

UNCLASSIFIED

*Report 260
(EPR-21)*

30 May 1947

Included herein is a historical record of the AAF sponsored NEPA Project during the period of October, 1945, to the present time, and covers in narrative form the nature of planning leading to the implementation of the project, the establishment of the operating group and its relationship to the Manhattan District (later to become the Atomic Energy Commission) and the approach to applicable technological problems bearing on both nuclear science and aeronautical propulsion engineering aspects.

Needless to say, numerous details have been omitted and only events which the writer considers to be significant are included. Further, it is to be noted that titles and positions of persons mentioned in the report are recorded as of the date of the incident with which such persons were associated.

C. D. GASSER
Lt. Col., A. C.

UNCLASSIFIED
Classification cancelled (or changed to) UNCLASSIFIED
memo & list nos. 50-80 from
by authority of decal. Br. dtd 7-18-61
by J.C. Rideman TISCR, date 8-17-61

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED
NK 2-21-95

SECRET

UNCLASSIFIED

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

THE ARMY AIR FORCES NEPA PROJECT

1. As a result of considerable study of general problems involved, of which knowledge was had at the time, the Research and Engineering Division of AC/AS-4, Headquarters, Army Air Forces, undertook an exchange of correspondence with Air Materiel Command activities in October, 1945, with a view toward exploring the feasibility of nuclear energy means of propulsion for inhabited and uninhabited aircraft and for guided missiles. Supplementing this was a series of formal and informal conferences between representatives of the Research and Engineering Division of AC/AS-4; the AAF Scientific Advisory Group of the office of the Commanding General, Army Air Forces; the office of the Deputy Chief of Air Staff for Research and Development (Headquarters, Army Air Forces); the office of the Deputy Commanding General, T-3, Air Materiel Command; the office of Chief, Engineering Division (AMC); and the Power Plant Laboratory (AMC). Of possible interest and certainly of historical value is the fact that the above AAF study and speculative thinking stemmed from a careful review which had been underway for some time of the then immediate and the indicated long range aspects of the AAF propulsion system research and development program and their effects on future types of aerial weapons and related methods of warfare. It seemed apparent to

the AAF, theoretically at least, that great promise lay in the adaptation to aeronautical propulsion of the inherent source of power available in nuclear energy, and it would essentially only be through the medium of nuclear propulsion that flight performance (velocity and range) could be practically achieved in the desired degree within and beyond the atmosphere. In fulfilling its responsibility this would then mean to the AAF the potential realization of superior propulsion systems required for new and advanced types of aircraft and guided missiles capable of successfully conducting specialized tasks associated with future methods of global warfare.

2. In November, 1945, the Deputy Chief of Air Staff for Research and Development, AAF (Major General C. E. LeMay), was appointed to a board of ten officers (five Army and five Navy) for the purpose of advising the Commanding General of the Manhattan District (Major General L. R. Groves) on the needs of the respective Services in relation to atomic applications. This, together with representations subsequently made by the Commanding General of the AAF (General Carl A. Spaatz), afforded the AAF an ideal opportunity to approach the Manhattan District and undertake discussions with General Groves and personnel on his immediate staff on policy matters and with other Corps of Engineers personnel and certain civilian scientists associated with the Manhattan Project regarding technological considerations. Consequently,

~~SECRET~~

UNCLASSIFIED

during the following months of December, 1945, to March, 1946, a series of preliminary discussions were entered into between AAF and Manhattan District personnel, which, in brief, covered investigation of ways and means whereby an appropriate project could be implemented. Several difficult problems of unprecedented nature were apparent, the most important of which included the type of organization that could be secured to intelligently and effectively undertake such work; the manner in which and the number of appropriate personnel, skilled particularly in nuclear science, that might be secured; and, the latitude that would be permitted any group selected by the AAF to conduct investigations, research and development, commensurate with the very stringent security measures that had been imposed on all atomic information and facilities.

