SIGNIFICANT AVIATOR & AVIATION EVENTS PROFILES

Manufacture of Bristol Beaufort Aircraft Parts and Components in South Australia

1. INTRODUCTION

The story of the manufacture of the Bristol Beaufort aircraft in Australia is one of triumph over the many obstacles that were encountered. It was a magnificent achievement given Australia's low industrial capacity and lack of experience in aircraft construction, the limited pool of technicians and skilled labour that were available, and that there were no facilities for producing machine tools. It involved not only the formation of an organisation capable of mass producing an all-metal, mid-wing monoplane with stressed skin but the establishment and development of a large group of technically complex industries. An indication of the magnitude of the problems faced by the project was expressed by Sir John Storey, Director of the Beaufort Division, Department of Aircraft Production, in 1943 when he stated:

> "Looking back from this point, I think I can say that it was fortunate that we had not the slightest appreciation of the difficulties with which we would be confronted. Had we had any conception of those difficulties, I feel that we would have recommended the abandonment of the project."

This article provides information on South Australia's participation in the Australian Beaufort manufacturing scheme.

2. TYPE OF AIRCRAFT TO MANUFACTURE

Little aircraft manufacture for the Royal Australian Air Force (RAAF) had been undertaken in Australia prior to 1938 when the Commonwealth Aircraft Corporation commenced manufacture of the Wirraway in Melbourne and the following year when de Havilland Australia started construction of the Tiger Moth in Sydney.

Also in 1939, a United Kingdom Government Air Mission visited Australia and advised the Australian Government to build the Beaufort. Designed and built by the Bristol Aeroplane Company, the Beaufort was in production in England shortly before the outbreak of war. The Beaufort was a twin-engine aircraft and, for its time, possessed long range and exceptional manoeuvrability and was versatile in a number of roles. It was of all-metal construction, and initially equipped to operate both as a torpedo and medium bomber. It had a hydraulically operated retractable undercarriage with a power operated gun turret and required a crew of four.

The Air Mission recommended that initially 180 Beaufort aircraft be manufactured in Australia, 90 of these for the Royal Air Force (RAF) Far Eastern Command and 90 for the RAAF with the first of these to be delivered during 1940.

Figure 1 *The first Bristol Beaufort in Australia, L4448, in 1941. [ADF Serials]*

3. THE BEAUFORT MANUFACTURING SCHEME

The Beaufort was well suited to both the industrial conditions and defence needs of the country. It was one thing to choose the right aircraft, but it was another to build it in a country lacking experience in aircraft construction, with a limited pool of technicians and skilled labour, and no facilities for producing the jigs, small tooling and gauges required for the many thousands of aircraft parts essential to a project of such magnitude.

In early 1939, the Australian Government commissioned a preliminary survey of the Australian engineering position covering the supply of skilled labour, industry organisation and the capacity of industries likely to be called upon to participate. This information was provided to the United Kingdom Government Air Mission which then provided a report setting out how the Beaufort manufacturing scheme could be implemented.

The Air Mission determined that the scheme be based upon:

- The utilisation of the existing railway organisations and, in particular, the manufacturing floor space in the large railway workshops in several states for major component assembly work and for sub-contracting to the engineering industry the manufacture of parts and subassemblies.

- The erection of two large factories at Melbourne and Sydney for the final assembly and fitting out of the aircraft.

- The setting up of a central organisation to control and manage the scheme.

- The supply of Bristol Taurus engines from England but investigations be made as to whether these could also be manufactured in Australia (ultimately Pratt and Whitney twin-row Wasp engines were used on all Australian manufactured Beauforts with about half of those engines being made in Australia).

- The drawings, jigs and tools, together with the materials for the first 20 airframes, be provided from England.

The extensive organisation required to produce in Australia such an advanced type of military aircraft necessitated the utilisation of a significant number of small businesses, with the result that some 600 contractors were entrusted with the manufacture of detailed parts and, in some instances, for sub assembly work. These parts and sub-assemblies then flowed to the area or main assembly workshops. The contractors had to be supplied with proper manufacturing methods, machine tools, equipment and staff.

