Introduction

Characterization of installations

OPTIMIZE

Occupational/nuclear safety of operations

Intervention scenarios

Waste strategies

Innovation at work in our business

MANUELA™
3D radiological mapping

WNE 2018

NanoPix
Miniature gamma camera

MARA
Mesh with Augmented Reality Assistance

RIANA™   WNE 2016
Multi-purpose carrier for investigations

RIANA SC
Radiological mapping of underside of containers

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MANUELA™

MANUELA™: Mobile Apparatus for Nuclear Expertise and Localisation Assistance

3D radiological mapping (*Real Time*)

- Simultaneous 3D radiological and topographical mapping of facilities

- Precise positioning of radiological measurements

Location of hot spots (*at the end of the scan*)

- Visualization of the intensity distribution of γ radiation

- Identification of irradiation sources location and characteristics

MANUELA™

**MANUELA™: Mobile Apparatus for Nuclear Expertise and Localisation Assistance**

Evaluation of the accumulated operators dose performing interventions *(at the office)*

• Integration of virtual operators into the reconstructed mapping in order to assess the accumulated dose of personnel performing interventions within the framework of ALARA approaches

• Simulation of operating scenarios and optimization of workstations

Transmission of information to teams prior to performing intervention *(during pre-job briefing)*

• Present the worksite environment to the operators, repeat the gestures, and understand the risks

• Export of data to a virtual reality interface for immersion of operators into the workspace

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MANUELA™
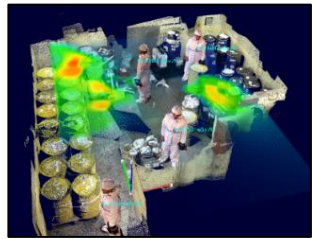
- **Quality**

  Reliability and traceability of radiological measurements and their spatial positioning

- **Performance**

  Increase in the quantity of information transmitted to teams performing interventions

- **Safety**

  Carrying out of risk and dose rate optimization studies

- **Universality**

  Can be adapted to all nuclear environments

- **Expertise**

  Analysis of data with specific post-processing

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Nuclear investigations by γ imaging with an ultra-compact γ camera in support

System allowing a real photo and a dose rate curve formally expressed by a colored patch to be superimposed over each other

Rapid location of γ sources that are not accessible and/or are in highly radiological environments

Possibility of being embedded onto different carriers (pole, robot, robot arm, drone, etc.)

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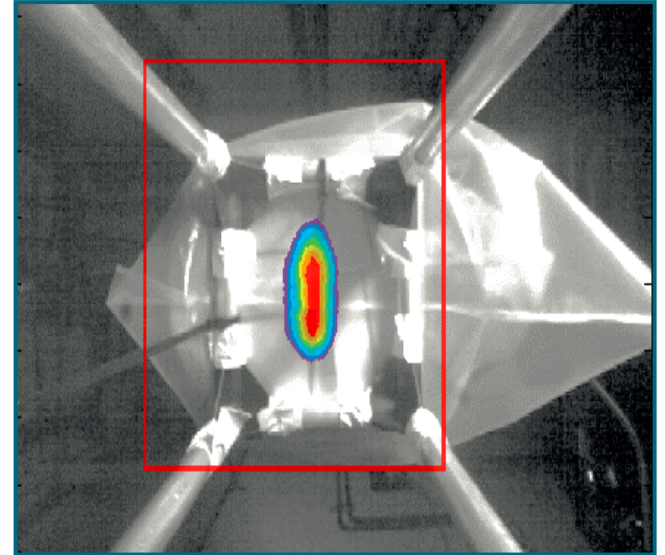
NanoPix

Ultra-portable γ imaging system : < 300g

Identification of irradiating points :
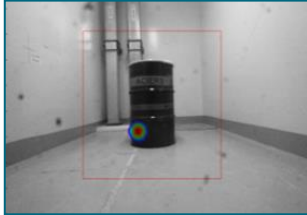
- In highly restrictive zones

- On equipment

Dimensions: H 7cm / **W** 3cm / **D** 5cm

Background reduction : anti-mask (automatic rotation)

Improved measurement sensitivity : implementation of coded mask technology

NanoPix

- **Adaptability**

  Access to highly restrictive zones (high levels of radiation, vessels, etc.)

