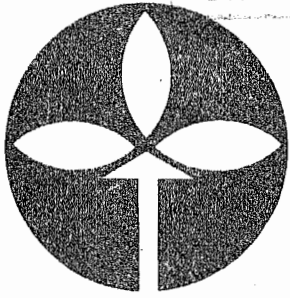


DEPT. OF AGRICULTURE



DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA

Agronomy Branch Report

CLOUD SEEDING OPERATIONS - 1968

J.D. McAuliffe

D.W. Kidd.

Report No. 24

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1. BACKGROUND:

Because of the 1967 drought and pressures from various organisations, the S.A. Government decided to run a Cloud Seeding programme for the winter and spring of 1968.

In 1967, two officers of the Department attended the 3rd Course of Instruction in Cloud Seeding Techniques run by C.S.I.R.O. Division of Radio Physics at Sydney University. Practical experience was then gained by working with N.S.W. and Victorian Departments of Agriculture and C.S.I.R.O. Tasmanian trial.

An Australia wide tender was let for the charter of a suitable aircraft and the decision to accept Civil Flying Services' tender was made early in February, 1968.

The trial commenced on 16/4/68 and continued until 16/10/68, when the contract expired.

Assessment of the rainfall figures showed inconclusive results. Further trials in the same rain shadow area would not be recommended.

2. THE AIRCRAFT:

Type: Beechcraft Baron B 55, Reg. VH-CFJ

Power: 2 x 260 HP fuel injected engines

Cruising Speed: 120- 200 knots

Climb in 20 mins.: 15,000' asl

Ceiling: 19,700' asl

Disposable Load (excluding fuel): 900 lbs.

Crew: 2 (with provision for an observer)

Necessary Instrument Flight Rules (I.F.R.) Equipment:

(1) 2 A.D.F.

(2) Autopilot (Honeywell H14)

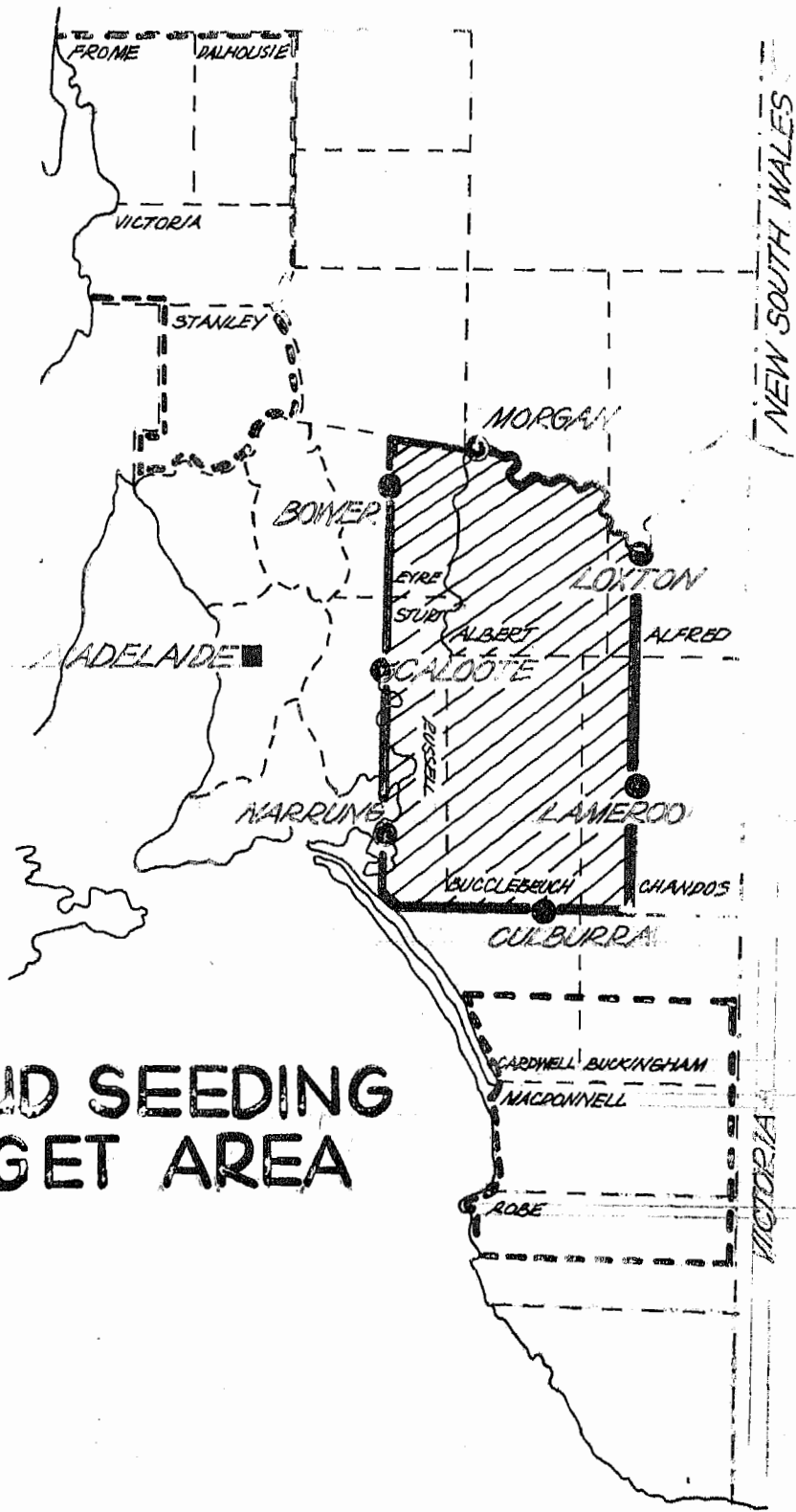
(3) VHF (360 Channel) and HF radio

Extra Navigation Equipment:- (Fitted to the chartered aircraft)

(1) Collins PN 101 integrated Navigation System

(2) VOR Receiver (Visual Omni Range)

(3) D.M.E. (Distance Measuring Equipment)



CLOUD SEEDING TARGET AREA

(4) I.L.S. (Instrument Landing System)

(5) Marker Beacon Receiver

Oxygen: Constant flow system with 4 outlets

De-icing Equipment: Fitted to all flying surfaces and propellers

Weather Radar: Not fitted but would be desirable extra.

The aircraft was chartered from Civil Flying Services of Moorabbin, Victoria, and had previously been fitted with silver Iodide burners. This meant that the cost of installing burners was reduced as much of the piping remained in the wings and fuselage.

The rates were:-

\$550 per month standing charge

\$30/hour

\$134.40 - installation and removal of plant

Total cost of the 200 hours guaranteed in the contract was \$22,334 + \$30 per hour ferry costs. A deposit of \$1,000 was required to be placed with the tender. This deposit was to be returned with the successful completion of the contract.

The aircraft maintenance was carried out at Civil Flying Services' (C.F.S.) maintenance workshops at Moorabbin, near Melbourne (i.e. 100 hourly inspections and services). 50 hourly inspections were done locally with the help of SAATAS. Instrument services were done in Melbourne as C.F.S. were not in the A.W.A. pool for exchange units that were available locally.

3. EQUIPMENT:

The airborne equipment consisted of 2 burners, a 16 gallon fume-proof tank and control panel with 2 high tension coils and 2 electric pumps (see Figs. 2 and 3). This equipment was installed in the aircraft by C.F.S.

The Horticulture Branch workshop made a stainless steel mixing tank and trolley to drawings supplied by C.S.I.R.O. Division of Radiophysics. This was kept along with the acetone and concentrate silver Iodide solution in the inflammable store at the T.A.A. maintenance hanger at Adelaide Airport.

