July 3, 2012

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
THE DETROIT EDISON COMPANY	)	Docket No. 52-033-COL
(Fermi Nuclear Power Plant, Unit 3)	)	
	)	
	)	

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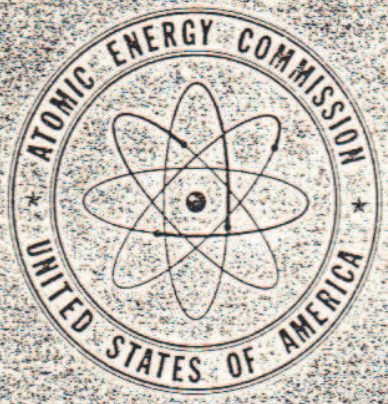
REFILED ***APPENDIX 1, "INFORMATION REPORT TO THE PROJECT COMPANIES OF THE DOW CHEMICAL-DETROIT EDISON AND ASSOCIATES, NUCLEAR POWER DEVELOPMENT PROJECT," ATTACHMENT TO INTERVENORS' MOTION FOR ADMISSION OF CONTENTION NO. 25***

INFORMATION REPORT TO THE PROJECT COMPANIES OF THE DOW CHEMICAL-DETROIT EDISON AND ASSOCIATES, NUCLEAR POWER DEVELOPMENT PROJECT



Technical Information Service, Oak Ridge, Tennessee

INFORMATION REPORT TO THE PROJECT COMPANIES OF THE DOW CHEMICAL-DETROIT EDISON AND ASSOCIATES, NUCLEAR POWER DEVELOPMENT PROJECT

A report to provide information for the managements of the Project Companies concerning the objectives and technical background of the Project.

This report has been written and compiled by the joint efforts of the working group in Detroit.

Nuclear Power Development Project
Dow Chemical-Detroit Edison and Associates
Detroit, Michigan

December 1, 1953

CONTENTS

CONTENTS

CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

PREFACE

The purpose of this report is to outline the objectives of the Dow Chemical-Detroit Edison and Associates Nuclear Power Project, and to summarize the problems that confront the project in the development and design of an economic power reactor and associated processing plant. The report has been assembled to make available to the management people of the Project Companies an understanding of the work in progress in Detroit.

PART I of the report is a summary of the important problems that must be resolved before the final engineering design phase and construction can be seriously contemplated.

PART II of the report covers the history and organization of the project and its relationship with the Atomic Energy Commission. It also reviews the first report to the Commission in December, 1951, which is the basis for our work on the fast reactor.

PART III of the report covers the technical work in progress in the development of a reference design reactor, and is intended to point up the problems which must be faced and solved in the design.

It must be stressed that the reference design now being undertaken by the Detroit group will undoubtedly be quite different from the final reactor which might be built. Atomic power development is in such an early conceptual stage that the design must necessarily be fluid enough to take advantage of the new discoveries and developments in the field. It is quite necessary, however, to carry the reference design to completion so that a determination of economics and feasibility may be made. It will also serve as a bench mark for the evaluation of future reactor designs.

PART I

SUMMARY

In the first report of this project, written in December, 1951, seven requirements for a reactor were enumerated and discussed. These requirements were determined as the result of an analysis made to resolve the fundamental principles and criteria most likely to result in an economic nuclear reactor to produce electric power and by-product materials. It was stated that an economic power reactor should:

1. Be a high temperature machine.
2. Be a breeder reactor.
3. Have maximum breeding gain.
4. Have fuel in mobile or liquid form.
5. Lend itself to rapid and low-cost processing of fuel.
6. Require minimum exclusion area.
7. Be capable of inherent self-control.

These seven points are still considered to represent a sound ultimate basis for the type of reactor economy which will minimize costs and offer the maximum incentive to private capital. As stated in the December, 1951, report, these points appear to indicate that the most desirable ultimate reactor for power and/or by-products is a high-temperature, liquid metal-cooled, fast breeder reactor with the fuel in liquid form, arranged for removal and replenishment on a rapid cycle.

