AIRCRAFT CONTROLLED BURNING OPERATIONS 1966

Aircraft - M.N. Rowell

Introduction:

This report covers the operational activities of the aircraft and crew during Aerial controlled burning operations, and the preparations for them during November, 1966.

Preparations:

Preparation of Aircraft and equipment commenced at Jandakot Aerodrome on Thursday November 4th, with instruction from C.S.I.R.O. Technicians to Department personnel on the : Design, Function, Operating technique and maintenance of a machine that C.S.I.R.O. had developed and constructed during the preceeding 12 months.

Other preparations included the filling by contract labour of 45,000 specially designed plastic capsules, with Potassium Permanganate.

The construction of a special back to back V.H.F. Transreceiver by Radio Branch.

The filling and testing of a high pressure water fire extinguisher.

Aircraft:

The aircraft used in the operations was a Cessna 337 Twin Engine push-pull Skymaster. The choice of this particular aircraft was made following satisfactory results from a similar model during the 1965 season, and its ability to carry the more bulky equipment developed for 1966 as well as a crew of four.

The 337 normally carries six and with the removal of the two centre seats was able to accomodate the Dropping machine mounted on the seat rails immediately behind the Co-pilot, and an eight tray bomb cabinet also mounted on the seat rails immediately behind the Pilot. The structure modifications necessary were:- The installation of an antenae in the roof, the tapping of the Aircraft electrical system for the dropping machine and the V.H.F. radio set, and the cutting of a hole in the floor to accomodate the dropping tube. It was feasible and practical to lash the V.H.F. set to the top of the bomb cabinet, thus no structural alterations were necessary for this unit. As the hole in the floor was close by one of the airframes main structural members it was necessary to engage an aircraft stress specialist who carried out the modification under the supervision of an officer of the Department of Civil Aviation.

Bases:

As the three operational areas were widely separated it was decided to operate from three separate bases, namely Jandakot for the Gleneagle, Serpentine and Harvey areas, all within 20 minutes flying time, Shannon for the Shannon and Manjimup areas, all within 10 minutes, and Busselton for the Nannup and Margaret River areas, within 15minutes.

Fuel was available at Jandakot from the Hiring Company's Bowser, whereas drum fuel and oil was transported to the Shannon and Busselton strips by Forests Department transport.

Flying Techniques & Burning Operations

Whenever possible it was found more satisfactory to Fuel and load the aircraft with capsules and all necessary stores the night before a proposed operation. It was thus possible to advise Ground Control that the Aircraft was ready to go by 10 a.m. each day. On one occasion Ground Control waited in vain for the aircraft due to a misunderstanding between Ground Control and the Co-pilot resulting in a delay of 20 minutes this did not affect the successful conclusion of this operation, but steps were taken to ensure that this error did not occur again.

With the aircraft on the ground and standing by, it was not always possible to contact Ground Control with Aircraft V.H.F. However this fact was known before hand and there was always another V.H.F. set at hand either installed in a vehicle or portable, and no difficulties were experienced.

On getting take off instructions from Ground Control it was always possible to be airborne with 4 minutes, and in radio contact with the Divisional officer in charge of the Burn area immediately this was achieved. There was generally no great difficulty in identifying the areas to be burnt although some suggestions for improvement are appended. When operating in one Division the previous days fire was always the ultimate in landmarks.

It was found that the most expedient method of identifying the Starting flight line, was for both markers to start a hot log fire, and to throw on green material some five minutes before the aircrafts E.T.A. and for the co-pilot to call for a flare from which ever marker the Aircraft was closest to.

A complete circuit of the area to enable all crew members to become as familiar as possible with its lay out and slope was found to be a great advantage, and well worth the short time spent. Generally it was possible to check all boundaries, re-check all Aircraft systems, re-establish contact with ground control and markers on whatever separate V.H.F. channel thought best for the day, and advise ground control that the Aircraft was ready to commence within 7 minutes after time of arrival. It was always the practice to receive the go-ahead from ground control before commencing the first flight line.

On receiving this signal it was found an advantage to make the first flight line a dummy run to enable the Pilot and co-pilot to assess the wind drift, to determine the amount of Flare trajectory they could expect to see, and to feel the strength of the marker beacons. All these factors were variable in the various areas but remained reasonably constant in any one area. This practice was found particularly useful in the southern Karri areas with their greater tree height and more undulating terrain. It was found that the following standard practice could be adopted for bombing runs of from 2½ to 6 miles.

