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REPORT OF AUGUST 21, 1943 ON PRESENT STATUS AND FUTURE PROGRAM ON ATOMIC FISSION BOMBS

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WAR DEPARTMENT

WASHINGTON

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21 August 1943

TO: Honorable Henry A. Wallace, Vice President,
Honorable Henry L. Stimson, Secretary of War,
General George C. Marshall, Chief of Staff.

FROM: Military Policy Committee on Atomic Fission Bombs

SUBJECT: Present Status and Future Program

Gentlemen:

The last report on the development of bombs of extraordinary power was dated December 15, 1942. That report with its recommendations was approved by you and later by the President of the United States.

GENERAL

Its most vital recommendation was "That this program be carried forward vigorously, and that it be given the highest priorities and allocations on materials, equipment, and personnel, with a view to completion at the earliest possible date." The approval of this recommendation has enabled the program to be pushed to the limit. Many scientific, engineering, and procurement difficulties have been overcome.

At the present time, so far as the production of the essential materials is concerned, there appear to be no insurmountable

difficulties which time and effort can not overcome successfully. A possibility has always existed that the material would not prove to be a controllable explosive. The likelihood of this possibility existing is steadily decreasing, although it can not be finally eliminated until after a sufficient amount of the materials is produced.

ORGANIZATION

The membership of the Military Policy Committee in general charge of all phases of the development and the manufacture of material and the production of atomic fission bombs and all the plans for their use as a weapon remains as originally constituted. The committee consists of Dr. V. Bush, Director of O.S.R.D., as Chairman, with Dr. J. B. Conant as his alternate; Rear Admiral W. R. Purnell, U.S.N., and Major General W. D. Styer, U.S.A., with Brig. Gen. L. R. Groves, U.S.A., in executive charge of the work and working in the closest cooperation with Dr. Conant. This report is presented by Brig. Gen. Groves in behalf of the Military Policy Committee.

PROGRESS

Since the December 1942 report on this subject, the work has progressed as follows:

A. A site of some 56,000 acres, the Clinton Engineer Works, has been acquired in the vicinity of Knoxville, Tennessee, as a location for the electro-magnetic and diffusion process production

plants, and a semi-works for the power process plant. Construction work on the administration and auxiliary facilities is essentially completed, and is progressing favorably on the production plants.

B. A site of over 400,000 acres, 237,000 acres of which are under lease, the Hanford Engineer Works, has been acquired in the vicinity of Pasco, Washington, as the location for the power process plant. The size and location of this site were determined by the necessity of restricting the hazards, many of them unknown or indefinite, to the actual operating personnel, and to a minimum of those, as well as by the need for a large supply of pure water. The design for this plant is essentially complete and construction has been initiated.

C. A site of approximately 54,000 acres has been procured in New Mexico, some 20 miles from Santa Fe, for the establishment of laboratory facilities for a special secret laboratory for solving the problems, both scientific and ordnance, involved in the production of the actual bombs and effective delivery on the desired targets.

D. All available ore in the United States, Canada, and all ore now known to be available in the Belgian Congo is being procured. The plants necessary for processing the ore have been essentially completed and are now in operation.

E. Construction of plants to yield approximately three tons of heavy water per month have been essentially completed and production has been initiated.

F. Limited scientific research is being continued on

the centrifuge method, but no major effort is being devoted to it.

g. No work is being done toward development of the long range power possibilities, except such research work as is incidental to the main effort of developing a fission bomb.

ELECTRO-MAGNETIC METHOD PRODUCING URANIUM 235

An experimental unit has been successfully operated and the production plant at the Clinton Engineer Works for producing U 235 is now approximately 35% complete. This plant is scheduled for completion early in 1944. It will furnish sufficient U 235 to provide material for the essential research that must be completed prior to fabrication of the first bomb. The still existing uncertainty as to the amount of material required for a bomb makes it impossible to tell when this method will produce a sufficient quantity for the first bomb. It could be anywhere from September 30, 1944 to early in 1945. We have in this method a possibility of advancing the previously estimated date of the first bomb by some months. Accordingly, all possible pressure is being placed on it. Engineering and construction are being done by the Stone and Webster Engineering Corporation, and the plant will be operated by the Tennessee Eastman Corporation, a subsidiary of the Eastman Kodak Company.