- **Performance**

  Project risks management thanks to consolidation of input data and scenarios prior to performing interventions

- **Safety / ALARA**

  Reduction of risks for the operator by means of remote investigation

- **Cost**

  Saving on operational times when performing the intervention and control over waste inventory

- **Expertise**

  Identification of specific irradiating points in inaccessible zones

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Mesh for mapping large areas

- Replacement for conventional intrusive mesh solutions

- Rapid and automatic construction of a mesh prior to radiological investigations

- Information entered directly on tablet or smartphone

- Production of intervention report directly on exiting worksite

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MARA

MARA: Mesh with Augmented Reality Assistance

Visualization of information collected

Visualization of the mesh created on the connected tablet and/or smartphone (augmented reality)

Automatic synchronization of information by Wi-Fi communication between the tablet and the smartphone
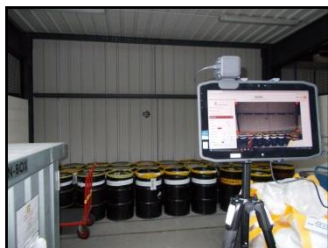
Traceability of information

Information is automatically saved to the tablet

In-situ memorization of measurements on NFC tag which can be written and read using the smartphone

MARA

- **Quality**

  MARA facilitates the meshing phase for radiological investigations and ensures a total data traceability.

  Reduction of HOF risk due to your measurement values being entered on-line

- **Adaptability**

  Intuitive interface means operators are able to get to grips with the tool immediately

- **Safety**

  Less troublesome meshing phase and optimization of time spent in irradiated zone

- **Easier to install**

  Can be installed on the worksite in less than 2 minutes

  Ready to use: no need to pre-load any site files

- **Traceability**

  Automatic backup of information on the tablet

  Writing and reading of information on NFC tags

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Radiological mapping of underside of containers

RIANA™

Ground level radiological mapping module with automatic positioning and manual adjustment of probes

- Measurement of dose rate, surface contamination and γ spectrometry

- Rapidly interchangeable probes

Remotely controlled arm with 3 degrees of freedom which can be used to take solid samples and perform radiological mapping of walls and equipment

- Interchangeable grippers for moving object and measuring probes

- Camera and lighting positioned at the end of the arm

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RIANA™

Module for taking liquid and powdery samples

Collection of 3 liquid or powdery samples (50 cm3 max.) and in situ dose rate measurement

Visualization of the fill level of vessels and monitoring of the aspiration phase

Mapping module

Real- time 2D map construction and accurate positioning of measurements

Possibility of defining a safety perimeter making it possible to slow down then stop when approaching an obstacle.

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RIANA™

Simplicity
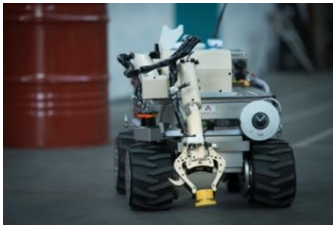- Easy and intuitive to control, both indoors and outdoors, thanks to the control joystick

Modularity
- Interchangeable measurement modules
- Quick to take samples

Accuracy
- Positioning in its environment and construction of an accurate 2D map of measurements and samples taken

Traceability
- Automatic recording of measurements which can be exported for use in post-processing

Safety / Radiation protection
- Measurements taken remotely

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RIANA SC

Radiological mapping of underside of containers

RIANA SC

RIANA SC : Robot for Radiological Mapping of Containers

Radiological mapping of radioactive material containers before shipment

- System enabling the radiological mapping of the underside of containers and visual inspection

- Wireless robot-assisted mapping with autonomous navigation

- Dose rate measurement at point of contact

RIANA SC

RIANA SC : Robot for Radiological Mapping of Containers

Supervision and traceability of data

- Control of the robot from a remote control station

- Real-time 2D mapping to identify areas of interest to be investigated by contact

