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ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND

MEMORANDUM REPORT ON REMY/EAN/EGCS/BA/CO/hhd

Date 1 December 1947

SUBJECT: Evaluation of J37 Proposals

OFFICE TSEFP

Contract or Order No.

SERIAL No. TSEFP-515-374

Expenditure Order No.

2-31(1-37)

A. PURPOSE

1. To submit recommendations on selection of a contractor to proceed with evaluation of the J37 engine features.

B. FACTUAL DATA

1. Appendix I is a discussion of items pertinent to continuation of the J37 engine development.
2. Appendix II is previous background on the status of the J37 turbo jet engine development program and is contained in Memorandum Report TSEFP-506-228, dated 25 September 1947.
3. Appendix III is a summary of the research and development facilities of the Packard Motor Car Company, Ranger Division, Fairchild Engine and Airplane Corporation, and Wright Aeronautical Corporation.
4. Appendix IV is a summary of the costs, rate of development time and other pertinent data of the three proposals.
5. Appendix V is a summary of the point grading of the proposals of the three manufacturers.
6. A total of six manufacturers were invited to submit their proposals for continuation of the J37 engine development. Definite proposals were submitted by only three companies, namely; Packard, Ranger and Wright Aeronautical Corporation. Packard's proposal is contained in letter dated 28 October 1947; Ranger's proposal is contained in letter dated 28 October 1947; Wright Aeronautical Corporation's proposal in letters dated 12 and 18 Nov. 1947, and Pratt & Whitney, Allison and General Electric declined to bid.

C. CONCLUSIONS

1. The J37 engine as now designed is probably too small and would require redesigning to be useful for service by the time its development could be completed.
2. The features of the J37 engine are sufficiently advanced in terms of current engine design that they should be evaluated and these data should be supplied to the entire aircraft engine industry for possible incorporation in future engines.

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3. The point grading of proposals based on 1000 total is as follows:

Wright Aeronautical Corporation	700
Pedcar Motor Car Company	515
Ranger Division, Fairchild	410

4. The Wright Aeronautical Corporation is the most feasible contractor to evaluate potentialities of the J57 features for the following reasons:

- a. The only contractor that can test the complete turbine with hot gas at sea level, full load and the complete compressor system at sea level.
- b. While not mentioned in their proposal, better production manufacturing facilities are available for this or subsequent engines incorporating these features.
- c. The contractor does not have a turbo-jet engine under development, as a complete engine, but is working on the development of a turbo-jet axial flow compressor.

D. RECOMMENDATIONS

1. It is recommended that:

- a. A contract be negotiated with Wright Aeronautical Corporation to evaluate the features of the J57 engine components and the results of this evaluation, excluding subsequent proprietary changes made to the engine or its components by Wright, be made available to the aircraft engine industry.
- b. At conclusion of (a), decision be made as to type and size of the most desirable engine at that time.

Distribution:

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Approved by: *[Signature]*

Chief, Power Plant Laboratory

Approved by: ALLEN H. GRANFORD, Brig. Gen., USAF
Chief, Engineering Division.

Concurrence: _____

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APPENDIX I

DISCUSSION OF ITEMS PERTAINING TO COMBINATION
OF J-37 ENGINE DEVELOPMENT

The Government desires to continue a program which will evaluate the J-37 engine design features and engine components for the following reasons:

a. **Cycle Features.** The design cycle features include intercooling, reheat afterburning and extremely high pressure ratios, which give small size, light weight and high efficiency as evidenced by approximately 20% lower cruising fuel consumption than any other jet type engine now in existence. This engine similarly offers extreme advantages in the turbo-prop field. The engine is designed to improve altitude performance by a variable speed drive to a portion of the compressor, a feature not offered in any other engine. The mechanical features represented in this design are:

- (1) Very light weight components.
- (2) Accurate compressor blade construction.
- (3) Possibilities of overcoming mass production difficulties now encountered in present construction methods for axial flow blading.
- (4) A very fast method of attaching turbine and compressor blades to rotor which reduces machining time to a minimum.
- (5) A high load carrying type of bearing not used in present type engines.
- (6) Variable aramonsic design.
- (7) A new type of fuel nozzle which flows both air and fuel.
- (8) An open vortex type combustion chamber design for very high pressure.
- (9) Air cooling of turbine blades.
- (10) An afterburner permitting temperatures up to 4000°P.
- (11) A liquid heat exchanger for applying intercooling in the compression cycle.
- (12) A constant speed engine offering safety advantages during wave-off or arrested approach for landing.