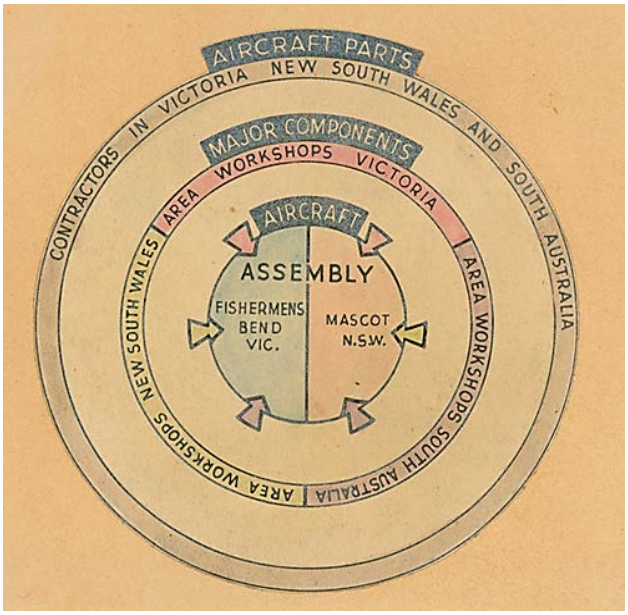

Figure 2: *Diagrammatic representation of the Beaufort manufacturing scheme. [National Archives Australia]*

When it was decided to build the Beaufort in Australia, further changes in design were required because of the use of substitute materials and components and these, together with changes necessitated from overseas experience, and others occasioned by new short-cuts to production being developed, were responsible for considerable modifications in the Australian version of the Beaufort.

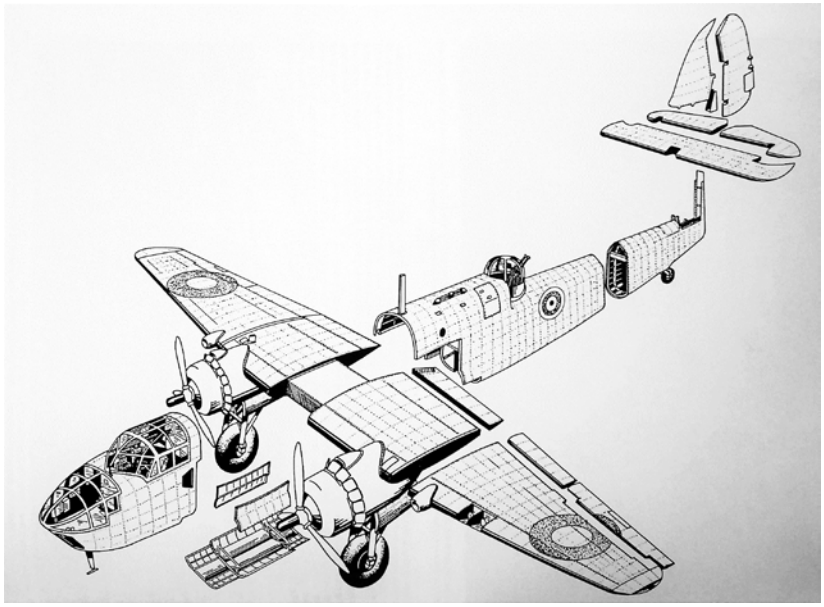

Figure 3: *Diagrammatic representation of the Beaufort manufacturing scheme [Beaufort Restoration Group]*

The increasing gravity of the war situation in Europe had stopped the flow of essential supplies from Britain and accentuated the difficulty of obtaining these from America. Australia therefore had to plan and develop its own local manufacturing capacity in this regard. It became necessary to undertake the manufacture in Australia of no fewer than 26,000 of the 33,000 jigs, tools, and fixtures required for construction of the Beaufort.

Through intensive and coordinated effort these and other pioneering difficulties were overcome so that nearly all of the 39,000 different parts required in every Beaufort were made in Australia.

Some 20 skilled engineers from Bristol were made available to assist in the establishment of Australian Beaufort production and approximately 80 Australian engineers and technical specialists travelled to England to be trained at Bristol's.

