



CONTAINER EXAMINATION FACILITIES RADIATION SAFETY

CONTAINER EXAMINATION FACILITY (CEF) LOCATIONS

Customs operates CEFs close to the port terminals in Melbourne, Sydney, Brisbane, Fremantle and Adelaide. A smaller container examination building is located in Darwin.

CEF OPERATING PROCESS

CEFs scan a truck carrying one or more shipping containers. The process involves the truck parking in the scanning hall and the driver entering a shielded waiting room for the duration of the x-ray scan.

The x-ray housing, incorporating the linear accelerator and detector array, passes across the container on a rail-type system at a rate of 10 metres per minute. The truck cabin is not x-rayed in this process.

A six million electron volt (MeV) linear accelerator is used in the x-ray scanning process in Sydney, Melbourne and Brisbane. In Fremantle, a truck mounted mobile inspection system is used which comprises a 2.5 MeV linear accelerator. In Adelaide, the container is unpacked and the cargo put through a 2.5 MeV dual view pallet x-ray system.

CUSTOMS RADIATION SAFETY RECORD

Since the opening of the first CEF in November 2002, no abnormal radiation related incidents or accidents have occurred in Customs CEFs.

The x-ray systems meet the stringent standards imposed by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and the World Health Organization (WHO) safety standards as part of licensing requirements.

Customs staff are trained in the use of the x-ray equipment and operate under comprehensive standard operating procedures. Specially trained radiation safety awareness officers are responsible for day-to-day safety issues and operate under the guidance of the facility radiation safety officer where more complex radiation safety issues arise.

Customs also has arrangements with an independent radiation safety company, who has expertise in all safety aspects of the operation of high-energy linear accelerators and is accredited by ARPANSA and relevant state regulatory authorities to provide design and operational safety advice to users of accelerator systems. They provide comprehensive quarterly image quality and system safety checks in addition to training services, maintenance and repair of the truck entry doors, interlock safety systems and related radiation safety reporting.

EFFECTS OF RADIATION ON CONTAINER CONTENTS

Customs commissioned comprehensive research to establish the effects of radiation on sensitive goods before construction of the CEFs.

Exposure limits for materials set by the WHO are less than 0.1 milliGray (mGy) (100 microGray (μ Gy)) at energy less than 9 MeV for container inspection. The 6 MeV x-ray systems that Customs operates have an absorbed dose per scan of less than 60 μ Gy. The system operates at a significantly lower limit than that set by the WHO and in a manner that allows the safe x-raying of sensitive items such as food, liquids, soil and fertiliser products, medicinal items and film.

The naturally occurring background radiation in Australia is approximately 400 μ Gy per week, so the exposure due to a container scan is comparable to that of one day's background radiation.

SAFETY OF CUSTOMS STAFF AND TRANSPORT DRIVERS

Personal safety is taken seriously by Customs and site safety is required for ARPANSA licensing. Buildings are designed so that leakage radiation due to the scanning process is less than 50 per cent of the limits recommended by the International Commission on Radiation Protection and accepted by the National Health and Medical Research Council as the Australian Standard.

Mechanisms are built into the x-ray system to ensure that no person will be exposed to radiation throughout the x-ray scanning process. These mechanisms include:

- Interlocking systems - there are several levels of interlocking provided with this system to ensure that the equipment is operating safely and within tolerance. These include:
 - Key interlock: the console key must be inserted and turned to the correct position by the operator in order for the beam to be initiated and maintained. Access to the console key is restricted.
 - Entry interlock: monitors facility entry/access points to ensure that if any point is breached then the beam is terminated.
 - Beam parameter interlocks: the shielding of the room is designed for a defined maximum radiation workload. This assumes that the dose rate of the accelerator is 0.11 Gray (Gy) per minute at one metre from the target. The image quality is also dependent on this dose rate. The system is interlocked so that if this output rate is exceeded the x-ray is switched off.
- Emergency lines/stopping buttons - these safety features are in the x-ray scanning hall, and in the x-ray operating rooms. When the x-ray is in progress, it can be stopped at any time by using these buttons, or pulling these cords. Shutdown will occur in less than 0.1 of a second.
- Communication systems - intercoms, telephones, loudspeakers and closed circuit TV ensure continual visual monitoring and communication during the scanning process.

In the extremely unlikely event that a person is exposed during an x-ray scan, a very low dose of radiation would be absorbed. Calculations show that the effective dose would be far less than 60 microSievert (μSv) (estimated to be of the order of $2\mu\text{Sv}$ for anyone not actually inside a container) and comparable to that received during an extended air flight. This is because the detectors are extremely sensitive and minimise the radiation levels required to produce a useful image. In addition, the accelerator is shielded to minimise leakage radiation and the beam geometry is such that scatter is only a small fraction of the primary beam.

SITE SAFETY ISSUES

Australia has among the most stringent radiation safety regulations in the world, which require that radiation safety issues be addressed in the construction, building and operating phases of any facility in which radiation is used. Customs met all ARPANSA and WHO safety standards through the planning and construction of the CEFs and a radiographic survey was completed to ensure the facilities met radiation safety requirements before commencement of operations.

Customs continues to meet these standards and reports to ARPANSA to satisfy licensing requirements.

FREQUENTLY ASKED QUESTIONS

How does Customs prevent radiation leaks from occurring?

The walls and doors of the scanning hall are constructed to fully enclose the radiation volume with a concrete shield. The entry and exit portals have radiation shielding doors, interlocked to the accelerator systems to prevent their opening while the x-ray is in operation.

How often is the x-ray equipment checked?

Regular monitoring is undertaken to ensure the x-ray equipment meets stringent radiation safety regulations. Daily tests verify the functionality of normal operational safety systems, weekly tests verify the functionality of major system interlocks, and quarterly independent audits ensure that procedures and equipment are in order.

Will the truck used to transport the containers receive radiation from being x-rayed?

No radiation is induced in the truck during the x-ray process.

What would happen if a person was in the x-ray hall while the x-ray was operating?

The radiation levels are very low in the x-ray hall. The facility radiation safety officer routinely surveys the hall with the system operating to verify that acceptable dose limits are not exceeded. A person inside a container being x-rayed would receive a dose of radiation less than or comparable to a normal x-ray, while someone elsewhere in the hall would receive a much lesser dose. The accelerator makes a specific sound and red lights flash when the beam is on to raise awareness that the x-ray is operating. An emergency lanyard inside the hall is available to instantly stop the machine.

How safe is the driver waiting room?

The driver waiting room is totally shielded from leakage from the scanner.

Are sensitive goods damaged by the x-ray process?

Customs engaged specialist consultants to test a range of sensitive goods, including food, liquids, medicinal items and film, to ensure that the scanning process did not adversely affect material inspected. The conclusive results were that the x-ray did not impact upon any of the products tested.

INQUIRIES

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