Study of Health Outcomes in Aircraft Maintenance Personnel (SHOAMP)

Phase II

Mortality and Cancer Incidence Study

Interim Report
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SYNOPSIS

Background

Following a directive from the Minister Assisting the Minister for Defence in April 2000[1], Defence commissioned an epidemiological study of the health of personnel involved in Desealing/Resealing (DSRS) activities for the F-111 jets at RAAF Base Amberley. The first phase of this Study of Health Outcomes in Aircraft Maintenance Personnel (SHOAMP) included a literature review of the evidence between solvent exposure and health outcomes, in addition to a qualitative study of those involved and the development of a protocol for conducting a General Health and Medical Study. The current report focuses on Phase II of SHOAMP, mortality and cancer outcomes within the exposed group relative to appropriate comparisons. The third phase currently under way, is a general health and medical study, which will be reported separately.

Aims

The aims of the Mortality and Cancer Incidence Study were to determine if there is an excess in mortality or cancer in the group of individuals who participated in the F-111 DSRS maintenance program(s), relative to appropriate comparison groups.

Methods

Workers involved in F-111 DSRS activities were identified through Board of Inquiry (BOI) lists, interviews, media notices, a telephone hotline, and reviews of squadron photos and records. Level of exposure was based on a combination of self-report, interviews, and reviews of records.

Two comparison groups were chosen:

- Aircraft maintenance personnel at RAAF Base Richmond (NSW) not exposed to F-111 DSRS activities; this comparison indicates the effect of DSRS specific exposures, controlling for other exposures involved in aircraft maintenance; and
- Other personnel, not involved in technical duties, posted at RAAF Base Amberley (QLD); this comparison indicates the effect of DSRS activities plus other exposures involved in aircraft maintenance.

Both these comparison groups were identified via review of posting dates in personnel records (AFPEMS database). Numbers of deaths and cancers for all three groups were determined by record linkage to the National Death Index, and the National Cancer Statistics Clearing House, respectively, both at the Australian Institute of Health and Welfare (AIHW).

Analysis

Analysis was limited to males, since the numbers of females was too small for reliable analyses. Non-exposed individuals from both comparison groups were frequency-matched to the exposed group on age category (5-year age groups), rank, and period of exposure or posting.

As the number of comparison per exposed individual varied among these variables, the comparisons were weighted to reflect a similar distribution of characteristics to the exposed group. The incidence of mortality (or cancer) in all three groups (exposed and two comparison) was generated as the number of deaths (or cancers) per total person years of observation.

[1] Ministerial Directive – Minister Assisting the Minister for Defence, the Hon Bruce Scott, April 2000.

Mortality ratios and cancer incidence ratios were obtained by taking the ratio of the relevant weighted mortality and incidence rates, and 95% confidence intervals were calculated.

Results

There was a trend to increased cancer incidence in the exposed group compared to the Amberley controls (Cancer Incidence Ratio 1.35, 95% CI=0.82-2.12) and to the Richmond controls (Cancer Incidence Ratio 1.38, 95% CI=0.85-2.16), which was stronger in those with the highest exposure. However, none of these point estimates was significant. There was a trend to decreased mortality compared to the Amberley controls (Mortality Ratio=0.77, 95% CI=0.30-1.67) and the Richmond controls (Mortality Ratio=0.75, 95% CI=0.29-1.60) which weakened in those with the highest exposure. Again, none of these estimates was statistically significant.

Discussion

The conflicting trends in cancer and mortality may reflect the uncertainty in the data and lack of statistical power. In addition, there are many issues concerning the quality of the data, various sources of bias, and limited power, which limit the confidence in these results. Nevertheless, we can reasonably rule out a 2.2 fold increase in cancer, and a 1.7 fold increase in mortality (with 95% confidence) due to F-111 DSRS activities. We outline a number of suggestions, which will enhance the validity of any future analyses.

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INTRODUCTION

This section provides background information on the F-111 Deseal/Reseal processes, concerns of adverse health effects experienced by maintenance workers involved in the processes and establishment of this study.

Background

In 1963, Australia ordered 24 General Dynamics (GD) F-111 aircraft from the USA. The aircraft, not yet constructed, were due to be delivered by 1968, however a series of problems deferred production so that the final delivery of the 24th aircraft was not until October 1973.

The Australian Air Force describes the F-111 as a long-range, strategic strike and reconnaissance weapons platform, which forms a significant component of Australia's defence capability. The aircraft's capability is limited, however, by the amount of fuel it can carry and consequently the distances it can fly. To minimise this limitation, the F-111 makes the best use of all available space and carries fuel in the wings, the fuselage and external fuel tanks.

Unlike many other aircraft, the fuel tanks of the F-111 do not contain internal bladders. The joints and mating surfaces in the aircraft's structure are sealed to prevent fuel leaks. These sealing systems used complex chemical sealant formulations and applications. The sealants are required to cope with extreme environments including heat generated during super-sonic flight, manoeuvring stresses placed on the structure and the chemically hostile environment of being immersed in aviation turbine fuel (1). The sealant originally utilised proved to be inadequate for the task and significant fuel leaks became apparent soon after taking delivery of the aircraft.

F-111 Fuel Tank Repairs and Maintenance

The F-111s have experienced ongoing problems with fuel tank leaks. To correct these problems a variety of repair and maintenance procedures have been performed on and inside the F-111 fuel tanks. In particular, sealant repairs were necessary to correct the fuel leaks and also as part of routine maintenance programs. A number of factors have contributed to the leaks including failure of the sealant to adhere to the tank structure, secondary damage and degradation of the sealant over time.

Four F-111 fuel tank Deseal/Reseal (DSRS) programs have been implemented over two decades (1975-1999), each involving different process. Program 1 ran from 1977 to 1982 (with preparatory work prior to that time), and Program 2 from 1991 to 1993. The third program, known as the Spray Seal Program, ran from 1996 to 1999. An additional program, the Wing DSRS Program, was used for maintaining the wing fuel tanks and was conducted from 1986 to 1992. The processes, activities and occupational titles involved in each of these four DSRS programs are outlined in Appendix A and Appendix B.

Three DSRS programs – Program 1, Program 2 and the Spray Seal Program – all involved entry into the fuel tanks. The Wing Program also involved tank entry, but the tanks were open to the air and there was therefore no need for personnel to be completely inside the wing tank. The tanks needed to be prepared prior to entry. This process involved removal of all fuel from the tanks (defuelling and depuddling) and then removal of plumbing and pipes (deplumbing). Once inside the tank, maintenance personnel manually removed the defective sealant from the surface of the tank (desealing). The surface was then cleaned and fresh sealant was laid (resealing). The tanks were then replumbed (replacing plumbing) and refuelled. The methods used for these processes changed over time.

Spray sealing, a different process, did not require any sealant to be removed unless it was obviously defective. Instead, the surface of the old sealant was cleaned and prepared for a new coat of sealant to be sprayed directly over the old sealant to form a new seal. This process was normally only used in the main fuselage fuel tanks of the F-111.

The Wing Program was developed in response to fuel leaks, which until 1985, were repaired in an *ad hoc* manner. As wing tanks were too small for personnel to enter, the tanks were completely opened and all work was conducted from outside. Chemical de-sealants were not used in this process. Desealing was conducted using water picks and walnut shell blasting.

Through the 1980s a series of maintenance programs were conducted on fuel tanks other than the fuselage and wing areas. These procedures were similar in application to those used on the wing tanks and included some work being conducted by an external contractor. For example, Program 2 used civilian contractors Hawker de Havilland.

In the 1990s the United States Air Force began using a new process to repair F-111 fuselage tanks. This process produced huge reductions in the time taken to repair the leaks and consisted of 'water pick' de-sealing and cleaning, followed by an overcoat application of the sealant. The process was further refined to do away with the pick process and use only patch repairs with the new sealant being sprayed over the old one. This process was employed by the RAAF from 1996 until its suspension in January 2000 (see Appendix C).

The DSRS programs have involved an estimated 800 personnel, both RAAF and a small number of contracted civilian workers. Workers on the DSRS programs spent a significant proportion of their time inside the fuel tanks in conditions that were cramped, almost fully enclosed and inadequately ventilated. Individuals were provided with chemical protective suits and supplied breathing air.

Personnel would frequently work in this environment for extended periods of time, sometimes up to five hours. The risk of exposure to jet fuel and the chemicals used in the sealant repair processes required the use of personal protective equipment (PPE). The protective equipment was unpleasant and additionally hazardous due to its weight, bulk and impervious nature increasing physical demands and interfering with thermo-regulation. It was later found that that the protective overalls did not provide adequate protection from the chemicals. Workers came into direct contact with the chemicals in liquid and vapour form.

Other Activities Associated with F-111 DSRS

Disposal

Health and safety issues have been raised about the disposal methods used for some of the chemicals used in the DSRS programs. In particular, the process for the disposal of the chemical SR51 (a chemical desealant used in Program 1) was cited by the Board of Inquiry as being "…poorly specified and supervised and … a serious cause of exposure". Disposal techniques included incineration and storage of waste in drums. Both these techniques were found to be substandard. The incinerator was found to be malfunctioning over an unknown period (possibly years) and the drums were found to be leaking on more than one occasion. There was also evidence that SR51 was regularly (a couple of times a week) burnt during fire training and this practice ran from the late 1970s until around 1990.

Mixing

Mixing of the sealant was another activity associated with potential exposure to toxic substances. In simulated workplace environments, testing showed that the level of contaminants during mixing was below the exposure standard. The test results led the Board of Inquiry (BOI) to conclude that it was "…unlikely that personnel conducting sealant mixing operations …(or others in the hangar)… would have experienced inhalation overexposure".

Other Contact

Other groups, which have been defined as constituting possible exposure, include disposal crews, other flight maintenance crews, fire crews and RAAF members borrowed from other units during staffing shortages.

Health Concerns

Despite the use of various forms of respiratory equipment and protective clothing, it is possible that DSRS workers were exposed to a variety of chemicals used in these programs. This is because the methods used during each program varied and occupational health and safety requirements for respiratory and skin protection may not have always been complied with. It is also not clear if respiratory equipment was used in the first program.

In early 1999 concerns were raised by the officer in charge of the aircraft maintenance section regarding various symptoms experienced by workers in the F-111 DSRS programs. The symptoms included memory loss, fatigue, and other neurological problems. Staff had been concerned over the possible connection between these symptoms and their work since late 1998 but the medical centre had not supported these concerns. The officer spoke to the senior medical officer and requested that tests be carried out on the affected personnel. The tests, including full blood test, liver function test and urinalysis returned inconclusive results and the medical centre discounted any association between the symptoms and the DSRS programs. Later that year a senior non-commissioned officer, new to the area, became concerned by the symptoms fuel tank repair workers were experiencing and encouraged the affected workers to report their symptoms to the medical centre. The medical staff then referred the matter to a higher level at RAAF Base Amberley. As a result the spray seal program was suspended in January 2000.

In parallel with this a review of the spray seal process was conducted by the environmental health section at Amberley, which included assessment of PPE activities. This review identified the inadequacy of the PPE suits to protect from some chemical exposures, in particular toluene.

An initial medical investigation, conducted internally in 2000, into the F-111 DSRS program concluded that a significant number of personnel had presented with symptoms consistent with solvent or isocyanate exposure. This conclusion was based on the very strong presumptive evidence that workers had been exposed and their symptoms were consistent with that exposure. It was found that exposure could have arisen from:

- Entering tanks without adequate protective equipment;
- Exposure while removing protective equipment;
- Use of inappropriate or inadequate protective equipment for certain procedures;
- Failure to comply with procedures;
- Inadequate ventilation; and
- Very high concentrations of chemicals, such as kneeling in fuel/solvent puddles (2).

The investigation found that this was not the first time concerns had been raised over adverse health effects associated with the DSRS program. There were at least four documented incidents where workers in the first program had demonstrated symptoms in keeping with chemical poisoning. None of these incidents had resulted in investigations being made into the work procedures associated with the program.

Response to Concerns

Internal Investigation

In response to the potential for adverse health findings in the DSRS workers, a formal internal investigation into possible exposure to unsafe levels of chemicals

during the DSRS programs was convened in February 2000. However, it soon became apparent that there was potential for exposure to have occurred during all of the DSRS programs dating back to 1977. It was determined in April 2000, in the face of both epidemiological and anecdotal evidence of adverse health effects in DSRS workers, that an independent epidemiological study, which included mortality and cancer incidence, be undertaken to investigate the potential adverse health effects of the DSRS programs and activities. In the face of the overwhelming potential health and legal consequences following on from this, a Board of Inquiry (BOI) was appointed to investigate the chemical exposure of the F-111 DSRS workers and to do so, where possible, in full public view.

Board of Inquiry

The BOI found there had been deficiencies in the Occupational Health and Safety procedures and inadequate incident and hazard reporting, among other factors. These deficiencies had potentially resulted in workers involved in the DSRS programs from 1975 to 1999 being exposed to toxic chemicals and suffering adversely as a consequence. The report of the BOI supported the decision to undertake an epidemiological study, and concluded that some issues regarding the relationship between exposure and adverse health outcomes could only be determined following completion of this study.

Health Study

In order to determine if there was evidence to support the anecdotal reports of adverse health problems of personnel involved in the DSRS programs, an epidemiological investigation was commissioned by the Department of Defence. To ensure that the Department of Defence would not be directly involved in conducting this Study, and that an objective and independent body would oversee the process, the Department of Veterans' Affairs (DVA) was requested to manage the research. The University of Newcastle Research Associates (TUNRA Ltd) were awarded the contract to undertake the epidemiological study.

This investigation aimed to assess whether adverse health outcomes were associated with an involvement in F-111 Deseal/Reseal programs or related activities. Numerous outcomes were of concern: including mortality and cancer incidence, neurological deficits regarding loss of colour vision, presence of tremor and loss of sensation, and neuropsychological outcomes such as memory, cognition, anxiety and depression. The Study of Health Outcomes in Aircraft Maintenance Personnel (SHOAMP) consisted of three Phases.

Phase I involved a detailed literature review to explore evidence of relationships between exposures potentially encountered during F-111 DSRS activities and adverse health outcomes, a qualitative study to obtain in-depth information on activities and exposures of individuals involved in DSRS, finalisation of definitions of the exposed and comparison cohorts and development of a detailed protocol manual for the general health and medical study. Phase II was a Mortality and Cancer Incidence Study, based on record linkage with data from the National Death Index and State and Territory Cancer Registries. Phase III of SHOAMP represents a General Health and Medical Study, involving a detailed postal questionnaire and a series of health and neuropsychological examinations to assess exposure and outcomes for individuals involved in F-111 DSRS activities and comparisons. Phase II – the Mortality and Cancer Incidence Study – is the focus of this report.

MORTALITY AND CANCER INCIDENCE STUDY

Aims

The aims of Phase II of the Study of Health Outcomes in Aircraft Maintenance Personnel were:

- To determine if there is an excess in mortality in the group who have been exposed to the DSRS fuel tank maintenance program, relative to appropriate comparisons, and
- To determine if there is an excess of cancer in the group who have been exposed to the DSRS fuel tank maintenance program, relative to appropriate comparisons.

Hypotheses

The hypotheses for this study were that:

- The risk of mortality in the exposed cohort would be 2 times that of the comparison cohorts, adjusted for gender, age, rank and exposure period, and
- The risk of cancer in the exposed cohort would be 2 times that of the comparison cohorts, adjusted for gender, age, rank and exposure period.

Specific concerns regarding cancer and mortality

The BOI found that over 400 personnel exposed to chemicals used in the various DSRS programs had "…suffered long term damage to their health" (3). A total of 662 workers who had possibly been exposed to harmful substances from the programs between 1979-1999 were identified by the BOI. Each of these workers completed

interviews and surveys about their health. Dr Eric Donaldson, an occupational physician with aviation medicine expertise, selected a subgroup of 110 of these for in-depth examination although it was stressed that the results of this examination were neither scientifically reliable nor conclusive.

The subgroup was shown to be suffering from a high number of "…symptoms consistent with those expected following absorption of toxic chemicals" (3). Many of the symptoms and abnormalities in pathology tests were found to be minor and transient and included headaches, dizziness, irritated eyes, abdominal cramps, body odour, contact dermatitis, diarrhoea and vomiting. There was also a broad range of psychiatric and neurological symptoms.

Diagnosed disorders included one case of disseminated sclerosis, three cases of arthritis, one of breast cancer (male) and one each of diabetes, nephritis, and ankylosing spondylitis. The comment was made that it was probable that most of these diagnoses had alternate aetiologies. There were also a number of birth defects, developmental abnormities and allergies in workers' children, which the BOI found to be within the range expected for the general population.

Apart from the one case of breast cancer and instances of solar keratosis, there were no documented cases of carcinoma at that time. The reports to the BOI by workers of an increased incidence of bowel and bladder neoplasms occurring within this group remained unsubstantiated. In concluding, the BOI stated that there was "no suggestion in the evidence available to the Board of early mortality among exposed workers. We draw no conclusions about cancer, early mortality or effects on the next generation; these are matters for the DVA study" (3).

STUDY ORGANISATION AND ADMINISTRATION

The Study of Health Outcomes in Aircraft Maintenance Personnel (SHOAMP) is a collaborative study conducted by researchers from the Hunter Medical Research Institute and The University of Newcastle Research Associates (TUNRA Ltd). The study is administered by the Department of Veterans' Affairs on behalf of the Department of Defence.

Scientific Advisory Committee

The Scientific Advisory Committee (SAC) oversees the scientific aspects of the study. The SAC standing members are:

- Professor Judith Whitworth (SAC Chair), Director John Curtin School of Medical Research, Australian National University;
- Professor Michael Moore, Director NH&MRC National Research Centre for Environmental Toxicology, Queensland University;
- Associate Professor David Roder, Consultant Epidemiologist, The Cancer Council South Australia;
- Dr Deborah Glass, Department of Epidemiology and Preventative Medicine, Monash University; and
- Emeritus Professor Scott Henderson AO, Centre for Mental Health Research, The Australian National University; Clinical Adviser in Mental Health, Commonwealth Department of Health and Ageing.