Subsequent to the meeting of the engine manufacturers on 15 September at the Power Plant Laboratory to discuss the future of the Kemasco J-37 and the turbo prop version thereof, several significant events have occurred. (1) Present emphasis on propulsion requirements appears to be shifting from turbo prop to turbo jet type engines for bombardment aircraft. (2) It is now recognized more fully that the engine features could be evaluated and an engine developed, the need would be for engines of much larger thrust rating. (3) The tentative 5-year aircraft and missile program placed increasing emphasis on the supersonic rather than the subsonic turbo jet engines.

The Government was compelled to terminate the J-37 development with the Kemasco Manufacturing Company because of lack of development facilities at that

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plant aside from the financial and management problems involved. In evaluating the proposals submitted to continue this development, the development test facilities have been considered as being the most important consideration. The engine manufacturing facilities for both present and future emergency requirements and acquisition of Messers personnel have been given the next most important consideration. The last items of importance in the evaluation were the method of attack of the problem and the effects on government contracts now at contractors' plants.

To evaluate the merits of the components of the J-37 engine, the most important items are:

- (1) Test evaluation of the compressor system.
- (2) Test evaluation of the turbine unit.

In the design cycle, it is a prerequisite that the compressor system and the turbine unit attain the assumed component efficiencies under actual operation as a minimum in order to justify the use of the cycle in an engine. The essential test facilities for a factual evaluation of the engine should consist of facilities wherein separate or independent testing of the major components as complete units can be accomplished. For adequate testing of the turbine, it is considered that - 1. It is necessary to test all stages as a complete unit because of the dependence of the stages upon each other. 2. It is imperative that the turbine be tested with hot gases at full sea level load to determine its thermodynamic and mechanical feasibility. These two objectives cannot be accomplished without a separate motor-ing source for the engine compressor to supply the high pressure air required and an independent absorption means of absorbing the power delivered by the turbine, with a separate laboratory combustion system interposed between the compressor and turbine, for adding heat. To test the compressor requires approximately 7,000 horsepower at 35,000 feet altitude; 3,500 horsepower separately for the front unit and 3,500 horsepower separately for the rear compressor unit, supplemented by inlet laboratory air conditions of 350°F. at 45 lbs. per sq. in. pressure. Altitude testing does not impose the air loads on the compressor blading. Approximately 12,000 horsepower available drive is required to test the compressor system at sea level.

The turbine unit requires approximately 12,000 horsepower absorbing equipment together with 12,000°F. air at 500 lbs. per square inch pressure for sea level tests and requires approximately 7000 absorption at 35,000 altitude.

When an analysis is made of the component testing facilities of the three bidders considered, it is noted that only Wright Aeronautical Corporation has sufficient capacity to test both complete compressor system and complete turbine system and this involves \$1,005,493.00 in modification of the existing facility. Packard cannot test the complete turbine system with hot gases because of - (1) Insufficient supply of high pressure air for sea-level running. (2) Power absorption equipment for sea-level tests is inadequate. Packard limitation on available

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driving power does not permit sea level testing of either compressor unit or the complete compressor system but the Packard refrigerated air facility does permit the certain altitude compressor testing. The full compressor system can be tested at only an altitude of approximately 55,000 ft. and above. The front compressor could be tested at approximately 45,000 ft. or above and the front might be tested at approximately the same altitude by re-arrangement of the testing facilities including the wind tunnel system which was not specifically mentioned in the Packard proposal.

Based upon the proposals from the Ranger Aircraft Engine Company, the facilities for testing either the compressor system or the turbine unit are not available and that Company must rely upon the use of other government facilities such as the HMA Laboratories. Consequently, this proposal has received the lowest facility evaluation.

The question has been considered as to whether the Packard Company and Ranger Division could accomplish the testing desired if the companies were given the \$1,007,409.00 Wright requires for modifying their facilities, plus any difference in cost that negotiations might indicate, for additional testing facilities. The large motoring and absorption equipment would seriously retard the evaluation of the J-27 engine features.

Manufacturing and Production Facilities.