From subsequent studies, it appeared to be a very long range development effort to build a liquid fuel fast reactor since available fuel materials have melting points which are too high to permit liquid operation with currently available container materials. In order to proceed on a practicable basis, a compromise design was formulated in June, 1952, and development of this design has proceeded since that date. The design, known as the "reference design," is a high-temperature liquid metal cooled fast breeder reactor, having the fuel in solid rather than liquid form. This substitution of solid for liquid fuel is the major compromise involved in the reference design with respect to the seven points. As a consequence of this compromise, it will not be possible to reprocess the fuel as simply and rapidly as it would be with liquid fuel. However, the compromise design provides for fabrication of fuel elements by remote casting, which appears simpler than solid state fabrication processes. Other lesser compromises are being made, such as accepting lower operating temperatures than originally hoped for, but these are matters of degree rather than principle.

With respect to the reference design, many problems still require solution. Most of these are capable of resolution without difficulties of the success or failure type. There are, however, six major problems which must be resolved before the reference design can be built.

One is needed amendments to the existing atomic energy law to permit private ownership of nuclear power plants and ownership or use of fissionable material on a basis satisfactory to investors. This is not discussed in this report because of the wide dissemination of the testimony from the hearings before the Joint Congressional Committee during the summer of 1953. The American Bar Association has also published a report on this subject.*

A second problem is the development of a satisfactory fuel element. No reactor design can be labeled as feasible until it has been demonstrated that it is based on a fuel element which can be fabricated for an acceptable cost and which will operate satisfactorily for the necessary lifetime without excessive radiation damage. Several promising fuel element designs are being investigated in connection with the reference design, but information presently available is not sufficient to demonstrate their feasibility.

The third major problem is development of a processing system which will permit rapid processing of the fuel for a reasonable cost. Because of the present high cost of other methods of processing, it has been decided to develop a pyrochemical separations technique, using molten metals. The development work is still in a very early stage although the laboratory work to date indicates that such a process can be developed. The possibility of reductions in cost of existing aqueous chemistry processing is also being investigated.

The fourth major problem is location. A large power reactor must be located in a fairly well populated area, since it must be within reasonable distance of large power markets. Large exclusion areas are not acceptable cost-wise. Hence, a high inherent stability with respect to control is required. It may be a requirement that the reactor be incapable of detonation, even as a result of sabotage. Further work is required to determine whether the reference design is satisfactory for location at a site in a reasonably populated area. In fact, complete stability may be proven only by construction and operation of the reactor.

The fifth major problem is the need for plutonium technology. Since plutonium is the fuel produced by a breeder reactor using uranium-238 as fertile material and since the highest breeding gain with a fast reactor is obtained when burning plutonium as fuel, it follows that the design of a fast reactor may not be really sound until it is based on a plutonium cycle. It might be considered that this is merely a part of the fuel element problem. Actually, it goes beyond this, because the toxicity of plutonium requires highly specialized techniques for handling and using it, and because almost all plutonium operations to date have been confined to Los Alamos and Hanford. The facility now being established at Argonne is expected to be quite helpful. However, there is a major job to be done in merely acquainting personnel with plutonium technology and handling methods in addition to the work of designing fuel elements incorporating plutonium.

The sixth problem is that of an overall cost evaluation to determine whether a reactor similar to the reference design is commercially feasible. A satisfactory solution of this problem requires not only a solution to the five preceding problems, but also at least approximate solutions to a large number

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*-Report of Special Committee on Atomic Energy submitted to Joint Committee on Atomic Energy, November 20, 1953.

of lesser problems. Since only an approximate cost is required, exact solutions to the problems are not considered necessary.

In summary, it may be said that the immediate goals of the project are:

1. Determination of the engineering feasibility of the reference design essentially by resolution of the first five major problems listed above.

2. Obtaining an approximate cost for a nuclear power plant utilizing a reactor of the reference design.

If it should prove impossible to design a fast reactor with control characteristics suitable for location in reasonably populated areas, it might still be possible to meet safety requirements with a thermal reactor. In this case there are at least two attractive alternatives. The first is a thermal reactor employing the thorium U-233 cycle, using thorium as a fertile material. This reactor may be a breeder. The second is the use of thermal reactors burning plutonium on a regenerative basis, resulting in the production of 85 to 95 percent of the fuel required to keep them in operation. There are possible fluid fuels for both types. In the latter case, the remaining 5 to 15 percent of the fuel could be U-235 obtained from isotope separation plants or might be plutonium produced by a fast breeder reactor operating in a remote area. It has been suggested that this combination, in any case, may be the logical outcome of nuclear power development so that both types may have an important place in a nuclear power industry.