In addition to standing members, the SAC is also regularly attended by representatives from a number of other organisations:

- Department of Veterans' Affairs
- TUNRA study team
- Defence Health Services Branch

- Defence Workplace Safety Project
- F-111 Advocate's Office
- Australian Institute of Health and Welfare
- Health Services Australia
- SHOAMP Consultative Forum

Consultative Forum

The Consultative Forum provides a link between the SAC and interested parties. They receive regular briefings on proposals in relation to the conduct of the study and provide a forum for feedback from members on issues such as privacy, storage of information and selection of control groups.

Organisations represented by the Consultative Forum include:

- Department of Veterans' Affairs
- TUNRA study team
- Defence Health Services Branch
- Defence Workplace Safety Project
- F-111 Advocate's Office
- SHOAMP SAC
- Warrant Officer of the Air Force
- Australian Veterans and Defence Services Council
- Armed Forces Federation of Australia
- Regular Defence Force Welfare Association
- Royal Australian Air Force Association
- Defence Community Organisation
- Returned and Services League of Australia Limited (RSL)
- SERCO Defence Services
- Repatriation Medical Authority
- Queensland Workcover
- Representatives from Deseal Reseal programs
- Health Services Australia

LITERATURE REVIEW

The acute health effects of simple organic solvents are reasonably well known and well described. However the long-term effects of these solvents and any possible associations with chronic diseases are unclear. In addition, the effects and interactions of complex mixtures and multiple concurrent exposures, such as occurred during DSRS activities, are even more poorly characterised.

A thorough literature search was conducted as part of Phase I of the Study of Health Outcomes in Aircraft Maintenance Personnel. The Report on the Literature Review should be referred to for a detailed description of associations to date. This short review aims only to present highlights of the report. For a number of substances used in the F-111 DSRS programs, the level of evidence for carcinogenicity is high, and have been classified by the International Agency for Research in Cancer (IARC). Results are summarised in Table 1.

Three known carcinogens are particularly worth noting:

a) Benzene is known to cause acute and chronic nonlymphocytic leukaemia, chronic lymphocytic leukaemia and haematological neoplasms (4). More recently, there has been a suggested risk of lung and nasopharynx cancer in a Chinese cohort (5). In particular, the occupation of painter and the exposure to white spirits, naphtha and Stoddard solvent was evaluated by the International Agency for Research on Cancer (IARC) in 1989 (6). They were classified as probable carcinogens and are associated with cancers of the lung and prostate as well as Hodgkin's lymphoma.

b) A number of chromate substances were used in the DSRS process. These included lead chromate, chromic oxide, strontium chromate and zinc chromate. The Hexavalent form of chromium has been classified as a human carcinogen

with links to pulmonary, lung, nasal, pharyngeal, gastrointestinal and sinus cancers.

c) Silica was one of the exposures in the spray seal program and this has been strongly linked to lung cancer.

Other exposures involved in the F-111 DSRS activities are only classified as possible carcinogens; these include carbon black, linked to lung and oesophageal cancers, and ethylbenzene, linked to renal cancer. As discussed previously, the carcinogenicity of many other exposures cannot be classified, due to their complex nature. The combined effects of even simple exposures taken concurrently are not well defined.

In conclusion, a number of the substances to which F-111 DSRS workers have been exposed are either known or possible carcinogens. Our synthesis from the literature was that the following cancers should be particularly noted in those exposed to DSRS activities: haematopoietic (including leukaemias and multiple myeloma), liver and pancreatic, brain and central nervous system cancers, genitourinary tract (including prostate, bladder and testicular), pulmonary, and buccal cavity (including sinus, nasal, and pharyngeal).

Table 1 : Summary of Chemicals Used With F-111 DSRS Programs and Their Associated Cancer Classifications

Chemical	Exposure	IARC Classification	Type of Cancer	References
Benzene	All programs	1: Carcinogen to humans	Acute & Chronic nonlymphocytic leukaemia, chronic lymphocytic leukaemia, haematological neoplasm	(4)
Chromium IV (component of lead chromate, zinc chromate, strontium chromate & chromic oxide)	All programs	1: Carcinogen to humans	Pulmonary, lung, nasal, pharyngeal, gastrointestinal, sinuses Shown to produce sister chromatid exchanges, chromosome aberrations, DNA strand breaks, formation of alkali-sensitive sites, and intrastrand DNA-DNA and DNA-protein cross-links	(11)
Silica	Spray seal	1: Carcinogen to humans	Lung cancer	(7)
Carbon black	All programs	2B: Possible carcinogen to humans	Lung & oesophagus	(8)
Ethylbenzene (constituent of paints)	Program 1 Program 2 Wing Program	2B: Possible carcinogen to humans	Renal adenomas observed in animal studies	(9)
Isopropanol	Program 1 Program 2 Wing Program	3: Not classifiable as carcinogen to humans	Paranasal sinuses and laryngeal cancers in isopropanol production	(10)
Jet Fuels including JP-8	All programs & at other times	3: Not classifiable as carcinogenic to humans	Evidence of skin cancer	(6)
Petroleum solvents including white spirits, naphtha, Stoddard solvent	Program 1 Program 2 Wing Program	3: Not classifiable as carcinogen to humans	Limited evidence of lung, prostate, Hodgkin's lymphoma.	(11)

METHODS

In this section the study design is described, as well as the methods used to assemble the study cohort, the comparison populations, allocation of person-years to time dependent exposure categories and ascertainment of mortality and morbidity status.

Occupational studies have a long and productive history in identifying causes of cancer. Many chemicals classified as carcinogens by the International Agency for Research on Cancer were first evaluated in the workplace (12). The retrospective cohort has historically been the method of choice for occupational studies and it has successfully identified many of the established chemical causes of cancer. This design was preferred for the current Phase II study, as it allowed the assembly of large numbers of people with exposures of interest from a relatively small number of workplaces. The elements of a cohort study are:

- The identification of a study population of persons exposed to the factors of interest;
- The identification of a comparison (reference) population;
- Follow-up of the cohort over time; and
- Comparison of disease rates between the cohort and a reference population.

Study Design

Phase II of the SHOAMP project, the Mortality and Cancer Incidence Study, was a retrospective cohort study. The aim of this Phase was to investigate whether an excess of mortality and cancer incidence had occurred in the study population. The method consisted of identifying all persons with possible involvement in or exposures related to the F-111 DSRS programs conducted at RAAF Base Amberley between 1975 and 1999 and identifying two comparison groups.

All persons were considered to be free of disease at the start of the follow-up period. The dates of death and / or diagnosis of cancer of the subjects were ascertained up to the time for which complete computerised coded data were available. Determination of an excess of disease was calculated by the comparison of age-specific death and cancer incidence rates between the exposed cohort and the comparison groups.

Study Population

Exposed Cohort

The Board of Inquiry concluded that "…the exact number of tradespeople and supervisors employed on the various stages of the DSRS programs and on closely allied duties was difficult to determine because the workforce was quite fluid". During the course of the Inquiry, approximately 800 people were identified as having been involved in DSRS at the working level to some degree.

The identity of these individuals was determined from fuel tank repair records, RAAF posting and attachment records, and contractor staff records. Photos were used to identify people who were working on the programs. These people were then able to name co-workers who had not been identified by the previous means.

The list of personnel named by the BOI was not exhaustive and DVA worked to expand this list, since the BOI finished. A wide advertising scheme had been operating to inform people who had worked on the programs about the possible health risks. A hotline was established and advertising appeared in national daily newspapers as well as in internal Defence publications and circulars and on official web-sites (see Appendix D). Workers who had been in contact with the DVA were asked to name anyone else they could remember who may have been at risk of DSRS exposure.

It has been difficult to ascertain exactly how many people have worked on the programs over the past three decades and especially difficult when including personnel who may have been affected but were only peripherally involved in the programs. While the BOI had a high level of confidence that those identified represented the full complement of people involved across the four programs, this is still unknown. In addition the BOI also identified two other groups who may have been at risk from DSRS activities.

The first group involved personnel employed on duties closely related to DSRS. These included tradespeople who carried out fuel tank repairs outside the formal DSRS programs. Although the amount of time spent repairing tanks was reduced, the amount and type of chemicals used by this group were similar in many respects to those employed by Program 2.

The second group of potentially exposed individuals included personnel working in such proximity as to be at risk. The most evident group to be at risk was the boiler attendants whose job it was to dispose of the used SR51[2] by incineration. Surface finishers who repaired the fuel tank paint as required, Electrical Fitters/Avionics Technicians who removed and then reinstalled electrical components within the fuel tanks, and Non Destructive Inspection Technicians who performed structural inspections before tanks were resealed were also part of this group. Immediately prior to application of both primer and sealant to fuel tanks a number of products first had to be mixed. This was performed using a mechanical mixer. Individuals who undertook this task were also considered to be potentially at risk of chemical exposure.

The criteria used to categorise workers have evolved over the past two years and some names have been moved from one category to another as more information comes to light. The DVA has tried to capture the names of as many individuals as possible who may have been involved with the DSRS programs or worked within close proximity even though they may not be eligible to participate in the study.

[2] SR51 was the thiophenol-based chemical desealant used in Program 1.

When the DVA Hotline was contacted, details were recorded and added to the database. The individual was then assessed as to what category they fitted. This assessment included searching of service records, follow-up contact with the persons and checking other available records. Generally, the basic means of allocation has been whether the tasks that person carried out were defined by the BOI as category 1, 2 or 3.

Classification of Exposure

Information on the DVA F-111 database included a variety of data relating individuals' self reported involvement in DSRS activities, time of start of exposure, type of exposure (for example Program 1, Program2, etc), rank at time of exposure – in addition to information on age, date of birth and problems experienced as a result of involvement with DSRS. The criteria for the classification of exposures were established in conjunction with the Scientific Advisory Committee, the Department of Veterans' Affairs, Department of Defence and the Consultative Forum. Information from the Board of Inquiry Report, literature review, as well as the qualitative information on work practices during the DSRS programs also assisted in establishing an exposure matrix to identify exposures. The workers have been categorised in two ways.

Exposure Category

In the process of assembling the exposed database described above workers identified were categorised according to their level of exposure to DSRS tasks. Table 2 shows the numbers in each category. The categories are defined as:

Exposure Category 1
People fall into this category if they were at any time directly involved with the Amberley F-111 Deseal/Reseal programs.

Exposure Category 2

This category supports workers who were not directly involved with the DSRS programs but worked in such proximity as to be at risk.

Exposure Category 3

This category includes personnel who were working on Base during the period of the DSRS programs but were not directly involved and did not work within such proximity to be at risk.

Program Category

Workers have additionally been categorised according to the DSRS program or activity on which they worked: for example Program 1, Program 2, Wing Program, Spray Sealant Program, Chemical Disposal or Miscellaneous.

Table 2 : Exposed Status by Program Involvement

	Exposure Status		
	Category 1	**Category 2**	**Total**
Program 1	252	67	319
Program 2	170	47	217
Wing Program	189	67	256
Spray Sealant Program	71	30	101
Chemical	3	13	16
Miscellaneous	150	51	201

Based on self-report information collected by DVA for F-111 DSRS workers. Categories are not mutually exclusive, as individuals may have participated in more than one program.

The exposed study population were all those identified during the BOI and/or self reported to the DVA either during or as a result of the BOI, or following the media campaigns, prior to 12 September 2002 (database lockdown date).

While 1226 workers were included on the database at this date, only the 969 classified as having been directly involved in any of the F-111 DSRS programs or activities or working in close proximity to DSRS (exposure categories 1 and 2 respectively) were eligible for inclusion in the Mortality and Cancer Incidence Study.

Comparison Cohorts

It was important that the comparison cohort be derived from the same source population as the exposed cohort to ensure that the groups being compared were as similar as possible with respect to all other factors except the exposure of interest. Comparison with a cohort from the general population was not considered appropriate for SHOAMP, due to the health and fitness requirements of those applying for and being accepted into the Defence Forces, in addition to lifestyle and cultural issues specific to Defence Force involvement.

The comparison cohort therefore consisted of Air Force personnel, of similar age and sex distribution, period of exposure or posting and military status to the exposed cohort. As well as problems of selection bias in obtaining controls, there was also the issue of exposure of Air Force personnel to other potential hazards that were not directly related to the DSRS program. These hazards included a range of chemicals and other exposures, including jet fuel. Contemporaneous controls were used – ie; individuals with equivalent characteristics to the exposed personnel at the time of the fuel tank maintenance programs.

Because of the uniqueness of the exposure, it was considered appropriate to have two comparison groups, each of which was similar to the exposed group in at least some respect. Observing a similar association for a number of different companion groups suggests that the study results are more likely to be valid.

Comparison Group one included Air Force personnel who worked at RAAF Base Amberley at the time the programs were conducted, but who were involved in non-technical musterings (job categories). This enabled a comparison of individuals with

similar environmental exposures, but who were not exposed to the aircraft maintenance duties in general, and DSRS specifically. This group should therefore not have been exposed to other chemicals or hazards inherent in any form of aircraft maintenance, for example, substances used in aircraft maintenance which would be in common with the DSRS workers.

The second comparison cohort consisted of Air Force personnel posted to RAAF Base Richmond at the time of DSRS programs or activities and who were involved in technical trades (but who had not at any time been involved in DSRS activities). This allowed comparison of outcomes for DSRS exposed individuals over and above any adverse effects of general aircraft maintenance. The mustering categories defining the Amberley and Richmond comparison groups are listed in Appendices E and F respectively.

Data for the comparison group sampling frames were provided by DVA from the computerised ***A***ir ***F***orce ***P***ersonnel ***E***xecutive ***M***anagement ***S***ystem (AFPEMS). Two different files were provided. The first was a file of personal details, and included service number, gender, date of birth, date of enlistment and date of death (if applicable), with one record for each individual. The second file included posting details, with one record for each posting or attachment to the relevant RAAF Base within the study time period. Separate files were provided for Amberley and Richmond comparisons. A brief description of the procedure for obtaining the comparison cohorts is provided in Appendices G and H.

The comparison cohorts needed to have a similar distribution to the exposed cohort for variables thought to be associated with the outcomes: gender, age group (≤19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75+; based on age at September 12, 2002, the date of lockdown of the DVA F-111 list); period of posting or exposure and rank (Enlisted, Non-Commissioned Officer, Officer) at the time of the fuel tank maintenance programs.

This was complicated because of multiple postings for individuals. For each potentially exposed individual, the year of first exposure was obtained from the DVA F-111 database. This was then categorised into one of five time periods: 1975-1979, 1980-1984, 1985-1989, 1990-1994 and 1995-1999.

Initially a 5:1 ratio for comparison to exposed individuals was considered. However the number of possible comparisons for each exposed individual varied, depending on the characteristics of age category, exposure or posting category and rank category. For some exposed individuals there were fewer than five possible comparisons, while for others there were more. It was then decided to include all relevant comparisons for this study. This would result in an overall increase in power for negligible cost. The variability in the ratio of comparison to potentially exposed individuals across strata necessitated weighting of the analysis (see Analysis section).

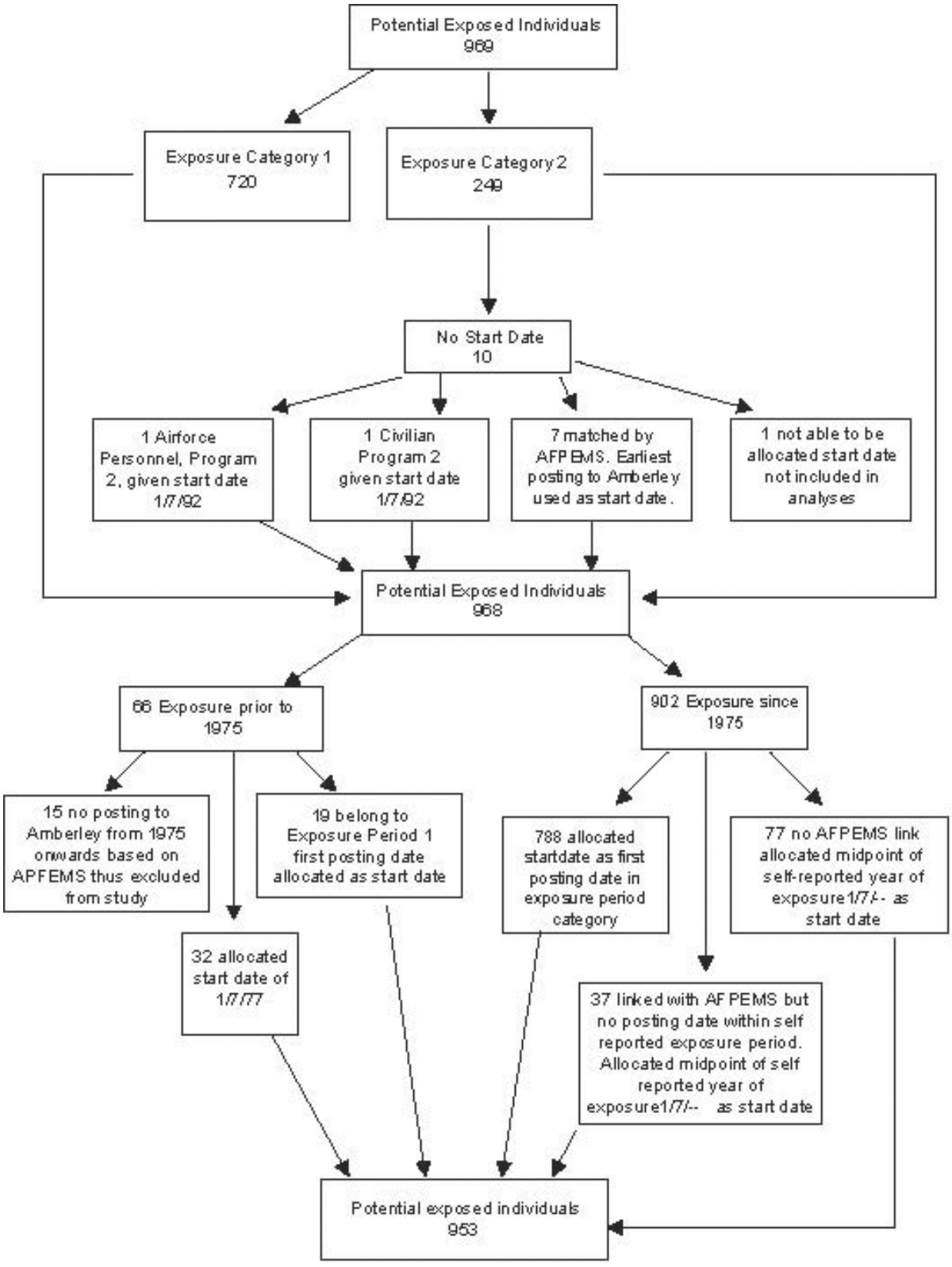
Allocation of start dates

Allocation for exposed individuals

Data for potentially exposed individuals on the DVA F-111 database were linked to AFPEMS data and information on postings, ranks, date of birth and gender obtained. Because of problems associated with missing in the DVA F-111 database, missing AFPEMS data for some individuals, and multiple postings per individual, the process of allocating the start date for calculation of person years at risk was complicated. This will now be outlined in detail. Refer to Figure 1 for a flow chart illustrating the procedure.

