

AN EVALUATION OF ENVIRONMENTAL DATA
RELATING TO SELECTED NUCLEAR POWER
PLANT SITES

THE THREE MILE ISLAND NUCLEAR STATION CASE

Ichwar P. Murarka
(Project Leader)



August 1976

117 029

DIVISION OF ENVIRONMENTAL IMPACT STUDIES
ARGONNE NATIONAL LABORATORY

Argonne, Illinois

79051506/8

AN EVALUATION OF ENVIRONMENTAL DATA
RELATING TO SELECTED NUCLEAR POWER
PLANT SITES

THE THREE MILE ISLAND NUCLEAR STATION SITE

by

Edwin D. Pentecost
Ishwar P. Murarka

August 1976

Division of Environmental Imp. Studies
Argonne National Laboratory
Argonne, Illinois 60439

117 030

Preface

The Office of Regulatory Research, U. S. Nuclear Regulatory Commission, is supporting a program at the Argonne National Laboratory for the evaluation of the data collected by field studies at a number of operating nuclear power plants. The objective is to analyze data from both a disciplinary and a statistical standpoint. Each of the plants chosen is required, by the terms of the licenses granted, to conduct certain monitoring programs. Some plants are running additional programs to serve their own interests. Do such programs meet the interests of ecologists concerned with the protection of biota? What is the precision and accuracy of the results? What decisions are made on the basis of the field data and how valid are such decisions? Answers to such questions would be of great value in establishing the most cost-effective programs for future plants and redesigning the programs for existing plants.

Through the cooperation of the companies operating the plants, the staff is obtaining the data from a number of installations. As the results are compiled the Laboratory plans to prepare an informal report such as this to present the analysis pertaining to each plant chosen. A summary and inter-comparisons of data, together with the Laboratory's recommendations, will then be presented in one or more reports to the NRC.

This, the fourth of the informal reports, pertains to the Three Mile Island Nuclear Station, Unit 1. Similar reports pertaining to the sites of the Zion, Prairie Island, and Nine Mile Point plants are envisaged.

Earlier reports issued in this series are:

ANL/EIS-1 *The Kewaunee Nuclear Power Plant Site.*

ANL/EIS-2 *The Quad-Cities Nuclear Power Station.*

ANL/EIS-3 *The Duane Arnold Energy Center Site.*

117 031

CONTENTS

	<u>Page</u>
Preface	iii
List of Figures	v
THE PLANT	
Location	1
Interaction with the Environment	1
Operating History	2
TERRESTRIAL ASSESSMENT	2
Plant-Specific Potential Ecological Impact	2
Predicted Impacts	2
Observed Impacts	6
ADEQUACIES AND DEFICIENCIES OF THE MONITORING PROGRAM IN DETECTING IMPACTS	6
Bird Kills	6
Effects of Cooling Tower Salt Drift on Vegetation	7
CRITIQUE, CONCLUSIONS AND RECOMMENDATIONS	7
References	8

117 032

FIGURES

<u>Figure No.</u>		<u>Page</u>
1	Three Mile Island Site	3
2	View of Station During Construction	4
3	Daily Power Generation	5

117 033

AN EVALUATION OF ENVIRONMENTAL DATA RELATING
TO SELECTED NUCLEAR POWER PLANT SITES

THREE MILE ISLAND SITE

Abstract

Environmental monitoring data for the years 1973 and 1974 pertaining to the Three Mile Island Nuclear Station Unit 1, which began operation in early 1974, were analyzed by the most practical qualitative and quantitative methods. Terrestrial biotic resources were considered for this plant. The effects of the operation of Unit 1 on the local terrestrial organisms were found to be undetectable. Although the plant has not operated long enough to reveal long-term deleterious effects, the present indications do not lead to a concerned prediction that any are developing.

The data acquired, method of analysis, and results obtained are presented in detail along with recommendations for improving monitoring techniques.

The primary purpose of biological monitoring of nuclear power plants is to detect any significant impacts of plant operation on the local ecology, or on any of its component parts, e.g., birds, mammals, vegetation, reptiles. A significant detrimental impact is one that adversely changes the populations in such a way that the lost or impaired individual organisms are either not replaced or replacement is delayed too long (a year or two) and the balance of the ecosystem is upset.

Certain non-radiological data from the Three Mile Island Nuclear Station were evaluated to determine the effectiveness of the surveillance requirements set forth in the license. Incidental to this undertaking is the development of an understanding of the nature and extent of environmental changes occurring in locales disturbed by the effluents from the plant.

