Paper presented at
11th Annual Environmental and Water Resources
Engineering Conference
Vanderbilt University
Nashville, Tennessee
May 31-June 1, 1972

PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS

AT OAK RIDGE NATIONAL LABORATORY

W. E. Browning, Jr.

—NOTICE—

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION

MASTER

Paper presented at
11th Annual Environmental and Water Resources
Engineering Conference
Vanderbilt University
Nashville, Tennessee
May 31-June 1, 1972

PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS

AT OAK RIDGE NATIONAL LABORATORY

W. E. Browning, Jr.

The National Environmental Policy Act of 1969 (NEPA) expressed a policy of protecting the environment. The Atomic Energy Commission (AEC) has asked some of the National Laboratories, including Oak Ridge National Laboratory (ORNL), to assist it in preparing the Environmental Impact Statements required by NEPA in connection with the licensing of nuclear power reactors. This paper describes some of the ORNL work on assessment of potential environmental impacts and on preparation of Environmental Impact Statements.

The overall objectives of this work can be simply stated: to make sure that the design of nuclear power plants adequately protects our environment. The program was initiated last fall as a result of major changes in federal policies growing out of NEPA. The stakes in this project are enormous: the environment itself must be protected; and over one hundred nuclear power plants are at some stage of the licensing process. These plants will produce over 100,000 megawatts of electric power when they have been constructed and licensed. This amounts to about one-fourth of the total electric power consumption in the United States. Several hundred million dollars is invested in each of these plants for a

MASTER

total investment of several tens of billions of dollars. Our task is to find a way to permit this investment to satisfy the power needs of the country while providing adequate protection of the environment from damage.

LEGISLATIVE, JUDICIAL, AND HISTORICAL BACKGROUND

Up until about a year ago the Atomic Energy Commission focused its attention on potential radiological effects of nuclear power plants. The AEC had been given authority in this area by Congress; they imposed regulations carefully and enforced them aggressively, taking pride in the record of radiation safety. As to non-nuclear effects, e.g., thermal, noise, chemical, traffic, economic, the AEC took the position that it was not empowered to regulate nuclear power plants. Compliance with local laws was required. The AEC proudly offered a technology permitting the production of power with reduced pollution. This position of the AEC was drastically changed by the National Environmental Policy Act of 1969 and by the Calvert Cliffs decision of July 23, 1971.

We are all familiar with the provisions of the National Environmental Policy Act, illustrated in Fig. 1 and summarized briefly in Fig. 2. In a nutshell, this act directs federal agencies such as the Atomic Energy Commission to consider environmental impacts in their decisions and to prepare environmental statements on major federal actions such as the licensing of nuclear power plants.

The initial response of the Atomic Energy Commission in implementing NEPA proved to be inadequate. The Act became law on January 1, 1970. AEC regulations implementing NEPA were adopted December 3, 1970 and took force

ORNL-DWG 71-11211

Public Law 91-190
91st Congress, S. 1075
January 1, 1970

An Act

83 STAT. 852

To establish a national policy for the environment, to provide for the establishment of a Council on Environmental Quality, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Environmental Policy Act of 1969".

National Environmental
Policy Act of
1969.

(b) In order to carry out the purposes of this Act, it is the continuing responsibility of each generation to use all practicable means, consistent with the national policy, to improve and protect the environment for the benefit of present and future generations;

(1) fulfill the environmental trust of the environment;

(2) assure a safe, healthful, productive, and esthetically pleasing and harmonizing surroundings;

(3) attain a high quality of life and environment without degradation, pollution, or other undesirable and unnecessary consequences; and

(4) preserve and enhance the natural and cultural heritage, and maintain, where possible, an environment which supports diversity and a variety of individual choice;

(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

37 081 (C)

Figure 1. National Environmental Policy Act.

ORNL DWG. 71-11230

NATIONAL ENVIRONMENTAL POLICY ACT (1969)

Declared National Policy

Each generation trustee of environment for succeeding generations

Safe, healthful, productive, and esthetically and culturally pleasing surroundings for all

Widest range of beneficial uses of environment

Preservation of historic, cultural, and natural aspects of our heritage

Balance between population and resource use for wide sharing of life's amenities

Enhance renewable resources

Authorized and Directed all Federal Agencies to "fullest extent possible" to:

Consider environmental impact in decisions

Provide environment statements on major Federal actions

Established Council on Environmental Quality

Figure 2. NEPA Details.

March 4, 1971, over a year after the date of Act. The new AEC regulations were not retroactive and they deferred to state standards. The hearing board would consider environmental factors only on challenge; and plants under construction would not be reviewed until they were completed, and this might be as much as four years. This administrative procedure was successfully challenged before the U.S. Court of Appeals, which rendered the Calvert Cliffs decision on July 23, 1971.