There were 969 potentially exposed individuals eligible for inclusion in the Mortality and Cancer Incidence Study; 720 in Exposure Category 1 (involved in DSRS) and 249 in Exposure Category 2 (working in close proximity). Ten of the 969 individuals did not report a start date of exposure.

Figure 1 : The Process of Allocating the Start Date



One reported involvement in Program 2, which ran from 1991 to 1993, and was therefore assigned a start date of the midpoint of Program 2; July 1 1992. A second individual, a civilian, was also assigned a start date of July 1st 1992, since it is known that civilians only worked on Program 2. Of the remaining eight with missing exposure date, seven could be linked with AFPEMS, and the earliest posting date to Amberley was used as their start date. The last individual did not have a matching AFPEMS record and could not be assigned a start date. This individual was therefore excluded from analyses. This resulted in 968 eligible potentially exposed individuals.

Initially, the period of potential exposure was determined to be from January 1975 to December 1999 (based on discussions with DVA and Defence personnel and BOI findings). As the aircraft did not come into service until late 1973, and the first DSRS program, Program 1, did not commence until 1977, a start period of 1975 was considered appropriate to cover early maintenance activities. The end period was determined based on time of suspension of the last program, the Spray Seal Program, in January 2000. However, sixty-six individuals reported an exposure prior to 1975. Since the comparison group only included individuals with a new posting date from January 1 1975 to December 31 1999, some of these potentially exposed individuals may not have had an appropriate comparison. Following examination of the APFEMS data, fifteen of these sixty-six individuals were found to have had no postings to Amberley from 1975 onwards, and were thus excluded from analyses. Of the remaining 51 individuals, 19 had a posting date between 1975 and 1979 (exposure period 1). These were then allocated their first posting date in this period as the start date. For the remaining 32 individuals, the start date was allocated as the midpoint of the exposure category – July 1 1977. The number of eligible potentially exposed individuals was then reduced to 953.

The procedure for allocation of a start date for the remaining individuals was as follows. For exposed individuals a check was undertaken to determine if there was a posting date within the self-reported exposure period category (1975-1979, 1980-1984, 1985-1989, 1990-1994, 1995-1999). For 788 individuals there was at least one posting date within the exposure period category.

For these individuals the first posting date within the exposure period category was allocated as the start date.

Thirty-seven individuals were linked with AFPEMS data, but had with no posting date within the self-reported exposure period category. A further 77 had no AFPEMS data because they were civilians or service personnel but could not be linked with AFPEMS. For these 114 individuals the midpoint of the self-reported year of exposure (ie; July 1 of exposure year) was allocated as the start date.

Allocation for comparison individuals

Most individuals in the comparison groups had more than one posting record, so it was necessary to select only one posting date for each individual to use as the start date. Initially the first posting date for each individual was selected as the start date for comparison individuals. These posting dates were also categorised into one of the five exposure period categories defined above. This then ensured that the same process for defining start date was used for exposed and comparison groups. There was some potential for this method to result in longer observation periods for the comparison group (relative to the potentially exposed cohort) which could bias results towards the null. Therefore a second selection was made from each comparison group using the last (most recent) posting date for each person as the start date. Analyses were repeated using this second data set.

Allocation of ranks

For the exposed cohort, where the start date had been generated as a posting date from the AFPEMS data, the rank category associated with this posting was used as the appropriate rank category. For the potentially exposed individuals where start date had not been obtained from the posting date, the self-reported rank category recorded in the AFPEMS data was used as the appropriate rank.

There were no ranks for individuals who were civilians, or those service personnel who could not be matched to AFPEMS data. These individuals were randomly allocated a rank, with the number assigned to each rank in the same distribution as for individuals with non-missing rank. For comparison individuals the rank associated with the posting used to allocate start date was used as the appropriate rank classification for comparison individuals.

Matching for Death

The National Death Index

Data for this study have been taken from the National Death Index (NDI). The NDI is a database maintained by the Australian Institute of Health and Welfare (AIHW) containing records of all deaths occurring in Australia since 1980. The Registrars of Births, Deaths and Marriages in each State and Territory supply all data contained in the NDI. The index has been designed to contribute to epidemiological studies and there are strict regulations confining its use. Only medical researchers who gain approval are able to access the data.

The Index maintains details of individuals including names, date of birth, and age at death, sex, martial status and main cause of death. Date of death is also recorded however it has only been recorded in all states and territories since the mid-1990s with Queensland being the last state to do so. For records post 1997, all contributing causes of death are also listed.

The process for data matching with the NDI database was achieved by providing the following variables:

- Study identification number
- Service number for military personnel
- Surname
- First name

- Gender
- Birth date
- Age at last contact
- Last date of contact

Further advantage would be had by the future inclusion of “postcode” of last known (or current) address. This would facilitate a more targeted search and matching process, resulting in a significantly lower number of redundant individuals identified, not relevant to this study.

Matching Criteria for Death

Deaths

To identify if a study participant had died their personal identifier was compared with the NDI. Matching was carried out using the computer program Automatch, a generalised record linkage system for probabilistic record matching which produces lists of likely matches weighted according to the probability of the matches being true. The matching can only be based on the information available on the files that are being matched. In this case the information available was surname, given names, gender and date of birth, date of last contact and age at last contact. Date of last contact was obtained from the latest of four dates – start date for posting or attachment, cease date for posting or attachment, start date for change in employment standard or cease date for change in employment standard. For civilians or individuals that could not be matched to AFPEMS records, the date of exposure was used as the date of last contact. Automatch assigns weight for each field considered, including negative weights for mismatches. The software is able to take into account how common the various fields are and is programmed to allow for typographical errors, miss-spellings and birth years which may vary by one or two years.

After the initial computerised matching a clerical review took place. This allowed for a review of the results and a manual over-riding of any results the investigator felt were not correct, allowing for the detection of Automatch mistakes such as fathers and sons that received high scores because of a common or similar first name. The clerical review allowed for human judgement of which matches would be accepted or rejected.

Criteria for acceptance of a match were:

- Surname, first name, date of birth, gender; or
- Common variants of names were acceptable; or
- Transposition of name components; or
- Minor variants in date of birth acceptable; or
- First and second names, date of birth in females that indicate change in surname (eg; Marriage).

Where a death registration was identified, the cause and date of death was reported to the SHOAMP study group. The cause of death was coded to the International Classification of Diseases, 9th Revision (known as ICD-9) and the International Classification of Diseases, 10th Revision (known as ICD10) depending of the date of death (13, 14). ICD-10 coded deaths were converted to ICD-9 using a chart provided by the NSW Health Department. Deaths were sub-categorised according to those categories used by AIHW in their published death data. Complete information on coded cause of death was available to December 31st 2000.

Matching for Cancer

In Australia, cancer is a notifiable disease. All Australian States and Territories have statutory requirements for the registration of incident cancers. The registries collect clinical and demographic information about people with newly diagnosed cancer and provide it to the National Cancer Statistics Clearing House (NCSCH) at the AIHW for the compilation of national statistics.

Matching for Diagnosis of Cancer

The same matching methodology was used for a diagnosis of cancer as that for death (already described). Where a cancer diagnosis was identified, the topography and histology codes and date of diagnosis were reported to the SHOAMP study group. The cause was coded to the International Classification of Diseases for Oncology, 2nd Edition (ICD-O) (15). Complete data on cancer incidence were available to December 31 1999. Registrations after this date were available for some states only. However data were not available for NSW or Queensland, the states where the majority of study individuals were expected to reside. Therefore Cancer Incidence is only determined to the end of 1999. Causes of cancer were sub-categorised according to those categories used by AIHW in their published death data.

Person-Years at Risk

A person-year is the length of time lived by one person in one year. For death, persons surviving to December 31 2000 contribute the time, in years, between the dates of entry into follow-up (the date of the start of the DSRS Program involved in) and the end date of follow-up, December 31st 2000. Persons known to have died before the end date contribute time, in years, between start date and date of death. The same process was used for calculation of cancer person years at risk. Individuals contributed time from start date to diagnosis of first cancer, death or the end of the observation period, December 31 1999.

Statistical Analysis

Cancer incidence involves analysis of time to first cancer only. Data analysis was undertaken using STATA version 7 (16). Mortality Ratios and Cancer Incidence

Ratios were obtained for the potentially exposed cohort compared to each of the comparison cohorts (Richmond technical and Amberley non-technical) separately, and for the Amberley comparison cohort relative to the Richmond comparison cohort. To adjust for differences in the distribution of characteristics expected to affect the outcome, sampling weights were calculated. Strata were generated for each of the three cohorts, for the combination of time period (exposure or posting) by age category and by rank. Counts in each of these strata were expressed as a percentage of the total number of observations, for each cohort. The sampling weight for each stratum was then obtained from the ratio of percentages in the exposed cohort relative to the comparison cohort. Comparison strata with no counts were excluded (prior to calculation of weights). There were seven strata with exposed but no comparison counts. The exposed individuals in five of these strata were then re-allocated to the next age category, at the same rank and within the same posting period. For individuals in two strata with the highest age group, re-allocation was made by assigning the next rank category. Strata weights are shown in Appendix I.

Incidence and mortality rates for each comparison group were calculated as the weighted number of cases (first cancer or death) divided by the weighted number of person years at risk. Mortality and Cancer Incidence Ratios were then calculated as the ratio of these rates. Exact ninety five percent Confidence Intervals were obtained using the method described by Rothman (18). The calculation assumes $\hat{IRR} > 1$. In the event $\hat{IRR} < 1$, STATA reverses the direction of the reported effect so ensuring $\hat{IRR} > 1$. Analyses were conducted for the total potentially exposed cohort (categories 1 and 2), and then repeated for the subgroup with the highest exposure level (category one).

Gender

Since causes of death and incidence of cancer vary between males and females analyses should be conducted separately by gender. The number of females potentially involved in the DSRS programs however was too small to conduct any

meaningful analyses (14 females were in category 1 – definitely involved in F-111 DSRS and 8 were classified as having worked in close proximity). Therefore the Mortality and Cancer Incidence analyses were conducted for males only.

ETHICAL APPROVAL

Ethical approval was granted from the following institutional ethics committees:

- The University of Newcastle Human Research Ethics Committee,
- The Australian Defence Human Research Ethics Committee (ADHREC),
- The Department of Veterans' Affairs,
- The Australian Institute of Health and Welfare Ethics Committee,
- All State and Territory Cancer Registries.

Appendix J provides a complete list of all Ethics Committees from which approval was obtained.

RESULTS

Of the 953 potentially exposed individuals eligible for inclusion in the current Mortality and Cancer Incidence Study, 22 were female and therefore excluded. A further 17 had missing age (16 of whom were civilians) and were also excluded. This left 914 potentially exposed individuals who were included, and used for selection of the comparison groups (94% of the original 969 classified as exposure category 1 or 2). Of the 914, 54 (27 civilians and 27 servicemen) had missing rank and were randomly assigned a rank (for the purposes of obtaining appropriate comparisons).

Table 3 shows the characteristics of individuals included in the Mortality and Cancer Incidence Study. As expected, due to the selection process, larger numbers of individuals are in the earlier, rather than later Exposure / Posting Category. The most common age groups are 35-39 years, 40-44 years and 45-59 years. Appendix K shows the characteristics for individuals selected using the last (most recent) posting date. There were 27 civilians in the sample. Reasons for postings for selected start dates for the potentially exposed groups and comparison groups are provided in Appendices L and M.

There were 392 individuals with a diagnosis of cancer. Thirty of these had a date of diagnosis of cancer of December 31 1999, which was the last date for which cancer registrations were available. Because the actual date of diagnosis was uncertain, these individuals were classified as being censored, rather than diagnosed at these dates. There were 232 deaths and 46 individuals with date of death of December 31, 2000, the last date for which complete death registration data were available. These deaths were also excluded from analyses.

Table 3 : Characteristics of Mortality and Cancer Incidence Study Subjects, Selected Using Last Posting Date

	Exposed category 1 N = 687		Exposed category 2 N =227		Amberley comparison N = 7685		Richmond comparison N =9698	
	N	%	N	%	N	%	N	%
Exposure / Posting Category								
1975-79	220	*32*	77	*34*	958	*12*	1211	*12*
1980-84	159	*23*	54	*24*	1451	*19*	1949	*20*
1985-89	156	*23*	53	*23*	1350	*17*	2054	*21*
1990-94	98	*14*	25	*11*	1391	*18*	1830	*18*
1995-99	54	*8*	18	*8*	2535	*33*	2654	*27*
Age Group								
20-24	1	*0.2*	0	*0*	154	*2*	77	*0.8*
25-29	31	*5*	13	*6*	610	*8*	627	*6*
30-34	91	*13*	13	*6*	837	*11*	1472	*15*
35-39	128	*19*	38	*17*	1129	*15*	1650	*17*
40-44	151	*22*	44	*19*	1296	*17*	1902	*20*
45-49	148	*21*	33	*14*	1136	*15*	1582	*16*
50-54	69	*10*	35	*15*	1069	*14*	1195	*12*
55-59	40	*6*	26	*11*	721	*9*	704	*7*
60-64	15	*2*	16	*7*	491	*6*	280	*3*
65-69	10	*1*	6	*3*	162	*2*	133	*1*
70-75	3	*0.5*	3	*1*	80	*1*	76	*0.8*
Rank								
Enlisted	514	*75*	133	*59*	3197	*41*	3910	*40*
Non-Comm Off	156	*23*	60	*26*	3150	*41*	5122	*53*
Officer	17	*2*	34	*15*	1338	*17*	666	*7*

- *Percentages may not add to 100 exactly, due to rounding*

Three individuals had date of death prior to start date, and these observations were excluded from further analyses. A further 10 had a cancer diagnosed before the start date. These cancers were therefore considered not relevant for the purposes of this study. One of these individuals had a second cancer, and this cancer was defined as first cancer for the study. A further 18 individuals had a second cancer, and one had a third. Again, they were not included in the analysis, as the study investigated first cancers only.

Cancer incidence

There were in total 352 cancers included in the analysis. Table 4 indicates the distributions and causes of cancer in each of the 4 groups (exposed category 1, exposed category 2, Amberley comparison, and Richmond comparison). The observed (unweighted) and weighted numbers of cancers and unweighted and weighted person years in each group are also shown in Table 4. The weighted standardised cancer incidence ratios are provided in Table 5. As shown, the Cancer Incidence Ratio point estimates are greater than 1 (1.35 and 1.38 respectively), indicating that there may be a slightly higher cancer rate in the exposed group relative to either comparison group. These point estimates increased to 1.47 and 1.51 respectively, when the analysis was restricted to those in exposure category 1 ("definitely exposed"). However, for all these estimates, the confidence intervals overlap 1, and the results are not statistically significant. The cancer incidence is very similar in the 2 comparison groups, with Cancer Incidence Ratios close to 1 (1.03) when compared to each other. These results are robust, and remain unchanged when start dates for controls are chosen from the latest posting date rather than the earliest (Refer to Appendix N).

Mortality Incidence

There were 183 observed deaths included in the analyses. Table 6 indicates the distributions and causes of death in each of the 4 groups (Exposed category 1,

Exposed category 2, Amberley controls, and Richmond controls). The observed (unweighted) and weighted numbers of deaths and unweighted and weighted person years in each group are also shown in Table 6. The weighted standardised mortality ratios are provided in Table 7. As shown, the Mortality Ratio point estimates are slightly smaller than 1 (0.77 and 0.75, respectively), indicating that there may be a slightly lower mortality in the exposed group relative to either comparison group.

These point estimates increase to 1.03 and 1.00 respectively, when the analysis was restricted to those in exposure category 1 ("definitely exposed"). However, for all these estimates, the confidence intervals overlap 1, and the results are not significant. The mortality is very similar in the 2 comparison groups, with Mortality Ratio's close to 1 (0.97) when compared to each other. These results are robust, and remain unchanged when start dates for controls are chosen form the latest posting date rather than the earliest (Appendix N).

Analyses were repeated including cancers and deaths with a date of diagnosis or death after the censoring date of December 31, 1999 (for cancer) or 2000 (for deaths). The inclusion of these additional events had minimal impact on the point estimates and confidence intervals.

Cancer Incidence and Mortality Ratios were also calculated for the exposed cohort compared to the Amberley and Richmond Comparison cohorts combined, since the individual ratios were similar for the two comparison groups. These analyses produced ratios, which were in between the separate ratios for the two comparison cohorts. The confidence intervals were in some cases slightly narrower than the confidence intervals for the separate comparison ratios, but all still included 1, indicating lack of statistical significance.