Personal equipment issued to cloud seeding officers consisted of:-

(3) Pumps

20	Pressure Switch	2	Lockheed 1201A (mod)
19	Terminal Blk.	1	Rowco. (Industrial)
18	Thermo Switch	2	Fermol 17302-0
17	Warning Light	4	E.S. Rubin Type 2011/S1
16	Spark Plug Cover	2	Lodge Plug Cover
15	Spark Plug	2	Lodge Type 324-1
14	Pump	2	Bend x Eclipse Type 744
13	Socket	2	AN3106-12-55
12	Braided Earthing	A/R	Braided Copper Earthing
11	Ignition Elbow Assy	2	Smith & Son Type HE/M '90
10	Potentiometer	2	Internl Resistance PR-50
9	Ampmeter	2	Paton Type K216
8	Warning Light	1	Arcoelectric Automotive
7	Plug	1	AN 3057 4
6	Socket	1	AN 3102
5	High Energy Igniter Unit	2	Rotax Type NB 25/3
4	Switch	4	Arcoelectric Automotive
3	Start Button	2	Arcoelectric Automotive
2	Circuit Breaker	2	5 Amp PSM-5-N
1	Circuit Breaker	1	10 Amp PSM-10-N
ITEM	DESCRIPTION	No. OFF	MATERIAL

(4)

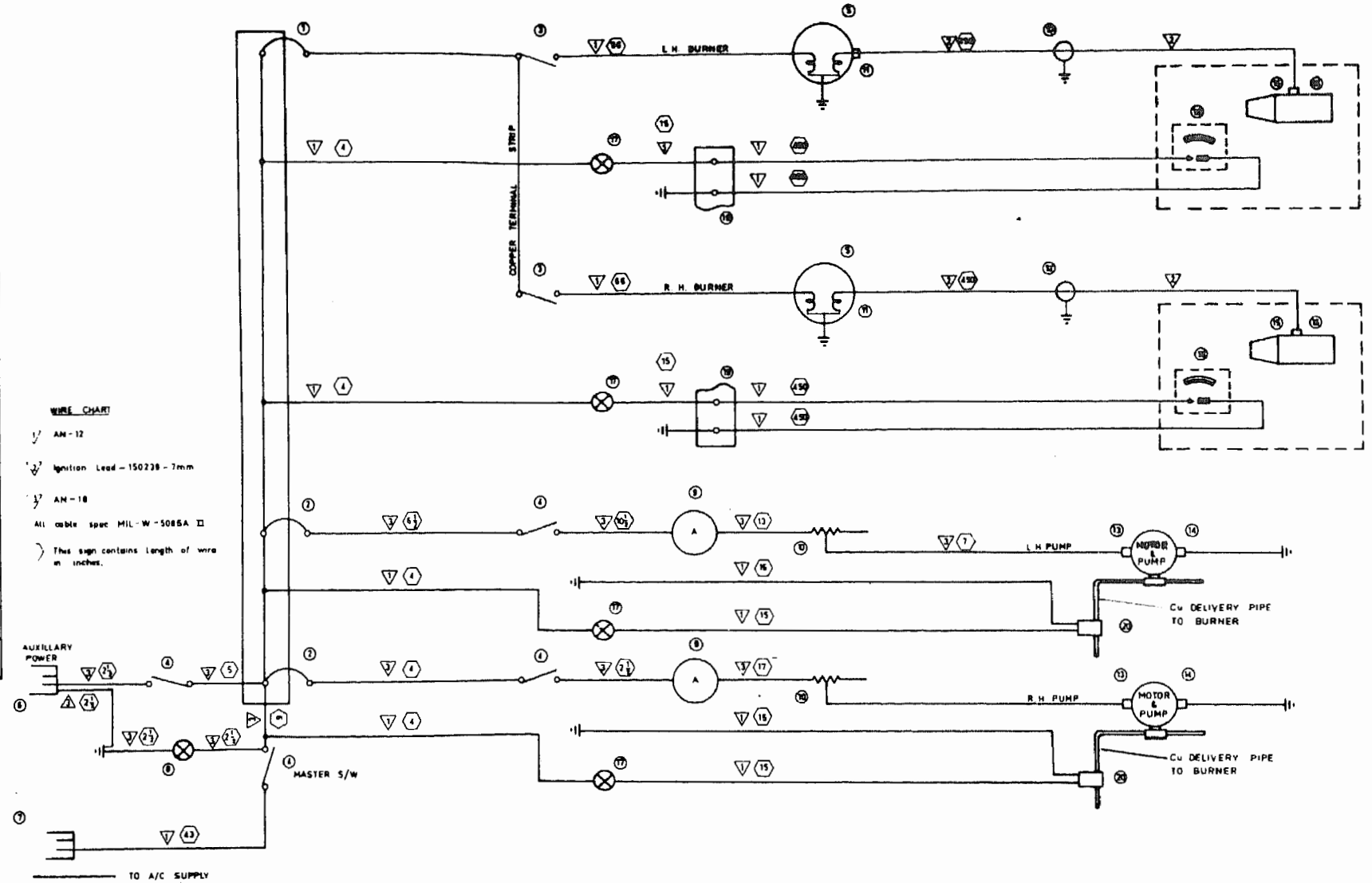
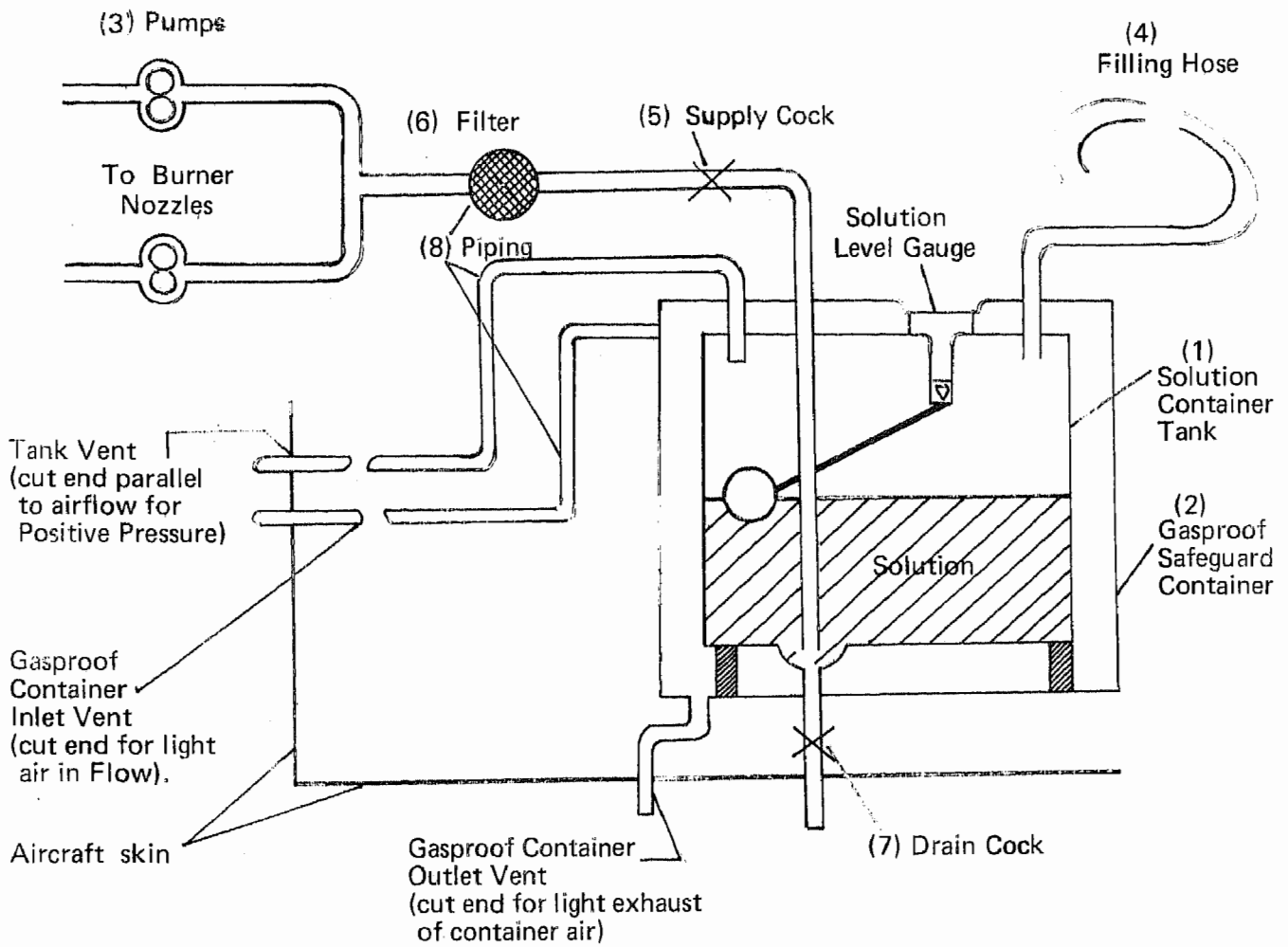


FIG. 2 - CLOUD SEEDING EQUIPMENT: ELECTRICAL CIRCUIT DIAGRAM



1. Solution Tank.
2. Gasproof Safeguard Container.
3. Pumps.
4. Filling Hose.
5. Supply Cock.
6. Filter.
7. Drain Cock.
8. Piping.

