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STATEMENT OF WORK
IROQUOIS PROGRAM
FOR THE ARROW WEAPON SYSTEM
ISSUE 2

MALTON ONTARIO CANADA

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PART I

SCOPE OF WORK

1.1 DEVELOPMENT WORK STATEMENT

1.1.1 Design of the Iroquois Engine and Control system

The requirements of the design portion of the Iroquois program necessary to achieve the requirements of Specification EMS-8, (Issue 1 and later Issue 2), are as follows:

- a) Program 1 - Engines X101, X102 and X103 - Design three bare engines for initial development running on a slave fuel system.
Program initiation - January 1955.
- b) Program 2 - Engines X104, X105 and X106 - Design required to include engineering changes brought out in early development, and to reduce manufacturing costs. Provision for the development of external proprietary equipment and the acceptance of alternative controls systems designs for breadboard manufacture.
Program initiation - November 1955.
- c) Programs 3 - Engines X107, X108 and X109 - Design to achieve the initial flight standard, and to incorporate the latest development improvements, together with design details of the light-weight flight type control systems.
Program initiation - August 1956.
- d) Program 4 - Engines X110, X111 and X112 - Design to include the latest flight packaging and finalized development additions. Control systems design detail released to production.
Program initiation - December 1957.
- e) Program 4A - Engines X113 and X114 - Design to incorporate the latest development changes, and be capable of passing the 50-hour Preliminary Flight Rating Test at full rating. Design for initial production release, subject to further development changes necessitated by further test bed, altitude tunnel, and B47 experience.
Program initiation - May 1958.

1.1.2 Manufacture of Initial Three Development Engines and Spares

Provision for the manufacture of three development engines (X101, X102, and X103) for original development experience, and manufacturing aids, in the Experimental Shop.

1.1.3 Redesign of the Engine and Control Systems

Provide for redesign of engines and controls, in the same or alternative programs, that require development changes prior to initiation of a new program.

1.1.4 Design, Acquisition and Modification of Associated Test Equipment

Provide for test equipment used in anticipated rig investigations on engine components, failure investigations on development engine components, and also for special engine test equipment.

1.1.5 Rig Testing of Engine Components

Tests to include individual rig tests on compressors, combustion chambers, ignition systems, turbines, afterburners, nozzles, instrumentation, control systems, turbo-pumps, gearboxes, bearings, seals and associated aerodynamic, thermodynamic and mechanical investigations of all engine components incorporated in the main engine.

1.1.6 The Design, Acquisition and Modification of Rig Test Components

Provision of component test pieces especially adapted and instrumented for rig testing as outlined in the preceding paragraph.

1.1.7 Bench Testing

Bench testing of the Iroquois engine necessary to develop and prove the product in the areas of performance, mechanical functioning and mechanical reliability. Provision for adequate engine running hours to assure a successful qualification test, as outlined in relevant reports of paragraph 1.1.21.

1.1.8 Stripping, Conversion and Rebuilding of Iroquois Engines

The strip, conversion and rebuild of Iroquois engines as necessary to fulfill the requirements of development bench testing, qualification testing and B47 flight testing.

The following table provides the estimated number of re-builds anticipated.

	1955	1956	1957	1958	1959
No. of engines available	4	7	9	14	14
Main rebuilds	16	40	28	35	35
Partial rebuilds	2	9	33	40	35

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The following schedule of engine conversions applies:-

Estimated Conversions

1st program to 3rd program	AX101	January 1957
	AX102	February 1957
	AX103	April 1957
2nd program to 3rd program	AX106	September 1957
3rd program to 4A program	BX105	July 1958
	BX107	October 1958
	BX108	December 1958
	BX110	January 1959
	BX109	February 1959
	BX104	March 1959
	BX106	April 1959

1.1.9

The Preparation Strip and Rebuild of Two Test Engines for Altitude Testing in the National Advisory Committee for Aeronautics Altitude Tunnel Cleveland Ohio. Provision of two test engines to provide preliminary engine information. The tests conducted included:-

- a) Steady state engine and component performance
- b) Operational limits
- c) Compressor surge limits
- d) Afterburner performance
- e) Ignition limits
- f) Combustion limits
- g) Windmilling tests
- h) Engine handling checks

Total engine running at NACA was 141.5 hours.

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1.1.10 Flight testing of the Iroquois engine in the B47 flight test vehicle.
To supplement engine bench testing and to provide solution to actual flight installation and performance problems prior to flight operation in a service vehicle. The anticipated requirements for this program to September 1959 are as follows:-

	Estimated flying hours
Installation and ground checks on engine 105	
Handling checks over the complete flight envelope	24
Recorded fuel, combustion and stability tests	33
Blade vibration	12
Intake velocity profile and efficiency tests	48
Total flying hours	117

1.1.11 Altitude Testing at Tullahoma

Preparation of two test engines and a spare engine plus auxiliary test equipment, instrumentation and associated work connected with altitude testing of the Iroquois engine at Arnold Engineering Development Centre, Tullahoma Tennessee.

Engines to be used:- Initial - AX102/4B
Subsequent - X114 backed by BX105

Testing Time

Initial engine:

Basic engine performance checks	8 hrs.
Afterburner evaluation	<u>10 hrs.</u>
Total	18 hrs.

Final version

Basic engine performance evaluation	22 hrs.
Afterburner evaluation	5 - 10 hrs.
Controls evaluation	30 hrs.
Flow Distortion tests	<u>5 hrs.</u>
Total	62 - 67 hrs.