Table 4 : Observed (Unweighted) Numbers of Cancers, Total and Sub-Types, in each Group and Weighted Group Totals

Cancers	Exposed category 1	Exposed category 2	Amberley comparison	Richmond comparison
Haematopoietic	0	0	12	17
Liver and pancreas	0	0	0	5
Brain and CNS	0	0	3	7
Genitourinary	1	3	39	34
Lung	2	0	15	6
Buccal cavity	3	0	16	13
Other	12	1	87	76
Total (unweighted)	**18**	**4**	**172**	**158**
Total (weighted)	**18**	**4**	**137**	**167**
Person years (unweighted)	**10690**	**3620**	**105369**	**135199**
Person years (weighted)	**10690**	**3620**	**119966**	**150334**

Table 5 : Standardised Incidence Rates for Cancer

	Comparison	Cancer Incidence Ratio	95% CI
Cancer (exposed category 1 & 2)	Exposed vs Amberley Comp	1.35	0.82 – 2.12
	Exposed vs Richmond Comp	1.38	0.84 – 2.17
Cancer (exposed category 1 only)	Exposed vs Amberley Comp	1.47	0.85 – 2.42
	Exposed vs Richmond Comp	1.52	0.88 – 2.47
Comparisons	Amberley Comp vs Richmond Comp	1.03	0.81 – 1.30

- *weighted analysis*

Table 6 : Observed (Unweighted) Numbers of Deaths, Total and Sub-Types, in each Group and Weighted Group Totals

Deaths	Exposed category 1	Exposed category 2	Amberley comparison	Richmond comparison
Cancer	4	0	26	30
Cardiovascular disease	0	0	22	25
Injuries and Accidents	0	0	17	32
Other	3	0	16	8
Total (unweighted)	**7**	**0**	**81**	**95**
Total (weighted)	**7**	**0**	**76**	**98**
Person Years (unweighted)	**11460**	**3854**	**114028**	**145696**
Person Years (weighted)	**11460**	**3854**	**128449**	**160888**

Table 7 : Standardised Mortality Rates

	Comparison	Mortality Ratio	95% CI
Deaths (exposed category 1 & 2)	Exposed vs Amberley Comp	0.77	0.30 – 1.67
	Exposed vs Richmond Comp	0.75	0.29 – 1.60
Deaths (exposed category 1 only)	Exposed vs Amberley Comp	1.03	0.40 – 2.23
	Exposed vs Richmond Comp	1.00	0.39 – 2.15
Comparisons	Amberley Comp vs Richmond Comp	0.97	0.71 – 1.32

- *weighted analysis*

DISCUSSION

The point estimates of the Cancer Incidence Ratios and Mortality Ratios seem to show increased cancer but decreased mortality, compared to either comparison group, and this pattern remains when analysing only those with the highest exposure. However none of these results are statistically significant. The conflicting directions of results for the cancer incidence and mortality are difficult to reconcile, and these data need to be viewed cautiously for three reasons: the quality of the data is not optimal, there are multiple sources of bias and there is limited power.

Data Quality Issues

The major issues are listed and elaborated in each paragraph below:

Lack of a sampling frame

It has not been possible to compile a definitive sampling frame of all individuals involved in the F-111 DSRS program(s). There was no definitive list of DSRS participants compiled at the time that the work was carried out, and DSRS activities were not comprehensively noted in participants' personnel files. Only 40 individuals from the list of 717 classified as having been involved in F-111 DSRS (according to DVA F-111 list) were found to have such a notation in their file. All attempts to define a sampling frame are therefore retrospective, and a number of possibilities were considered:

A search of all paper records for all individuals posted to Amberley Air Force Base during the time that DSRS programs and activities were conducted. This would involve searching over 10,000 files, and DVA and Defence staff considered it unwieldy, as well as unlikely that all individuals involved would have a notation in their files.

a) Use of a code identifying individuals who had undertaken a confined space entry course. It was suggested that individuals working inside F-111 fuel tanks should have completed this course. However this may not have been the case, and all Air Force Personnel who had undertaken this course would certainly not have been involved in F111 DSRS activities. It was also unclear how far back this code would have been relevant. In addition, not all individuals potentially involved in DSRS would have undertaken this course, since not all activities of interest required fuel tank entry.

b) Other methods include trying to determine musterings and/or postings specific to DSRS, including the use of additional payment for tank entry. None were considered useful/appropriate, because records were no longer available or not comprehensive.

The lack of a sampling frame does not allow one to be certain in knowing that all participants were identified, or to judge how representative the participants are of the entire group of DSRS participants.

Non-standardised definition of exposure

Exposure category was based on a combination of self-report, additional questions asked by DVA telephone staff, data from the BOI, and, for selected persons, cross-referencing to personnel records. An overall evaluation was made in categorising the person as definitely involved in DSRS, working in close proximity, or not involved to DSRS activities. This process, although reasonable, was carried out by several people and was not standardised; the validity of the classification is unknown at this stage. The activities questionnaire that has been included with the mail-out should address this issue and allow a uniform definition of exposure, as well as the assignment of a dose to the exposure. However this information will not be available until later in 2003. It is recommended that the Mortality and Cancer Incidence Study be repeated when this information is available.

Uncertain period of exposure

The start time for the exposure period used to calculate the person years of follow-up was based on self-report. In some cases this was missing, or if present, was at odds with the dates of the program in which the participant claimed to have been involved. In some cases, there was no date or program of involvement, and a likely date was imputed based on posting dates to Amberley (recorded in AFPEMS). There was also no information on length of exposure; for example, involvement in DSRS activities for 1 month or 1 year in the same capacity could not be differentiated.

Incomplete linkage to death and cancer registries

Due to the structure of the DVA F-111 and Australian Electoral Commission (AEC) databases, it was judged too time-consuming to extract middle names of the participants. Since middle names can increase the probability of finding matches in the registries (especially with more common names), there are probably fewer matches than could potentially be found, and the linkage is probably not as complete as it could be.

Missing or incorrect data

This is a problem with all large data sets. Examples include Air Force personnel with missing ranks, civilians with a rank assigned, and a male who appeared to have a cancer of the female genital tract. For this initial linkage, there were insufficient time and information to permit such errors to be resolved. With more time for analysis, and with the further information to be gathered as part of the physical exam, such errors should be minimised.

Sources of bias

The major sources of bias, as well as the direction of the biases, are listed in the following paragraphs:

Selection bias

As described in the methods, the selection process for the exposed group was complicated and involved a number of processes, including being identified by the BOI (via lists, interviews, personnel records, etc.), through media notices, through web-sites, via the F-111 health scheme, through review of squadron photos, etc.

The implications of this for interpretation of results of the Mortality and Cancer Incidence Study are unclear. For many studies involving volunteers or requiring participant involvement, participants are often “healthier” than non-participants. This may not be the situation for this study however, as anecdotal evidence based on feedback from members of the Consultative Forum, indicates that individuals may not want to be involved in SHOAMP and/or have their details included on the F-111 list as they do not believe that they have any health problems. This may then produce a bias away from the null, whereby the exposed cohort included in the study is, in general, in poorer health than all F-111 DSRS individuals. Alternatively other potentially exposed individuals may not chose to become involved because they are unwell, or have legal action against Defence because of adverse health effects perceived to be associated with DSRS. This would then bias the results toward the null, providing a cohort that was healthier than the true exposed group.

Because of the small number of females involved in F-111 DSRS, it was not possible to estimate risks for Mortality and Cancer for exposed relative to comparison personnel. This continues to be a problem for occupational health studies, including Defence Personnel studies, because of the low ratio of females relative to males.

In a retrospective study of this nature, one of the major sources of error is tracing exposed individuals who have already died and who obviously cannot respond to calls for participation. Every effort was made to identify such individuals through the BOI lists, interviews, review of squadron photos, etc, and 19 deceased people were identified (not all of these were eligible for the mortality study). Nevertheless, there is no assurance that this represents all those exposed who indeed died, and may cause bias towards the null.

It was not possible to obtain community comparisons for the civilians who were classified as having been involved in DSRS programs or activities. An appropriate method for obtaining relevant comparisons would require obtaining details of individuals living in Ipswich, and of the same age and gender, at the time the potentially exposed individuals were involved in DSRS. This would have required obtaining electoral roles from 1977 to 1999, and sampling from these. This was determined to be non-feasible. Therefore Defence personnel, of the same age and gender, were used for comparisons. It is unclear what effect this may have on the results. There has been some discussion in the literature of the "Healthy Soldier" effect – ie; that individuals in the Military may have better health than other workers, because of strict entry requirements and necessity that Military maintain a reasonable level of fitness throughout their enlistment period. This would have caused a bias away from the null, since it would include people in "poorer" health selectively in the exposed group. Given that only 27 civilians were eligible for the Mortality and Cancer Incidence Study, and that the civilians were undertaking similar technical activities as the Defence personnel, the magnitude of this bias should be negligible.

Information bias

There were also concerns that the deceased individuals may not have been given an appropriate exposure classification because they could not be contacted. Therefore a review of their service records was undertaken by DVA, in conjunction with Defence Workplace Safety Project.

This level of investigation has not been undertaken for other individuals on the DVA F-111 list, or for comparisons. Thus the validity of DSRS exposure classification is likely to be better for the F-111 list deaths. It is difficult to guess the direction of the bias in this case.

As mentioned previously, exposure category was based mainly on self-report. Due to the possible perceived benefit from being labelled “exposed”, either because of free health care through the F-111 Health Scheme, or because of possible legal proceedings against the Air Force, there may be a bias against the null. A number of people (n=66) reported exposure prior to 1975, when the first program began. These may represent people who were involved in training (in which case the dose of exposure was likely minimal), or who remembered their exposure time incorrectly. Since exposure before 1975 was not anticipated, no controls were recruited before 1975. Fifteen of these individuals were excluded because they had not posting date after 1975. Rather than lose the information from the remaining participants due to the inability to find a match in the unexposed group, 19 were allocated their first posting date between 1975 and 1979, and the remaining 32 were assigned a start date for exposure at the midpoint of the 1975-79 period. This would be equivalent to shortening the person years of observation that these people contribute, increasing the incidence rate and biasing results away from the null.

Complete, coded death data were only available for deaths registered from 1980 up to December 2000. Complete Cancer Incidence data were only available from 1982 up to December 1999. This is due to a time lag between diagnosis and registration, the considerable amount of time taken to clean and check the cancer registration data and that data are provided by the State and Territory Registries on annual basis only. Although this means that more recent deaths and cancers are not included, this occurs equally for both exposed and comparison groups and should not cause any bias. However the lag time between the start of exposure (1975) and the start of cancer and mortality surveillance (1980 and 1982) may cause some bias. If the effect of exposure to DSRS activities is to speed up the occurrence of cancer, then there may have been some early cancers in the exposed group that were missed; this would bias results towards the null.

Confounders

Because the Mortality and Cancer Incidence Study involved record linkage of computerised data obtained from AFPEMS and the DVA F-111 list, no information on confounders or risk factors for mortality or cancer was available. While smoking status and alcohol intake, for example, will be available for individuals participating in the General Health and Medical Study later in 2003, these data will not be available for individuals in the "working in close proximity" group, nor for the comparisons (except for the sub-sample who have also participated in the General Health and Medical Study). If there are differences in levels of risk factors between exposed and comparison groups, then this may bias the results. The effect of this will depend on whether risk factors in the exposed group are higher than the comparison groups (resulting in bias away from the null) or lower than the comparison groups (resulting in bias toward the null).

Of greater concern, however is potential confounding due to other occupational exposures – military and civilian. For example, individuals in a technical trade may have been exposed to a considerable range of potentially harmful substances or activities. These may include other jet fuel, solvents and other chemicals and even radiation. This may increase differences between the exposed cohort and the Amberley non-technical cohort, but this may not be as large a problem for the Richmond technical comparison group, as long as other such exposures are similar for these two groups. Similarly other environmental exposures may differ between Amberley and Richmond. While including an Amberley comparison group should allow consideration of this, again, this requires an assumption of similar amount of exposure between exposed and Amberley comparison cohorts. However at this stage other occupational exposures are unknown. While information on other occupational exposures will only be available for individuals involved in the General Health and Medical Study, this will at least provide some data on comparative exposures among the groups.

Power

The third consideration in interpreting these results with caution is the limited power of the study. We detail the power calculations for cancer and mortality below. Power calculations have been based on an average follow up time of 12 years (average of 1975-1999); rate of cancer in comparison group of 100 per 100,000 or 0.001 (based on rates observed in the Richmond and Amberley comparison groups); rate of death in comparison group of 60 per 100,000 or 0.0006 (again based on rates observed in the Richmond and Amberley comparison groups).

Cancer

Using exposure categories 1 and 2 combined (n~900), we found a Relative Risk point estimate of 1.3-1.4 for the incidence of all cancers, although the confidence interval was wide. If this is the true Relative Risk, based on the incidence in the comparison group of 0.001, we would have needed ~12,000 people in each of the exposed group and comparison group to reach statistical significance; the other way to say this is that given the number of people exposed, we have no more than 15-20% power (at a 5% significance level) to detect this RR of 1.3-1.4 for cancer incidence. Power is 2-4% lower when considering just those in exposed category 1. Alternatively, from the confidence limits, we can say that we are 95% sure that the Relative Risk increase in cancer incidence is not greater than 2.2.

Mortality

Using exposure categories 1 and 2 combined (n~900), we found a Relative Risk point estimate of ~0.75 for mortality, although the confidence interval was wide. If this is the true Relative Risk, based on the mortality rate in the comparison group of 0.0006, we would have needed over 25,000 people in the exposed group and 25,000 in each of the control group to reach statistical significance; the other way to say this is that given the number of people exposed, we have no more than 10-15% power (at a 5% significance level) to detect this RR of 0.7 for mortality.

Power is 2-4% lower when considering just those in exposed category 1. However we are not really interested in a benefit in mortality in the DSRS group; we want to ensure no increase in mortality. Alternatively, from the confidence limits, we can say that we are 95% sure that the results rule out any increase in mortality greater than 1.7 fold.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

No significant evidence of increased mortality or cancer was found in the group exposed to F-111 DSRS activities, relative either to non-technical trades on the same Base, or aircraft maintenance personnel at another Base. However, the lack of a demonstrable effect does not imply the definitive absence of the same, ie; we cannot conclude that the exposure was harmless. The conflicting trends (ie; decreased mortality but increased cancer) cannot be easily explained and there are multiple sources of error in the data, as well as multiple sources of bias, which undermine the validity of these results.

Recommendations

We recommend repeating the analysis at a future time with the following variations:

1. Reassign exposure category and level when results from the Activities Questionnaire are available. This questionnaire will standardise exposure assessment, as well as dose and length of exposure. This will allow construction of a dose response curve.

2. Repeat the linkage process with DVA records, with the provision of middle names of individuals. This will increase the probability and certainty of matches. The maximum amount of information needs to be provided on each individual to facilitate a more effective matching process and higher number of final matches for analysis.

3. Perform a survival analysis, which incorporates time to event, rather than just incidence.

4. Comparisons with Australian mortality and cancer incidences may be useful as a check, and to put the analyses in perspective.

5. Examine sub-types of cancer. The occurrence of rare cancers such as male breast cancer, or three eye melanomas[3] should be examined, although power will obviously be very limited.

6. Repeat the analyses using incidence density; this would count second and third cancers in individuals, instead of focusing on first cancers only.

[3] One each in a comparison and exposed individual, and one that occurred in a comparison individual prior to their allocated start date.

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APPENDICES

Appendix A : Activities and Occupations Associated with F-111 Deseal/Reseal Programs

Activities and Occupations Associated with F-111 DSRS Program 1

Process	Activities	Occupations
Chemical Deseal	Fit Deseal plumbing, sprinklers, spray nozzles, score/slash sealant Fill deseal rig with SR51, preheat SR51, SR51A circulation. Spot repair plumbing leaks. Spot checks Drain SR51 into storage tank or drums Fill rig with Alkali wash (ED500 and eater) Circulate then drain into dam Fill with fresh water, rinse and drain Clean out deseal rig (remove sealant sludge) Remove deseal plumbing and residue (water, loose sealant) Hand scrub with ED500 solution	Fitting (and defitting) Rig monitor Trade and independent inspectors
Water Pick	Fit blanking plates, protective tape Water pick sealant Wash with ED500 solution Rinse with high pressure hose (fire hose)	Waterpick / hydrolaser operator Safety observer Runner
Hand clean with Mil-Spec	Clean with Mil-Spec, cheesecloth soft metal scrapers, bristle brushes and metal tools	Hand cleaner Trade and independent inspectors
Primer Application	Flush with PR148 and remove excess	General technicians and Inspectors
Barrier Application	Mix 2-part Epoxy (in sealant hut) Apply Epoxy barriers XA3598 with semco gun	Sealant quality control General technicians Inspectors
Sealant Application	Mix sealant (A and B) Apply A sealant Apply B sealant	Sealant quality control General technicians Inspectors
Dispose of SR51	Transfer water to incinerator Transfer waste to dam, collect with tech blocks Incinerate tech blocks Monitor incinerator Clear blockages/breakdowns	General hands Boiler attendants

Activities and Occupations Associated with F-111 DSRS Program 2

Process	Activities	Occupations
Water Pick	Fit blanking plates, protective tape Waterpick sealant Wash with ED500 solution, rinse with high-pressure hose (fire hose)	Waterpick / hydrolaser Operator Safety observer Runner
Hand clean with Mil-Spec	Clean with Mil-Spec, cheesecloth soft metal scrapers, bristle brushes and dental tools	Hand cleaner Trade and independent inspectors
Barrier application	Mix 2-part Epoxy (in sealant hut) Apply Epoxy barrier XA3598 with Semco gun	Sealant quality control General technicians Inspectors
Sealant application (2 coats)	Mix sealant (A and B)	Sealant quality control General technicians Inspectors

Activities and Occupations Associated with F-111 DSRS Spray Seal Program

Process	Activities	Occupations
Alkali wash	Rinse with detergent wash with high-pressure hose with hot water	General technicians
Spot clean	Wipe down tank surfaces with Nil-Spec	General technicians
Primer application	Mix primer Apply primer with manoeuvrable pressure pot	Sprayer Observer Mixer General technician
Sealant application	Mix A sealant Mix B sealant Apply A sealant with air-assisted airless gun Apply B sealant with air-assisted airless gun Inspect and patch up	Sprayer Observer General technician Trade and independent inspectors

Activities and Occupations Associated with F-111 DSRS Wing Program

Process	Activities	Occupations
Water Pick	Remove sealant with waterpick / hydrolaser	Operator Observer
Seed Blasting	Remove sealant with walnut shell blaster	
Hand cleaning	Wash with ED500 Clean with Mil-Spec Remove by hand all remaining sealant	General technicians
Reseal wing	Flush with PR148 Mix 2-part Epoxy Apply Epoxy barrier Prime with EC1945 Brush coat Q4 sealant Apply sealant Q4 with Semco gun	General technician Trade and independent inspectors
Refit plank	Wipe down top-skin panel with Mil-Spec Wipe down top-skin panel with pR148 Mix PR1750 B sealant Apply PR1750 B sealant to top-skin panel Refasten panel while sealant is wet (6 hours time limit)	

