plus losses)
SPLa = annual system peak load (MW), and
8760 = the number of hours in a year (8784 in a leap year)

- Capacity Factor is the ratio of the average load (MW) on a plant or entire system to the capacity rating (maximum rated output, MW) of the plant or system for the time period being measured.

- Reserve Margin is the difference between system maximum capacity (MW) and system peak load, divided by the system peak load, for any given moment in time. The most commonly used reserve margin is defined at the time of the system peak demand:

$$RMp = \frac{SCp - SDp}{SDp}$$

where: RMp = system reserve margin
SCp = system maximum capacity at time of peak
SDp = system peak demand

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