Total on all engines - 80 - 85 hrs.

Time permitting a rebuild of AX102/4B or use of engine BX107 with improved performance will be tested.

1.1.12 Altitude testing the Iroquois in the Orenda facility.

Evaluate modifications resulting from NACA and Tullahoma tunnel tests, and demonstrate that the altitude performance and control of the engine meets the requirements of the model specification at the time of the qualification test. The following tests and checks will be carried out:-

	<u>Estimated Hours</u>
1) Inlet flow distortion tests, performance and handling checks	20
2) Engine with Arrow intake duct, Sub-sonic running	25
3) Running with the Arrow ejector	30
4) Basic engine tests to investigate and prove mod. spec. rating points for Q.T.	50
5) Engine/afterburner test. Demonstration of ability to meet mod. spec. requirements	25

Total estimated facility running times for program - 150 hours

1.1.13 The Development of New Materials and Processes

Provision for the investigation of new materials, and processes necessary to insure that targets set for engine performance, weight, and dimensions, are not prejudiced by lack of adequate metallurgical, manufacturing, and quality control technology.

1.1.14 Development and Control Testing of New Materials

Provision for continuous quality and characteristics testing of new materials, and for development of manufacturing techniques.

1.1.15 Preparation of Engine Mock-ups

Provision of, alterations to, and maintenance of mock-up engines to fulfil the following purposes:-

	<u>Date</u>
Program 1	- February 1954
B47 flying testbed	- April 1956
Program 3 - Bendix Control	- June 1956
Program 3 - Lucas Control	- December 1956
Display	- July 1957
Program 4	- August 1957
Prototype Arrow	- January 1958
Program 4A	- January 1958
Prototype Production	- July 1958

1.1.16 Conversion of the B47 Aircraft

Provision of specifications, drawings and data connected with the design, manufacture, calculations, checks and wind tunnel tests on the Iroquois/B47 engine pod, by Canadair.

1.1.17 B47 Instrumentation

Procurement by purchase or manufacture, and packaging of flight test instrumentation, including airborne and ground telemetering, equipment for the Iroquois/B47 test program, with maximum utilisation of Orinda's CF100 instrumentation.

1.1.18 Model Specifications

Provision and co-ordination of the initial and revised model specifications dated July 1954 and February 1958 respectively, as negotiated and agreed between the RCAF and the Contractor. The final model specification, defining the production engine, will be prepared for co-ordination approval on completion of the efficient qualification test of the engine model presently scheduled for July 1959.

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1.1.19 Drawing Release to Production

Supply of drawings, specifications, standards, and data together with engineering support to enable the manufacture of production engines in accordance with requirements for the Arrow program.

The drawing release to production schedules are shown in Fig. 2.

1.1.20 Liaison with Avro Aircraft Limited

Provision of liaison and services to Avro Aircraft relating to investigations into areas of mutual interest to establish acceptable overall installed engine/airframe performance and reliability.

1.1.21 Preparation and Supply of Reports

Compile reports dealing with the progress of the project for issue to Government authorities concerned with the Iroquois program. Provision of any currently available technical data especially requested by the RCAF.

Periodic reports to be provided are:-

Monthly Progress Report
Quarterly Financial Report
Semi-Annual Technical Report
Preliminary Design Report
50 Hour Preliminary Flight Rating Test Report
100 Hour Endurance Test Report
Demonstration Run Report
Qualification Test Report
Development Report
Progress Appraisal
Miscellaneous Technical Reports

1.1.22 Performance of Official Test and Demonstrations

- (a) Performance demonstration at approximately 16,000 lb thrust dry.
- (b) 50 hour Preliminary Flight Rating Test at approximately 16,000 lb thrust dry.
- (c) Demonstration of afterburner operation.
- (d) 50 hour Preliminary Flight Rating Test at approximately 18,000 lb thrust dry.
- (e) 100 hour test at approximately 18,000 lb thrust dry.
- (f) Performance demonstration at approximately 20,000 lb thrust dry and 25,000 lb thrust afterburning.
- (g) 50 hour Preliminary Flight Rating Test at the Preliminary Model Specification Rating.
- (h) 150 hour Qualification Test at the Preliminary Model Specification Rating.

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Performance of Official Test and Demonstrations (Cont'd)

Note: Preliminary Model Specification EMS-8 refers specifically to Issue 2, dated February 1958.

The scheduled dates for the completion of official tests and demonstrations is shown in Fig. 1.

1.1.23 Aerodynamic Afterburner Program

Design, development, build and testing of an aerodynamic afterburner for the Iroquois engine as outlined in Orندا brochure "Proposal for an Aerodynamic Afterburner for the Iroquois". (B2-58)

1.1.24 Proprietary Parts Qualification Test

Test to qualification of Iroquois engine proprietary parts as outlined in Orندا brochure "Proposal for Qualification Requirements and Costs for Proprietary Parts for Iroquois 2 Engines". (B3-58)

1.1.25 Altitude Test of Type Test Engines

Testing of Iroquois type test engines to verify altitude rated performance as specified in EMS-8 Issue 2 dated February 1958, in the Orندا altitude test facility.

1.1.26 B47 Repairs

Normal repairs to the B47 flight test vehicle required as a result of damage incurred during flight test operations provided the repairs required are reasonably within the capabilities of the Orندا flight test personnel.

Airframe modifications, such as may be required by the U.S.A.F., are specifically excluded.

1.1.27 Conversion of Orندا 2 Compressors

Conversion of Orندا 2 compressors as slave units for the engine altitude test facility. Sixteen compressors are required.

