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4

UNLIMITED **SECRET**
A PRELIMINARY REPORT ON THE BASE
FACILITIES REQUIRED AT RCAF GOLD LAKE
FOR THE AVRO CF105 FLIGHT AND
DEMONSTRATION PROGRAM
DECLASSIFIED
Report No. 72/GEQ/4 January 1958.

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By: (Name)

(Dept)

Date: JAN 8 96

B.J. Petzinger
Deputy Coordinator
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CEPE Arrow Team
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A PRELIMINARY REPORT ON THE BASE FACILITIES REQUIRED AT RCAF COLD LAKE
FOR THE ARROW 2 DEVELOPMENT AND DEMONSTRATION PROGRAMME

Report No. 72/GEQ/4

January 1958

Classification cancelled/changed to

By authority of (date)

Signature Rank

Prepared:

T. David

Approved:

A.R. Littleboy
Section, Chief, Ground Equipt.

Approved:

J.P. Booth
Chief of Equipment Design

Authorized:

G. Hake
Project Designer - Arrow

ENGINEERING DIVISION

AVRO AIRCRAFT LIMITED, MALTON, ONTARIO.

1. INTRODUCTION

- 1.1 The RCAF have requested preliminary information on the air base facilities required to support the ARROW Weapon System "Development and Demonstration" programme to be conducted at RCAF Cold Lake.

It must be realised that the information contained in the report is preliminary and subject to confirmation. The details of the requirements will be enlarged in three reports which are to follow early this year.

These are:-

1. Complete report of facilities required at Cold Lake.
2. A study of Arrow 2, 1st line maintenance and turn-around facilities.
3. A study of Arrow 2, 2nd line maintenance facilities

The facilities recommended in this report will support the ten ARROW aircraft scheduled to arrive at Cold Lake between February and September of 1960. Four of these aircraft will be utilized for the Demonstration programme and the other six will be engaged in the various phases of the CEPE performance and handling trials reference RCAF letter S-36-38-105-13- (ACE-1) reproduced in Appendix "A" (see also fig. 1 Appendix "A").

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2. SUMMARY OF REQUIREMENTS

<u>Service</u>	<u>Space</u>	<u>Estimated</u>	<u>Power</u>
1. (a) Arrow Maintenance Hangars - or	2 x 160 x 220 ft.)	}	1908 KVA/550V.
(b) Turn-around Hangars	2 x 148 x 300 ft.)		16 KVA/110V.
(c) Hangar for Targets, Drones and Towing Equip.	2 x 110 x 80 ft.		550 KVA/550V.
(d) Hangar space for Target Towing Aircraft.			16 KVA/110V.
			See Para. 3.3
2. Ground Equipment Building	800 sq. ft.		See Para. 3.1
			To be investigated
3. (a) Missile Test & Assembly Building	10,000 sq. ft.	}	To be further investigated
(b) Missile Fusing Building	3,312 sq. ft.		
(c) Armament Pack Servicing and Loading	100,000 sq. ft.)		
4. (a) Astra Sub-System Shops	5125 sq. ft.		20 KVA-115/200V. 400 cps 2 KVA-110V-60 cps
(b) Astra system Standards Installation	4875 sq. ft.		20 KVA-115/200V 400 cps 2 KVA-110V-60 cps
5. Electrical Workshops			See Para. 5.2
6. Instrument Workshops			See Para. 5.3
7. Battery room	100 sq. ft.		
8. Liquid Oxygen Charging and Storage	800 sq. ft.		
9. (a) Engine Assemble Building	2500 sq. ft.		
(b) Engine Test Facility	2200 sq. ft.		
10. Complete Aircraft Run-Up Muffler	One pair of DURASTACK Mufflers		
11. Water Softening Plant			
12. Hydraulic Test Shop	400 sq. ft.		110 KVA/550V
13. Drag Chute Servicing			Existing parachute-hanging buildings will accommodate.
14. Data Reduction Building and Instrumentation Servicing Lab.			At present being investigated.
15. Aircraft Systems Trainer Building			See Para. 5.12.