3. Based on a careful evaluation of existing contractor agencies in the recognized aircraft industry, it was quite clear that none was particularly suited to carry forward the project in question because of a general lack of qualified talent, appropriate facilities, and an understanding of the scope and nature of the nuclear aspects. It was also obvious that personnel would not be available to the AAF from within the normal AAF or Civil Service structures with which to staff an organization that could fulfill scientific responsibilities associated with such a venture. However, the Manhattan District was receptive to the AAF entering into a contract of its own with the provisos that--

~~SECRET~~

UNCLASSIFIED

[REDACTED]

a single agency would be selected which would prosecute the contract; no attempt would be made to proselyte nuclear specialists from the Manhattan Project or its associated contractors, nor would any nuclear specialists be engaged who had previously been employed on the Manhattan Project but had since been engaged elsewhere, without approval of the Manhattan District: a security system satisfactory to the Manhattan District would be established and administered within the AAF; and, any AAF contract and all resultant work undertaken involving classified Manhattan District information or facilities would be subject to prior approval by the Manhattan District. During this period the AAF was invited to attend, on an observer basis, a meeting in New York sponsored by the Manhattan District to be held for the purpose of discussing the organization and plan of work of the Monsanto Chemical Company group which had been selected to pursue development of the Daniels stationary power pile. Based on such information as was obtained at this meeting, it was apparent that while an appreciable amount of basic research had been considered and accomplished on stationary power pile problems, little emphasis or consideration had been given to other reactors and their components, particularly the type in which the AAF was primarily interested.

4. In considering all these problems the AAF concluded that a new group or organization would have to be formed which would essen-

51

tially incorporate two basic elements; namely, nuclear science and aircraft engine specialists headed up by a qualified individual who not only had a sincere interest in the project, but who also had the confidence of the aeronautical industry. Based on the above and an evaluation of unsolicited nuclear propulsion proposals which had been submitted to the AAF by that time by certain agencies within the aeronautical industry, the Fairchild Engine and Airplane Corporation, under the guidance of Mr. J. Carlton Ward, was selected as the prime contractor agency and nucleus of the organization to lead the project. Personnel available to Fairchild also had some bearing on this decision since the services of certain technicians who had previously been connected with contractors to the Manhattan District or had been in the direct employ of the Manhattan District had subsequently become or were about to become associated with Fairchild. Further, ideas which these technicians had developed had been reflected in Fairchild's proposal, obviously substantially enhancing its concept. With Fairchild forming the nucleus of the activity to undertake the project, it was further deemed appropriate that all recognized aircraft engine industry should be invited into the organization as direct participating member activities, each of which would have an equal voice in the technical program. It was also considered appropos that the National Advisory Committee for Aeronautics should be invited to partici-

[REDACTED]

-pate in the project on a par with the aircraft engine industry. It is probably important to note that the above mentioned action to include only recognized aircraft engine agencies in the project was an arbitrary policy decision which was reached by the AAF and was based on the assumption that it would be wise, at least at the outset, to limit the number of participants and concurrently the number of voices in the technical direction of the project in view of the unfamiliar nature of the entire undertaking. It was, however, understood that there was no intent to set a "hard and fast" rule which would permanently exclude other worthy participants at some future date who could materially contribute; conversely, "too many cooks in the early stages could well spoil the broth".

5. The plan then that was evolved was to enter into a contract direct with Fairchild of a no-profit, no-loss type which would be based on the pattern of the Manhattan District-Monsanto Chemical Company contract. Such a contract was approved in principle by the Manhattan District and on 28 May 1946 an AAF Letter of Intent in the amount of \$1,300,000 was signed by Fairchild in order to permit execution of firm policy and technical planning. Approximately one month earlier, in fact on 23 April 1946, a conference was held at the Pentagon Building in Washington, D. C., under the joint auspices of the AAF and Fairchild, attended by members of the aircraft engine industry.

previously mentioned, the N.A.C.A., the Bureau of Aeronautics, the Manhattan District, and the Monsanto Chemical Company. At this conference a brief outline was given by Major General C. E. LeMay, Brigadier General A. R. Crawford, and Mr. J. Carlton Ward, relative to the purpose of the project, the operating group visualized, relevant policy and procedure, and the broad scope and nature of work to be undertaken. Very helpful comments and information on Manhattan District procedure, security and patent measures were furnished by Brigadier General K. D. Nichols and Captain R. A. Lavender (USN) of the Manhattan District and the Office of Scientific Research and Development, respectively. Dr. C. R. McCullough and Professor F. Daniels of Monsanto, also present, outlined the relationship between Monsanto and the Manhattan District, particular points of interest concerning the Daniels power pile project, and in addition gave several constructive suggestions in a proposed Monsanto sponsored educational project and a method by which the AAF project could best establish liaison with Monsanto on both a working and educational program level. An invitation was extended to the Bureau of Aeronautics through Rear Admiral L. C. Stevens, who attended the conference, to participate in the project in an observer status in order to permit full appraisal of that agency of AAF research and development plans, and also with a view toward soliciting the Bureau's assistance and joint participation should