PART II - PROJECT BACKGROUND

A. HISTORY, ORGANIZATION AND OBJECTIVES

1. Original Study Agreement

In April 1951, The Dow Chemical Co. and The Detroit Edison Co. signed an agreement with the Atomic Energy Commission to undertake a study of the practicability of using nuclear power for industrial purposes with the main objective of creating a large scale reactor to produce power and fissionable materials as joint products.

The purpose and scope of the study as stated in the agreement is:

(a) To determine the engineering feasibility of their designing, constructing and operating a materials and power producing reactor.

(b) To examine the economic and technical aspects of building this reactor in the next few years.

(c) To determine the research and development work needed, if any, before such a reactor project can be undertaken.

(d) To offer recommendations in a report to the Commission concerning such a reactor project and industry's role in undertaking and carrying it out.

The term for the study agreement was for one year. The Atomic Energy Commission agreed to assist the companies in carrying out the study by making available pertinent information and, for consultant purposes, a reasonable share of the time of its personnel and that of its contractors.

2. Report to the AEC, December 1951

The Companies submitted a report to the Commission which stated in essence that present reactor designs could not be constructed with private funds without government guarantee for private capital expended and a subsidy for the materials and power produced. There was, however, an attractive potential in the use of atomic energy for industrial purposes in a more advanced and longer range reactor program. The report included a list of seven criteria which should be the objectives in such a reactor design. These are discussed in some detail in Part II, B-"Reactor Design Objectives". Briefly, these criteria determined that the reactor should be a breeder using a low cost fluid fuel and should operate at high coolant exit temperatures. The reactor should be integrated with a low cost metallurgical separations system.

The Companies proposed that a research and development effort on such a reactor concept be undertaken jointly with the A.E.C. to determine its engineering practicability and whether or not it is commercially economic. This proposal was accepted in substance by the Commission in April 1952. A press release announced that the A.E.C. was prepared to carry out research and development estimated to cost $725,000 in direct costs and the Companies estimated their costs on the same basis at $275,000. It was announced that

negotiations were in progress to formulate an agreement toward these ends.

This agreement would cover the present efforts or the so-called "Phase 2" of the program and is intended to include only those development studies needed to collect engineering data to decide engineering feasibility and economic potential. The justification for providing private capital to carry on the subsequent "Phase 3", Design Engineering, and "Phase 4", Construction, would be based on the results of these studies.

3. Agreement Negotiations and Patents

By letter of May 16, 1952, the Commission formally accepted the Companies' proposal and submitted a proposed agreement for the joint program. The covering letter stated in part:

> "The reactor development objectives proposed by the Dow Chemical and Detroit Edison Companies are sound and substantially in agreement with the long range objectives of the Atomic Energy Commission's reactor development program. The high temperature, fast breeder (or converter) reactor being considered by the Dow Chemical and Detroit Edison Companies is an advanced concept offering considerable promise of meeting these objectives.
>
> "The Dow-Detroit Edison Companies during the past year by their preliminary studies have contributed very significantly to the development of this type of reactor. The Atomic Energy Commission believes that these companies will continue to make outstanding contributions and therefore wishes to encourage them to continue research along the lines indicated by their preliminary studies."

The proposed agreement was generally satisfactory in most respects except as to patents. The Commission proposed the use of their so-called type "A" patent clause, which grants to the Commission sole power to determine whether or not and where a patent application shall be filed and to determine the disposition of the title to and rights under any application or patent that may result. No claim for pecuniary award or compensation may be made.

The Atomic Energy Commission, in administering the Act, has established two other types of patent articles for insertion in their contracts with private industry. All of these are much more restrictive in their patent provisions than required by the Atomic Energy Act.

Besides the type "A" patent clause, there is the so-called type "B" which allows the contractor at least a non-exclusive, irrevocable, royalty free license for his invention or discovery, but such license is limited to the manufacture, use, and sale for purposes other than use in the production or utilization of fissionable material or atomic energy.

The type "C" patent provision grants a sole license (except against the government or its account) and in addition, the contractor has the sole right to grant sublicenses for the use of his discovery or invention in the limited fields stated under the type "B" provision.