Since Wright, Packard and Ranger have existing development contracts from the Air Force or Navy for gas turbine type engines, all three companies, with the possible exception of special tools peculiar to the J-27 engine such as projection welders, have equipment for fabrication of most experimental engine parts which will be needed. Of the three companies, the Wright Aeronautical Corporation has the greatest potential capacity for production with their Woodridge, New Jersey production plant which is now used to turn out limited quantities of reciprocating engines for the Navy. This plant, however, has not been converted or tooling for gas turbine production. A total of 2,399,455 sq. ft. of floor space is available of which 2,287,315 sq. ft. is company owned with 112,140 sq. ft. leased from the Government under Planor 994 which also includes the gas turbine laboratory facilities.

Ranger has a total of owned and leased production space of 423,757 sq. ft. at Farmingdale, Long Island, N.Y., of which 105,021 sq. ft. is company owned and 318,736 sq. ft. is leased from the Government. This facility was used during World War II to establish production lines on the Ranger L-40 and W-70 reciprocating engines and has not as yet been converted to gas turbine production since Ranger development on gas turbine type engine has not reached the production stage.

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Packard has no production facilities as such which would be available for production of the J-37 or other engine design which might result from evaluation of the X-37 features. Packard estimates that service test quantities, only, could probably be manufactured with the equipment now used for experimental fabrication of engine parts. During World War II, approximately 4,500,000 sq. ft. of floor space in the Detroit Packard automobile plant was used to produce approximately 50,000 Packard Merlin reciprocating engines and in the event of a future emergency, would again be available. However, any demand on Packard for engine quantities above small service test quantities, would necessitate the government furnishing production facilities for peacetime production or making arrangement for production of the engine elsewhere.

Effect of J-37 Evaluation Project Upon Contractors Current Development Programs

The evaluation of the J-37 engine major components and the continued development of the engine project by one of the three companies submitting proposals to continue the work will affect that company's current engine development program. The following comments are submitted:

- (1) The Packard Company has only one project which extends beyond 1 July 48. Namely, the J47 ducted fan engine. The J47 turbo jet will be completed in June 48 with no further work contemplated. Therefore, from the standpoint of timing the J-37 development with added Memasco engineering personnel, might well fit into the activities at that plant.
- (2) The Wright Aeronautical Corporation has only one major development project since the T-43 turbo prop and the J51 turbo jet have been deleted as complete engine development objectives from their program. The J-37 project, from the standpoint of personnel and timing, would fit into Wright Aeronautical Corporation without detriment to existing projects now under contract.
- (3) The Ranger Division has at present, two gas turbine projects under development for the Bureau of Aeronautics. The first is a large multi-unit turbo prop of 30,000 H.P. and the second is a 1000 lb. thrust turbo jet engine. The Ranger would have to be consulted as to how the J-37 might fit into the Ranger program. Ranger would require essentially the Memasco engineering staff operating as a distinct unit under Mr. Price to carry out the program.

Cost and Rate of Development.

Because of the differences in method of attack of the engine development problem, caused largely by wide variation of testing facilities available, it is impossible to make a direct cost comparison as could be done in the purchase of a well defined end product. To this problem is added the further complication of fixed price contract proposal in the case of Wright Aeronautical Corporation

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and cost plus fixed fee contract for Packard and Ranger. Therefore, other features, notably, testing facilities, are considered so much more important that cost has not been considered in the evaluation and negotiations by Procurement Division should be undertaken to obtain the best possible contract with the contractor selected on the basis of engineering points. Although all three manufacturers propose an intensive rate of development, the different development procedures as dictated largely by facilities make a direct comparison of development rates impracticable.

Method of Attacking this Problem

The method of attack as exemplified in the proposals would indicate:

- (1) Packard Company places emphasis upon the importance of securing Manasco personnel and attendant know-how to carry on the development of the J37 design and state that the brief review, the design cycle in their opinion is entirely feasible, providing the component efficiencies are actually attained.
- (2) Wright Aeronautical Corporation by the nature of their proposal indicates less willingness to accept on face value the feasibility of the cycle without considering more detailed theoretical review.
- (3) From the nature of their proposal, Ranger Division envisions proceeding with full scale engine test as the engine now exists and following through with 50 hour qualification test and 350 hour type tests.