[REDACTED]

time prove the project to be justifiable. As a result of the above, representatives of all aircraft engine companies and the N.A.C.A. who were present indicated a desire on behalf of their respective activities to participate in the project except one (Packard), who dropped out on the basis of being able to contribute neither qualified personnel nor technical advice. Accordingly, as of 23 April 1946, in addition to the Fairchild Engine and Airplane Corporation as the prime contractor, the following aircraft engine activities had indicated, subject to confirmation by top management of their respective companies, a desire to participate in the project henceforth to be known as the NEPA Project (a first letter abbreviation of the title Nuclear Energy Propulsion for Aircraft):

Allison Division, General Motors Corp.

Pratt & Whitney, United Aircraft Corp.

Wright Aeronautical Corp., Curtiss-Wright

General Electric Company

Westinghouse Electric Company

Fredric Flader, Inc.

Northrop Aircraft, Inc.

Menasco Manufacturing Corp.

Continental Aviation & Engine Corp.

Lycoming Division, The Aviation Corp.

[REDACTED]


N.A.C.A. (Cleveland Aircraft Engine Research Laboratory)

Bureau of Aeronautics - Joint participation with the

AAF under conditions previously mentioned.

In addition to having a voice in the technical phases of the NEPA Project, it was agreed that wherever appropriate participating activities would also be given an opportunity to assign qualified personnel to the NEPA working organization and that each activity would be included in the NEPA sub-contracting program commensurate with their respective abilities, facilities and skilled personnel. Alternately, because of obvious reasons, participating activities would not be held responsible for the formulation of important decisions on nuclear science research and development phases, such phases being delegated to competent nuclear specialist consultants to the NEPA Project. These consultants were located at various universities and research foundations, at activities of contractors to the Manhattan District or in the Manhattan District organization.

6. On 28 May 1946, which was the same date that the NEPA Project Letter of Intent was signed by Fairchild, a conference was held in the Pentagon Building attended by representatives of companies who, as previously mentioned, had participated in the 23 April conference. Aeronautical industry representatives who had been requested during the previous conference to secure any final concurrence necessary from



the management of their respective companies relative inclusion in the project, stated their formal intentions which were to participate. It was agreed that representatives from agencies other than Fairchild directly participating in the NEPA Project would be identified as the NEPA Board of Consultants. During the conference matters pertaining to the NEPA group organization, administration, technical, educational and security aspects, all of which had become somewhat more formalized, were reviewed and agreed upon. Summarizing the outcome of the 23 April and 28 May conferences, the NEPA Project had been officially established; a broad administrative organizational, technical, educational, security and operational structure had been formulated, and the majority of recognized aeronautical engine industry had evidenced its interest to be included as direct participants in the Project. As outlined by the AAF and agreed to by the prime contractor and participating agencies, the scope and nature of the program, its goals and principles were manifold including essentially the following:

- a. A careful and methodical prosecution of feasibility investigations and research leading toward the adaptation of nuclear energy as a means of propulsion applicable to aeronautical purposes.
- b. The introduction of considered aeronautical requirements into over-all nuclear research plans.
- c. The indoctrination and education of the recognized

[REDACTED]

aircraft industry and other applicable industry in the field of nuclear science and its adaptation to aeronautical means of propulsion leading to the time when such industry could undertake on its own behalf development of nuclear energy means of propulsion as might be applicable to and available for military and civil aeronautics use.

d. Designing and constructing within such limits as might be imposed by the Manhattan District, or its successor activity, nuclear energy means of propulsion for aircraft and possibly guided missiles.

e. The over-all advancement of nuclear and associated sciences.