1.1.28 Engine Silencer Program

Investigation, design, manufacture and test of an experimental silencer for the Iroquois engine in accordance with the proposal made in brochure "Proposal for a Noise Suppression Program for the Iroquois 2/Arrow 2 Application". (B18-58)

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1.1.29 Starter Development Program

Undertake the development of an air turbine starter for the Iroquois engine.

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1.2 Prototype Work Statement

This work covers the provision of engines and parts in support of the Iroquois development program together with the provision of engines required for three experimental Arrow 2 Aircraft. These engines and spares are to be manufactured under the design Specifications of the Development Work Statement and will be subsequently assigned to development testing, rebuild and further testing until the engine model standard is proved by the completion of the Official Qualification Test.

1.2.1 Manufacture and Assembly of Eleven Initial Prototype Engines

Manufacture and assembly of eleven engines will involve the provisioning of materials to Experimental production-type drawings, manufacturing aids, test runs on new materials, and adequate scrap allowances. Engines allocated will be those numbered X104 to X114 inclusive.

Manufacture of Spares and Modified Engine Parts

1.2.2 Provision will be made of an adequate number of parts to ensure engine development running on rebuilt engines (X104 to X114 inclusive) until qualification test or official scrap status is reached.

1.2.3 The Manufacture and Assembly of Nine Further Prototyps Engines

Nine engines, in addition to the eleven development engines will be allocated to the sixth, seventh and eighth Arrow aircraft. Engines allocated will be numbered X115 to X123 inclusive. The schedule of deliveries of these engines is shown on Fig. 1.

1.2.4 Prepare an initial list of the spare parts and assemblies required to support engines X115 to X123 inclusive, and after approval by the RCAF manufacture and/or acquisition of the above noted spares. Cost to include packaging and storage where necessary.

1.2.5 Manufacture and/or acquisition of engine and afterburner containers for prototype engines as directed by the RCAF. RCAF directive dated July 18, 1958 reference S36-35CT (GT Eng) indicates that a stand and packaged engine arrangement will be satisfactory.

1.2.6 The provision of technical publications in the form of "Advanced Data Sheets" as required for the maintenance of prototype engines and their associated ground support equipment. Revision of these technical publications will be directed by the RCAF.

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- 1.2.7 Design and/or specification of modifications in accordance with the related Orenda supplement to PROC 100-14 as negotiated between the RCAF and the contractor, to the Prototype engines and/or engine systems and associated GSE resulting from engine development, or as requested by the RCAF.
- 1.2.8 Manufacture and/or incorporation of mod kits for prototype engines as approved by the RCAF. Cost to include packaging and storage where necessary.
- 1.2.9 Collection of statistical **information and technical analysis of all defect** data on the prototype engines, and furnishing the co-ordinating contractor with defect data as directed by the RCAF.
- 1.2.10 Maintenance appraisal and the collection and preparation of maintenance and logistics data on the prototype engines and their associated GSE.

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1.3 PRODUCTION TOOLING WORK STATEMENT

The Production Tooling contract covers the process planning, design, development and manufacture or acquisition, and subsequent modification * where necessary; of such tooling, jigs, dies, fixtures and gauges as may be required by Orenda Engines Limited and the sub-contracting organizations, for the manufacture of Iroquois engines in accordance with schedules laid down in the Iroquois Work Program. Such tooling is to be suitable for production at rates up to and including 15 engines per month.

* Modifications does not include changes resulting from ECP action.

The following milestones and estimates apply to the Production Tooling Contract

Commence preliminary planning and design	November 1955
Commence manufacture of pre-production tooling	April 1957
Commence manufacture of engine parts	January 1958
Completion of 50% of tools	September 1958
Completion of 60% of the tools and delivery of 1st production engine	January 1959
Completion of 100% of the tools	March 1960
Peak production	April 1960

The present Production Tooling Contract extends to March 31, 1960.

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1.4 Pre-Production Work Statement

This work covers the manufacture of 87 Iroquois engines in accordance with the ARROW/IROQUOIS program schedule, specifically as follows:-

- 1.4.1 The manufacture of 87 pre-production engines. The schedule of deliveries of these engines is found on Fig. 1.
- 1.4.2 The carrying out of a production support program on the Iroquois engine, including where necessary investigations preparatory to the issue of engineering change requests. The manufacture and/or acquisition of the required engine parts.
- 1.4.3 Prepare an initial list of maintenance spare parts and assemblies required to support the 87 pre-production engines to 31 March 1962, and after approval by the RCAF, manufacture and/or acquisition of the above noted parts. Cost to include packaging and storage as necessary.
- 1.4.4 Preparation of the basic set of Iroquois Engineering Orders to RCAF Spec PROC 100-3 to a schedule specified by the RCAF, and revisions to such engineering orders as directed by the RCAF/AMCHQ.

The following EO's comprise the basic engine set:

- i) Description and Maintenance Instructions
- ii) Repair and Overhaul Instructions
- iii) Illustrated Parts List
- iv) Maintenance Schedule - Primary
- v) Maintenance Schedule - Periodic
- vi) Storage, Preservation and Shipping Instructions

- 1.4.5 Pre-production Expenditure
 - a) Plant re-arrangement necessary to facilitate the Iroquois production program.
 - b) Alterations to machines and equipment which are necessary to adapt them to Iroquois tooling requirements but which do not increase the value or capacity of the asset.
- 1.4.6 Evaluation and recommendation to the RCAF of the requirement for all EO's required to support the engine other than the basic set, in accordance with RCAF Spec Proc 100-15.
- 1.4.7 Preparation or procurement of EO's other than those included in the basic engine set in accordance with RCAF Specs or to an available format as directed by RCAF/AMCHQ.