72/GEQ/4

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3. HANGAR SPACE

3.1 Maintenance Hangars

Accommodation will be required during 1960 for 10 Arrow aircraft. These aircraft could be accommodated in TWO RCAF standard "arch type" hangars (160 X 220 feet) or in ONE cantilever hangar (2 bays, each 148 X 300 feet) as shown in Figs. 2 and 3.

Additional accommodation will be required for four target towing aircraft (2 aircraft for the Sparrow development program, and 2 aircraft for the CEPE evaluation program). The facilities required for these aircraft will be dependent on the aircraft type chosen for this role.

The following services will be required at each aircraft position:

- (a) Up to 40 KVA at .75 PF of 115/200 volt 400 c.p.s.
3 phase AC power. It is proposed that this be supplied by individual motor generators.

The current must satisfy Avrocan Specification E-500, "Electrical Supply Systems (A.C and D.C), Aircraft," the main AC characteristics being as follows:-

Rated voltage	208/120
Voltage regulation	$\pm 1 \frac{1}{2}\%$
Voltage recovery time	$\pm 1 \frac{1}{2}\%$ in 0.2 secs.
Frequency, steady	400 c.p.s. $\pm 1\%$
Frequency, transient	400 c.p.s. $\pm 5\%$
Amplitude factor	1.41 ± 0.11
Harmonic content - total	5%
Harmonic content - any phase	3%
Symmetry (Voltage unbalance)	1% for P.F. .75
Overload	150% for 5 minutes 200% for 5 seconds
Unbalanced loads	Voltages within $\pm 4\%$ and phase voltage angle at generator terminals $120 \pm 4^\circ$.

A suitable unit in respect of current characteristics appears to be the Motor Generator Corporation's model # 1050 of 60 KVA rating. This capacity is in excess of the immediate known requirements per aircraft and a 40 KVA set would be suitable, if available. The above unit does not meet the overload requirements but this is considered unnecessary for ground operation.

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3.1 Maintenance Hangars (Continued)

- (b) A minimum of 150 lbs/min. of cooling air at 4.5 p.s.i.g. and 55°F (max.) with no free moisture content is required, at the aircraft connection.

An electrically driven self contained unit of stationary industrial machinery is recommended for each aircraft, the units being located off the hangar floor with ducting to each aircraft position.

- (c) Electrical power outlets will be required at each aircraft position to operate the following equipment:-

- (a) Main hydraulic rig 550 volt 60 cycle 3 phase AC 105 KVA
- (b) Auxiliary hydraulic rig 550 bolt 60 cycle 3 phase AC 5 KVA
- (c) Nitrogen compressor 550 volt 60 cycle 3 phase AC 14 KVA
- (d) Electronic Test equipment 110 volt 60 c.p.s. single phase 2 KVA

In order to determine the total load for the maintenance hangar it is assumed that the following equipment would be in use at one time:-

TOTAL number of ARROW aircraft which TWO hangars can accommodate - 12

Aircraft with electrical power 'on'	- 8
Aircraft with cooling air 'on'	- 8
Aircraft with auxiliary hydraulic rig 'on'	- 8
Aircraft with main hydraulic rig 'on'	- 4
Aircraft with nitrogen compressor 'on'	- 4
Aircraft with electronic test equipment 'on'	- 8

Therefore the total 550 volt 60 c.p.s. load would be:-

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3.1 Maintenance Hangars Cont'd...

8 electrical 400 c.p.s. generators (output 40 KVA) (input 50 KVA approx.)	=	400 KVA
8 cooling air supplies at 134 KVA	=	1072
8 auxiliary hydraulic rigs at 5 KVA each	=	40
4 main hydraulic rigs at 105 KVA each	=	420
4 nitrogen compressors at 14 KVA each	=	56
		<hr/>
		1988 KVA

The total 110 volt 60 c.p.s. single phase
load would be:-

8 sets of electrical test equip. at 2 KVA = 16 KVA

3.2 Turn-around Hangar Space

Two turn-around hangars will be required to effectively demonstrate the
states of readiness and "turn-arounds".