The reason the Beaufort was well adapted to local manufacturing conditions was because it lent itself to dispersed construction, components being assembled in separate facilities (see exploded view on previous page). This enabled the utilisation of what was limited available skilled labour in the widely separated and large centres of population.

Before the end of 1939 arrangements had been made for the railway workshops in New South Wales, Victoria and South Australia to construct certain airframe components and assemblies and details had been prepared for the installation of the necessary jigs and tools. The proportion of work allocated to each State was based on the available engineering technical staff, the actual floor space, suitable labour trades and the suitability of the existing organisations to take on the additional work with the minimum of extra staff. Initially, manufacturing was determined based on the following number of required workers: 1,000 in New South Wales, 1,000 in Victoria, 1,800 in South Australia and 500 in Queensland (Queensland was soon omitted from the scheme and the work distributed over the remaining three States).

Based on the above, manufacture ended up being allocated as follows:

State Rail Workshops - Newport, Victoria
Rear fuselage, tail plane, elevators, fin, rudder

Department of Aircraft Production - Fairfield, Victoria
Gun turret

State Rail Workshops - Chullora, New South Wales
Front fuselage, stern frame, undercarriage, nacelle structure, observer's screen and pilot's top structure (perspex and frame).

National Motor Springs - New South Wales
Oleo legs.

Commonwealth Aircraft Corporation - Lidcombe, New South Wales
Pratt & Whitney R-1830 twin-row Wasp engines (2-stage).

De Havilland Australia - Sydney, New South Wales
Curtiss-Electric propellers.

State Rail Workshops - Islington, South Australia
Centre section, port and starboard main planes, bomb cell floor.

General Motors Holden - Woodville, South Australia
Wing leading and trailing edges, wing tank doors, wing ribs, wing tips, tail assembly, flaps.

Department of Aircraft Production - Fisherman's Bend, Victoria
Final assembly and fitting out of aircraft.

Department of Aircraft Production - Mascot, New South Wales
Final assembly and fitting out of aircraft.

4. THE SOUTH AUSTRALIAN INVOLVEMENT

Like most other States, when the Beaufort scheme was announced, South Australia sought its share of the aircraft manufacturing. Premier Tom Playford was in contact with both the Prime Minister and the Secretary of the Department of Defence to ensure that South Australia received as much of the available work as was practicable. In April 1939 Colonel W Smith, a director of the Bristol Aeroplane Company, visited South Australia to explore the aircraft manufacturing potential in the State. Smith inspected the Railway Workshops at Islington, Richards Industries at Mile End and General Motors-Holden's motor body building works at Woodville.

Initially South Australia was allocated 42% of the manufacturing work but this was reduced when Australia was cut off from overseas supplies and new work allocated to the other States. As stated above, it was estimated that 1,800 workers would be required to undertake this work but eventually 2,500 in total were required (1,400 of these being employed at the South Australian Railways Workshops, Islington alone).

The three main manufacturing centres in South Australia were:

- South Australian Railway's Workshops, Islington.
- General Motors-Holden's, Woodville.
- Richards Industries, Keswick and Mile End.

In addition, the following contractors were engaged:

- British Tube Mills, Kilburn.
- Carr Fasteners, Royal Park.
- Fireproof Tanks, Light Square, Adelaide.
- Kelvinator, Keswick.
- JA Lawton & Sons, North Terrace, Adelaide.
- Perry Engineering, Mile End.