7. During the period of June 1946, to September 1946, inclusive, work on the NEPA Project was generally reflected in progress being made in establishing more firm and definitive parameters of a program of investigation and research, plus the securing of a more complete staff of nuclear specialists and an engineering and administrative staff. Steps were taken to establish appropriate security measures and channels governing the transmission of classified information to the NEPA technical staff from libraries and files under the cognizance of the Manhattan District. Work was also undertaken relative drafting of a definitive contract between the AAF and Fairchild, which, when approved, would cover the entire project, and, accordingly, replace the Letter of Intent

[REDACTED]

under which work was being performed. This contract was in the total amount of \$3,300,000 (from 1946 and 1947 FY AAF research and development fund resources, and included the amount of \$1,300,000 covered by the Letter of Intent). During the month of July a visit was made by representatives of the AAF and Fairchild to Oak Ridge where matters pertaining to administrative and laboratory space and housing were discussed with Manhattan Engineer District personnel. The technological aspects of the program were also discussed with Clinton Laboratories personnel, including Prof. E. P. Wigner and Drs. C. R. McCullough, F. Daniels and E. J. Murphy.

8. Perhaps one of the most important and far reaching implications which had become increasingly apparent by this time was the urgent need for top flight nuclear specialists for the NEPA Project in both a part-time consultant capacity and a full-time working capacity. The part-time services of Drs. Hans Bethe and R. F. Bacher of Cornell University had been secured as nuclear consultants primarily through the efforts of Mr. Ward (Dr. Bacher later severed his relationship with the NEPA Project due to his appointment to the Atomic Energy Commission). The part-time services of Mr. Kenneth Browne of the Chesapeake and Ohio Railroad as an aerodynamic and airplane installations consultant had also been secured. Principal full-time technical personnel who had been assigned to the NEPA Project included Mr. G.

[REDACTED]

Simmons, Jr., as Technical Director; Mr. J. A. Armitage, as Assistant Technical Director; Mr. A. Kalitinsky, as Chief Engineer; and Mr. S. H. Turkel, as Senior Physicist. While the above personnel were definite assets to the NEPA Project; additional well qualified nuclear specialists and also mechanical engineers, metallurgical and electronic engineers and aerodynamicists, particularly on a full-time basis, were clearly needed. Restrictions imposed on the AAF by the Manhattan District relative hiring of any nuclear specialists engaged in activities either under or outside of Manhattan Project cognizance had proved to be an aggravation to the critical situation confronting the NEPA Project; however, the reason for this prohibition was understood by the AAF.

9. In September 1946 the NEPA Project staff, which had been operating practically entirely from Fairchild offices in New York City, moved to Oak Ridge, Tennessee, to establish a permanent site from which the project could be directed and at which planning and certain applied research work bearing on nuclear investigations and research could be conducted. Further important reasons prompting this move were the desirability of locating the NEPA group in close proximity to the administrative and scientific staff of the Research Division of the Manhattan District, nuclear data, library facilities of the Manhattan District, and Clinton Laboratory facilities and personnel associated

with the Monsanto Chemical Company, operators of the Clinton Laboratory and under whose cognizance investigations were progressing toward development of the Daniels stationary power pile project. Concurrent with this move an AAF representative, Major Donald J. Grant, was assigned on a full-time status to the NEPA Project at Oak Ridge, to be responsible to the Commanding General, Air Materiel Command, for the administration and direction of applicable contractual and operational matters. Through the combined efforts of the AAF, the NEPA administrative and technical staffs and with the assistance and approval of the Manhattan District a site identified as S-50 Area was assigned, services including office space, applicable equipment and transportation were arranged for, and a housing schedule for NEPA personnel was implemented. Salary and wage scales as well as job titles used by the Monsanto Chemical Company were in the main employed as patterns by NEPA in order to forestall dissatisfaction amongst personnel of other Manhattan District contractors' activities. A suitable program was also initiated covering health and accident insurance for NEPA personnel.

