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UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

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OFFICE DIARY
GLENN T. SEABORG
Ch. USAEC, 1961-
FOLDER-PAGE 4127

CLASSIFICATION CANCELLED APR 17 1964
BY AUTHORITY OF DGE/OC

Carl Wilson 11/30/87

REVIEWED BY DATE
*Ltr. DOS Burke To DOE, DC
Gilbert dated 8/19/87
J. Diaz 11/30/87

Dear Bob:

Among the several possible methods of separating uranium isotopes, the gas centrifuge ranks high as a competitor to the gaseous diffusion process. In fact, during World War II, the gas centrifuge was developed to a point where it was seriously considered as the process to use for the large-scale separation of enriched uranium for weapons. However, the gaseous diffusion process was selected as the production process because it had fewer remaining development problems yet to be solved. No further work was done on gas centrifuge development until 1953 when the AEC reopened studies to evaluate the process as a means of separating uranium isotopes. A small scale research program was conducted continuously until 1960.

In 1960, on the basis of data obtained from its research program and of information regarding work on the process by foreign nations, the AEC estimated the potential of the gas centrifuge as a means by which additional nations might acquire an enriched uranium materials production capability and thus be in a position to fabricate nuclear weapons. This Nth power assessment was based primarily on an extrapolation of technology on laboratory type rather than production type centrifuges. On the basis of this assessment, the AEC undertook a more extensive investigation of the gas centrifuge process in order to obtain a more realistic appraisal of the gas centrifuge as a production process.

The Commission has recently completed a reassessment of the Nth power problem on the basis of the technology developed over the past three years. This re-evaluation is more comprehensive and useful since it is now based on actual performance of a pilot cascade using production type units. These units, incidentally, represent a significant advancement over the laboratory types available in 1960.

DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW	
1st REVIEW DATE: <i>10/12/87</i>	DETERMINATION (CIRCLE NUMBER):
AUTHORITY: <input checked="" type="checkbox"/> DC <input type="checkbox"/> DD	1. CLASSIFICATION RETAINED
NAME: <i>Ann Hester</i>	2. CLASSIFICATION CHANGED TO:
	CONTAINS NO UNCLASSIFIED INFO
2nd REVIEW DATE: <i>10/16/87</i>	COORDINATE WITH: <i>memo 12/3/87</i>
AUTHORITY: <i>DC</i>	3. CLASSIFICATION CANCELED
NAME: <i>S. Emery</i>	4. CLASSIFIED INFO BRACKETED
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Honorable Robert S. McNamara

- 2 -

OFFICE DIARY
GLENN T. SEABORG
Chf USAEC, 1961-72
FOLDER-PAGE 41278

In summary, the AEC work has demonstrated that gas centrifuges can be cascaded in plant arrangements for the production of weapons-grade enriched uranium; production units now developed can be directly used in a production plant; and the power and space requirements for such a plant are amenable to clandestine operation.

The AEC considers it important to the national defense and security of the United States to minimize the spread of gas centrifuge technology and thereby reduce the possibility of non-nuclear countries developing an enriched uranium production capability. We believe that, with access to information such as developed by the AEC, it would be feasible for a number of countries with industrial capability to produce enriched uranium by means of a small gas centrifuge plant or assist others, not so industrialized, to develop such a production capability.

Some countries, such as the United Kingdom, West Germany, and the Netherlands, are now engaged in development work with the objective of developing the process as an economic competitor to gaseous diffusion for producing enriched uranium for use in nuclear power reactors and other peaceful purposes. Thus, we can expect that there will be continued interest by countries in the development of the gas centrifuge process in hope that it will become economically attractive to provide a source of enriched uranium that will be independent of the United States.

In addition to the use of the gas centrifuge for the separation of fissionable material, it can also be used to separate isotopes of other elements such as tungsten, molybdenum, sulfur, etc., which may have important peaceful uses. Further, some of the technological capability developed during the investigation of the gas centrifuge process would permit a country to apply this capability in areas of materials, fabrication techniques, stress analysis, bearings, rotor dynamics and fluid mechanics. An example of particular interest and of potentially far-reaching benefit is the application of the AEC capability in developing unclassified liquid centrifuges. This development has been used by both the AEC and the National Institutes of Health in the separation of virus materials in cancer research.

