



RadScan® 900 Detector  
Head and Operator Interface  
computer

## RadScan® 900

Cavendish Nuclear's RadScan® 4pi Gamma Imaging system is used to provide an enhanced radiological characterisation of gamma hotspots in a variety of environments including building surfaces, cells, gloveboxes and process vessels.

### Gamma Ray Imaging

The RadScan® 900 is a portable gamma ray imaging system that remotely locates and characterises gamma radiation from a wide variety of environments including building surfaces, cells, gloveboxes, drums and process vessels.

RadScan® can be operated from a safe and remote location and so supports the application of the principles of ALARP.

RadScan® automatically scans and records the distribution and intensity of gamma radiation and displays this as a coloured overlay on a colour video image. The image clearly shows where the radioactive contamination is located and its intensity.

In contrast to other gamma imaging systems, RadScan® also collects spectral data, so identifying individual radioisotopes.

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RadScan® can also provide estimates of activities at the source of contamination and this data can be used to produce 3D dose rate maps of the environment.

### Features

- Real-time and remote gamma ray imaging
- High level of portability
- Rapid deployment
- High spatial resolution
- High sensitivity
- Low resolution gamma spectroscopy
- Operates in both low and high dose rate environments
- Full 360° scanning
- Excellent shielding/collimation
- Optional 3D dose maps & tomography
- Detection head can readily be protected by plastic hoods



RadScan® 900 Detector Head showing collimator (bottom left) video camera (bottom right) and laser rangefinder

### Benefits of RadScan® Gamma Ray Imaging

- Supports ALARP principles
- Images pinpoint the origins of elevated dose rates
- Activity estimates of hot spots
- Dose rate estimates of hot spots

- Includes spectroscopy
- Saves operator dose uptake by reducing the requirements of manual area monitoring
- Saves costs by supporting optimisation of maintenance, refurbishment and decommissioning strategies
- Rapid deployment by a single operator
- Remote control and operation
- Real-time video images and count rates
- 4π automatic scanning of an environment
- In-situ analysis from a single automatic scan
- Can be deployed on a range of mechanical platforms
- Ideal for high dose rate environments and hot cells
- Large dynamic operating range

#### Applications

The remote location and characterisation of gamma activity can support the optimisation of maintenance activities, refurbishment plans and implementation of decommissioning strategies.

RadScan® is therefore a valuable tool for nuclear facility decommissioning planning and decommissioning operations and in operating plants for identifying mal-operations and supporting maintenance & repair.

- RadScan® enables clean-up teams to identify and prioritise the removal of radioactive materials, or determine which areas require shielding or decontamination, at the earliest stage, leading to a safer and more cost-effective process. Processes are optimised as RadScan® pinpoints exact locations of contamination.
- Typical applications involve the characterisation of building surfaces, hot-cells, fuel ponds, the interior and exterior of gloveboxes, process vessels, pipework, waste items, redundant items etc.
- RadScan® operates in high radiation environments so can be placed in



Setting up the RadScan® 900 detector head and tripod prior to deployment

- hot cells and other high dose rate environments.
- Planning and monitoring of decontamination activities. RadScan® is very useful for initial contamination surveys to plan the operation and then ongoing surveys to evaluate the effectiveness of the decontamination activities.
- Monitoring of dynamic radiological conditions. RadScan® can be deployed at regular intervals to check for any changes in the location, distribution and activity of contamination.
- Checking for spreading of contamination. RadScan® can be deployed before and after an operation to ensure that contamination was not spread.

- Evaluation of spills. A RadScan® survey can quickly tell the response team where the radioactivity is located.
- Shielding design and evaluation. A RadScan® image allows engineers to put the optimum amount of shielding in the right place. The system's spectroscopy allows the system to differentiate between higher energy direct radiation and lower energy scatter.
- Safe and remote surveys of large areas, including panoramic views which show the various items and areas of a plant in a single image. More detailed images can be produced, if needed, containing only those areas of interest.
- Estimation of activities and specific activities for waste classification. Analysis of the RadScan® data yields quantitative information about the radionuclide activities present. The activity of an item can be determined from a single automatic scan. Known or estimated information about the size and weight of an object can be used to improve the analysis and generate a specific activity. Similar analysis can be performed to determine whether an item in situ is ILW or LLW. This provides a cost effective segregation of wastes.
- Decommissioning planning and operations
- Operating plants supporting maintenance and repair and investigating mal-operations
- Waste assay and classification
- Useful for both beta/gamma & alpha plants

#### Deployment & Operation

RadScan® 900 is comprised of an inspection head, an electronics box and a laptop PC. Data analysis, data storage and all aspects of the head operation are controlled from the PC, which can be operated from a remote and safe location.

The standard deployment is a



RadScan® 900 detector head and Pan / Tilt Unit

lightweight, collapsible and height-adjustable tripod. The system can also be deployed on many other platforms including fixed or mobile stands, cranes and Remotely Operated Vehicles (ROV). The system is set-up rapidly by a single operator and following automatic system self-checking is ready to scan within a few moments.

The RadScan® control software provides complete image acquisition and analysis using simple menu driven commands.

#### Data Collection & Analysis

During an automatic scan, at each measurement position, RadScan® collects gamma count rates, angles, distance, a video image and spectroscopy information. The entire spectrum for each and every measurement position is recorded by RadScan®, from < 30 keV to > 1500 keV which affords enormous flexibility in data analysis.