1.4.8 The provision of the following technical bulletins:-

- i) Service Bulletins
- ii) Modification Bulletins
- iii) Manufacturers Bulletins

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- 1.4.9 Investigation and design of repair schemes for Iroquois engine spare parts and assemblies as requested by the RCAF.
- 1.4.11 Prepare item identification in accordance with RCAF Spec PROC 100-5, Issue 2, for items delivered to the RCAF under this contract. The specific items requiring identification to be defined by the RCAF/AMCHQ. Two copies of each complete identification will be delivered.
- 1.4.12 Manufacture and/or acquisition of engine and afterburner containers for pre-production engines as directed by the RCAF.
- 1.4.13 Investigation of change requests and incorporation into the engine design and/or mock-ups of agreed changes resulting from the mock-up, or evaluation conferences.
- 1.4.14 The altitude testing of three pre-production Iroquois engines in the Oranda altitude test facility. These engines are to be as selected by the RCAF.
- 1.4.15 Design and/or specification of agreed modifications in accordance with the related Oranda supplement to PROC 100-14 as negotiated between the RCAF and the Contractor, to the pre-production engines and/or engine systems and associated GSE resulting from engine development, or as requested by the RCAF.
- 1.4.16 Manufacture and/or incorporation of modifications for pre-production engines as approved by the RCAF. Cost to include packaging and storage where necessary.

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- 1.4.17 Collection of statistical information and technical analysis of all defect data on the pre-production engines, and furnishing the co-ordinating contractor with defect data as directed by the RCAF.

- 1.4.18 Investigations preparatory to the issue of proposal documents for work requiring special authorization and investigation preparatory to amendments to the contract.

- 1.4.19 Provision of field service representatives

- 1.4.20 Design, development and manufacture of one engine and one afterburner container.

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1.5 Flight Testing of the Iroquois Engine in Arrow Aircraft 25207

The following work is considered necessary to perform the flight tests required for flight development of the Iroquois engine.

- 1.5.1. Flight test Iroquois engines in an Arrow 2 flight test vehicle on the basis of an estimated 80 hours of flying per year including the following:-
- a) Maintenance of installed engines.
 - b) Maintenance of engine instrumentation for Iroquois testing.
 - c) Flight clearance testing of test engines.
 - d) Specialized engineering and laboratory support.
 - e) Provision of flight crews for the flight test program.
 - f) Build and strip of flight test engines, not including maintenance spares or repair and overhaul spare parts.

The above mentioned work will not include airframe modifications, engineering support by the airframe manufacturer, nor the repair and overhaul of the airframe.

- 1.5.2 Provision of, maintenance of (with Avro installation and removal assistance), and necessary changes to, special engine sensing instrumentation and engine data telemetering adaptation equipment, in Arrow aircraft 25207 according to Orinda brochure B7/58 entitled "Proposed Flight Test Schedule and Instrumentation Requirements for the Iroquois 2 in Arrow 2 Aircraft 25207", with the exception that no B-47 instrumentation will be utilized.
- 1.5.3 Provision of airborne telemetering equipment for flight testing the Iroquois in A/C 25207.

1.6 Repair and Overhaul

1.6.1 Repair and Overhaul of Prototype Engines

The repair and overhaul of engines X115 to X123 inclusive and related spare parts and assemblies and the manufacture and/or acquisition of the required repair and overhaul spare parts as directed by the R.C.A.F.

The number of overhauls necessary for engines X115 to X123 inclusive is estimated to be 26 in the 27 month period following April 1, 1959.

1.6.2 Repair and Overhaul of Pre-Production Engines

The repair and overhaul of pre-production engines and related spare parts and assemblies and the manufacture and/or acquisition of the required repair and overhaul spares as directed by the RCAF.

Estimated repair and overhaul requirements to March 1962 are:-

92 engine overhauls based on the following flying hours -

Estimated flying:

To March 31, 1960 - 25 hrs. - 5 overhauls
April 1, 1960 to March 31, 1961 - 1800 hrs. - 40 overhauls
April 1, 1961 to March 31, 1962 - 3300 hrs. - 47 overhauls

Assume engine life:

1st 20 @ 50 hrs. overhaul life and 30 hrs. realized life
next 67 @ 100 hrs. overhaul life and 60 hrs. realized life
O/H after April, 1960 @ 150 hrs. overhaul life and 70 hrs. realized life.

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PART 2

SPECIFIC EXCLUSIONS

This portion of the Work Statement covers work that is specifically excluded namely:-

- 2.1.1 Extra work occasioned by changes to the engine specification requirements.
- 2.1.2 Extra work occasioned by an increase in the present scope of work described in Part 1 of this Work Statement.
- 2.1.3 Work entailed in the failure of Government Supplied Material (GSM) to meet required schedules or standards.
- 2.1.4 Special studies undertaken in excess of those stated herein.
- 2.1.5 Any further overhauls on prototype and pre-production engines over and above those defined herein.

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PART 3

PROPOSED PRODUCTION PROGRAM

Assuming an order for 500 Iroquois production engines, the following work is anticipated in order to carry out this program.