It is desirable that these be as described in Avro Report No. 72/G.OPS/2
"A Study of 1st Line Maintenance and Turn-around Facilities" now in course
of printing. In this case the floor space required will be 2 bays, each
110 feet X 80 feet, with total power requirements 550 KVA. This includes
an estimate of 116 KVA for hydrant refueling pumps.

Alternatively, 2 readiness hangars of existing type may be adapted as
suggested in Avro report LOG/105/9 Arrow 2 "Readiness Facility" (Fig. 7).
In this case the power requirements will be 434 KVA, if hydrant refuel-
ing is not provided.

3.3 Hangar Space for Targets and Towing Equipment

The details of this requirement are not known but two bays of existing
type Readiness Hangars might be considered for this purpose. If these
are erected adjacent to the turn-around hangars, ultimate use as turn-
around bays is possible.

3.4 Covered Space for Ground Equipment

A floor space of at least 8000 sq. ft. is considered likely to be
necessary to service mobile ground equipment such as engine starting
units; power and cooling air trucks; main hydraulic rigs, nitrogen
compressors, engine change equipment and access platforms.

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3.4 Covered Space for Ground Equipment (Continued)

If a cantilever hangar is used for housing the 10 Arrow aircraft then adequate space would be available in this hangar for accommodating the "in-use" ground support equipment.

4. ARMAMENT STORAGE AND TEST FACILITIES

A missile test and assembly building of 10,000 sq. ft. has been proposed in Avro report LOG/105/36 "CF-105 Preliminary Study of Proposed Armament Storage and Test Facility".

It is understood that a facility is to be prepared for CF-100 Mk. 5M Sparrow missile firing at Cold Lake and that this will be available for subsequent use on the Arrow programme.

A missile fusing building is also required and a building of 3312 sq. ft. has been proposed.

As it will probably be required to demonstrate inter-changeability of armament packs, it is also recommended that a armament pack building be erected and that this be sited in the armament compound as shown in Fig. 9, Avro report LOG/105/36.

The immediate requirement for the Cold Lake programme will not likely be in excess of a facility to handle more than 4 packs and the pack building shown could be reduced, say from 172,000 sq. ft. to 100,000 sq. ft.

5. ARROW 2 SUB-SYSTEM WORKSHOPS

5.1 Astra Sub-System Shops

(a) Component Servicing Shop

This will comprise Fire Control System Shop; automatic Flying Control System shop; Tele- communications shop and Navigation system shop.

It is estimated that these shops can be accommodated within 10,000 sq. ft. made up as follows:-

Floor space	FCS shop -	2750 sq. ft.	
	AFCS shop -	875 sq. ft.	
	T & N shop-	1500 sq. ft.	
		<u>5125</u>	5125
Dynamic Test Installation	-	3844	
Tool store and Equipment store	-	<u>1031</u>	
		<u>4875</u>	4875
			10,000 sq. ft.
			72/GEQ/4

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5.1 Astra Sub-System Shops

(a) Component Servicing Shop (Continued)

It should be noted that the FCS shop and Dynamic Test Installation should have an unobstructed outside view to permit radar transmission tests.

Power will be required up to 30 KVA of 115/200 volt 400 c.p.s. AC. A motor generator set # 1049, by the Motor Generator Corporation, of 37 KVA would be suitable.

60 cycle 110 volt single phase AC up to 2 KVA will be required for test equipment.

5 KVA of 550 volt 60 cycle 3 phase will be required for driving a hydraulic test rig which will probably be a modified RCAF unit of Section and reference number 4G/222.

Cooling air will be required with suitable ducting to each test stand. The detail requirement is not known but it will not exceed 150 lbs/min at 4.5 psig at 55°F. A similar rig as suggested for hangar use will probably be suitable.

Air conditioning will also be required in these shops, but the details are not yet available.

(b) Astra System Standards Installation

This will be a complete mock-up of the Astra system to be used as a reference standard for checking out equipment after servicing. If required this may be accommodated in a separate shop of estimated area 3844 sq. ft.