For this report, the matters considered are those relating to effects of cooling tower drift on local crops and natural vegetation, and bird kills from collisions with cooling towers during spring and fall migrations. The results of this evaluation are presented in this report.

THE PLANT

LOCATION

The Three Mile Island Nuclear Station occupies part of an 814-acre site consisting of Three Mile Island and adjacent islands in the Susquehanna River, 117-034

approximately ten miles southeast of Harrisburg, Pennsylvania (Fig. 1). The station consists of two pressurized water reactors. Three Mile Island is about 11,000 feet long and 1700 feet wide.

Between 1957 and the start of construction (1968), 270 acres on the island were leased for the growing of corn and tomatoes. The land is flat and the sandy-silt soil is rich. Recreation cabins, a picnic area and boat dock facilities occupied part of the island. About 200 acres on the periphery and southeastern portion of the island were wooded.

INTERACTION WITH THE ENVIRONMENT

The most conspicuous structures on the site are the four 370-foot-high, hyperbolic, natural-draft cooling towers, as shown in Figure 2. The two finished towers for Unit 1 are to the left in the figure.

The cooling towers are used to dissipate the heat rejected from the plant steam cycle. Virtually all the heat is dissipated to the atmosphere through these towers. Makeup for cooling tower evaporation, drift, and blowdown is obtained from the secondary services water pumping system. The maximum makeup flow is about 27,000 gpm (gallons per minute), which includes the 20,000 gpm blowdown from the cooling tower basins.

OPERATING HISTORY

The pressurized water reactor for Three Mile Island Unit 1 produces a net output of 792 MWe. On April 19, 1974, a full-term operating license was issued for Unit 1. Initial criticality was achieved on June 5, 1974, and commercial operation began on September 2, 1974. Since then, daily power generation levels have been reported by the utility to NRC. We obtained these data from the NRC "Gray Book" and made the plot of power generation on a daily basis for 1974-1975 (Fig. 3). From this plot it is evident that daily power generation fluctuates over the full range from no output to the maximum level of 792 MWe. Such an operational characteristic influences the environmental measurements and the biota, water chemistry, and thermal plume in the vicinity of the plant.

TERRESTRIAL ASSESSMENT

PLANT-SPECIFIC POTENTIAL ECOLOGICAL IMPACT

In Section V of the Final Environmental Statement (FES)¹ for the station and in Section 4.1.2 of the Environmental Technical Specifications, two potential sources of impact on terrestrial ecosystems have been identified: (1) the impacts of cooling tower drift on local crops and natural vegetation, (2) bird kills from collisions with the four 370-foot-high natural-draft cooling towers during spring and fall migrations.

PREDICTED IMPACTS

The use of red navigation lights on the cooling towers may confuse migrating birds, causing them to collide with the towers. Salt drift from the cooling towers, although not expected to adversely impact local agricultural