**FIG. 3—CLOUD SEEDING EQUIPMENT
MECHANICAL ARRANGEMENT**

- 1 Navigation computer
- 1 Navigation protractor
- 1 WAC chart Adelaide and VEC chart
- 1 pair dividers
- 3 Chinagraph pencils
- 2 Pair overalls
- 1 Pair of fleecy lined boots
- 1 Pair Polaroid sunglasses
- 1 Attache case
- 1 Copy of Visual Flight Guide

4. TRAINING OF CLOUD SEEDING OFFICERS:

The third Course of Instruction in Cloud Seeding Techniques run by C.S.I.R.O. Division of Radiophysics was attended by Mr. D.W. Kidd and Mr. I.H. Williams, two officers of the Department of Agriculture.

The course ran from August 7th-18th, 1967 and while short, was very comprehensive.

Follow up practical training for Mr. Kidd involved spending from:-

- (1) September 4th-18th, 1967 at Cobar where the N.S.W. Department of Agriculture had an aircraft based.
- (2) September 20th-October 2nd, 1967 at Horsham where the Victorian Department of Agriculture had two aircraft stationed.
- (3) November 27th-December 4th, 1967 at Hobart working with C.S.I.R.O. Radiophysics long term trial.

Mr. Williams had a similar programme:-

- September 4th-18th, 1967 - Wagga
- October 2nd-16th, 1967 - Horsham
- December 4th-18th, 1967 - Hobart

The fourth Course of Instruction in Cloud Seeding Techniques was attended by Mr. M.C. Catt in 1968.

5. OPERATIONS:

The operation cycle usually began with a visit to the Forecasting Office of the Commonwealth Bureau of Meteorology, at approximately 11.00 p.m. the previous day. A short discussion was usually sufficient to determine whether an early start would be necessary the following morning and allow the pilot to be prepared.

At 6.30 a.m. approximately the Cloud Seeding Officer would again call at the Forecasting Office and collect a specially prepared weather forecast.

If the Cloud Seeding Officer decided that conditions were suitable or would perhaps be suitable later the pilot was notified. It was important that the pilot not be put on standby if possible because time on standby counted as flying time under Department of Civil Aviation regulations. (Under ANO Part 48.1 there are stringent daily, weekly, monthly and annual limits on pilots flying time which must not be exceeded).

Flight planning and pre-flight inspections made the minimum reaction time 1 hour which was almost too long on some occasions.

All flights were made to Instrument Flight Rules. Typically a flight consisted of a climb to the -10°C level on a heading to Meningie, Halidon or Stonefields reporting points.

Height and temperature were graphed, cloud types and heights were noted and a mean wind for the climb calculated as well as wind speed and direction at the desired seeding level (see Diagrams 1 to 5). A clearance was then obtained to fly (when suitable cloud was present) a path which was across the wind direction and upwind from the target area, a distance equal to half the wind speed in miles/hour. Research work in Australia and overseas has shown that 30 minutes is the minimum time for the ice nuclei of silver Iodide (Ag I) to grow and produce the resultant rainshower. Because of air-space restrictions it was often impossible to fly the ideal flight path on many days of westerly winds.

Navigation was simplified by the excellent "Nav aids" installed in the aircraft and the good spread of "Naviad" ground stations in the target area.

Reliability of the aircraft was good, the weakest link being the poor standard of service in Melbourne. Luckily service periods usually coincided with spells of fine weather.

6. ASSESSMENT:

As cloud seeding was only carried out for one six month period (April to October, 1968), any assessment will have little meaning.

DIAGRAM 2

APRIL-MAY

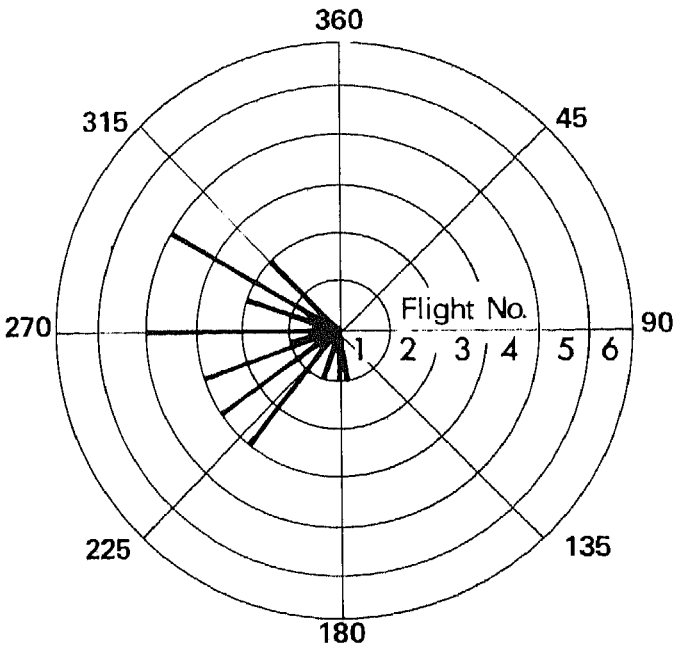


DIAGRAM 3

JUNE-JULY

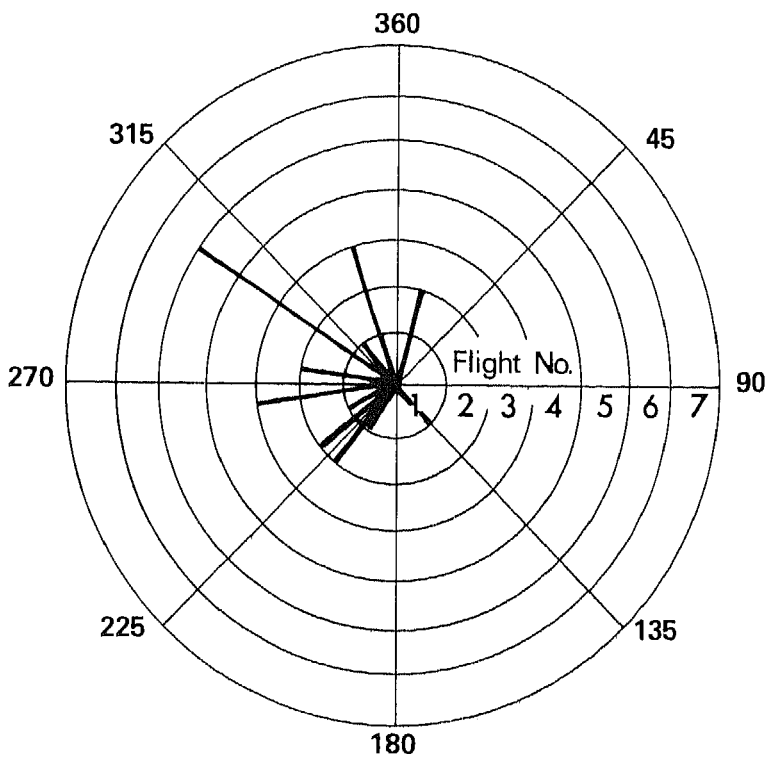


DIAGRAM 4

AUGUST-SEPTEMBER

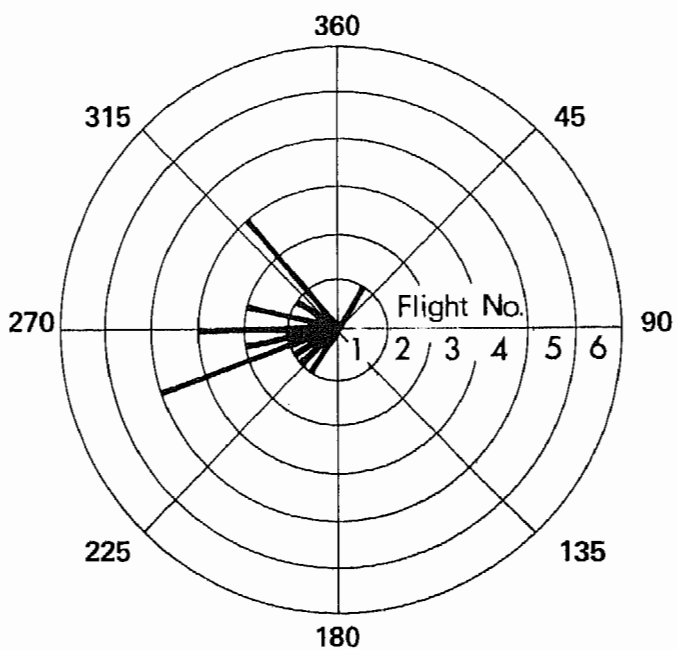
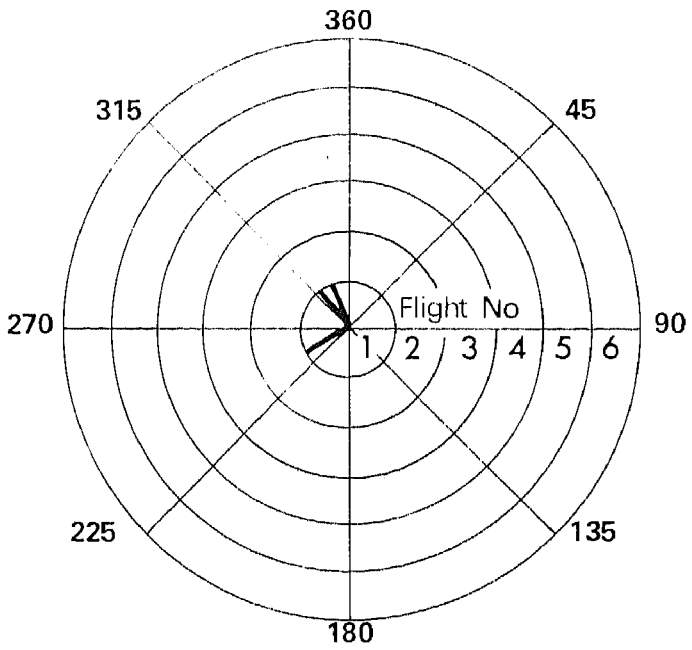