10. Pursuant to prior circulation amongst representatives of the NEPA Board of Consultants of a more or less complete outline of proposed work, a conference was held in the Pentagon Building on 8 October 1946 for the purpose of securing each representative's comments

and to consider any constructive recommendations relative modifications or changes which might be introduced. In addition to attendance by members of the NEPA Board of Consultants under the Chairmanship of Mr. Ward of Fairchild, others of importance attending this conference included: Lt. Gen. L. H. Brereton, Chairman of the Military Liaison Committee to the Atomic Energy Commission (the successor activity to the Manhattan District which was in the process of being formed); Maj. Gen. E. M. Powers, AC/AS-4, Hq., AAF; Maj. Gen. B. W. Chidlaw, Deputy Commanding General (T-3), Air Materiel Command; Maj. Gen. L. E. Oliver, member of the Military Liaison Committee to the A.E.C.; Brig. Gen. A. R. Crawford, Chief, Research and Engineering Division, AC/AS-4; Rear Admiral T. C. Lonquest, Office Chief of Naval Operations; Rear Admiral L. C. Stevens, Chief of Research and Engineering Group, BuAer; Rear Admiral W. S. Parsons, Director of Atomic Energy Defense (USN); and Drs. E. J. Murphy and C. R. McCullough of the Monsanto Chemical Company. Principal subjects covered included a review of all technical proposals which had been received by NEPA (from member companies and other sources), the then current plan of NEPA Research and Development, the proposed educational program, and miscellaneous matters. During discussions held concerning correlation of the NEPA program with other nuclear projects and with other governmental agencies sponsoring or having an interest in such work, it was mentioned that the Joint Research

[REDACTED]

and Development Board, an agency established to coordinate Army-Navy research and development programs with a view toward eliminating duplication and toward directing work in proper channels, was about to be activated and would incorporate in its structure a group of Atomic Advisors for the purpose of evaluating the desirability and relative priority of all nuclear projects sponsored by the Services. It was further brought out that the NEPA Project would no doubt be considered by this group together with other projects and that Lt. Gen. Brereton, Chairman of the M.L.C., would probably become a member of the JRDB (it will be seen later that the JRDB was to play a very important and influential role insofar as the NEPA Project was concerned). Announcement was made that the services of an additional number of part-time consultants had been secured since the 28 May conference, including those of Prof. W. H. McAdams of M.I.T. on heat transmission and chemical engineering matters; Prof. C. R. Soderberg of M.I.T. on power plant matters; Dr. H. H. Goldsmith, Associate Prof. at the University of Chicago, on nuclear/editorial and information matters; and Dr. M. Kolodney of CCNY on heavy metals metallurgical matters. So far as concerned the NEPA research and Development Program, it was the consensus of opinion of representatives of the NEPA Board of Consultants and the Monsanto Chemical Company who attended, that the program was essentially satisfactory in its concept, and work should

[REDACTED]

proceed as outlined. In the latter part of October 1946 a broad program of proposed NEPA research and development was forwarded to the Manhattan District by the AAF together with pertinent comments relative to operations and sub-contracting procedure. The above program and related matters were in essence approved by the Manhattan District in the latter part of November 1946. Definitive clarification was also furnished on several important points and phases of operations concerning applicable facilities, equipment and materials falling under the cognizance of the Manhattan District, whereby NEPA Project work involving such matters would require prior approval by the Manhattan District. Also pointed out was the fact that a new organization identified as the United States Atomic Energy Commission had been appointed by the President to control atomic energy activities in this country and that all references that had been made as of that date to the Manhattan District should be interpreted to refer to the U. S. Atomic Energy Commission at such time as the Commission assumed active control.

11. During this same period (October and November 1946) two events of some importance occurred which are worthy of mention because of their influence on applicable AAF policy and the nature of the future operation of the NEPA Project. The first of these was in the form of a proposal by North American Aviation, Inc. to undertake investigations

and research leading toward the development of a nuclear-powered propulsion system, and in turn the adaptation of this means of propulsion to long range guided missiles. North American's proposal was essentially to undertake work outlined as a direct participating member of the NEPA Group within and adjacent to their plant at Inglewood, California. However, evaluation of North American's proposal by NEPA Project technicians indicated that nuclear considerations had not progressed sufficiently to warrant serious consideration. North American was advised accordingly and was also invited to submit any further or more advanced ideas they might have. The second event was the effort underway by the Douglas Aircraft Company, Inc. through the medium of their RAND contract with the AAF to pursue applied research at the Battelle Memorial Institute in the field of nuclear rocket propulsion. In brief, this work was comprised of investigations and research leading to the construction of a "percolator" type reactor for use in a rocket device which essentially embodied a drilled porous aggregate block impregnated with a uranium oxide. According to Douglas, this work was necessary to fulfill a portion of their over-all RAND obligation to the AAF. As a result of a series of correspondence between Headquarters AAF offices and Douglas, and a conference (held in January 1947 in the Pentagon Building), attended by representatives of Douglas, NEPA, Battelle and the AAF, it was

