

## How RADAR was introduced into the RAAF



### **Receiving (left) and transmitting towers at Toorbul, QLD RS210 in 1944**

The British Committee of Imperial Defence first shared their technical radar knowledge with Australian, New Zealand, South African and Canadian scientist in a top secret meeting in London in February 1939. It was anticipated that these commonwealth nations would launch their own research and use the new technology for defence developments. In August 1939, just weeks before the outbreak of war, the Australian Council for Scientific and Industrial Research approved the creation of the Radiophysics Laboratory Board concealed in the University of Sydney. In May 1941 Wing Commander Albert George Pither was put in charge of RAAF's radar operations. Pither was in Britain, studying radar when the technology was put to use during the Battle of Britain in 1940. He developed a plan to surround Australia with a 'home chain' of radar stations of nine 'Advanced Chain Overseas' (ACO) radar stations established on mainland Australia using British imported ACO radar.

On the 7th November 1941, one month before the attack on Pearl Harbour, the RAAF were given full responsibility for Australia's early warning radar operations and adopted Pither's radar defence plans. The delays that Australia experienced in acquiring radar equipment spurred an innovative period of radar development by Australia's scientists. In 1941 Britain was the only supplier of radar equipment. The tyranny of distance, competing demands and lack of material resources meant that Australia would not receive its first shipment of radar equipment until the middle of 1942. As a result, key modifications and electrical engineering solutions developed by Australia's scientists led to the creation of the Australian 'Air Warning' (AW) radar. The AW employed an innovative switching circuit developed by Dr Joseph Pawsey of the Radiophysics Laboratory and aerials engineered by J.G Worledge at the Eveleigh Annexe of the NSW Railways. By the time the first ACO radars were installed, features of its design had already been superseded by the Australian AW radar, especially its conspicuous twin towers. The AW design included replacement of the cumbersome towers with a single aerial that rapidly switched between transmitting and receiving. By December 1941 a prototype of the Australia designed AW radar system was ready for production. The radar equipment was manufactured by The Gramophone Company at Homebush which produced 100 units by the end of WWII. The Australian AW radar was a robust and light weight system that proved useful for the conditions of the war in the Pacific and was used on sea and land.

In 1941 the Joint Planning Committee of the armed forces agreed that the limited supply of radar equipment in Australia was to be utilised for the protection of the vital industrial region of Newcastle - Sydney - Port Kembla. At that time, the Newcastle region was an important focal area for coal mining, steelworks and associated heavy industry. The region was also vitally important as Australia's principal centre for the manufacture of armaments needed for the war effort and the Port of Newcastle was considered vulnerable to air and seaborne enemy attack. In November 1941 Air Force Officers including Wing Commander Pither, made a reconnaissance flight

of the Newcastle - Sydney - Port Kembla coastal strip. In January 1942 the air warning defence began in the Newcastle region with the establishment of a radar station at Shepherd's Hill followed by the installation of the Australian designed AW radar at Tomaree in April of that year. The ACO radar installation at Mine Camp was to be the third permanent radar station within the Newcastle region. The British made Advanced Chain Overseas (ACO) radar installations were distinguished by robust towers capable of withstanding hurricanes in the Far East. These radar installations were regarded as sophisticated, complex and at the time, very expensive at an estimated cost of 21,000 Pounds. It took several months to construct and calibrate an ACO radar system and the sheer size of the transmitter and receiver towers made them difficult to camouflage (see picture above). The War Cabinet had originally intended to have 32 units to implement the plan for Australia's radar station chain, but this became difficult to achieve and later unnecessary after significant events that changed the course of the war.

A typical Radar Station had an establishment of about 40 personnel consisting of 1 RAAF Officer, 1 WAAAF Officer, 14 RAAF and 24 female radar Operators were from the Women's Auxiliary Australian Air Force (WAAF). The first radar training for WAAAF personnel commenced in July 1942. Women were selected on the basis of vision, speech, education, intelligence and ability to calculate and use maps and plans. The male radar Mechanics were from the Royal Australian Air Force. Training was conducted in segregated classes over four weeks at the Richmond RAAF Base. A unit also included guards, cooks and other trades. The Operators communicated plotted data to an associated Fighter Unit by land line or radio telephone.

The radar Operator monitored aircraft activity from an eleven inch cathode ray tube screen using 'goniometre' consisting of switches and controls of the direction and height finding components and would alter the screen and make comparisons to decipher the direction, elevation and distance of the aircraft. The radar mechanics were required to regularly climb the radar towers to service relay switches and aerials. The ACO, a fixed radar station, had some advantages over others with its quick height finding capabilities and ability to monitor aircraft movements up to 200 miles.

The transmitter was a British MB3 model which put out 250Kw of power at 42.5 MHz. The frequency was in the VHF band which would later become a common use in television transmission. However, in 1942 this short wavelength was unfamiliar technology. The transmitter aerial system was in two parts set at different heights to enable height finding using the floodlit system. Each part had four elements to cover four sectors of 120 degrees. The receiver was a British RF7 (receiver fixed location) model built in four vertical racks held in a frame of 2 x 2 x 0.6metres. The receiver detected radio echoes from all directions simultaneously. The receiver compared the strength of the echo from within a radius to identify the direction from which a signal was originating. The receiver had two parts on the tower plus crossed dipoles used for the height finding of an aircraft by comparing the echoes from the higher and lower sections on the tower.

As the towers did not rotate like those commonly used in other radar models, the ACO radar installation required fourteen switches on the receiver tower and more on the transmitter. These had to be constantly relayed from on to off, lower to higher and to between different directions. The switches were controlled by the radar operator from the radar console located within a control bunker. The towers were built to the design of the Directorate of Works for the Air Ministry in Britain by the Allied Works Council. The complex timber towers were prefabricated in Sydney from Australian oak supplied by the Sydney timber firm of A.E. Willis & Sons. The timber towers were fixed to steel members set in four concrete footings and placed in a north and south alignment. The complex arrangement of the structure was designed to withstand hurricanes and took a dozen men ten weeks to construct.

The development of the Radar Station required the involvement of several defence units prior to reaching operational stage. The complex timber towers were prefabricated by Civil Construction Corps in Sydney and built to the design of the Directorate of Works for the Air Ministry in Britain by the Allied Works Council. The site construction was carried out by the Allied Works Council whilst specialist RAAF and British RAF personnel installed and calibrated electrical and radar equipment. The RAAF Radar Installation and Maintenance Unit (RIMU) was established in June 1942 to provide specialist installation, calibration and maintenance support. The RAAF also established Fighter Sector Units to evaluate data generated by radar stations and issue commands directly to RAAF bases to respond as necessary. The fall of Singapore generated urgency for the establishment of fighter command and control and in 1942 Fighter Sector No. 2 was established in the Newcastle suburb of New Lambton. Fighter Sector No. 2 occupied the New Lambton Public School. The fighter sector commenced 24 hour operations on the 29th March 1942 and directed the fighter planes at Williamtown Air Base. It received plotted data from Radar Station 208 and other regional radars stationed at Tomaree and Ash Island.