- 3.1.1 The manufacture of 500 Iroquois engines and their associated GSE. This will be accomplished at a rate of 12 engines per month beginning in April 1960 until 500 engines have been delivered; with the exception that the rate for August is six engines. This gives an annual delivery of 138 engines.
- 3.1.2 Design and/or specification of agreed modifications in accordance with the Orenda supplement to PROC 100-14, as negotiated between the RCAF and the contractor, to the production engines and/or engine systems and associated GSE resulting from engine development or as requested by the RCAF.
- 3.1.3 Manufacture and/or incorporation of mod kits for production engines as approved by the RCAF. Cost to include packaging and storage where necessary.
- 3.1.4 Have available for possible requirements one complete set of current engine production drawings in accordance with RCAF Spec. PROC 100-11, Issue 3 Parts 1-6 as amended by Part 7. The part 7 amendments to be negotiated with DDP and RCAF/AMCHQ.
- 3.1.5 In accordance with PROC 100-11 ensure that all vendors of proprietary equipment are aware of the need for engineering drawings as prepared by the design manufacturer to be available to the RCAF for maintenance, cataloguing and identification purposes.
- 3.1.6 Prepare item identification in accordance with RCAF Spec. PROC 100-5 Issue 2 for items delivered to the RCAF under this contract. The specific items requiring identification to be defined by the RCAF/AMCHQ. Two copies of each identification will be delivered.
- 3.1.7 Collection of statistical information and technical analysis of all defect data on production engines, and furnishing the co-ordinating contractor with the defect data as directed by the RCAF.

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- 3.1.8 The EO's as outlined in the Pre-Production Work Statement shall be kept current in the Production Contract under the terms outlined in the former.
- 3.1.9 The provision of the following technical bulletins:-
- i) Service Bulletins
 - ii) Modification Bulletins
 - iii) Manufacturers Bulletins
- 3.1.10 Carry out a production support program on the Iroquois engine, and manufacture and/or acquire the required engine parts.
- 3.1.11 Manufacture and/or acquisition of engine and afterburner containers for production engines as directed by the RCAF.
- 3.1.12 Estimate requirement for maintenance spares on production engines to March 31, 1962 and, after approval by the RCAF, manufacture and/or acquisition of the above noted parts. Cost to include packaging and storage where necessary.
- 3.1.13 Carry out a continuous product improvement program.
- 3.1.14 Altitude testing of one in 50 production engines, as selected by the RCAF, in the Orenda altitude test facility.
- 3.1.15 Maintenance of Iroquois engines prior to Arrow Aircraft acceptance by the RCAF.
- 3.1.15 Provision of field service representatives.

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3.1.16 Evaluation and recommendation to the RCAF of the requirement for all EO's required to support the engine other than the basic set in accordance with RCAF Spec. PROC 100-15.

3.1.17 Investigation and design of repair schemes for Iroquois engine spare parts and assemblies as requested by the RCAF. Repair and overhaul of production engines and related spare parts and assemblies (GSE) as directed by the RCAF.

Estimated number of R. & O's required for this program are:-

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PART 4

Arrow Weapons Systems Support

Support by Orenda Engines Limited to the Arrow Weapons System will entail the following:-

- 4.1 Prepare a list of the specialized Iroquois ground support equipment including special tools and test equipment, other than work and installation stands, required to support Arrow Aircraft 6-37 inclusive.
- 4.2 Design and/or specification of the specialized ground support equipment called up in para. 4.1.
- 4.3 After RCAF approval of the design and/or specification, manufacture and/or acquisition of the specialized ground support equipment called up in para. 4.1 above, as directed by the RCAF.
- 4.4 Investigation of change requests and incorporation into the specialized ground support equipment called up in para. 4.1 above of agreed changes resulting from engineering evaluation.
- 4.5 Manufacture and/or installation of the modifications required to maintain the current modification status of specialized ground support equipment called up in para. 4.1 above as approved by the RCAF.
- 4.6 Manufacture and/or acquisition of spare parts and assemblies required for the support of the specialized ground support equipment called up in para. 4.1 above as directed by the RCAF.
- 4.7 Provide the original drawings of all specialized ground support equipment in accordance with RCAF Spec. PROC 100-2. The drawings to be delivered to a schedule negotiated and agreed between the RCAF/AMCHQ and the Contractor.
- 4.8 Provision and operation at Malton, and operation at Cold Lake, of Iroquois maintenance facilities to serve all associate contractors' requirements.
- 4.9 Provision of facilities and services to train personnel on the Iroquois engine and the required ground support equipment used in the Arrow application. This includes provision of instruction classes, manuals, schematics, sectioning engine and components supplied by R.C.A.F., transparencies and slides.

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The following instruction requirements are anticipated:-

To be defined by the R.C.A.F.

- 4.10 Provision by December 1, 1959 of an Iroquois engine or mock-up to be used for practice installation and removal, and to have the various external adjustments associated with the installation incorporated.
- 4.11 Technical assistance to Avro Aircraft in obtaining RCAF acceptance of the Arrow 2 Aircraft.
- 4.12 Study of a silenced Iroquois run-up and check-out facility.
- 4.13 Complete a Personnel Requirements Data (PRD) study as directed by the RCAF. Time from go-ahead to supply of preliminary information - 4 months. Time from go-ahead to issue of initial complete report to Avro - 10 months.
- 4.14 Prior to the completion of the PRD study, carry out a study of the maintenance procedures and techniques involved in the maintenance of Iroquois engines at RCAF bases. This study to complement and amplify the study of the run-up facility and the list of specialized ground support equipment.
- 4.15 Collaboration in and supply of available data for studies of weapon system performance, air base requirements and supporting facilities.
- 4.16 Collaboration in, and supply of, available data for studies of weapons system effectiveness, growth potential and flight/tactical trainer.
- 4.17 Maintenance of Iroquois engines and their associated ground support equipment not including engine work and installation stands, assigned to the Arrow flight test program.
- 4.18 Provision of available flight test data for use in an Arrow aircraft flight simulator.