Appendix B : Summary List of F-111 Deseal/Reseal Activities

De-fuelling fuel tanks
De-puddling of fuel tanks
De-plumbing of fuel tanks
Chemical de-sealing of fuel tanks
Removing sealant by the use of high pressure water pick
Removing sealant with walnut shell blaster
Scrubbing / smoothing of tank surface by hand
Applying high pressure detergent wash to tanks
Applying hot rinse to tanks
Application of Primer with manoeuvrable pressure pot
Mixing of Sealant
Cleaning mixing machines with detergent products
Cleaning mixing machines with MEK
Application of new sealant with air-assisted airless gun
Application of Epoxy Barrier (XA3598)
Application of new fillet sealant
Re-plumbing
Refitting wing planks
Leak testing
Inspection of tanks
Inspection with black light
Resealing of voids
Storage of chemicals
Cleaning of chemical storage facilities
Decanting or recanting of chemicals
Disposal of waste SR51 or Rinse Solution
Burning of waste SR51 or Rinse Solution
Pouring of solutions into drains
Transportation of sludge to remote areas for air drying
Collection of air-dried powder
Burning of air-dried powder
Absorption of SR51 by Tec Blocks
Disposal of SR51 soaked Tec Blocks

Appendix C : Summary of Chemicals/Processes for Deseal/Reseal Activities

First DSRS Program

Application	Product	Specification
Desealant	SR-51 SR-51A	FMS-1119
Alkaline / detergent wash	AIRTECH 23 ED-500	MIL-C-87936A MIL-C-25769G
Solvent	ME767[4] MEK T4460[5]	MIL-C-38736 TT-M-261[6] MIL-C-38736
Metal surface protection	PR1560 DESOTO 823-707 Alodine 1200S	MIL-C-27725 MIL-P-23377 MIL-C-27725 MIL-C-81706
Barrier	XA3598 / (EC-3580 B/A)[7]	
Primer / adhesion promoter	PR-148	P6140
Sealant	PRO_SEAL 899 PR-1750	MIL-S-83430 FMS-1004[8] MIL-S-83430 AMS 3276[9]

Second DSRS Program

Application	Product	Specification
Solvent	ME767 / (T4460) MEK	MIL-C-38736 TT-M-261[10]
Metal surface protection	Alodine 1200S DESOTO 823-707	MIL-C-81706 MIL-C-27725 MIL-P-23377

[4] ME767 was commonly referred to as 'Mil-Spec'
[5] T4460 was commonly referred to as 'Mil-Spec'
[6] The prefix TT is used for US federal specifications
[7] For subsequent programs XA3598 /became EC3580 B/A. EC-3580 B/A did not contain asbestos
[8] The prefix FMS is used for Fort Worth Material Specifications
[9] The prefix AMS is used for Aerospace Material Specifications and replaces any Mil-Specs
[10] MEK was not used during the second DSRS program sae as an ingredient when mixing Mil-Spec

Second DSRS Program continued…

Application	Product	Specification
Barrier	EC-3580 B/A	
Primer / adhesion promoter	PR-148	P6140
Sealant	PR-1750	MIL-S-83430

Spray Seal Program

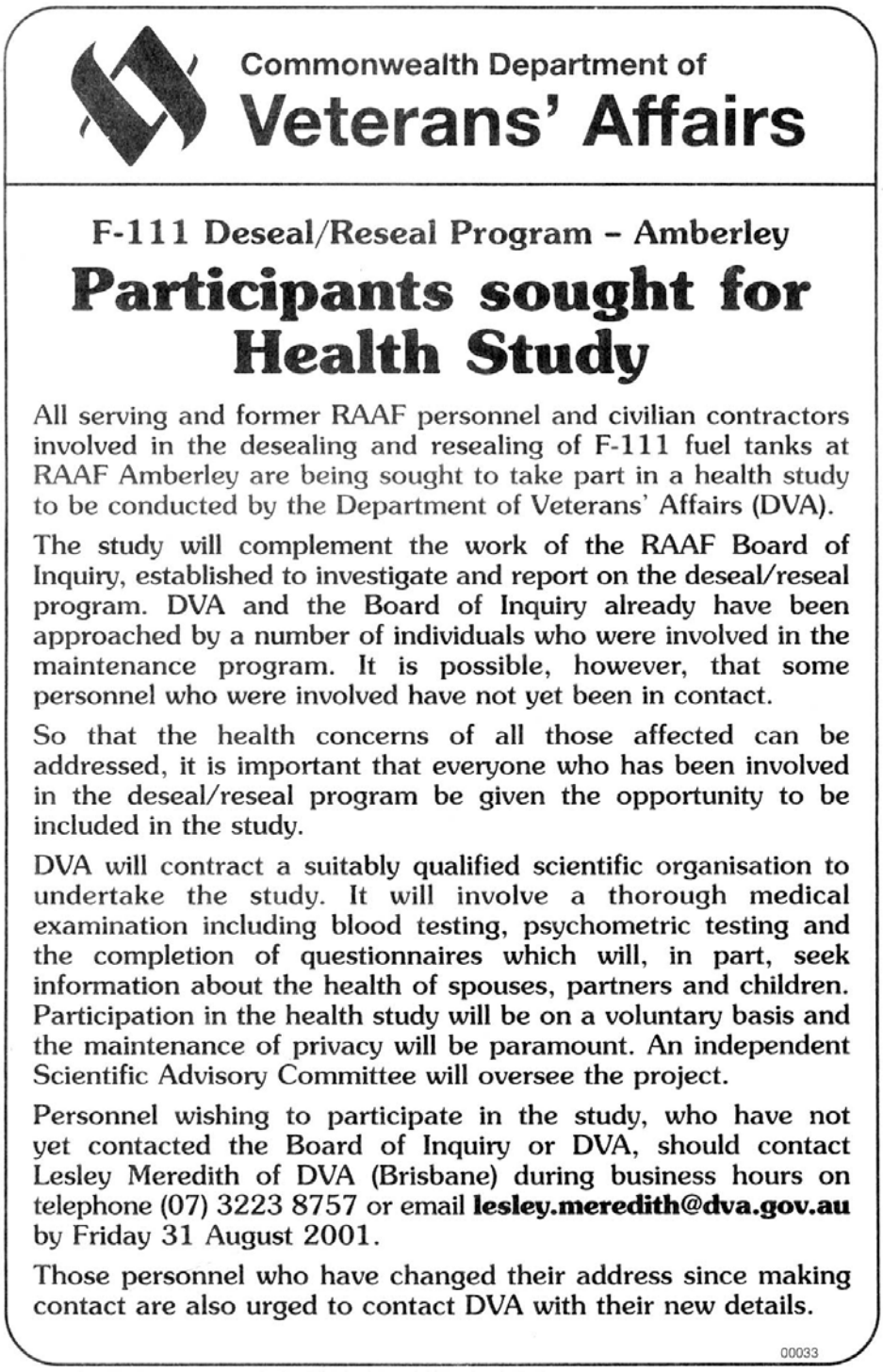
Application	Product	Specification
Alkaline / detergent wash	ZI-400	MIL-C-25769G
Solvent	MEK	TT-M-261
Metal surface protection	Alodine 1200S	MIL-C-81706
Barrier	EC-3580 B/A	
Primer / adhesion promoter	666-2003-427	MMS-425
Sealant	PR-1750 PR-2911 PR-1826	MIL-S-83430 AMS-3279

Wings DSRS Program

Application	Product	Specification
Alkaline / detergent wash	ED-500 AIRTECH 23	MIL-C-25769 MIL-C-87936A
Solvent	MEK T4460	TT-M-261 MIL-C-38736
Metal surface protection	Alodine 1200S	MIL-C-81706
Barrier	EC-2216 EC-3580 B/A	
Primer / adhesion promoter	EC-1945 B/A SS-4004 PR-148	FMS-1058 P6140
Sealant	PR-1750 QR-2817 94-002/9[11]	MIL-S-83430 FMS-1043 / AMS 3375 FMS-1043B/A

[11] Flurosilocone sealant was the original wing sealant and was a by-product of the water pick process

Appendix D : Commonwealth Department of Veterans' Affairs Advertisement 'Participants sought for Health Study'



Commonwealth Department of
Veterans' Affairs

F-111 Deseal/Reseal Program – Amberley

Participants sought for Health Study

All serving and former RAAF personnel and civilian contractors involved in the desealing and resealing of F-111 fuel tanks at RAAF Amberley are being sought to take part in a health study to be conducted by the Department of Veterans' Affairs (DVA).

The study will complement the work of the RAAF Board of Inquiry, established to investigate and report on the deseal/reseal program. DVA and the Board of Inquiry already have been approached by a number of individuals who were involved in the maintenance program. It is possible, however, that some personnel who were involved have not yet been in contact.

So that the health concerns of all those affected can be addressed, it is important that everyone who has been involved in the deseal/reseal program be given the opportunity to be included in the study.

DVA will contract a suitably qualified scientific organisation to undertake the study. It will involve a thorough medical examination including blood testing, psychometric testing and the completion of questionnaires which will, in part, seek information about the health of spouses, partners and children. Participation in the health study will be on a voluntary basis and the maintenance of privacy will be paramount. An independent Scientific Advisory Committee will oversee the project.

Personnel wishing to participate in the study, who have not yet contacted the Board of Inquiry or DVA, should contact Lesley Meredith of DVA (Brisbane) during business hours on telephone (07) 3223 8757 or email **lesley.meredith@dva.gov.au** by Friday 31 August 2001.

Those personnel who have changed their address since making contact are also urged to contact DVA with their new details.

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Appendix E : List of Mustering Categories for the Amberley Comparison Group (Non-Technical Trades)

Code	name
C031	Supply
C031	Supply
C031	Supply
C031	Logistics Officer
C032	WKS
C033	EQUIPUNCAT
C033	Supply Non-Specialist
C034	Logistics Officer
C035	Legal Officer 1
C036	Legal Officer 2
C037	Legal Officer 3
C038	Legal Officer 4
C039	Legal Officer 5
C041	Medical
C042	Dental
C043	Pharmacy
C044	Environmental Health
C044	Environmental Health
C045	Laboratory
C046	Radiography
C047	Medical Non-Specialist
C048	Medical Non-Specialist
C049	Nurse
C050	AHP
C051	Accounting
C052	Medical Non-Specialist
C053	MEDICAL NON SPECIALIST CIVILIAN GRAD
C061	Administration

Code	name
C062	Air Traffic Control
C062	Air Traffic Control
C063	Ground Defence
C063	Ground Defence
C064	Air Defence
C064	Air Defence
C065	Photography
C065	Photography
C065	Photography
C066	Police
C066	Police
C066	Police
C067	Education
C067	Education
C068	Legal
C068	Legal
C069	WRAAF
C070	PRO
C070	PR
C071	Meteorology
C071	Meteorology
C072	WRAAFM
C073	Intelligence
C073	Intelligence
C074	Operations
C074	Operations
C075	Other Non-Specialist
C075	Other Non-Specialist
C075	Other Non-Specialist
C076	Facilities
C076	Facilities
C076	Facilities

Code	name
C077	Other Non-Specialist
C077	Other Non-Specialist
C078	Other Non-Specialist
C078	Other Non-Specialist
C079	Journalist
C080	SECURITY POLICE OFFICER
C081	Chaplain
C082	General List
C085	GLEX
C086	GLEXO
C087	RACT
C092	Legal – Uncategorised
M000	NO ENTRY
M003	SIG
M020	CLERK GRADE 1/TRAINEE
M021	CLERK GRADE 1
M022	CLERK GRADE 2
M024	CLERK GRADE 1/PROVISIONAL
M026	DENTMECH
M027	DRAFTSMAN architect
M030	DRAFTSMAN ENGINEER
M033	DMANSURV
M035	COMMS & INFO SYSTEMS CONTROLLER/TRAINEE
M036	COMMS & INFO SYSTEMS CONTROLLER
M038	LINGUIST6
M040	PRLINOP
M041	PRLCAMOP
M042	PRMONOP
M043	PRPRFRDR
M054	WKSSUP
M055	IMAGERY ANALYST/TRAINEE
M056	IMAGERY ANALYST

Code	name
M057	ELECTRONIC DATA PROCESSING OPERATOR
M061	BBDR(W)
M068	ATCNCO
M068	ATC
M080	CINOP6
M092	HYGINSP
M092	ENVIRONMENTAL HEALTH SURVEYOR
M094	DENTAL SUPERVISOR GRADE 1
M095	DENTAL SUPERVISOR GRADE 2
M099	MNAV
M109	MBBM
M110	MBBW
M111	PSASSES6
M112	PHOTOGRAPHER
M118	PUBLIC RELATIONS ADMINISTRATION
M121	PRBBIND
M124	PRCOMP
M131	COMPOP
M138	COMMS & INFO SYSTEMS CONTROLLER GRADE 1
M139	COMMS & INFO SYSTEMS CONTROLLER GRADE 2
M140	WOSIGS
M142	DET SPVR COMMS & INFO SYSTEMS CONTROLLER
M143	SPVR COMMS & INFO SYSTEMS CONTROLLER
M145	MANAGER COMMS & INFO SYSTEMS CONTROLLER
M148	RADIOG6
M149	CLERK SUPPLY
M152	SCLKSPLY
M155	SUPPLIER
M156	SUPPLIER GRADE 1
M157	SUPPLIER GRADE 2
M158	SPLYSUP1
M158	SPLYSPVR

Code	name
M159	SPLYSUP2
M159	SPLYSPVR
M160	SPLYSUP3
M160	SPLYSPVR
M163	MESSPVR
M166	CHEF
M169	ASSTSPLR
M171	BUTCHER
M174	CLERK EQUIPMENT ACCOUNTS
M177	CLERK FINANCIAL ACCOUNTS
M180	CLKG
M180	STENOGRAPHER
M183	EDUCATION ASSISTANT
M189	MNADMIN
M196	TAILOR
M199	TELSOPC
M200	TPRINOPC
M201	METASST
M202	MEDICAL SUPERVISOR GRADE 1
M204	AIRFIELD DEFENCE GUARD GRES GRADE 1
M205	ADGGR2
M205	AIRFIELD DEFENCE GUARD GRADE 2
M205	AIRFIELD DEFENCE GUARD GRADE 1
M206	ADGGR3
M206	AIRFIELD DEFENCE GUARD GRADE 3
M206	AIRFIELD DEFENCE GUARD GRADE 2
M207	Airfield Defence Guard Grade 3
M208	ADOP
M209	ADPLOT
M210	ADSUP
M210	ADSPVR
M210	ASSPVR

Code	name
M211	Supervisor Airfield Defence Guard
M212	Manager Airfield Defence Guard
M213	ACCTMOP
M216	ACPLOT
M223	CATERER
M226	CLERK ADMINISTRATION
M229	CLKE
M230	CLERK MEDICAL
M238	FIREMAN
M238	FIREFIGHTER
M240	INST REP
M244	MTD
M250	PHYSICAL TRAINING INSTRUCTOR
M256	SP
M261	ADI
M263	PLANT INSPECTOR
M265	COOK
M266	COX1
M267	COXWAIN GRADE 2
M270	DI
M271	EQASST
M277	MARINE CRASH CREWMAN
M280	MEDORD
M283	SGUARD
M283	POLICE DOG HANDLER
M286	AIR PHOTO PLOTTER
M289	WARRANT OFFICER DISCIPLINARY
M291	WRADNCO
M292	COMMUNICATIONS OPERATOR
M295	BBDR
M296	SWNCO
M302	PUBLICATIONS ASSISTANT

Code	name
M305	MEDICAL ASSISTANT GRADE 2
M306	MEDICAL ASSISTANT GRADE 3
M308	CLERK
M311	DENTAL ASSISTANT
M314	WTD
M317	TELSOP
M320	TELEPHONE OPERATOR
M323	TPRINOP
M324	VCANIZER
M325	DENTSPVR
M328	MEDICAL ASSISTANT GRADE 1
M330	MEDICAL SUPERVISOR GRADE 2
M331	COOKS ASSISTANT
M334	GENERAL HAND
M337	GUARD
M338	STEWARD GRADE 1
M341	STEWARD GRADE 2
M339	Mess Operator Grade 1
M340	Mess Operator Grade 2
M342	MESS OPERATOR
M344	TRAINEE
M356	COOK GRADE 1
M359	COOK GRADE 2
M362	MOTOR TRANSPORT DRIVER GRADE 1
M365	MOTOR TRANSPORT DRIVER GRADE 2
M368	DENTAL HYGIENIST
M371	PHOTOGRAPHIC INTERPRETER
M374	SIGNALS OPERATOR
M377	PRSUP
M378	LMUSIC
M378	MUSICIAN GRADE 3
M381	MUSICIAN

Code	name
M381	MUSICIAN GRADE 2
M384	CINEMA OPERATOR
M390	LINGUIST
M393	PSYCHOLOGY ASSESSOR
M396	RADIOG
M433	ADOP1
M433	AIR SURVEILLANCE OPERATOR GRADE 1
M434	ADOP2
M434	AIR SURVEILLANCE OPERATOR GRADE 2
M437	ROYAL AUSTRALIAN AIR FORCE POLICE
M440	RAAF POLICE INSPECTOR
M443	PRBBIND1
M444	PRBBIND2
M454	CESYSTECH1
M455	CESYSTECH
M455	CESYSTECH2
M460	RAAF POLICE GRADE 1/TRAINEE
M461	RAAF POLICE GRADE 1
M462	RAAF POLICE GRADE 2
M463	SECURITY POLICE GRADE 1
M464	SECURITY POLICE GRADE 2
M465	SECURITY POLICE/TRAINEE
M466	PHOTOGRAPHER GRADE 1
M467	PHOTOGRAPHER GRADE 2
M468	PHOTO UNIT SUPERVISOR
M469	IMAGERY PRODUCTION MANAGER
M470	FLIGHT TEST PHOTOGRAPHER
M471	UNIT FLIGHT TEST SPECIALIST
M472	PHOTO UNIT SPVR FLIGHT TEST PHOTOGRAPHER
M473	IMAGERY PRODUCTION MNGR FLT TEST PHOTO
M474	SIGNALS OPERATOR LINGUIST GRADE 1
M475	SIGNALS OPERATOR TECHNICAL GRADE 1