Judge Skelly Wright, expressing his opinion in colorful language, made it plain that NEPA means exactly what it says, and that failure by AEC to follow its requirements would only lead to judicial reversal. Referring to NEPA he said, "important legislative purposes, heralded in the halls of Congress, (must not be) lost or misdirected in the vast hallways of the federal bureaucracy." The AEC in their deposition spoke of "transitional implementation problems." Judge Wright condemned "foot-dragging agencies" and asserted that "transition... must proceed at a pace faster than a funeral procession." Figure 3 shows press reaction to this decision.

We all know in general terms the substance of the Calvert Cliffs decision; but I would like to call attention to some of its more important points, since it specifies the framework for the environment impact analysis which is required as part of the decision process in a major federal action, and spells out in detail some of the things an environmental impact statement must contain. Thus the National Environmental Policy Act, reconfirmed by the Calvert Cliffs decision, provides the basis for our work just as the laws of physics and chemistry provide the basis for ordinary engineering design.

THE WALL STREET JOURNAL
Monday, July 26, 1971

U.S. Court Says AEC Makes 'Mockery' Of Pollution Act in Atom Plant Licensing

By a WALL STREET JOURNAL Staff Reporter
WASHINGTON — A federal appeals
court sharply criticized the Atomic Energy
Commission for making "a mockery" of the
National Environmental Policy Act (NEPA).

It will include some features which do significantly
improve the environment and which

(Note: This article is subject to formal review before publication in the
Federal Register or U.S. Armed Forces. There are requests to modify the
content of our formal review to make sure that corrections may be made before the
document is printed.)

United States Court of Appeals FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 34,830

CALVERT CLIFFS' COORDINATING
COMMITTEE, INC. et al., PETITIONERS

v.

UNITED STATES ATOMIC ENERGY COMMISSION AND
UNITED STATES OF AMERICA, RESPONDENTS
BALTIMORE GAS AND ELECTRIC COMPANY, INTERVENOR

No. 34,871

CALVERT CLIFFS' COORDINATING
COMMITTEE, INC. et al., PETITIONERS

v.

UNITED STATES ATOMIC ENERGY COMMISSION AND
UNITED STATES OF AMERICA, RESPONDENTS

Petitions for Review of an Order
of the Atomic Energy Commission

Decided July 23, 1971

Judgment entered
this date

JUDGE WRIGHT

AEC's New Environmental Rules for Nuclear Plants May Open New Debate, Extend Delays, Raise Plant Costs

Court Decision Jolts AEC

The U.S. Court of Appeals for the District of Columbia issued on 23 July a decision that harshly criticizes the Atomic Energy Commission (AEC) for dawdling in its implementation of the National Environmental Policy Act (NEPA), which went into effect in January 1970.

Figure 3. Calvert Cliffs Decision.

Figure 4 shows some of the more important points in the Calvert Cliffs decision. NEPA permits discretion by a federal agency such as the AEC in weighing project benefits against environmental risks, but requires that environmental impact be considered. It is required that an independent assessment be made of environmental effects even where there are established local or regional standards. Thus for example, a project which satisfies state water quality standards might be faced with more stringent requirements growing out of the environmental assessment. The decision requires that conformance with NEPA be retroactive to the date of the Act, January 1, 1970. This judicial decision was accepted by the AEC without appeal as the first action of the new AEC chairman, Dr. Schlesinger.

THE ENVIRONMENTAL IMPACTS PROJECT AT ORNL

Immediately after the Calvert Cliffs decision, Oak Ridge National Laboratory was asked to give assistance, and a project was established under the direction of E. G. Struxness. From the beginning we have attempted to cultivate an attitude of concern for the environment. We chose to avoid the temptation to construct a minimal rationale for AEC approval of a nuclear power plant. In the past, public concern for environmental protection had mounted. There were vocal environmentalists making themselves heard; but outside the AEC. There needed to be equally interested individuals concerned with the environment at work within the AEC participating in the decision process. With this attitude, we regard the environmental assessment and also the preparation of the

ORNL DWG. 71-11232

CALVERT CLIFFS DECISION

**NEPA permits discretion in weighing project
benefits against environment risks; but**

Requires *consideration* of environmental impact

**Independent assessment of environment aspects
required**

**Possibly more stringent requirements than state
requirements**

Retroactive to Jan. 1, 1970

Consider halting construction of nuclear plants

Accepted by AEC without appeal

Figure 4. Calvert Cliffs Decision Details.

environmental impact statements as an opportunity to look in greater depth at the adequacy of environment protection in nuclear power plants.