The Act, of course, is much less restrictive in its patent provisions.

While it forbids patents useful solely in the production or utilization of fissionable material or atomic energy for a military weapon and in certain research fields, it does, however, allow patents for non-military utilization if such patents are not concerned with production of fissionable material. Patents not forbidden by the Act, however, are subject to be found affected with public interest and when so found are subject to use by the Commission and its licensees at a reasonable royalty rate to be agreed upon, or if not agreed upon, to be set by the Commission. Even in the forbidden production and military fields, the inventor is at least entitled to compensation for his discoveries.

The "A" patent clause was reluctantly accepted in the original study agreement but was considered entirely inappropriate to the second phase. It was recognized by the Companies that private funds could not be induced into this development program unless some return could be seen in the form of patent or license to use inventions developed by these private funds.

The Companies did not sign the proposed agreement of May 16, 1952 and instead have been operating under extensions of the original agreement (with the type "A" patent clause) while patent negotiations were in progress.

In October 1953, the Commission proposed a modified type "C" clause which, in addition to the licensing rights granted in the normal type "C", also gives certain "shop rights" or non-exclusive licenses in the fields of "production or utilization of fissionable material or atomic energy".

It was concluded that this clause is satisfactory for the present "Phase 2" studies. The aforementioned proposed agreement, of May 16, 1952, was outdated in several respects and required considerable alteration in order to reflect the present efforts of the Companies and the development work expected of the Commission.

Since the Companies' contract with the Commission had expired in July 1953, it was agreed to be expeditious to sign another extension of the original study contract except with the insertion of the modified type "C" clause. This was done on October 21, 1953, the contract having an expiration date of January 31, 1954. The Companies are presently preparing a new agreement for submission to the Commission.

The modified type "C" patent clause which will be part of the new agreement reads as follows:

> "1. Whenever any invention or discovery is made or conceived by the contractor or its employes in the course of any of the work under this contract, the contractor shall promptly furnish the Commission with complete information thereon and shall specify at the time of such disclosure whether or not the contractor desires to file a patent application subject to security restrictions and requirements. The contractor shall retain at least (1) an exclusive (except as against the Government and its account), irrevocable, royalty-free license, with the sole right to grant sub-licenses, under said invention, discovery, application or patent for all purposes other than use in the production or utilization of fissionable material or atomic energy and (2) a non-exclusive, irrevocable, royalty-free license under said invention, discovery, application, or patent for use in the production or utilization of fissionable material or atomic energy. The title and additional rights shall be determined by

the Commission as it deems equitable and appropriate. The contractor, for itself and its employees, agrees to execute all documents and do all things necessary to facilitate the filing and prosecution of applications.

"2. No claim for pecuniary award or compensation under the provisions of the Atomic Energy Act of 1946 shall be asserted by the contractor or its employees with respect to any invention or discovery made or conceived in the course of any of the work under this contract.

"3. The contractor agrees to secure appropriate agreements to effectuate the purposes of paragraphs 1 and 2 from all persons who perform any work under this agreement except such clerical and manual labor personnel as will not have access to technical data."

4. Organization

At the start of the original study in 1951, The Detroit Edison Company and The Dow Chemical Company requested of the AEC that The Babcock and Wilcox Company become an associate in the study. At the same time, the Companies proposed that the Nuclear Development Associates, Inc. be engaged to provide a nuclear consultant service to the Project, the cost of their services to be paid for by the companies. Both these requests were approved by the AEC.

Soon after Commission acceptance of the joint development program in April 1952, plans were made to organize the project on a more effective basis which would be commensurate with the work required. Recognizing the magnitude of the effort and the need to proceed rapidly on as broad a front as possible, steps were taken to interest other industrial firms who would be willing to contribute to the project.

In September 1952, a request was made of the Commission to allow eleven companies to become associated with the project which would be known as the Dow Chemical-Detroit Edison Nuclear Power Development Project. The new associates proposed were:

The Cincinnati Gas & Electric Company

The Cleveland Electric Illuminating Company

Consolidated Edison Company of New York, Inc.