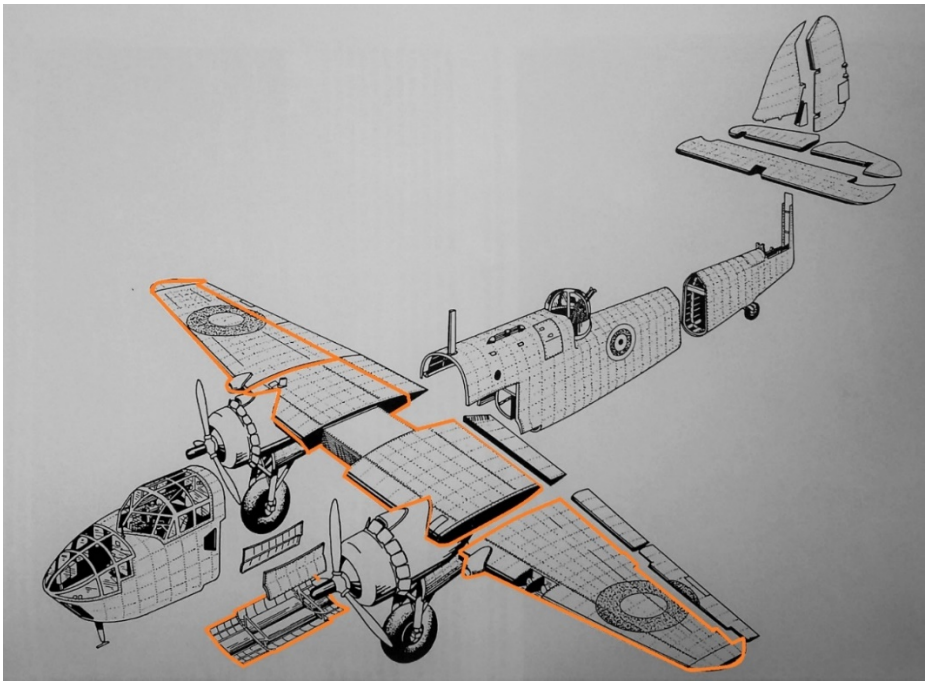

Figure 4: *Major components and assemblies constructed at Islington outlined in orange [Beaufort Restoration Group]*

Furthermore, the Department of Aircraft Production built large Airframe Repair Workshops at Parafield, with an annex at Northfield. These had the capacity to rebuild, repair and maintain a variety of military aircraft. There was also one storehouse located in South Australia for the storage of parts and components prior to shipment interstate.

Almost 13,000 airframe parts were required to be manufactured in South Australia for each aircraft plus a number of spare parts, the spares amounting overall to an additional 10%. Once the enormity of the manufacturing task was realised and to increase production rates to 40 sets of materials per month, the factory floor area at Islington was doubled. Similarly, additional floor space was required to be built at both General Motors-Holden's, Woodville and Richards Industries, Mile End.

4.1 South Australian Railways Workshops – Islington

The Islington Workshops were contracted to construct the complete centre section and the port and starboard outer wings and manufacture the bomb cell floor. The manufacture of railway engines and rolling stock ceased or was much reduced to allow the heavy machinery to be used for large parts.

Figure 2*: South Australian Railways Workshops, Islington [State Library of South Australia]*

Figure 6*:* Workshop floor at Islington [National Archives Australia]

Centre sections were the largest single assembly produced. To give an idea of the size of this major component alone, it required a special transport case 7.3m x 3.6m x 1.2m. Each centre section produced at Islington weighed over 500kg and each outer wing over 160kg. A number of smaller parts needed to be sourced from contractors to allow for the construction of both the centre section and wings.

