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ATOMICS INTERNATIONAL
A Division of North American Aviation, Inc.

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NAA-SR-MEMO 1863

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NAA-SR-MEMO-1363
Issue Date: 2/15/57

TO: Technical Steering Committee

FROM: J. R. Wetch

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DATE: February 12, 1957

SUBJ. TSC PRESENTATION OF SPPP PROGRAM (FEBRUARY 13, 1957)

Objectives: Atomics International has been selected as the sole Nuclear Auxilliary Power Plant System Contractor for the U. S. Airforce 117L Advanced Reconnaisance System. The formerly planned operation date of September 1960 has been extended to mid 1961 due to a budget curtailment. The heat source budget in Fiscal 1957 is $900,000 and the power conversion system budget is $425,000. In Fiscal 1958 the combined budget is currently planned to be $600,000. Thus it is imperative that the remaining effort in Fiscal 1957 and 1958 be concentrated upon the crucial problems associated with establishing APU system feasibility, and building the capacity to undertake a full scale development program when it is authorized. The purpose of the project is to develop an APU system to deliver a net electrical output of 3 kw. The entire system must weigh less than 500 lbs and operate unattended for a period of one year and radiate the cycle rejected heat from an area of less than 150 $feet^2$.

Description: The proposed reactor is a homogeneous U^{235} fueled hydrogen moderated beryllium reflected sphere. The core is a pseudo sphere composed of 4 concentric cylindrical annuli which consists of a hydrided alloy of uranium, zirconium, and yttrium. The unusually high hydrogen densities (7 to 8×10^{22} atoms/cc) and the relatively high temperature stability (1200° to 1400°F) of zirconium alloy hydrides makes this material especially attractive for this application where size is a premium. Further size reduction is accomplished by the use of a non-uniform radial fuel distribution. The beryllium reflector is machined to fit the pseudo sphere and its thickness is determined by minimum reactor weight considerations (100-150 lbs) rather than neutron economy. Heat is removed from the reactor by liquid sodium which is pumped through series connected annular passages between the fuel moderator cylinders. The core operates at an average temperature of 1200°F with an inlet sodium temperature of 1000°F and an outlet temperature of 1200°F. Since the reactor is epithermal and has a high neutron leakage (43%), the most effective means of control will probably be by a movable reflector element. The reactor control system must be extremely reliable and might be either an electro-mechanical or a thermo-mechanical system.

The power conversion portion of the system is being developed by the AiResearch Division of the Garrett Corporation under subcontract from Atomics International. The system uses mercury in a Rankine cycle. The major system components that AiResearch is developing include a sodium to mercury once through boiler, a turbine and alternator, a condenser, and a boiler feed pump. The cycle rejection heat is transferred by an organic loop to the radiating surface for ultimate rejection.

Major Problems: The crucial reactor problems are materials and physics. The materials problems include alloying, hydriding, materials property measurements, fabrication, fuel-moderator material cladding, and hydrogen loss. To date practically all physics work has been done with various multigroup [illegible] region codes. It is important that this information be verified by experimental evidence. The crucial power [illegible] system problems include zero g

operation, and long service life of rotating components. Efforts to date indicate that zero g boiling, condensing, and turbine operation are feasible. The high temperature operation of an alternator and long life bearings remain to be demonstrated. The major efforts in the immediate future must be concerned with these problems in order to establish system feasibility at the earliest possible date.

Fiscal 1957 Budget Status - AEC

Project	Manhours To Feb. 3 Budget	Manhours To Feb. 3 Expended	Manhours To July 1 Orig. Budget	Manhours To July 1 Proposed Budget Rev.
1. Gen. Effort	1,200	1,700 +	2,500	3,000 +
2. Reactor Analysis	3,080	3,200 +	7,200	6,400 -
3. Control System	2,000	1,770 -	5,900	4,200 -
4. Coolant System	2,610	3,309 +	5,350	4,400 +
5. Materials Dev.	2,850	2,235 -	6,450	8,200 +
6. Fabrication Dev.	3,150	2,700 -	10,100	9,200 -
7. Facilities Design	2,650	3,200 +	2,650	3,400 +
8. Critical Exp.	2,770	2,700 -	7,480	6,700 -
9. Reactor Dev.	1,650	700 -	4,500	3,200 -
Summary Total			52,130	48,700
Previous Expenditure			+ 8,870	+ 8,870
			61,000	57,570
Authorized			65,000	65,000
Balance (Manhours)			4,000	7,430
Equipment			84,500	124,000
Materials and Services			84,500	110,000
Procurement Expense			59,000	82,000
Direct Expenses			61,200	40,000
			289,200	356,000
Less excess 7,430 manhours				- 67,000
				289,000

Fiscal 1957 Budget Status - Air Force

Project	Manhours To Feb. 3 Remaining Hours
1. General Effort	850
2. Heat Rejection & Enviornment	1600

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The general effort hours are just sufficient to complete 1957 activities in coordination, liason, integration of the system, and heat transfer and flow analysis.

The heat rejection and environment budget allows 200 hours to the shielding group to complete a memo on radiation environment and 1400 hours for coolant system development.

The proposed budget revision is a result of the curtailment scheduled for Fiscal 1958. The AEC and Airforce contracting officers agreed that control system, components, environment, and power testing design and development and optimization analysis should be curtailed now in order that more 1957 money can be used for materials and equipment, which would be used in Fiscal 1958. The total effort should be concentrated on the crucial areas determining feasibility. Thus the equipment budget has been increased to accommodate the purchase of a vacuum arc melting furnace and accessories. The materials budget was increased to cover the over-run on the facility modification and to provide for the procurement of materials for a massive hydride critical experiment.

The Fiscal 1958 budget may now be summarized as follows:

Project	Men	Material	Equipment	Total + 20%	Total
Criticals	2+2+½	7,000	5,000	14,400	104,400
Physics	2+½	6,000	-----	12,200	62,500
		5,000			
Materials	3	2,000	8,000	12,000	72,000
Fabrication	2½+2½+1½	4,000	9,000	15,600	145,600
Coolant System	1¼+¼	2,000		2,400	36,000
General Effort	3+½	10,000			80,000
Subtotal					500,500
AiResearch					100,000
Total					600,500

TSC approval of the proposed Fiscal 1957 Budget Revision and the Fiscal 1958 Budget is required.

J R Wetch

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Reactor Development

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