Consumers Power Company

General Public Utilities Corporation

New England Electric System

Philadelphia Electric Company

Public Service Electric and Gas Company

The Toledo Edison Company

Vitro Corporation of America

Wisconsin Electric Power Company

These companies would contribute one or more men on essentially a full time basis to work on the project and in addition, clearances would be granted to some of the management and engineering officials to contribute their guidance and management experience to the project.

This association was approved by the Commission on October 16, 1952.

On April 24, 1953, the Commission approved further enlargement of the project by the addition of the following twelve companies:

Allis-Chalmers Manufacturing Company

Atlantic City Electric Company

Bendix Aviation Corporation

Consolidated Gas Electric Light and Power Company of Baltimore

Ford Motor Company

Gibbs & Cox, Inc.

The Hartford Electric Light Company

Niagara Mohawk Power Corporation

Potomac Electric Power Company

Rochester Gas & Electric Corporation

The Southern Company

United Engineers & Constructors, Inc.

The associates now number twenty-six companies included in which are eighteen electric utilities, four manufacturing industries, one chemical company and three engineering and construction firms.

A Nuclear Power Development Department was organized in The Detroit Edison Co. General Offices, Detroit, Michigan, in which classified facilities are provided to carry on the development studies. There are some thirty-five employes of the associated companies working full time on the project. In addition to the Detroit group, there are a number of other people giving substantial amounts of their time to the study.

Nuclear engineering services are being provided to the project by Nuclear Development Associates, White Plains, N. Y. Several other consultants and specialists in various phases of atomic energy have been engaged to provide direction to the development studies. The expense of these consultants has been borne by The Detroit Edison Co. and The Dow Chemical Co.

Other work of a development nature is being carried on at private expense in the research laboratories of the Babcock & Wilcox Co. and the Ford Motor Co. Privately supported development contracts are also in effect with

such contractors as Mine Safety Appliances Co., Modine Manufacturing Co. and the Clifford Manufacturing Co. Important contributions are also being made by industrial organizations not formally affiliated with the group.

Close liaison is being maintained with Commission installations performing research and development specifically needed in our studies as well as on related work of interest.

Recognizing that management and legal aspects are equally as important as the technical developments of the program, a management steering committee has been organized whose function is to contribute high level management direction and be advised of financial and organizational needs of the project. A more formal framework for the organization and management of the project is being developed at this writing.

The legal aspects concern not only federal law changes to permit and encourage private participation in atomic energy but also include the legal implications in industrial liability, health and safety, security, and also state regulatory considerations and organizational problems (formal or otherwise) affecting the project. Several members of the University of Michigan Law School, Phoenix Memorial Project, have been engaged as consultants in these matters, and are contributing their efforts in conjunction with several of the legal counsels of the Associated Companies.

Over the past several months, legal research in the context of the "Atomic Energy Act of 1946" has been undertaken by Dean Stason and his associates of the University of Michigan Law School. The results of their studies have been published from time to time in memoranda form and several of general interest have been distributed among the Associated Companies.

One of these analyses entitled "Memorandum on Private Utility Ownership and Operation Under the Present Atomic Energy Act" was submitted in the testimony before the Joint Congressional Committee on Atomic Energy. This and other analyses have also been given to the staff of the Atomic Energy Commission.

5. General Project Objectives

It was stated earlier that the original objective of the study agreement, as specified by the Commission, was the development of a large scale reactor to produce power and fissionable materials as joint products. The Commission stated that this was one of the major objectives of the Commission's reactor program.

These studies were carried on by four industrial participation groups and it was generally assumed that the government was in the market for the fissionable material that would be available from these reactors. During the summer of 1952, the Commission made it plain that there would be no guaranteed government market for fissionable material and therefore the study groups, if still interested, should direct their efforts towards an unsubsidized power reactor or as it was called a "power only" reactor. Fissionable material must,

therefore, carry its own weight in the open market as a reactor fuel.*

When the Companies were informed of this policy, the Commission was told that no re-direction of this project was required since very early in the study it was decided that this was the only basis on which a private atomic power industry could exist.

The objectives of the Dow Chemical-Detroit Edison Nuclear Power Project have been reiterated on many occasions during the past year. These objectives were first summarized in a classified memorandum to Commissioner Murray on January 15, 1953. Since then they have been restated many times such as at open and closed hearings before the Joint Committee, to members of the Commission and its staff as well as at technical and business association meetings in many parts of the country. Copies of many of these statements have been distributed among the Associated Companies.