DIAGRAM 5

OCTOBER



DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA

CLOUD SEEDING RESEARCH PROGRAMME

COMPOSITE FLIGHT LOG

MONTH . APRIL YEAR . 1958

Flying
 Seeding
 No. Cloud 0
 Adverse Wind A
 Mechanical Trouble M

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Remarks				
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SEEDING HRS.																																				

Hrs. to Inspection
48.55

60 HRS. INSPECTION

TOTAL

DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA
CLOUD SEEDING RESEARCH PROGRAMME

COMPOSITE FLIGHT LOG

MONTH JUNE YEAR 1968

Flying
Seeding
No. Cloud O
Adverse Wind A
Mechanical Trouble M

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Remarks			
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SEEDING HRS.	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/
TOTAL	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/

Acetone

Concentrate

Hrs. to Inspection

INST FLIGHT TEST DCA

100 HR. OVERHAUL MELBOURNE

32.35 TOTAL
5.0 TOTAL

DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA
 CLOUD SEEDING RESEARCH PROGRAMME
 COMPOSITE FLIGHT LOG

Flying _____
 Seeding
 No. Cloud O
 Adverse Wind A
 Mechanical Trouble M

MONTH AUGUST YEAR 1958

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Remarks					
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SEEDING HRS.	1/43		1/43				1/43	1/43	1/43	1/43	1/43			1/20			1/40	1/25	1/35	1/40	1/35	1/40	1/30	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	10.04	TOTAL	

Acetone 3 galls.
 Concentrate 3 galls.
 Hrs. to Inspection 3 Hrs. 50 Mins.

A ranking method was used in the assessment (see below under analysis method). In this method the mean monthly rainfall for the target area was compared with the mean monthly rainfall for the control area, this was then compared with data from the same stations for the last 46 years. Figures were produced for monthly, 3 monthly and 6 monthly intervals. None of these showed any trend.

Iso-percentiles of normal monthly and 3 monthly rainfall were drawn on a map of the area. No pattern was revealed. Actually in the year cloud seeding was carried out rainfall was below normal in the target area and above normal in the controls. The Victorian Department has taken the data and is using it as part of their assessment of the Victorian cloud seeding programme.

Analysis Method

T_m = mean of gauges in Target Area for month m .

$$C_m = \frac{C_m^1 + C_m^2}{2}$$

Where C_m^1 is mean of North control area gauges for month m and C_m^2 is mean of South control area for month m .

find $\frac{T_m}{C_m}$

Calculate $\frac{T_m}{C_m}$ for each year of historical record.

i.e. 46 values for all stations -

- (1) each month
- (2) each 3 months
- (3) each 6 months

Place in order of magnitude find order $\frac{T_m}{C_m}$ operational.

This method does not assume any form of distribution for each Station on map (supplied) compute monthly normal.

Express operational monthly total as % of normal then draw Isopercental 3 months and 6 months.

APPENDIX A:

DEPARTMENT OF AGRICULTURE

SOUTH AUSTRALIA

TENDER DOCUMENT

AIRCRAFT CHARTER

This tender document shall be forwarded complete to:-

The Minister of Agriculture,
Box 668, G.P.O.,
ADELAIDE. S.A. 5001

C O N T E N T S

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Form of Tender	5
Schedule of Rates	7
Conditions of Contract	9
Specification	16
Drawings*	Fig. 1

* Also see Journal of Agriculture, S.A., 72
page 116.

Instructions to Tenderers

SOUTH AUSTRALIAN DEPARTMENT OF AGRICULTURE

CLOUD SEEDING RESEARCH PROGRAMME

AIRCRAFT CHARTER

INSTRUCTIONS TO TENDERERS

1. TENDER:

The Tender shall be made out upon the Form of Tender attached hereto without alteration or mutilation and shall be signed by a principal and delivered together with the Tender Document duly filled in and completed. No alteration shall be made in the Form of Tender or in any of the documents attached hereto. The Tender shall be enclosed in a sealed package and endorsed clearly on the outside with the words:-

Tender for Cloud Seeding Research Programme,
Aircraft Charter

2. DATA TO ACCOMPANY TENDER:

The Tender shall be accompanied by the following documents (the paragraph references are to these Instructions to Tenderers):-

- (a) Schedule of Rates (see paragraph 6)
- (b) Covering Letter (see paragraph 13).

3. DELIVERY OF TENDER:

The Tender shall be addressed to:-

The Minister of Agriculture,
Box 668, G.P.O.,
ADELAIDE. S.A. 5001

and delivered to the above address not later than 2.30 p.m. Central Australian time on the date advertised for closing of Tenders.

4. VALIDITY OF TENDER:

In the event of late delivery of a Tender, or the omission of any of the stated supporting documents, the Tender may not be considered. The Tender shall not be withdrawn before the expiration of 21 days from the date advertised for closing of Tenders, but shall remain binding and may be accepted at any time before the expiration of such 21 days.

5. ARTICLES OF ASSOCIATION:

Any Tender submitted by a Company shall be accompanied by sufficient information to define the constitution of the Company, Powers of Attorney and other relevant information, and any Tender submitted by a Partnership or Firm shall be accompanied by relevant extracts from the Partnership Deed or other documents, so as to show by what persons and in what manners contracts may be entered into or by or on behalf of the Company, Partnership or Firm, and what persons are directly responsible for the execution of such contracts and can give valid receipts on behalf of the Company, Partnership or Firm.

6. SCHEDULE OF RATES:

The Schedule of Rates priced fully or in part shall accompany each Tender. In the case of discrepancy between the "Rate" and the "Amount" for any Item in the Schedule of Rates, the "Rate" shall govern and the "Amount" shall be amended accordingly. The Tenderer shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of the Tender for the Works and of the Rates and Lump Sums set out in the Schedule of Rates which Rates and Lump Sums shall cover all his obligations under the Tender Document and all matters and things necessary for the proper execution and completion of the Works.

7. NEGLECT TO OBTAIN RELIABLE INFORMATION:

Any neglect or failure on the part of the Tenderer to obtain reliable information on the spot or elsewhere upon the foregoing or any other matters affecting the Tender Document shall not relieve the Contractor from any risks or liabilities or from the responsibility of completing the Contract as specified in the Tender Document.

8. INFORMATION SUPPLIED NOT BINDING ON MINISTER:

Except as provided in Paragraph 10 of these Instructions to Tenderers no member or employee of the Department of Agriculture has any authority to make any representation or explanation to the Tenderer as to the meaning of the Tender Document, or as to anything to be done or not to be done by the successful Tenderer, or as to these Instructions to Tenderers, or as to any other matter or thing, so as to bind the Minister or bind or fetter the judgment of the Minister's Agents in the exercise of their power and duties as specified in the Tender Document. No claim for an increase of the price will be entertained, nor shall the successful Tenderer be entitled to make any claim on

the ground of representation, or on the ground that he was supplied with information, or given any promise or guarantee by the Minister, his agents, or employees or any other persons.