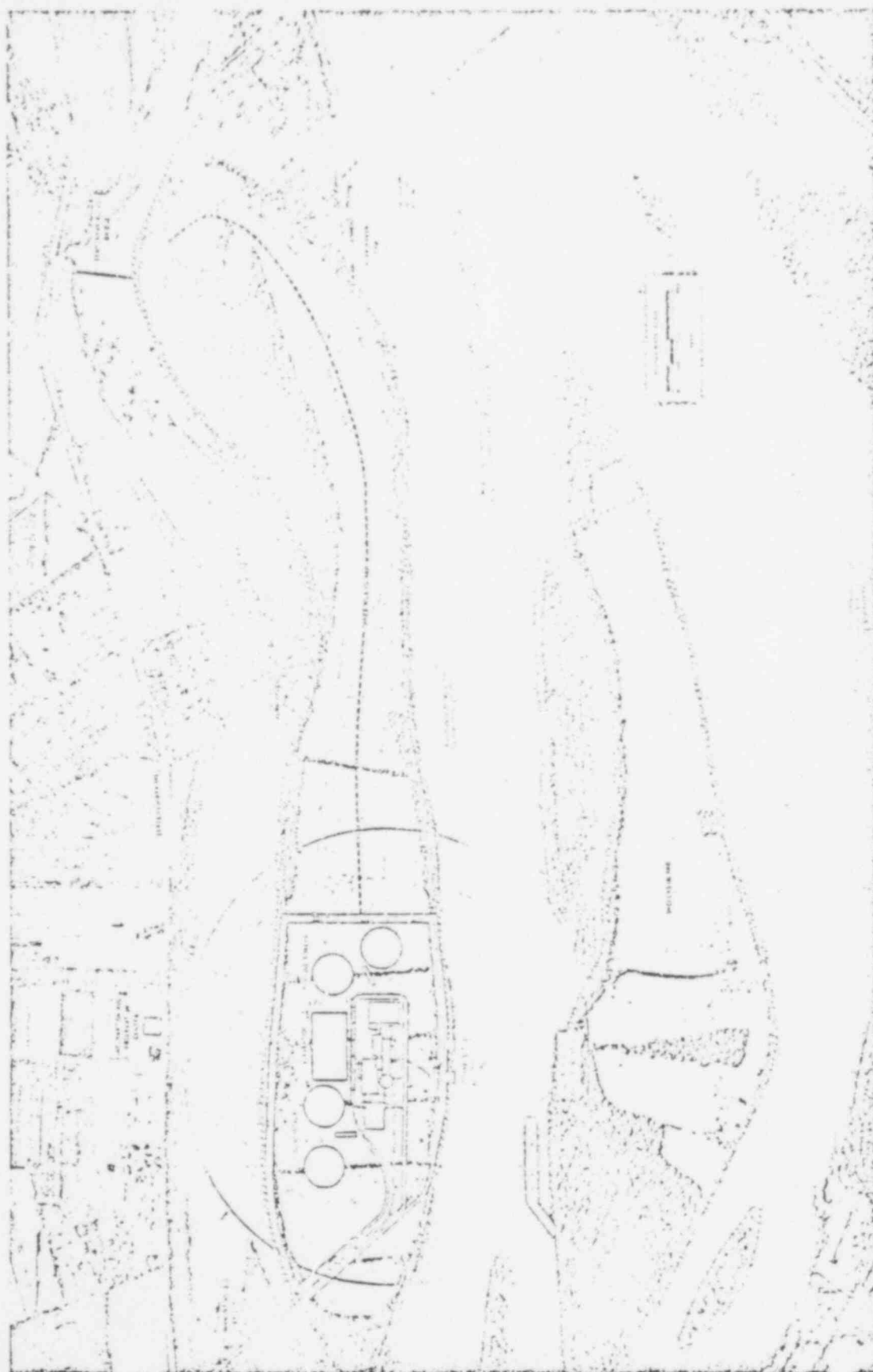


Fig. 1. Three Mile Island Site.



Fig. 2. View of Station During Construction.