We have staffed the project with people chosen not only for their expertise but also for their concern for the environment. We have at Oak Ridge a large share of what we sometimes call "the Obed River Type." These are people like myself who like to go white water canoeing in the unspoiled waters of the Obed River in the Cumberland Mountains near Oak Ridge, or who lobby to protect such streams from encroachment. There are other devotees of wilderness planning and others who are just ordinary nature lovers or who like to breathe clean air. Many of these people were drawn to nuclear research because of the promise they saw that nuclear energy could reduce pollution. This project offers them an opportunity to help require that the nuclear industry realize this ideal.

We drew these people together into several parallel reactor task groups. Each nuclear power reactor being considered for a license is assigned to one of these task groups. Each task group comprises specialists in areas such as reactor cooling systems, biology, ecology, radiology, cost/benefit analysis, etc. From all of the task groups, specialists of a particular sort, e.g., reactor cooling systems, are affiliated together under the leadership of a problem area group leader to develop solutions to problems that are common to more than one reactor and to strive for uniform treatment of various reactors. The various specialists within a reactor task group are led by a hard-driving task group leader who is responsible for completing the assessment and preparing the impact statement on schedule without sacrificing quality.

It is essential that enough time be spent for a thorough assessment of potential environment impacts to be completed, and for adequate safeguards to be devised to protect the environment from damage; but it is also important that this process not be allowed to drag out indefinitely. We would be less than responsible if we were to avoidably delay the licensing of a nuclear power plant and as a result have people in the region to be served by that plant suffer brownouts or blackouts in the coming winter. Another less dramatic but important consequence of delays is the cost of an idle plant. A typical nuclear power plant ready to operate awaiting licensing has over two hundred million dollars invested in it. The interest charges will usually exceed twelve million dollars a year, which is about thirty thousand dollars a day, or one thousand dollars an hour. It may seem that reducing these costs would only increase the profits of an impersonal corporation; but in reality the increased costs of delay would probably be passed on to the utility customers, and our people are often found working late at night or over the weekend in an effort to speed up the licensing process without sacrificing the quality of our environmental impact assessment.

We convene for each impact statement a special review board made up of ORNL staff members who are both technologists and environment-oriented persons. This board reviews the document and comments in minute detail on matters ranging from technical accuracy to emotional effect of the presentation. This review board does not give a polite rubber-stamp approval but often makes suggestions which bring about an agonizing reappraisal leading to a major re-write of certain sections of the report. Also sitting as unpaid consultants are staff members' wives and children and

their friends. These consultants help us look at the plant with an environment-sensitive attitude. When I told my wife about the mile-long intake pipe through which seawater is drawn to cool one of the reactors and assured her that any fish entrained would be safely pumped back into the ocean, she exclaimed, "Oh, those poor fish! Without any eyelids they can't close their eyes; they can't even put their hands over their eyes; all they can do is stare in glassy-eyed horror at the fate which is befalling them."

When the impact report is nearly complete, a preliminary draft is submitted to the AEC in Washington where legal technicalities and other matters outside the mandate of ORNL are considered. The document is combined with sections not delegated to ORNL and issued by the AEC as the Official Draft Detailed Environmental Statement. The AEC, not ORNL, is the responsible institutional author. In principal the AEC could modify the report in any way they found desirable. However, they prudently consult with the ORNL staff about any necessary changes, since in many cases the ORNL staff will be called upon to testify at public hearings to explain some of the details of the document. Comments on the Draft Environmental Statement are received from federal and local agencies and from other interested parties and are considered in preparation of the Final Environmental Statement. This document provides the basis for the action by the AEC on the construction permit or operating license. Since this document has such a bearing on the construction permit or operating license, one can well see the reasons for the personnel to try in every way possible to prevent the delay in processing the document.

ASSESSMENT OF ENVIRONMENTAL IMPACTS

The central part of our job is to assess the potential environmental impacts which might result from the construction and operation of each nuclear power plant. We draw on many resources to obtain information for our assessment. When we have been assigned a particular plant we compile all the official documents relating to it, including the safety analysis reports and the environmental report which the applicant is required to submit to the AEC. Ideally these should provide most of the information we require; however, it is important for our assessment to be independent of that of the applicant. Especially during the early post-Calvert Cliffs transition, the applicants' reports have been far from adequate; although more recent ones have been improving. We also search the technical literature and collect information from the popular press. This information is placed in the hands of the specialists on our staff who are assigned to work on that particular plant. We gather additional information from the applicant during a visit to the site and by subsequent contacts both through informal discussions and by formal questions. We also visit city, county, state, and regional officials to get information about the environment in which the reactor is located and about the concerns of responsible persons in the vicinity of the reactor. We also visit in the field, oftentimes unaccompanied by representatives from the applicant, searching for any environmental features which may not have come to light in our earlier information. This visit is followed by a period of one or two months during which time our specialists are calculating, analyzing, and gathering additional information, and assessing it. At

this stage we attempt to identify and investigate every possible effect of the nuclear plant. Figure 5 summarizes the scope of this analysis.