Code	name
M476	SIGNALS OPERATOR LINGUIST GRADE 2
M477	SIGNALS OPERATOR TECHNICAL GRADE 2
M478	SIGNALS OPERATOR LINGUIST ANALYST
M479	SIGNALS OPERATOR GENERAL LINGUIST
M480	SIGNALS OPERATOR TECHNICAL ANALYST
M481	SIGNALS OPERATOR LINGUIST ADV ANALYST
M482	SIGNALS OPERATOR ADVANCED LINGUIST
M483	SIGNALS OPERATOR TECHNICAL ADV ANALYST
M484	SENIOR MANAGER PROCESSING
M485	SENIOR MANAGER TECHNICAL
M700	DIPCDT1
M706	CADET
M712	SIGTR
M713	DIPCDT2
M719	ACCTMOP-trainee
M722	ACPLOT-trainee
M725	AIRFIELD DEFENCE GUARD GRADE 1/TRAINEE
M728	AIR PHOTO PLOTTER/TRAINEE
M743	CLERK/TRAINEE
M746	CLKE-trainee
M747	CLERK EQUIPMENT ACCOUNTS/TRAINEE
M750	CLKM-trainee
M753	COOK-trainee
M756	DENTAL ASSISTANT/TRAINEE
M759	DI-trainee
M762	EQASST-trainee
M763	FABWKR-trainee
M766	FIREMAN/TRAINEE
M766	FIREFIGHTER/TRAINEE
M769	MEDICAL ASSISTANT GRADE 1/TRAINEE
M769	MEDICAL ASSISTANT/TRAINEE
M772	PHOTOGRAPHER/TRAINEE

Code	name
M775	PSASSES-trainee
M778	PHYSICAL TRAINING INSTRUCTOR/TRAINEE
M781	SGUARD-trainee
M781	POLICE DOG HANDLER/TRAINEE
M784	SP-trainee
M787	STEWARD/TRAINEE
M793	TELSOP-trainee
M794	TELEPHONE OPERATOR/TRAINEE
M797	TPRINOP-trainee
M800	WRADNCO-trainee
M803	EDPOP-trainee
M806	APHPLOT-trainee
M809	UNICDT
M818	EDASST-trainee
M821	CLKFA-trainee
M824	CLERK ADMINISTRATION/TRAINEE
M830	AIRFIELD DEFENCE GUARD/TRAINEE
M833	BBDR(W)-trainee
M834	CLERK SUPPLY/TRAINEE
M837	DENTAL HYGIENIST/TRAINEE
M840	DMANENG-trainee
M849	HYGINSP-trainee
M849	ENVIRONMENTAL HEALTH SURVEYOR/TRAINEE
M858	SUPPLIER/TRAINEE
M865	LINGUIST-trainee
M868	AIR DEFENCE PLOTTER/TRAINEE
M875	MCCREW-trainee
M884	COMMSOP-trainee
M887	BBDR-trainee
M888	SWNCO-trainee
M891	PUBASST-trainee
M892	SIGNALS OPERATOR/TRAINEE

Code	name
M895	TAILOR/TRAINEE
M898	ADOP1-trainee
M898	AIR SURVEILLANCE OPERATOR/TRAINEE
M901	COOK/TRAINEE
M904	RAAF POLICE/TRAINEE
M909	EQUIPUNCAT
M910	Engineer Non-Specialist
M912	Other Non-Specialist
M915	WORKS SUPERVISOR

Appendix F : List of Mustering Categories for the Richmond Comparison Group (Technical Trades)

Code	name
C021	ENGRARM
C021	Armament Engineer
C022	ENGRAERO
C022	Aeronautical Engineer
C023	ENGRELEC
C023	ELEC
C024	ENGRINST
C024	INST
C025	ENGRMAR
C025	MAR
C026	ENGRMECH
C026	MECH
C027	ENGRRAD
C027	RAD
C028	ENGRTECH
C029	Engineer Non-Specialist
C030	Electronics Engineer
C076	Airfield Engineer
M001	TRADE APPRENTICE AVIONICS
M001	TRADE APPRENTICE AVIONICS
M002	TRADE APPRENTICE AIRCRAFT
M002	TRADE APPRENTICE AIRCRAFT
M005	ASTFITT1
M006	ASTFITT2
M007	ADVANCED AIRCRAFT STRUCTURAL FITTER
M008	ADVANCED AIRCRAFT STRUCTURAL TECHNICIAN
M009	GROUND SPT ENGINEERING FITTER GRADE 1
M010	GROUND SPT ENGINEERING FITTER GRADE 2

Code	name
M011	GROUND SUPPORT ENGINEERING TECHNICIAN
M012	ADVANCED GROUND SPT ENGINEERING TECH
M013	COMMUNICATIONS ELECTRONICS MECHANIC
M014	COMMS ELECTRONICS FITTER GRADE 1
M015	COMMS ELECTRONICS FITTER GRADE 2
M016	COMMUNICATIONS ELECTRONICS TECHNICIAN
M017	ADVANCED COMMS ELECTRONICS TECHNICIAN
M018	COMMS ELECTRONICS SYSTEMS TECHNICIAN
M019	COMMS ELECTRONICS FITTER/TRAINEE
M023	GROUND SPT ENGINEERING FITTER/TRAINEE
M037	INSTRUMENT FITTER
M039	PLANTOP
M045	RADIO TECHNICIAN AIR
M048	RADIO TECHNICIAN GROUND
M051	WELDER AIRCRAFT
M052	WELDER AIRCRAFT GRADE 1
M053	WELDER AIRCRAFT GRADE 2
M058	TELECOMMUNICATIONS TECHNICIAN
M064	MTFITTGR1
M064	MOTOR TRANSPORT FITTER GRADE 1
M065	MTFITTGR2
M065	MOTOR TRANSPORT FITTER GRADE 2
M069	AIRCRAFT METAL WORKER GRADE 1
M069	AIRCRAFT STRUCTURAL FITTER GRADE 1
M070	AIRCRAFT METAL WORKER GRADE 2
M070	AIRCRAFT STRUCTURAL FITTER GRADE 2
M071	AIRCRAFT METAL WORKER
M073	AFCARP
M074	AFFITT
M075	ARMFITT
M076	BARRACKS ELECTRICIAN
M076	ELECTRICIAN

Code	name
M079	BLACKSMITH
M081	ELECTRICAL FITTER
M082	ELECTROPLATER
M085	ENGINE FITTER
M086	GENCARP
M086	CARPENTER
M089	GENERAL FITTER
M096	MCFITT
M102	MTFITT
M103	METAL MACHINIST
M104	METAL MACHINIST GRADE 1
M105	METAL MACHINIST GRADE 2
M106	MOTOR BODY BUILDER
M115	PLUMBER
M125	PRLMACH
M126	PRPLMKR
M127	PROMACH
M128	SWRIGHT
M134	TELEG
M137	WARRANT OFFICER ENGINEER
M141	WELDER GENERAL
M144	WOOD MACHINIST
M147	WKSFITT
M186	MOTOR TRANSPORT TRIMMER
M190	SAFETY EQUIPMENT WORKER
M190	AIRCRAFT LIFE SUPPORT FITTER
M191	AIRCRAFT LIFE SUPPORT FITTER GRADE 1
M192	AIRCRAFT LIFE SUPPORT FITTER GRADE 2
M193	SURFACE FINISHER
M194	AIRCRAFT SURFACE FINISHER
M217	AIR FRAME MECHANIC
M220	ARMEMENT MECHANIC

Code	name
M231	ELECSMAN
M234	ENGINE MECHANIC
M237	FABRICATION WORKER
M241	INSTRUMENT MECHANIC
M247	MOTOR TRANSPORT MECHANIC
M253	RADIO MECHANIC
M257	WKSFITTGR1
M258	WKSFITTGR2
M262	BOILATT
M262	PLANT ATTENDANT
M274	LINESMAN
M274	TELECOMMUNICATIONS RIGGER
M299	DENTAL TECHNICIAN
M387	LABTECH
M397	AIR FRAME FITTER GRADE 1
M398	AIR FRAME FITTER GRADE 2
M401	ARMAMENT FITTER GRADE 1
M402	ARMAMENT FITTER GRADE 2
M405	ELECTRICAL FITTER GRADE 1
M406	ELECTRICAL FITTER GRADE 2
M409	ENGINE FITTER GRADE 1
M410	ENGINE FITTER GRADE 2
M413	INSTRUMENT FITTER GRADE 1
M414	INSTRUMENT FITTER GRADE 2
M415	INSTFITT3
M417	LABTECH1
M418	LABORATORY TECHNICIAN GRADE 2
M418	LABORATORY TECHNICIAN
M421	RADIO TECHNICIAN AIR GRADE 1
M422	RADIO TECHNICIAN AIR GRADE 2
M423	RADTECHA3
M425	RADIO TECHNICIAN GROUND GRADE 1

Code	name
M426	RADIO TECHNICIAN GROUND GRADE 2
M427	RADIO TECHNICIAN GROUND GRADE 3
M429	TELECOMMUNICATIONS TECHNICIAN GRADE 1
M430	TELECOMMUNICATIONS TECHNICIAN GRADE 2
M431	TELECOMMUNICATIONS TECHNICIAN GRADE 3
M446	ASYSTECH1 M447 ASYSTECH
M447	ASYSTECH2
M448	AIRCRAFT SYSTEMS TECHNICIAN
M450	AVSYSTECH1
M451	AVSYSTECH
M451	AVSYSTECH2
M452	AVIONICS SYSTEMS TECHNICIAN
M703	TRADE APPRENTICE
M703	TRADE APPRENTICE ENGINEERING
M704	TRADAPPRAD
M716	TECHNICAL APPRENTICE
M716	TECHNICAL APPRENTICE ENGINEERING
M717	TECHAPPRAD
M731	BOILATT-trainee
M731	PLANT ATTENDANT/TRAINEE
M734	CATEGORY 1A/TRAINEE
M734	CATEGORY 1/TRAINEE
M737	CAT2A-trainee
M740	CATEGORY 2B/TRAINEE
M740	CATEGORY 2/TRAINEE
M790	TELEG-trainee
M812	LABORATORY TECHNICIAN/TRAINEE
M815	MBB-trainee
M827	AIRCRAFT METAL WORKER/TRAINEE
M827	AIRCRAFT STRUCTURAL FITTER/TRAINEE
M835	AIRCRAFT MECHANIC/TRAINEE
M836	AIRCRAFT FITTER/TRAINEE

Code	name
M838	AVIONICS MECHANIC/TRAINEE
M839	AVIONICS FITTER/TRAINEE
M841	MTFITT-trainee
M842	RADIO TECHNICIAN GROUND/TRAINEE
M843	ELECTROPLATER/TRAINEE
M846	GENFITT-trainee
M852	LINESMAN/TRAINEE
M852	TELECOMMUNICATIONS RIGGER/TRAINEE
M855	METAL MACHINIST/TRAINEE
M861	SURFACE FINISHER/TRAINEE
M864	WKSFITT-trainee
M871	WOODMACH-trainee
M874	PLANTOP-trainee
M878	MCFITT-trainee
M881	SAFETY EQUIPMENT WORKER/TRAINEE
M881	AIRCRAFT LIFE SUPPORT FITTER/TRAINEE
M906	MECH-trainee
M920	AIRCRAFT MECHANIC
M921	AIRCRAFT FITTER GRADE 1
M922	AIRCRAFT FITTER GRADE 2
M923	AIRCRAFT TECHNICIAN GRADE 1
M924	AIRCRAFT TECHNICIAN GRADE 2
M925	ADVANCED AIRCRAFT TECHNICIAN
M930	AVIONICS MECHANIC
M931	AVIONICS FITTER GRADE 1
M932	AVIONICS FITTER GRADE 2
M933	AVIONICS TECHNICIAN GRADE 1
M934	AVIONICS TECHNICIAN GRADE 2
M935	ADVANCED AVIONICS TECHNICIAN

Appendix G : Procedure for Defining the Amberley Comparison Group

Some 24064 individual personnel are listed on the Air Force Personnel Executive Management System (AFPEMS) database as having been posted or attached for duty at RAAF Amberley between 1975 and 1999. Most of these were RAAF personnel but it also included some overseas military personnel on exchange as well as some Navy and Army personnel. Some 103221 postings and attachments were recorded for these personnel. The posting records for the following groups were excluded to obtain a group for random selection of an appropriate comparison group:

- Confirmed Deseal Reseal participants. The 714 Deseal Reseal group was obtained from the DVA F-111 Chemical Exposure Microsoft Access database from the Query titled “ConfirmedAmbDesRes”.
- Overseas personnel. These were identified by unique identifying numbers >800000.
- Navy and Army personnel. These were identified by rank_code >59 on the database.
- Technical categories and musterings. These were identified as “List =T” as previously assigned in the cat_must_new table.
- Aircrew categories and musterings. These were identified as “List = A” as previously assigned in the cat_must_new table.
- Personnel leaving the RAAF at Amberley. These were identified as ‘Resignation’, ‘Discharge’ or ‘Transfer to the Reserve’ in the ‘Duty’ field in the posting table shown on the following page.

Amberley Postings Table

Item	Number	Records for Selection of Comparison Group
Total Posting/Attachments Records		103221
Less Deseal Reseal group (714)	3784	99437
Less Overseas personnel	297	99140
Less Navy and Army personnel	15	99125
Less Technical occupations	39085	60040
Less Aircrew occupations	7521	52529
Less resignations, discharges and transfers to the Reserve	3885	48644

Prepared by Dr Warren Harrex, DVA

Appendix H : Procedure for Defining the Richmond Comparison Group

Some 26,063 individual personnel are listed on the Air Force Personnel Executive Management System (AFPEMS) database as having been posted or attached for duty at RAAF Richmond between 1975 and 1999. Most of these were RAAF personnel but it also included some overseas military personnel on exchange as well as some Navy and Army personnel. Some 104476 postings and attachments were recorded for these personnel. The posting records for the following groups were excluded to obtain a group for random selection of an appropriate comparison group:

- Confirmed Deseal Reseal participants. The 714 Deseal Reseal group was obtained from the DVA F-111 Chemical Exposure Microsoft Access database from the Query titled “ConfirmedAmbDesRes”.
- Overseas personnel. These were identified by unique identifying numbers >800000.
- Navy and Army personnel. These were identified by rank_code >59 on the database.
- Technical categories and musterings. These were identified as “List = null” as previously assigned in the cat_must_new table.
- Aircrew categories and musterings. These were identified as “List = A” as previously assigned in the cat_must_new table.
- Personnel leaving the RAAF at Richmond. These were identified as ‘Resignation’, ‘Discharge’ or ‘Transfer to the Reserve’ in the ‘Duty’ field in the posting table shown on the following page.

Richmond Postings Table

Item	Number	Records for Selection of Comparison Group
Total Posting/Attachments Records		104476
Less Deseal Reseal group (714)	820	103656
Less Overseas personnel	176	103480
Less Navy and Army personnel	0	103480
Less Non Technical occupations	54401	49079
Less Aircrew occupations	12847	36232
Less resignations, discharges and transfers to the Reserve	1910	34322
Personnel eligible for comparison group	10100	34322 postings records

Prepared by Dr Warren Harrex, DVA

Appendix I : Strata Weights

Sampling Weights – First Date

Posting Category	Age Category	Rank Category	Exposed Group Strata Number	Amberley Comp. Group Strata Number	Richmond Comp. Group Strata Number	Exposed Group Strata Percent	Amberley Comp.Group Strata Percent	Richmond Comp. Group Strata Percent	Exposed Group Strata Weight	Amberley Comp. Group Strata Weight	Richmond Comp. Group Strata Weight
1980-84	40-44	Enlisted	63	244	312	6.892779	3.136247	3.200328	1	2.19778	2.153772
1980-84	45-49	Enlisted	84	306	590	9.190372	3.933162	6.051903	1	2.336637	1.518592
1980-84	50-54	Enlisted	31	256	330	3.391685	3.290488	3.384963	1	1.030754	1.001986
1980-84	55-59	Enlisted	16	103	108	1.750547	1.323907	1.107806	1	1.322258	1.580193
1980-84	60-64	Enlisted	3	55	41	0.3282276	0.7069409	0.4205559	1	0.4642928	0.7804611
1980-84	65-69	Enlisted	2	26	18	0.2188184	0.3341902	0.1846343	1	0.6547719	1.185145
1980-84	70-74	Enlisted	1	6	4	0.1094092	0.0771208	0.0410298	1	1.418672	2.666576
1980-84	35-39	Enlisted	58	173	319	6.345733	2.22365	3.27213	1	2.853746	1.939328
1980-84	40-44	Enlisted	61	346	615	6.673961	4.447301	6.308339	1	1.500677	1.057958
1980-84	45-49	Enlisted	21	148	273	2.297593	1.902314	2.800287	1	1.207789	0.8204848
1980-84	50-54	Enlisted	5	92	102	0.5470459	1.182519	1.046261	1	0.4626106	0.5228579
1980-84	55-59	Enlisted	2	38	38	0.2188184	0.4884319	0.3897836	1	0.4480019	0.5613843
1980-84	60-64	Enlisted	2	20	8	0.2188184	0.2570694	0.0820597	1	0.8512035	2.666576
1980-84	65-69	Enlisted	2	7	2	0.2188184	0.0899743	0.0205149	1	2.43201	10.6663
1980-84	70-74	Enlisted	1	3	1	0.1094092	0.0385604	0.0102575	1	2.837345	10.6663
1980-84	45-49	NCO	13	35	40	1.42232	0.4498715	0.4102985	1	3.161613	3.466548
1980-84	50-54	NCO	22	149	246	2.407002	1.915167	2.523336	1	1.256811	0.9538969
1980-84	55-59	NCO	29	135	262	3.172867	1.735219	2.687455	1	1.828511	1.180621