With the Aircraft approaching from the west: west beacon <u>on</u>, Bombadier standing by with both field and start switches <u>on</u>. A flare from East marker as soon as the A.D.F. needle locks on to the west beacon, and the aircraft is within 10 chains from him, on passing over him the A.D.F. needle swings and points back at him, on this needle indication and only on this signal is the order to "Commence", given to the Bombadier. East marker is told that his flare has been sighted and the aircraft is on track to him, this is also the signal for him to switch his beacon <u>on</u> and for west marker to switch <u>off</u> before moving to his next position which he generally is able to reach and advise by the time the aircraft has completed

half of its west-east run.

A good fire from east marker with plenty of smoke is essential at this stage of the first run, as this and the visual sighting of his boundary road are the only reliable means of giving the co-pilot an indication of when to give the bombadier the stand by signal, and subsequently the stop order. The A.D.F. whilst keeping the Aircraft headed towards east marker, and is infallible for starting the dropping machine, must never be used for stopping it. It is far too late.

On passing over east marker, the aircraft turns and prepares to line up for the next run from east to west, giving east marker time to move up to his next predetermined position. On very short runs of from 1 to 2 miles the following variations are necessary: it is essential that the marker at the start of the run switches off his beacon within three seconds of the aircraft passing over him and for the finishing marker to switch on at that instant. It was found that greater precision could be ATTAINED by the co-pilot giving the beacon off-on order. It was also found that with experience it was quite often not necessary to call for a flare on the shorter runs when using this method.

After the 4th and 5 runs, it was possible to give ground control a reasonably accurate count of the number of actual spot fires burning on the first and second flight lines, this figure alongside the number of bombs dropped on these runs gave a good indication of the state of the ground fuel and if consistant, the type of fire one could expect. 55 - 60% of fires, against number of bombs dropped was considered satisfactory and was achieved in almost all areas.

On the completion of the final flight line, permission was sought from Ground Control to "fill-in" the odd corners and pockets that appeared sleepy, but still obviously contained fuel. This was always received, after determining that there was no ground personnel in the area, these corners and pockets were generally cleaned up in approx. 20 minutes, when the aircraft was taken up to 1,500 feet to have a good look at the area, the boundaries, and the general state of the fire.

No "hop-overs" were sighted at any of the fires. During two of the earlier operations some five bombs were dropped over the finishing boundary, the co-pilot on each occasion was immediately conscious of his error, and though Ground Control was able to direct a suppression crew to the scene, it was noted that they were extremely quick off the mark, and on one occasion a gang member could be seen raking out a spot within 30 seconds of the alert being given.

On getting a clearance from Ground Control, markers were directed from the aircraft to switch over to the appropriate channel and report to Ground Control. The aircraft was retruned to base and prepared for the following days operation.

Equipment

Dropping Machine:

Basically consists of an eight station rotating turntable, geared and timed to an automatic injection syringe. It is electrically driven and operates on 24 volts drawn from the aircrafts internal electrical system. The regulation of turntable speed and subsequently the capsule ejection rate is controlled through a large twin coil rheostat, mounted on top of the machine giving a range of speeds of from one ejection every two seconds, to one every six seconds. The machine is 24" wide x 18" deep and some 36" high, it has an all up weight of 145 pounds.

Operation:

The incendiary capsules previously loaded with 5.5 grammes of Potassium Permanganate and closed with a special polythene cap are fed by hand into the turntable.

The turntable rotates clockwise $\frac{1}{8}$ turn per cycle and eventually passes the capsule to the injection stage, where a specially designed syringe introduces $1\frac{1}{2}$ ML of ethylene glycol through the Polythene cap.

The glycol reacts with the permanganate and after approximately 30 seconds begins to burn fiercely, however before this occurs the turntable rotates to the Ejection stage where the capsule falls into a dropping tube and is sucked from the aircraft by the slupstream.

Safety:

In the event of the aircrafts electrical system failing, it is possible to operate the machine by hand and eject any primed capsule within 5 seconds.

The machine is also equipped with an emergency water supply and pump. It is possible to completely flood the turntable in 5 seconds, provided of course the aircrafts electrical system is still intact. This pump is electrically driven and a note concerning this method is appended among the suggestions of possible improvements.

