Innovation tools to improve physical and radiological characterization of nuclear zones

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12/05/18 10am

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Unrestricted
Introduction

Characterization of installations

OPTIMIZE

Occupational/nuclear safety of operations

Intervention scenarios

Waste strategies
Innovation at work in our business

**MANUELA™**
3D radiological mapping

**NanoPix**
Miniature gamma camera

**MARA**
Mesh with Augmented Reality Assistance

**RIANA™**
Multi-purpose carrier for investigations

**RIANA SC**
Radiological mapping of underside of containers
Innovation at work in our business

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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 \(\gamma\) radiation
- Identification of irradiation sources location and characteristics
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
- **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
Innovation at work in our business

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  - 3D radiological mapping

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  - Radiological mapping of underside of containers

**WNE 2016**

**WNE 2018**
NanoPix

Nuclear investigations by $\gamma$ imaging with an ultra-compact $\gamma$ 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 $\gamma$ 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.)
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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MARA: Mesh with Augmented Reality Assistance

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
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
**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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RIANA SC
Radiological mapping of underside of containers
RIANA™: Robot for Investigations and Assessments for Nuclear Areas

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
RIANA™: Robot for Investigations and Assessments for Nuclear Areas

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.
• **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
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
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
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
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.
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
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 $\alpha$ contamination, Fixed $\alpha$ contamination, Non-fixed $\beta/\gamma$ contamination, Fixed $\beta/\gamma$ contamination, Dose rate, Maximum dose rate, Comments.

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

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.
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 omni-directional 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 a été conçu pour répondre à la problématique transport, i.e. le contrôle 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 disparaît 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.