We examine the plant in its regional setting identifying nearby population centers, industrial developments, and natural features which might be important in considering the effects of the plant. Figures 6, 7, and 8 illustrate the kind of information we assemble for a typical nuclear power plant. We compile information about the various life forms surrounding the plant, about the ecological systems of which they are a part, and about the terrestrial and aquatic environment in which they live.

We try to look at the plant from the viewpoint of various persons and things which might be affected by it, particularly, those residents nearest the plant. We identify food chain pathways and give particular attention to radioactive discharges and make sure they are limited adequately to protect the most sensitive population group (Fig. 9). We examine the effects of the reactor cooling system, evaluating quantitatively the effects of entrainment of fish and other organisms as well as the effects of thermal discharge. We consider in detail the seasonal variation in river flow and temperature and calculate the resulting temperature changes in the body of water adjoining the plant. We identify the biologically critical times for the various life forms and calculate isotherm maps for those times so we can consider the possible effects (Fig. 10).

An alternative to direct cooling commonly used is the cooling tower, in which water is cooled by spraying and is recirculated through the plant (Fig. 11). This alternative reduces the thermal impact on the natural

ORNL DWG. 71-11234

ANALYSIS FOR ENVIRONMENTAL IMPACT

**We examine each proposed nuclear power
plant for effects on:**

- People**
- Land use**
- Water use**
- Historic and esthetic things**
- Animals and plants**

We consider

- Radiological effects**
- Thermal pollution**
- Chemical wastes**
- Sewage**
- Noise**
- Traffic**
- Economic impact**
- Transmission lines**

We look at

- Need for power**
- Alternatives**
- Expended resources**

Figure 5. Analysis for Environmental Impact.

Figure 6. Vermont Yankee Nuclear Power Station 1/2 Mile.

Figure 7. Vermont Yankee Nuclear Power Station 5 Miles.

ORNL DWG. 71-11235

Reactors are designed to be safe for the most sensitive population group

Figure 9. Radiological Impact.

Predicted Temperatures in Vernon Pond During Spawning Time (Early Spring) of Yellow Perch, White Sucker, and Walleye (River Flow = 15,000 cfs. and temperature = 42°F).

Figure 10. Temperature During Spawning of Yellow Perch.

Figure 11. Cooling Towers.

bodies of water, but can cause adverse impacts of its own. Cooling towers can produce noise offensive to the nearby population. They are rather large and can be aesthetically offensive to some observers and can under some conditions produce local fog.

We search out all the chemicals used in the plant and calculate the resulting concentrations in discharges so that their effects on biota can be considered and limited by regulation.

Miscellaneous effects which we look for include the effects of transmission lines and electrical substations (Fig. 12); much larger land areas are involved here than in the plant site itself. Traffic can be particularly troublesome during the construction stage when perhaps 1000 workers stream through the adjoining small towns (Fig. 13). Such effects must not be ignored since construction periods sometimes extend over many years when several units are erected sequentially. Historic and archaeological artifacts are given careful attention to make sure that they are not altered or obliterated by the plant. We consider economic effects of construction and of operation of the plant on the region.

Alternatives to the plant are examined, particularly those which might reduce an adverse environmental impact. We consider alternative cooling methods, alternative chemical treatments, alternative types of reactors, alternative fuel, other than nuclear, and alternative sites.

Finally, we carry out a cost/benefit analysis of the project as a whole. Wherever possible we do this analysis on a dollar basis, but many of the more important costs and benefits cannot be assigned a dollar value. Our mandate is clear: both NEPA and Judge Wright emphasized that presently unquantifiable costs must be considered. In such cases we

Figure 12. Transmission Lines.

Figure 13. Construction Traffic.

identify the cost, discuss it as quantitatively as possible, and attempt to weigh it qualitatively against comparable benefits. Naturally, value judgments of this sort are often subjective. We feel it our duty to identify the various points of view and to consider each of them. Thus to one observer, a carefully architected nuclear plant may be an "image of strength symbolizing the regional revitalization which can result from the production of power." To another observer, the same architectural forms are "an aesthetic affront symbolizing the passing of the much-loved peaceful rural countryside" (Fig. 14). We attempt to consider both sides, albeit unquantitatively.