#### Accessing RadScan® Gamma Ray Imaging

For plants and projects, often the most cost effective solution is to opt for a

RadScan® service. Cavendish Nuclear has over 15 years' experience of providing RadScan® surveys into a wide range of nuclear facilities and supports a team of specialists trained in gamma imaging.

A RadScan® service is initiated with a plant visit and discussions to understand the exact scanning and analysis requirements. This allows a scope of work to be produced taking into account issues such as access, deployment, safety and power requirements. A Cavendish Nuclear specialist carries out all the imaging work to ensure that the best results are collected.

Images from the scanning can be viewed as the work is in progress and so if necessary the focus of a survey can be changed. Following completion of all scanning the results are analysed to meet the needs of the plant and a detailed technical report can be provided to the customer within an agreed timescale. RadScan® systems are also available for rental for short or long term agreements, for which operator training is given.





## Performance

### Detection limits:

<0.2  $\mu\text{Ci}$  (or  $7.4 \times 10^3 \text{ Bq}$ ) for  $^{137}\text{Cs}$  in FOV at 1m (photopeak)

<50 mg for Pu ( $\sim 20\% \text{ }^{240}\text{Pu}$ ) in FOV at 1m

<1 g for  $^{235}\text{U}$  in FOV at 1m

<2.5  $\mu\text{Ci}$  (or  $9.25 \times 10^4 \text{ Bq}$ ) for  $^{241}\text{Am}$  in FOV at 1m

### Energy resolution (FWHM):

$\sim 6\%$  at 1332keV

$\sim 9.5\%$  at 662keV

$\sim 36\%$  at 60keV

### Operating range:

<1  $\mu\text{Ci}$  to 0.5 Ci (or  $3.7 \times 10^4 \text{ Bq}$  to  $1.85 \times 10^{10} \text{ Bq}$ ) for  $^{137}\text{Cs}$  in FOV at 1 m

**Dose rate envelope:** 0 to 500 mSv/hr for  $^{137}\text{Cs}$

**Energy range:** < 30 keV to > 1500 keV

### Dynamic range in a single image:

Approximately 1,000; that is, two point sources whose absolute activity is a factor of 1,000 apart are both imaged on a single overlay image.

**Detection range:** 0.5 m to  $\infty$

**Detector collimator FOV:**  $4^\circ$  (standard) with screw in end cap

**Collimator Accessories:** Screw in background plug,  $3^\circ$  screw on extension,  $2^\circ$  insert screw in insert,  $1^\circ$  combined insert and extension

### Camera:

Resolution: 1024 by 768 pixels, 24 bit colour

FOV:  $\sim 40^\circ$  horizontal by  $\sim 30^\circ$  vertical (4:3 aspect ratio)

## Scan Time

10 - 20 minutes in a low dose rate, natural background environment.

## Specifications

**Detector Head size:** H 195 mm x W 165 mm x L 385 mm

**Detector Head mass:** 25 kg

**Inspection Head size:** H 490 mm (Head Horizontal), Rotates within a <500 mm diameter

**Inspection Head mass:** 43.3 kg (Rapidly disassembles in to components of 25.0 kg, 14.6 kg and 3.7 kg)

**Deployment orientation:** Upright or inverted

**Deployment mechanism:** Standard 3.7kg height adjustable, collapsible tripod. Alternative deployment on ROV, vehicle, on a crane / 'cherry picker'

**User workstation:** Laptop PC, < 3.0 kg

**Scanning angle:**  $-179.5^\circ$  to  $+179.5^\circ$  (pan)  $-53.0^\circ$  to  $+90.0^\circ$  (tilt)

**Scanning speed:**  $10^\circ/\text{sec}$  pan & tilt (fast),  $5^\circ/\text{sec}$  pan & tilt (slow)

**Detector:** NaI(Tl) scintillator with miniature photomultiplier tube

**Camera:** Miniature colour CCD video camera

**Rangefinder:** Red laser diode Class II (IEC 60825-1 Amendment 2 / 2001)

**External data storage media:** Writeable CD/DVD, USB port for memory stick or external drives

**Operating system:** Microsoft Windows 7

**Electrical supply:** 110Vac / 230Vac, 50Hz / 60Hz, 1A / 70VA (max) auto sensing

### Distance between inspection head and laptop:

Standard 10m between the inspection head and the electronics box, up to 80m between the electronics box and laptop. If required, longer cables can be supplied.

**Calibration:** Periodic energy calibration or calibration check is quickly and easily performed using commonly available sealed sources.

### Environmental:

**Detector Head / Power Box** IP65 to (EN 60529), dustproof and waterproof (water jets)

**Pan/Tilt Unit** IP67 to (EN 60529), dustproof and waterproof (water jets)

**Electronics Box** IP54 to (EN 60529), dustproof and waterproof (splashes)

**Operating temperature**  $0^\circ\text{C}$  to  $40^\circ\text{C}$

A PVC hood can be fitted over system to prevent contamination ( $3^\circ$ ,  $2^\circ$  collimators and background plug can be installed/removed in-situ without removing hood).

### Safety:

#### Electrical:

Complies with IEC 61010 - 1:2010

#### Laser:

Blink Safe' Class II (IEC 60825-1 Amendment 2 / 2001)

## Summary

- Real time and remote gamma ray imaging
- Highly portable
- Rapid deployment
- High spatial resolution
- High sensitivity
- Full  $360^\circ$  scanning
- Optional 3D dose mapping and tomography
- Excellent shielding and collimation to enhance resolution

For more information please contact  
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