concluded that the portion of the work underway by Douglas involving actual design and fabrication of the above rocket device overlapped responsibility falling under the cognizance of NEPA; however, since the RAND-Battelle Project was definitely in the realm of national interest, it should be prosecuted under the direction of NEPA. Actually the NEPA program already had in its concept a series of projects under negotiation with Battelle, and any inheritance by NEPA of the Douglas program would not alter the situation. Accordingly, action was initiated by Fairchild through NEPA Project personnel to prepare a suitable contract with Battelle which essentially included in its entirety, and to some degree expanded, the referenced Douglas program. In brief summary, these two events together with others of less significance not mentioned here, evidenced a growing interest in the over-all undertaking by the portion of aeronautical industry and other industry not included as participating activities in the NEPA program or as contractors. This fact, together with certain expressions of opinions by nuclear specialists associated with other governmental agencies and elsewhere, emphasized the necessity to both Fairchild and the AAF of having a modern, aggressive program of as technically sound a concept as possible—one that would produce results at the earliest practicable time. It further emphasized that Fairchild, backed by the AAF, should be conscious of all new proposals and talent

[REDACTED]

that might be offered or otherwise available and that such proposals and talent should be used wherever possible and practicable to insure that the basic goals of the program were met.

12. During the months of December 1946 and January 1947, work by the central NEPA group at Oak Ridge progressed by means of a continuation of compilation of pertinent nuclear and other data from A.E.C. research and library sources located at Oak Ridge and elsewhere, investigations and analyses associated with the entire field of applicable problems preparatory to undertaking applied research, and augmenting and expanding administrative and technical staffs, facilities and equipment. On 28 January 1947 a further NEPA Board of Consultants' conference was held in the Pentagon Building. In addition to the normal complement of Board of Consultant, NEPA Technical Staff and NEPA technical consultant members present, headed up by Mr. Ward, also attending were representatives of Headquarters AAF, the Air Materiel Command, the Bureau of Aeronautics, the Office of the Secretary of the Navy, the Atomic Energy Commission and the Monsanto Chemical Company (Clinton Laboratories). Principal matters discussed included the over-all NEPA program of research including firm and tentative subcontracting phases that had been developed as of that date and the NEPA educational training program. Since reports covering these matters had been given earlier circulation amongst practically all personnel

██████████

attending the conference, considerable discussion developed, particularly concerning nuclear considerations and associated technological aspects. However, with minor exceptions, the program was concurred in as being satisfactory in its entirety pending further progress and resultant changes and modifications which might develop. Announcement was made of a seminar scheduled to be held at Oak Ridge during the first half of the following month (February 1947) which would be of an introductory nature to essentially familiarize member companies' representatives with the subjects of nuclear physics, applicable metallurgy, reactor design, etc., and to acquaint them with activities of the Central NEPA Group located at Oak Ridge.

13. During February 1947 the Seminar mentioned in Par. 12 above was held at Oak Ridge (Feb. 4 to 12, inclusive) and for all intent and purposes was a complete success. The faculty secured by the Central NEPA Group from various universities and other organizations was of the highest order and included Drs. B. T. Feld of M.I.T., M. Kolodney of CCNY, F. Seitz of X-10 (Clinton Laboratories), G. Young of X-10, H. H. Goldsmith of NEPA and Professors E. P. Wigner of X-10, J. S. Schwinger of Harvard University and P. Morrison of Cornell University. Attending the Seminar were representatives of the Member Companies of NEPA, the AAF, Navy, A.E.C., Monsanto Chemical Co., Carbide and Carbon Chemicals Corp., and the Tennessee Eastman Corp.. In