9. ADDENDA:

Addenda to the Tender Document may be issued prior to the date advertised for closing of Tenders for the purpose of clarifying the Tender Document or to effect modification in the design or Contract terms. If the Tenderer is in doubt as to the true meaning of any part of the Tender Document, he shall at once notify the Secretary of the Department of Agriculture and obtain clarification prior to delivering his Tender. Any interpretation of the Tender Document shall be made only by formal addendum to the Tender Document. The Minister will not be responsible for any other interpretation. Each addendum issued will be distributed to each person or organisation to whom a copy of the Tender Document has been issued. The recipient shall acknowledge receipt of each addendum by signing and returning to the issuing office the receipt form distributed with the addendum. All addenda issued become part of the Tender Document, and shall be delivered together with the other documents comprising the Tender.

10. RIGHT TO REJECT TENDERS, ETC.:

The Minister does not bind himself to accept the lowest or any Tender or any part of a Tender and will not assign any reason for the rejection of any Tender or any part of a Tender.

11. TENDER DOCUMENTS (INCLUDING DRAWINGS):

A copy of the Tender Documents (including the Drawings) may be obtained upon application to the Secretary of the Department of Agriculture, Box 901E, G.P.O., Adelaide. S.A. 5001.

12. COVERING LETTER:

If the Tenderer considers it necessary to submit qualifying conditions and or exceptions with his Tender then all such qualifying conditions and exceptions shall be contained in a single covering letter giving where possible the sum of money which could be directly attributable to such qualifying conditions or exceptions. The Tenderer shall include in the covering letter his reasons for including any additional item in the Schedule of Rates.

13. DEPOSIT:

The attention of the Tenderer is drawn to Clause S.10 of the Specification which specifies the deposit required to accompany the Tender.

FORM OF TENDER

SOUTH AUSTRALIAN DEPARTMENT OF AGRICULTURE

CLOUD SEEDING RESEARCH PROGRAMME

AIRCRAFT CHARTER

FORM OF TENDER

To:

The Hon. Minister of Agriculture,
Box 668, G.P.O.,
ADELAIDE. S.A. 5001

Sir,

Having examined the Tender Document for the Works abovenamed, we do hereby tender and offer to execute and complete the whole of the said Works in conformity with the said Tender Document at the Rates and Lump Sums set out in the Schedule of Rates or such other Rates and Lump Sums as may be ascertained in accordance with the said Tender Document.

A deposit of \$1,000 accompanies this Tender, as specified in the Tender Document.

Unless and until a formal Agreement is prepared and executed, this Tender, together with your written acceptance thereof, shall constitute a binding Contract between us.

In consideration of the trouble and expense incurred by you in preparing the Tender Document and in examining and considering this Tender, we undertake that the same shall not be withdrawn by us before the expiration of 21 days from the date thereof, but shall remain binding upon us and may be accepted at any time before the expiration of such 21 days.

We understand that you are not bound to accept the lowest or any Tender you may receive.

We are, Sir,
Yours faithfully,

Signature:

Address:

Date:

SCHEDULE OF RATES

SOUTH AUSTRALIAN DEPARTMENT OF AGRICULTURE

CLOUD SEEDING RESEARCH PROGRAMME

AIRCRAFT CHARTER

SCHEDULE OF RATES

Item No.	Description	Quantity	Unit	Rate	Amount
1	Aircraft charter time (1 week equals 168 hours)	24	week		
2	Actual flying time (payable additional to Item 1). Guaranteed minimum 200 hours	300 approx.	hour		
3	Installation of equipment				
4	Removal of equipment				
Total					

NOTE: The Tenderer may add items to the above if desired. His reasons for the additions shall be stated in the covering letter.

CONDITIONS OF CONTRACT

SOUTH AUSTRALIAN DEPARTMENT OF AGRICULTURE

GENERAL CONDITIONS OF CONTRACT

(Hereinbefore Referred To)

- - - - -

Interpretation of Terms

1. In the contract, and in these general conditions and in all other documents forming part of or annexed to the contract, the words or terms in this clause defined or explained shall, unless a contrary intention appears, have the meanings respectively set out hereunder:-

"Contract" shall mean and include the whole of the written and/or printed documents and/or drawings subscribed or signed by the Contractor, or by which the Contractor is in any manner bound, or by which his rights, liabilities, duties, obligations, or engagements are in any manner defined or limited, including the specification and conditions of contract, the schedule of quantities and prices, or prices only, the conditions of tender, the tender, acceptance of tender, the contract drawings, schedules, and all other documents (if any) annexed to the contract documents or intended to form part thereof.

"Minister" shall mean the Minister of Agriculture of South Australia or his agent.

"Month" shall mean a calender month.

"Drawings" shall mean and include any map, drawing, plan, or section, provided by the Minister for the purposes of the contract, or any map, drawing, plan, or section submitted by the contractor and accepted by the Minister for the said purposes. Each of the words "Specification" and "Drawings" shall be respectively construed to comprise both.

"Materials" shall mean and include the whole of the materials included in and provided for by the contract, and shall include all extras, additions, or alterations from or in the materials as originally designed or proposed.

"Contractor" shall mean and include the said
. his heirs, executors, administrators,
and assigns, and, in the case of a corporate body, its successors
and assigns.

Words importing the singular number only shall include the plural number and words importing the plural number shall include the singular number. Words importing the masculine gender shall include the feminine and the neuter gender and vice versa.

A CONTRACT AT SHCHEDULE OF PRICES

2. When the contract is a schedule of prices contract, and not a contract for a bulk or lump sum, the approximate weights, number, or quantities are given in the schedule, but the Minister does not guarantee the same, and will not be deemed to incur any responsibility in respect thereof. The contract will be deemed to include such extras, additions, deductions, enlargements, alterations, and omissions as are herein provided. Subject to these conditions and the specification, the Minister will be liable to pay the Contractor only for the actual weights, numbers, or quantities of each respective kind of materials ordered and delivered at the respective rate set forth in the schedule, whether such shall be more or less than the weights, numbers, or quantities stated in the schedule.

The contract prices shall include amounts payable for patent rights, trade marks, copyrights, and/or royalties in respect of material or any part thereof, and the Contractor shall indemnify and keep indemnified the Minister against all actions or claims for infringement of patent rights, trade marks, copyrights, or royalties by reason of the purchase, possession, or use of material or any part thereof. Except where expressly provided to the contrary, the Contractor shall bear all charges and expenses, fees, and royalties incurred in connection with the provision of materials any trade usage to the contrary notwithstanding.

No extra shall be paid for unless an order in writing therefor has been given to the Contractor with the authority of the Minister.

DRAWINGS

3. If neither the drawings, specification, schedule of quantities, and prices, or general conditions contain any notices of minor parts, the intention to include which is nevertheless clearly to be inferred, and which parts are obviously necessary for the proper completion and stability of the work, all such parts are to be made and supplied by the Contractor without extra charge.

TIME OF COMPLETION

4. The Contractor shall deliver the whole of the materials comprised in this contract or complete the work, as the case may be, within the time or times specified, and in the event of the non-delivery or completion within the specified time or times, should the Minister not have proceeded under clause 10, the Contractor shall pay to the Minister as liquidated damages and not by way of penalty, the sum of five hundred dollars per week for every week after the time or times specified during which the materials or any part thereof remain undelivered or during which the works remain uncompleted, which sum or sums may be deducted from any money payable or to be paid to the Contractor under this or any other contract, including any money deposited or given as security for the completion or delivery of the materials or execution of the work. No certificate for payment on account of materials delivered or for work executed will be given after the specified date for the completion of the contract, until the whole of the materials shall have been certified by the Minister's Agent as having been properly delivered, or the whole of the work be certified by the Minister's Agent to have been duly executed.

EXTENSION OF TIME

5. The Minister, on the recommendation of the Minister's Agent, may, upon the written application of the Contractor, grant, in writing executed by them, an extension of time for completion of the contract, and the Contractor shall not be entitled to any extension of time unless so granted.

DELIVERY WHEN COMPLETE

6. The delivery of the materials, or any portion thereof, by the Contractor to the Minister at the times aforesaid, or at any subsequent time, shall be a delivery only if accepted by the Minister, and when a certificate in writing under the hand of the Minister's Agent shall have been given to the Minister to the effect that the several materials delivered by the Contractor are sound, workmanlike, and in a complete condition, and that the Contractor has, in the opinion of the Minister's Agent, reasonably fulfilled and completed his contract and undertaking. Provided that as to any materials approved at place of manufacture by the Minister's Agent, the Minister's Agent shall be precluded from objecting to such materials on proof of identity, except only as to damage arising subsequent to the examination by the Minister's Agent, or any fraudulent concealment from him. Such materials shall be inspected and all objections made within fourteen days after

delivery to the Minister at the port of delivery in South Australia, and if not so made shall be considered waived.