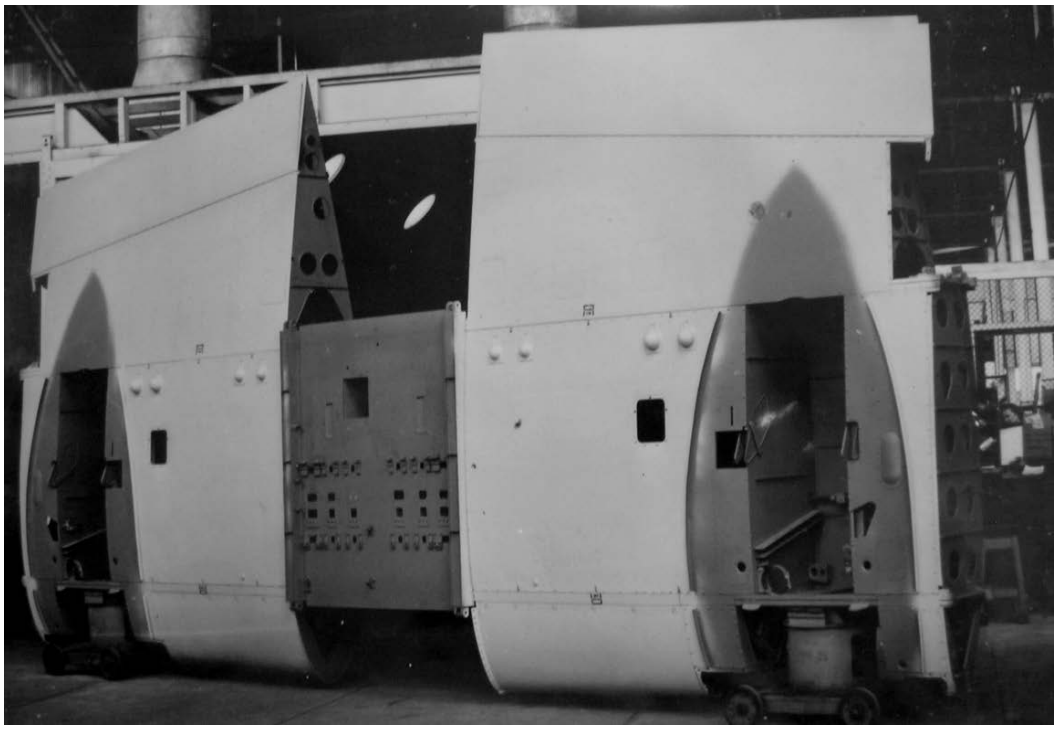

Figure 7*: Completed centre section, Islington workshops [National Archives Australia]*

Once these major components were manufactured, they needed to be transported to the assembly sites in Melbourne and Sydney. Many wooden transport cases had to be made for each component. Rail and road transport had to be modified to accept these cases, in some circumstances requiring new trailers. Where there was a change of rail gauge – Peterborough (SA) or Albury (Vic) – unloading and reloading of these cases was a major undertaking.