117 037

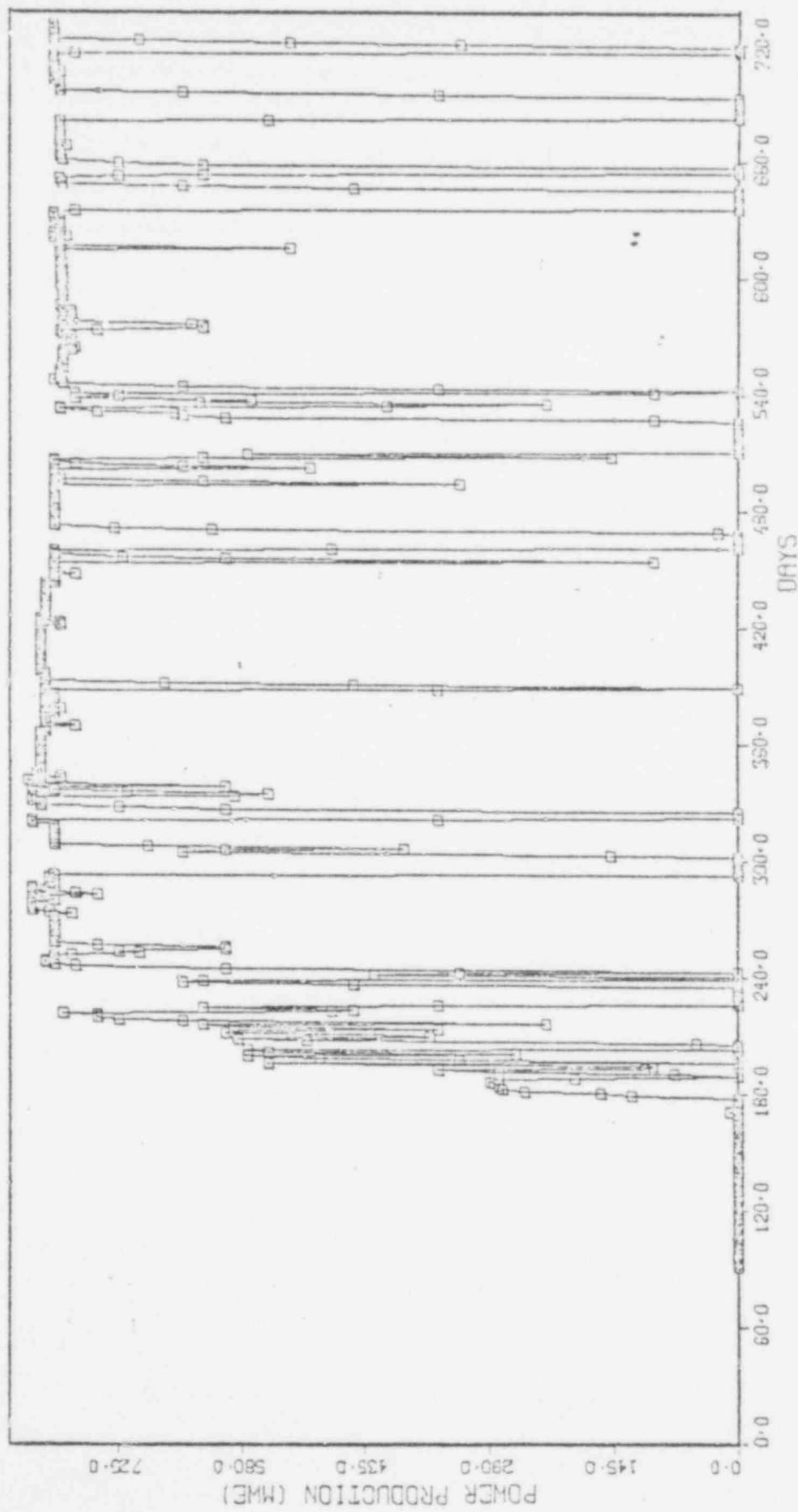


Fig. 3. Daily Power Generation.

117 038

crops or natural vegetation, was given an extensive treatment in the FES.¹ The proposed conversion of a portion of the site into a recreation area could have a greater impact on the local terrestrial ecosystems than would construction or operation of the station.

The proposed recreational facilities include 80 boat slips and docks, parking for 50 cars and boat trailers or 275 cars, 125 picnic sites, two comfort stations, two group picnic areas, and two picnic shelters with comfort stations. The construction of parking areas and picnic shelters precludes use of these areas for wildlife habitat. The creation of picnic areas will require the clearing of small trees and shrubby vegetation. Subsequent maintenance of picnic areas will hinder or halt secondary ecological succession in these areas. The creation of picnic areas will increase human use of many portions of the island now consisting mainly of wildlife habitat. This action will likely reduce bird nesting habitat and bird species diversity and alter the normal movement patterns of squirrels and chipmunks on a local level. The construction of marina launching ramps will reduce the available habitat for amphibians and turtles using the western shore of the island.

OBSERVED IMPACTS

Preoperational and operational data concerning the vegetation communities in the vicinity of Three Mile Island Nuclear Station were compared and reported by the applicant in the 1974 Semiannual Environmental Monitoring Report. The data collected included subjective observations for plant pathology resulting from salt deposition, measurements of numbers of stems per plot in 1973 versus 1974, and ground cover comparisons between years for herbaceous vegetation. This comparison revealed no detectable impacts of the cooling tower salt drift on the surrounding vegetation.

Bird kills from collisions with the cooling towers were recorded from June 5-June 30 and from September 1-November 30, 1974. Seven birds were killed (all during October) from collisions with the towers. All but one of the birds were killed when wind speeds exceeded 10 mph. In addition, during June ten dead birds (eight grackles, two rock doves) were removed from the trash screens for the towers. The utility postulated that since these species were frequently observed perched on the cooling tower fill, they may have nested or roosted within the towers prior to the June 5 startup of Unit 1.