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- 4.19 Provision of available Iroquois data for Arrow 2 Model. Specification preparation.
- 4.20 Provision of available data for Arrow 2 ground support equipment model. specification co-ordination.
- 4.21 Assistance with evaluation of sub-system model specifications and changes thereto.
- 4.22 Supply of drawings to other associate contractors as necessary to ensure compatibility of equipment installation in the airframe.
- 4.23 Provision of personnel to be trained on the Arrow aircraft and its associated sub-systems and ground support equipment.
- 4.24 Provision of available technical progress reports.
- 4.25 Supply of available schedule and status reports for the Iroquois program.
- 4.26 Collaboration and assistance in the planning of the weapon system demonstration, and in the technical co-ordination of the actual demonstration.
- 4.27 Supply of data to, and liaison with, the co-ordinating contractor in co-ordination of ground support equipment design and government supplied material (GSM).
- 4.28 Supply and/or specification of systems trainers used in the Iroquois/Arrow application as directed by the RCAF.
- 4.29 Provision of available data to, and liaison with, the co-ordinating contractor in:-
- Preparing a master statement of work for AWS.
 - Preparing a master phasing schedule for AWS.
 - Study of support recommendations.
 - Preparing a master component requirement schedule.
 - Preparation and assessment of reliability statistics.
- 4.30 Maintenance appraisal and the collection and preparation of maintenance and logistics data on the engine and associated G.S.E.

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PART 5

SUPPORT FROM AIRFRAME MANUFACTURER

5.1 Support from Avro Aircraft

5.1.1 Provision of Aircraft 25207 to be used for the Iroquois flight test program.

5.1.2 Provision of materials and services for the operation of Aircraft 25207 from Malton for the Iroquois flight test program including:-

- a) Operation including fuel and oil.
- b) Maintenance of the aircraft including procurement of maintenance assistance from outside contractors.
- c) Hangar space.
- d) Ground support equipment used in the Arrow program.
- e) Data reduction facilities and services including those for reduction of telemetering data.
- f) Ad hoc experimental manufacturing support.
- g) Use of and assistance with available test equipment for checking out of the airframe and its associated equipment.
- h) Provision of ~~airframe~~ ground telemetering facilities.
- j) Provision of a chase aircraft for at least three supersonic chase flights and an additional five CF-100 chase flights.

5.1.3 The repair and overhaul of aircraft, aircraft sub-systems or components, other than those associated with the Arrow aircraft, used in the Iroquois flight test program.

5.1.4 Instrumentation work on Aircraft 25207 comprising:-

- a) Design and/or Specification of airframe sensing instrumentation and of its installation.
- b) Design of the installation and installing of airborne data recording instrumentation.
- c) Check-out and calibration of airframe instrumentation.

5.1.5 Manufacture of an instrument pack for Aircraft 25207.

5.1.6 Assistance with maintenance and changes to aircraft instrumentation in Aircraft 25207 after ROAF acceptance of the aircraft.

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- 5.1.7 Provision of necessary office and storage facilities at Malton.
- 5.1.8 Training of two Orenda **pilots** and on-the-job-training of Orenda ground crews.
- 5.1.9 Modifications, alterations and installations necessary to provide a flight test vehicle for the Iroquois engine, including:-
- (a) Installation of a specially instrumented Iroquois engine.
 - (b) Design and/or specification, provision and installation of special cockpit instrumentation, **cables and pipe runs etc.**
 - (c) Design and incorporation of airframe and systems changes to accommodate (a) above.
 - (d) Specification of the packaging and installation of recording instrumentation to be supplied by Orenda.
 - (e) Provision of special liaison services with Orenda Engines Limited as may be necessary.
 - (f) To assist Orenda with its flight test program including:-
 - The supply of raw data.
 - Services for ground check-out runs.
 - Provision of safety facilities.

PART 6

SUPPORT FROM CANADIAN GOVERNMENT AGENCIES

Support from Canadian Government Agencies will be required as follows:-

- 6.1 Supply of a B47 flight vehicle for flight testing the Iroquois engine.
- 6.2 Tunnel testing of the Iroquois engine at Tullahoma.
- 6.3 Tunnel testing of the Iroquois engine at Cleveland.
- 6.4 Transportation of engines to and from NACA, Cleveland.
- 6.5 Transportation of engines to and from Tullahoma.
- 6.6 Provision of other associate contractors' hardware and test specimens.
- 6.7 Provision of Government furnished special test equipment.
- 6.8 Provision of office space, laboratory space and living quarters for personnel supplied by Orenda in support of operations at Cold Lake.
- 6.9 NAE Anti-icing tests.