DIFFUSION PLANT FOR PRODUCING URANIUM 235.

Construction on a production plant for producing U 235 by the diffusion method has just been initiated; it is scheduled for completion by about Christmas 1944. It is expected to use this

plant in conjunction with the electro-magnetic method. The diffusion process will bring the material to a certain richness, 25 to 35 percent; the electro-magnetic plant will then take this enriched material and produce the final product. If it is reasonably successful it will produce sufficient quantities for our military use. Research and experimental work are being conducted at Columbia University. The production plant is being constructed at the Clinton Engineer Works. The manufacture of a number of the component parts of the process equipment is now being initiated. It is hoped that material for the first bomb will be available early in 1945. Engineering is being done by the Kellex Corporation, a subsidiary of M. W. Kellogg and Company, and the plant will be operated by the Carbide and Carbon Chemicals Corporation, a subsidiary of Union Carbide and Carbon Corporation.

POWER METHOD FOR PRODUCING ELEMENT 94

Experimental units utilizing a graphite uranium pile have demonstrated the successful application of many of the principles involved. A semi-works unit located at the Clinton Engineer Works is scheduled to begin operation in September of this year. Research, experimental work, and operation of the semi-works are being done by the University of Chicago. A production plant is now being constructed at the Hanford Engineer Works. Completion of the first production unit is scheduled for the summer of 1944. Final completion of the plant is scheduled for early 1945. The scheduled production rate

is sufficient for military use. The E. I. du Pont de Nemours and Company is engineering, constructing, and operating the plant. This work is being done under a contract providing for no profit and a one dollar fee. A special, well staffed division has been set up by du Pont for doing the work. Studies are being made to determine the feasibility of utilizing radioactive materials as a military weapon. These materials are a by-product of the expected element 94 plants. Plans for defense against their possible use by the enemy are being formulated. The enemy might produce a dangerous supply of these radio-active materials before the time when either he or we could complete a plant suitable for the production of an explosive bomb. He might use it as a means of denying an area against our advance or even in an attack on a heavily populated area.

HEAVY WATER

Although the heavy water uranium pile still appears to have certain engineering advantages over the graphite uranium pile, from the standpoint of time the graphite uranium pile was definitely better and our main effort for producing element 94 is based on the use of the graphite. Research and experimental work pertaining to the use of heavy water with uranium has been conducted, but no experimental or production units have been constructed, although engineering plans are about to be initiated.

Four plants are being constructed for the production of

heavy water. The combined capacity of these plants is approximately three tons per month. One of the plants is now completed and all are starting initial operation. One of these plants is located in Canada and the other three are located in the United States.

A committee of disinterested, eminent scientists has just completed a review of the heavy water problem and has recommended continuance of the heavy water work.

SECRET LABORATORY

Under the direction of Dr. J. R. Oppenheimer, a strong group of eminent scientists and selected individuals of proper industrial or military experience has been formed and suitable facilities provided at an isolated location in New Mexico. The mission of this group is to carry on research and experiment necessary for the final purification of the production material, its fabrication into suitable active components, and the combination of these components into a fully developed, usable weapon. The program of this laboratory has been examined into and approved by a committee of eminent, disinterested scientists.

ORES

The program for acquiring sufficient uranium ore for military use has been pushed vigorously. Sufficient ore for expected needs is now on hand, under contract, or available either in the United States or Canada, and contract arrangements for the latter will be completed in the near future. In addition to contracting for the purchase of

ore known to be available and for the mining of additional ore in the mines in Canada and the United States now being operated, every effort is being made to discover new sources and to develop those that may be most readily mined. Our investigations since last December indicate that the best ore supply is in the Belgian Congo rather than in Canada. We are obtaining ore from both places, as well as from the Colorado area.

A complete system of manufacturing plants for processing the ore for use as a feed material in the main production plants has been essentially completed and is now in operation at a rate sufficient for our use. All except one of these plants are located in the United States. The other is in Canada.