To summarize appropriately these objectives, the following is quoted from a classified letter dated October 20, 1953 to Chairman Strauss, signed by Mark E. Putnam and Walker L. Cisler:

> "The main objective of the Dow Chemical-Detroit Edison Nuclear Power Project is the development of a new source of heat energy, that is, nuclear fuels, to compete commercially with conventional fuels. Our specific interests are the release and utilization of heat from the fission process for the economical production of electric power, and the production of a high-grade by-product fuel. Other by-products of the fission process, such as the fission products, would be utilized and marketed for the maximum use and value which can be developed for them.
>
> "The economic production of power and fuel is the prime basis on which substantial private investment capital can be induced to come into the new atomic energy industry. If we can carry the development forward and become convinced that there is a real promise of producing competitive power and fuel, we can expect to build a reactor in full scale size, using private capital and without direct government subsidy.
>
> "We have already expended substantial sums of money in the study and pioneer development of and selection of a high temperature fast breeder reactor integrated with a metallurgical separations process as having the most promise to meet these objectives. The military aspects of this reactor and its great value in the country's defense potential have not been given appropriate emphasis. In fact, the industrial study groups were advised at one time that they should not anticipate a military market for plutonium. Apparently this situation has changed and the military aspects as we see them are:

*Chairman Strauss of the Atomic Energy Commission in his testimony before the Joint Committee accepted this policy with "minor reservation", stating "I am not prepared to rule out the possibility of plants which are designed to produce weapons grade plutonium as a by-product of power--I am assured, however, that the Commission's power policy statement was not intended to preclude such dual purpose plants as a possibility so much as to emphasize the greater desirability of plants which are economically justified in terms of power production alone."

"1. High rate of production of fissionable material - A fast breeder, and particularly a fast plutonium breeder reactor, will inherently produce a much higher return of fissionable material per unit of fuel consumed than a thermal reactor. This statement, is based, of course, on the relative potential breeding ratios for the different types of reactors. Where weapons material production is the prime objective, as appears to be the case in much of the Commission's program, our present studies indicate that the cheapest source would be very large size breeder reactors operated for the maximum production of fissionable material. We are of the opinion that this source, once proven economic, could be provided, at little or no cost to the government, by breeder reactors installed by private industry for the primary purpose of generating electric power.

"2. Conservation of Uranium - The total energy potentially available in both natural uranium and in the present stock-pile of depleted uranium can be made available for use only in a breeder reactor. This very effectively multiplies our uranium reserves and makes us less dependent on foreign uranium sources.

"3. Unique Weapons Materials - The physical characteristics of the fast reactor and the rapid processing with the contemplated metallurgical separations system will permit our reactor to provide very high purity weapons material. In addition, the rapid processing will make available a source of fresh fission products for radiological weapons.

"We have not attempted to minimize the technical difficulties involved in our program and fully appreciate that we must have the continued cooperation of the National Laboratories. We are firm in our belief, however, that these objectives are basically sound and that their attainment is worth a great deal of effort and expense on the part of industry and the government."

Concerning our expected relations with the government operated atomic energy facilities, this is summarized briefly in the "Statement Advocating Private Competitive Industry Development of Atomic Energy for Peacetime Purposes" which was submitted as testimony before the Joint Committee on July 1, 1953.

"Our proposal is consistent with governmental participation. This means, in brief, that governmental ownership and operation of its facilities, constructed at great cost, can continue exactly as at present. The government can continue its own and independent development. Private industry only requests that Congress give it the right to own and operate its own facilities subject to regulation in the interest of national security, health and safety.

"Until now, the A E C has borne the cost of research, contributing to private programs because that research also has added to the overall store of knowledge and information. If, hereafter, the A E C decides that a reasonable charge to industry is proper, then private industry can decide for itself whether to meet the charge or to provide its own similar facilities.

"It should be remembered by all of us that we are dealing with but one form of natural resource, a source of heat energy just as is coal, gas and oil. No one suggests that the research and development of the use of coal be nationalized as does the Atomic Energy Act in the case of fissionable materials. We make no 'grab' and we do not seek to appropriate something that is not paid for by private capital and that we do not develop from our own effort."