[REDACTED]

addition to fulfilling its fundamental purpose, the advent of the Seminar cleared up any question in the minds of both Fairchild and the AAF relative the value of such courses and the desirability of holding courses of instruction of advanced scope in the future. It was during this same month that an additional and advanced study prepared by North American Aviation, Inc., identified as North American Report NA 47-15 was received by the AAF. This study, somewhat spectacularly advanced in its concept over North American's previously mentioned original proposal, requested authority to undertake research into and development of nuclear reactors together with associated rocket and ram-jet engines to be tied in with the development of two specific missile designs; all work to be done under the cognizance of North American Aero-Physics Laboratory. Subsequent to discussions held at Headquarters AAF by the AAF and North American representatives regarding their proposals, copies of the report together with a letter of instructions were forwarded to the AAF office located at the site of the NEPA operations at Oak Ridge, requesting that the technical soundness and feasibility of nuclear considerations included in the North American report should be evaluated by the NEPA Project technical staff, and further, if possible, similar evaluations should be secured from technical groups of the Research Division of A.E.C. and the Monsanto Chemical Company at Clinton Laboratories.

[REDACTED]

On 28 April 1947 a conference was held in the engineering building on the S-50 Area attended by representatives of North American, RAND, Fairchild/NEPA, Clinton Laboratories and the AAF, at which time technical discussion was had regarding nuclear considerations incorporated in the North American report. This discussion was supported by written data furnished by the Research Division of A.E.C., Clinton Laboratories and as prepared by Fairchild/NEPA, and without question gave adequate treatment to both broad and definitive data included in the report as well as those presented verbally by North American personnel who were present. At the time of this writing, formal evaluations of the technical work and feasibility of nuclear considerations included in the referenced North American report as prepared by Fairchild/NEPA, the Research Division of A.E.C., and by Clinton Laboratories, have been forwarded to the Office, Chief, Research and Engineering Division, AC/AS-4, Headquarters AAF, for final disposition. In brief, the consensus of conclusions which could be gathered from previously mentioned technical evaluations was to the effect that while Report NA 47-15 was in many respects a good engineering document and some of the nuclear considerations were interesting, North American personnel appeared to be from twelve to eighteen months behind time so far as concerned advanced nuclear science information which had become available (in the

[REDACTED]

A.E.C.). Because of this lack of modern information, some of North American's nuclear considerations bordered on the impossible, many of their considerations failed to come even close to advanced or so-called "optimized designs" (simply the difference between impractical and practical) and certain vital features had been given treatment of the most vague nature.

14. Dating back to February 1947 the NEPA Project had come under the observation of the Joint Research and Development Board in connection with the Board's over-all considerations and evaluation of various programs actually involving or intimately associated with the use of atomic energy. Since that time programs taken under consideration by the JRDB have included the A-bomb, breeder piles, nuclear ground power pile applications, nuclear submarine and surface vessel propulsion, atomic war heads and aeronautical nuclear means of propulsion (the NEPA Project). As a matter of record, several activities have been involved in varying degrees in these programs, including the Atomic Energy Commission, the Navy Department and the AAF, together with contractors to these agencies including the Monsanto Chemical Corp., the General Electric Co., the RAND Group and the Fairchild Engine and Airplane Corp. JRDB concern has been to the effect that based on the present and foreseeable limited amount of fissionable material available, it will be problematical as to whether or not all programs can be, or are worthy of

[REDACTED]

continuation, and that a decision should therefore be made by competent authority relative which projects should be actively pursued at this time, together with their respective priorities. Neglecting other projects mentioned, the Fairchild Project (NEPA) has been, and is specifically being considered by the JRDB to ascertain its feasibility, practicability, timeliness and actual necessity. Several papers and verbal presentations have been made to Atomic Advisors of the JRDB by AAF, Bureau of Aeronautics and Fairchild/NEPA personnel, as to the reason behind implementation of the NEPA Project, its scope and nature, and the indicated requirement for aeronautical nuclear means of propulsion. Questions set forth above are still under consideration; however, appropriate recommendations are apparently to be made by Atomic Advisors of the JRDB to higher authority in the near future.