The bulk of the basic supply, and certainly the richest ores, are located in the Belgian Congo in an area held under concession by Union Miniere, which is reliably reported to be controlled by the Bank of England and the King of Belgium. Certain lower grade ores are in existence in other parts of the world, among them Colorado and the states to the south and west. Our knowledge with respect to use of lower grade ores is not yet perfected to a point where a proper estimate of the situation can be made, but it now appears that after our program is carried out and our existing supplies of uranium ore are converted into explosives in this war, our basic supplies and those in Canada will be well on the way to exhaustion, with the major world supply in the Belgian Congo not under our control in any way.

PATENTS

If the possibility of world disaster through the development of this superexplosive and its possible military by-products is to be avoided and the enormous hazard involved in its preparation minimized, the utilization of atomic power must always be under close control by governments interested in the welfare of mankind rather than in absolute domination and exploitation of other peoples. If the United States has a strong patent position, the achievement of the above will be facilitated. In accordance with your earlier instructions, steps have been taken to establish this position. A group of experienced scientific patent lawyers is handling the patent situation. All personnel, both scientific and industrial, engaged on the work are required to assign their entire rights to any inventions made in this field to the United States Government. Any important patent applications on this subject will be held in secrecy. No general effort has been made to buy patent rights of individuals ~~outside our control because all of these are as yet of doubtful~~ value and validity. In one case, however, negotiations are now in progress for the purchase of certain patents which, while not essential to us, are believed to have sufficient validity to make it advisable to procure them, particularly for reasons of security. This program is sound for the war period, which now has first consideration, and will lay the groundwork for proper control thereafter.

It is desired to emphasize that the program consists not only of the development of the design and construction of the production plants but also of the procurement and processing of the ore, the operation of the manufacturing plants in the production of materials, and in the production of the actual bombs and the means of delivery on the desired targets. As the problems have become more clearly defined, it has likewise been possible to define more accurately the many costs involved in carrying out the entire program. The exact amount can not yet be estimated more than approximately because of the many unknown factors yet remaining. We are learning more about these factors every day, but there are still many gaps from a cost standpoint in the extent of our knowledge. Even when we are certain we can solve a problem, we can not predict the cost of the solution. We started with four methods of producing the material and to date have only been able to drop one safely. We had hoped at the time of the December report to drop down to two and possibly one method. This has not proven to be feasible if we are to retain the original, and in our opinion vital, conception of getting an adequate solution at the earliest possible date. The procurement and processing of all possible available uranium bearing ore has also added considerably to the cost of the program. The entire program as now estimated, including operating costs through early 1946, will probably amount to over

$1,000,000,000. To date, $385,000,000 has been made available from construction funds under the control of the Chief of Engineers, and $400,000,000 additional has been provided for under disguised purposes in the Military Appropriation Acts for 1944. No need is seen for the provision of additional funds in the immediate future as the Chief of Engineers has been authorized by the President to enter into contracts, the estimated expenditures of which would exceed available funds.

SIZE OF BOMB

The amount of material which it will be necessary to use in the bomb is still unknown, but the situation with respect to it is a constantly changing one as time and work change assumptions into knowledge. The estimated explosive power and hence the expected damage per kilogram remain substantially unchanged. However, the material is not explosive unless a definite amount is placed in a proper arrangement. This definite amount, known as the critical amount, determines the size of the bomb. In June 1942 the amount was estimated as 5 to 10 kilos; in December it was estimated as 15 kilos, with the size of the bomb for an efficient explosion estimated as 25 kilos. The increased knowledge since December indicates that the size of bomb for good efficiency of explosion may vary from 20 to 80 kilos. The effect of a 5 to 10 kilogram bomb would be enormous if it could be made to explode. It is estimated as the equivalent of perhaps as much as 5,000 tons of TNT. Any larger bomb would be

correspondingly more effective. A 20 kilo bomb, for example, would be the equivalent of 10,000 tons of TNT. From a military standpoint, the smaller figure is large enough so that the advantage of increasing it is definitely not proportionate to the increase in the amount of material. What is needed is one decidedly powerful bomb, plus the ability to follow it up with others. If the enemy is wavering, this might readily end the war. However, the increase in critical size runs up the size and cost of the production plants and increases the time element. Fortunately, our plans for the pile and diffusion methods have been based on the production of a sufficient amount of material so that the increase in bomb size will not cause too great a delay. This is not true of the electro-magnetic process, where the amount of material produced per unit is extremely small.