Power requirements will be as for the total Astra component shop, listed in 3.1 (a).

5.2 Electrical Workshops

Detail investigation of this requirement has not been made but it is likely that existing facilities will be near adequate in respect of floor space. A generator test rig may be required capable of driving the Arrow 40 KVA 400 c.p.s. generator to full power checks. No equipment is specified as yet. 400 c.p.s. AC power will also be required for component testing. This can probably be drawn from the hangar units and no additional units are envisaged.

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5.2 Electrical Workshops (Continued)

28V DC and 60 cycle 110 volt single phase will also be required. A detailed analysis has not been made but the requirement is not likely to exceed existing supplies.

5.3 Instrument Workshop

Additional facilities will be required for servicing and checking new type instruments such as Direction/Attitude Indicators, Integration Destination Indicators, Stable Platforms, Combined IAS/EAS Indicators, Mach Meters, Altimeters and Rate of Climb Indicators.

It is not thought likely that additional space will be required as new type equipment can probably be housed in existing shops.

Optimum layout and space requirements have not yet been determined.

400 c.p.s. AC power will also be required but this could be supplied from the hangar units.

5.4 Battery Room

An additional battery room will be required to handle the Nickel cadmium batteries used by the Arrow 2. It is not advisable that these alkaline batteries be accommodated with lead acid standard type batteries.

For the evaluation and demonstration programme a separate space of about 100 sq. ft. would be adequate.

5.5 Liquid Oxygen Charging and Storage

A space of approximately 600 sq. ft. will be required for charging, servicing and storing Arrow 2 oxygen convertors. In addition approximately 200 sq. ft. will be required for accommodating a 500 gallon storage tank and 50 gallon mobile liquid oxygen trailer.

5.6 Engine Accesories Assembly and Test Facility

A hoist of at least 12,000 lbs. capacity will be required to handle crated engines at the supply section. A similar hoist will be required in an engine uncrating and assembly shop. The assembly shop will have to be approximately 2500 sq. ft. to accommodate 2 engines for uncrating and assembling components such as after burners, starters, constant speed unit, generator, power take-off for gear box and piping.

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5.6 Engine Accessories Assembly and Test Facility Cont'd...

An engine running facility is recommended for pre-installation checks, trouble shooting and maintenance. A design study of this facility is in progress and is envisaged as a semi-permanent installation consisting of an engine run-up stand, exhaust muffler, control room or trailer, fuel supply and cooling water for afterburner operation.

Because of the high noise factor of this installation, it would have to be located in an area remote from other servicing facilities. The facility will occupy approximately 2000 square ft. of which a section would be concrete hard standing capable of supporting the equipment listed above.

The exhaust muffler water requirement is approximately 1500 GPM for after burner operation. This could be supplied from a header tank and pump installation located on the facility.

The requirement for afterburner operation should not exceed 1 minutes duration.

5.7 Complete Aircraft Run-up Muffler or Pen

The optimum form for this facility is under investigation but one of these three alternatives seems likely.

- (a) A pair of Durastack mufflers as at present in use at Avro Aircraft Ltd.
- (b) A pair of mufflers housed within a walled pen.
- (c) A pair of mufflers housed within a completely enclosed "Run-up" facility.

The efficiency and economics of each is at present being studied. As a minimum, one pair of Durastack mufflers is required.

5.8 Water Softening Plant

Two water softening plants are required - one at the proposed turn-around hangar and one at the main site. Two stage ionization is recommended to purify the water for use in the Arrow heat exchanger boiler to not more than 5 parts per million of scale forming substances.

5.9 Hydraulic Test Shop

An analysis of the equipment it will be desirable to function test in this shop has not been made, so a total flow requirement is not known at this time. However, a pressure of 4000 p.s.i. will be required and a flow of 40 US gallons per min. is not likely to be exceeded. Thus approximately 110 KVA of 550 volt 60 c.p.s. power for driving 2 X 50 H.P. hydraulic pumps is necessary.

It is likely that this hydraulic test shop could be accommodated within 400 sq. ft.