Posting Category	Age Category	Rank Category	Exposed Group Strata Number	Amberley Comp. Group Strata Number	Richmond Comp. Group Strata Number	Exposed Group Strata Percent	Amberley Comp.Group Strata Percent	Richmond Comp. Group Strata Percent	Exposed Group Strata Weight	Amberley Comp. Group Strata Weight	Richmond Comp. Group Strata Weight
1980-84	60-64	NCO	10	132	114	1.094092	1.696658	1.169351	1	0.6448511	0.9356405
1980-84	65-69	NCO	9	80	73	0.9846827	1.028278	0.7487947	1	0.957604	1.315024
1980-84	70-74	NCO	3	43	52	0.3282276	0.5526992	0.533388	1	0.593863	0.6153636
1980-84	40-44	NCO	2	15	53	0.2188184	0.1928021	0.5436455	1	1.134938	0.402502
1980-84	45-49	NCO	12	83	182	1.31291	1.066838	1.866858	1	1.230656	0.7032727
1980-84	50-54	NCO	19	146	215	2.078775	1.876607	2.205354	1	1.107731	0.9426034
1980-84	55-59	NCO	7	175	157	0.7658643	2.249357	1.610422	1	0.3404814	0.4755676
1980-84	60-64	NCO	5	124	50	0.5470459	1.59383	0.5128731	1	0.3432272	1.06663
1980-84	65-69	NCO	2	55	39	0.2188184	0.7069409	0.400041	1	0.3095285	0.5469898
1980-84	70-74	NCO	1	28	19	0.1094092	0.3598972	0.1948918	1	0.3040012	0.5613843
1980-84	45-49	Officer	5	55	40	0.5470459	0.7069409	0.4102985	1	0.7738214	1.333288
1980-84	55-59	Officer	3	88	30	0.3282276	1.131105	0.3077239	1	0.290183	1.06663
1980-84	60-64	Officer	2	69	25	0.2188184	0.8868895	0.2564366	1	0.2467256	0.8533041
1980-84	65-69	Officer	1	29	20	0.1094092	0.3727506	0.2051492	1	0.2935185	0.5333151
1980-84	40-44	Officer	5	36	58	0.5470459	0.4627249	0.5949328	1	1.182227	0.9195088
1980-84	45-49	Officer	2	59	17	0.2188184	0.7583548	0.1743769	1	0.2885436	1.254859
1980-84	50-54	Officer	3	60	24	0.3282276	0.7712082	0.2461791	1	0.4256018	1.333288
1980-84	55-59	Officer	2	69	13	0.2188184	0.8868895	0.133347	1	0.2467256	1.64097
1980-84	60-64	Officer	1	42	11	0.1094092	0.5398458	0.1128321	1	0.2026675	0.9696638
1985-89	30-34	Enlisted	47	215	370	5.142232	2.763496	3.795261	1	1.86077	1.354909
1985-89	35-39	Enlisted	70	436	629	7.658643	5.604113	6.451944	1	1.366611	1.187029
1985-89	40-44	Enlisted	27	227	352	2.954048	2.917738	3.610627	1	1.012445	0.8181539

Posting Category	Age Category	Rank Category	Exposed Group Strata Number	Amberley Comp. Group Strata Number	Richmond Comp. Group Strata Number	Exposed Group Strata Percent	Amberley Comp.Group Strata Percent	Richmond Comp. Group Strata Percent	Exposed Group Strata Weight	Amberley Comp. Group Strata Weight	Richmond Comp. Group Strata Weight
1985-89	45-49	Enlisted	11	83	100	1.203501	1.066838	1.025746	1	1.128101	1.173293
1985-89	50-54	Enlisted	2	23	27	0.2188184	0.2956298	0.2769515	1	0.7401769	0.7900964
1985-89	60-64	Enlisted	2	6	1	0.2188184	0.0771208	0.0102575	1	2.837345	21.33261
1985-89	35-39	NCO	2	26	38	0.2188184	0.3341902	0.3897836	1	0.6547719	0.5613843
1985-89	40-44	NCO	7	84	159	0.7658643	1.079692	1.630937	1	0.7093362	0.4695856
1985-89	45-49	NCO	10	99	162	1.094092	1.272494	1.661709	1	0.8598015	0.6584136
1985-89	50-54	NCO	9	124	145	0.9846827	1.59383	1.487332	1	0.617809	0.6620464
1985-89	55-59	NCO	3	82	64	0.3282276	1.053985	0.6564776	1	0.3114159	0.4999829
1985-89	60-64	NCO	3	36	28	0.3282276	0.4627249	0.2872089	1	0.7093363	1.142818
1985-89	35-39	Officer	6	46	97	0.6564552	0.5912597	0.9949738	1	1.110265	0.6597713
1985-89	40-44	Officer	3	43	29	0.3282276	0.5526992	0.2974664	1	0.593863	1.103411
1985-89	45-49	Officer	1	63	27	0.1094092	0.8097686	0.2769515	1	0.1351117	0.3950482
1985-89	50-54	Officer	4	64	17	0.4376368	0.8226221	0.1743769	1	0.5320022	2.509718
1985-89	55-59	Officer	1	39	4	0.1094092	0.5012854	0.0410298	1	0.2182573	2.666576
1985-89	60-64	Officer	1	34	4	0.1094092	0.437018	0.0410298	1	0.250354	2.666576
1990-94	25-29	Enlisted	12	230	216	1.31291	2.956298	2.215612	1	0.4441062	0.5925723
1990-94	30-34	Enlisted	36	355	602	3.938731	4.562982	6.174992	1	0.8631923	0.637852
1990-94	35-39	Enlisted	19	155	225	2.078775	1.992288	2.307929	1	1.043411	0.90071
1990-94	40-44	Enlisted	14	74	91	1.531729	0.9511568	0.9334291	1	1.610385	1.64097
1990-94	45-49	Enlisted	6	15	38	0.6564552	0.1928021	0.3897836	1	3.404814	1.684153
1990-94	50-54	Enlisted	2	8	12	0.2188184	0.1028278	0.1230895	1	2.128009	1.777717
1990-94	55-59	Enlisted	1	3	2	0.1094092	0.0385604	0.0205149	1	2.837345	5.333151

Posting Category	Age Category	Rank Category	Exposed Group Strata Number	Amberley Comp. Group Strata Number	Richmond Comp. Group Strata Number	Exposed Group Strata Percent	Amberley Comp.Group Strata Percent	Richmond Comp. Group Strata Percent	Exposed Group Strata Weight	Amberley Comp. Group Strata Weight	Richmond Comp. Group Strata Weight
1990-94	30-34	NCO	3	9	92	0.3282276	0.1156812	0.9436865	1	2.837345	0.3478142
1990-94	35-39	NCO	3	44	106	0.3282276	0.5655527	1.087291	1	0.580366	0.3018765
1990-94	40-44	NCO	7	56	112	0.7658643	0.7197943	1.148836	1	1.064004	0.6666439
1990-94	45-49	NCO	10	41	61	1.094092	0.5269923	0.6257052	1	2.076106	1.748574
1990-94	50-54	NCO	3	31	44	0.3282276	0.3984576	0.4513283	1	0.8237453	0.7272479
1990-94	55-59	NCO	1	22	27	0.1094092	0.2827764	0.2769515	1	0.3869107	0.3950482
1990-94	60-64	NCO	2	16	5	0.2188184	0.2056555	0.0512873	1	1.064004	4.266521
1990-94	30-34	Officer	1	80	57	0.1094092	1.028278	0.5846754	1	0.1064004	0.1871281
1990-94	35-39	Officer	1	59	30	0.1094092	0.7583548	0.3077239	1	0.1442718	0.3555434
1990-94	45-49	Officer	1	42	10	0.1094092	0.5398458	0.1025746	1	0.2026675	1.06663
1990-94	50-54	Officer	1	27	6	0.1094092	0.3470437	0.0615448	1	0.3152606	1.777717
1995-99	20-24	Enlisted	1	155	77	0.1094092	1.992288	0.7898246	1	0.0549164	0.1385234
1995-99	25-29	Enlisted	29	292	248	3.172867	3.753213	2.543851	1	0.8453733	1.247269
1995-99	30-34	Enlisted	10	187	126	1.094092	2.403599	1.29244	1	0.455189	0.8465319
1995-99	35-39	Enlisted	4	73	59	0.4376368	0.9383034	0.6051903	1	0.4664129	0.7231391
1995-99	40-44	Enlisted	2	26	23	0.2188184	0.3341902	0.2359216	1	0.6547719	0.9275045
1995-99	45-49	Enlisted	2	11	5	0.2188184	0.1413882	0.0512873	1	1.547643	4.266521
1995-99	25-29	NCO	1	3	108	0.1094092	0.0385604	1.107806	1	2.837345	0.0987621
1995-99	30-34	NCO	7	39	250	0.7658643	0.5012854	2.564366	1	1.527801	0.2986564
1995-99	35-39	NCO	2	56	126	0.2188184	0.7197943	1.29244	1	0.3040012	0.1693064
1995-99	40-44	NCO	2	63	76	0.2188184	0.8097686	0.7795671	1	0.2702233	0.2806922
1995-99	45-49	NCO	2	45	29	0.2188184	0.5784062	0.2974664	1	0.3783127	0.7356071

Posting Category	Age Category	Rank Category	Exposed Group Strata Number	Amberley Comp. Group Strata Number	Richmond Comp. Group Strata Number	Exposed Group Strata Percent	Amberley Comp.Group Strata Percent	Richmond Comp. Group Strata Percent	Exposed Group Strata Weight	Amberley Comp. Group Strata Weight	Richmond Comp. Group Strata Weight
1995-99	50-54	NCO	2	14	12	0.2188184	0.1799486	0.1230895	1	1.216005	1.777717
1995-99	55-59	NCO	1	14	6	0.1094092	0.1799486	0.0615448	1	0.6080025	1.777717
1995-99	25-29	Officer	2	83	54	0.2188184	1.066838	0.553903	1	0.2051093	0.3950482
1995-99	35-39	Officer	1	56	21	0.1094092	0.7197943	0.2154067	1	0.1520006	0.5079191
1995-99	40-44	Officer	2	60	25	0.2188184	0.7712082	0.2564366	1	0.2837345	0.8533041
1995-99	45-49	Officer	1	48	8	0.1094092	0.6169666	0.0820597	1	0.1773341	1.333288
1995-99	50-54	Officer	1	28	6	0.1094092	0.3598972	0.0615448	1	0.3040012	1.777717

Sampling Weights – Last Date

Posting Category	Age Category	Rank Category	Exposed Group Strata Number	Amberley Comp. Group Strata Number	Richmond Comp. Group Strata Number	Exposed Group Strata Percent	Amberley Comp.Group Strata Percent	Richmond Comp. Group Strata Percent	Exposed Group Strata Weight	Amberley Comp. Group Strata Weight	Richmond Comp. Group Strata Weight
1975-79	40-44	Enlisted	63	94	102	6.892779	1.223162	1.051763	1	5.635213	6.553546
1975-79	45-49	Enlisted	84	154	258	9.190372	2.003904	2.660342	1	4.586235	3.454582
1975-79	50-54	Enlisted	31	119	152	3.391685	1.548471	1.567333	1	2.190344	2.163984
1975-79	55-59	Enlisted	16	47	55	1.750547	0.611581	0.5671272	1	2.86233	3.086692
1975-79	60-64	Enlisted	3	31	27	0.3282276	0.4033832	0.2784079	1	0.8136867	1.178945
1975-79	65-69	Enlisted	2	17	9	0.2188184	0.2212102	0.0928026	1	0.9891878	2.35789
1975-79	70-74	Enlisted	1	5	3	0.1094092	0.0650618	0.0309342	1	1.681619	3.536834
1975-79	45-49	NCO	13	23	30	1.42232	0.2992843	0.3093421	1	4.752403	4.597885
1975-79	50-54	NCO	22	94	164	2.407002	1.223162	1.69107	1	1.967852	1.42336
1975-79	55-59	NCO	29	81	165	3.172867	1.054001	1.701382	1	3.010306	1.864876
1975-79	60-64	NCO	10	80	70	1.094092	1.040989	0.7217983	1	1.051012	1.515786
1975-79	65-69	NCO	9	51	54	0.9846827	0.6636304	0.5568159	1	1.483782	1.768417
1975-79	70-74	NCO	3	29	38	0.3282276	0.3773585	0.3918334	1	0.8698031	0.8376713
1975-79	45-49	Officer	5	30	19	0.5470459	0.3903708	0.1959167	1	1.401349	2.792238
1975-79	55-59	Officer	3	46	28	0.3282276	0.5985686	0.2887193	1	0.5483541	1.13684
1975-79	60-64	Officer	2	44	19	0.2188184	0.5725439	0.1959167	1	0.3821862	1.116895
1975-79	65-69	Officer	1	13	18	0.1094092	0.1691607	0.1856053	1	0.6467766	0.5894724
1980-84	35-39	Enlisted	58	71	141	6.345733	0.9238777	1.453908	1	6.868586	4.364604

Posting Category	Age Category	Rank Category	Exposed Group Strata Number	Amberley Comp. Group Strata Number	Richmond Comp. Group Strata Number	Exposed Group Strata Percent	Amberley Comp.Group Strata Percent	Richmond Comp. Group Strata Percent	Exposed Group Strata Weight	Amberley Comp. Group Strata Weight	Richmond Comp. Group Strata Weight
1980-84	40-44	Enlisted	61	261	420	6.673961	3.396226	4.33079	1	1.965111	1.541049
1980-84	45-49	Enlisted	21	111	264	2.297593	1.444372	2.722211	1	1.590721	0.8440173
1980-84	50-54	Enlisted	5	73	86	0.5470459	0.9499024	0.8867808	1	0.575897	0.6168897
1980-84	55-59	Enlisted	2	38	41	0.2188184	0.4944697	0.4227676	1	0.4425314	0.5175855
1980-84	60-64	Enlisted	2	27	10	0.2188184	0.3513338	0.103114	1	0.6228219	2.122101
1980-84	65-69	Enlisted	2	9	3	0.2188184	0.1171113	0.0309342	1	1.868466	7.073669
1980-84	70-74	Enlisted	1	3	1	0.1094092	0.0390371	0.0103114	1	2.802699	10.6105
1980-84	40-44	NCO	2	19	53	0.2188184	0.2472349	0.5465044	1	0.8850628	0.4003963
1980-84	45-49	NCO	12	65	209	1.31291	0.8458035	2.155083	1	1.552264	0.6092156
1980-84	50-54	NCO	19	135	263	2.078775	1.756669	2.711899	1	1.183362	0.7665383
1980-84	55-59	NCO	7	163	196	0.7658643	2.121015	2.021035	1	0.3610839	0.3789465
1980-84	60-64	NCO	5	137	78	0.5470459	1.782694	0.8042895	1	0.3068648	0.6801605
1980-84	65-69	NCO	2	72	49	0.2188184	0.9368901	0.5052588	1	0.2335582	0.4330818
1980-84	70-74	NCO	1	43	34	0.1094092	0.5595316	0.3505878	1	0.1955371	0.3120736
1980-84	40-44	Officer	5	22	32	0.5470459	0.286272	0.3299649	1	1.910931	1.657891
1980-84	45-49	Officer	2	44	22	0.2188184	0.5725439	0.2268509	1	0.3821862	0.9645912
1980-84	50-54	Officer	3	53	23	0.3282276	0.6896552	0.2371623	1	0.47593	1.383979
1980-84	55-59	Officer	2	66	13	0.2188184	0.8588158	0.1340483	1	0.2547908	1.632385
1980-84	60-64	Officer	1	39	11	0.1094092	0.5074821	0.1134254	1	0.2155922	0.9645912
1985-89	30-34	Enlisted	47	69	131	5.142232	0.897853	1.350794	1	5.727254	3.806822
1985-89	35-39	Enlisted	70	233	442	7.658643	3.03188	4.557641	1	2.526037	1.680397

Posting Category	Age Category	Rank Category	Exposed Group Strata Number	Amberley Comp. Group Strata Number	Richmond Comp. Group Strata Number	Exposed Group Strata Percent	Amberley Comp.Group Strata Percent	Richmond Comp. Group Strata Percent	Exposed Group Strata Weight	Amberley Comp. Group Strata Weight	Richmond Comp. Group Strata Weight
1985-89	40-44	Enlisted	27	131	305	2.954048	1.704619	3.144978	1	1.732966	0.9392905
1985-89	45-49	Enlisted	11	56	82	1.203501	0.7286922	0.8455352	1	1.65159	1.42336
1985-89	50-54	Enlisted	2	23	32	0.2188184	0.2992843	0.3299649	1	0.7311388	0.6631564
1985-89	35-39	NCO	2	33	35	0.2188184	0.4294079	0.3608992	1	0.5095816	0.6063145
1985-89	40-44	NCO	7	92	213	0.7658643	1.197137	2.196329	1	0.6397465	0.348702
1985-89	45-49	NCO	10	105	241	1.094092	1.366298	2.485049	1	0.8007711	0.4402698
1985-89	50-54	NCO	9	192	234	0.9846827	2.498374	2.412869	1	0.3941295	0.4080963
1985-89	55-59	NCO	3	111	111	0.3282276	1.444372	1.144566	1	0.2272459	0.2867703
1985-89	60-64	NCO	5	47	43	0.5470459	0.611581	0.4433904	1	0.8944783	1.233779
1985-89	35-39	Officer	6	17	71	0.6564552	0.2212102	0.7321097	1	2.967563	0.8966622
1985-89	40-44	Officer	3	33	44	0.3282276	0.4294079	0.4537018	1	0.7643724	0.7234434
1985-89	45-49	Officer	1	63	33	0.1094092	0.8197788	0.3402764	1	0.1334618	0.3215304
1985-89	50-54	Officer	4	58	24	0.4376368	0.754717	0.2474737	1	0.5798687	1.768417
1985-89	55-59	Officer	1	47	6	0.1094092	0.611581	0.0618684	1	0.1788957	1.768417
1985-89	60-64	Officer	1	40	7	0.1094092	0.5204945	0.0721798	1	0.2102024	1.515786
1990-94	25-29	Enlisted	12	127	80	1.31291	1.65257	0.8249124	1	0.7944658	1.591576
1990-94	30-34	Enlisted	36	229	381	3.938731	2.979831	3.928645	1	1.321797	1.002567
1990-94	35-39	Enlisted	19	157	167	2.078775	2.042941	1.722005	1	1.01754	1.207183
1990-94	40-44	Enlisted	14	61	54	1.531729	0.793754	0.5568159	1	1.929727	2.750871
1990-94	45-49	Enlisted	6	21	31	0.6564552	0.2732596	0.3196535	1	2.402313	2.053646

