Inspection report

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| **Licence holder:** Department of Defence and Australian Defence Force (Defence) | **Licence number:**  S0042 |
| Location inspected: A Defence base in New South Wales | **Date/s of inspection:** 6 June and 17 July 2017 |
| **Report no:** R17/07755 |
| An inspection was conducted as part of ARPANSA’s baseline inspection program to assess compliance with the *Australian Radiation Protection and Nuclear Safety Act 1998* (the Act), the Australian Radiation Protection and Nuclear Safety Regulations 1999 (the Regulations), and conditions of the Source Licence S0042.  The scope of the inspection included an assessment of Defence’s performance in the management of thorium alloys against the Source Performance Objectives and Criteria (PO&Cs). The inspection consisted of a review of records, interviews, and physical inspection of sources. Background Jet engines typically operate at elevated temperatures. In order to provide the engines with strength and thermal stability, thorium is used in the alloy. This has been done since the 1950s. It is understood that these engines typically contain only a small amount of thorium (about 3-4%) within certain engine components. However, since the thorium used is naturally radioactive, the engines themselves emit an external radiation field. This was confirmed by the dose rates measured by the inspector, which were in the range 9.5 µSv/h to 12 µSv/h at contact. Furthermore, due to the nature of the radiation emitted by thorium, the engines also have the capacity to produce an internal radiation hazard if mechanically damaged or altered.  Defence suppliers have provided two estimates of the thorium content of the alloys. These range from 62 kBq/kg to 161 kBq/kg. It is understood that the affected components weigh approximately 72 kg. Therefore, the amount of radioactivity is estimated to be between 4.5 MBq to 11.5 MBq. The exempt activity concentration for thorium is 10 Bq/g and the exempt activity is 10 kBq. Therefore, based upon the available information, the jet engines are considered to contain an amount of radioactivity that should either be authorised by ARPANSA or otherwise exempt from licensing. Defence have not pursued either a licence or an exemption for the radioactivity, and therefore, is potentially non-compliant with the Act.  In 2013, Defence sold some of the engines to a private third party on the proviso that the purchaser comply with the ARPANS Act 1998, the Defence source licence, the Defence Radiation Safety Manual and Defence’s reporting obligations to ARPANSA. This third party was contracted to provide Defence trainees with education in the basic maintenance and repair of jet engines. It is understood that the trainees spend about a month performing hands-on work with the engines. For instance, the students will remove and re-install various components. This will involve the student spending some time adjacent to the engine, however, other work is conducted at a distance away from the engine. It is expected that, when the student is working at a distance, the dose rate will be close to background levels.  The main codes and standards applicable to this activity with these sources are:   * Code for Radiation Protection in Planned Exposure Situations (2016) (RPS C-1) * Australian Standard – Safety in laboratories Part 4: Ionizing Radiations (1998) (AS 2243.4-1998)  ObservationsConfiguration control Defence has conducted a series of risk assessments and safe work method statements and environmental protection plans (SWMS) for these engines. For instance, a risk assessment of the trial breakdown was conducted in September 2013. This was not signed or approved. A risk assessment on the storage of these engines has also been performed. Similarly, it is not marked with when it was created, who created it, who reviewed it, who authorised it, and when it would be reviewed again. A third risk assessment was performed on 25 February 2015. This expired on 25 February 2016. This was not signed by the team members who performed the risk assessment. Three SWMS were prepared for the breakdown and packaging of these engines. None of these SWMS were signed by the personnel performing the work. Inspection, testing and maintenance A radiation contamination survey was conducted in a number of areas over a period of 2 days in February 2013. This resulted in 11 radiological clearance statements being issued to the Commanding Officer of this base. The purpose of these statements is to provide a transparent and traceable record that a survey was performed and the area was verified to be free from sources of radiation or contamination. However, these statements consistently used the ‘greater than’ symbol when it is presumed that ‘a less than’ symbol was the intent. Hence, instead of certifying that an area was free of contamination it suggested that contamination was present. Furthermore, these forms did not show the date that the survey meter(s) being used was last calibrated so that it is traceable to a national standard, did not show the background reading (although sometimes it was recorded that a reading was at background levels). It is worth observing that Defence provided 2 radiological clearance statements performed by an external consultant. These forms also did not provide details demonstrating that the survey meters used had been calibrated in manner that is traceable to an Australian standard.  