ADEQUACIES AND DEFICIENCIES OF THE MONITORING PROGRAM IN DETECTING IMPACTS

BIRD KILLS

Since monitoring for mortality and injury to birds colliding with the cooling towers was conducted from June 5-June 30 and September 1-November 30, 1974, there was no opportunity to observe impacts to the avifauna during spring migration. Migration of songbirds occurs from mid-April through May in this region of the country. Large migratory flocks are more common in spring than in fall, thus increasing the potential for tower collisions. The only conclusion that can be drawn from the data available is that catastrophic bird kills did not occur during one fall migratory period. Caution should be used not to interpret these data as indicating that bird mortality at natural-draft

117 039

cooling towers seldom occurs during fall migration. Additional years of data at Three Mile Island and other nuclear power plants are needed to substantiate such a conclusion. Overcast, low ceiling conditions in the vicinity of high towers (500 to 1500 feet) or buildings are conducive to migratory bird kills. A monitoring program during only one season may yield erroneous or misleading data, particularly if meteorological conditions for that year were not representative for the area. Bird migration peaks may not have been coincident with nights of low ceiling and dense cloud cover.

EFFECTS OF COOLING TOWER SALT DRIFT ON VEGETATION

No short-term (within one growing season) impacts of salt drift on the natural vegetation and agricultural crops were observed. Although visual observations of agricultural crops and natural vegetation were made from June through October 1974, the reports did not indicate the criteria used for assessing salt damage. As stated in the Environmental Technical Specifications, chemical analyses of plant foliar tissue would be made if visual observations indicated salt drift damage. A monitoring program to subjectively evaluate vegetative condition lacks the sensitivity needed to detect such changes as foliar absorption of metals or other chemicals present in the cooling tower drift. These chemicals may have long-range effects, particularly if accumulating in perennial plant species. A comparison of species composition, density and basal area of trees before plant operation and during the first growing season after the commencement of plant operation also failed to show any effects of salt drift on the local vegetation. This means of assessing the effects of salt drift cannot possibly detect chemical changes in the vegetation. All that can be concluded using these techniques is that a catastrophic change in vegetative composition did not occur from cooling tower drift. Possibly this type of monitoring, in conjunction with studies on appropriate control areas, would be adequate to give an indication of vegetative changes if 20 to 30 consecutive years of data were collected.

Changes in the vegetative composition of abandoned fields in the vicinity of the Three Mile Island Nuclear Station were not different from changes expected due to normal ecological succession. Without control sampling in an area distant from the cooling towers, it is not possible to distinguish between vegetative changes resulting from succession and those caused by salt drift. Multiple controls (vegetative community types of the same general floral composition for each community type in the areas of potential impact) should be established in areas near the nuclear generating station.

CRITIQUE, CONCLUSIONS AND RECOMMENDATIONS

A basic problem in detecting any impacts of plant operation on terrestrial biota is determination of the extent to which any observed changes are due to natural annual and seasonal variation in population levels of the species being monitored. In general, many terrestrial animals are highly variable in population density from one year to the next. Unfortunately, state-of-the-art sampling techniques often reflect variations in data which are artifacts of the techniques, further complicating the problem of accounting for the ranges in annual variation. As a result, many years of data are needed to detect trends in the data with an acceptable degree of reliability. In the case of Three Mile Island Nuclear Station, the monitoring techniques

employed lacked the sensitivity needed to detect any effect of plant operation on the terrestrial biota. The monitoring program failed to include all factors needed for impact evaluation.

The following recommendations are aimed at improving and providing an acceptable level of sensitivity or resolution to the Three Mile Island monitoring program:

1. A soil monitoring program should be established in conjunction with the vegetation monitoring. Samples analyzed for heavy metals and salts will provide information on changes in local soil characteristics as a result of cooling tower drift. Annual samples should be taken at the same plots for at least a ten-year period. All experimental plots should be located at various distances from the towers along the axis of the predominant wind direction. Control plots could be established on similar soil types at locations distant from the towers.
2. The vegetation monitoring program should be changed drastically. Chart-quadrat methods should be employed to monitor the effects of salt drift on perennial woody vegetation such as tree saplings and shrubs. Observing the same individual plants from year to year would provide better data for showing the effects of salt drift than would point-center-quarter techniques currently used. A yearly analysis of leaf chlorophyll content, heavy metals and salts would enhance the detection of subtle effects from cooling tower drift. As with soil samples, study plots should be concentrated along the axis of the major wind direction from the cooling towers.
3. The bird kill monitoring program should be conducted for three to five years during both the spring and fall migratory season. The 1974 Semiannual Environmental Monitoring Report includes data only from June 5-June 30 and September 1-November 30, 1974. A multi-year study would take into account effects of weather on bird migration.

Reference

1. "Final Environmental Statement related to the operation of Three Mile Island Nuclear Station Units 1 and 2," USAEC, Directorate of Licensing, Docket Nos. 50-289 and 50-320, December 1972.

117 041