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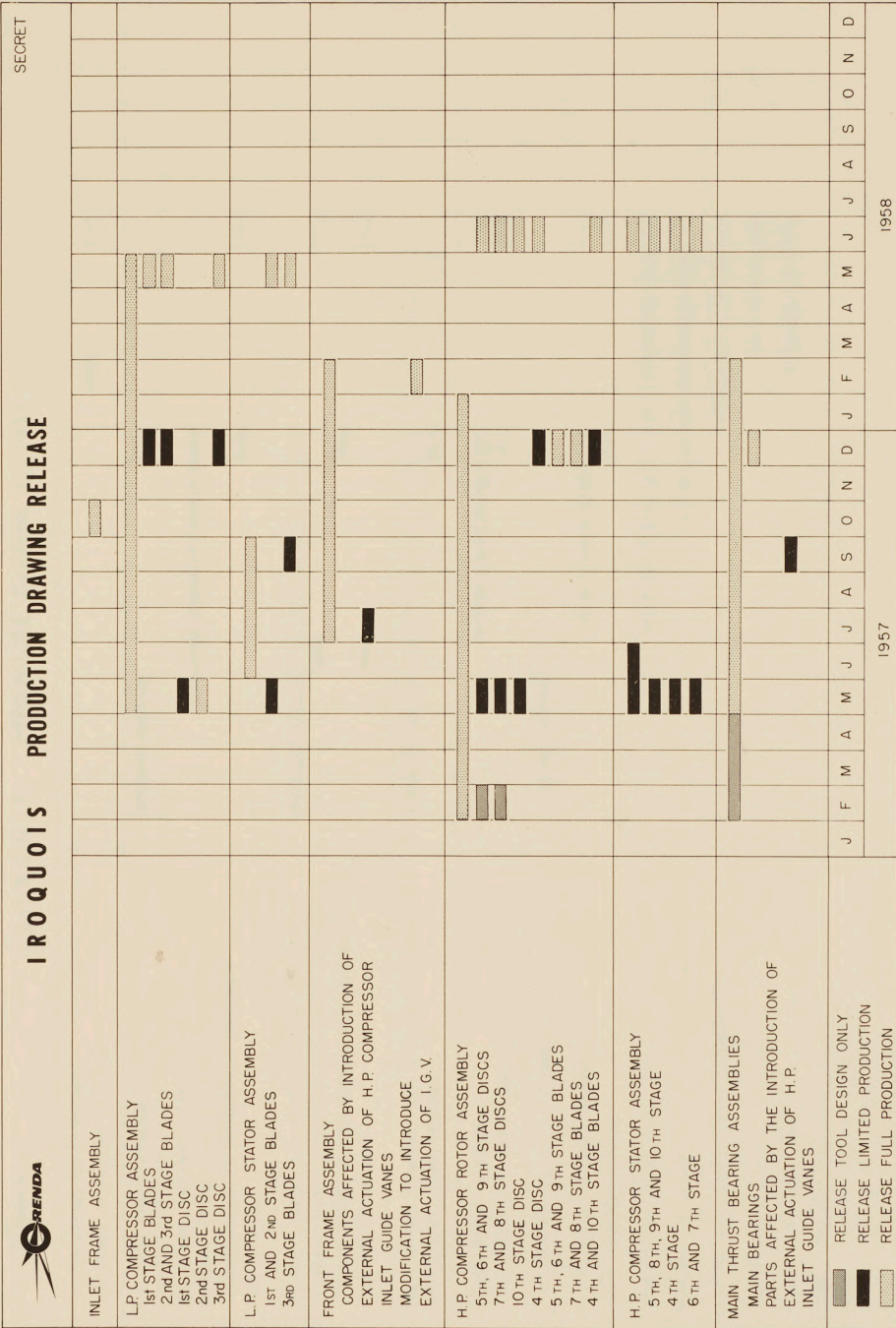


