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ADDENDUM TO DC 56-8-167

M.S. Harned
103 PROJECT

September 17,1956

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GENERAL ELECTRIC-AIRCRAFT NUCLEAR PROPULSION DEPARTMENT-CINCINNATI 15, OHIO

U.S.A.E.C., WASH., D. C.

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ABSTRACT OF REPORT NO. DC 56-9-88

TITLE: ADDENDUM TO DC 56-8-167

AUTHOR & ORIGINATING UNIT: M. S. Harned, 103 Project

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This document is an addendum to DC 56-8-167 and gives a description of the proposed Navy nuclear seaplane program and the objectives of the X211 engine study program.

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SUBJECT: ADDENDUM TO DC 56-8-167 UNCLASSIFIED

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CINCINNATI 15, OHIO
September 14, 1956

TO: B. W. Bruckmann
Manager - X211 Project
JED, Building 500

A description of the proposed Navy nuclear seaplane program and the objectives of the X211 engine study program are given below. The basic ground rule is that there will be no modification made to the basic 125A System power plant which will penalize the performance of the 125A bomber. The only alterations permitted will be in the tailpipe and exit nozzle. If any more specific information is needed, we shall be glad to provide it if this is possible.

The Navy requirement is for a low level, high speed, attack seaplane. This is to be used against shore bases, ships at sea, and for high speed mine laying, Although the Navy began with a strictly subsonic mission, they now are also considering supersonic applications.

The basic requirement is for a seaplane of 200,000 to 300,000 pound gross weight, which can cruise on nuclear power alone at better than Mach .7 between 25,000 and 35,000 feet for a radius of 8,000 nautical miles. The aircraft shall also be capable of flying at slow speeds (Mach .4 to .5) at sea level on nuclear power alone.

A 400-mile-radius sprint is also desired. This sprint for the subsonic design would be at Mach .9, and could be, for the direct cycle power plant, all-nuclear. Achievement of the Mach .9 on nuclear power alone will depend upon the final selection of the CDP limitation. For the supersonic application it is desired that the aircraft sprint at Mach 1.15 to Mach 1.2 at sea level. It is felt that with this latter capability an air speed of Mach 1.4 at 35,000 to 45,000 feet could also be achieved. The supersonic sea level sprint would require chemical afterburning. This achievement is also dependent upon the CDP limitation and, of course, upon the aircraft design.

The Navy has both the Glenn L. Martin Company and Convair-San Diego studying aircraft for these missions. Glenn L. Martin is proposing aircraft using the direct cycle power plant which satisfy:

(1) The completely subsonic mission. This is a modification of the P6M. It utilizes one AC 110 power plant and no others.

(2) The supersonic mission. They have two aircraft proposals for the supersonic mission, each of which uses one AC 110 power plant plus two chemical engines. The basic difference between these two proposals lies in the chemical engines selected.

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They are also proposing aircraft utilizing the liquid metal cycle power plant.

Convair-San Diego also is proposing aircraft to satisfy the subsonic and the supersonic mission requirements. In both cases these aircraft utilize one AC 110 power plant with no chemical engines. The difference in these proposals is in the basic design of the airframe. Convair feels that with the 245 psi CDP limit their supersonic design can marginally attain a sea level air speed of Mach 1.15. This aircraft has been so tailored, however, that they are not sure it will float. With a CDP limit of 275 psi they are sure of achieving the Mach 1.15, and would take advantage of the increased thrust available to improve on the flotation design. In either case the supersonic sprint would be achieved with full afterburner operation.

The most critical point in any of the Convair designs is take-off. They require an additional 30,000 to 60,000 pounds of thrust over that which is provided by military power operation as outlined in APEX 210. The smaller augmentation provides a 60-second take-off, and the maximum a 36-second run.