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5.10 Drag-chutes

As a drag-chute will normally be used at each landing, additional storage space will be required for storing packed chutes and hanging those which are not fit for immediate re-use. It is anticipated that this requirement will not exceed five per day. Each packed drag-chute has approximate dimensions 3 X 2 X 2 ft. and the hanging dimension required is about 30 feet, which may be accommodated within existing facilities.

5.11 Data Reduction Facility and Instrumentation Servicing Laboratory

The total requirement in respect of an instrumentation and a data reduction facility is not known at present as firm test programs have not been allocated and the methods and techniques of data acquisition and reduction are still under discussion.

5.12 Aircraft Systems Trainer

It is recommended that a building be provided for the installation of an Aircraft Systems Trainer at Cold Lake to be used in conjunction with the immediate program planned for this base and for subsequent use thereafter by the RCAF for training personnel.

Studies to date indicate a need for 8000 square ft. of floor space which will allow the individual trainers to be set up in separate training rooms or in areas having adequate seating and demonstration space around them.

Power requirements in this building would be up to 5 KW of 28 V DC; 4 KVA of 115/200 V - 400 c.p.s. - 3 phase - AC; 5 KVA of 110 V - 60 c.p.s. - single phase - AC and 22 KW of 550 V - 60 c.p.s. - 3 phase AC.

The foregoing space and power requirements do not take into consideration that which would be required for a complete ASTRA systems trainer. The ASTRA contractor has not yet established his systems trainer requirement. An estimate of the space and power requirement for an ASTRA system trainer is as follows:-

Area = 3844 square ft.
Power = 30 KVA 115/200V - 400 c.p.s. - 3 phase
2 KVA 110V - 60 c.p.s. - Single phase AC
140 KVA 550V - 60 c.p.s. - 3 phase AC (for cooling air supply and hydraulic unit for antenna drive).

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A P P E N D I X A

Copy - S36-38-105-13 (ACE-1)

Malton, Ont. 15 November 1957.

Mr. J.A. Morley,
Vice President,
Sales and Service,
Avro Aircraft Limited,
Malton, Ontario.

Arrow Aircraft - Ground Support Equipment

Dear Sir,

With reference to your letters 4877/7/2234 dated 13th June and 3588/12/J dated 4 November, 1957. The following information, as outlined in S1038CN-180 (AMTS/DAEng) 26 September, 1957, Minutes of Ad Hoc Meeting to Discuss the Revised Arrow Flight Test Programme, copies of which have been forwarded to Avro, is reiterated hereunder for your convenience:-

- (a) Aircraft 1 to 11 inclusive - no change,
Aircraft 12 to 15 inclusive - Weapons
System development and Demonstration -
Cold Lake,
Aircraft 16 to 17, Phase 4 - Cold Lake,
Aircraft 18 to 19, Phase 5 - Cold Lake
and/or Eglin Field,
Aircraft 20 to 25, Phase 6 - Cold Lake (?)
Aircraft 26 to 27, Phase 7 - Cold Lake,
Aircraft 28 to 33, Phase 8 - Cold Lake (?)
Aircraft 34 to 36, attrition
Aircraft 37 on - Squadron.

In answer to your specific questions, the initial 11 aircraft are to be considered as operating from one base. The two aircraft for RCA will be temporarily detached from Malton with GHE from that base.

- (b) The subsequent aircraft are to be assumed to be operating from two bases (see paragraph two below) - Malton and Cold Lake, with a staging base to cater for ferry flights to Cold Lake.

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- (c) The aircraft will be utilized for flight testing, intensive flying and operational suitability trials.

The question marks in paragraph 1 (a) above indicate that no definite decision has been made as to where these 12 aircraft will be stationed. It is probable that the aircraft for Phases 6 and 8 will be operated from a base other than Cold Lake, in which case, paragraph 1 (b) must be read "operating from three bases".