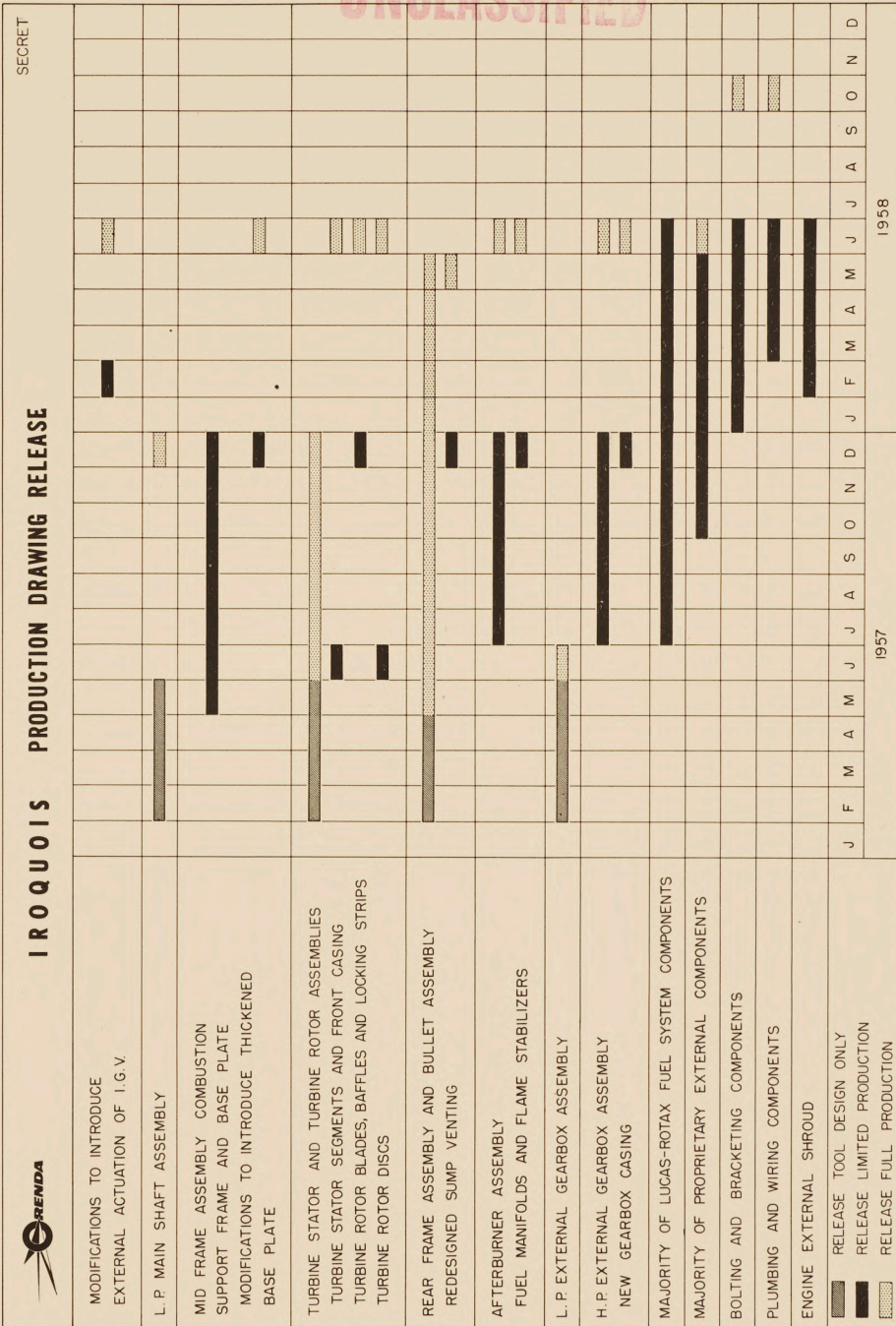
Fig. 2 Sheet 1



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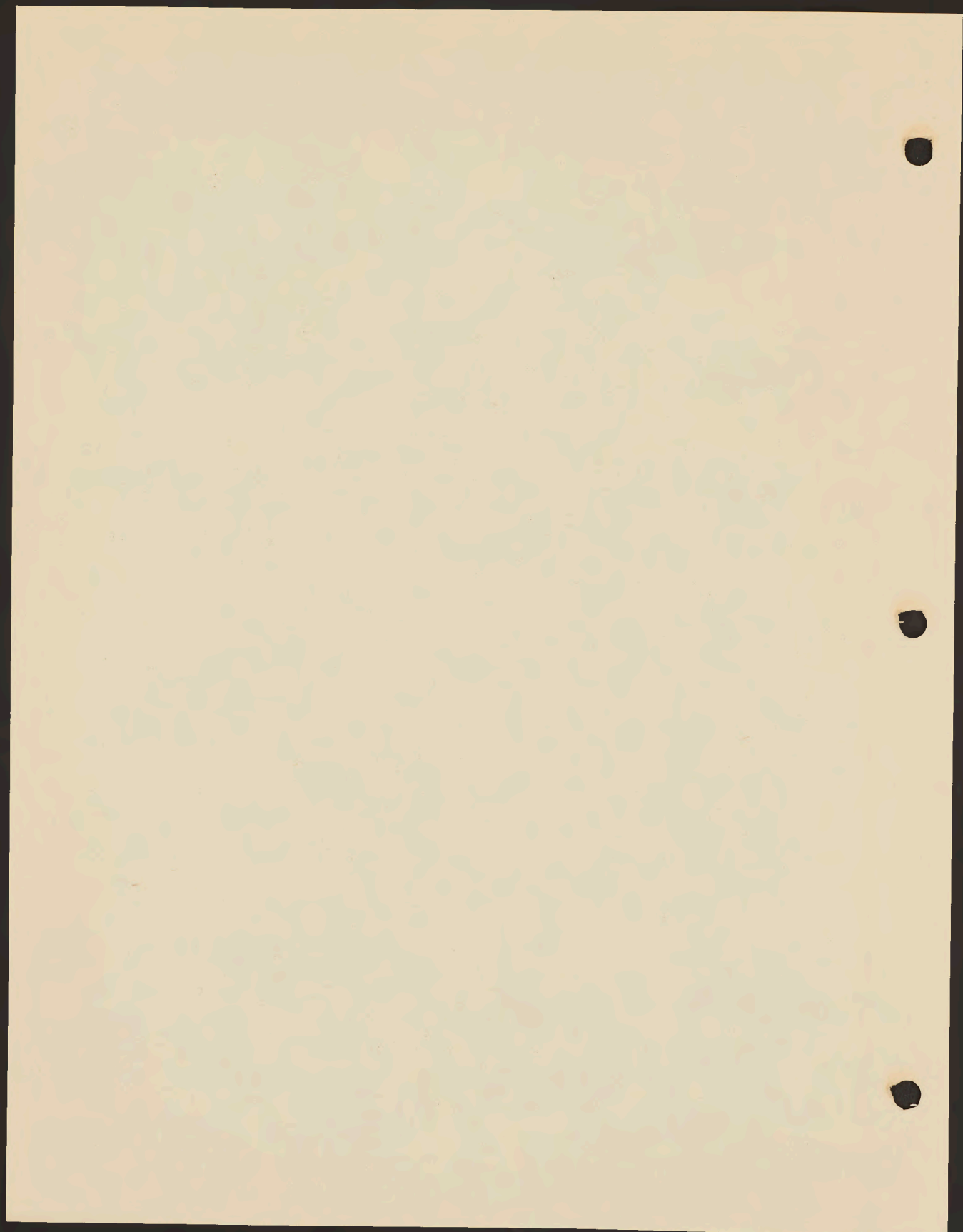
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Fig. 2 Sheet 2



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