The AEC has over the last few years taken steps which have been effective in limiting the spread of gas centrifuge technology. Near the end of 1959, it became apparent to the AEC that unclassified programs being conducted in West Germany and the Netherlands had progressed to the point

CONFIDENTIAL

41278

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Honorable Robert S. McNamara

- 3 -

OFFICE DIARY
GLENN T. SEABORG
Chf USAEC, 1961-72
FOLDER-PAGE 41279

where their technology might be equal to or better than that developed in the United States. Following an evaluation of our own advances in gas centrifuge technology as well as those published by the Germans and the Dutch, the AEC concluded that a "breakthrough" in gas centrifuge technology had occurred and that henceforth work in this field subject to the jurisdiction of the United States would be kept classified. In July 1960, as a result of discussions among representatives of the US, UK, West German and Netherlands Governments, special arrangements were evolved under which these countries agreed to keep their gas centrifuge programs classified. These arrangements have worked out satisfactorily up to the present time but there is now pressure building up to open the field. There are indications of a desire on the part of the Dutch and Germans for a relaxation of the arrangements. This was evidenced during a recent visit to Germany where a meeting on this subject was held by US, British, Dutch and German representatives at which time it was agreed that the classification arrangements would be continued. Also, the German and Dutch Governments stated their intentions to remain free to file classified patent applications in countries with which they have arrangements enabling such filing.

We have also taken stringent steps to prevent the spread of gas centrifuge technology at home. Although the AEC currently allows US private industry to participate, with private funds, in the development of the gas centrifuge method of isotope separation, and provides access to AEC research and development information in this area, special criteria are imposed so that only companies who are engaged in or propose to engage in a substantial effort in centrifuge development are granted an access permit in this category under tight security restrictions. Within its own internal administration, the AEC considers gas centrifuge information as sensitive as that of gaseous diffusion technology and therefore restricts its dissemination to a limited number of personnel. Further, we have had gas centrifuges placed on the Department of Commerce's Positive List to assure US control over the export of such equipment and/or its component parts.

The AEC is considering the question of the level at which it should continue its research and development efforts in this area. The objectives of the program would be to enable us to be adequately informed on the important aspects of this field of technology, and effective in discussing classification of gas centrifuge work with others. In addition we would be in a position to make sound judgments on policy matters related to this area of AEC activity, and to evaluate properly the Nth power problem.

~~CONFIDENTIAL~~

41279

Honorable Robert S. McNamara

- 4 -

OFFICE DIARY
GLENN T. SEABORG
Chf USAEC, 1961-72
FOLDER-PAGE 41280

Copies of a report summarizing the analysis of the gas centrifuge process for the production of enriched uranium by an Nth power are enclosed. It includes a range of estimates from centrifuges presently available to centrifuges substantially more advanced in technology. The report identifies the time intervals for the production of the first weapon assuming cases where the Nth power does and does not have available the present US centrifuge technology. The potential of the advanced centrifuges for weapons material production, i. e., centrifuges with peripheral speeds beyond 450 m/s, is based on extrapolation of existing technology. The estimates using the more advanced machines do include uncertainties which can only be removed by demonstrations similar to those for the present centrifuges.

In view of the pressures from abroad to remove restrictions on the dissemination of information on centrifuge technology, in recognition of the usefulness of the centrifuge process for peaceful applications not related to separation of isotopes of fissionable material; and recognizing that despite our best efforts to limit the dissemination of the gas centrifuge technology this knowledge will eventually be acquired by Nth powers, we wish to assure that the policy we adopt at this time will best serve our national security interests. We would particularly welcome your views or comments on:

The importance to the U. S. of maximum delay in the acquisition by an Nth Power of a capability to produce fissionable materials suitable for atomic weapons use, even in very limited quantities.

If such delay is of great importance, are there other national security objectives which would limit the implementation of a prevention or maximum delay policy as it may relate to any particular Nth Power?

We would also welcome any comments you may have with respect to the analysis contained in the Nth Power Report and on possible approaches toward limiting dissemination by other countries of gas centrifuge technology.

We have transmitted similar letters and copies of the Nth Power Report to the Secretary of State; Director, Central Intelligence Agency; and Director, Arms Control and Disarmament Agency. We propose that appropriate representatives of our respective staffs, and representatives of

41280

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Honorable Robert S. McNamara - 5 -

OFFICE DIARY
GLENN T. SEABORG
CM USAEC, 1881-72
FOLDER-PAGE 41281

State, CIA, and ACDA meet to discuss the gas centrifuge - Nth question and to develop a prepared policy for our consideration. We hope such discussions can begin by mid-May and that we might have your comments by that time.

Sincerely yours,

~~Glenn T. Seaborg~~

~~SEP 24 1964~~

Chairman

The Honorable Robert S. McNamara
Secretary of Defense

Enclosure: Nth Power Evaluation

See: Chairman, Cys. 3A and 4A, w/enc. ✓
Commissioner Palfrey, Cy. 5A, w/enc.
Commissioner Kamey, Cy. 6A, w/enc.
Commissioner Tapp, Cy. 7A, w/enc.
General Manager, Cys. 8A and 9A, w/enc.
AGRP, Cy. 10A, w/enc.

Distribution:

1A - 2A Addressee
3A - 10A See's as noted
11A PI Files, w/enc.
12A, 13A, 14A, PD Files, w/enc.

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4128