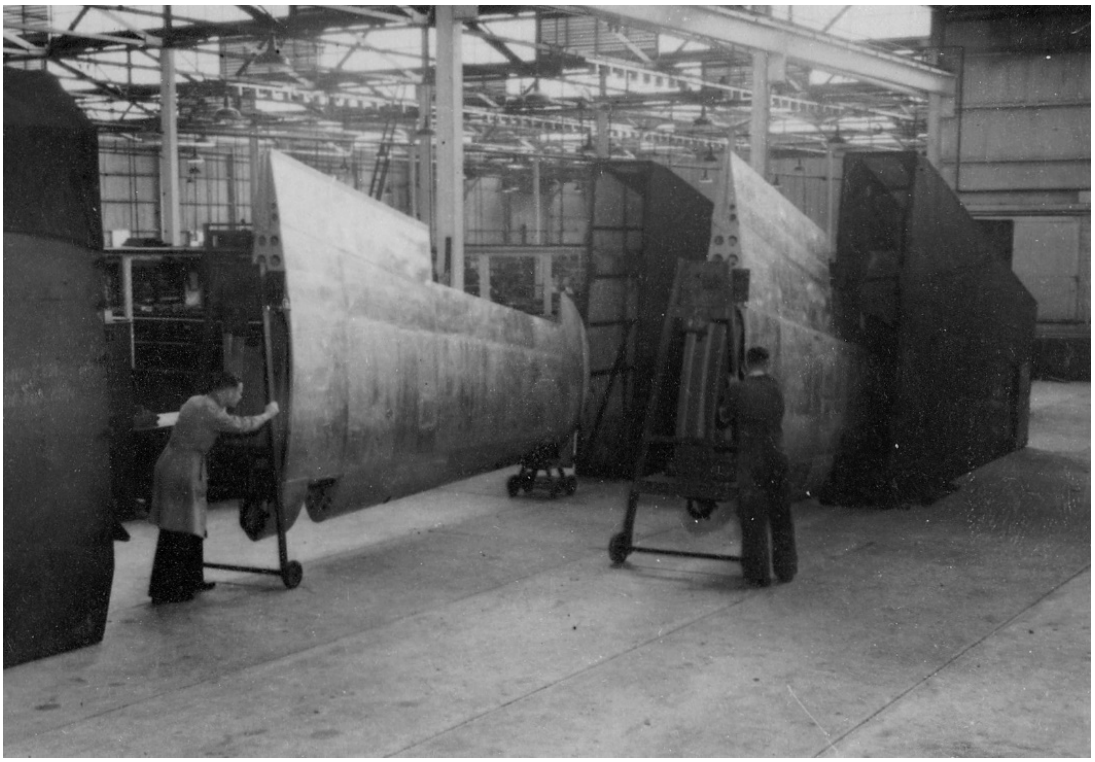

Figure 8: *Loading outer wings into transport cases for transport from Islington*
[National Archives Australia]

Figure 9: *Road transport of centre sections by a specially constructed low loader.*
[National Archives Australia]

Figure 10: *Transporting centre sections and outer wings from Islington to the railway yards for transport to Melbourne or Sydney. [National Archives Australia]*

4.2 General Motors-Holden's – Woodville

General Motors-Holden's was contracted to manufacture wing leading and trailing edges, wing tank doors, wing ribs, wing tips, flaps, internal equipment for the centre section and wings, navigator's seat, cockpit heating, anti-icing installation, engine nacelle fairing, control locking, fuel tanks, fuel tank management systems, pipe conduit brackets, engine cowlings, air compressor cooling duct and numerous pressed metal fairings and detail parts. Equipment at the Woodville plant was already being used for the production of pressed metal parts for motor vehicle bodies and these were converted for aircraft parts manufacture.

Figure 11: *General Motors-Holden's at Woodville [State Library of SA]*

Holden's, the largest motor-body manufacturing plant in the British Commonwealth, applied its automotive technique of metal pressings to aircraft manufacture with successful results. A number of components were cut down to two major parts, deleting some 15 to 20 minor parts. As an example, the redesign of the nose ribs of the Beaufort to one pressed part deleted the fabrication of several minor parts, and considerably lightened the part.

Figure 12: *Sample of the pressed metal parts manufactured at General Motors-Holden's, Woodville. [State Library of SA]*

General Motors-Holden's, Woodville started manufacturing fuel tanks and certain other components in May 1940. The fuel tanks were complicated and time consuming to manufacture and included internal baffles. With the development of the Beaufort scheme, certain processes never before employed in Australia were introduced, such as salt bath treatment of aluminium alloys, anodising of these alloys, and spot-welding of light alloys.

Figure 13: *Fuel tanks being manufactured at General Motors-Holden's Woodville [State Library SA]*

Figure 14: *Factory floor at General Motors-Holden's, Woodville [State Library of SA]*

Specialist pneumatic riveting equipment was developed resulting in faster and improved production; also special machines were developed for distinct operations, such as those for high speed vertical drilling, radial arm drilling, and for punching and driving two rivets per stroke. Some 13,600 pressed metal detail parts, 2,800 sub-assemblies and 40 component assemblies were produced for each aircraft.

Figure 15: *Sewing fuel tank covers at General Motors-Holden's, Woodville [Australian War Memorial]*

4.3 Richards Industries – Mile End and Keswick

Richards Industries was contracted to manufacture certain metal pressed parts and oil and auxiliary fuel tanks. Like Holden's, Richards also applied its experience to improve processing efficiencies and a number of pressed parts were provided to Holden's.

Figure 16: (Right) *Cleaning dust from oil tanks at Richards industries, Mile End. [State Library of SA]*

5. STAFFING AND TRAINING

Before the outbreak of war, the nucleus of the skilled workforce had to be recruited from civilian production. As such, the resources of peacetime had to be organised to enable small establishments to produce the types of parts required and this involved educating the workforce to work to fine tolerances and finishes never previously called for in Australia. However, the workforce was strengthened, following the outbreak of war, by the release from private industrial establishments of leading production engineers and other technical personnel.