CONTRACTOR NOT TO SUB-LET WORKS OR ASSIGN CONTRACT OR MONEYS

7. The Contractor shall not sub-let any portion of this contract or enter into any contract for the execution thereof or any portion thereof, or assign over this contract or the deposit moneys, or any part thereof, or all or any part of the moneys payable, or to become payable under the contract, or all or any part of any other benefits whatsoever arising, or which may arise, under the contract, without the consent in writing of the Minister first being obtained, and the Minister shall not be bound to accept or recognise any such sub-letting, contract, or assignment, or any agreement, contractor, or covenant for the same, or any irrevocable power of attorney, or any power of attorney coupled with an interest to receive any such deposit or contract moneys, or any part thereof respectively, unless its consent in writing as aforesaid shall, in each case, have been first had and obtained, and if any such sub-letting contract, assignment, agreement, contractor, or covenant thereof, or any such power of attorney is not accepted and recognised by the Minister, the same shall have no effect and shall be void to all intents and purposes.

SECURITY

8. See Specification S.10.

PAYMENTS

9. See Specification S.9.

DETERMINATION OF CONTRACT

10. If the Contractor fails to deliver the materials or any of them contracted to be supplied in the manner and at the rate of progress required by the contract, or if the Contractor fails to carry out, perform, and observe the terms, conditions, and agreements contained in the contract, or any of them, or if the Contractor shall at any time before the complete fulfilment of his contract become insolvent or make an assignment for the benefit of his creditors, or propose any composition to his creditors for the settlement of their debts, or shall carry on or propose to carry on his business or undertaking under inspection on behalf of his creditors, or shall commit an act of insolvency, it shall be lawful for the Minister, under the authority of this condition in their discretion, to

determine this contract by notice in writing executed by the Minister being served upon the Contractor, or left at his last known place of abode or business, and thereupon all sums of money that may be due or unpaid to the Contractor, including moneys lodged to secure the carrying out of the contract, and all sums of money due or owing to the Minister by the Contractor as liquidated damages for the non-fulfilment of the contract within the time or times specified, or otherwise, shall be forfeited to and be the property of or become payable to the Minister, and shall be considered as ascertained damages for breach of contract.

SETTLEMENT OF DISPUTE

11. Should any question or dispute arise between the parties hereto in connection with the materials supplied or to be supplied, or services rendered or to be rendered, or work done or to be done, or as to the interpretation or construction of any of the terms, conditions, or provisions of the contract, or as to whether any moneys or damages are payable or are to be paid by either party to the other, or as to any other matter or things connected with the contract or to be done or performed under it, such question or dispute shall be referred to the arbitrator appointed by the Minister, viz. the South Australian Under Treasurer, whose decision, with or without any formal or informal reference, submission, notice of hearing, or hearing, shall be final and binding on both parties, and the obtaining of such a decision thereon shall be a condition precedent to any right of action whatsoever with respect to such question or dispute.

CUSTOMS DUTY

12. The contract price of goods or materials to be supplied or delivered under the Contract, which at the time of the execution of the contract are not within the Commonwealth, shall include all Customs duty on importation of the material into the Commonwealth as estimated by the Contractor at the time of tendering and shown by him in his tender. Such tender shall also show the amounts included in the contract price for duty on such goods or material the Tariff rates applies in estimating such amounts, and the valuations on which duty is assessed. The Contractor undertakes that the valuation for duty has been stated correctly as at the time of tendering and that as far as he could he has duly advised the Minister of any grounds which may lead to the imposition of special duty under the Commonwealth Customs Tariff (Industries Preservation) Acts (anti-dumping legislation). Should the amounts actually paid by the Contractor in respect of such goods or material as duty on importation into the Commonwealth be greater (or less) than those set out in the

tender, such variation in amount shall be borne by (or as the case may be) credited to the Minister.

The Minister shall not, however, bear or be responsible in any way for an increase in Customs duty which is incurred through delay in effecting shipment, or which would have been avoided by delivery of the goods or material at the time or times specified for delivery under contract.

The requirements of the Customs Department shall be observed in determining the amount to be set forth in the Customs Invoice as the current domestic value of the material, and in particular where the Contractor is indenting the material, the amount of any genuine trade discounts allowed to the contractor on the material shall be deducted. This provision does not refer to special prices or special deductions.

The Minister will not accept responsibility for any increase in duty incurred by reason of the non-observance of these principles, and in particular increases in duty incurred by the use at the time of tendering of incorrect valuations for duty.

Where variations of the work are ordered and the contract price is consequently increased or reduced in cases where such variations are in respect of goods or material to be imported for the purposes of the contract, an appropriate adjustment shall be made of the amounts of estimated duty before any credit or debit is made to the Minister under this clause.

VARIATION OR PROVISIONS

13. None of the clauses or provisions of the specification or of these conditions, or of any other part of this contract shall be varied, waived, discharged, or released, or held or deemed so to be, either in law or in equity, unless in the manner prescribed hereby, or by the express consent in writing executed by the Minister.

Witness to the signature of the Minister)
.) Minister

Witness to the signature of the Contractor)
.) Contractor

Dated day of 19

SPECIFICATION

SPECIFICATION

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SOUTH AUSTRALIAN DEPARTMENT OF AGRICULTURE

CLOUD SEEDING RESEARCH PROGRAMME

AIRCRAFT CHARTER

SPECIFICATION

S.1 DOCUMENTS:

This Specification shall be read in conjunction with the attached Form of Tender, Schedule of Rates, Conditions of Contract, Special Conditions of Contract and Drawings, and the whole shall be deemed to constitute one document.

S.2 INTERPRETATION AND DEFINITION:

S.2.1 In this document where the context requires, the word "works" shall be read and construed as meaning the subject matter of the Contract and everything incidental thereto necessary for the performance as specified.

S.2.2 "Approved" means approved by the Department of Civil Aviation and in accordance with the Air Navigation Act, the Air Navigation Regulations and the Air Navigation Orders.

S.2.3 "Agreed" means agreed between the Minister and the Contractor except that in the event of failure to reach agreement a ruling by the Department of Civil Aviation shall be considered as final.

S.2.4 In the General Conditions, Conditions of Contract, "Minister's Agent" shall be deemed to mean the Cloud Seeding Officer as specified herein.

S.3 VARIATIONS:

S.3.1 In the General Conditions, Conditions of Contract, "Schedule of Quantities and Prices" shall be deemed to read "Schedule of Rates".

S.4 DRAWINGS:

The Drawings attached, and referred to herein are copies of photographs of the equipment to be installed by the Contractor, and fitted to the aircraft at his expense, and a plan of the seeding area. Detailed drawings of the equipment to be installed may be inspected at the

office of the South Australian Department of Agriculture, Gawler Place, Adelaide.

S.5 EXTENT OF CONTRACT:

- S.5.1 The Contract to which this Specification applies consists of the exclusive chartering of an aircraft, including its operation and maintenance, for participation in a cloud seeding research programme, for a period of not less than six months from mid-April, 1968. Cloud seeding equipment will be provided by the Minister and installed and, at the end of the Contract, removed and any consequent damage to the aircraft made good, by the Contractor. The actual installation and removal will be done under the supervision of officers of the Commonwealth Scientific and Industrial Research Organisation and in accordance with the regulations of the Department of Civil Aviation.
- S.5.2 The requirement of exclusive charter may for short periods be waived by the Minister at his discretion and a pro rata reduction of payment made therefor.
- S.5.3, The Contractor shall be deemed, before tendering, to have informed himself of all conditions pertinent to the Contract.

S.6 GENERAL DESCRIPTION OF REQUIREMENT:

- S.6.1 The object will be to seed suitable clouds, whenever they appear over or near a seeding area, with silver iodide smoke released from generators, installed on the aircraft. The flying times will total approximately 300 hours with a guaranteed minimum total of 200 hours and will occur at irregular intervals, depending on the weather. Continued operations in adverse weather conditions will make stringent demands on the aircraft and its equipment and on the experience of the crew.
- S.6.2 Emphasis is placed on aircraft serviceability and crew readiness to take advantage of brief opportunities. The Contractor will provide the pilots and the Minister will provide "Cloud-Seeding Officers" (C.S.O.) who will direct the cloud-seeding or research aspects of the operation.

The C.S.O. will set and continuously revise a state of readiness, according to which the aircraft shall be available for take-off at anything from 1 hour's to one day's notice.