Posting Category	Age Category	Rank Category	Exposed Group Strata Number	Amberley Comp. Group Strata Number	Richmond Comp. Group Strata Number	Exposed Group Strata Percent	Amberley Comp.Group Strata Percent	Richmond Comp. Group Strata Percent	Exposed Group Strata Weight	Amberley Comp. Group Strata Weight	Richmond Comp. Group Strata Weight
1990-94	50-54	Enlisted	2	13	8	0.2188184	0.1691607	0.0824912	1	1.293553	2.652626
1990-94	55-59	Enlisted	1	4	3	0.1094092	0.0520494	0.0309342	1	2.102024	3.536834
1990-94	30-34	NCO	3	23	155	0.3282276	0.2992843	1.598268	1	1.096708	0.2053646
1990-94	35-39	NCO	3	96	222	0.3282276	1.249187	2.289132	1	0.262753	0.1433852
1990-94	40-44	NCO	7	134	257	0.7658643	1.743657	2.650031	1	0.4392289	0.289002
1990-94	45-49	NCO	10	136	183	1.094092	1.769681	1.886987	1	0.6182424	0.579809
1990-94	50-54	NCO	3	96	115	0.3282276	1.249187	1.185812	1	0.262753	0.2767957
1990-94	55-59	NCO	1	69	49	0.1094092	0.897853	0.5052588	1	0.1218565	0.2165409
1990-94	60-64	NCO	2	46	15	0.2188184	0.5985686	0.1546711	1	0.3655694	1.414734
1990-94	30-34	Officer	1	42	36	0.1094092	0.5465192	0.3712105	1	0.2001928	0.2947362
1990-94	35-39	Officer	1	49	40	0.1094092	0.6376057	0.4124562	1	0.1715938	0.2652626
1990-94	45-49	Officer	1	44	22	0.1094092	0.5725439	0.2268509	1	0.1910931	0.4822956
1990-94	50-54	Officer	1	44	12	0.1094092	0.5725439	0.1237369	1	0.1910931	0.8842086
1995-99	20-24	Enlisted	1	154	77	0.1094092	2.003904	0.7939782	1	0.054598	0.1377987
1995-99	25-29	Enlisted	29	341	246	3.172867	4.437215	2.536606	1	0.7150581	1.250832
1995-99	30-34	Enlisted	10	308	165	1.094092	4.007807	1.701382	1	0.2729901	0.6430608
1995-99	35-39	Enlisted	4	129	75	0.4376368	1.678595	0.7733553	1	0.2607162	0.5658935
1995-99	40-44	Enlisted	2	58	48	0.2188184	0.754717	0.4949474	1	0.2899343	0.4421043
1995-99	45-49	Enlisted	2	23	11	0.2188184	0.2992843	0.1134254	1	0.7311388	1.929182
1995-99	25-29	NCO	1	47	246	0.1094092	0.611581	2.536606	1	0.1788957	0.0431321
1995-99	30-34	NCO	7	166	604	0.7658643	2.160052	6.228088	1	0.3545583	0.1229694

Posting Category	Age Category	Rank Category	Exposed Group Strata Number	Amberley Comp. Group Strata Number	Richmond Comp. Group Strata Number	Exposed Group Strata Percent	Amberley Comp.Group Strata Percent	Richmond Comp. Group Strata Percent	Exposed Group Strata Weight	Amberley Comp. Group Strata Weight	Richmond Comp. Group Strata Weight
1995-99	35-39	NCO	2	228	416	0.2188184	2.966819	4.289544	1	0.0737552	0.051012
1995-99	40-44	NCO	2	259	326	0.2188184	3.370202	3.361518	1	0.0649274	0.0650951
1995-99	45-49	NCO	2	151	154	0.2188184	1.964867	1.587956	1	0.1113655	0.1377987
1995-99	50-54	NCO	2	78	63	0.2188184	1.014964	0.6496185	1	0.2155922	0.3368414
1995-99	55-59	NCO	1	49	37	0.1094092	0.6376057	0.381522	1	0.1715938	0.2867703
1995-99	25-29	Officer	2	95	55	0.2188184	1.236174	0.5671272	1	0.1770126	0.3858365
1995-99	35-39	Officer	1	116	41	0.1094092	1.509434	0.4227676	1	0.0724836	0.2587928
1995-99	40-44	Officer	2	132	48	0.2188184	1.717632	0.4949474	1	0.1273954	0.4421043
1995-99	45-49	Officer	1	110	23	0.1094092	1.43136	0.2371623	1	0.0764372	0.4613262
1995-99	50-54	Officer	1	91	19	0.1094092	1.184125	0.1959167	1	0.0923967	0.5584475

Appendix J : Organisations Which Provided Ethics Approval

Organisation	Committee
The University of Newcastle	The University of Newcastle Human Research Ethics Committee
Australian Defence	Australian Defence Human Research Ethics Committee
Commonwealth Department of Veterans' Affairs (DVA)	DVA Human Research Ethics Committee
Australian Institute of Health and Welfare (AIHW)	AIHW Ethics Committee
ACT Department Of Health & Community Care	Human Research Ethics Committee
NSW Health Department	Endorsement of the Cancer Council's Ethic Committee's decisions
NT Department of Health & Community Services and Menzies School of Health Research	Human Research Ethics Committee
Queensland Cancer Registry	Queensland Cancer Registry Advisory Committee
SA Department of Human Services: Strategic Planning and Policy Division	Human Research Ethics Sub-Committee
Tasmanian Cancer Registry: Menzies Centre for Population Health Research, University of Tasmania	Authority for the release of named data on Tasmanian cancer cases
The Cancer Council	Human Research Ethics Committee
WA Department of Health	Confidentiality of Health Information Committee (CHIC)

Appendix K : Charactertics of Individuals Selected Using Latest Posting Date

	Exposed category 1 N = 687		Exposed category 2 N =227		Amberley comparison N = 7780		Richmond comparison N =9749	
	N	%	N	%	N	%	N	%
Exposure / Posting Category								
1975-79	220	*32*	77	*34*	1811	*23*	2305	*24*
1980-84	159	*23*	54	*24*	1719	*22*	2196	*22*
1985-89	156	*23*	53	*23*	1730	*22*	2253	*23*
1990-94	98	*14*	25	*11*	1267	*16*	1736	*18*
1995-99	54	*8*	18	*8*	1253	*16*	1259	*13*
Age Group								
20-24	1	*0.2*	0	*0*	155	*2*	77	*0.8*
25-29	31	*4.5*	13	*5.7*	608	*7.8*	626	*6.4*
30-34	91	*13*	13	*5.7*	885	*11*	1497	*15*
35-39	128	*19*	38	*17*	1124	*14*	1650	*17*
40-44	151	*22*	44	*19*	1274	*16*	1905	*20*
45-49	148	*21*	33	*14*	1133	*15*	1582	*16*
50-54	69	*10*	35	*15*	1022	*13*	1186	*12*
55-59	40	*6*	26	*12*	768	*9.9*	711	*7.3*
60-64	15	*2.2*	16	*7.1*	534	*6.9*	287	*2.9*
65-69	10	*1.5*	6	*2.6*	197	*2.5*	152	*1.6*
70-75	3	*0.4*	3	*1.3*	80	*1*	76	*0.8*
Rank								
Enlisted	514	*73*	135	*59*	4397	*57*	5964	*61*
Non-Comm Off	156	*23*	58	*26*	2104	*27*	3152	32
Officer	17	*2.5*	34	*15*	1279	*16*	633	*6.5*

** Percentages may not add to 100 exactly, due to rounding*

Appendix L : Reasons for Postings - Exposed / Comparison Groups, Selected Using Latest Posting Date

Description of Posting	Exposed category 1 N = 658		Exposed category 2 N =202		Amberley comparison N = 7685		Richmond comparison N =9698	
	N	%	N	%	N	%	N	%
AFMAN Enlistment Posting.	0	-	1	*0.5*	84	*1.1*	27	*0.3*
AFMAN initial load history	497	*76*	153	*76*	2566	*33*	2765	*29*
Attachment	0	-	1	*0.5*	391	*5.1*	242	*2.5*
Attachment – AFMAN Initial Load	74	*11*	26	*13*	2045	*27*	3652	*37*
Attachment - Exercise Manning	0	-	0	-	44	*0.6*	49	*0.5*
Attachment – Relief Manning	1	*0.1*	0	-	67	*0.9*	25	*0.3*
Attachment – Temporary Duty Overseas	0	-	0	-	8	*0.1*	23	*0.2*
Attachment – Training / Course	4	*0.6*	2	*1.0*	961	*13*	1208	*12*
Posting	75	*11*	17	*8*	1200	*15*	1549	*16*
Posting – Discharge	0	-	0	-	13	*0.2*	6	*0.1*
Posting – Discharge – Medically Unfit	0	-	0	-	2	*0.0*	1	*0.0*
Posting – Preferential Treatment	0	-	0	-	12	*0.2*	6	*0.1*
Posting - Relief Manning	0	-	0	-	20	*0.3*	0	-
Posting – Supernumerary	6	*0.9*	2	*1.0*	88	*1.1*	89	*0.9*

Appendix L continued…

Description of Posting	Exposed category 1 N = 658		Exposed category 2 N =202		Amberley comparison N = 7685		Richmond comparison N =9698	
	N	%	N	%	N	%	N	%
Posting – Training / Course	1	*0.1*	0	-	155	2.0	12	0.1
Posting – Transfer to General Reserve	0	-	0	-	2	*0.0*	0	-
Posting Non Effective - LWOP	0	-	0	-	1	*0.0*	0	-
Posting Non Effective – Medical	0	-	0	-	26	*0.3*	36	*0.4*
Attachment – Detention Purposes	0	-	0	-	0	-	1	*0.0*
Posting – Full Time Civil Schooling	0	-	0	-	0	-	2	*0.0*
Posting Non Effective – SLWOPASM	0	-	0	-	0	-	5	*0.1*

Appendix M : Reasons for Postings - Exposed / Comparison Groups, Selected Using Earliest Posting Date

Description of Posting	Exposed category 1 N = 658		Exposed category 2 N =202		Amberley comparison N = 7780		Richmond comparison N =9749	
	N	%	N	%	N	%	N	%
AFMAN Enlistment Posting.	0	*0.0*	1	*0.5*	128	*1.7*	23	*0.2*
AFMAN initial load history	479	*76*	153	*76*	4170	*54*	4828	*49*
Attachment	0	*0.0*	1	*0.5*	98	*1.3*	84	*0.9*
Attachment – AFMAN Initial Load	74	*11*	26	*13*	1860	*24*	3175	*33*
Attachment - Exercise Manning	0	*0.0*	0	*0.0*	5	*0.1*	18	*0.2*
Attachment – Relief Manning	1	*0.2*	0	*0.0*	29	*0.4*	7	*0.1*
Attachment – Training / Course	4	*0.6*	2	*1.0*	240	*3*	671	*6.9*
Posting	75	*11*	17	*8*	734	*9*	788	*8*
Posting – Discharge	0	*0.0*	0	*0.0*	5	*0.1*	2	*0.0*
Posting – Preferential Treatment	0	*0.0*	0	*0.0*	9	*0.1*	2	*0.0*
Posting - Relief Manning	0	*0.0*	0	*0.0*	5	*0.1*	0	*0.0*
Posting – Supernumerary	6	*0.9*	2	*1.0*	58	*0.7*	128	*1.3*
Posting – Training / Course	1	*0.2*	0	*0.0*	435	*5*	14	*0.1*
Posting Non Effective - Medical	0	*0.0*	0	*0.0*	3	*0.0*	9	*0.1*
Posting Non Effective – SLWOPASM	0	*0.0*	0	*0.0*	1	*0.0*	0	*0.0*

Appendix N : Analyses Based on Selection of Comparison Groups using Latest Posting Dates

Table N1 – Observed (Unweighted) Numbers of Cancers, Total and Sub-Types, in each Group and Weighted Group Totals

Cancers	Exposed category 1	Exposed category 2	Amberley comparison	Richmond comparison
Haematopoietic	0	0	11	13
Liver and pancreas	0	0	0	5
Brain and CNS	0	0	3	7
Genitourinary	1	3	33	30
Lung	2	0	14	6
Buccal cavity	3	0	13	12
Other	12	1	78	72
Total (unweighted)	**18**	**4**	**152**	**145**
Total (weighted)	**18**	**4**	**133**	**164**
Person years (unweighted)	**10690**	**3620**	**77775**	**105195**
Person years (weighted)	**10690**	**3620**	**115813**	**146019**

Table N2 – Standardised Incidence Rates for Cancer*

	Comparison	Cancer Incidence Ratio	95% CI
Cancer (exposed category 1 & 2)	Exposed vs Amberley Comp	1.34	0.81 – 2.11
	Exposed vs Richmond Comp	1.37	0.83 – 2.14
Cancer (exposed category 1 only)	Exposed vs Amberley Comp	1.47	0.84 – 2.41
	Exposed vs Richmond Comp	1.50	0.87 – 2.44
Comparison	Amberley Comp vs Richmond Comp	1.02	0.81 – 1.29

** weighted analysis*

Table N3 – Observed (Unweighted) Numbers of Deaths, Total and Sub-Types, in each Group and Weighted Group Totals

Deaths	Exposed category 1	Exposed category 2	Amberley comparison	Richmond comparison
Cancer	4	0	25	29
Cardiovascular disease	0	0	21	25
Injuries and Accidents	0	0	17	32
Other	3	0	16	8
Total (unweighted)	**7**	**0**	**79**	**94**
Total (weighted)	**7**	**0**	**103**	**111**
Person Years (unweighted)	**11460**	**3854**	**86210**	**115547**
Person Years (weighted)	**11460**	**3854**	**124184**	**156586**

Table N4 – Standardised Mortality Rates*

	Comparison	Mortality Ratio	95% CI
Deaths (exposed category 1 & 2)	Exposed vs Amberley Comp	0.55	0.22 – 1.18
	Exposed vs Richmond Comp	0.64	0.25 – 1.37
Deaths (exposed category 1 only)	Exposed vs Amberley Comp	0.74	0.29 – 1.57
	Exposed vs Richmond Comp	0.86	0.34 – 1.84
Comparisons	Amberley Comp vs Richmond Comp	1.17	0.89 – 1.54

* weighted analysis

Appendix O : Mortality and Cancer in the General Population

Mortality Data[12]

Cancer and cardiovascular disease are the major causes of death for males aged 45 years and over. In the younger years, injury and poisoning claim that majority of male lives. In the year 2000 the major cause of death for Australian males aged 15-24 was injury and poisoning (51%) while cancer was responsible for 7% of deaths. For males aged 25-44, injury and poisoning was the major cause of death (52%) followed by cardiovascular disease and cancer (13% and 12% respectively). Those aged 45-64 died most commonly from cancer (41%) and cardiovascular disease (29%). The age groups 65-84 and 85 years plus died from cardiovascular disease (38% and 48% respectively) and cancers (35% and 18%).

Cancer Data[13]

The age-standardised incidence rate in 1999 for all cancers combined (excluding non-melanocytic skin cancers) was 469.6 new cases per 100,000 for males and 339.2 per 100,000 for females, resulting in an age-adjusted sex ratio of 1.4. Males have a higher incidence rate for every cancer site, except breast and cancers of the anus, gall bladder, thyroid and adrenal gland. In age groupings, 10% of all cancers occur in the 15-44 year group, 32% in the 45-64 year group and 58% in those aged 65 and over. Patterns of cancer deaths are similar to these levels although a higher proportion of deaths due to cancer occurs in the 65 years and over age group. The age-specific incidence rate for all cancers in 1999 (excluding non-melanocytic skin cancers) was 94.5 per 100,000 population for 15-44 year old, 3678 per 100,000 for 45-64 year olds and 2143 for those aged 65 years and over, showing that cancer risk increases with age.

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[12] www.aihw.gov.au/mortality/faqs.html

[13] Source: Cancer in Australia 1999. November 2002. Australian Institute of Health and Welfare, Australasian Association of Cancer Registries, Canberra. AIHW cat no CAN 15.

The most common cancers are those of the colon and rectum, collectively known as bowel or colorectal cancer. It was the most common cancer in 1999 among both sexes with 11,637 new cases. As the group in the current study is all male this section concentrates on the statistics relating to cancers occurring in males only. The most common cancers in males in 1999 were: prostate (10,232 new cases), colorectal (6,188 new cases), lung cancer (5,275 new cases), melanoma (4,627 new cases), and bladder (2076 new cases). Cancer deaths in males in 1999 were most commonly lung cancer (4,645 deaths), prostate cancer (2,512 deaths) and colorectal cancer (2,483 deaths). The lifetime risk of contracting cancer and the number of person-years of life lost to cancer for different cancers are summarised below.

Risk of contracting and years of life lost to cancers in males (1999)

Site of Cancer	Lifetime Risk	Person-Years of Life Lost
Prostate	1 in 11	5,470
Colorectal	1 in 18	16,453
Lung	1 in 21	29,048
Melanoma	1 in 25	7,085
Bladder	1 in 60	2,180
Non-Hodgkin's Lymphoma	1 in 67	7,048
Unknown site	1 in 81	7,745
Kidney	1 in 74	4,465
Stomach	1 in 91	5,288
Pancreas	1 in 129	6,055
All cancers *(excluding non-melanocytic skin cancer)*	1 in 3	138,368

"Lifetime Risk" - a measure which estimates the risk of contracting a type of cancer in a lifetime (given that the risk remains constant throughout life).

"Person-years of life lost" - a measure which approximates the number of years of life "lost" per annum due to death after the age of 75.

Other risk factors associated with the DSRS programs have been considered. In relation to cancer the two most common are alcohol and smoking. There are many cancers associated with alcohol and smoking. It is estimated that 39% of all oropharynx (mouth and throat) cancers, 46% of oesophagus cancers, 39% of liver cancers and 51% of those occurring in the larynx (voice box) were directly attributable to alcohol. The percentage of cancers directly attributable to smoking include oropharynx (57%), oesophagus (54%), stomach (14%), anus (48%), lung (84%), bladder (43%), and renal (28% and 55%) depending on the location within the kidney.

The two cancers cited as being of most concern to the F-111 DSRS workers were those of the bowel (colorectal) and bladder. There were anecdotal accounts of increased rates of these cancers occurring among those who had worked on the DSRS programs. The incidence rates for colorectal cancers in males increased from 1990 to 1999 by an average of 0.2% per year. The mortality rates, however, fell by 1% per annum between 1990 and 1999. The incidence of cancer of the bladder in males rose by an average of 0.3% per annum between 1990 and 1990 – probably as a result of increased screening for prostate cancer leading to increased detection of any existing bladder cancers. There was also an increase of 0.5% per annum in death rates from bladder cancer between 1990 and 1999.