There is a difference of opinion within the Navy as to which mission should be required for the first aircraft, as to which of the two aircraft companies has the best proposal, and as to which power plant cycle is best. There is also a difference of opinion as to how many aircraft will eventually be required and, depending upon who you talk to, estimates can be obtained that vary from a total of 50 to 500 operational aircraft. The only thing that seems to be fairly firm is that the Navy will require two power plants each for 8 flight test aircraft of each type of power plant (i.e., 16 liquid metal power plants and 16 direct cycle power plants). They will also require some chemical versions of each power plant and some preliminary nuclear power plants for their own ground testing.

During the week of August 20th, both aircraft companies presented the results of their studies to date to the Bureau of Aeronautics and the staff of the Chief, Naval Operations. These are not final reports and it is anticipated that the studies will continue. (Since this was written, the Navy approach has been somewhat modified. They have now officially decided to use the GE power plant as their prime effort. Accordingly, a design competition between Glenn L. Martin and Convair, San Diego has begun. Both of these companies are basing their aircraft designs on the basic AC 110 power plant. The design competition is expected to be completed and the aircraft manufacturer selected by January 1, 1957. Phase 1 Aircraft Design will start shortly thereafter, and it is expected that mockup will be completed by Spring of 1958. The aircraft company which loses this design competition will carry on a very minor effort, on study basis of aircraft using the Pratt & Whitney power plant. The Navy is therefore putting nearly all their money and giving all backing to the GE System.)

The power plant studies for the Navy are to be accomplished by the Air Force ANP contractors, General Electric and Pratt & Whitney. The studies are to be handled by insertion of a specific work statement in the Air Force contracts and by a transfer of funds from the Navy to the Air Force. It is anticipated that these studies will begin on October 1.

A copy of the Navy work statement has been received at ANPD which states in general that we shall make a study of the AC 110 power plant in regard to its application to the Navy mission. Both subsonic and supersonic operations are included. This study shall cover such items as engine modification, installation requirements, ground handling and maintenance, effect of special atmospheres on

the power plant as a whole, and for reference requires generation of performance data which will not be produced by the study for the SAC mission. We are to work closely with both aircraft companies until such time as the Navy decides otherwise. The main objectives of this study are to determine not only what modifications should be made for the Navy application, but those which can be practically made in view of present state of the art and effect on the AC 110 power plant program. It is agreed that no modifications will be made which will in any way seriously affect the AC 110 SAC program.

In the engine study phase of this over-all study, the objectives are as follows:

(1) A study and proposal of an optimum afterburner for the Navy requirement for maximum augmentation on take-off. This shall include a study of two configurations and result in performance data for these afterburners at sea level operation at air speeds up to Mach 1.2. The study must also include appropriate converging nozzle and ejector. It is anticipated that two configurations again shall be studied, one of which shall be a low base drag design.

(2) The installations as proposed by both aircraft companies require divergent and extended tailpipes. The engine study must therefore also include the effects of these modifications. It is anticipated that studies of four configurations may be necessary in order to cover the requirements and proposals of both aircraft companies. Proposed divergence angles vary from 3° to 7°, and tailpipe extensions from 12 feet to 30 feet.

(3) Performance data which the Navy will require, which will probably not be covered in the SAC studies, which cover the range from 0 to 5,000 feet and from sea level static to Mach 1.2.

ANP will include in their studies investigations of the effects of salt water ingestion on the over-all power plant. It is desired that the X211 Project cooperate on this phase, adding their knowledge of the effects on the engine compressors. It is not anticipated that this will extend to any test work, but will be more in the nature of a survey of past experiences and, insofar as the reactor, a study of the anticipated effects.

The Navy desires that preliminary estimated costs and production schedules for the design and fabrication of modified parts be determined and submitted in an interim report six months after the start of the study. For the engine study, estimates for the new afterburner, nozzle, and ejector, as well as the tailpipe extensions would be included. This would probably require such information by April 1, 1957.

Arrangements have been made for a study of an accessory power system tailored to the Navy requirement by the Aircraft Accessory Turbine Department of AGT. As this will require some information about the basic X211 and its accessory systems, it is desired that the X211 Project cooperate with such requests from AATD.

M S Harned

M. S. Harned, Manager, 103 PROJECT, ANPD

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