Communications:

A standard Forests Department V.H.F. Transreceiver was converted by Radio Branch for use in the aircraft, and apart from a minor and unusual failure, almost at the completion of the Nannup "Biddella" operation on November 12th, performed extremely well. The quality of both transmission and reception was excellent, and much better than that usually experienced when using V.H.F. from Vehicle to Vehicle on the ground. The noise level within the aircraft necessitated the use of headphones throughout the operation.

In addition the aircraft standard high frequency "Skyphone" transciever was available for communication with ground control and any other aircraft within the area, this proved extremely useful from time to time, and was available to take over after the Biddella failure. This did not give the co-pilot direct contact with the markers, but a workable arrangement with them was established through ground control. This set has a wide range of frequencies, and enabled the crew to keep up to date with the latest weather situtation and the declining fortune of the state side in the Sheffield shield matches.

The Phonetic alphabet used by other organisations, including D.C.A. and all Aircraft differs greatly from that currently used by this Department, and it is essential for whoever is handling communications from the aircraft to have a sound knowledge of both systems.

On the request of O.I.C. Radio Branch, the special V.H.F. set was thoroughly tested during the south bound flights from Jandakot. All divisions along the flight track were raised with no difficulty and references to various fire sightings were made and acknowledged.

From 4,000 feet over the Stirling Dam, it was possible to still communicate with Como Radio Workshop, and by selecting the appropriate channel to have clear communication with Divisional and District Headquarters at Harvey, Dwellingup,

Ludlow, Nannup, Manjimup and Shannon. On the flight track from Shannon to Busselton it was not possible to raise Como, as stated this was purely a test and the necessity to do so did not, and is not likely to arise.

It was necessary to cut down the text of messages and signals to and from the ground markers beacon crews, to the barest practical minimum, as at the start of each run it is necessary to transmit and receive acknowledgement three and sometimes four times within the space of a few seconds. The marker crews being referred to simply as, east and west. Communication with Ground Control was always concluded during the bombing run across the area when there was more time for detailed descriptions and conversation.

Incendiary Capsule and Container

The incendiary capsules were specially moulded by Messrs "Duranol Plastics" to C.S.I.R.O. specifications, they measure 2½" x 13/32nd" when sealed with a Tightly fitting polythene cap, the centre of which is very thin to assist the entry of the injection needles. They were prepared with the charge of 5.5 grammes of Potassium Permanganate by contract labour at Manjimup, the rate being $4.50 per 1,000.

The grade or size of the Permanganate crystals is of great importance for the desired reaction with the charge of Ethylene glycol. To meet the C.S.I.R.O. specifications it was necessary to obtain supplys from the English chemical company Messrs May and Baker. The maximum load of capsules that can be carried by the aircraft in a specially designed steel box is 1,850, this with planned flight lines 10 chains apart, and with the machine ejecting once every two seconds, the aircraft travelling at 100 knots, the result achieved is a spot fire every five chains thus giving a total area range of 9,250 acres. It was necessary therefore, during the longer operations at Shannon to return to the airstrip half way through the operation.

Fire Extinguisher

C.S.I.R.O. selected a 2½ gallon high pressure Air/Water extinguisher, but it was found far to bulky to carry on the aircraft, it was decided therefore to rely on the two extinguishers already fitted in the cabin as standard equipment, should an emergency arise.

Observation from the Aircraft

The spot fires could be clearly seen from the aircraft, usually some four or fives runs after they had been activated. There number; shape; rate of spread; and flame height were noted and relayed to Ground Control. Also the movement of Fauna was noted, large flocks of birds could be seen leaving the areas as well as many Kangaroos, they all appeared to have ample time to get away. On three occasions a pair of wedge tail eagles were noted hovering over the area and some 200 feet above the aircraft.

Crew:

During each operation consisted of four - mainly:

The pilot: In command of the aircraft and responsible for its function and safety at all times.

Co-pilot: To give the pilot all assistance he requires to bring about the satisfactory functioning of the aircraft.

To maintain communication with Ground Control and markers.

To be responsible for the commencement and stopping of each bombing run. To give accurate and reliable reports to Ground Control on the progress and state of the fires.

Bombadier:

Responsible for the functioning of the dropping machine, its safety devices and maintenance. Also the Bomb supply.

Observer:

To assist with the identification of the area.