15. In brief resume of the current technical situation, from the date of its inception, the over-all magnitude of work associated with the NEPA Project was recognized by the AAF and Fairchild, perhaps not as clearly at the outset as at the time of this writing, but nevertheless appreciated as being a major and very difficult undertaking. So far as concerned phases of development incident to nuclear powered engines other than the reactor and its immediate supporting elements, there never were, nor presently are there, any

[REDACTED]

serious doubts but that the end results will be successfully achieved; however, with respect to the reactor and its functional components, it has become quite clear as a result of investigations and analyses completed thus far, as to the nature of research which must be pursued. Concurrently, it has also become quite clear that nuclear engineering problems associated therewith are significantly difficult as to have been given little or no treatment to date. The potential promise of successful achievement therefore obviously lies in the application of the combination of careful and methodical effort plus scientific thinking of a most receptive and advanced nature. It initially was and in fact presently remains technically undesirable to completely finalize any program of research leading toward the development of a specific experimental reactor (or reactors). Conversely, a position has been arrived at which appears sound and appropriate so far as concerns a program of work leading toward the design of a reactor, namely, one which will incorporate variables permitting maximum latitude in experimentation, and in turn a final selection of optimized efficiency, aspect ratio, weight, cost, safety, and conservation of fissionable material considerations. The reactor type selected will essentially be fast and initial adaptation is contemplated in an available turbo-jet engine type, thereby obviating inherent design and development problems normally associated

[REDACTED]

with such an engine itself. The probably equally difficult control and shielding problems are being given treatment commensurate with their respective importance to the reactor, and in turn engine/vehicle applications. The development of the single reactor type mentioned above of course does not mean that all NEPA Project work is being directed toward a development of a reactor applicable only to turbo-jet type engines to the exclusion of other specific reactor designs and their associated means of propulsion (such as ram-jet and rocket engines). Fundamental investigations and certain applied research are simultaneously being prosecuted on reactor work applicable to the latter engine types mentioned, and upon successful laboratory demonstration of the full scale reactor/turbo-jet engine combination, will be expanded to include applied development work. Basically the necessity for the selection of a minimum number of reactor types on which applied research and development should be done at this time is predominately dictated by the desire to achieve maximum conservation of fissionable material rather than technological possibilities. Influencing this, however, to a lesser degree, is the further fact that technically there is little or no need to develop more than one reactor type until a considerable amount of operational laboratory experience and data on the first full scale engine have become available. It is felt that except under National

UNCLASSIFIED

Emergency conditions such a program will suffice, and in addition to its other desirable features will also be commensurate with intelligent utilization of man-power and funds.

16. At the present time the great majority of work on the NEPA Project is yet to be done. The compilation of nuclear and other pertinent data from A.E.C. sources, its analysis, and the development of a comprehensive research program are well underway by the Central NEPA Group; however, with the exception of preliminary experiments being done by Northrop, Flader and M.I.T., and certain basic experimentation by the Central NEPA Group, no applied work has as yet started by the Central Group, any member company or subcontractor. Expansion of such work as is presently underway as well as the undertaking of the over-all feasibility program and phase research and development portion of the project is contingent on the results of the forthcoming evaluation by the JRDB and other high authority, and the resultant decision regarding the position of the project and its priority in its relationship to those projects involving fissionable material as may be approved and continued. As previously mentioned, the magnitude of the NEPA Project, while being generally recognized at the outset, has since come into far clearer focus. It is quite evident there is nothing "quick and dirty" about any phase of the NEPA Project, that all plans must be carefully

UNCLASSIFIED

analyzed before execution, and investigations and research must be prosecuted in an orderly sequence. The time element is still vague; however, five-eight years seem to be a consensus of opinion (from the date of inception of work at this site in September 1946) before an experimental laboratory engine will become available. The above time is obviously contingent on the establishment of a suitable priority to the NEPA Project by the JRDB and other high authority, and access to qualified talent, all applicable information, adequate facilities, equipment and funds.

17. It is concluded as being unfortunate in a sense that thus far the NEPA Project has not been successful in securing the services of eminent nuclear specialists on a full-time basis. This fact, to a degree, has hindered the acceptance of the NEPA Project in the scientific world. The contractor has repeatedly been urged to make greater effort to secure the full-time services of such personnel and it is hoped that results will soon become evident. To date it is not indicated that the project has particularly suffered from a technological standpoint, and technical personnel who are directly associated with the project on a full-time basis together with the part-time services of outstanding nuclear consultants, have managed to arrive at what appears to be a generally sound and timely program of research and development. Henceforth, however, the full-

-time services of one, and preferably more, outstanding nuclear specialists will be necessary on behalf of the NEPA Project to give competent and proper guidance to nuclear science work proposed plus prestige to the entire program.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of 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. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.