- Real-time display of dose rate measurements

- Automatic recording of data for each investigation performed

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RIANA SC

- **Quality**

  Elimination of non-quality related to inspection errors prior to shipment

- **Simplicity**

  Simple, intuitive solution deployable in minutes

- **Nuclear Safety / Radiation Protection**

  Robot remotely controlled to reduce the radiological impact on the operator

- **Adaptability**

  Wireless standalone solution with capability to include additional radiological measurements

- **Occupational Safety**

  Elimination of risks for the operator during the operation

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SUMMARY

Innovative tools to improve physical and radiological characterization of nuclear zones

D&D operations (D&D) of nuclear facilities aim at being **economically viable, adapted to the sites and customer needs**.

The key point of D&D projects, is to know **how to optimize each phases of D&D's process**:
- **from the initial status** when input data are collected to determine necessary resources, cost and duration of all operations
- **to the characterization** of the final waste before deconstruction or decommissioning of the facility.

Different innovative technological bricks have been deployed by Orano to address these issues:

- **RIANA™** and **RIANA SC** : wireless mobile carriers with autonomous navigation for investigations.
- **Nanopix**, an ultra-compact γ camera which replaces operators and robots intervention in unknown radiological environments.
- **MANUELA™**, a Real-Time 3D Topographical and Radiological mapping tool.
- **MARA**, mesh with augmented reality assistance for radiological investigations, ensuring the traceability of measurements.

Thanks to these versatile tools, **Orano proposes turnkey services** to bring under control D&D's operations of nuclear facilities.

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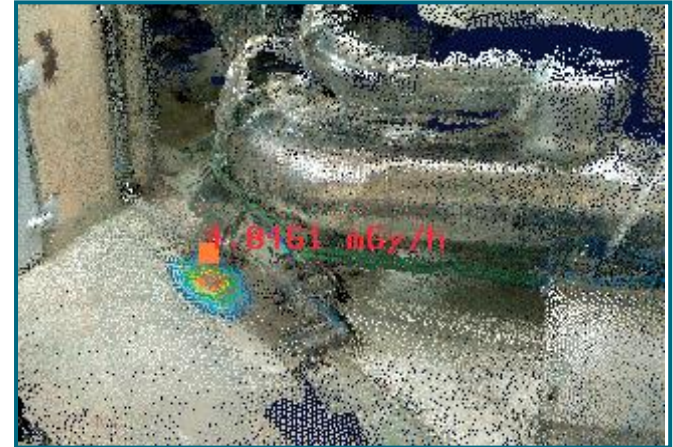
Key data - MANUELA™

Autonomy: 4 hours of scanning   **Weight**: approx. 1.5 kg

Measurement probes: dose rate and γ spectrometry (CdZnTe)

Data processing

Retro-projection of radiological γ distribution on a 3D model

Visualization in real time of the 3D reconstruction / radiological measurements

Data export

Interface with different modeling tools for the estimation of activities

Interface with VR tools: pre-job briefing , training, etc. and AR tools: visualization of radiological information by the operator while performing the intervention

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Key data - MARA

MARA pack includes : 1 tablet, 1 smartphone, 1 laser rangefinder, 1 tripod, NFC tags , 1 armband

Mesh configuration : precise mesh positioning, choice of colors, cell identification

Mesh visualization : AR

Information you can saved: Local ID, Wall ID, Cell ID, Non-fixed α contamination, Fixed α contamination, Non-fixed β/γ contamination, Fixed β/γ contamination, Dose rate, Maximum dose rate, Comments.

MARA smartphone extension : offers the same functionalities as the app on the tablet. The video available on the tablet is also visible on the smartphone via Wi-Fi connection. It can run the telemeter remotely for creating a mesh.