To give more detailed reports on the state of the fire to Ground Control and the Divisional Officer concerned.

As he is himself often a senior officer of the Division concerned, to decide on whether or not to abandom an operation.

A high level of firm but flexible discipline is essential and every effort has been made to maintain this in the aircraft at all times.

Not only is it necessary to be fully efficient in ones own task, it is essential to have a sound understanding of each crew members job, and difficulties - as there is always the possibility he may need a han d - and sometimes in a hurry.

It is considered essential that the Department personnel occupying the positions of co-pilot and Bombadier have a close affinity with aircraft and flying and not subject to any of the maladies associated with the occupation. It is frequently very rough at the low altitude for the bombing runs and extremely hot in the cabin.

Costs "Aircraft Hire Only"

The total area dealt with was 188,363 acres, occupying a total flying time of 96 hours 50 minutes, and costing $5,229 or 2.77 cents per acre. A more detailed list of the various operations, their acreages and costs is appended. It will be noted that there is a great deal of variation.

e.g. On November 12th at Nannup "Biddella" only 4,500 acres were dealt with for a cost of $310. Whereas on November 21st at Shannon "Challar" 18,000 acres were burnt for the lower figure of $238.

This difference is explained as follows:

The shape and size of the "Challar" Block lends itself well for aerial burning. The aircraft was able to spend most of its time actually over the area dropping incendiaries instead of turning at the end of short runs. The Challar Block is within 8 minutes flying time from the Shannon Strip, whereas the Biddella operation necessitated first of all taking the aircraft to Busselton to pick up the Divisional observer, and the necessary plans, thence the flight to the area which was an awkward shape with badly defined boundaries. The aircraft spent most of its time in turning and lining up for the next flight line.

It was also, because of the nature of the fuel and weather, necessary to close down the flight line widths to 7 chains. No critisism of the choice of this area is either offered or intended, as it is understood it was particularly desirable for it to be handled from the air, but it was thought necessary to explain the difference in cost of the areas concerned.

Suggestions for possible improvements

Identification of Area:

There appears to be reluctance in the past of ground personnel to light up their boundary fires. If possible they should be lit some 30 minutes before the aircraft E.T.A. instead of waiting until it is in the area.

With the wind strengths considered safe for aerial burning. Smoke neither disperses or shifts very far in that time, and even if it does its source can be easily traced. On the aircrafts arrival at some areas the smoke has only just started to filter through the tree canopy. Earlier fires would be of greater assistance.

Bases:

The completion of air strips at both Manjimup and Nannup, would add greatly to the efficiency and economy of any future operations in these Divisions. Much valuable time and vehicle costs were wasted in getting personnel to and from the existing bases.

Dropping Machine Safety:

A failure in the aircraft electrical system although unlikely, is not impossible would stop the machine and could leave it in the position where the injection needles were jammed in the cap. In the event of the operator not being able to free them by hand and eject the primed capsule which again is unlikely but not impossible, the result would be a fire in the turntable with 30 seconds.

The electrictrally driven pump and sprinkler would in this case be useless. "The Electrical System having already failed."

The eight station turntable is of very solid construction, and there is every reason to believe that a burning capsule in the injection chamber would not necessarilly ignite any of the remaining seven, however severe damage to the needle head and syringe would be inevitable. It is suggested therefore that a self-priming hand pump be fitted to the machine for use in such an emergency. This suggestion will be included in a report to C.S.I.R.O. on the behaviour of the machine, when it is shipped back to them for inspection at the conclusion of this years programme.

Communication "V.H.F."

A combined Head Set and microphone, with a foot control button would be of great assistance to the Co-pilot, this leaving both hands free during transmission and reception. Failing this an Aircraft Slot type microphone would be preferable to the standard Forests Department type used this year. The slot type eliminates almost of the background cabin and engine noise. Such equipment is essential with an aircraft such as the Cessna 337 when both engines are housed almost in the same compartment as the crew, it is all times an extremely noisy aircraft.

Aerial Direction Finder (A.D.F.)

A stronger signal from the marker beacons would be on great assistance.

A temporary set constructed by C.S.I.R.O. officers during their stay gave a strong signal up to a range of four miles.

The present beacons are sometimes not effective until almost on top of them and they are also very variable. The A.D.F. unit operates on 1696 K.C's.

TECHNICAL ASSISTANT

MNR:LH
MANJIMUP
18th January, 1967.