The costs and benefits can be distributed unevenly in the regions surrounding the plant. The benefits of power generation are widely distributed over a region comparable in size to a state. The environment impacts are local having their strongest effect on people within at most a few miles from the plant. Recognizing this disparity we carry out separate cost/benefit analyses for the region as a whole and for the close-in population. We often find that the nearby residents are compensated for their inconvenience or displeasure by local taxes and other benefits supported by the plant. In some cases a nearby community will have a new town hall, a library and improved schools, and at the same time major reduction of tax rates. But even though local residents may be satisfied, we nevertheless scrutinize local effects very carefully for the possibility that they may prove to be larger than anticipated or may affect a wider population.

Figure 14. "An Image of Strength 'or' An Aesthetic Affront?"

THE ENVIRONMENTAL STATEMENT

The results of our environment impact assessment are expressed in the Environmental Statement. NEPA specifies certain things which must be contained in this document, and its form has become somewhat standardized. Figure 15 shows the contents and organization of a typical statement. The section on site describes the environment in which the plant is to be located, giving particular emphasis to ecology of the environment. Another section describes the nuclear plant with particular emphasis on discharges of heat, radioactivity, and chemicals to the environment. Other sections treat the effects of plant construction and operation on this environment with emphasis on the effects on life forms and analysis of radiological impact. A final section discusses alternatives and presents the cost/benefit analysis. A number of these statements have now been issued by the AEC in draft form and several final statements have been issued.

LIMITATION OF IMPACT

Issuance of the environmental statement is not the end of the process. In the course of our analysis we identify potential effects which could become unacceptable if control is not carefully exercised in the operation of the plant. We feel compelled to insure that such control is exercised. Accordingly, we identify operating limits which we derive from considerations of the potential impacts. In the area of thermal effluents we consider all of the life forms which might be affected by the heated discharge, and from this we derive a temperature limit which will prevent

TABLE OF CONTENTS

	<u>Page</u>
SUMMARY AND PRELIMINARY CONCLUSIONS	1ii
FOREWORD	xvii
1. INTRODUCTION	1-1
2. THE SITE	2-1
3. THE PLANT	3-1
4. ENVIRONMENTAL IMPACT OF SITE PREPARATION AND PLANT CONSTRUCTION	4-1
5. ENVIRONMENTAL IMPACT OF PLANT OPERATION	5-1
6. ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS	6-1
7. UNAVOIDABLE ADVERSE EFFECTS	7-1
8. SHORT-TERM USES AND LONG-TERM PRODUCTIVITY	8-1
9. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES	9-1
10. THE NEED FOR POWER	10-1
11. ALTERNATIVES TO THE PROPOSED ACTION AND COST-BENEFIT ANALYSIS OF THEIR ENVIRONMENTAL EFFECTS	11-1
12. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT DETAILED STATEMENT ON ENVIRONMENTAL CONSIDERATIONS	12-1

Figure 15. Sample Contents

unacceptable effects. This analysis requires consideration of not only desirable species such as sport fish, but also undesirable species such as algae, gnats, or mosquitos, which might be favored by heated water. In accordance with NEPA these limits are derived independently of established water quality standards.

The legal basis of such limits is of some interest. Our role in the licensing process does not give us directly the authority to impose and enforce such limits; however, NEPA requires that an environmental statement be prepared for the action of granting a license to the plant. If the plant is operated within our limits, the statement we prepare can speak favorably of the environment impact. Such a favorable environmental statement would not be valid for a plant operated outside those limits. If the AEC issues a favorable environmental statement, it would appear necessary for the AEC to qualify the operating license, making it conditional upon the operator keeping the plant within the limits on which the favorable environment statement was based. Thus, we expect that when limits are solidly based on considerations of potential environmental impact, they will be imposed as technical specifications which are appended as a condition to the operating license as illustrated in Figure 16.

ORNL DWG. 72-12910

Environmental technical specifications
(Limits to protect environment)

Derived from consideration of impacts.

Examples:

No more than 10 acres of the river may experience temperature increase of 5 F° in summer, or 10 F° in winter.

Total residual chlorine concentration may not exceed 0.1 mg/l.

Only the chemicals considered in the FES may be discharged.

Enforcement:

Operation permitted only if in compliance.

Appendix B to the operating license.

Figure 16. Environmental Technical Specifications.

CONCLUSION

By careful scrutiny of proposed nuclear power plants and analysis of their potential impacts on the environment, we can identify the conditions under which they can operate with adequate protection of the environment, and thus the promise of clean nuclear power can be realized.