A copy of a radiation dose rate survey performed near the shipping container and engine cocoons was received. This survey was not dated nor did it indicate what instrument(s) were used and when that instrument was last calibrated so that it is traceable to a national standard. Training Two Defence Ionising Radiation Protection Officers (DIRPOs) are located at the site. One of these DIRPOs undertook his training in recent years, while the other did the course in 1999. This second DIRPO is attempting to get approval to sit the course again. It was not possible to evaluate the breadth and depth of the DIRPOs knowledge while at the base. Given that DIRPOs are often required to fill many roles that do not relate to radiation safety, it is possible that, over periods of time, knowledge may fade. Radiation protection In 2004, Defence engaged a contractor to perform a radiological risk assessment of the practice undertaken at this base. This characterised the external radiation field emitted from the engines and obtained several samples of the removable surface contamination from various areas on the engines. The highest level of removable contamination was on the compressor case nut mounts. Based upon this data, the contractor estimated the doses likely to be incurred by the instructors and the trainees. This included doses due to external radiation as well as doses that may occur if the radioactivity is taken inside the body (inhaled or ingested). It is evident that, at the time the report was published, external doses were considered to be the dominant exposure pathway, followed by doses due to inhalation and the ingestion. However, there appears to have been an oversight in the estimation of the level of contamination present which would affect the magnitude of the calculated doses, and as such, there may be reason to revise the assessment. Defence has not re-evaluated the radiological risk.  Defence identified that it held a number of unused engines, and hence, decided to undertake a project to dismantle theses engines. This started in 2014 when 35 engines were dismantled into their component parts. These were stored until February 2017 when the components were placed in forty-four 200 Litre drums. These drums are now held in one shipping container. Some details of the drums were recorded in a spreadsheet. However, many details were missing. For instance, alpha wipe tests were recorded for only 4 drums. Pack numbers were missing for 12 drums and serial numbers were missing for 29 of the drums.  Larger components which could not fit into a 200 Litre drum, and the unused spare parts which are still in their original packaging, are held in another shipping container. A few dose rate measurements were taken at the entrance to and outside the shipping containers. These measurements were within the allowable limit set by the Australian Standard *Safety in Laboratories Part 4: Ionizing Radiations* (AS 2243.4-1998).  Personnel who work with the engines do not routinely wear passive personal dosimeters (TLDs). However, they were worn by a small group of people for a period of approximately 9 months. It is understood that the dismantling project occurred during this period. Electronic personal dosimeters (EPDs) were worn by two staff in February 2017 when the dismantled engines were placed into 200 Litre drums. Personal dose records for these individuals were provided. This showed that the RPO had monitored the cumulative dose recorded during the working week. However, the record did not show whether the EPD that had been worn had been calibrated so that it was traceable to a national standard. Findings The inspection revealed the following potential non-compliance/s:   1. Defence are not considered to be licensed to deal with these jet engines.   The inspection revealed the following areas for improvement:   1. A systematic process for continuing professional development or otherwise monitoring the level of knowledge maintained by DIRPOs. 2. Review and oversight of documentation related to radiation safety. 3. Routinely re-evaluate radiation safety assessments to confirm that the assumptions and judgements used in the initial assessment are valid and that the methods of assessment are accurate and appropriate.   It is expected that improvement actions be taken in a timely manner. | |

*In response to any potential non-compliance, the licence holder must carry out its responsibilities under Regulation 45*

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