TIME SCHEDULE

It is not possible to predict when bomb production can begin on a one per month basis, primarily on account of the uncertainty as to the critical size. A prediction can be made, however, as to the initiation of production, and the following statement is believed to present a fair picture of the possibilities:

a. There is a chance, and a fair one if a process involving the use of a hydride form of material proves feasible, that the first bomb can be produced in the fall of 1944.

b. There is a reasonable chance, if the hydride does not prove to be feasible, that the first bomb can be produced

about January 1, 1945.

g. There is a good chance that the first bomb can be produced during the first part of 1945 and that this bomb can be followed up at reasonable intervals with other bombs, the interval being dependent upon the critical size. If the critical size is not too great, the rate of production can be at the rate of one bomb per month.

GERMAN ACTIVITY

It is proving difficult to obtain satisfactory information as to enemy activity. Germany started work along these general lines in 1939. Leading German physicists are working in various laboratories in Germany, with the most important activity believed to be centered in the Kaiser Wilhelm Institute near Berlin, and persons working on this matter are exempt from conscription. Specific information as to the known locations of installations important to Germany in this connection has been furnished to the proper military authorities, with strong recommendations that they be destroyed.

After the fall of Norway strenuous efforts were made by the Germans to increase the production of heavy water in a plant at Rjukan, Norway. All of this product has been shipped to Germany. Early in March 1943, this plant was sabotaged by British agents, and it was reported at that time that it would be out of commission for at least a year. It is now reported that the plant was back in

operation in less than two months. The speed with which this plant was repaired indicates that it must have been given a completely overriding priority on all other production activities in Germany with respect to materials, equipment, and personnel. It has been reported that the Germans feel that the heavy water is essential both in the splitting of the atom and in the production of the explosive.

It is reliably reported that high German military and diplomatic officers possess unusual confidence with respect to the outcome of the war. These reports are accompanied by the explanation that this confidence is quite possibly due to the perfection of a new weapon. It is doubtful if this is based on an atomic bomb, although the possibility can not be disregarded. There is no reason to believe that we have as yet overcome the six months to a year advantage which Germany originally held over us on the solution of this problem, unless by chance our bombing program has caused a dislocation in their plans. There is a possibility, therefore, that Germany may be in a position to use this material in the present war, particularly if events should lengthen the struggle unduly. However, even if the Germans succeed in producing a usable bomb, we are now in a position to overtake them and eventually produce like material in greater quantities. This may result in a situation where it will be necessary for us to stand the first punishing blows before we are in a position to destroy the enemy.

BRITISH EFFORTS

Up until December, 1942, there was a close scientific interchange with the scientific group working on the problem in England. The British program was in two parts. The first was the development of a diffusion process for making the material. This process differed considerably from our own diffusion process. It was scheduled for testing in a small model plant early last spring; however, they did not then indicate any intention, even though the small plant proved successful, to build a large scale plant in England. This was due not only to a shortage of men and materials and their vulnerability to bombing from Germany, but also to the fact that they now expect us to make the full scale effort in this field. The second part of their program had to do with experimentation for a power plant using a heavy water uranium pile. The scientific group carrying this on was made up of European refugees, and was transferred recently to Canada where they are carrying on their work on a laboratory and research basis. As far as is known no plans have been made for constructing any full scale production facilities.

RELATIONS WITH THE BRITISH

The President approved in December 1942, among other recommendations of the Policy Committee, the one dealing with our relations with the British. This reads as follows:

"Restricted interchange of information only to the extent that it can be used now by the recipient."

The interpretation of this policy was as follows:

"1. Electro-magnetic method--no interchange. (British doing no work on this method.)

2. Diffusion--unrestricted interchange between the U. S. firms designing and constructing the Plant and the British concerned with the same project.

3. Manufacture of '49' and heavy water--interchange only of scientific research; no interchange of the design of plants. If all of the information obtained would be made available to U. S. Engineers, the initial Trail product* could be made available to the Canadian group to an extent sufficient for them to pursue their experimentation. Since there would be no developmental work in Canada, British or Canadian access to the design of our plants or to the plants after construction would not be provided for.