Manasco Personnel

In regard to the proposed use of key Manasco personnel, Wright Aeronautical Corporation states that discussions have already been held with Mr. H. G. Price on this subject for the purpose of establishing those personnel, including Mr. H. G. Price, who will most effectively bring to this company the accumulated experience on the J37 engine, and further that it is the intent of this company, if a contract is obtained, to establish negotiations for the employment and transfer of selected Manasco personnel to Woodridge and also that in these negotiations, the maximum incentive possible to encourage their transfer will be made. However, it will be necessary to establish salary and job rating terms on the basis of this company's present wage standard and organizational structure. It is further planned to integrate these personnel into this company's existing engineering and manufacturing organization.

Ranger states that they recommend transfer of approximately 40 engineers and key personnel maintained as the nucleus of an integrated organization under the supervision of Mr. H. G. Price.

Packard states that their proposal contemplates the employment of approximately 30 key personnel associated with this program and strongly emphasizes this point and in a telephone conversation 1 December 1947 stated they definitely intend to negotiate for the employment of Mr. H. G. Price.

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Of the above, Ranger's proposal for personnel utilization is considered the best of the three since it preserves the know-how of the J-37 as a unit. Wright Aeronautical Corporation and Packard have similar proposals although Wright Aeronautical Corporation stated verbally that they intend to hire 20 to 25 key personnel. Of the 37 engineers considered as key men, 20 is probably a more realistic figure since transfer must be made from the west coast to the east coast and personnel problems will probably eliminate a good proportion of these 37 people.

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ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND

MEMORANDUM REPORT ON

SUBJECT: Menasco XJ37 Turbo-Jet Engine
Development

TSEPP-6/LAW/hds
Date 25 September 1947

OFFICE TSEPP

Contract or Order No. W-33-038-AO-15310

SERIAL No. TSEPP-506-226

Expenditure Order No. 506-15

A. PURPOSE:

1. To outline the position of the Government with respect to the XJ37 turbo-jet engine development.

B. FACTUAL DATA:

1. Memorandum Report TSEPP-506-220 dated 10 September 1947 reports on a conference with Menasco personnel wherein the financial position of the Menasco Manufacturing Company and its ability to continue the XJ37 was discussed.
2. Memorandum Report TSEPP-506-226 dated 24 September 1947 reports on a conference with representatives of Lockheed Aircraft Corporation wherein the attitude of Lockheed with regards to disposition of the XJ37 is set forth.
3. Memorandum Report TSEPP-506-223 dated 15 September 1947 reports on a conference with representatives of Menasco Manufacturing Company on the disposition of the XJ37 engines resulting in a recommendation that action be taken to investigate an established engine company with proper facilities taking over the XJ37 engine project.
4. Memorandum Report TSEPP-506-224, dated 22 September 1947 reports on a conference held at Wright Field with representatives of Lockheed, Menasco, and of major engine manufacturers wherein the engine companies were presented opportunity to consider assuming the development and production of the Menasco XJ37 turbo-jet engine, the turbo-prop version of the XJ37, and possibly the ram jet development under way at Menasco.

C. CONCLUSIONS:

1. As a result of the above-listed conferences it is concluded that:
 - a. The Army Air Forces is definitely interested in continuing the development of the XJ37 turbo-jet and turbo-prop versions of this engine. (M.R. TSEPP-506-223 dated 15 September 1947)

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25 September 1947

- b. Menasco Manufacturing Company does not have facilities or necessary financing to continue the XJ37 engine project. (M.R. TSEFP-506-220 dated 10 September 1947)
- c. Lockheed Aircraft Corporation does not have necessary facilities for development of the XJ37 engine provided they were to assume the project obligation. Financing of necessary facilities would be difficult for Lockheed to attempt and Lockheed is not interested in carrying on the XJ37 project. (M.R. TSEFP-506-226 dated 24 September 1947)
- d. The engine development can best be furthered by transferring the project and Menasco's key personnel to an established engine company possessing the necessary facilities. (M.R. TSEFP-506-223 dated 18 September 1947)
- e. In the event no established engine manufacturer is interested, the development should be cancelled since the present West Coast facilities would not permit further development of the engine.