Yours truly,

(J.D. Young)
Flying Officer,
for: Officer Commanding,
RCAF Technical Services Detachments,
Avro Aircraft Limited.

cc: Mr. J. C. Floyd
Mr. C. A. Hore
Mr. P. Adams
Mr. J.P. Booth

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ARROW 2 DEVELOPMENT, DEMONSTRATION & EVALUATION PROGRAM
ACTIVITIES PLANNED FOR RCAF STATION COLD LAKE

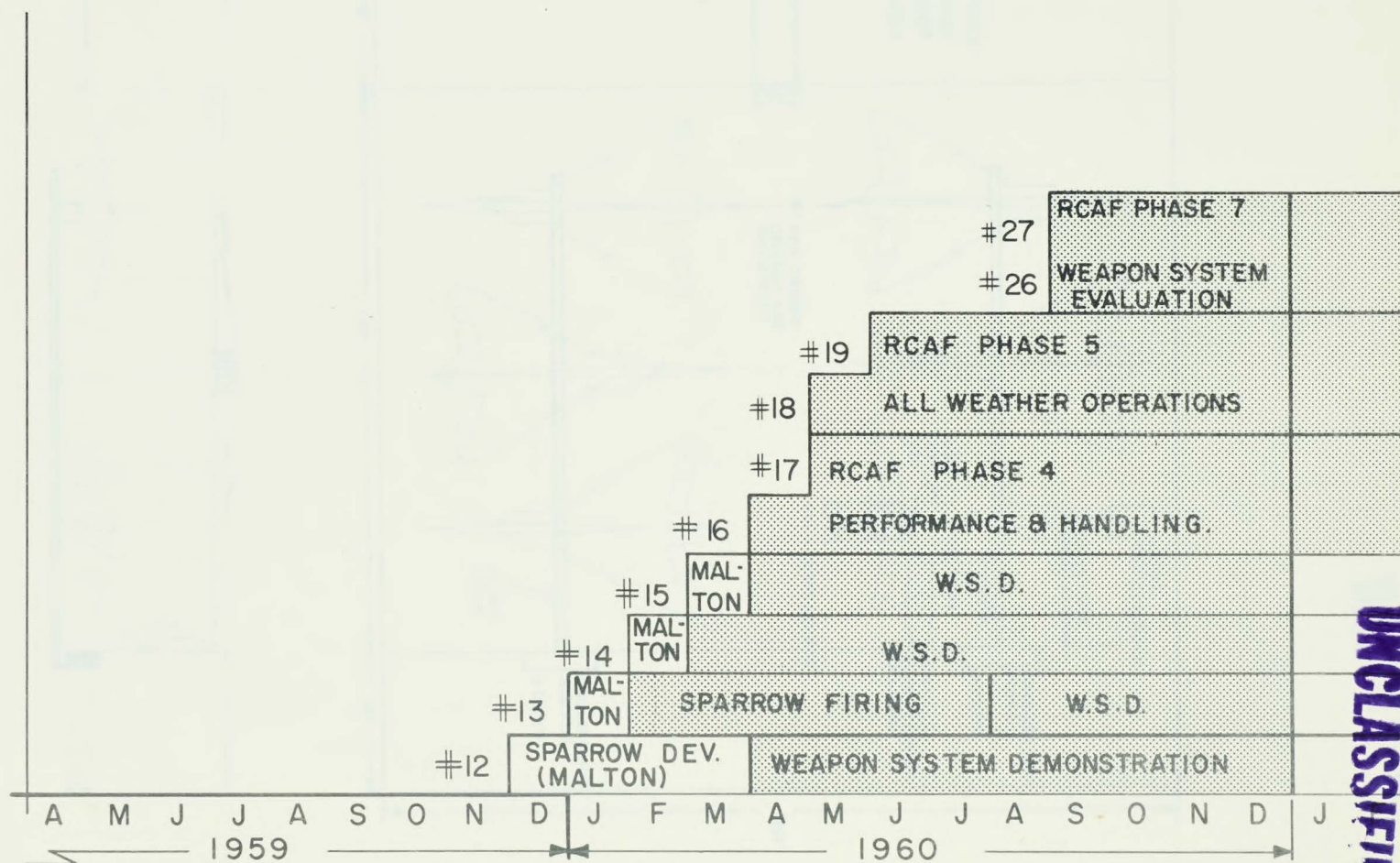
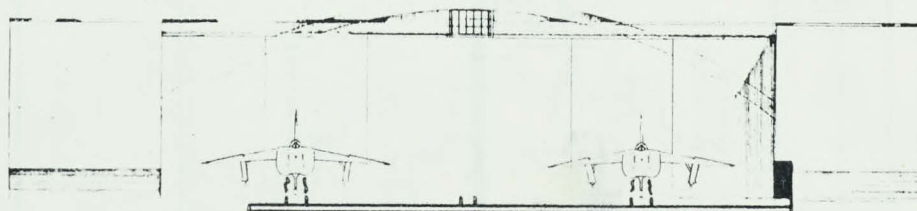
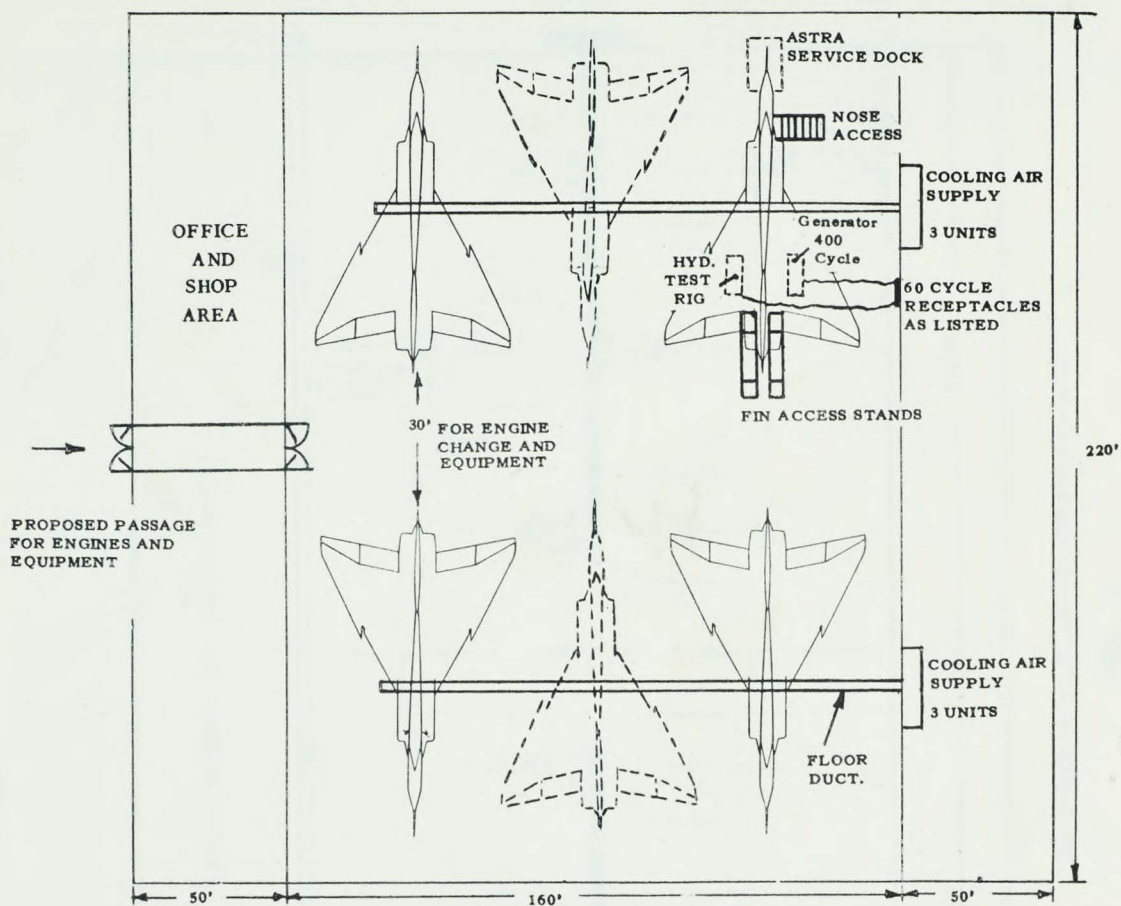


FIG. 1.