S.6.3 A typical flight includes proceeding about 100 miles to the seeding area, two climbs to about 15,000 feet, seeding for as long as possible at heights usually about 7,000 feet but sometimes much higher, and returning to base or alternative airport. Much of this may take place in icing conditions.

S.7 BASE OF OPERATIONS:

The aircraft will be required to operate from West Beach Airfield while in South Australia. Other aerodromes may be used by agreement and negotiation between the Minister and the Contractor.

S.8 DURATION OF CONTRACT:

S.8.1 The aircraft shall be available at airfield on and from 9 a.m. on the 14th day of April, 1968, to enable installation of the cloud seeding equipment to proceed.

S.8.2 The Contract shall be deemed to begin at 9 a.m. on the 14th day of April, 1968, subject to the aircraft being available as specified on that date, and shall continue until the 14th day of October, 1968. Both dates may be varied by written agreement between the parties.

S.8.3 Failure without valid reason to make the aircraft available at the time and place specified or nominated may be regarded by the Minister as a break of contract, which may then be cancelled by him, and the deposit forfeited.

S.8.4 The Contract shall be deemed to end at noon on the day on which the seeding equipment is finally removed, and any consequent damage to the aircraft made good, as agreed.

S.8.5 If any airfield other than West Beach is the airfield nominated in S.8.1, then the aircraft charter shall be deemed to be suspended for the time between the completion of installation of the cloud seeding equipment at that airfield, and the availability of the aircraft at West

Beach. The aircraft shall be available at West Beach and the Department of Agriculture so advised not more than three days after the completion of installation and the suspension of the contract will then be deemed to have ended.

S.8.5.1 Except as may be agreed, the Minister will not make any payment for costs incurred by the Contractor during the period of suspension.

S.8.6 Aircraft charter time shall be reckoned from the nearest on the hour local time at the suspension of Contract or availability of the aircraft as the case may require.

S.8.6.1 In computing aircraft charter time, one week shall be reckoned to consist of 168 hours.

S.9 PAYMENT:

S.9.1 Aircraft Charter Time (Item 1 on the Schedule of Rates).

Payment will be made net weekly at the rate shown on the Schedule of Rates on the presentation of the Contractor's account duly certified by the C.S.O. Such account shall show:-

S.9.1.1 Any deduction made in consequence of the Minister's waiver of his right to exclusive charter (Clause S.5).

S.9.1.2 Any deduction made in consequence of delays in operation (Clause S.15).

S.9.2 Actual Flying Time (Item 2 on the Schedule of Rates).

Payment for each flight requested and certified by the C.S.O. will be made weekly at the rate shown on the Schedule of Rates on the presentation of the Contractor's account duly certified by the C.S.O. Flying time shall be deemed to be the actual time from "Engines on to engines off".

S.9.3 Other

Payment of such sums or at such other or additional rates, and in such a way, as may be agreed or negotiated and confirmed in writing by both parties.

S.10 DEPOSIT:

The tenderer shall lodge with his tender a deposit of \$1,000. Deposits of unsuccessful tenderers will be returned as soon as possible. The deposit of the successful tenderer will be retained until the satisfactory completion of the contract, less any amount deducted as provided in S.9.1.2.

S.11 PERFORMANCE OF AIRCRAFT:

- S.11.1 The aircraft, being at normal category weight with no overload, shall be capable of and shall be completely furnished for transporting a quantity of research equipment and not less than two (2) adult persons in addition to the aircraft operating crew for a flight time of six (6) hours at an agreed cruising speed and an altitude of seven thousand (7,000) feet, including an agreed climb allowance and have a service ceiling of at least seventeen thousand (17,000) feet.
- S.11.2 The maximum weight of the research equipment, including an allowance for installation, will not exceed 300 pounds weight including a maximum of 30 pounds weight of research equipment with a maximum frontal area of one (1) square foot installed on the fuselage or wings of the aircraft.
- S.11.3 The performance of the aircraft shall allow operation in adverse weather conditions without need for concessions from the Department of Civil Aviation.
- S.11.4 The aircraft shall be approved for flight in icing conditions and shall be capable of operating for extensive periods in icing conditions. (De-icing boots or similar approved de-icing equipment).
- S.11.5 The aircraft shall have more than one engine and, when iced, shall possess a one (1) per cent single-engined climb gradient, one hour after take-off at maximum approved weight, at an altitude of seven (7,000) feet, International Standard Atmosphere; but the definition of the degree of icing shall be subject to agreement between the Minister and the Contractor.

S.12 OPERATION:

- S.12.1 The Contractor shall supply, provide and accommodate approved personnel and crew, including stand-by crew as required, for the full operation of the aircraft during the periods, and in the locations, stated in Clause S.8 of this Specification.
- S.12.2 Pilots shall have Senior Commercial Pilot Licences with First Class Instrument Ratings and extensive cloud-flying experience or other agreed qualifications. In the case of sickness, recreation leave, or flight time limitations, an approved relief pilot shall be available on agreed notice.
- S.12.3 The Contractor shall not use, or cause to be used, the aircraft, during the currency of the Contract, for pilot training purposes unless written permission is obtained from the Minister.
- S.12.4 The Contractor shall, subject to agreed requirements of safe flying, have the flight crew and the aircraft available for flying at all times during daylight hours and including adverse weather conditions, when the aircraft is under charter to the Minister, and the Contractor shall arrange and provide for the aircraft to be airborne within the period of time requested by the Cloud Seeding Officer.
- S.12.5 The Contractor shall pay all costs of operating the aircraft including remuneration and expenses of the charter crew, running costs, maintenance and repair expenses, airport dues and hangarage expenses.

S.13 EQUIPMENT:

S.13.1 De-icing and Anti-icing Equipment

The aircraft shall be fitted with first-class approved de-icing and anti-icing equipment of proven usefulness. Thermal anti-icing equipment shall be fitted to wind-screens, air screws and air frames unless otherwise agreed.

S.13.2 Instrument Installation and Radio Navigational Systems

Flight and navigational instruments of types approved for use in regular public transport aircraft and including Distance Measuring Equipment shall be installed in the aircraft for operation under the Instrument Flight Rules.

S.13.3 Standard Radio Equipment

The aircraft shall be equipped with approved radio equipment of types in common use in Australia and specified in Air Navigation Order 20.8 for use in regular public transport aircraft.

S.13.4 Oxygen System

An approved regulated demand oxygen system, with an endurance of at least three (3) hours at flight altitudes in excess of thirteen thousand (13,000) feet and suitable for four (4) persons, shall be a fixed installation in an unpressurised aircraft and shall comply with the provisions of Air Navigation Orders Part 20 Section 20.4. Oxygen masks shall give nose and mouth coverage and shall incorporate microphones unless otherwise agreed. Pressurised aircraft shall have provision for the use of oxygen in accordance with Air Navigation Orders Part 20 Section 20.4.

S.13.5 Heating

The aircraft shall be provided with adequate pitot-heating and cabin heating of proven capacity.

S.13.6 Auto-Pilot

An approved electronic three-axis auto-pilot system shall be installed in the aircraft.

S.13.7 Fitting of Special Equipment

The Contractor will be responsible for the costs involved in fitting special equipment for research or experimental work in the aircraft, and for the costs involved in the removal of such equipment and making good any subsequent damage to the aircraft as agreed. Detailed drawings may be inspected at the office of the South Australian Department of Agriculture.

S.13.8 Electrical Equipment Voltage

Electrical equipment shall operate on twenty-eight (28) volts unless otherwise agreed.

S.14 MAINTENANCE:

- S.14.1 The Contractor shall provide full maintenance of the aircraft with effective service and adequate spare parts during the Contract.
- S.14.2 The Contractor shall provide, transport, maintain and accommodate all necessary maintenance personnel.

S.15 DELAYS IN OPERATION:

Other than agreed lay-ups for normal maintenance, any delay in operation due to unavailability of flying crew or aircraft or similar cause after agreed notice has been given or lack of effective maintenance or provision of adequate spare parts, shall be deductible from the payable aircraft charter time. Additionally there shall be deductible from payment to become due, a sum calculated at the rate of ten dollars per hour or part of an hour to a maximum of four hours per day, for each such delay.

S.16 INSURANCE:

The Contractor will indemnify the Minister against all claims, suits, actions and demands whatsoever arising from the use of the aircraft except those attributable to cloud-seeding operations by chemicals; and the aircraft and its contents (excluding the Minister's property) is to be fully insured at all times against damage or total loss from any cause whilst on charter to the Minister.