D. RECOMMENDATIONS:

1. It is recommended that every effort be made to permit an established engine manufacturer to take over the XJ37 turbo-jet and turbo-prop development.
2. It is recommended that in the event no established engine manufacturer having the proper facilities can be interested in carrying on the XJ37 engine development that the engine project be cancelled, present contracts closed out with delivery of currently due reports and equipment, and that these reports and equipment be made available to all established engine manufacturers on an equal basis in order that the Army Air Forces would benefit to the fullest extent from the knowledge and designs already paid for.

Distribution:

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TSBPS - Lt. Col. J.R. Martin
Lockheed Aircraft Corp.
Menasco Mfg. Co.

Prepared by E. A. WILFE

Approved by E. I. WILFE
Chief, Working Engine SF.

Approved by H. J. MINTY, Colonel, A.C.
Chief, Power Plant Lab.

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APPENDIX III

SUMMARY OF MAJOR TEST FACILITIES AVAILABLE FOR J37 ENGINE DEVELOPMENT

TRTF-515-774
1 December 1947PACKARD

See Packard Report PB 2513 7/1/47

Compressor Drive - 1400 HP + 1100 HPAircraft Engine -

Total 2500 HP

Speed Increasing Gear Required

Limited to Altitude Tests Only

112/sec air at -70°F Refrigeration

Capacity

198/sec air at 44°F Refrigeration

Capacity

Turbine - 8000 HP Absorption Dynamometer 1 ea.

2700 HP " " 1 ea.

600 HP " " 2 ea.

Cold Test and Simulated Hot Test at
Altitude. 1 1/2" Dust Dia. Max.
Air flow 90-110/sec at 60" hg.Combustion Chamber
30-110" at 60" Hg.Spin Test Pit - Handle 61" dia.
72" long up to 10000 and 25,000 RPMCells - 2 - 24" x 24" x 100"
4 - 20" x 20" x 40"Schlieren Photographic EquipmentRANGERCompressor Drive - 1 ea. - 1500 HP
Engine.
Additional 1500 HP Marine Engine in
February 1948
Test Only Four Stages of Front
Compressor.Turbine - NoneRequire NACA or other Government
Facilities.Combustion Chamber - Require Outside
FacilitiesIntercooler - Require Outside
FacilitiesSpin Pit - No StatementCells - 1 cell, Size Not StatedWRIGHTCompressor Drive - 12,000 RPM 15,000 HPAir Flow 612/sec at 160" Hg
No RefrigerationTurbine - 2 ea 8000 HP Absorption Dynamometers
5 - 12,000 RPM
2 ea 1000 HP Dynamometers
612/sec at 700" PCombustion Chamber Test
60 psia 15.38/secSpin Test Pit36" dia x 28" long 25,000 RPM
Hot Test, 11-1/2" dia. 30,000 RPMCells - 2 - 30" x 30"Schlieren Photographic Equipment
Electric Analogous Equipment for Control
Analysis

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APPENDIX IV

COST AND TIME SUMMARIES INCLUDED IN J-37 DEVELOPMENT PROPOSALS

PACKARD MOTOR CAR COMPANY

Notes: A. Type of Contract - Cost Plus Fixed Fee

- B. Following are maximum cost estimates.
- C. Phases I and II cover the Smeadette proposal. Phases III, IV, V, VI and the Turbo-prop items cover subsequent programs based on completion of Phases I and II.
- D. The proposal is based on completion of four (4) sets of parts as now on contract by Hesseco.
- E. Costs include transfer costs of key personnel from Hesseco to Packard.
- F. Costs do not include payments to Lockheed for Patent Rights (\$85,000.00)

Item	Description	Cost	Delivery Date
PHASE I			
1	Movement and Establishment of Project at Packard	\$50,000.00	3-1-48
2	Reports Covering Tests of Components as Received		
	Rear Compressor	\$110,000.00	
	Combustion Chamber (Low Pressure)	25,000.00	
	Turbine Nozzle Flare (2 Sections)	137,000.00	
	Compressor Nozzle of 1 Stage Turbine Blades	24,000.00	
	Fixed Fee	20,000.00	
		\$226,000.00	10-1-48
3	Preparation and Fabrication of Test Equipment Covering Front Compressor, High Pressure Test of Combustion Chamber Segment, Combs of 1 Turbine or Compressor Blades, Cold Air Test of Combs to Turbine	700,000.00	10-1-48
4	Preparation and Fabrication of Test Equipment and Set-up of Full Scale Engine	68,000.00	10-1-48
5	Tests under Item 3 (Actual Bench Test Work)	98,000.00	2-1-49
6	Tests under Item 4 (Actual Test Work)	14,000.00	2-1-49