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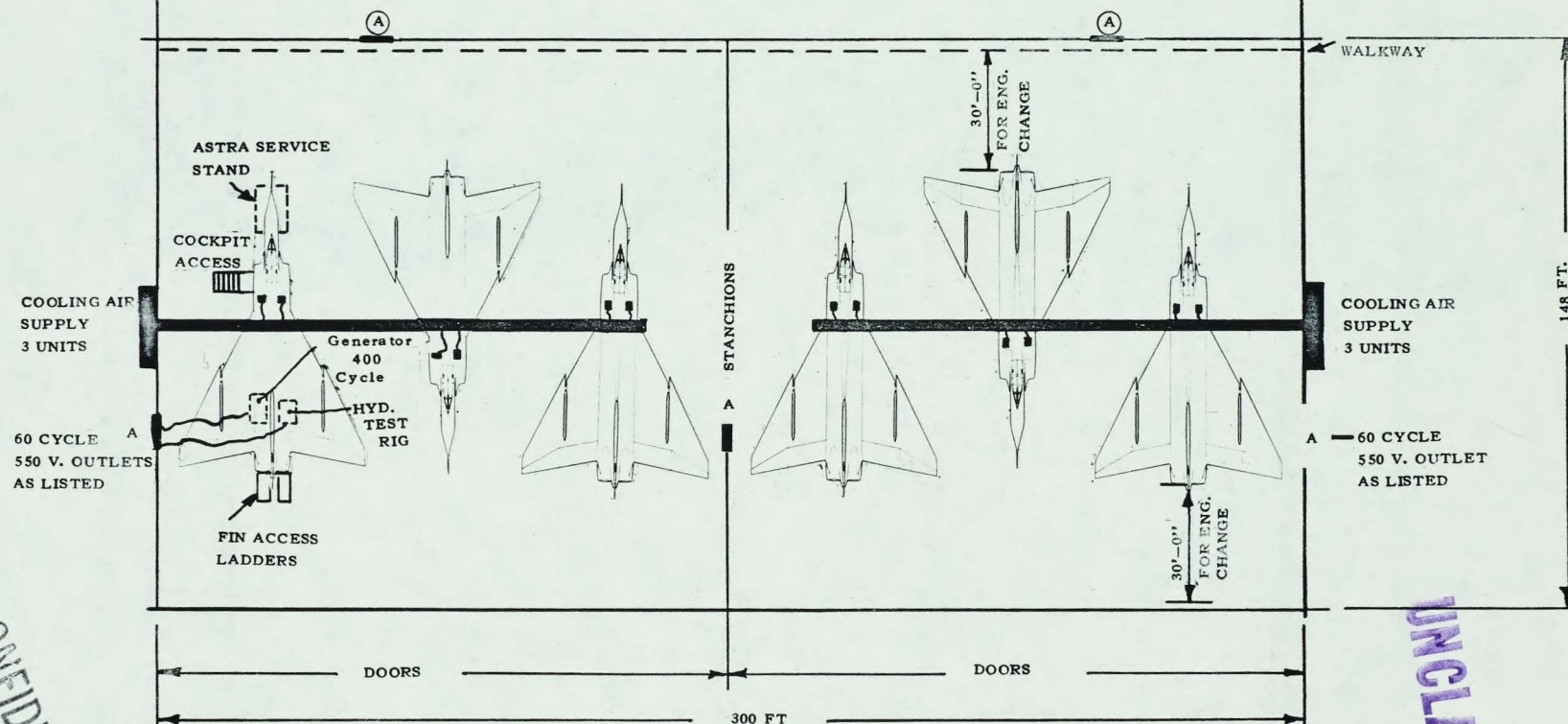
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PROPOSED FLOOR PLAN "ARCH TYPE" HANGER

FIG. 2

CENTRE W/SHOPS AND OFFICES (N.T.S.)



PROPOSED FLOOR PLAN - CANTILEVER HANGER

FIG. 3

SCALE: 1/500

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