4. No interchange on research or development being conducted in special secret laboratory on bomb design."

*Note: Heavy water.

This plan, in the opinion of the Military Policy Committee, was entirely fair to both nations. Its purpose was to expedite in every way the winning of this war and to leave post war problems to be decided at a later date. Although no official expression of opinion was securable, it is believed that it was entirely satisfactory to the Canadians. It was not accepted by the British; apparently the decision was made by the Prime Minister himself. Direct instructions of the President to Dr. Bush have led recently to further consideration of the problem, and the resulting conferences between Sir John Anderson, President of the Privy Council, who heads the British efforts along these lines, and Dr. Bush have led to an interchange of letters. Sir John Anderson has accepted the principles laid down in the last letter from Dr. Bush, and if these principles are approved by the Prime Minister, the way will be clear towards fulfilling the views of the Military Policy Committee of unlimited interchange of information where such interchange would be of value in winning this war. Among these principles is a provision for a combined committee with headquarters in Washington. If the principles are approved and this committee is established, it will undoubtedly be able to iron out any differences of opinion which may arise as to the interpretation of the general policies.

RUSSIAN ACTIVITIES

The Russian Government has made unsuccessful attempts to secure uranium concentrates in this country, both through private firms and officially through the Lend Lease Administration,

allegedly for uses not related to uranium fission. The Russians have constructed a cyclotron, and are unduly curious in their questioning of American scientists visiting Russia concerning our work on uranium fission.

Late in March of this year Joseph Weinberg, a physicist employed in the Radiation Laboratory, University of California, at Berkeley, is known to have given secret information concerning the project to Steve Nelson for the stated purpose of transmission to the Russian Government. Nelson immediately thereafter had a clandestine meeting with Ivanoff, an official of the Russian Consulate at San Francisco. Thereafter Nelson was observed meeting with Zubilin, Third Secretary of the Soviet Embassy, Washington, D. C. Zubilin transmitted funds to Nelson, and they discussed the use of the Communist Party, U.S.A., for espionage purposes.

Steve Nelson, alias Stephan Mesarosh, alias Joseph Fleislinger, is a naturalized citizen of Yugoslavian origin who was political commissar of the Abraham Lincoln Brigade of the Loyalist Army in Spain during a portion of the Civil War. He thereafter went to Russia, and after several years' residence there returned to this country. He is now a member of the National Committee of the Communist Party, U.S.A., and leader of the Communist Party in Alameda County, California.

A close associate of Joseph Weinberg on the project, and a member of the Communist Party, Giovanni Rossi Lomanitz, was

observed in discussion with Steve Nelson, at which time Rossi asked permission to come out in the open in his Communist activities and go to work in the shipyards or go into the Army. Nelson instructed him to stay on the project, as he could be of more use to the Communist Party there than anywhere else.

The Federation of Architects, Engineers, Chemists, and Technicians (CIO) Local No. 25, is making extraordinary efforts to organize the Electro-Magnetic Laboratory at Berkeley. This activity goes to the extent of securing and training prospective employees. Steve Nelson is actively directing these activities, and it is known that the union organization is obtaining information about the work being done.

Steps are being taken to avoid any draft deferment of Weinberg, Lomanitz, or any other Communists on the project. The union, in close consultation with Steve Nelson, is making strenuous efforts to secure the deferment of Lomanitz and force his retention on the project.

No similar activities have been observed at other installations. No espionage activities by the Axis nations with respect to this project have been developed by our counterintelligence, although there have been suspicious indications. All espionage suspects are under continuous surveillance and extraordinary security measures, as directed by the President, have been taken.

SUMMARY

We are continuing in every possible way to expedite the successful and speedy accomplishment of the project, which in our opinion remains vital to the security of the nation.

RECOMMENDATIONS

It is recommended:

a. That this program continue to be carried forward vigorously, and that it continue to be given the highest priorities and allocations on materials, equipment, and personnel, with a view to solution at the earliest possible date.

b. That in view of the recent correspondence with Sir John Anderson, which was placed in the President's hands by Dr. Bush, the President give us further instructions with respect to the interchange of information with the British.

This report has been drawn up under the direction of the Military Policy Committee, and has been read and approved by each of the members.

L. R. GROVES
Brigadier General, C. E.