Therefore, a critical part of the scheme was the need to train staff in the manufacture of this type of aircraft. Trainees for work in aircraft manufacture were drawn from all walks of life and to give these people the necessary theoretical and practical training in aircraft construction, specialist training schools were established in the various states to supply personnel for the aircraft servicing contractors. Dedicated classes were established at technical schools in New South Wales, Victoria and South Australia for the training of process workers and aircraft assemblers. Hundreds of personnel received this training and a large number of the foremen and leading hands graduated from classes established at the various scheme's plants.

Certain specialist tradesmen and foremen needed to be trained at the Bristol Aeroplane Company in England. Altogether the proposal was for 80 to be trained there, 23 each from Melbourne and Sydney, 25 from Adelaide and 9 from Brisbane. The specialist tradesmen were those working in the Machine Shop, Press Shop, Spars and Rolling Mill, Sheet Metal and Fitting Shop, Tinsmiths and Coppersmiths, Heat Treatment Shop, Planning and Progress, Stores, and Inspection Areas and Sub Assembly and Main Assembly Halls.

Figure 17: *Workers leaving Islington Workshops 15 December 1943 [National Archives Australia]*

It was arranged that four groups of trainees would leave Australia, one each in August, September, October and November 1939 for a period of 3 months. Of the 25 foremen and skilled tradesmen sent to England from South Australia, they were specialists from the machine shop, sub assembly area, heat treatment, stores, planning and organisation areas.

The groups from South Australia left for England as follows:

- Group 1 of 6 in August 1939.
- Group 2 of 9 on 7 September 1939.
- Group 3 of 6 on 3 October 1939.
- Group 4 of 4 on 7 November 1939.

To further assist in the training of workers at Islington, in December 1939 one complete Beaufort centre section arrived by ship from the Bristol Aeroplane Company for general instructional purposes.

In 1941 manufacturers sought an additional 1,200 workers for the scheme immediately, 600 men and 600 women. The men could be skilled or semi-skilled and up to 65 years of age and there was no experience required for the women, married women being eligible. Throughout all phases of the scheme, rigid inspection of all parts and components was required. This was a very specialist profession and inspection staff needed to be well trained; some inspectors were also sent to England before production began to obtain first-hand experience at Bristols.

To boost morale in the South Australian Beaufort scheme workforce, and to provide a tangible result of their manufacturing effort, the first Beaufort to fly in Australia was flown to Adelaide in July 1941 and this aircraft did several circuits over assembled workers at both the South Australian Railway's Workshops, Islington and General Motors-Holden's, Woodville.

6. CONCLUSION

The building of the Beaufort in Australia was no mean performance for a country uninitiated in the production of modern front-line aircraft. Other aircraft followed (the three main manufacturers and other contractors in South Australia continued until after war's end to make components and assemblies for the Beaufighter, the aircraft that followed the Beaufort). It was notable that for the first time in such an endeavour, a large proportion of the workforce was female (around 35%).

An Australian-built Beaufort flew one of the first missions against the Japanese from Malaya on the morning of 8 December 1941 and Beauforts flew the last in New Guinea on 15 August 1945. The Beaufort equipped 10 operational RAAF squadrons (although not all at the same time) and many other units. In total, 700 were manufactured. It flew on active service from the Philippines down to Tasmania, from Bougainville across to Borneo and off Western Australia.

The three main manufacturers in South Australia produced the following:

- South Australian Railway Workshops, Islington: approximately 800 centre sections and outer wings.

- General Motors-Holden's, Woodville: approximately 9,590,000 pressed parts supplied as 1,694,000 sub-assemblies and 25,670 main assemblies, together with 910 sets of fuel tanks.

- Richards Industries, Mile End and Keswick: 2,500 oil tanks and 168 auxiliary fuel tanks.

Figure 18: *Beaufort of 14 Squadron RAAF based at Pearce, Western Australia. [ADF Serials]*

Without its automotive industry, and particularly General Motors-Holden's, Australia would not have been able to build aircraft on the scale attained at the height of the war. The industry's experience in sub-contracting made it an ideal coordinating contractor, accustomed as it was to bringing parts and sub-assemblies from hundreds of different factories and assembling, testing and delivering a product – in this case an aircraft – to a pre-arranged time-table.

Kevin Gogler
November 2021