S.17 INFORMATION TO BE SUPPLIED BY TENDERER:

- S.17.1 Experience of flying personnel and Company management, particularly when working under Instrument Flight Rules.
- S.17.2 Proposed maintenance procedures and facilities existing or proposed in South Australia, including availability of spare parts.
- S.17.3 Manufacture of aircraft and type of model.
- S.17.4 Power plant.
- S.17.5 Particulars of aircraft instruments including equipment for flight under Instrument Flight Rules.

- S.17.6 Particulars of radio and navigational equipment, including availability of spares; if spare units are held in the pool and planned maintenance procedures.
- S.17.7 Possibilities of extending standard fuel capacities and endurance.
- S.17.8 Basic weight.
- S.17.9 Payload.
- S.17.10 Any other relevant details such as service ceiling, single-engine ceiling, normal cruising speed, etc.
- S.17.11 Aircraft flying hours available per month (an average of 40 flying hours per month is expected to be required).

Cabinet is 14" deep (approx)

54 lbs.

NO SMOKING

12"

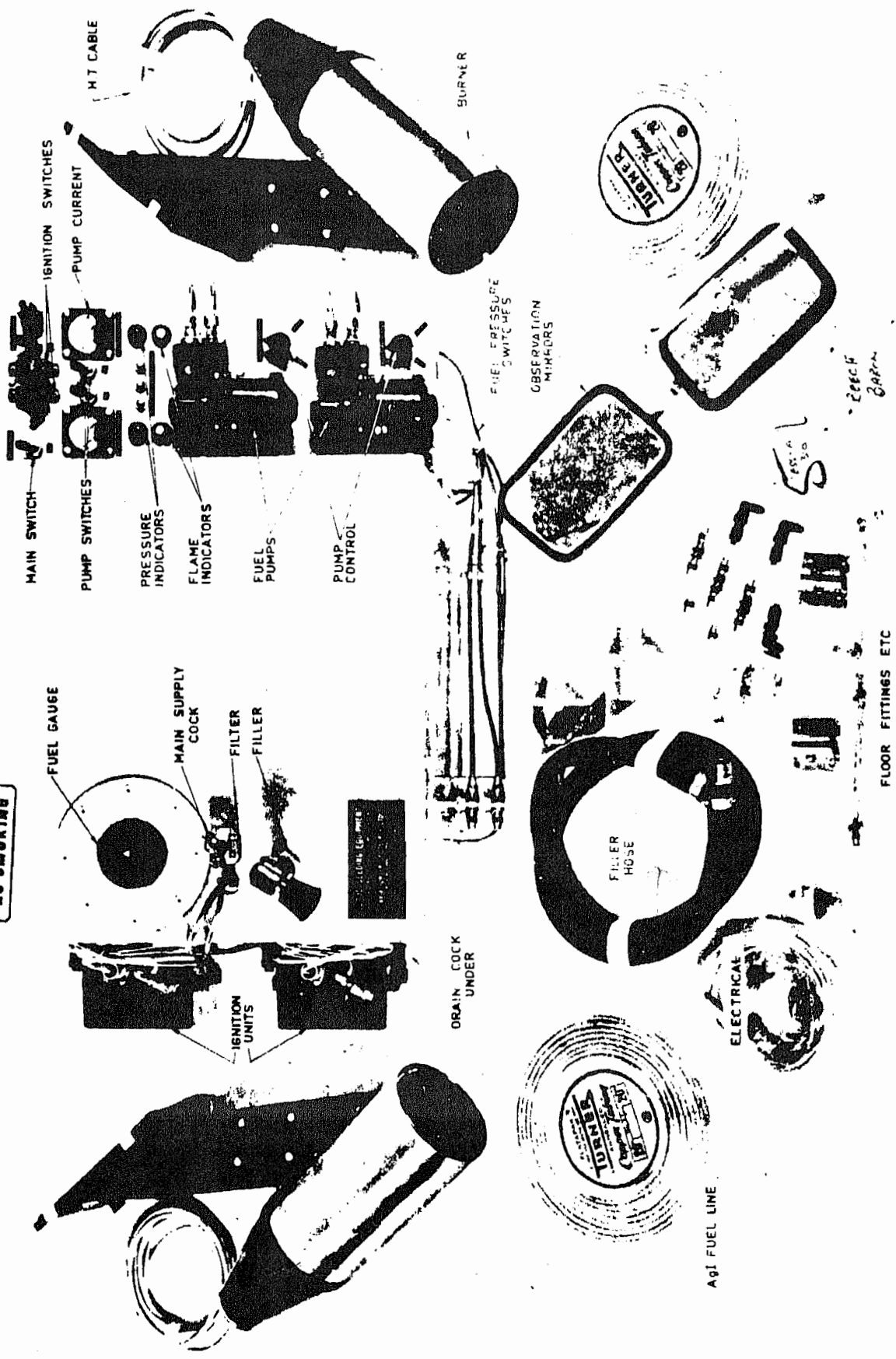


FIG.1 - GENERAL VIEW OF CLOUD SEEDING EQUIPMENT

APPENDIX B:

TRAINING PROGRAMME AT HEADQUARTERS OF DIVISION OF
RADIOPHYSICS, SYDNEY

Monday, August 7th, 1967	Introduction and Orientation Basic Physics of Meteorology Weather Systems Films
Tuesday, August 8th	Cloud Physics Ice Nucleation Introduction to Clouds Distribution of Ice Nuclei
Wednesday, August 9th	Rain Physics Seeding Methods and Materials Visit to Bureau of Meteorology Laboratory Demonstrations
Thursday, August 10th	Aircraft The Aircraft Environment Seeding Experiments on Single Clouds Cloud Seeding Overseas
Friday, August 11th	Seeding Experiments over Large Areas Laboratory Demonstrations Visit to Bureau of Meteorology
Saturday, August 12th	Baulkam Hills Field Station and Mascot Burner Testing and Installation
Monday, August 14th	Operations - Introduction The Cloud Seeding Officer Field Organisation Evaluation of Results of Operations
Tuesday, August 15th	Practical Experience of Operations Organisation of Cloud Seeding within a State Government Department Conference on Future Plans
Wednesday, August 16th	Behaviour of Pressure Systems in Australia Weather Systems and the Occurrence of Cloud Cloud Types, Description and Environment Technique of Seeding

Thursday,
August 17th

Crew Activities
Navigation
Equipment and Servicing
Practical Operational Experience

Friday,
August, 18th

Plans for Flying Training
Contributions by Participants
Final Discussion

APPENDIX C:

DUTIES OF A CLOUD SEEDING OFFICER

(As defined by the N.S.W. Department of Agriculture)

Departmental Title: Agronomist (Cloud Seeding Investigations)

Detailed statement of duties:

1. Cloud Seeding Operations

- (a) Decides when to fly, where to fly and where to seed after daily study of weather reports, area forecasts, synoptic situation and actual weather conditions.
- (b) Decides, the suitability or otherwise of individual clouds or cloud systems for the process of seeding.
- (c) Directs pilots to the clouds or areas which have been selected as suitable for seeding.
- (d) Nominates the direction, position, altitude and speed required for the seeding operation.
- (e) Cleanses equipment daily.
- (f) Overhauls and maintains the seeding equipment (burning chambers, ignitors, nozzles, filters and pumps).
- (g) Mixes seeding solution (acetone and silver iodide) in the correct proportions and replenishment of aircraft tank.
- (h) Stores silver iodide solution.
- (i) Orders supplies of silver iodide and acetone.
- (j) Assists the pilot in the navigation and positioning of the aircraft.
- (k) Operates the seeding equipment whilst in flight.

2. Reports and Correspondence

- (a) Prepares flight report for each flight performed, covering flying and seeding time, area covered, cloud conditions, seeding heights and temperatures.
- (b) Prepares composite flight logs for each day's operation, covering flying and seeding time.
- (c) Prepares weekly statement of flight details for insurance purposes.
- (d) Prepares weekly report to head office on cloud seeding operations.

- (e) Prepares annual reports on cloud seeding investigations particularly in reference to number of hours engaged in cloud seeding, rainfall patterns observed and possible value of cloud seeding for increasing rainfall.

3. Extension Duties

- (a) Addresses meetings of farmers organisations and other organisations on cloud seeding.
- (b) Prepares newspaper articles, radio broadcasts and television broadcasts on cloud seeding.

4. Training

- (a) Assists in the training of other New South Wales Departmental officers for cloud seeding duties.
- (b) Assists in the training of officers from other State Departments for cloud seeding duties.

5. Performs other duties as required.

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Note: In the New South Wales Department of Agriculture, an Agronomist must possess minimum qualification of diploma at Hawkesbury or Wagga Agricultural College or equivalent.