Data can be saved : On the tablet where a dedicated folder is created, Via in-situ memorization of measurements on NFC tags

Generation of configurable intervention report : Addition of notes and sketches

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Key data - RIANA™

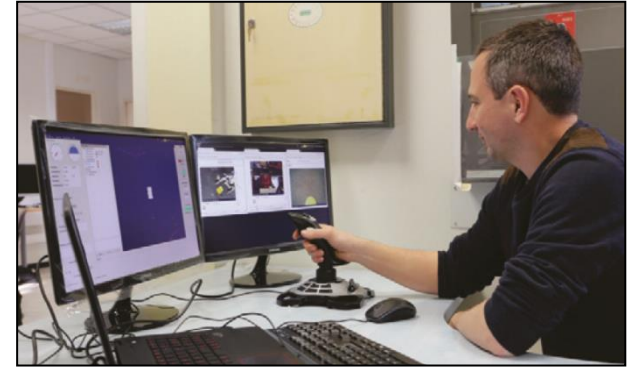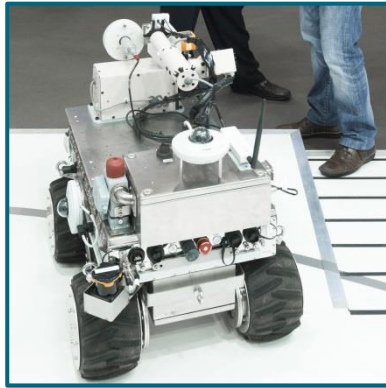**Dimensions :** L 775 mm x W 540 mm x H 560 mm

Weight : 65 kg

Clearance : 120 mm

Load Capacity : 65 kg

Maximum speed : 3 m/s

Wireless Communication : Wifi

Ingress Protection rating : IP54 Autonomy > 2h

Key data - RIANA SC
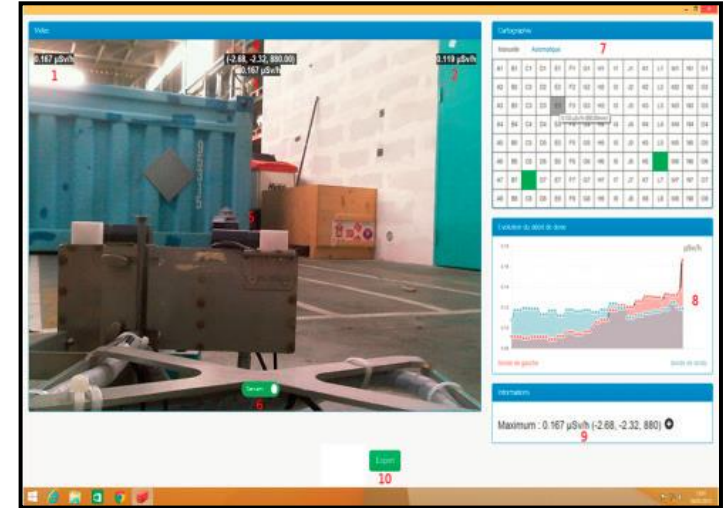
Wireless mobile base with omnidirectional wheels

Autonomous navigation below the container

Probe elevation system for contact measurements

Real-time transmission of radiological data and creation of 2D mapping

Extended measurement range (via 2 measurement probes) from a few tens of nSv/h to a few Sv/h

Recording of mapping for traceability

RIANA SC

RIANA SC a été conçu pour répondre à la problématique transport, i.e. le controle des 6 faces d'un conteneur et notamment la face du dessous qui est associé à un gros risque humain.

Les 4 points forts du robot sont:
- On remplace complètement l'humain. Ce n'est pas un système de pont ou autre qui diminue le risque en le laissant subsister, là il disparait complètement.
- Le robot fait un maillage automatisé, moins de risque de manquer quelque chose.
- Le robot ne sort jamais de la zone définie par les 4 câles, ce qui permet la co-activité sans risque et surtout un gain de temps puisque les opérateurs font autre chose. (Environ 15mins sur 1h30).
- Il y a désormais une traçabilité du contrôle. la carto peut-être transmise au client avant expédition par exemple.

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