PHASE II

7	Testing of Mechanical Auxiliaries as Received. Gear Trains and Bearings, Fuel, Starting and Control Systems, Afterburner and Variable Area Exhaust Nozzle	331,700.00	6-1-49
	TOTAL PHASES I AND II	\$1,231,000.00	

PHASE III

	Redesign and Development Testing (Assumes A. Completed Sets of Parts as Now on Contract with Hesseco)	675,000.00	4-1-49
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PHASE IV

	Manufacture of 5 Combs to Engine	1,250,000.00	12-1-49
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PHASE V

	Final Development of Components and Development Testing of Engines	700,000.00	12-1-49
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PHASE VI

	150 Hour Qualification Test	200,000.00	4-1-50
	Fixed Fee	\$2,465,000.00	
		\$2,775,000.00	
	TOTAL - ALL PHASES	\$3,083,750.00	
	TOTAL - ALL PHASES	\$4,268,750.00	

RAMMO AIRCRAFT ENGINE DIVISION

Notes: A. Type of Contract - Cost Plus Fixed Fee

- B. Two engines will be available for delivery upon completion of Phase I.
- C. Costs include transfer costs of 40 people from Hesseco to Rammo.
- D. Changes in procuring modifying and equipment are considered allowable charges against contract costs.
- E. Costs for further fabrication of parts by Hesseco or patent right payments to Lockheed are not specifically mentioned, but it is implied that they are not included.

Item	Description	Cost	Delivery Date
PHASE I			
1	Component and Full Scale Testing		
	a. Front Compressor		
	b. Variable Speed Section of Front Compressor		
	c. Compressor Gearing		
	d. Rear Compressor		
	e. Combustion Chamber (Mach facilities required)		
	f. Intercooler		
	g. Turbine		
	h. Interstage Burner (Two Experimental Testings)		
	i. Operation of Combs to Engine, not including Exhaust or Afterburning and V48 Hesseco-Billings Starting System.		
	j. Includes Sample Run of Manufacturing of Last Three of Five Engines.	\$2,750,000.00	1-1-49
2	Redesign of Component Testing. Includes 4 Additional Engines, Component at Full Scale and 50 Hour Test.	2,425,000.00	2-1-50
3	Fabricate 5 Engines, Development Testing, Including 150 Hour Qualification Test.	2,425,000.00	1-1-50
		\$7,600,000.00	

WRIGHT AERONAUTICAL CORPORATION

Notes: A. Type of Contract - Fixed Price

- B. Costs do not include transfer of personnel from Hesseco to Wright (Estimate \$5,000.00 per individual)
- C. Costs do not include payments to Lockheed for patent rights (\$85,000.00)
- D. Costs are not predicated upon completion or further fabrication of J-37 parts by Hesseco

Item	Description	Cost	Delivery Date
PHASE I			
1	Analytical Studies of Design and Installation	\$ 155,164.00	11-1-48
2	Design and Fabrication of Test Equipment Modification for Component Testing	1,205,167.00	1-1-49
3	300 Hour Component Bench Testing	370,158.00	1-1-49
4	Design and Fabricate Adaptors for Components - Compressor Burner and Turbine	789,109.00	1-1-49
5	Fabricate and Development Testing of Major Components. 200 Hours Testing	650,000.00	9-1-49
6	Design and Fabricate Full Scale Engine Test Modifications	100,000.00	9-1-49
		\$5,164,864.00	
7	Full Scale Engine Testing	Not Specified	Not Specified

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APPENDIX V

Point Grading of Proposals

Maximum Attainable - 1000 Points

	<u>Maximum Value</u>		<u>Grade Value</u>	
		Wright	Faehard	Range
Test Facilities	400	300	150	25
Manufacturing Facilities	200	150	50	100
Effect on Government Contracts at Contractor's Plant	100	75	75	50
Method of Attacking This Problem	100	75	90	60
Manasco Personnel	<u>200</u>	<u>100</u>	<u>150</u>	<u>175</u>
Total	1000	700	515	410

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